Capital Indexed Bonds

Introduction

1. Over time, the Reserve Bank of India has taken several measures for development of the Government securities market. Instrument development has been one of the components of these measures. Reserve Bank has issued dated securities across the yield curve up to 30 years, floating rate bonds, and a bond with call and put option. While introduction of a variety of instruments meets the diverse investment and hedging needs of investors as well as market participants and in the process imparts depth to the market, it also helps in the widening of the market with instruments attracting diverse class of investors and market participants. Carrying this effort forward, Reserve Bank in consultation with Government of India, proposes to introduce Inflation Indexed Bonds.

2. In the developed debt markets, such as, United Kingdom, USA, New Zealand, Canada, Sweden, and South Africa the Inflation Indexed Bonds issued by the Government are one of the popular debt instruments. These Governments undertake issuance of the bonds at a regular interval with an aim to: (a) provide a new instrument to investors that offers hedging against inflation risk, (b) enhance credibility of anti-inflationary policies, (c) provide an estimate of inflation expectations and (d) create an additional avenue for fund deployment and thereby facilitating widening of Government securities market. Out of several variants of Inflation Indexed Bonds, the Capital Indexed Bonds (CIB) is the most popular and widely issued debt instrument internationally. In India also one variant of CIB (viz., 6 per cent Capital Indexed Bond 2002) was issued for the first time on December 29, 1997. Subsequent to that issuance, there was no further issuance of CIB mainly due to lack of an enthusiastic response of market participants for the instrument, both in primary and secondary markets. Some of the reasons cited for the lackluster response are: (a) it only offered inflation hedging for the principal, while the coupons of the bond were left unprotected against inflation and (b) complexities involved in pricing of the instrument. Taking into account past experience as well as the internationally popular structure of Capital Indexed Bonds a modified structure of Capital Indexed Bonds has been designed.

Proposed Structure of new Capital Indexed Bonds

3. In line with the most popular structure prevalent internationally, the proposed CIB would offer inflation linked returns on both the coupons and principal repayments at maturity. The basic feature of bonds would be that the coupon rate for the bonds would be specified in **real terms.** Such real coupon rate would be applied to the inflation-adjusted principal to calculate the periodic semi-annual coupon payments. The principal repayment at maturity would be the inflation-adjusted principal amount or its original par value, whichever is greater, thus with an in-built insurance that at the time of redemption the principal value would not fall below par. The inflation protection for the coupons and the principal repayment on the bond would be provided with respect to the Wholesale Price Index (WPI) for All Commodities (1993-94=100), the leading measure of inflation in India.

Method of Issue

4. The CIB would be sold through auction under which competitive bidders would be required to bid in terms of a desired **real yield** (yield prior to inflation adjustment), expressed as a percentage with two decimals, e.g., 3.00%. Specific terms and conditions for the auction, including the auction date, issue date, tenure of the bonds and the notified amount would be announced prior to each auction.

Issue Price

5. The first issuance of a CIB may be at par, i.e., at Rs. 100. The price of re-issued bond will be determined in the auction and may be at, below par or above par depending upon the real coupon of the bond vis-à-vis the cut-off real yield of the bonds under re-issuance. The settlement price of the re-issued bonds would be determined by discounting all the future real cash flows (real coupon and the real redemption amount) with the cut-off real yield emerging in the auction and then multiplying the resulting present value of the real cash flows by the Index Ratio (described below). Applying the settlement price thus arrived to the offer amount of the successful bidder would provide the settlement amount (please see **Annex 1** for calculation of the settlement price).

Selection of Inflation Index

6. The broad criteria for selection of an index to measure the inflation rate for the coupon payments and redemption of the principal at maturity for an inflation indexed bond are: (a) it should fulfill the hedging requirements of both the issuer and investors, (b) it should closely track inflation, (c) it should be a widely accepted indicator of inflation, (d) it should be available to the public and (e) it should have high periodicity or frequency of release. Out of the existing measures of inflation in India, viz., Consumer Price Index (CPI), GDP deflator and the Wholesale Price Index (WPI), the WPI emerges as the best index for the CIB (Please see **Annex 2** for more details on the selection of the index). Thus, the WPI for All commodities (1993-94=100) released by the Office of the Economic Adviser, Ministry of Commerce and Industries, Government of India would be taken as the index for measuring the inflation rate for the proposed bonds. However, for the purpose of inflation protection the monthly average of WPI (average of weeks) as worked out by the Reserve Bank of India, instead of WPI at the last week of the month, would be used as it smoothens the weekly variability in WPI and its effect on the market price of the bonds.

Indexation Process

7. Internationally two broad variants of indexation process are used by the countries which have issued inflation indexed securities, viz., (a) UK model and (b) Canadian model. The basic difference between the two models is with regard to the indexation lag. The Canadian model is an improvement over the UK model as it reduces the length of indexation lag (Please see **Annex 3**). As the length of

indexation lags has direct relationship with real value certainty or level of inflation protection, particularly in situations of fluctuating inflation rates, it is preferable to adopt the Canadian model which offers smaller indexation lag. Accordingly, the proposed CIB would also adopt the indexation process of Canadian CIB. Incidentally, the CIB issued by the Governments of USA, South Africa, New Zealand, etc. also follow the Canadian model for indexation process.

Index Ratio

8. As stated, the CIB would be issued with a fixed real rate of interest determined through the auction which would remain constant for the term of the particular bond. Interest payments would be based on the security's inflation-adjusted principal at the time interest is paid. This adjustment would be made by multiplying the par amount of the security by the applicable Index Ratio. Index ratio for any particular date for a particular CIB would be ratio of the Reference WPI applicable to such date and the Reference WPI applicable to the original issue date. The formula for calculating the Index Ratio would be:

$$\text{Index Ratio}_{\text{Date}} = \frac{\text{Ref WPI}_{\text{Date}}}{\text{Ref WPI}_{\text{Issue Date}}}$$

Where Date = Interest payment date

The numerator of the Index Ratio, the Ref WPI $_{\text{Date}}$, is the Reference WPI applicable for a specific day, i.e., interest payment date, and the denominator of the Index Ratio is the Reference WPI $_{\text{Issue date}}$ applicable for the original issue date.

Reference WPI

9. The Ref WPI $_{\text{Date}}$ for the first day of any month would be the weekly average of the Wholesale Price Index (WPI) for All commodities (1993-94=100) of the fifth preceding calendar month. For example, the Ref WPI applicable to June 1, 2004 in any year is the weekly average of Wholesale Price Index for the month of January, 2004. The Ref WPI $_{\text{Date}}$ for any other day of a month is determined by a linear interpolation between the Ref WPI applicable to the first day of the month in which such day falls (i.e., weekly average of WPI for the fifth preceding month) and the Ref WPI applicable to the first day of the next month. For purposes of interpolation, calculation with regard to the Ref WPI $_{\text{Date}}$ and the Index Ratio for a specific date would be truncated to six decimal places and rounded off to five decimal places such that the Ref WPI and the Index Ratio for that date would be expressed up to five decimal places. The formula for the Ref WPI for a specific date is:

$$\text{Ref WPI}_{\text{Date}} = \text{Ref WPI}_{M} + \frac{(t-1)}{D} \times [\text{Ref WPI}_{M+1} - \text{Ref WPI}_{M}]$$

Where Date = valuation date

D = the number of days in the month in which the Date falls

t = the calendar day corresponding to Date

Ref WPI_M = Ref WPI for the first day of the calendar month in which Date falls

e.g., Ref $WPI_{June\ 1}$ is the $WPI_{January}$

Ref WPI_{M+1} = Ref WPI for the first day of the calendar month immediately following Date

Illustration: Calculation of Ref WPI for June 15, 2004

$$\text{Ref } WPI_{June\ 15,\ 2004} = \text{Ref } WPI_{June\ 1,\ 2004} + \frac{14}{30} \times [\text{Ref } WPI_{July\ 1,\ 2004} - \text{Ref } WPI_{June\ 1,\ 2004}]$$

where D = 30, t = 15

If Ref $WPI_{June\ 1,\ 2004}$ = 154.40 (i.e. the weekly average WPI for all commodities for the month of January 2004)

If Ref $WPI_{July\ 1,\ 2004}$ = 154.90 (i.e. the weekly average WPI for all commodities for the month of February 2004)

Putting these values in the equation above we can arrive at the Ref WPI for June 15, 2004 as under:

$$\text{Ref } WPI_{June\ 15,\ 2004} = 154.40 + \frac{14}{30} \times [154.90 - 154.40]$$

$$\text{Ref } WPI_{June\ 15,\ 2004} = 154.633333$$

This value truncated to six decimals is 154.633333; rounded to five decimals it is 154.63333. To calculate the Index Ratio for June 16, 2004, for CIB issued on June 15, 2004, the Ref $WPI_{June\ 16,\ 2004}$ must first be calculated. Using the same values in the equation above except that t=16, the Ref $WPI_{June\ 16,\ 2004}$ works out to be 154.650000.

The Index Ratio for June16, 2004 is:

$$\text{Index Ratio}_{June\ 16,\ 2004} = \frac{154.65}{154.63333} = 1.000107803.$$

This value truncated to six decimals is 1.000107; rounded to five decimals it is 1.00011.

Change of Index

10. If the Ministry of Commerce and Industry, Government of India changes the base year for the WPI during the tenor of the bonds, the index ratio for the existing CIBs would be calculated after conversion of the index at the new base year to the base year 1993-94 by using the conversion factor as announced by the Government of India or by the Reserve Bank in consultation with the

Government of India. The new CIBs from the date of change of the base year will be indexed to the new WPI series.

Repayment

11. Based on the Wholesale Price Index for All Commodities, the principal value of CIB would be adjusted. The inflation-adjusted principal value of the bonds can be obtained for any date by multiplying the par value by the index ratio applicable to that date. The inflation adjustment to the principal would not be payable until maturity. At maturity the CIB would be redeemed at its inflation-adjusted principal amount or its original par value, whichever is greater, with an inbuilt insurance that the redemption value would not be below par.

Coupon

12. Interest on CIB would be payable on a semiannual basis at a fixed real rate of interest throughout the tenure of the bonds. The fixed real rate of interest would be applied not to the par amount of the security, but to the inflation-adjusted principal. To explain, each interest payment would be calculated by multiplying the inflation-indexed principal (regardless of whether it is greater or lower than the par value) by one-half the real interest rate determined at auction. Thus, the nominal interest amount payable on the bond would vary with WPI throughout the life of the bonds.

Illustration: A 10-year CIB with coupon of 3% was issued on July 15, 2003, with the first interest payment due on January 15, 2004. The Ref WPI on July 15, 2003 (Ref WPI $_{\text{Issue Date}}$) was 120, and the Ref WPI on January 15, 2004 (Ref WPI $_{\text{Date}}$) was 132. For a par amount of Rs. 1,00,000 the inflation-adjusted principal on January 15, 2004 would be

Rs.1,00,000 x 132/120 = Rs. 1,10,000.

The semiannual interest payment for the bonds would be calculated by multiplying the inflation adjusted principal amount with the applicable coupon rate (i.e. half of 3 per cent) as under:

Rs. 1,10,000 x 0.03/2 = Rs.1,650.00

In the same example, if the Ref WPI on January 15, 2004 was 115, the inflation adjusted principal on that day would be

Rs. 1,00,000 x 115/120 = Rs. 95,833.33

and the semi annual interest payment, accordingly, would be

Rs. 95833.33 x 0.03/2 = Rs. 1437.5

Taxation

13. The value of the investment in the CIB and the coupon payable thereon would be governed by the provisions of tax laws as applicable from time to time.

_____**xxxxxxxxxxxxxxx**_____

Annex 1

Calculation of Settlement Price of Capital Indexed Bonds

Formula for Derivation of settlement price of a CIB

For a nominal bond paying a regular nominal coupon C_N, the settlement price P_N is derived by the under noted nominal bond equation:

$$P_N = \sum_{j=1}^{n} \frac{C_N}{(1+Y)^j} + \frac{R_N}{(1+Y)^n}$$

where R_N represents nominal redemption payment at maturity and Y represents prevailing yield to maturity. Similarly, the settlement price P_r of a CIB having a regular real coupon c_r and the real redemption payment r_n at maturity can be given by equation:

$$P_r = \sum_{j=1}^{n} \frac{c_r \prod (1+\pi_i)}{(1+y)^j \prod (1+\pi_i)} + \frac{r_n \prod (1+\pi_i)}{(1+y)^n \prod (1+\pi_i)}$$

where π_i is the rate of inflation between the i-1 and i. As the CIB is perfectly indexed, the indexation factors scaling up the cash flows (in numerator) exactly match those discounting the cash flows (in denominator). These get canceled to give:

$$P_r = \sum_{j=1}^{n} \frac{c_r \cancel{\prod (1+\pi_i)}}{(1+y)^j \cancel{\prod (1+\pi_i)}} + \frac{r_n \cancel{\prod (1+\pi_i)}}{(1+y)^n \cancel{\prod (1+\pi_i)}}$$

$$= \sum_{j=1}^{n} \frac{c_r}{(1+y)^j} + \frac{r_n}{(1+y)^n}$$

The above equation reduces the relationship between the price of a CIB, its real cash flows and the real interest rates to exactly the same form as that between the price of nominal bonds, its nominal cash flows and the nominal interest rate.

The settlement price of the bonds is calculated by multiplying the real present value of discounting real cash flows , i.e., P_r with the Index factor. The settlement price can thus be calculated as under:

$$\text{Index ratio} \left\{ \frac{\text{Annual Real Coupon in Rupee}}{(1+y/2)^{d/180}} \times 2 + \frac{\text{Annual Real Coupon in Rupee}}{(1+y/2)^{d/180+1}} \times 2 + \frac{\text{Annual Real Coupon in Rupee}}{(1+y/2)^{d/180+2}} \times 2 + \ldots + \frac{\text{Annual Real Coupon in Rupee}}{(1+y/2)^{d/180+n}} \times 2 + \text{Redemption amount} \right\}$$

where, y represents the prevailing real yield and d represents number of days (on 30/360 day count basis) from the settlement to next coupon payment and n represents number of coupon payments.

Illustration: 3% 10-year CIB was originally issued on July 15, 2003 at par (i.e., Rs. 100) which would fall due for redemption on July 15, 2013. The interest payment dates for the bond are January 15 and July 15. What would be the settlement price of the bond (face value Rs. 100) on re-issue at April 15, 2004, if the real yield determined in the re-issue auction is 3.40%, the base index applicable to the issue date of this bond (i.e. July 15, 2003) is 120 and the reference WPI applicable to April 15, 2004 is 132.

On the bond, the inflation compensation would accrue from July 15, 2003 to April 15, 2004. The broken period interest on the bond would, however, accrue only from January 15, 2004 to April 15, 2004. The index Ratio for the bond on April 15, 2004 would be 1.10 as illustrated below:

$$\text{Index Ratio}_{\text{April 15, 2004}} = \frac{\text{Ref WPI}_{\text{April 15, 2004}}}{\text{Ref WPI}_{\text{July 15, 2003}}} = \frac{132}{120} = 1.10$$

Annual Real Coupon on bond (face value Rs. 100) = Rs. 3.0

Real YTM emerging in re-issue auction of the bonds = 3.40 per cent

Date of original Issue = 15 July 2003

Settlement Date for Re-issue = 15 April 2004

Date of maturity = 15 July 2013

Coupon Payment Dates= July 15 and January 15 every year.

Date for Cash Flows	Term to the time of cash flows (from date of settlement) (in Years)	Real Coupon /Principal Cash flows (in Rs.)	Discounted cash flows at YTM of 3.40% per annum
15/07/04	0.25	1.5	1.487410293
15/01/05	0.75	1.5	1.462546994
15/07/05	1.25	1.5	1.438099306
15/01/06	1.75	1.5	1.414060281
15/07/06	2.25	1.5	1.390423089
15/01/07	2.75	1.5	1.367181012
15/07/07	3.25	1.5	1.344327445
15/01/08	3.75	1.5	1.321855895
15/07/08	4.25	1.5	1.299759975
15/01/09	4.75	1.5	1.278033407

15/07/09	5.25	1.5	1.256670017
15/01/10	5.75	1.5	1.235663734
15/07/10	6.25	1.5	1.215008588
15/01/11	6.75	1.5	1.19469871
15/07/11	7.25	1.5	1.174728328
15/01/12	7.75	1.5	1.155091768
15/07/12	8.25	1.5	1.135783449
15/01/13	8.75	1.5	1.116797885
15/07/13	9.25	101.5	74.30677506

? Discounted Real Cash flows = Rs. **97.59491524**

Settlement Price = Index Ratio x ? Discounted Real Cash flows

=1.10 x 97.5949152 = **Rs. 107.3544**

= Rs. 107.35

ANNEX 2

Selection of Inflation Index

In principle, the index-linked bonds could be indexed to any available index for prices such as GDP deflator, Wholesale Price Index (WPI) and the various variants of Consumer Price Index (CPI). Ideally, the basic criteria for the selection of an index would be to enable the fulfillment of the hedging requirements of both the issuer and investors. However, on many occasions these requirements do not match. For instance, if a government observes that its revenue collections are strongly correlated to movements in GDP deflator then that government would prefer to issue index linked bonds which is linked to GDP deflator. On the other hand, the retail investors may prefer the bonds that are linked to consumer price index, which captures the impact of inflation on their budget more closely. The other objective criteria for selection of index could be (a) it should closely track inflation, (b) it should be widely accepted indicator of inflation (c) it should be available to the public (d) it should have high frequency of release.

2. While the CPI is a widely used index for adjusting the cash flows for the indexed bonds in many countries, in India the WPI has been used on previous occasions for indexing cash flows of index linked and capital indexed bond. Out of available prices indexes, (viz., GDP deflator, CPI and WPI), the WPI is the main measure of the rate of inflation commonly used in India. The WPI has better availability for all commodities and for major groups, sub-groups and individual commodities. The basic advantage of this measure of inflation is its availability at high frequency, i.e., on weekly basis with a gap of about two weeks (for the provisional figure). This index, however, does not cover non-commodity producing sectors, viz., services and non-tradable commodities.

3. The national income deflator, on the other hand, is a comprehensive measure but statistically derived from national accounts data released by the Central Statistical Organisation (CSO) as a ratio of GDP at current and constant prices. Since it encompasses the entire spectrum of economic activities including services, the scope and coverage of national income deflator is wider than any other measure. However, the GDP deflator is available only annually with a long lag of over one year and hence its utility for indexing cash flows of an index linked bond is limited. Further, it is neither a widely accepted indicator of inflation nor do the investors have much familiarity with it.

4. Yet another important measure of inflation, at the point of consumption, is the Consumer Price Index for Industrial Workers (CPI-IW) which is meant to reflect the cost of living conditions and is computed on the basis of the changes in the level of retail prices of selected goods and services on which a homogeneous group of consumers spend the major part of their income. CPI-IW is available with a lag of 2 months. Its coverage is broader than the other indices of CPI like the CPI for Agricultural Labourers (AL) and the CPI for Urban Non-Manual Employees (UNME). Thus, CPI-AL and CPI-UNME could not be considered as robust national inflation measures as they are designed for specific groups of population with the main purpose of measuring the impact of price rise on rural and urban segment of population.

5. While each of the measures has its advantages as well as weaknesses, the selected index of inflation should broadly capture the interplay of effective demand and supply forces in the economy at frequent intervals. This will be facilitated if the price indices have a high periodicity of release, and it is in this context that WPI can be considered superior to CPI with the weekly frequency of releases as against the monthly frequency of CPI-IW. WPI's coverage of commodities is also high. While services do not come under the ambit of WPI, the coverage of non-agricultural products is better in WPI than CPI, making WPI less volatile to relative price changes as compared to the CPI. The coverage of tradable items, essentially manufactured products (weight = 57.06 per cent), is higher in the case of WPI whereas the coverage of non-tradables like services pertaining to education, medical care and recreation is higher in the case of

CPI-IW. Further, WPI is computed on all-India basis whereas CPI is just constructed for specific centers and then aggregated to obtain the all-India index. The weekly periodicity of WPI with a small lag of a fortnight is another advantage of WPI vis-à-vis other measures of inflation. Given the above advantages of WPI over the other price indexes, the WPI may be ideally used for hedging the cash flows of indexed bonds as was done hitherto. Contextually, it may also be mentioned that the monthly average of WPI (average of weeks) as worked out by the Reserve Bank of India, instead of WPI at the last week of the month, would be more appropriate for indexed linked bonds as it smoothens the weekly variability in WPI and hence reduces the level of variability in price of the bonds and also the cash flows arising from the bond in the form of interest payments/ principal repayment at redemption.

ANNEX 3

Design of Capital Indexed Bonds

The inflation indexed bonds have been designed for providing real value certainty to the investors. Thus, technically, all payments on the index linked bonds need to be perfectly linked to inflation on contemporaneous basis. However, in practice, there are always some lags between actual movements in the price index and actual payments on the bonds which distort "inflation proofing" properties of indexed bonds. The lag between the two could be on account of two reasons. First, the lag could be on account of some delay with which the inflation figures are published. Second, the lag may arise due to institutional arrangements for trading and settlement of bonds between coupon payment dates. The second type of lag, which is also the more significant lag, arises whenever a bond changes hands. The buyer of the bond in addition to the clean price also needs to compensate the seller for the accrued interest. As the accrued interest is computed on a *pro rata* share of the next coupon payment, it becomes essential that the next coupon payment rate is known with certainty. For this purpose, the bond issuing authority needs to announce the next coupon payment rate on / before the existing coupon payment date. Thus, for a bond offering semi annual coupon payments, the indexation lag on account of institutional factor would be six months.

2. There are two most prevalent designs of capital indexed bonds linking inflation with the coupon payments. The first design is being used by the Debt Management Office of the United Kingdom under which the upliftment of principal and the coupon on this uplifted principal are paid on the basis of inflation figure lagged for 8 months (2 months for publication lag and 6 months for institutional lag). For example, the principal value of 2% IL 2006 issued by the UK Treasury in July 1981 and redeeming in July 2006, will actually be uplifted by the percentage increase in Retail Price Index (RPI) between November 1980, and November 2005. The cash value of semi annual coupons are calculated as follows:

$$\text{Coupon paid} = \frac{C}{2}\left\{\frac{RPI_{m-8}}{RPI_{i-8}}\right\}$$

Where C is the quoted annual coupon, RPI_t is the RPI for month t,

m is the payment month and i is the issue month

Similarly, the cash value of the redemption amount is:

$$\text{Redemption value} = 100 \times \left(\frac{RPI_{r-8}}{RPI_{i-8}}\right)$$

Where r = the redemption month

3. The second design, popularly known as the Canadian model was developed by Canadian Treasury and is being currently followed by Sweden, the United States, France and South Africa treasuries. The accrued interest under the Canadian design is calculated on the basis of cumulative increase in inflation index from the last coupon payment date and hence it is not necessary to know the nominal value of the next coupon with certainty at all times, as is the case with the UK design. Under the Canadian design, the cumulative increase in the inflation index is captured in 'index ratio' which is used to compute the inflation adjustments to the coupons of the bonds as well as the principal. Thus, the major changes between the two designs could be seen in the method of calculating accrued interest in such a way that indexation lag remains limited up to publication lag.
The index ratio for a given settlement date is defined as the ratio of reference RPI applicable to the settlement date (Ref RPI $_{\text{Set Date}}$) divided by reference (RPI $_{\text{First Issue Date}}$).

$$\text{Index Ratio}_{\text{Set Date}} = \frac{\text{Ref RPI}_{\text{Set Date}}}{\text{Ref WPI}_{\text{First Issue Date}}}$$

4. The reference RPI for the first day of any calendar month is the RPI for the calendar month falling three months earlier, so the reference RPI for June 1 corresponds to RPI for February. The reference RPI for any other day in a month would be calculated by linear interpolation between reference RPI applicable for the first day of the month in which the settlement falls and the reference RPI applicable to the first day of month immediately following settlement date. Interpolated value for Ref RPI $_{\text{Set Date}}$ is rounded off to say five basis points, as applicable for value of Index Ratio $_{\text{Set Date}}$.

The formula used to calculate Ref RPI $_{\text{Set Date}}$ can be expressed as follows:

$$\textbf{Ref RPI}_{\textbf{Set Date}} = \textbf{Ref RPI}_{\textbf{M}} + \frac{(t-1)}{D}\left[\textbf{Ref RPI}_{\textbf{M+1}} - \textbf{Ref RPI}_{\textbf{M}}\right]$$

Where D= the number of days in the calendar month in which the settlement date falls

t = the calendar day corresponding to the settlement date

Ref RPI_M = Reference RPI for the first day of the calendar month in which settlement date falls

Ref RPI_{M+1} = Reference RPI for the first day of the calendar month immediately following the settlement date.

5. For an indexed principal bond, the inflation uplift or inflation compensation accrued to a particular date (Inflation Compensation Set Date) is defined as the product of the principal and the Index Ratio for that date minus the principal.

Inflation Compensation $_{\text{Set Date}}$ = (Principal x Index Ratio $_{\text{Set Date}}$) - Principal .

The semi-annual interest payment are calculated as :

$$\textbf{Coupon Payment}_{\text{Div Date}} = \frac{C}{2} \times (\textbf{Principal + Inflation Compensation}_{\text{Div Date}})$$

Where C = annual real interest rate