Experiences in Japan: Inflation Indexed Bond Markets

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1. Introduction

Cannon and Tonks (2008) state that "as countries grapple with the demographics of aging populations, it is predicted that the demand for annuity products will increase", that "any funded DC scheme requires instruments to convert the accumulated capital into a retirement income stream. This is what an annuity accomplishes", and that "the supply situation is more complicated because most annuity products are based on bonds, and the state of the government bond market is determined to a large extent by a government's policies on the size and management of its national debt"(p.1).

This paper will briefly discuss one of the most powerful financial instruments in annuity products, that is, the inflation indexed bond for which the coupon and principal payments are indexed to the Consumer Price Index.

This debt security becomes the globally traded government bond and well accepted in the financial markets. Indeed, Inflation Indexed bonds have been issued by a total of 30 countries. Major examples of such issues are outlined in Table 1 which shows that in most instances the issuance of indexed bonds began after the start of the 1990s. While this in part reflects the actions taken by such high-inflation countries as Brazil, Turkey and Mexico, several factors have contributed to growing demand for long-term financial products with built-in inflation hedges. Since being first introduced in United Kingdom in 1981, pension funds, life insurance companies and other institutional investors have been increasingly drawn to indexed bonds in light of the aging of society. Indexed bonds also provide various advantages to issuers and have come to be

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recognized as a standard financial asset issued by governments. For instance, they have been used as a means for inflation control and fiscal discipline to bolster market confidence. Furthermore, the expected rate of inflation can be unambiguously derived from market prices. With the adoption of inflation targeting by a growing number of countries during the 1990s, central banks persistently lobbied for the issuance of indexed bonds to serve as a source of market information on inflation[1].

Table 2 illustrates international comparisons of inflation indexed bonds among the major countries. As of December 2008, the outstanding balance of U.S. Treasury Inflation-Protection Securities (TIPS) amounted to $530.1 billion, equivalent to 9.14% of total outstanding U.S. government bonds. Compared to the United Kingdom where indexed bonds held a 29.3% share as of September 2008, the U.S. figures indicate that market scale remains small. In case of Japan, as of September 2008, the Ministry of Finance issued the indexed bonds amounted about 10 trillion yen, equivalent to 1.47% of total outstanding Japanese government bonds.

As to the issue of who holds the inflation indexed bonds, as far as we know, in UK, life insurance and pension funds hold near 80%, in USA, mutual funds and investment trust are the major holder of 10% of indexed bonds, and in Japan, very odd to say, 80% of the indexed bonds holders are foreign institutional investors such as life insurance, pension funds and hedge funds.

2. Structure of U.S. Treasury Inflation-Protection Securities

The structure of Indexed Bonds can be summarized as follows.
Firstly, ensuring the real value of interest and principal requires indexation. The Ministry of Finance does this by multiplying the principal by the ratio between CPI (Core Consumer Price Index, excluding fresh foods) as measured three-months prior to settlement date and CPI for the first issue date. Specifically, the following formula is used.

(1) $\text{Index Ratio}_{\text{Set Date}} = (\text{Ref CPI}_{\text{SetDate}}/\text{Ref CPI}_{\text{FirstIssueDate}})$

[1] Countries appearing in Table 1 which have adopted inflation targeting are Australia, Canada, New Zealand, Sweden and the United Kingdom.

Daily CPI values are linearly interpolated using CPI for the first of the month and the first of the following month.

(2) Ref $CPI_{SetDate}$=Ref CPI_M+(t-1)/D*(Ref CPI_{M+1}-Ref CPI_M)

Where D = number of days in month, t = settlement date, Ref CPI_M= CPI for first day of month M, Ref CPI_{M+1}= CPI for first day of M+1 month.

Inflation compensation is defined as the difference between the indexed and nominal principals.

(3) Inflation $Compensation_{SetDate}$=(Principal*Index $Ratio_{SetDate}$)-Principal

Twice-a-year interest payments are computed as follows.

(4) Interest $Payment_{DivDate}$=c/2*(Principal+Inflation $Compensation_{DivDate}$)

Where c = annual coupon rate.

Given this definition, the relation between the price and interest payments of indexed bonds in the secondary market can be expressed as follows.[2]

(5) (Nominal) Price per $100 face value
= Inflatration-Adjusted Price+ Inflation-Adjusted Accrued Interest

This relation can be specified as follows.
(6)

$$P_{ib} = \frac{Ref\text{CPI}_{\text{setdate}}}{Ref\text{CPI}_{\text{first}}}\left[\left(\frac{1}{1+\frac{f}{d}\cdot\frac{r}{2}}\right)\times\left\{\frac{C_{ib}}{2}+\frac{C_{ib}}{2}\sum_{h=1}^{n}\left(\frac{1}{1+\frac{r}{2}}\right)^{h}+100\left(\frac{1}{1+\frac{r}{2}}\right)^{n}\right\}-\frac{C_{ib}}{2}\left(\frac{d-f}{d}\right)\right]$$

[2] The U.S. Treasury Department guarantees that principal at redemption will not fall below the nominal value, 100 even under deflation. This points to an asymmetry in indexation in the sense that U.S. Treasury Inflation-Protection Securities are adjusted to guarantee real values under inflation, while nominal values are guaranteed under deflation. As opposed to this, indexed bonds issued in Japan, U.K and Canada are adjusted under deflation to guarantee real amounts. The fact that U.S. indexed bonds guarantee the nominal value of the principal implies that a put option comes into play under deflation. Strictly speaking, the price of this option should also be calculated.

d = number of days between interest payment dates
f = number of days between settlement date and next interest payment date
n = number of interest payments between next interest payment date and maturity
C_{ib} = Real coupon rate of indexed bonds

During the last six months to maturity, cash flow is discounted based on simple interest instead of compound interest.

Similarly, the price of nominal bonds can be expressed as follows.

$$(7)\quad P_{nb} = \left(\frac{1}{1+\frac{g}{e}\cdot\frac{R}{2}}\right)\left[\frac{C_{nb}}{2}+\frac{C_{nb}}{2}\sum_{j=1}^{m}\left(\frac{1}{1+\frac{R}{2}}\right)^{j}+100\left(\frac{1}{1+\frac{R}{2}}\right)^{m}\right]-\frac{C_{nb}}{2}\left(\frac{e-g}{e}\right)$$

e = number of days between interest payment dates (half year =÷ 182)
g = number of days between settlement date and next interest payment date
m = number of interest payments between next interest payment date and maturity
C_{nb} = Nominal coupon rate

The following relation holds when arbitrage is taking place between the nominal bond and indexed bond interest rates.

Because (1+r) x (1+π) = (1 +R)

--> r = (1+R)/(1+π)-1 = (R -π)/(1+π) or π = (R-r)/(1+r)

In other words, if the yield of the nominal bond (R) and the yield of indexed bond (r) are known, it is possible to compute the break even inflation rate (π; sometimes called BEI). As a rule of thumb, we take it as a market expected inflation rate.

Note that this decomposition does not pay any attention to risk premium, liquidity premium and other option values that might be included in break even inflation rate. At the moment, economists and financial engineers are engaged in a research of decomposition of BEI into a pure expected inflation rate, risk premium, liquidity premium and other factors. In so doing, we need to introduce equations that enable to identify these premiums and other factors.

3. Current trading records

Ministry of Finance has been issuing the inflation indexed bonds successfully and steadily since 2004 (see Tables 3-5). Kitamura (2006) provides an interim report on the inflation indexed bond in Japan. He finds that econometric estimation indicates that the first three issues of inflation indexed bonds contain very poor information while the later issues reveal some valuable information for expected inflation estimation. Although liquidity of bonds is still limited and institutional investors in Japan are reluctant to purchase the indexed bonds in a large scale, in the future, inflationary environments would induce high demands for indexed bonds. At the same time, further institutional amendments would stimulate the institutional investments of indexed bonds. In addition, the base year revision of consumer price index (CPI) from Year 2000 to Year 2005 was announced on 25 August 2006 and the new CPI indicated -0.4% downward shift from the old CPI. This created so called the CPI shock on 25 August 2006. According to his econometric estimation, the net impact of this CPI shock on expected inflation rate was about -0.15%.

Current financial crisis hit the indexed bond markets very hard around the world. Break even inflation rates in the major countries collapsed simultaneously after September 2008. This drop did not imply that market participants expected deflation in the near future, but it reflects the market imbalance such that most institutional investors tried to sell the indexed bonds world wide while very little demand exists. It was a fly to liquidity, no matter how much the institutional investors would loose by selling indexed bonds such low prices.

The Japanese government stopped issuing inflation indexed bonds from October 2008 until the market conditions return to normal. On the other hands, indexed bonds are issued as usually scheduled in UK and USA.

4. Reluctant Institutional Investors

Pension Funds and Life Insurance Companies in Japan are very reluctant to hold Indexed bonds. As a consequence, 70% of indexed bond holders are said to be foreign investors such as life insurance, pension funds and hedge funds.

Why the Japanese investors are so reluctant to hold indexed bonds? There are several reasons for this. First, prospect of inflation is very low in Japan. Second, as public pension is based on a pay-as-you-go system, the demand for inflation hedge among public pension fund management seems low. Third, institutional investors such as life insurance and pension funds are reluctant to introduce new operation and accounting system that can handle indexed bonds (i.e. valuation of indexed bonds is changing day by day, it is different from the treatment of nominal bonds.), Fourth, combining the above three reasons, market liquidity is very limited and the price volatility is high as was demonstrated in September 2008. Inexperienced fund managers in Japan seem to decide to wait and see how to invest in indexed bonds in the coming years.

5. Conclusion

In the long run, inflation indexed bond will be proved to be a very useful instrument in public pension fund management in general and annuity products in particular.

In order to encourage the pension fund managers to hold inflation indexed bonds in their portfolio, Ministry of Finance should exchange the views of future prospects of bond markets not only with the bond market primary dealers and the major participants but also with ultimate bond holders such as pension funds and life insurance companies. Ministry of Finance also needs to promote inflation indexed bonds among institutional investors by improving investment environments such as relaxing accounting regulation, removing investor's restriction, increasing liquidity of the indexed bonds by buying back and allowing trading strips.

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Table 1 Countries Issuing Indexed Bonds

Country	Issue Date	Index Used
Argentina	1972-89	Non-agricultural wholesale price
Australia	1983-	Consumer prices
	1991	Average weekly earnings
Austria	1953	Electricity prices
Brazil	1964-90	Wholesale prices
	1991-	General prices
Canada	1991-	Consumer prices
Chile	1966-	Consumer prices
Colombia	1967	Wholesale prices
	1995-	Consumer prices
Czech Republic	1997-	Consumer prices
Denmark	1982-	Consumer prices
Finland	1945-67	Wholesale prices
France	1952,1973	Gold price
	1956	Level of industrial production
	1956	Average value of French securities
	1957	Price of equities
Greece	1997-	Consumer prices
Hungary	1995-	Consumer prices
Iceland	1955-	Consumer prices
	1964-80	Cost of building index
	1980-94	Credit Terms Index
	1995-	Consumer prices
Ireland	1983-	Consumer prices
Israel	1955-	Consumer prices
Italy	1983	Deflator of GDP at factor cost
Mexico	1989-	Consumer prices
New Zealand	1977-84	Consumer prices
	1995-	Consumer prices
Norway	1982	Consumer prices
Poland	1992-	Consumer prices
Sweden	1952	Consumer prices
	1994-	Consumer prices
Turkey	1994-97	Wholesale prices
	1997-	Consumer prices
United Kingdom	1975-	Consumer prices
	1981-	Consumer prices
United States	1742,1780	Commodity prices
	1997-	Consumer prices

Source: Deacon and Derry (1998) Table 1.1, p.6.

Note: In addition to government bonds, this table includes issues by public corporations, semi-government authorities, and those that carry a government guarantee.

Table 2 International Comparisons of Structures in Inflation Indexed Bonds

	United States	United Kingdom	France	Italy	Canada	Japan
Time of Introduction	January 1997	March 1981	September 1998	December 2003	December 1991	March 2004
type of CPI	CPI-U (urban CPI)	RPI (Retail Price Index)	CPI (except tobacco), HICP (except tobacco	HICP (except tobacco)	CPI	Core CPI
Linked CPI Lag	three months	three or eight months	three months	three months	three months	three months
Principal Guaranteed	Yes	No	Yes	Yes	No	No
Term Years	5, 10, 20, 30 years	6-50 years	4,10, 15,30 years	5,10,15,30 years	30 years	10 years
Interest Payment Frequency	twice a year	twice a year	once a year	twice a year	twice a year	twice a year
Strips	OK	No	No	OK	No	No
Amount of Issue	US$536.2 billion (¥4830 billion) October 2008	UK£157 billion (¥2140 billion) September 2008	Euro 151.3 billion (¥1920 billion) September 2008	Euro 83.7 billion (¥1060 billion) October 2008	CA$31.5 billion (¥340 billion) November 2008	¥1010 billion December 2008

Source: Treasury Department of the United States, Debt Management Office of United Kingdom, the Department of Treasury of Italy, Bank of Canada, Ministry of Finance of Japan and the Bank of Japan (Mizuho Securities)

Table 3 Issue Record of Indexed Bonds

Issue	April 2007	June	August	October	December	February 2008	April	June	August
Amount of Issue (billion yen)	5 00	5 00	5 00	5 00	5 00	5 00	5 00	5 00	5 00
Month of Interest Payment	September, March	December June		March, September	June, December		March, September	June, December	
Month of Redemption	March	June		September	December		March	June	
Base Month	December	March		June	September		December	March	

Note: August and February are basically reopen.

Table 4　Historical Changes in Issue Amount of Indexed Bonds

Fiscal Year	2003	2004	2005	2006	2007	2008
Annual Amount of Issue (billion yen)	0.1	0.8	2.0	2.5	3.0	1.5
Issue Lot Frequency of Bid	0.1×1	0.3×1 0.5×1	0.5×4	0.5×5	0.5×6	0.5×3
Annual Number of Issue	1	2	4	3	4	3

Table 5 Outstanding Issue Amount

March 2004	March 2005	March 2006	March 2007	December 2007	March 2008	December 2008
0.1	0.9	3.0	5.5	7.9	8.4	9.9

Note: Time is at the end of the month.