

### Outline

The Nomura Bond Performance Index, or NOMURA-BPI, has been regularly compiled and published since 1986, more than 30 years ago. During this time, it has become widely used by institutional investors in Japan and other countries as a benchmark for measuring bond performance and is now a leading bond market index in Japan. Aiming to develop a benchmark index with stable durations, Nomura Securities' Quantitative Research Center has developed the NOMURA-BPI/Ladder, which charts the performance of laddered JGBs, and the NOMURA Swap Index, an index of interest rate swap performance. Nomura Securities also releases an index of 15-year floating-rate JGBs and inflation-linked JGBs, which have risk-return profiles that are different from fixed-coupon bonds. This report explains the characteristics and inclusion criteria of each of these bond indices, as well as the computation methods of each index. We also address some of the questions that readers have asked of us.

### Updates from the last fiscal year

As for the NOMURA-BPI MBS sector and NOMURA CMT Index, part of risk indicators (T-spread, effective duration etc.) are calculated by using an Interest Rate Model. We switched risk indicators; they are now calculated based on a model that corresponds with negative interest rates because, in the current bond market, many investors expect negative interest rates to become a normal phenomenon. The model has been introduced in Section 1 (5).

The NOMURA FIG Index, which is a market capitalization-weighted index that includes accrued interest and covers bonds (except bank debentures, or "kinyusai") issued by banks, is published from end-April 2016. The detail of the NOMURA FIG Index is added in section 7.

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14 June 2016

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# 1. NOMURA-BPI

## (1) Outline of index

### What is the NOMURA-BPI?

The Nomura Bond Performance Index (NOMURA-BPI) was developed to reflect the performance of the entire secondary market for publicly offered, fixed-income bonds issued in Japan. The value of the index reflects the performance of the bonds that make up the index (hereafter, the index portfolio), determined based on given inclusion criteria.

Currently, the NOMURA-BPI is used as a benchmark of domestic bond performance by many institutional investors, including pension funds. The index comprises approximately 10,500 issues as of April 2016, with a total face value of over JPY870 trillion.

### Inclusion criteria

The NOMURA-BPI has a set of criteria for the inclusion of bonds in the index portfolio so that the index can be widely used by institutional investors as an investment benchmark. The index portfolio includes all bonds that meet the criteria listed in Fig. 1 as of around the 25th of every month, and the index portfolio component issues are determined the following month. See Fig. 2 for the selection dates.

**Fig. 1: NOMURA-BPI Inclusion Criteria**

Market of issue	Publicly-offered bonds issued in Japan <sup>1</sup>
Currency Denomination	Yen
Coupon	Fixed
Outstanding amount	JPY1 billion or more
Term to maturity	1 year or more
Rating	Corporate bonds, yen-denominated foreign bonds, MBS and ABS: At least A <sup>2</sup> or the equivalent Others: No minimum rating
Inclusion for newly-issued bonds	JGBs – Following month Bank debenture bonds – Three months after issuance Other – Two months after issuance

<sup>1</sup> Excluding CBs, WBs, ABS, CBOs, CLOs, and step-up bonds. Note that the following types of asset-backed securities may be included: FILP ABS, life insurer assets such as funds and subordinate loan bonds, and investment corporation bonds.

<sup>2</sup> Rated at least 'A' or equivalent by R&I, JCR, S&P, and Moody's.

Source: NSC

The inclusion criteria listed in Fig. 1 are as of March 2016. The NOMURA-BPI is an index measuring the performance of the bond secondary market overall, and the inclusion criteria have been revised based upon changes in the market environment. See Fig. 2 for past changes in inclusion criteria.

Please note that, beginning with the April 2014 portfolio determination, “retail investor bonds (corporate bonds tailored for retail investors and resident-participatory local government bonds)” will be excluded from the index portfolio. In addition to retail investor bonds issued in April and beyond, those included in the March 2014 index portfolio (126 names, about JPY3trn in face value) will be excluded. Assuming that retail investor bonds are excluded from the March 2014 index portfolio, the modified durations would have lengthened by 0.08yrs for the NOMURA-BPI Corporates and by 0.02yrs for the NOMURA-BPI.

**Fig. 2: Past Changes in NOMURA-BPI Inclusion Criteria**

Oct 1993	Inclusion timing of newly-issued non-JGB bonds changed to two months following issuance from one month following issuance with the release of daily data.
Dec 1993	Offering method for bank debentures reviewed, and the timing of inclusion of newly-issued bank debentures changed to three months following issuance from two months following issuance starting with November 1993 issuances.
Jan 1996	Corporate bonds: New rating criteria applied (at least A or the equivalent) Samurai bonds: Rating criteria changed (to at least A or the equivalent from AAA) JGBs: Intermediate issues may be included. <sup>1</sup>
June 2002	Date for determining inclusion in portfolio changed from last business day of month to 25 <sup>th</sup> of month, and inclusion standards then change as follows: <ul style="list-style-type: none"> <li>• Inclusion determined based on rating as of 25<sup>th</sup> of that month.</li> <li>• Inclusion determined based on remaining value as of end of following month using data through 25<sup>th</sup> of that month.</li> </ul>
April 2003	Government Housing Loan Corporation MBS are added
June 2005	Date for following month's portfolio determination date: Changed to earlier of: 1) first business day after 25 <sup>th</sup> ; or 2) three business days before last business day of the month. Note that the inclusion selection is made one business day prior to the portfolio determination day.  Note: The portfolio determination day may be changed if the JGB auction for a given month falls later than the day after the portfolio determination date.
April 2008	Some ABS included (FILP ABS, REIT bonds, life insurance capital fund notes and subordinated loan bonds)
April 2014	"Retail investor bonds (corporate bonds tailored for retail investors and local government bonds for retail subscription)" will be excluded from the index portfolio.

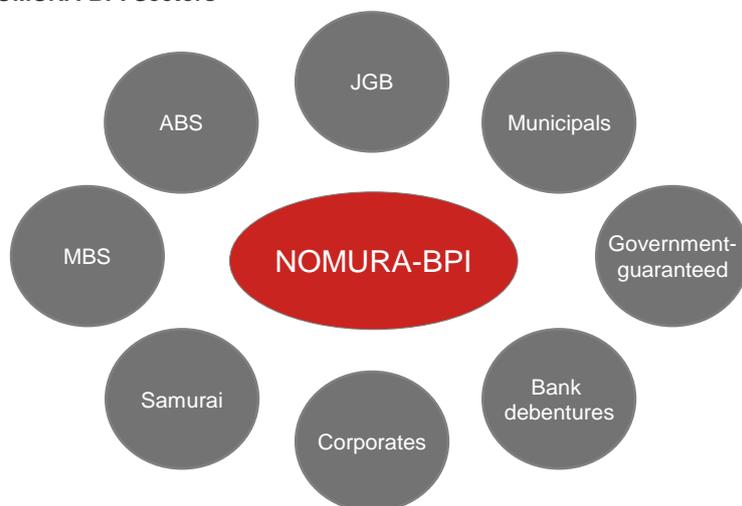
<sup>1</sup>JGB (medium) (2yrs and 4yrs) had a strong tendency to be accumulated by medium-term JGB funds geared toward retail investors, and the Nomura-BPI did not include medium-term interest-bearing JGBs when it was first developed. However, large amounts of JGB (4YR) were issued periodically starting in 1993 and were added to the index from 1996 as they were actively traded among investors.

Source: NSC

### Sector Classifications

Fixed-income securities are diverse; the risk profiles and performances differ for each type of bond. As of April 2016, securities in the NOMURA-BPI are classified among the eight sectors shown in Fig. 3.

Usually sector classifications do not change from the time a security is first added to the NOMURA-BPI until it is removed. However, some securities have changed sectors, as illustrated in Fig. 4.

**Fig. 3: NOMURA-BPI Sectors**

Source: NSC

**Fig. 4: Sector Changes in the NOMURA-BPI**

May 2003	Some petroleum bonds were taken over by government following repeal of Japan National Oil Corporation Law. Government-guaranteed petroleum bonds were thus re-classified as JGBs, instead of government-guaranteed bonds.
January 2004	With the repeal of the Electric Power Development Promotion Law, electric power development corporation bonds were re-classified as electric/gas utility bonds, instead of FILP-agency bonds.
Feb 2004	As with the change in May 2003, government-guaranteed petroleum bonds taken over by the government were reclassified as JGBs, instead of government-guaranteed bonds.
Jan 2005	Portfolio index released in accordance with rating classifications by ratings agency.
Apr 2009	Securities issued by Japan Finance Corporation for Municipal Enterprises and Japan Finance Organization for Municipal Enterprises were classified as follows:  Municipal corporation bonds backed by government: government-guaranteed bonds (same as before)  Municipal corporation bonds not backed by government: Corporate bonds (through March 2009), municipal bonds (from April 2009)  Bonds issued by Japan Finance Organization for Municipal Enterprises: Corporate bonds (through March 2009), municipal bonds (from April 2009)

Source: NSC

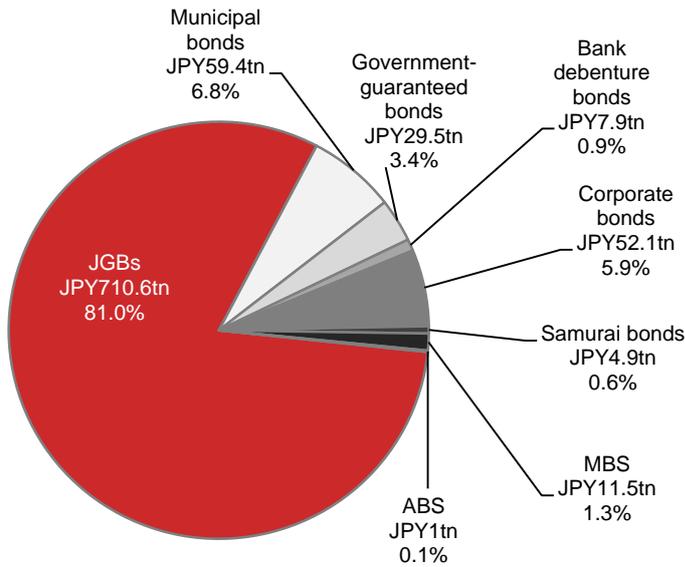
For reference, Fig. 5 shows the face value and weightings of each sector, and Fig. 6 shows the changes in face value of each sector over time.

In Fig. 5, the face value weighting of JGBs was 80.0%, followed by municipal bonds (6.8%), corporate bonds (5.9%), and government-guaranteed bonds (3.4%). Fig. 6 shows that face value of the NOMURA-BPI was approximately JPY150 trillion in 1989, growing to over JPY860 trillion as of end-2015— more than five times the 1989 size. Note that the value of JGBs has grown in particular—around nine-fold, from approximately JPY70 trillion as of the end of 1989 to JPY700 trillion as of end-2015.

The value of municipal bonds and corporate bonds has also risen, while government-guaranteed bonds have remained approximately the same, and bank debentures have been declining.

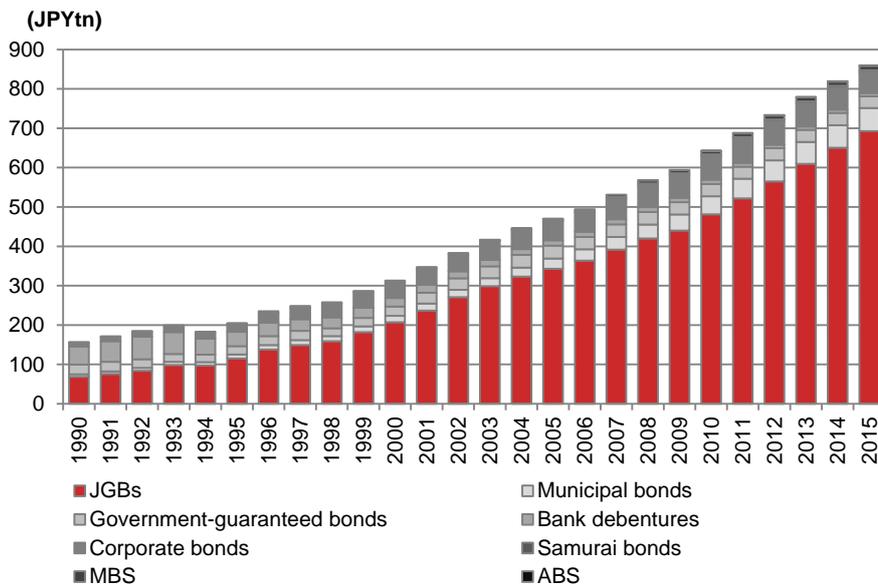
**Fig. 5: Face Value and Weightings by Sector, NOMURA-BPI**

(The April 2016 portfolio as of the end of March 2016)



Source: NSC

**Fig. 6: Face Value by Sector, NOMURA-BPI**



Source: NSC

**Changes in pricing**

As of April 2016, the Nomura Securities final mid price is used for pricing to calculate the NOMURA-BPI. Pricing methods have changed, as have inclusion criteria, with changes in the market environment. Those changes are tabulated in Fig. 7 below.

**Fig. 7: Changes in Pricing**

	Listed bonds		Unlisted bonds
	JGB	Non-JGB	
Dec.30, 1983 - Sep.30, 1993	TSE closing price		
Oct.1, 1993 - Nov.30, 1998			
Dec.1, 1998 - Sep.30, 2000	Nomura Securities bid rate		
Oct.10, 2000 -	Nomura Securities final mid price		

Source: NSC

## (2) NOMURA-BPI/Extended

The NOMURA-BPI Extended was introduced in October 2000. The NOMURA-BPI Extended has different inclusion criteria for ratings than the NOMURA-BPI. The differences with the NOMURA-BPI are as follows:

### - NOMURA-BPI inclusion criteria

Corporate bonds, Samurai bonds, MBS and ABS must be rated A or above (rated by any of the following: R&I, JCR, Moody's, and S&P)

### - NOMURA-BPI/Extended

Corporate bonds, Samurai bonds, MBS and ABS must be rated BBB or above (rated by any of the following: R&I, JCR, Moody's, and S&P)

Since all other NOMURA-BPI/Extended inclusion criteria apart from the ratings criteria are the same as with the NOMURA-BPI, the NOMURA-BPI/Extended index portfolio is the same as the NOMURA-BPI index portfolio, with the addition of corporate bonds, Samurai bonds, MBS, and ABS rated BBB (portfolio attribute indicator data has been collected since January 1996).

## (3) Sub-Indices

Nomura Securities' Quantitative Research Center also computes and releases sub-index performance indices and portfolio indicators aside from the sector indices noted above for a variety of factors, such as ratings, industry, and term remaining. This chapter describes those sub-indices.

### Term remaining

The sub-index for time remaining until maturity is classified based on the number of years remaining until maturity based on the last day of the month for that month's Fig. 8. Indices are also released by term remaining for different sub-index portfolios of sectors, ratings, and industry.

**Fig. 8: Portfolio Classification by Term Remaining**

Classification	Issues
Short-term (1-3)	1-3yrs
Medium-term (3-7)	3-7yrs
Long-term (7-)	7yrs and longer
Long-term (7-11)	7-11yrs
Super long-term (11-)	11yrs and longer
Super long-term (11-15)	11-15yrs
Super long-term (15-)	15yrs and longer

Source: NSC

### Corporate bonds industry classifications

Corporate bonds are classified by industry, based upon the TSE 33 industry classifications.

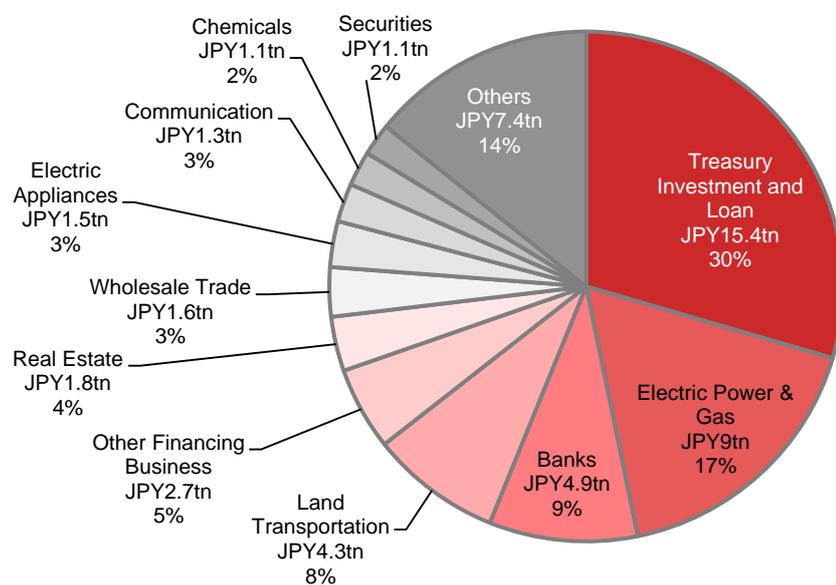
**Fig. 9: OMURA-BPI Corporates Industry Classifications**

Fishery, Agriculture & Forestry	Mining
Construction	Foods
Textiles & Apparel	Pulp & Paper
Chemicals	Pharmaceutical
Oil & Coal Products	Rubber Products
Glass & Ceramics Products	Iron & Steel
Nonferrous Metals	Metal Products
Machinery	Electronic Appliances
Transportation Equipment	Precision Instruments
Other Products	Electric Power & Gas
Land Transportation	Marine Transportation
Air Transportation	Warehousing & Harbor Transportation Services
Information & Communication	Wholesale Trade
Retail Trade	Banks
Securities & Commodity Futures	Insurance
Other Financing Business	Real Estate
Services	FILP Agency bonds and others

Source: NSC

**Fig. 10: NOMURA-BPI Corporates Outstanding Face Value by Sector**

(The April 2016 portfolio as of the end of March 2016)



Source: NSC

**Ratings**

Portfolio indicators are released for corporate bonds and Samurai bonds by their ratings. Further, portfolio indicators are also released for a sector consisted of corporate bonds and Samurai.

Note that the classification refers to the individual issue rating assigned to each bond, not to issuer rating. However, rating agencies may not assign ratings to some issues by the same issuer even though unrated issues have the same terms with rated issues. In such cases, that ratings agency is regarded as having assigned the same rating as the ratings assigned to other issuances. For details, see 11. (2) Q11.

Further, the highest rating is the highest among the four ratings assigned by R&I, JCR, Moody's, and S&P, while the lowest rating is the lowest of the four ratings assigned by the four agencies.

Fig. 11 illustrates the ratings classifications in detail. Fig. 12 shows the face value of corporate bonds and Samurai bonds by rating.

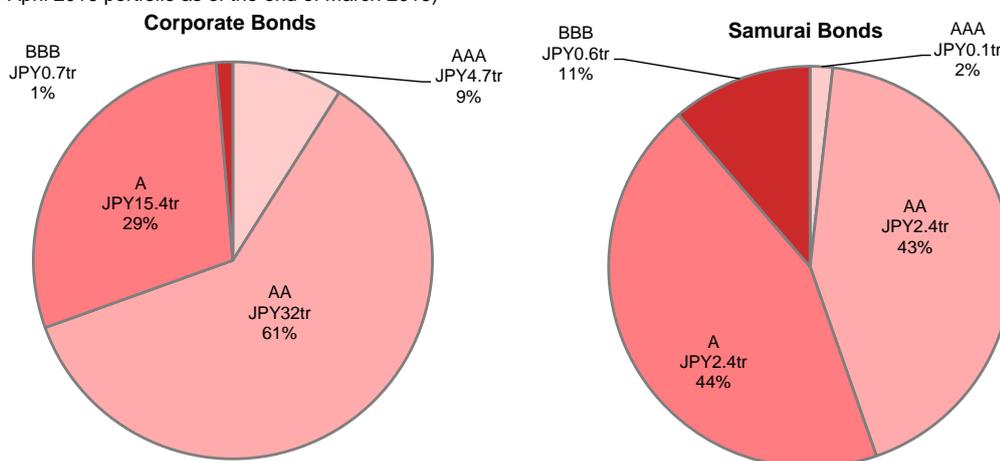
**Fig. 11: Rating Classifications<sup>1</sup>**

Sector	Rating Type	Classification
Corporate bonds, Samurai bonds	Highest rating	AAA--AA
		AAA--A
		AAA--BBB
		AAA--BB
		AAA
		AA
Corporate bonds	Highest rating	A
	Lowest rating	BBB
	R&I rating	BB
	JCR rating	under B
	Moody's rating	no rating
Corporate bonds	R&I rating	same as above
	JCR rating	
	Moody's rating	
	S&P rating	
Samurai bonds	same as above	same as above

Source: NSC

**Fig. 12: NOMURA-BPI/Extended Outstanding Face Value by Highest Rating**

(The April 2016 portfolio as of the end of March 2016)



Source: NSC

## (4) Calculating Index value, Return, Risk indicators

### Definition of Index value, Return

#### <Index Value>

The Index value is computed by totaling monthly return rates; it shows the aggregate performance from a base point in time. The calculation method is shown in detail below. First, an index portfolio meeting the inclusion criteria for a given month is valued as of the end of the previous month, including accrued interest. Next, the return is calculated

<sup>1</sup> As for sub-indices for which highest ratings are used, double-B or lower ratings are excluded ('AAA~BB,' 'BB,' and 'under BB' are not included)

by adding coupon payments and redemptions to the market value of the portfolio as of the end of the previous month. The Index value is computed by multiplying this return by the Index value at the end of the previous month. The NOMURA-BPI Index value is calculated in a time series, with end-December 1983 as the base date with a base value of 100.

All coupon payments and redemptions from the end of the previous month are treated as if received on the day they are made, and at the end of the month they are reinvested.

$$BPI_{(today)} = BPI_{(e.l.m.)} \times \frac{MVLt_{(today)} + CF_{(e.l.m.,today)}}{MVLt_{(e.l.m.)}}$$

$BPI_{(today)}$	:	Index value, today
$BPI_{(e.l.m.)}$	:	Index value, end of previous month
$MVLt_{(today)}$	:	Total market value of index portfolio including accrued interest, today
$MVLt_{(e.l.m.)}$	:	Total market value of index portfolio including accrued interest, end of previous month
$CF_{(e.l.m.,today)}$	:	Total income gains and redemptions paid from end of previous month through today

#### <Capital Index>

The Capital Index is an index of capital gains on investment principal. The base date is set as end-December 1983, with a base value of 100, the same as for the Index Value. Also, redemptions are treated the same as in the Index Value.

$$BPIc_{(today)} = BPIc_{(e.l.m.)} \times \left( 1 + \frac{MVLc_{(today)} - MVLc_{(e.l.m.)} + RD_{(e.l.m.,today)}}{MVLt_{(e.l.m.)}} \right)$$

$BPIc_{(today)}$	:	Capital index value, today
$BPIc_{(e.l.m.)}$	:	Capital index value, end of last month
$MVLt_{(e.l.m.)}$	:	Total market value including accrued interest, end of last month
$MVLc_{(today)}$	:	Total market value today (excluding accrued interest)
$MVLc_{(e.l.m.)}$	:	Total market value, end of last month (excluding accrued interest)
$RD_{(e.l.m.,today)}$	:	Mid-term redemptions arising from end of previous month through today

## &lt;Return&gt;

## Total return

$$Rt(m,n) = \left( \frac{BPI(n)}{BPI(m)} - 1 \right) \times \frac{365}{\Delta t_D}$$

- $Rt(m,n)$  : Total return from time  $m$  through time  $n$   
 Note that time  $m$  is before time  $n$
- $BPI(n)$  : Index value at time  $n$
- $\Delta t_D (> 0)$  : Days between time  $m$  and time  $n$

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Total return calculation method before September 30, 1993

$$Rt(m,n) = \left( \frac{BPI(n)}{BPI(m)} - 1 \right) \times \frac{12}{\Delta t_M}$$

- $\Delta t_M (> 0)$  : Days between time  $m$  and time  $n$

## Capital return

$$Rc(m,n) = \left( \frac{BPIc(n)}{BPIc(m)} - 1 \right) \times \frac{365}{\Delta t_D}$$

- $Rc(m,n)$  : Capital return from time  $m$  through time  $n$   
 Note that time  $m$  is before time  $n$
- $BPIc(n)$  : Principal Investment Return Index at time  $n$
- $\Delta t_D (> 0)$  : Days between time  $m$  and time  $n$

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Capital return calculation method before September 30, 1993

$$Rc(m,n) = \left( \frac{BPIc(n)}{BPIc(m)} - 1 \right) \times \frac{12}{\Delta t_M}$$

- $\Delta t_M (> 0)$  : Days between time  $m$  and time  $n$

## Income return

$$Ri(m,n) = Rt(m,n) - Rc(m,n)$$

- $Ri(m,n)$  : Income return from time  $m$  through time  $n$
- $Rt(m,n)$  : Total return from time  $m$  through time  $n$
- $Rc(m,n)$  : Capital return from time  $m$  through time  $n$   
 Note that time  $m$  is before time  $n$

**Definition of Index value, Return**

The issue-specific indicators are defined as below. Indicators for the MBS sector, including some risk indicator computation methods, are summarized in 1. (5).

The symbols used to define return index and risk indicator are shown below.

$P$	:	Market value including accrued interest
$SP$	:	Market value excluding accrued interest
$Cpn$	:	Bond coupon (%)
$FV$	:	Face value (yen)
$CF_i$	:	$i$ th cash flow
$T_i$	:	Number of years until $CF_i$ occurs
$Yr$	:	Term to maturity (years)

Current yield  $CY$  (%)

$$CY = \frac{Cpn}{SP} \times 100$$

Simple yield  $SY$  (%)

$$SY = \frac{Cpn + \frac{FV - SP}{Yr}}{SP} \times 100$$

Compound yield  $r$  (%)

$$P = \sum_i CF_i \times \left(1 + \frac{r}{200}\right)^{-2t_i}$$

Multiple values  $r$  fit formula above

Duration  $D$  (Years)

$$D = \sum_i \frac{CF_i \times \left(1 + \frac{r}{200}\right)^{-2t_i} \times t_i}{P}$$

Modified duration  $mD$  (Years)

$$mD = \frac{D}{1 + \frac{r}{200}} \left( = -\frac{1}{P} \frac{dP}{dr} \right)$$

## Convexity CV

$$CV = \sum_i \frac{CF_i \times \left(1 + \frac{r}{200}\right)^{-2t_i - 2} \times t_i \times \left(t_i + \frac{1}{2}\right)}{P} \left( = -\frac{1}{P} \frac{d^2 P}{dr^2} \right)$$

## Term to maturity

$$WAL = \frac{\sum_i t_i \times CFP(t_i)}{\sum_i CFP(t_i)}$$

*WAL* : Weighted average life

*CFP(t<sub>i</sub>)* : Principal cash flow at point *t<sub>i</sub>*

*t<sub>i</sub>* : Years until CFP (*t*) occurs

## Effective duration, effective convexity

$$EffD = \frac{1}{P} \sum_i t_i \times CF_i \times DF(t_i) \times \exp(-\alpha t_i)$$

$$EffCV = \frac{1}{P} \sum_i t_i^2 \times CF_i \times DF(t_i) \times \exp(-\alpha t_i)$$

Here,  $\alpha$  (yield curve spread) is used in the following formula

$$P = \sum_i CF_i \times DF(t_i) \times \exp(-\alpha t_i)$$

*DF(t<sub>i</sub>)* : JGB discount factor at point *t<sub>i</sub>*

Here, the JGB discount factor is computed using the NOMURA Par Yield Model.

## T-spread

Generates value *P* when the bond is regarded as a JGB

$$\bar{P} = \sum_i CF_i \times DF(t_i)$$

Calculate *r* (compound yield) for *P* as

$$\bar{P} = \sum_i CF_i \times \left(1 + \frac{\bar{r}}{200}\right)^{-2t_i}$$

The difference with the real compound yield *r* is the T-spread.

$$Tspd = r - \bar{r}$$

**Definition of portfolio indicators**

Portfolio indicators are calculated using the individual issue indicators of all issues in the index portfolio. The weighted average is used in the calculation, but weighted average methods used differ for indicators, as shown in Fig. 13.

**Fig. 13: Portfolio Indicator Calculation Methods**

Indicator	Calculation Method
Coupon rate Term to maturity Market price Market price including accrued interest	Face value weighted average
Current yield Simple yield Compound yield T-spread	Market value weighted average
Duration Modified duration Convexity Effective duration Effective convexity	Market value including accrued interest weighted average

Source: NSC

## (5) The MBS Sector

### What are JHF MBS?

Japan Housing Finance Agency mortgage-backed securities (including Government Housing Loan Corporation mortgage-backed securities, or GHLC MBS; hereafter, they are both referred to as JHF MBS in this report) was first issued in March 2001. The NOMURA-BPI began to incorporate JHF MBS including already-issued bonds in April 2003. As of March 2012, the MBS sector classification consisted of JHF MBS only.

JHF MBS are fixed-rate securities backed by mortgages on residential property. They are pass-through MBS, in which an issuer collects monthly repayments from loan borrowers and then passes on a proportionate share of the collected principal and interest to the investor. The borrower's principal repaid monthly is not repaid in accordance with the schedule determined at the start of the loan; generally, the loan is prepaid ahead of schedule (prepayment). With JHF MBS being a pass-through MBS, this unscheduled cash flow is passed through to the investor. This makes JHF MBS fixed-income securities that do not define future cash flow.

Thus, portfolio indicators including compound yields and duration cannot be computed as they are for ordinary fixed-coupon bonds. It is thus necessary to project future prepayments and calculate the risk indicators based on the projected cash flow. Prepayment projection method is an extremely important point in calculating risk indicators.

The speed of prepayment is usually shown using single monthly mortality (SMM) or conditional prepayment rate (CPR). In the following formula, SMM is the rate of prepayment per month and is expressed in monthly terms. CPR is this rate in annualized terms.

$$\text{SMM}[\%] = \frac{\text{monthly prepayment amount}}{\text{previous month's principal balance} - \text{scheduled principal payment}} \times 100$$

$$\text{CPR} [\%] = 100 - \left( 1 - \frac{\text{SMM}[\%]}{100} \right)^{12} \times 100$$

A prepayment model is developed in order to project SMM or CPR when analyzing MBS. Also, when long-term loan delinquency, changes in loan terms and the like occur in the underlying collateral pool, these loans would be replaced with healthy loans for some JHF MBS— monthly MBS issued before March 2007 and S-series MBS<sup>2</sup>. For monthly MBS issued from April 2007, these loans are removed from the collateral pool, and JHF

<sup>2</sup> There are two types of JHF MBS, monthly issues and S-Series, which are issued irregularly.

MBS investors are repaid for the amount equivalent to the removed loans. Since this repayment has the same effect on cash flow as prepayment, the probability of long-term delinquency, changes in loan terms and the like must also be projected (a cancellation model) for monthly JHF MBS issued since April 2007.

Another attribute that must be watched is the cleanup call clause. According to this, if the balance of a JHF MBS falls below 10% of the balance at issuance, the JHF can make an early repayment of the said MBS. Risk indicators related to JHF MBS are computed with the assumption that clean up calls will be made the month after JHF MBS balances fall below 10% of issuance balance.

After prepayment trends are summarized below, NOMURA Prepayment Model and cancellation model used in the NOMURA-BPI are introduced. The calculation methods of risk indicators and investment return indicators are then explained. Changes in the models that have been used for JHF MBS are shown in Fig. 14.

**Fig. 14: Changes in Models**

April 2003	JHF MBS included in NOMURA-BPI for first time (NOMURA Prepayment Model introduced)
April 2007	Cancellation Model introduced
April 2011	NOMURA Prepayment Model revised (Cancellation Model unchanged)
April 2016	Started to use an interest rate model that corresponds with negative interest rates

Source: NSC

### Prepayment behavior

There are a number of different reasons for prepayment of JHF MBS, or rather prepayment of the residential mortgages that serve as collateral of the JHF MBS. Residential mortgage holders can prepay not only the entire outstanding balance of the loan all at once (full prepayment), they can also prepay a portion of the outstanding balance (partial prepayment). Typical reasons for both types of prepayment are:

Full prepayment: Refinancing, housing turnover, etc.

Partial prepayment: Prepayment with surplus funds, etc.

There are a number of factors that could lead to prepayment, and they are believed to have multiple effects. We discuss the factors affecting full prepayment and partial prepayment below using historical loan redemption data (static data) released by the JHF.

### Key factors of full prepayment

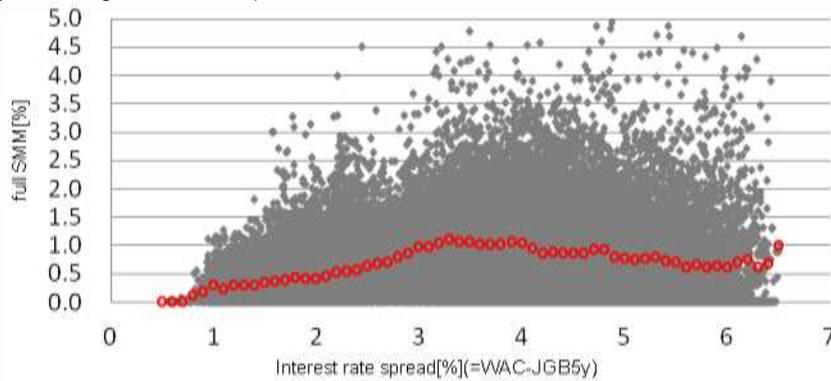
#### <Interest rates>

In Fig. 15, the spread between the Weighted Average Coupon (WAC) of the collateral loans at the end of the loan repayment month and the 5Yr JGB par yield<sup>3</sup> as of end-month three months earlier (hereafter, interest rate spread) is the X-axis, while the Y-axis is the SMM of full prepayment (hereafter, full SMM). The red circles show the average of full SMM at each interest rate spread level. (The following figures in this section show the same.)

<sup>3</sup> The reference point for 5Yr JGB par yield was selected after applying various different points to the prepayment model, selecting the most appropriate point, and then using the month-end value for the point three months earlier. Such a time lag is thought to occur because there is a slight time lag between changes in market interest rates and changes in refinancing mortgage rates by banks and other financial institutions; because some time is required between banks and other financial institutions changing the mortgage rates, the borrower considering the new rates and preparing the necessary materials, and the refinancing bank processing the application; and also because applications must be submitted to JHF by one month prior to the prepayment.

**Fig. 15: SMM of Full Prepayment: Interest Rate Factor**

(using data through end-Feb 2012)



Source: Compiled by NSC from Japan Housing Finance Agency data.

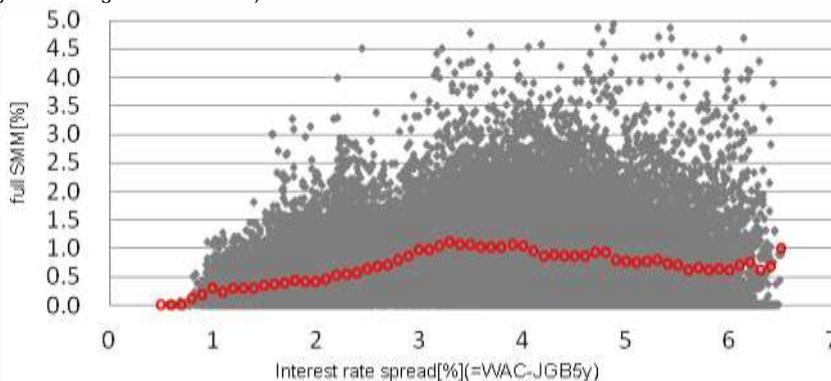
This figure shows that when interest rate spreads are 3% or less, full SMM tends to rise as market interest rates decline (interest rate spreads widen), and conversely, as market interest rates rise (interest rate spreads narrow), full SMM tends to decline. This is considered to show that when market interest rates fall after the loan is made, mortgage rates also fall and financially-rational refinancing is more likely to occur. When interest rate spreads are at 4% or more, full SMM tends to decline slightly; this is thought to be from the impact of the burnout effect, as described below.

## &lt; Seasoning &gt;

Fig. 16 shows the linkage between the loan age and full SMM. Full SMM gradually rises for some time after the loan commences, remains steady as the loan age approaches more than 70 months, then peaks at approximately 120 months. Thereafter, full SMM tends to gradually decline. The tendency of full SMM to be low at the initial loan start, then the ratio rising to a certain level as the loan age increases, is thought to be due to qualitative reasons like 1) there is little need to change residences soon after purchasing a home; and 2) refinancing is unlikely soon after beginning repayment as long as interest rates do not fall dramatically. Further, full SMM peaking at 120 months is thought to be due to borrowers whose loan interest rates re-set at a higher rate 10 years after beginning loan repayments trying to repay their loans in advance as much as possible before the higher mortgage rates begin.

**Fig. 16: SMM of Full Prepayment: Seasoning Factor**

(using data through end-Feb 2012)



Source: Compiled by NSC from Japan Housing Finance Agency data.

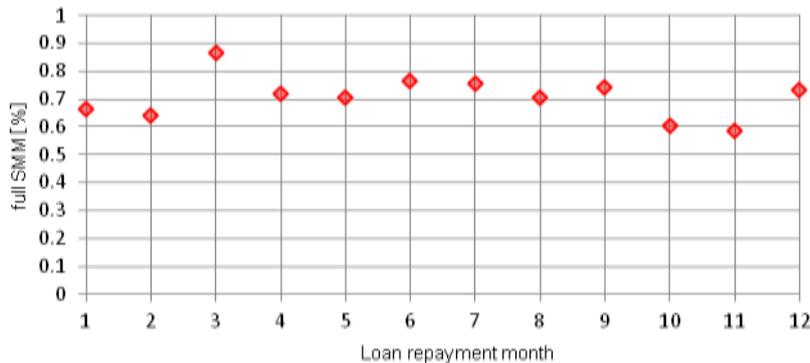
The decline in full SMM after 120 months is considered to be due to fewer borrowers in the loan pool actively trying to prepay their loans because the borrowers sensitive to interest rate changes or with surplus funds have paid off their loans in full. Thus, part of the decline in full SMM is likely due not to the seasoning factor, but rather to the burnout effect described below.

**< Seasonality >**

Fig. 17 shows average full SMM values by number of loan payment months. This figure shows that full SMM tends to rise in March and be low in January, February, October, and November. This is thought to be because March is the end of the fiscal year in Japan, and full prepayments because of changes in residence are more likely to occur in March than in other months.

**Fig. 17: SMM of Full Prepayment: Seasonality**

(using data through end-Feb 2012)



Source: Compiled by NSC from Japan Housing Finance Agency data

**<Burnout effect>**

Residential mortgage borrowers have many different repayment behaviors, but borrowers more sensitive to changes in interest rates are probably most likely to drop out of the pool of borrowers due to prepayment. Therefore, it is said that the more the pool has experienced low interest rates, the more the pool loses the sensitivity to low interest rates. This is called the burnout effect.

What sorts of explanatory variables should be used in including burnout effect in the model? Several possibilities come to mind, but here we use *cumulative incentive* as an explanatory variable for burnout, as defined below, based on our viewpoint that more burnout is thought to occur the longer the loan pool has experienced stronger incentives to refinance<sup>4</sup>.

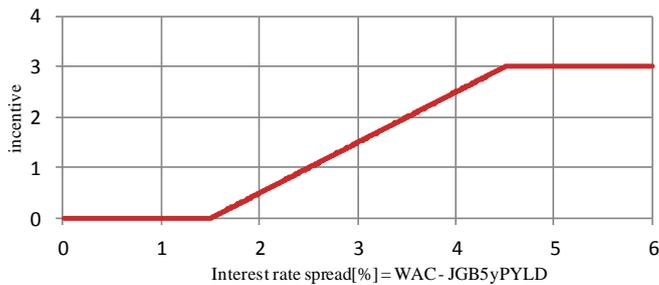
$$cumulative\ incentive_t = \sum_{n=1}^{t-1} incentive_n$$

$$incentive_n = \min\{\max\{spread_n - threshold, 0\}, upper\_bound\}$$

Here,  $n$  represents the number of months since the loan begins,  $t$  is the number of months data is observed since the loan begins.  $Spread_n$  is the interest rate spread, an explanatory function for interest rate factor, at each point.  $Incentive_n$  is a simple expression of how much full prepayment incentive exists in a given month due to interest rates. For example, the linkage with the interest rate spread is shown in Fig. 18 for a threshold = 1.5 and upper\_bound = 3.0.

<sup>4</sup> WAC history from the start of the loan is needed to calculate cumulative incentive. Because observation of historical loan redemption data began in May 1996, WAC was not observed at initial loan start for pools with loans that commenced prior to that. Therefore, cumulative incentive for such pools is calculated assuming that the oldest WAC data has been constant from the start of the loan. This assumption is thought to be appropriate because WAC does not change much as long as the applied interest rate has not changed for loans in the pool. However, because historical loan redemption date includes loans with interest rates that reset higher 10 years after commencement, only WAC after interest rate re-set is observed for loans that began prior to May 1986. Data for loans that began before May 1986 is not used because WAC after interest rate re-sets cannot be considered to have remained the same.

**Fig. 18: Incentive Function (threshold = 1.5 and upper\_bound = 3.0)**



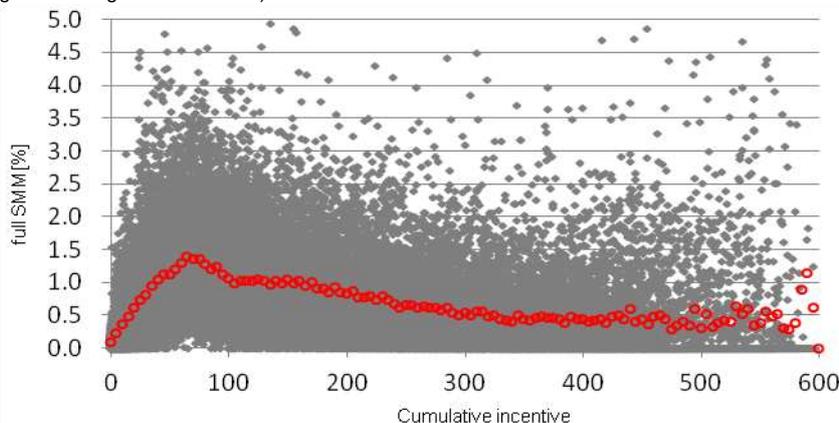
Source: NSC

This function is defined by the trend of the interest rate factor described above and may be considered as a simple version of the interest rate factor function  $f$  in the prepayment model below. Once the interest rate spread is a certain size, even if it widens further, incentive to prepay is not likely to rise much more; conversely, when an interest rate spread shrinks to a certain degree, the incentive to prepay approaches zero. The cumulative value of incentive, or *cumulative incentive*, can be considered to show how much the relevant pool has been incentivized to make full prepayment from when the loan began to the month before the loan repayment month.

Fig. 19 shows the linkage between cumulative incentive and full SMM when threshold = 1.5 and upper\_bound = 3.0. Full SMM tends to rise when cumulative incentive is up to around 70, then tends to gradually decline once cumulative incentive exceeds 70. The initial rise in full SMM is thought to correspond to the rise in the seasoning factor through about the 70<sup>th</sup> month, and the decline in full SMM is thought to be a reflection of the burnout factor once cumulative incentive exceeds 70.

**Fig. 19: SMM of Full Prepayment: Burnout Factor**

(using data through end-Feb 2012)



Source: NSC

**<Other factors>**

In addition to those discussed above, various other factors are believed to impact full prepayment. These include real estate values and regionalism, as well as changes in social system.

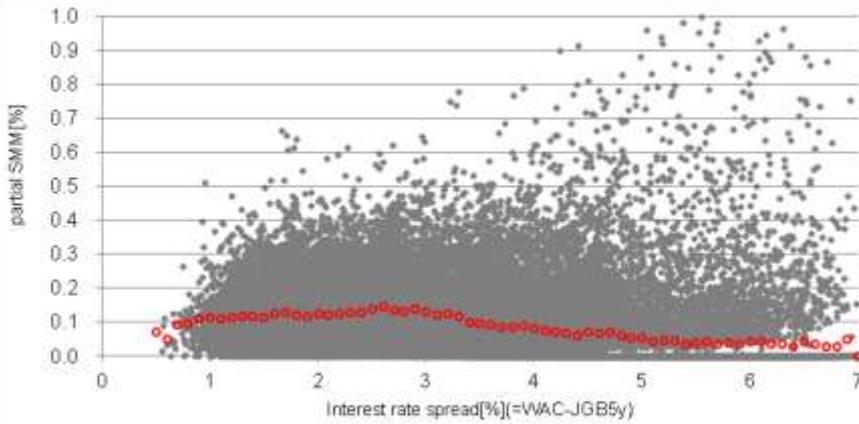
**Key factors of Partial prepayment**

**<Interest rate>**

In Fig. 20, the spread between the Weighted Average Coupon (WAC) of the loan balance at the end of the loan repayment month and the 5Yr JGB par yield as of end-month three months earlier (hereafter, interest rate spread) is the X-axis, while the Y-axis is the SMM of partial prepayment (hereafter, partial SMM).

**Fig. 20: SMM of Partial Prepayment: Interest Rate Factor**

(using data through end-Feb 2012)



Source: Compiled by NSC from Japan Housing Finance Agency data.

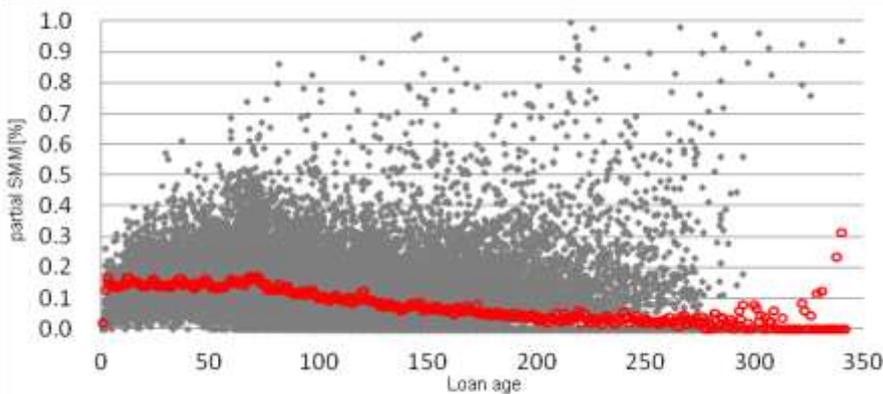
Note that the amount of partial prepayment is on average smaller than the amount of full prepayment, and the scale marks on the Y-axis are one decimal point smaller than those for full SMM. This figure does not clearly show a linkage between interest rate spread and partial SMM. Even considering the ten-fold difference with full SMM, partial SMM can be considered to have a roughly constant linkage with interest rate spread.

<Seasoning>

Fig. 21 shows the linkage between the loan age and partial SMM. The figure shows that partial SMM is fairly high from immediately after the loan commences, and then tends to gradually decline after the 70th month. There appear to be a number of borrowers who use surplus cash in hand to make partial prepayments from an early stage in order to alleviate future interest rate payments by reducing the loan balance. Together with the full SMM trend shown in Fig. 16, most prepayments immediately after repayments begin are partial prepayments, and thereafter the ratio of full prepayment tends to rise.

**Fig. 21: Partial Prepayment Rate: Seasoning Factor**

(using data through end-Feb 2012)



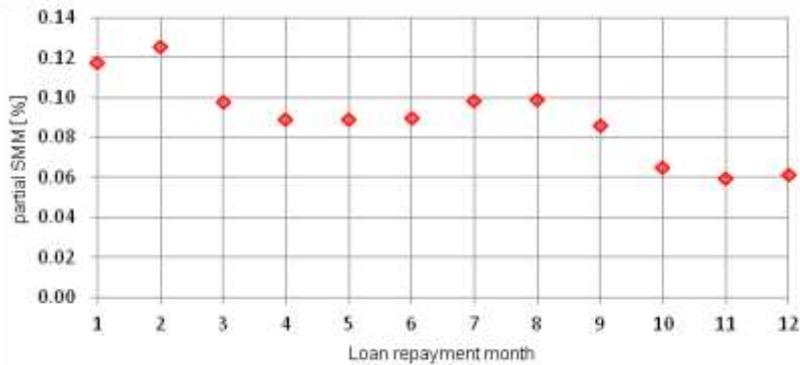
Source: Compiled by NSC from Japan Housing Finance Agency data.

<Seasonality>

Fig. 22 shows average partial SMM figures for each loan payment month.

**Fig. 22: Partial Prepayment Rate: Seasonality**

(using data through end-Feb 2012)



Source: Compiled by NSC from Japan Housing Finance Agency data.

This figure shows that partial SMM tends to be high early in the year and low at the end of the year, and that partial SMM tends to be high in January, February, July, and August. This is believed to be because the size of the residential mortgage tax credit is determined based on the loan balance at the end of the year, so this acts as an incentive to pay down loans early in the year rather than at year's end. Many borrowers make partial advance payments on their mortgages with cash on hand following the distribution of bonuses.

**<Other factors>**

In addition to the factor discussed herein, various others are believed to impact partial prepayment. These include real estate values and regionalism, as well as changes in social system.

**The Prepayment Model**

In order to analyze the returns and risks of JHF MBS, the speed with which mortgage borrowers prepay their loans must be projected. The Prepayment Model models this behavior. Below is a description of the current NOMURA Prepayment Model used starting from the April 2011 portfolio. The previous model will be covered in the following section.

The NOMURA Prepayment Model, the prepayment model used to calculate risk indicators in the NOMURA-BPI, gives more weight to stability, consistency, and usability<sup>5</sup>, and full SMM and partial SMM are each modeled, as shown below. Each parameter value uses the latest data<sup>6</sup> and is estimated monthly. However, the two parameters used in calculating interest yield incentive (threshold and upper\_bound) are assigned as follows: threshold=1.5 and upper\_bound=3.0.

$$SMM[\%] = \text{full SMM}[\%] + \text{partial SMM}[\%]$$

$$\text{full SMM}_t[\%] = f(wac_t - r_{t-3}, burnout_t) \times g^{\text{full}}(age_t) \times h^{\text{full}}(month_t)$$

$$\text{partial SMM}_t[\%] = g^{\text{partial}}(age_t) \times h^{\text{partial}}(month_t)$$

Where

$wac_t$  = loan balance weighted average mortgage rate as of month-end of loan repayment month

$r_{t-3}$  = 5Yr JGB par yield as of month-end of payment month

$burnout_t$  =  $\sum_{n=1}^{t-1} incentive_n$  (=cumulative incentive<sub>t</sub>)

$age_t$  = number of months elapsed since loan commences

<sup>5</sup> 'Stability' is weighted more in order to limit changes in risk indicators when the model parameter is renewed. Also, 'Consistency' is important because the model must to some extent be consistent with public data released by JHF so that it does not diverge too much from market direction. 'Usability' is also a consideration because the model must not become too complex in meeting these conditions.

<sup>6</sup> Parameters are estimated monthly using data updated by JHF, Historical Loan Redemption Data. (Data is available from the data vendor. See [http://www.jhf.go.jp/english/mbs\\_screen.html](http://www.jhf.go.jp/english/mbs_screen.html) for vendor information.)

### Model of Full SMM

Full SMM is shown by the product of interest rate factor function  $f$ , seasoning factor function  $g^{full}$ , and seasonality function  $h^{full}$ , and burnout effect is also included by making interest rate factor function dependent not only on the interest rate spread but also cumulative incentive (the explanatory variable for burnout effect). Real estate values, one of the Other Factors given, are not considered because gathering data and projecting future values is rather difficult. Also, regionalism is not addressed because there are few borrowers in the loan pool with data by region, and the dispersion of observed SMM is wide; thus, for ease, these factors are not considered.

#### Interest rate function $f$

$$f(wac_t - r_{t-3}, burnout_t) = \alpha_0 + \alpha_1 \times (1 - e^{-\Omega}) \times b(burnout_t)$$

$$\Omega = \exp\{\beta_0 + \beta_1 \times (wac_t - r_{t-3})\}$$

$$b(x) = \frac{1}{1 + (\gamma_0 x)^{\gamma_1}}$$

Interest rate function  $f$  has six parameters,  $\alpha_0$ ,  $\alpha_1$ ,  $\beta_0$ ,  $\beta_1$ ,  $\gamma_0$ , and  $\gamma_1$ , all of which are non-negative, except for  $\beta_0$ . This is a function where as  $wac_t - r_{t-3}$  approaches  $\alpha_0$  as it becomes sufficiently small, and  $wac_t - r_{t-3}$  approaches  $\alpha_0 + \alpha_1 \times b(burnout)$  as it becomes sufficiently large. Also, function  $b$ , which reflects burnout effect, is a function that declines from 1 toward 0 as  $x$  rises.

Please note that cumulative incentive is the cumulative value of incentives from when the loan commences, not from when the JHF MBS is issued. Cumulative incentive is 0 at the time of issuance for recent monthly JHF MBS because loans are securitized immediately after contract. However, issues like S-series JHF MBS and monthly JHF MBS issued in the past which did not have weighted average loan age of 0 at the time of issuance, basically do not have cumulative incentive at the time of issuance of 0.<sup>7</sup>

#### Seasoning factor function $g^{full}$

$$g^{full}(age_t) = \min\left[\frac{age_t}{\tau}, 1\right]$$

Full SMM seasoning factor function  $g^{full}$  has one parameter  $\tau > 0$ . In  $0 < age < \tau$ , it increases at a constant rate from 0 to 1, and thereafter remains flat. It is the same form as the PSJ model.<sup>8</sup>

#### Seasonality function $h^{full}$

$$h^{full}(month_t) = h_{month}^{full}$$

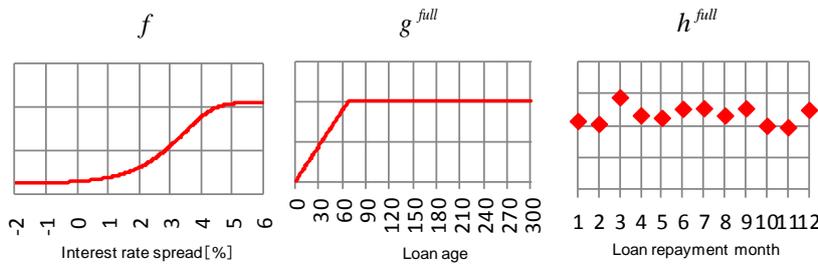
Full SMM seasonality function  $h^{full}$  has 12 parameters  $h_m^{full}$  ( $m=1, 2, \dots, 12$ ), and  $h_{10}^{full} = 1$ .

Fig. 23 shows each function for full prepayment using observed parameters based on data released through the end of February 2012. Function  $f$  shows the condition for when cumulative incentive is 0.

<sup>7</sup> Cumulative incentive at the time of loan issuance is calculated by adding interest rate incentive from when weighted average loan age is 0. So, the WAC prior to issuance is needed. Since mortgage rate is constant until it steps up at a certain timing decided in the contract, WAC can be calculated when all loans in the collateral pool have not stepped up at the time of issuance, assuming that WAC at the time of issuance is observed from before issuance. Pre-issue WAC is estimated using historical loan redemption data for collateral pools with loans whose mortgage rates have stepped up after issuance, like JHF S type loans since the No. 13 issue.

<sup>8</sup> The Prepayment Standard Japan (PSJ) model is a prepayment model introduced by the Japan Securities Dealers Association as a simple model showing Japanese RMBS prepayment. For further information, see the JSDA website (<http://www.jsda.or.jp/shiraberu/syoukenka/psj/files/guide.pdf> (Japanese only)).

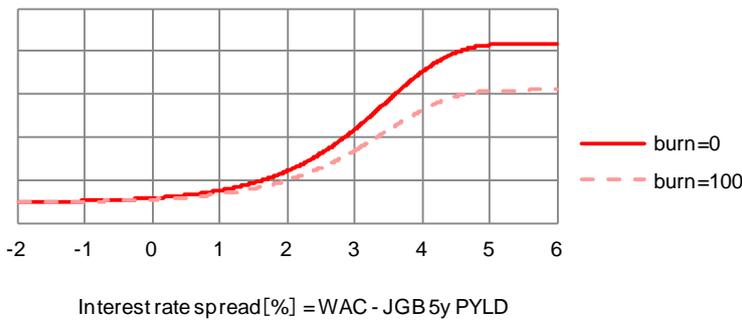
**Fig. 23: Functions for Full Prepayment**



Source: NSC

Here we will touch upon the impact of the burnout effect included in the interest rate factor function  $f$ . Function  $f$  in the model is a function where, as the cumulative incentive increases, the upper limit value (the value approached as the interest rate spread widens sufficiently) falls. Fig. 24 shows the interest rate function  $f$  when the cumulative incentive is 0 and 100. As cumulative incentive figure thus increases, function  $f$  does not increase much even as the interest rate spread widens, so the rise of full SMM is limited. Thus, the degree of sensitivity to the interest rate spread decreases.

**Fig. 24: Interest Rate Factor Function  $f$**



Source: NSC

**Model of Partial SMM**

Partial SMM does not address the interest rate factor because the effect of interest rates does not appear clearly. Thus, partial SMM is a product of seasoning factor function  $g^{partial}$  and seasonality function  $h^{partial}$ .

**Interest rate function  $g^{partial}$**

$$g^{partial}(age_t) = k_0 + \frac{k_1 - k_0}{t_0 - 1} \times \{\min(age_t, t_0) - 1\} + \frac{k_2 - k_1}{t_2 - t_1} \times \max(\min(age_t, t_2) - t_1, 0)$$

Partial SMM seasoning factor function  $g^{partial}$  includes six parameters  $k_i$  ( $i = 0, 1, 2$ ),  $t_i$  ( $i = 0, 1, 2$ ), where  $k_i > 0$  ( $i = 0, 1, 2$ ),  $1 < t_0 < t_1 < t_2$ .

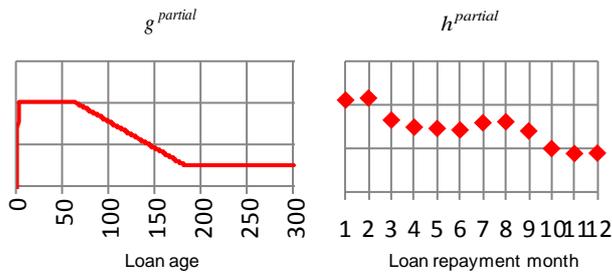
**Seasonality function  $h^{partial}$**

$$h^{partial}(month_t) = h_{month}^{partial}$$

Partial SMM seasonality function  $h_m^{partial}$  includes 12 parameters ( $m = 1, \dots, 12$ ), where  $h_{10}^{partial} = 1$ .

Fig. 25 shows each factor function for partial prepayment using observed parameters based on data released through the end of February 2012.

**Fig. 25: Functions for Partial Prepayment**



Source: NSC

**Cancellation model**

For monthly JHF MBS issued after April 2007, the cancellation model is used to project not only prepayment rate, but also the occurrence of extended delinquency and changes in financing terms for residential mortgages.

This model classifies cancellations as either cancellations due to extended delinquency or cancellation due to other than extended delinquency, and these two categories are modeled as follows. Please note that both model cancellation rates are annualized rates. Note that cancellation rates are modeled with the addition of some qualitative analysis, as data does not show trends as clearly as it does for prepayment rates.

**Cancellation due to extended delinquency rate estimation function  $d$  [%]**

$$d(t) = \begin{cases} \theta_0 \min(X, t) & (t \leq Y) \\ \theta_0 X + \theta_1 \min(t - Y, Z - Y) & (Y < t) \end{cases}$$

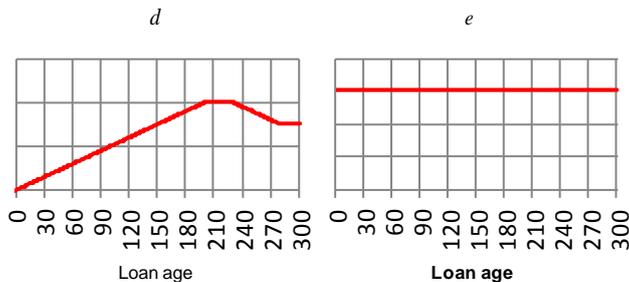
**Cancellation not due to extended delinquency estimation function  $e$  [%]**

$$e(t) = u$$

Includes one parameter  $u$ .

Fig. 26 plots each function based on parameters applied in March 2012.

**Fig. 26: Functions for Partial Prepayment**



Source: NSC

**Calculating future cash flow**

At the time of JHF MBS issuance, the initially scheduled balance ratio after monthly payments is released as *Scheduled Factors*, and updated figures (*Rescheduled Factors*) considering repayment progress are released every six months. These figures do not consider future prepayments nor cancellations, but the projected cash flow can be determined based on risk factors calculations, reflecting projected prepayment rates and cancellation rates with models.

Residential mortgages—the collateral of MBS—have varied characteristics and repayment periods and applied interest rates differ depending on the borrowers. Therefore, even if the same amount is repaid in advance, the impact on future cash flow differs, depending on how borrowers made prepayments (full prepayments or partial prepayments. In case of partial prepayments, shorten the period or reduce the repayment amount). However, it is realistically impossible to fully reflect the individual

characteristics of these borrowers, so we have calculated repayment schedules based on the assumption that there are many such borrowers.

Under such assumptions, the effects of projected full SMM and cancellation rates can be assessed by reducing the amount of cash flow proportionally at each point in the future in calculating projected cash flow. Considering that, for partial SMM, many partial prepayments shorten the loan term, and the calculation to some extent reflects the term shortening effect. In particular, the calculation of partial SMM is based upon the assumption that cash flow does not change at future points in time (the projected principal balance declines at the same amount at each point in the future).

### Calculating risk indicators

Concepts like compound yield and modified duration, used for normal fixed income bonds, do not apply directly to JHF MBS, whose future cash flow is uncertain. Detailed calculation methods of each risk indicator for JHF MBS are shown below. Please note that the risk indicators are values that depend on the prepayment model.

#### <Compound yield, modified duration, weighted average life<sup>9</sup>, etc.>

In the prepayment model, the SMM at any point in time can be shown once one future interest rate path is determined. We therefore consider the forward rate implied from the current yield curve as the future interest rate path, and determine future cash flow. Compound yield, modified duration, and weighted average life (WAL) can then be calculated. The calculation steps are outlined below.

1. Determine the forward interest rate path in the future assuming that the forward rate implied from yield curve on the day of calculation will be realized..
2. Calculate the SMM at each point in the future using input variables interest rate (calculated from 1), WAC, cumulative incentive, loan age, and seasonality (what month).
3. Calculate future cash flow from the SMM (from 2) and scheduled factors.
4. Calculate compound yield, duration, modified duration, convexity, and WAL from future cash flow (in 3) and using the same calculation methods as with ordinary fixed-coupon bonds (see 1.(4)).

#### <Option Adjusted Spread (OAS)>

Compound yield, modified duration, and WAL were determined using a calculation to determine future cash flow. However, future cash flow will differ depending on future interest rate trajectories, and the calculation results for these indicators should vary accordingly. In particular, for risk indicators like duration and convexity, future interest rate changes are more important, and one calculation using only one interest rate path is inadequate. Also, even the T-Spread (the spread versus JGB yield), which is reported in the NOMURA-BPI as a return indicator, cannot be easily evaluated like an ordinary fixed-coupon bond because of the optionality embedded in JHF MBS. Given these, the option-adjusted spread (OAS) concept is used for valuation. In order to evaluate such sensitivity to interest rates embedded in JHF MBS, an interest rate model must be used with the prepayment model.

Future interest rate movements must be modeled in order to develop a model to determine SMM depending on future interest rate changes. In the NOMURA-BPI, one-factor model with the mean reversion of the short rate  $r(t)$ . Specifically, the short rate is determined based on stochastic differential equation below<sup>10</sup>.

$$dr(t) = (\theta(t) - \phi(t)r(t))dt + \sigma(t)dz(t)$$

Here,  $\theta(t)/\phi(t)$  is the mean reversion level,  $\phi(t)$  is the speed of mean reversion,  $\sigma(t)$  is volatility, and  $z(t)$  is the standard Brownian motion. The parameters  $\theta(t), \phi(t), \sigma(t)$  are estimated using market discount rate and swaption volatility as input data. The JGB

<sup>9</sup> The concept weighted average life, rather than term to maturity, is often used for the period principal remains in cases when the principal is partially repaid before maturity, as with JHF MBS. In keeping with market practice, NOMURA-BPI used weighted average life for term to maturity of JHF MBS, and releases this as one portfolio indicator. This is consistent with the definition of term to maturity in 1.(4). However, the term to maturity inclusion criteria use years remaining until final repayment, rather than weighted average life.

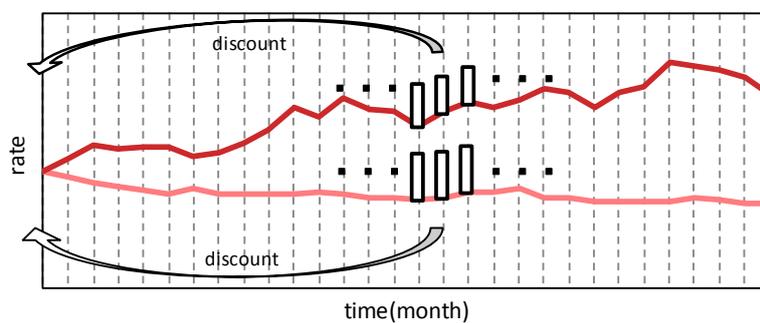
<sup>10</sup> We switched risk indicators; they are calculated based on a model that corresponds with negative interest rates as of March 2016.

discount rate calculated using the Nomura par yield model is used as the market discount rate.

OAS is calculated using this interest rate model and prepayment model<sup>11</sup>.

1. Generate multiple future interest rate paths using the interest rate model.
2. Calculate reference interest rates (5Yr par yield) at points in the future for each interest rate path in (1), and then cash flow using the prepayment model. The values for each interest rate path are calculated by adding present values of cash flows which are discounted with the interest rate plus constant spread  $\delta$ .
3. The theoretical value of JHF MBS is determined by averaging the values of the interest rate paths calculated in (2).
4. OAS is derived by seeking  $\delta$  where the values calculated in (3) match JHF MBS market value (including accrued interest).

**Fig. 27: Calculating Value for Each Interest Rate Path (conceptual diagram)**



Source: NSC

For JHF MBS, OAS is announced as the T-Spread. When calculating the T-spread for sub-indices that include JHF MBS as well as the NOMURA-BPI, the OAS is the weighted average according to market value, just as with the T-Spread for fixed-coupon bonds.

#### <Effective Duration, Effective Convexity>

Effective duration and effective convexity are calculated as shown below. Here, we assume a fixed value for the OAS as calculated above, and calculate effective duration and effective convexity defined as the price sensitivity to changes in the yield curve upward and downward.

<sup>11</sup> This method is called Monte Carlo Simulation, and is generally used to value instruments with path dependency (future cash flow depends on interest rates path). The NOMURA Prepayment Model used through March 2011 used a calculation method using an interest rate tree, but path dependency has increased since the burnout effect has been introduced with the change in models. Subsequently, the Monte Carlo Simulation was adopted.

1. Generate interest rate paths in the same way as OAS calculation based on the spot rate curve obtained by raising or lowering the market spot rate curve by  $\Delta r$ .
2. Calculate the fair value using the same method as OAS calculation steps 2) and 3) for each tree with OAS calculated above as constant  $\delta$ .
3. Calculate effective duration using the formula below from market price and two values calculated in step 2).

$$\text{Effective duration} = \frac{P(-\Delta r) - P(+\Delta r)}{2P(0)\Delta r}$$

$$\text{Effective convexity} = \frac{P(-\Delta r) + P(+\Delta r) - 2P(0)}{P(0)(\Delta r)^2}$$

$P(-\Delta r)$  : Value when the spot rate curve has been moved down by  $\Delta r$ .

$P(+\Delta r)$  : Value when the spot rate curve has been moved up by  $\Delta r$ .

$P(0)$  : Market price (market price plus accrued interest)

$\Delta r$  : Margin that moves the spot rate curve

In section 1.(4), effective duration and effective convexity for fixed-coupon bonds are defined, but please note that the definition used here differs.

**<Key Rate Duration>**

While effective duration shows the sensitivity to changes in spot rates across the curve, key rate duration is the sensitivity to changes in interest rate in specific ranges of the curve. MBS cash flow is dispersed across a wide range of terms to maturity, and effective duration alone cannot address interest rate risk completely. Therefore, key rate duration, a more precise gauge of risk, is necessary.

For the MBS sector, a total of 30 key rates are set with one-year intervals between year 0 and year 29, and the sensitivity is measured for each key rate. Each key rate moves up or down as illustrated in Fig. 28, and the key rate duration is calculated using the same method as for effective duration.

$$\text{Year } t \text{ key rate duration} = \frac{P(-\Delta r_t) - P(+\Delta r_t)}{2P(0)\Delta r_t}$$

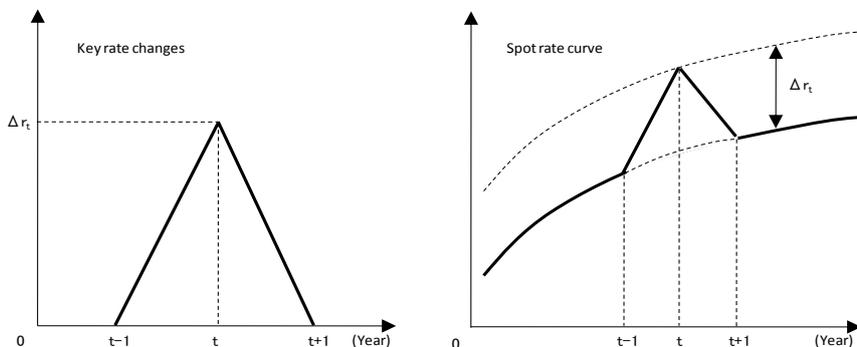
$P(-\Delta r_t)$  : Price at which year  $t$  key rate moves down as in figure

$P(+\Delta r_t)$  : Price at which year  $t$  key rate moves up as in figure

$P(0)$  : Market price (market price plus accrued interest)

$\Delta r_t$  : Margin that moves year  $t$  key rate

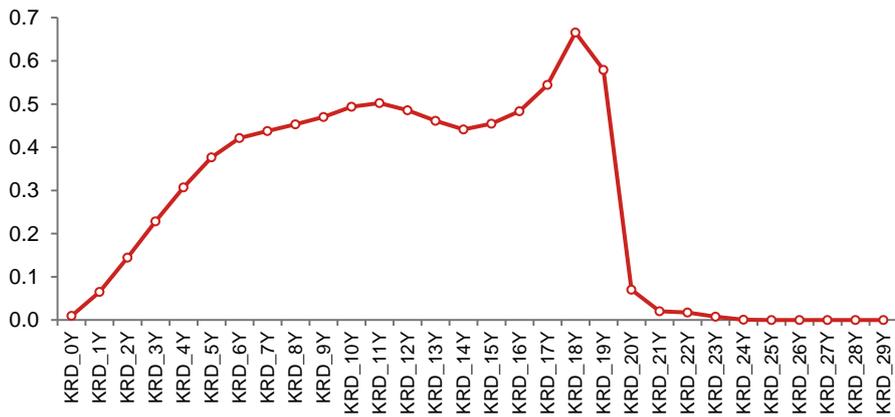
**Fig. 28: Changes in Key Rate and Spot Rate Curve (conceptual diagram)**



Source: NSC

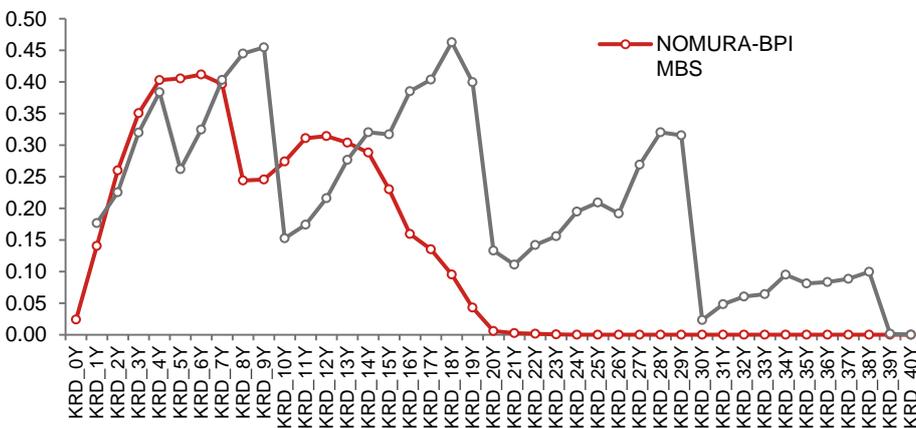
Fig. 29 shows the key rate durations of JHF MBS #107 (effective duration 8.31 as of April 28, 2016). The JHF MBS differs from bullet redemptions as MBS key rate duration has measurable values for many ranges other than maturity. This reflects the difference between the MBS projected cash flow and the cash flow of fixed-coupon bonds, whose principal is redeemed only when it matures (bullet maturity).

**Fig. 29: Key Rate Durations: JHF MBS #107 (end-April 2016)**



Source: NSC

**Fig. 30: Key Rate Durations: BPI MBS vs. BPI JGB (end-April 2016)**



Source: NSC

Fig. 30 shows key rate durations in the NOMURA-BPI MBS Sector and the NOMURA-BPI. Although the NOMURA-BPI, the portfolio of which more than half consisted of bullet redemptions, resembles a residual structure, similar characteristics are not observed in the NOMURA-BPI MBS Sector.

**Calculating the investment return index**

The investment return index and investment return rate for JHF MBS are calculated using the same method as in the NOMURA-BPI. However, the factor (expected outstanding balance after monthly principal repayment the following month) released every month on the 25th (or immediately preceding business day if the 25th is not a business day) by the Japan Housing Finance Agency must be treated carefully. It goes without saying that the outstanding balance including accrued interest on the day of calculation and the last day of the previous month is determined, regardless of whether the repayment amount for the following month has been determined or not. Therefore, the actual repayment made in the following month does not affect the calculation of the investment return rate. Note that return indices such as compound yield and risk indicators such as duration are calculated considering the determined cash flow after it is released.

$$MVLt_{(today)} = TA \times F_{(today)} \times \frac{P_{(today)}}{100} \quad MVLt_{(e.l.m.)} = TA \times F_0 \times \frac{P_{(e.l.m.)}}{100}$$

$$CF_{(e.l.m.,today)} = \begin{cases} 0 & \text{(Prior to payment date)} \\ TA \times F_0 \times \frac{C}{1200} + TA \times (F_0 - F_1) & \text{(After payment date)} \end{cases}$$

$$F_{(today)} = \begin{cases} F_0 & \text{(Prior to payment date)} \\ F_1 & \text{(After payment date)} \end{cases}$$

- $TA$  : Issue par amount
- $C$  : Coupon (%)
- $F_1$  : Current month actual factor (released 25<sup>th</sup> of previous month)
- $F_0$  : Previous month actual factor (released 25<sup>th</sup>, two months before)
- $P_{(today)}$  : Unit price including current day interest
- $P_{(e.l.m.)}$  : Unit price including previous month-end interest

## 2. NOMURA-BPI/Dur

### (1) Outline of the Index

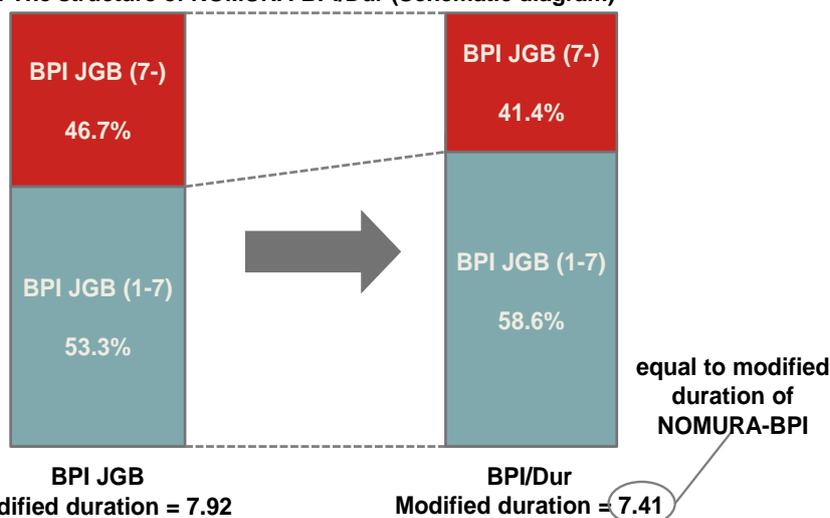
#### What is the NOMURA-BPI/Dur?

The NOMURA-BPI/Dur comprises the same issues as those included the NOMURA-BPI JGB, and is structured in such a way that the duration risk is equal to that implied in the NOMURA-BPI. The Quantitative Research Center released NOMURA-BPI/Dur on July 30, 2012 based on data from December 29, 1995. The NOMURA-BPI Corporates/Dur, which was created based on the NOMURA-BPI Corporates and by applying the same concept, was released on November 30, 2012.

#### Structure

The NOMURA-BPI/Dur comprises issues included in the NOMURA-BPI JGB (1-7 years)<sup>12</sup> and NOMURA-BPI JGB long-term (7 years or more), and is structured in such a way that it has modified duration equal to that of the NOMURA-BPI (see Fig. 31).

Fig. 31: The structure of NOMURA-BPI/Dur (Schematic diagram)



Source: NSC

The NOMURA-BPI/Dur rebalances at the same time as the NOMURA-BPI, and the weighting of the NOMURA-BPI JGB (1-7 years) and NOMURA-BPI JGB long-term is based on the valuation on the last trading day of the previous month.

In the event that the weighting of the two indices falls in negative territory relative to the NOMURA BPI (i.e., the modified duration of NOMURA BPI falls outside of the range that can be defined by adjusting the weighting of the two sub-indices), or is expected to become negative in the future, different sub-indices may be used.

### (2) Calculating index value, return and risk indicators

#### Definition of index value, return and indicator

Below, we calculated the return and indicators for a portfolio structured based on the inclusion criteria described in the previous section. As the portfolio for NOMURA-BPI/Dur is determined by adjusting the two NOMURA-BPI JGB sub-indices in such a way as to have the same modified duration as that of the NOMURA-BPI, the return and risk indicators can be calculated based on those for the NOMURA-BPI JGB sub-indices. In the section below we explain how we compute the weighting of the sub-indices for calculating the return and risk indicators.

#### Weighted average method for calculating return and risk indicators

Here we define the weighting of short and intermediate JGBs (1-7yr) and long-term JGBs (7yrs and longer) included in NOMURA-BPI/Dur as  $W_*^{sm}$  and  $W_*^l$ , respectively. Although we limit our discussion to the NOMURA-BPI/Dur, the NOMURA-BPI Corporates/Dur can

<sup>12</sup> NOMURA-BPI JGB (1-7yr) is made up of the Nomura-BPI JGB (1-3yr) and NOMURA BPI JGB (3-7yr).

be calculated by the same weighted average method regarding the modified duration of NOMURA-BPI Corporates.

The symbols are shown below.

$R_{total}^{prt}(s,t)$	: Total return from time $s$ to time $t$ on portfolio $prt$
$R_{capital}^{prt}(s,t)$	: Capital return from time $s$ to time $t$ on portfolio $prt$
$mD^{prt}(t)$	: Modified duration at time $t$ on portfolio $prt$
$CP^{prt}(t)$	: Market price of portfolio $prt$ at time $t$
$DP^{prt}(t)$	: Market price of portfolio $prt$ including accrued interest at time $t$
$e.l.m.$	: Last business day of previous month
$today$	: Portfolio determination day
$JGB,sm$	: NOMURA-BPI JGB Short and intermediate (1-7yr)
$JGB,l$	: NOMURA-BPI JGB Long-term (7yr and longer)
$BPI$	: NOMURA-BPI

#### ●Index value

The index value is computed by the same method as the NOMURA-BPI, using the total return from end of last month  $R_{total}(e.l.m.,today)$  and the capital return from end of last month  $R_{capital}(e.l.m.,today)$ , shown below.

#### ●Return

○Total return from end of last month  $R_{total}(e.l.m.,today)$  and capital return from end of last month  $R_{capital}(e.l.m.,today)$

$$R_{total}(e.l.m.,today) = W_{dpa}^{sm}(e.l.m.) \cdot R_{total}^{JGB,sm}(e.l.m.,today) + W_{dpa}^l(e.l.m.) \cdot R_{total}^{JGB,l}(e.l.m.,today)$$

$$R_{capital}(e.l.m.,today) = W_{dpa}^{sm}(e.l.m.) \cdot R_{capital}^{JGB,sm}(e.l.m.,today) + W_{dpa}^l(e.l.m.) \cdot R_{capital}^{JGB,l}(e.l.m.,today)$$

where

$$W_{dpa}^{sm}(e.l.m.) = \frac{mD^{BPI}(e.l.m.) - mD^{JGB,l}(e.l.m.)}{mD^{JGB,sm}(e.l.m.) - mD^{JGB,l}(e.l.m.)}$$

$$W_{dpa}^l(e.l.m.) = 1 - W_{dpa}^{sm}(e.l.m.)$$

Other returns are calculated by the same method as the NOMURA-BPI based on the total index value and capital index value.

#### ●Weight adjusted by face value $W_{amt}^{sm}(t)$ , $W_{amt}^l(t)$

(Market price, market price plus accrued interest, yield, remaining term to maturity)

$$W_{amt}^{sm}(t) = \frac{W_{amt,unadj}^{sm}(e.l.m.)}{W_{amt,unadj}^{sm}(e.l.m.) + W_{amt,unadj}^l(e.l.m.)}$$

$$W_{amt}^l(t) = \frac{1 - W_{amt,unadj}^{sm}(t)}{1 - W_{amt,unadj}^{sm}(t)}$$

where

$$W_{amt,unadj}^{sm}(e.l.m.) = \frac{W_{dpa}^{sm}(e.l.m.)}{DP^{JGB,sm}(e.l.m.)} \cdot 100$$

$$W_{amt,unadj}^l(e.l.m.) = \frac{W_{dpa}^l(e.l.m.)}{DP^{JGB,l}(e.l.m.)} \cdot 100$$

• Weight adjusted by total market value  $W_{cpa}^{sm}(t)$ ,  $W_{cpa}^l(t)$

(Current yield, simple yield, compound yield, T-spread)

$$W_{cpa}^{sm}(t) = \frac{W_{cpa,unadj}^{sm}(t)}{W_{cpa,unadj}^{sm}(t) + W_{cpa,unadj}^l(t)}$$

$$W_{cpa}^l(t) = \frac{1 - W_{cpa,unadj}^{sm}(t)}{1 - W_{cpa,unadj}^{sm}(t)}$$

where

$$W_{cpa,unadj}^{sm}(e.l.m.) = \frac{W_{amt}^{sm}(t) \cdot CP^{JGB,sm}(t)}{100}$$

$$W_{cpa,unadj}^l(e.l.m.) = \frac{W_{amt}^l(t) \cdot CP^{JGB,l}(t)}{100}$$

• Weight adjusted by total market value including accrued interest  $W_{dpa}^{sm}(t)$ ,  $W_{dpa}^l(t)$

(Duration, modified duration, convexity)

$$W_{dpa}^{sm}(t) = \frac{W_{dpa,unadj}^{sm}(t)}{W_{dpa,unadj}^{sm}(t) + W_{dpa,unadj}^l(t)}$$

$$W_{dpa}^l(t) = \frac{1 - W_{dpa,unadj}^{sm}(t)}{1 - W_{dpa,unadj}^{sm}(t)}$$

where

$$W_{dpa,unadj}^{sm}(t) = \frac{W_{amt}^{sm}(t) \cdot DP^{JGB,sm}(t)}{100}$$

$$W_{dpa,unadj}^l(t) = \frac{W_{amt}^l(t) \cdot DP^{JGB,l}(t)}{100}$$

### (3) Comparing NOMURA-BPI/Dur total return and NOMURA-BPI total return

**Interest rate factor of NOMURA-BPI can be defined almost entirely by NOMURA-BPI/Dur**

Returns from the NOMURA-BPI can be divided into interest rate factors and credit factors based on the origins of the risk. We explain this based on our analysis of factors affecting returns on individual issues.

The following approximate expression can generally be applied to bond portfolios;

$$\begin{aligned}
R(s,t) &\approx -mD(s) \cdot \Delta r + r(t) \\
&\approx (-mD(s) \cdot \Delta r_{JGB} + r_{JGB}(t)) + (-mD(s) \cdot \Delta Tspd + Tspd(t)) \\
&= (a) \qquad \qquad \qquad + (b)
\end{aligned}$$

Where

$$\begin{aligned}
R(s,t) &: \text{Returns from time } s \text{ to time } t \\
mD(t) &: \text{Modified duration at time } t \\
r(t) &: \text{Compound yield at time } t \\
r_{JGB}(t) &: \text{Compound yield on JGB with the same remaining term to maturity as } r(t) \text{ at time } t \\
Tspd(t) &: \text{T-spread at time } t \\
\Delta r &= r(t) - r(s) \\
\Delta r_{JGB} &= r_{JGB}(t) - r_{JGB}(s) \\
\Delta Tspd &= Tspd(t) - Tspd(s)
\end{aligned}$$

Based on this, we define formula (a) as interest rate factors and (b) as credit factors. Here we applied the above equation to the return on NOMURA-BPI as broken into by the remaining term to maturity at one-year intervals (1-2yrs, 2-3yrs, and so on up to 40-41yrs), and defined the sum of these the figures calculated by formula (a) and formula (b) as the interest rate factor and credit factor, respectively, in the NOMURA-BPI. This can be expressed as follows:

$$\begin{aligned}
\text{Interest rate factor} &= \sum_i \left( -mD^i(s) \cdot \Delta r_{JGB}^i + r_{JGB}^i(t) \right) \\
\text{Credit factor} &= \sum_i \left( -mD^i(s) \cdot \Delta Tspd^i + Tspd^i(t) \right)
\end{aligned}$$

Where suffix  $i$  expresses the sub-index by remaining term to maturity ( $i = 1\text{-}2\text{yrs}, 2\text{-}3\text{yrs}, \dots, 40\text{-}41\text{yrs}$ ).

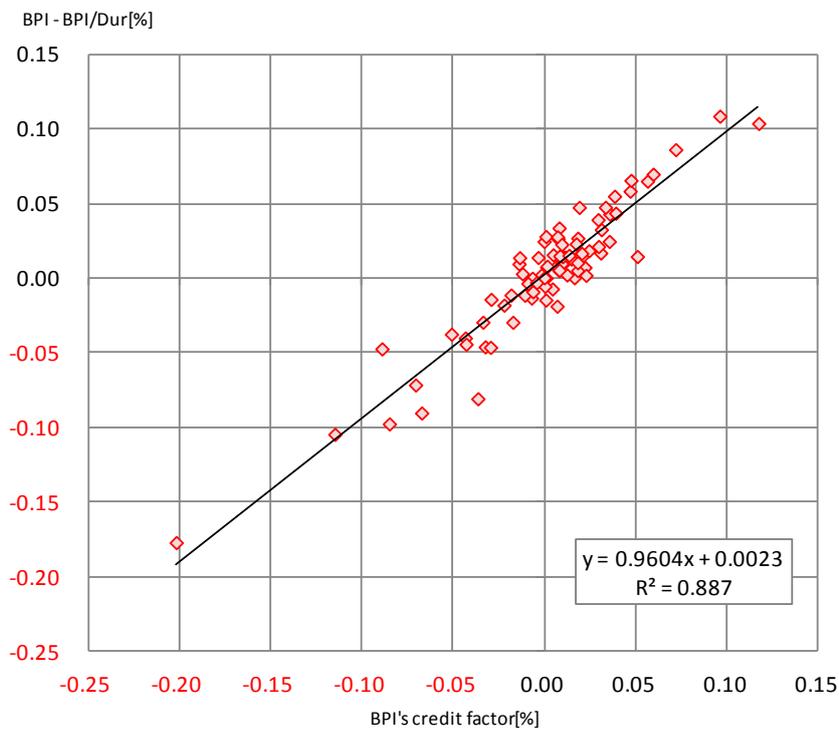
The return on the NOMURA BPI/Dur, which has the same interest rate sensitivity as NOMURA-BPI, should be considered equivalent to the interest rate factor as calculated by the above methodology:

$$\begin{aligned}
\text{(Total return on)} \\
\text{NOMURA-BPI)} &\approx \underbrace{\text{(Interest rate factor)}}_{\downarrow} + \text{(Credit factor)} \\
&\qquad \qquad \qquad \text{(Total return on)} \\
&\qquad \qquad \qquad \text{NOMURA-BPI/Dur)}
\end{aligned}$$

Accordingly, when subtracting the total return on the NOMURA-BPI/Dur from that on the NOMURA-BPI, the balance should be considered equivalent to the credit factor for the NOMURA BPI.

As reference, Fig. 32 indicates the difference between the total returns on the NOMURA-BPI and the NOMURA-BPI/Dur, which approximates the credit factor in the return on the NOMURA-BPI. This is a simplified method for expressing credit factors in the NOMURA-BPI.

**Fig. 32: BPI -BPI/Dur and BPI's credit factors**



Note: Monthly returns from January 2006 to January 2013.

Source: NSC

## 3. NOMURA-BPI/Ladder

### (1) Outline of the Index

#### What is the NOMURA-BPI/Ladder?

Nomura Securities Financial & Economic Research Center introduced the NOMURA-BPI/Ladder in November 2005 as an index of performance of laddered JGBs. The index is intended as a benchmark of stable durations. The Quantitative Research Center currently releases the NOMURA-BPI/Ladder. Initially, the NOMURA-BPI/Ladder featured 10-year and 20-year indices, but in February 2006 a 5-year index and in February 2009 a 30-year index were introduced.

#### Inclusion criteria

The NOMURA-BPI/Ladder calculates the performance of a portfolio of bonds that meet the criteria listed in Fig. 33.

**Fig. 33: NOMURA-BPI/Ladder Inclusion Criteria**

Security type	NOMURA-BPI/Ladder 5 year : 5yr JGBs NOMURA-BPI/Ladder 10 year : 10yr JGBs NOMURA-BPI/Ladder 20 year : 20yr JGBs <sup>1</sup> NOMURA-BPI/Ladder 30 year : 30yr JGBs <sup>2</sup>
Currency denomination	JPY
Coupon	Fixed
Term to maturity	Undefined (held to maturity)
Amount of new issues added to index	A fixed amount (JPY10bn) of a single JGB issue is incorporated into the index on each redemption day
Inclusion timing for new issues	Month after issuance
Included issues	5 year : Issues redeemed in March, June, September, and December of every year <sup>3</sup> 10 year : Issues redeemed in March, June, September, and December of every year <sup>3</sup> 20 year : Issues redeemed in September of every year <sup>3</sup> 30 year : Issues redeemed in H1 (Apr-Sept) and H2 (Oct-Mar) of every year <sup>4</sup>

<sup>1</sup>Though JGB (20YR) are eligible for inclusion, portfolios prior to September 2006 added JGB (10YR) and JGB (20YR), which had shorter remaining terms to maturity than JGB (30YR) No. 1.

<sup>2</sup>Though JGB (30YR) are eligible for inclusion, portfolios prior to March 2010 added JGB (10YR), which had a shorter remaining term to maturity than JGB (20YR) No. 2. Also, JGB (20YR) were added to the April 2010 portfolio because of the shorter remaining term to maturity than JGB (30YR) No. 1.

<sup>3</sup>Of JGBs redeemed every month, those issued earliest are included.

<sup>4</sup>Of JGBs redeemed in H1 and H2, those issued earliest are included.

Source: NSC

Durations in the NOMURA-BPI depend on the term structures of component bonds to be released in the future, but the NOMURA-BPI/Ladder stabilizes durations by adding fixed amounts for each term to the portfolio.

### (2) Calculating Index value, Return, Risk indicator

#### Definition of index value, return, indicators

The calculation methods for the index value and various indicators of the portfolio that meet the inclusion criteria described in the previous section are the same as with the

NOMURA-BPI. Individual issue indicators are also calculated according largely to the same definitions in the NOMURA-BPI. Market value, as with the NOMURA-BPI, uses the Nomura Securities final mid price<sup>13</sup>.

However, the calculation method for individual issues is partially changed when there is only one cash flow left (i.e., at maturity), that is, when the remaining term to maturity is six months or less.

#### Calculating indicators of issues with six months or less remaining maturity

In the NOMURA-BPI calculation methods of compound yield and simple yield, there may be a big difference between compound yield and simple yield and the value of the compound yield may be negative depending on the number of days between final maturity date and the second-to-last interest payment date for issues with six months or less remaining until maturity<sup>14</sup>.

This problem is not relevant to the NOMURA-BPI because issues with six months or less remaining to maturity do not meet the inclusion criteria. However, issues in the NOMURA-BPI/Ladder are held until maturity, so this poses a problem. In order to avoid this problem, simple yield is used for the compound yield for JGBs with less than six months remaining until maturity. Also, duration is computed using the formula below. Here, *SY* is simple yield to maturity and *Yr* is years remaining until maturity.

Duration	:	$D$	=	$Yr$
Modified duration	:	$mD$	=	$\frac{Yr}{1 + SY \times Yr}$
Convexity	:	$CV$	=	$2 \times mD^2$
Effective duration	:	$EffD$	=	$Yr$
Effective convexity	:	$EffCV$	=	$EffD^2$

### (3) Comparing the NOMURA-BPI/Ladder and the NOMURA-BPI

#### Objective

By comparing the portfolio indicators and index value of the NOMURA-BPI/Ladder with the NOMURA-BPI, we can observe the characteristics of the index.

#### Portfolio Indicators

Fig. 34 compares the duration and portfolio indicators of the NOMURA-BPI/Ladder 10 year with the NOMURA-BPI and the NOMURA-BPI JGB. The comparison period is from end-May 1994 through end- April 2016. We see that the duration of the NOMURA-BPI/Ladder 10 year has been stable.

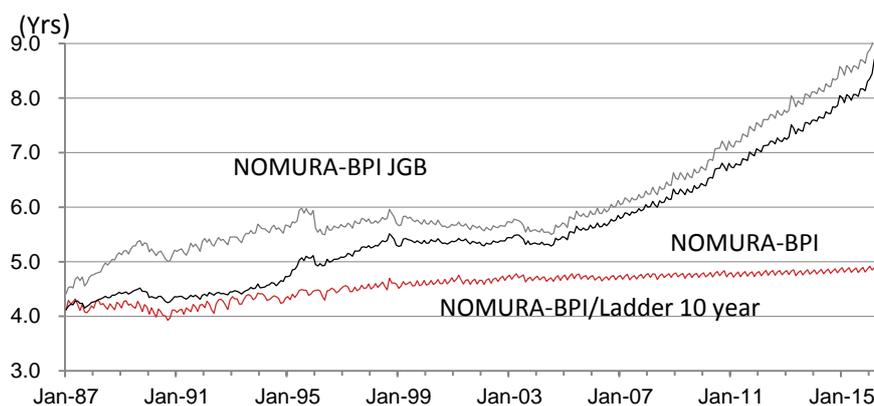
Fig. 35 compares the duration and portfolio indicators of the NOMURA-BPI/Ladder 20 year with the NOMURA-BPI Long-term (7 years or more) and the NOMURA-BPI JGB Long-term (7 years or more). The comparison period was from end-January 1997 through end- April 2016.

Due to increased issuances of long-term bonds, the durations of both the NOMURA-BPI Long-term and JGB Long-term portfolios lengthened. Meanwhile, the duration of the NOMURA-BPI/Ladder 20 year was stable, between about 8.0 years to 9.0 years. Note that since only one issue is added every year, the duration lengthened immediately following the addition of a new issue, and gradually shortened until the next addition was made.

<sup>13</sup> The assessed values of the JGBs within the NOMURA-BPI change as shown in Figure 7, but in the NOMURA-BPI/Ladder, all calculations use Nomura Securities market prices.

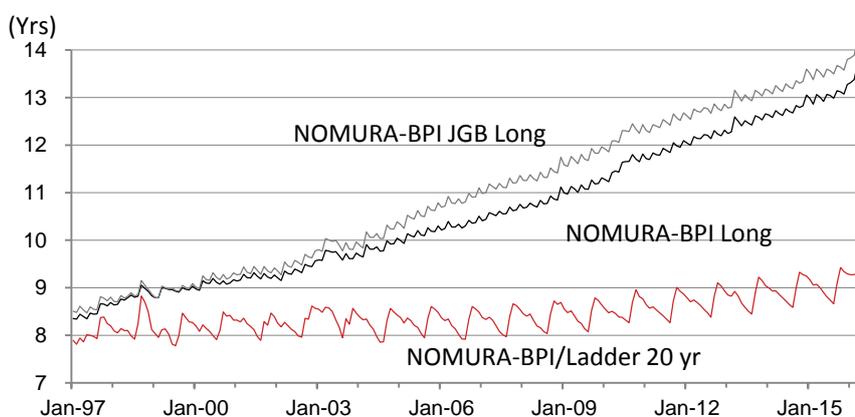
<sup>14</sup> More precisely, this occurs when there is only one cash flow left between the date on which the portfolio is valued and the maturity date of the JGB in question. Please note that, in this specific case, JGB refers to coupon-bearing JGBs with biannual coupon payments.

**Fig. 34: Duration of NOMURA-BPI/Ladder 10 year**



Source: NSC

**Fig. 35: Duration of NOMURA-BPI/Ladder 20 year**



Source: NSC

**Performance Attributes**

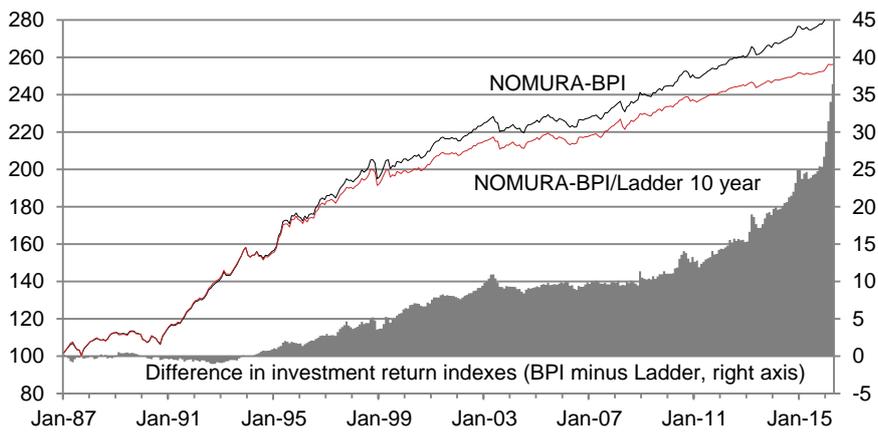
Fig. 36 compares the index values of the NOMURA-BPI/Ladder 10 year and the NOMURA-BPI. Assigning a base value of 100 to end-December 1986, monthly data through end-April 2016 are plotted.

Both index values started out very similar but started to diverge from 1995. As Fig. 34 showed, durations began to diverge in 1995, and the differences in performance were largely due to the differences in duration.

Fig. 37 compares the index values of the NOMURA-BPI/Ladder 20 year and the NOMURA-BPI Long-term (7 years or more). Assigning a base value of 100 to end-December 1996, monthly data through end-April 2016 are plotted.

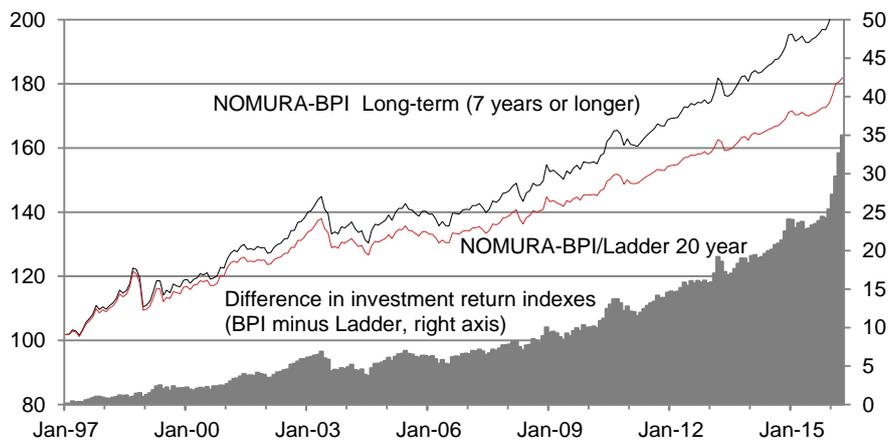
As with the NOMURA-BPI/Ladder 10 year, performances differed because of the difference in durations.

**Fig. 36: Investment Return Indices of NOMURA-BPI/Ladder 10 year**



Source: NSC

**Fig. 37: Investment Return Indices of NOMURA-BPI/Ladder 20 year**



Source: NSC

## 4. NOMURA CMT Index

### (1) Outline of Index

The NOMURA CMT Index is an index of investment return for 15-year floating rate JGBs (JGB floaters). The index was designed based upon the NOMURA-BPI, and the only difference is that it covers JGB floaters. At present, JGB floaters are the only floating-rate bond included in the index, but the index composition may become more varied in the future as types of floating-rate bond become varied.

**Fig. 38: Nomura CMT Index Inclusion Criteria**

Securities covered by index	15yr floating-rate JGBs
Security type	Publicly-offered bond certificates issued domestically by the Japanese government
Currency	Yen
Timing for inclusion of new issues	Following month of the issuance
Amount of new issues added to index	Equivalent to private-sector absorption
Outstanding amount	JPY1bn or more as of end of current month
Term to maturity	One year or longer

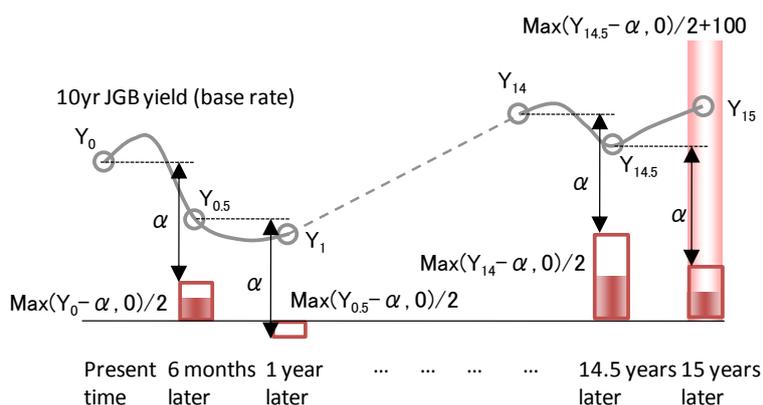
Source: NSC

### (2) Features of 15yr floating-rate JGBs

The coupon rate of the JGB floaters is determined by subtracting a fixed value (usually expressed as  $\alpha$ ) from a reference rate (the compound yield of the average accepted bid of the 10-year JGB auction which was held 6 months before the coupon payment month). The base rate changes every six months. The spread  $\alpha$  is determined by the JGB floater auction, and this does not change until redemption, and has a zero floor, the effect of which cannot be overlooked particularly in the recent low yield environment.

Because JGB coupon rates are calculated over the half-year prior to the coupon payment date, the reference rate is roughly equivalent to the 10yr JGB yield six months prior to the coupon payment date. Fig. 39 illustrates the concept of yield determination, including the zero floor.

**Fig. 39: Reference Rate of JGB Floaters and Cash Flow (conceptual figure)**



Note that  $Y_t$  shows base rate(10yr JGB yield) at time  $t$

Source: NSC

### (3) Calculating Index value, Return, and Risk Indicators

The NOMURA CMT Index releases return-related indicators including index value and return rate (since the previous business day, since the previous month-end, since the previous year-end, and since the previous fiscal year-end). The index value base date is end-March 2003, with a value of 100. All indicators are based upon the NOMURA-BPI indicators, and are calculated using the same definitions. The Nomura Securities final midprice is used for market value.

The Nomura CMT Index releases, along with the index value and return rate, a number of indicators that describe the attributes of the index portfolio. Each indicator is calculated through weighted averaging after the value of each issue is calculated. Fig. 40 lists the calculation methods of each indicator. These include 27 key rate durations, from year 0 through year 26.

**Fig. 40: NOMURA CMT Index Portfolio Indicators**

Indicator	Calculation method
Face value	Total
Coupon rate	Weighted average of face value
Term to maturity	
Market price	
Interest-accrued market price	
Theoretical value	
T-Spread (OAS)	Weighted average of total market price
Effective duration	Weighted average of interest-accrued total market price
OAS duration	
Key rate duration	

Source: NSC

Indicators other than T-Spread (OAS), theoretical value, effective duration, OAS duration, and key rate duration are calculated as in the NOMURA-BPI. Below we explain the calculation methods for the remaining five indicators.

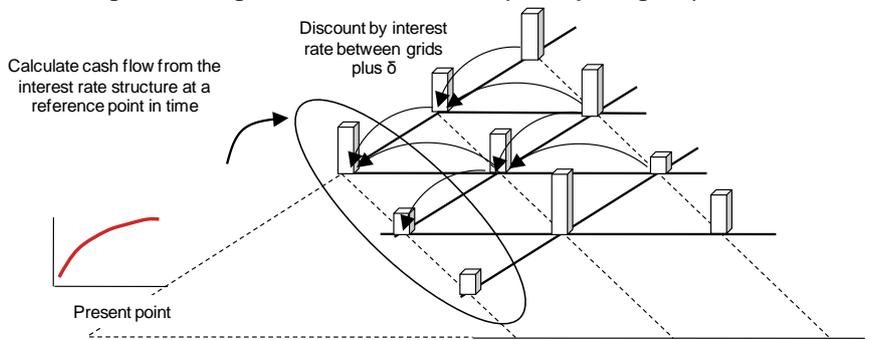
#### <T-Spread (OAS)>

The T-Spread is the spread versus the JGB yield, and the value also appears in the NOMURA-BPI. The NOMURA CMT Index uses Option Adjusted Spread, or OAS, which has the same significance as the T-Spread. OAS adjusts for option factors in cash flow

and shows the additional interest rate for the given financial instrument versus JGBs. The same interest rate model is used in calculating OAS as with MBS (see 1. (5)). However, a different reference interest rate from the MBS is used for floating rate JGBs due to differences in product characteristics (this is calculated using 10Yr par yield for six months prior to the interest payment date for floating rate JGBs), and the actual calculation methods differ. OAS for floating rate JGBs is calculated as follows.

1. A tree showing interest rates at points in the future is constructed using an interest rate model.
2. Cash flow is calculated for each interest payment point and redemption point. Interest payment cash flow is calculated using the 10Yr par yield from six months earlier.
3. Node values for the previous term are calculated, using each interest rate node value and cash flow. However, for discounted interest rates, the fixed variable  $\delta$  is added for interest rates in between nodes.
4. Steps 2 and 3 are repeated for different points, and the current value is calculated.
5.  $\delta$  is calculated so that the value determined in Step 4 and market value (fair value plus accrued interest) match. This is OAS.

**Fig. 41: Valuing OAS Using an Interest Rate Model (concept diagram)**



Source: NSC

#### <Theoretical value>

This value is the projected value of future cash flow derived from the current interest rate term structure and is calculated using an OAS of 0.

#### <Effective duration>

It is difficult to define duration and convexity for JGB floaters in the same way as fixed-coupon bonds. This is because, with the coupon rate changing over time, it is impossible to define yield to maturity, which is necessary to define duration.

Still, it is possible to calculate effective duration even for JGB floaters. Effective duration is the sensitivity of the price to parallel movements in the spot rate curve. The NOMURA CMT Index calculates the effective duration using the same method used for MBS (see 1.(5)).

#### <OAS Duration>

While effective duration is the sensitivity to parallel movements in the spot rate curve estimated based on fixed-coupon JGBs, OAS duration is the sensitivity of the price to OAS movements. OAS duration is calculated using market value that changes depending on the OAS calculated by the above-described method.

$$\text{OAS Duration} = \frac{P(-\Delta\text{OAS}) - P(+\Delta\text{OAS})}{2P(0)\Delta\text{OAS}}$$

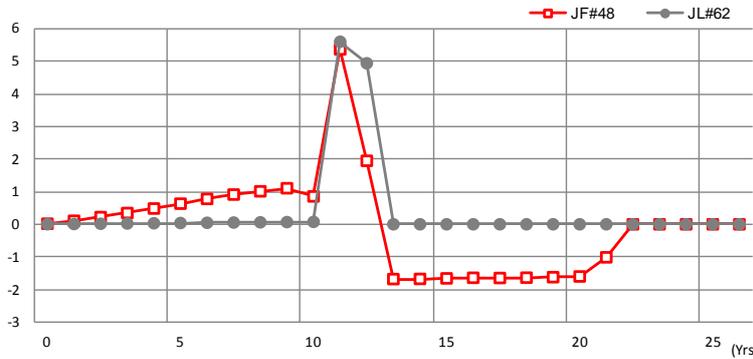
$P(-\Delta\text{OAS})$  : Price when OAS falls  
 $P(+\Delta\text{OAS})$  : Price when OAS rises  
 $P(0)$  : Market price (price plus accrued interest)  
 $\Delta\text{OAS}$  : Margin that moves OAS

<Key Rate Duration>

The absolute value of effective duration of JGB floaters is generally small, and therefore not necessarily appropriate for measuring interest rate risk. Because of this, a more precise risk gauge, key rate duration, is necessary. The NOMURA CMT Index calculates 27 key rate durations, from year 0 through year 26. Key rate durations are calculated the same way as for the MBS sector (see 1. (5)).

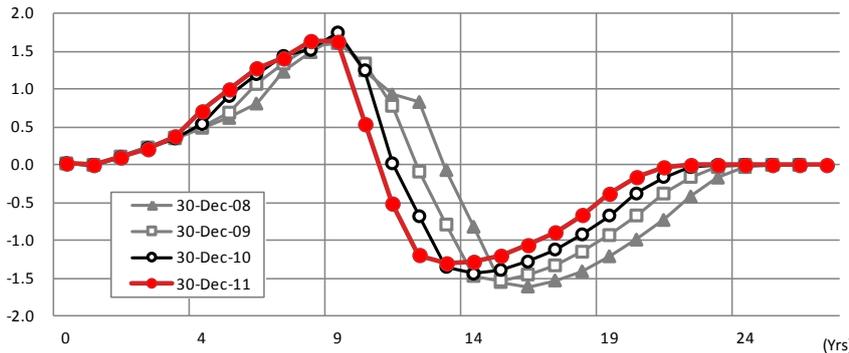
Fig. 42 illustrates key rate durations of JGB floaters. Unlike fixed-rate JGBs, key rate duration is negative after 15 years. Fig. 43 shows key rate durations for the NOMURA CMT Index. Since the issuance of JGB floaters was halted in May 2008, key rate duration for the portfolio has shortened.

**Fig. 42: Key Rate Durations of JGB Floaters and Fixed-Coupon JGBs**  
(as of end-Dec 2011)



Source: NSC

**Fig. 43: Key Rate Durations for NOMURA CMT Index**



Source: NSC

## 5. NOMURA Inflation-Linked JGB Index (NOMURA J-TIPS Index)

### (1) Outline of the Index

#### What is the NOMURA Inflation-Linked JGB Index?

The NOMURA Inflation-Linked JGB Index, or the NOMURA J-TIPS Index, like the NOMURA CMT Index, is an investment return index developed to show clearly the direction of the overall secondary market for Inflation-linked JGBs (JGBis), which have return/risk profiles that differ from ordinary JGBs. The inclusion criteria and calculation methods are based upon the NOMURA-BPIs, and it is possible to compare the NOMURA-BPI Index and the NOMURA CMT Index.

Beginning with Series 17 10yr inflation-linked JGBs, issued in October 2013, the principal is protected at maturity. JGBis with this new feature also are included in NOMURA J-TIPS Index, but the two different types of inflation-linked JGBs are distinguished as follows:

- Bonds with principal protection – floored
- Bonds without principal protection – non-floored

#### Inclusion Criteria

Fig. 44 lists the inclusion criteria for the NOMURA J-TIPS Index. Inclusion criteria are based upon NOMURA-BPI's criteria, but the remaining face value refers to the face value before adjusting for inflation.

**Fig. 44: NOMURA J-TIPS Index Inclusion Criteria**

Security type	Inflation-linked JGBs
Issuance form	Publicly offered within Japan
Currency Denomination	JPY
Coupon	Fixed
Inclusion timing for new issues	Month following issuance
Amount of new issues added to index	Equivalent to private-sector absorption
Outstanding amount	JPY1bn or more as of end of current month (pre-inflation-adjusted)
Term to maturity	At least one year

Source: NSC

### (2) Calculating Index Value, Return, Risk Indicators

#### Definitions of index value and return

The NOMURA J-TIPS Index releases index value and return (since the previous business day, since the previous month-end, since the previous year-end, and since the previous fiscal year-end). End-March 2004 is the base date for index value, with a value of 100. All indicators are based upon the NOMURA-BPI indicators, and are calculated using the same methods. Also, Nomura Securities final mid prices are used for market value.

#### Definition of Individual Issue Indicators

The NOMURA J-TIPS Index releases, along with the index value and return rate, a number of indicators that describe the attributes of the index portfolio. However, JGBis differ from fixed-coupon JGBs in that future cash flow changes depending on the inflation rate. Therefore, the NOMURA J-TIPS uses risk indicators that are different from those in the NOMURA-BPI.

Before adjusting for inflation, the NOMURA J-TIPS indicators are calculated in the same manner as the NOMURA-BPI indicators. Inflation is adjusted for by multiplying the indexation coefficient to the pre-adjustment figures. Below, we introduce the index ratio and break-even inflation rate, which are not relevant to fixed-rate bonds. Please note that,

beginning with the Series 17 bonds, included in the November 2013 NOMURA J-TIPS index, all JGBis will be principal protected (floored). Some of the relevant risk indicators will be calculated by slightly different formulas depending on the type of bonds (i.e., floored or non-floored)

#### <Indexation coefficient>

The indexation coefficient of a given day is calculated by dividing the Ref index for that day by Ref index for the 10th day of issue month and rounding off to the third decimal place (JGBis that have been issued since April 2016 are rounded off to the fifth decimal place).

$$\text{Indexation coefficient of given date} = \frac{\text{Ref index used on given data}}{\text{Ref index for the 10th day of issue month}}$$

#### <Break-Even Inflation Rate>

Assuming that the future inflation rate until the maturity date is a constant figure  $\pi$ , we can determine the future nominal yield payment and redemption amount. The present value of this cash flow based on the nominal discount rate is the market value including accrued interest before adjusting for inflation.

Deriving  $\pi$  from the formula below gives us the break-even inflation rate (BEI).

For JGBis with floor

$$DP = \sum_i CF_i (1 + \pi)^{t_i} DF(t_i) + \max \left\{ 100 \times (1 + \pi)^T, \frac{100}{\text{Indexation coefficient}} \right\} DF(T)$$

for JGBis without floor

$$DP = \sum_i CF_i (1 + \pi)^{t_i} DF(t_i)$$

- $DP$  : Market value including accrued interest before adjusting for inflation
- $\pi$  : Break-even inflation rate
- $t_i$  : Years until  $i$ th coupon cash flow occurs
- $T$  : Years until redemption cash flow occurs
- $CF_i$  :  $i$ th real coupon cash flow
- $DF(t_i)$  : (Nominal) discount coefficient at time  $t$

#### <Nominal Compound Yield>

For JGBis with floor

$$DP = \sum_i CF_i (1 + \pi)^{t_i} \left(1 + \frac{n}{2}\right)^{-2t_i} + \max \left\{ 100 \times (1 + \pi)^T, \frac{100}{\text{Indexation coefficient}} \right\} \left(1 + \frac{n}{2}\right)^{-2T}$$

for JGBis without floor

$$DP = \sum_i CF_i (1 + \pi)^{t_i} \left(1 + \frac{n}{2}\right)^{-2t_i}$$

- $DP$  : Market value including accrued interest before adjusting for inflation
- $\pi$  : Break-even inflation rate
- $t_i$  : Years until  $i$ th coupon cash flow occurs
- $T$  : Years until redemption cash flow occurs
- $CF_i$  :  $i$ th real coupon cash flow
- $n$  : Nominal compound yield (half-year compound yield)

**<Real Compound Yield>**

We define real compound yield  $r$  as the compound yield for real cash flow.

$$DP = \sum_i CF_i \left(1 + \frac{r}{2}\right)^{-2t_i}$$

$DP$	:	Market value including accrued interest before adjusting for inflation
$r$	:	Real compound yield
$t_i$	:	Years until $i$ th cash flow occurs
$CF_i$	:	$i$ th real cash flow

Note that the BEI can also be defined as the difference between the nominal yield of JGBs and the yield on the said JGBs with approximately the same terms remaining. Particularly for a half-year compound rate of return, the following formula is used in many occasions.

$$\frac{(1 + r/2)^2}{(1 + n/2)^2}$$

However, this method compares returns when the terms to maturity are different. Furthermore, it is uncertain whether nominal JGBs with approximately the same terms to maturity are available, particularly as the years to maturity of JGBs are more varied.

The nominal yields used in this formula can also be derived from the interest term structure model. However, the nominal par yield in this case is based on the par value at JPY100, and precise comparisons are not possible when JGBs are at over-par or under-par levels.

**<Duration >**

$$D = \frac{1}{DP} \sum_i CF_i \times t_i \times \left(1 + \frac{r}{2}\right)^{-2t_i}$$

$D$	:	Duration
$DP$	:	Market value including accrued interest before adjusting for inflation
$r$	:	Real compound yield
$t_i$	:	Years until $i$ th cash flow occurs
$CF_i$	:	$i$ th real cash flow

**<Modified duration>**

Modified duration refers to the sensitivity of market value to changes in real yields.

$$mD = \frac{D}{1 + \frac{r}{2}} \left( = -\frac{1}{DP} \frac{d}{dr} DP \right)$$

$mD$	:	Modified duration
$D$	:	Duration
$DP$	:	Market value including accrued interest before adjusting for inflation
$r$	:	Real compound yield

**<Portfolio Indicators Defined>**

Fig. 45 lists the portfolio indicators and their calculation methods. Essentially, these indicators are calculated by the same weighted average methods as for the NOMURA-BPI and based on the inflation-adjusted data. However, the inflation-adjusted price and inflation-adjusted market value including accrued interest are calculated by weighted averaging the face value before adjusting for inflation. This weighted average method allows us to calculate the total market value after adjusting for inflation and total accrued-interest market value after adjusting for inflation from portfolio indicators.

**Fig. 45: NOMURA J-TIPS Index Inclusion Criteria**

Indicator	Calculation method
Face value before adjustment for inflation Face value after adjustment for inflation	Total
Inflation-adjusted unit price Inflation-adjusted interest-accrued unit price	Weighted average of face value before adjusting for inflation
Coupon Term to maturity Unit price before adjusting for inflation Interest-accrued unit price before adjusting for inflation	Weighted average of face value after adjusting for inflation
Effective compound yield return Break-even inflation rate	Weighted average of total market value after adjusting for inflation
Duration Modified duration	Weighted average of interest-accrued total market value after adjusting for inflation

Source: NSC

## 6. NOMURA Swap Index

### (1) Outline of the Index

#### What is the NOMURA Swap Index?

The NOMURA Swap Index was launched in December 2008 as a performance index of yen interest rate swaps. The global trend in financial accounting is for mark-to-market valuation of pension liabilities and immediate recognition of actuarial losses. A specific type of pension fund management called liability-driven investment (LDI), which is primarily based on mark-to-market valuations of pension liabilities, is gaining popularity in the US and Europe.

As interest rate swaps do not require the payment of principal, and the tenors and transaction amounts are comparatively flexible, they are garnering attention as a new way to manage interest rate risks. In Japan, customized investments are expected to become more prominent as a method for managing pension liabilities. Because of this trend, we have developed a new customized index called NOMURA Swap Index, in addition to the NOMURA-BPI/C (See Sector 8.) and the NOMURA-BPI/Ladder.

#### Eligible transactions

The NOMURA Swap Index calculates the return and risk indicators for 80 types of collateralized yen interest rate swap transactions (i.e., 40 tenors and two different timing for rebalancing, Fig. 46). We chose these types of transactions because they are comparatively high in market liquidity.

**Fig. 46: Yen Interest Rate Swaps in the NOMURA Swap Index**

Term	One-year intervals from 1-10 years
Fixed rate (swap rate)	1-12,15,20,25,30,35 and 40 years: Swap rate (mid rate at close of trading) provided by Nomura Other maturity ranges: Estimated rate
Floating rate	6-month LIBOR
Trade dates	Monthly rebalancing: Last trading day of the each month Six-monthly rebalancing: Last trading day in March and September
Notional principal	JPY1bn

Source: NSC

#### Rebalancing

The NOMURA Swap Index enters yen interest rate swap trades on the last trading day of the month, and exits them for new trades regularly based on scheduled rebalancing dates. For example, the NOMURA Swap Index 10-year with monthly rebalancing enters a transaction with a 10-year tenor on the last trading day of the month, while the NOMURA Swap Index 20-year with six-monthly rebalancing enters a transaction with a 20-year tenor on the last trading day of March or September. We provided two types of rebalancing to meet various types of investor demand in terms of investment plans and cost restrictions.

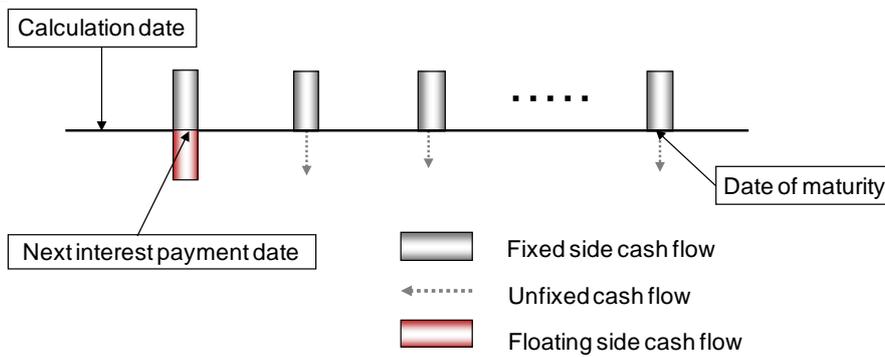
### (2) Eligible interest rate swap transactions

#### Eligible transactions

The interest rate swap transactions referenced in the NOMURA Swap Index are plain vanilla yen interest rate swaps with the floating leg referencing 6-month Libor. The Index assumes that the swap is collateralized by following the Credit Support Annex.<sup>15</sup>

<sup>15</sup> CSA (Credit Support Annex) is a standard collateral contract regulated by the ISDA (International Swaps and Derivatives Association).

**Fig. 47: Interest rate swap cash flow**



Source: NSC

### (3) Calculating Return Index, Rate of Return, Risk indicators

#### Symbol definitions

For bond indices, like the NOMURA-BPI, in addition to index value and total return, index value, capital return, and income return are defined. However, interest does not accrue on swap transactions, and therefore the NOMURA Swap Index calculates only index value and total return. To begin with, we define the symbols as follows:

$MV_{(today)}, MV_{(e.l.m.)}$	:	Market value of yen interest rate swap on day in question or at end of previous month
$Amt$	:	Notional principal of yen interest rate swap
$R_{(m,n)}$	:	Total return on the NOMURA Swap Index from time $m$ to time $n$
$I_{(today)}, I_{(e.l.m.)}$	:	Index value for Nomura Swap Index on day in question and at end of previous month
$\Delta t_{(m,n)}$	:	Elapsed days from time $m$ to time $n$ (including one of these dates)
$N$	:	Number of cash flows remaining in swap
$CF_i^*$	:	$i$ th-defined cash flow
$t_i$	:	Life remaining until $CF_i^*$

#### Definition of return index, rate of return

##### <Notional principal>

Notional principal is defined as JPY1.0bn

$$Amt = \text{JPY}1,000,000,000$$

##### <Total market value>

Market value of the transaction is defined by  $DF_L(t)$ .

$$MV = \sum_{i=1}^N CF_i^* \times DF_L(t_i)$$

##### <Total return since end of last month>

Total return cannot be defined by the same methodology as for bond indices, because a yen interest rate swap has a JPY0 market value at origination. Total return is defined as the total of the market value of the swap transaction plus its notional principal.

$$R_{(e.l.m.,today)} = \left( \frac{MV_{(today)} + Amt}{MV_{(e.l.m.)} + Amt} - 1 \right) \times \frac{365}{\Delta t_{(e.l.m.,today)}}$$

$$= \frac{\Delta MV_{(e.l.m.,today)}}{MV_{(e.l.m.)} + Amt} \times \frac{365}{\Delta t_{(e.l.m.,today)}}$$

note, however, that  $\Delta MV_{(e.l.m.,today)} = MV_{(today)} - MV_{(e.l.m.)}$

#### <Index value>

Swaps with a 20-year or shorter tenor are assigned a base value of 100 to end-March 2002. Swaps with a 20 to 30-year tenor are assigned a base value of 100 to end-September 2005. Swaps with a 30-year or longer tenor are assigned a base value of 100 to end-March 2009.

$$I_{(today)} = I_{(e.l.m.)} \times \left( 1 + R_{(e.l.m.,today)} \times \frac{\Delta t_{(e.l.m.,today)}}{365} \right)$$

#### Definition of risk indicators

- Grid point sensitivity (6m, 1-12, 15, 20, 25, 30, 35 and 40 years)

Grid point sensitivity shows how sensitive the market value of a swap transaction is to changes in the swap rate in each of the tenors (6m Libor in the case of 6m).

$$\text{Grid point sensitivity at year } t = \frac{1}{Amt} \frac{\partial MV_{(today)}}{\partial r_t}$$

$r_t$  : Swap rate at year  $t$

(However, 6m Libor in the case of 6m.)

## 7. NOMURA FIG Index

### (1) Outline of index

#### What is the NOMURA FIG Index?

The Financial Engineering & Technology Research Center of Nomura Securities introduced the NOMURA FIG Index in May 2016. This index is used to show the performance of bonds issued in Japan by banks. The index covers fixed-rate bonds as well as bonds that were switched from a fixed rate to a floating rate (“fix-to-float”) and meet certain conditions. In addition, bonds must have at least two months remaining to maturity (at least two months to the first call date for fix-to-float bonds). Consequently, the NOMURA FIG Index covers a wider range of bank bonds than the banking-sector sub-index of the NOMURA BPI.

#### Inclusion Criteria

The NOMURA FIG Index is calculated on the basis of the performance of a bond portfolio using the inclusion criteria listed in Fig. 48.

**Fig. 48: NOMURA FIG Index Inclusion Criteria**

Eligible bonds	Bonds issued by a financial institution or cooperative financial institution in accordance with the banking laws in the home country of the issuer at the time of issuance. Also bonds issued by a wholly owned subsidiary of a financial institution or cooperative financial institution that are guaranteed by the parent institution.  However, this index excludes bonds issued by government-affiliated financial institutions with 100% direct ownership by a government and bonds issued by a central bank. Bank debentures are not included, either.
Currency	Yen
Coupon	<ul style="list-style-type: none"> <li>▪ Fixed-rate coupon</li> <li>▪ Fix-to-float bonds that also meet the following conditions</li> <li>- Must be capital securities (e.g., subordinated bonds/notes)</li> <li>- Must be callable bonds/notes issued and traded as fixed coupon-bearing bonds/notes and turned into floating-rate bonds/notes after the first call date</li> </ul>
Rating	BBB or higher from any of the following rating companies: R&I, JCR, Moody's and Standard & Poor's
Issuance type	Domestic public offerings only
Years to maturity	Fixed-rate coupon: at least two months to final maturity Fixed-to-float: at least two months to the first call date
Remaining face value	JPY1 billion or more
Bonds for retail investors	Not included in the index <sup>1</sup>
Inclusion of new bonds	Two months after issuance
Government guarantees	Bonds issued by banks with a government guarantee are not included in the index

<sup>1</sup>For bonds issued before April 2006, it is not possible to determine which bonds were issued for sale to retail investors. As a result, all bonds are included in the calculation of reference values in prior years.

Source: NSC

#### Rebalancing

To assemble the index portfolio, bonds are selected on the next-month portfolio determination date shown in Fig. 49 from among the issues that fulfill the inclusion criteria. The composition of the index then remains unchanged during the following month. As shown in Fig. 48, the decision to include or exclude bonds depends on the business category of the issuer at the time of bond issuance. Therefore, even if an issuer's business category changes while the issuer's bond is in the index portfolio and the bond no longer meets the requirement in Fig. 48, the bond will not be excluded from the index portfolio for this reason. For more information about this subject, in “Issuers Included in the NOMURA FIG Index”

**Fig. 49: NOMURA FIG Index Next-month Portfolio Determination Date**

The next-month portfolio determination date is the earlier of the following dates.

- The business day after the 25th day of the month
- The third business day before the last business day of the month

However, the next-month portfolio determination date may be changed if the auction for the Japanese government bonds issued in the preceding month is held on the day after the determination date or afterward.

Source: NSC

**(2) Structure of the NOMURA FIG Index****Sub-indices by remaining life to maturity**

The remaining life to maturity used for categories of sub-indices is based on the remaining years as of the last day of each month. Categories remain the same throughout each calendar month. The period to the first call date is used for fix-to-float bonds. Fig. 50 shows portfolio information of portfolios by remaining life to maturity for the NOMURA FIG Index.

**Fig. 50: Eligible Bonds in Sub-indices Categorized by Remaining Life to Maturity**

Sub-index	Eligible bonds
Short (2m-3yr)	2 months to less than 3 years remaining
Medium (3yr-7yr)	3 years to less than 7 years remaining
Long (7yr-)	7 years and longer 7 years

Source: NSC

**Sub-indices by issuers maturity**

Fig. 51 shows sub-indices divided by issuer categories

**Fig. 51: Bonds in Sub-indices Categorized by Issuers**

Sub-index	Bonds
Domestic bonds	Banks operating in Japan
Samurai bonds	Banks operating in other countries

Source: NSC

**Sub-indices by coupon type**

Fig. 52 shows sub-indices divided by the type of coupon.

**Fig. 52: Bonds in Sub-indices Categorized by Coupon Type**

Sub-index	Bonds
Fixed	Fixed interest rate from issuance to maturity
Fix to Float	Fixed rate first and switch to floating rate on or after th

Source: NSC

**Sub-indices for subordination**

Fig. 53 shows sub-indices for senior and subordinated bonds.

**Fig. 53: Senior and Subordinated Bond Sub-indices**

Sub-index	Bonds
Senior bonds	Ordinary corporate bonds with no subordination
Subordinated bonds	Bonds with subordination

Source: NSC

### Sub-indices for the highest ratings

Fig. 54 shows sub-indices for portfolios that use the highest issuer rating for each bond.

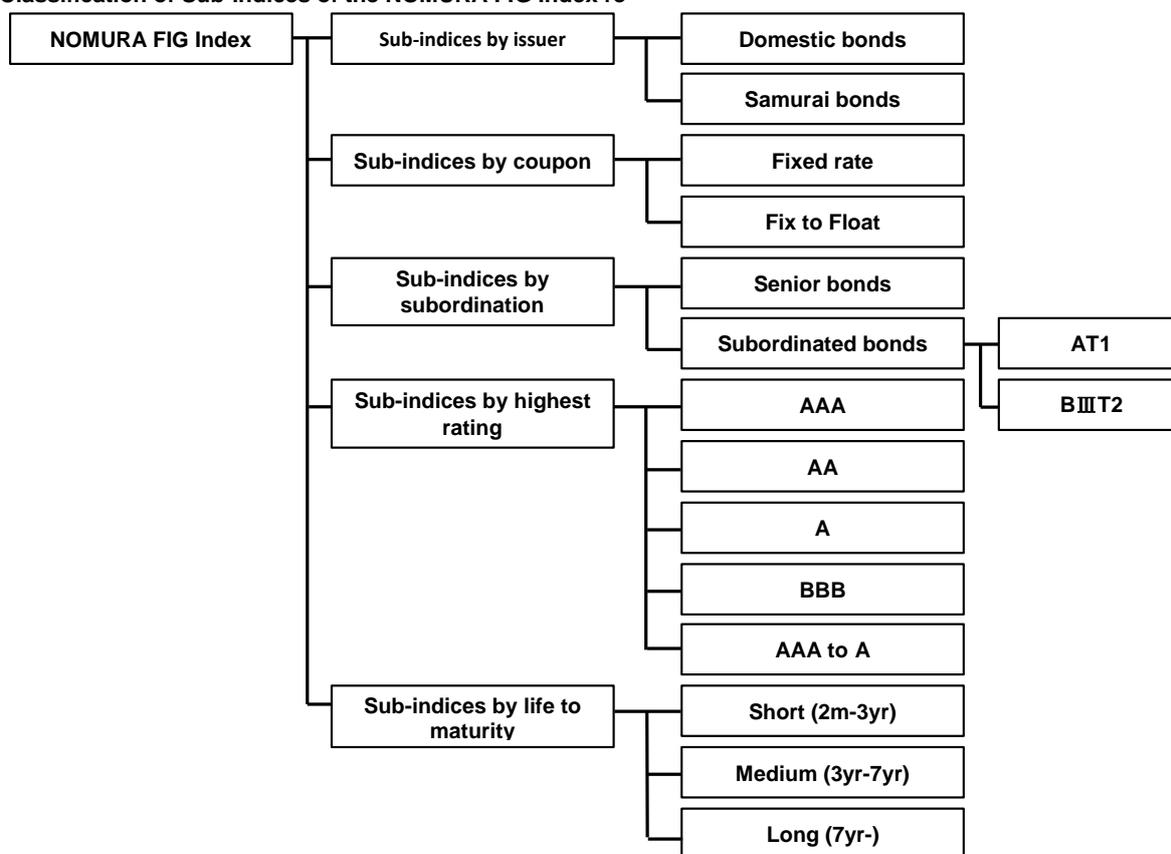
**Fig. 54: Sub-indices for Bond Ratings**

Sub-index	Bonds
AAA	Highest rating <sup>1</sup> is AAA
AA	Highest rating is AA
A	Highest rating is A
BBB	Highest rating is BBB
AAA to A	Highest rating is AAA to A (same as for NOMURA-BPI)

<sup>1</sup>The highest rating among the ratings assigned by JCR, R&I, S&P and Moody's

Source: NSC

**Fig. 55: Classification of Sub-indices of the NOMURA FIG Index re**



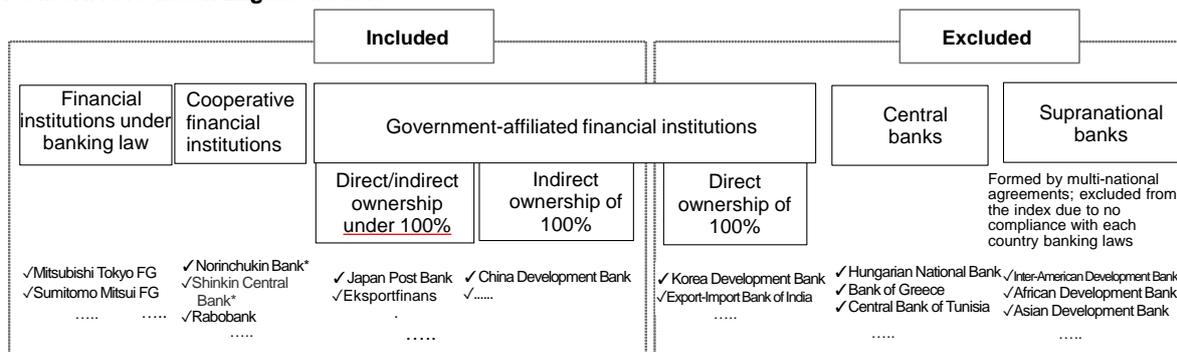
Source: NSC

### Issuers Included in the NOMURA FIG Index

The term “bank” is defined as a financial institution or a cooperative financial institution that operates in accordance with the banking laws of applicable countries. The NOMURA FIG Index includes bonds of issuers that were a bank at the time the bonds were issued.

However, the index does not include bonds issued by government-affiliated financial institutions with 100% direct ownership by a government and bonds issued by a central bank. Bank debentures are also not included.

**Fig. 56: NOMURA FIG Index Eligible Issuers**



\*The index does not include bank debentures.

Source: NSC

The eligibility of a bond for inclusion in the NOMURA FIG Index is determined by whether or not the issuer fulfilled the definition of a bank at the time the bond was issued. Consequently, even if an issuer ceases to be a bank as defined above after a bond was issued, the bond will not be removed from the index for this reason.

In addition, note that bonds issued before the issuer became a bank as defined above are excluded from this index.

Example 1) AEON Financial Service started a banking business on April 1, 2013. Bonds issued by this company since this date are not eligible for inclusion in the index.

Example 2) Goldman Sachs and Morgan Stanley became bank holding companies on September 22, 2008. Bonds issued by these companies since this conversion are eligible for inclusion in the index.

Furthermore, note that bank debentures are excluded even though the issuer may be eligible for inclusion in the index.

**Pricing**

The Nomura Securities final mid price is used for pricing to calculate the NOMURA FIG Index.

**Index Value**

The index value is calculated by using the method used for the NOMURA-BPI Index. The calculation method is shown 1. (4).

The index value for each sub-index is continuously calculated and indexed to a value of 100 used for the base date in Fig. 57. Index values from the end of March 2004 to the base date were calculated for reference purposes.

**Fig. 57: Index Base Date**

Index	Base date
NOMURA FIG Index :	March 31, 2014

Source: NSC

**Individual issue indicators**

The issue-specific indicators are calculated by using the method used for the NOMURA-BPI Index (refer to 1. (4)). However, risk indicators for fix-to-float bonds are calculated by using the first call date as the redemption date.

**Portfolio indicators**

Portfolio indicators are calculated by using the individual indicators of all issues in the index portfolio. Weighted averages are used. Weighted averages are used (refer to Fig. 13).

### (3) NOMURA G-SIBs/ D-SIBs Index

As part of activities to start publicizing the NOMURA FIG Index, the Index Operations Office of Nomura Securities' Financial Engineering & Technology Research Center has created an index for bonds of issuers designated as a G-SIBs (Global Systematically Important Banks) by the Financial Stability Board (FSB) and an index for bonds of issuers designated as a D-SIBs (Domestic Systematically Important Banks) by the Financial Services Agency (FSA). Other than the differences in the terms for issuers included, both indices are the same as the NOMURA FIG Index. The methods to calculate performance indices and portfolio indicators for these indices are the same as those for the NOMURA FIG Index.

#### Inclusion criteria

The performance of a bond portfolio using the inclusion criteria listed in Fig. 58 is used to calculate the NOMURA FIG G-SIBs/D-SIBs Index.

**Fig. 58: NOMURA G-SIBs/ D-SIBs Index Inclusion Criteria**

Eligible bonds	NOMURA G-SIBs Index: Bonds of issuers designated by the FSB NOMURA D-SIBs Index: Bonds of issuers designated by the FSA Both indices exclude bank debentures and include wholly owned subsidiaries of these issuers
Currency	Yen
Coupon	<ul style="list-style-type: none"> <li>▪ Fixed-rate coupon</li> <li>▪ Fix-to-float bonds that also meet the following conditions               <ul style="list-style-type: none"> <li>- Must be capital securities (e.g., subordinated bonds/notes)</li> <li>- Must be callable bonds/notes issued and traded as fixed coupon-bearing bonds/notes and turned into floating-rate bonds/notes after the first call date</li> </ul> </li> </ul>
Rating	BBB or higher assigned by any of the following rating companies: R&I, JCR, Moody's and Standard & Poor's
Issuance type	Domestic public offerings only
Years to maturity	<ul style="list-style-type: none"> <li>Fixed-rate coupon: at least two months until the final redemption date</li> <li>Fixed-to-float: at least two months until the first call date</li> </ul>
Remaining face value	JPY1 billion or more
Bonds for retail investors	Not included in the index
Inclusion of new bonds	Two months after issuance
Government guarantees	Bonds issued by banks with a government guarantee are not included in the index

Source: NSC

#### Rebalancing

To assemble an index portfolio, bonds are selected on the next-month portfolio determination date shown in Fig. 59 from among the issues that fulfill the inclusion criteria. The composition of the index then remains unchanged during the following month. The decision to include or exclude bonds depends only on the ownership of the issuer at the time of bond issuance. Therefore, even if an issuer's ownership structure changes while the issuer's bond is in an index portfolio, the bond will not be excluded from the portfolio for this reason.

**Fig. 59: NOMURA G-SIBs/D-SIBs Index Next-month Portfolio Determination Date**

The next-month portfolio determination date is the earlier of the following dates.

- The business day after the 25th day of the month
- The third business day before the last business day of the month

However, the next-month portfolio determination date may be changed if the auction for the Japanese government bond issued in the month is held on the day after the determination date or afterward.

Source: NSC

**Issuers Included in the NOMURA G-SIBs/D-SIBs Index**

The NOMURA G-SIBs Index includes bonds issued by financial institutions that were designated as G-SIBs by the FSB when the bonds were issued.

The NOMURA D-SIBs Index includes bonds issued by financial institutions that were designated as D-SIBs by the FSA when the bonds were issued. Bank debentures are excluded.

Both indices also include bonds issued by wholly owned subsidiaries of these financial institutions.

Since 2011, the FSB has announced a revised list of G-SIBs every year. Issuers that can be included in the NOMURA G-SIBs/D-SIBs Index are determined by no later than the end of the month following the month in which a revised list is announced by the FSB and/or FSA. The bonds to be included in the index each month are selected from among the eligible bonds issued starting in the second month after the revised list was announced.

The first designation and announcement of D-SIBs was in November 2015. Before November 2015, bonds included in the NOMURA D-SIBs Index were selected from among the bonds of the issuers in the list announced in November 2015 that fulfill the inclusion criteria in Fig. 58.

---

**Fig. 60: G-SIBs Designated by the Financial Stability Board (As of November 2015)**

- HSBC
- JP Morgan Chase
- Barclays
- BNP Paribas
- Citigroup
- Deutsche Bank
- Bank of America
- Credit Suisse
- Goldman Sachs
- Mitsubishi UFJ FG
- Morgan Stanley
- Agricultural Bank of China
- Bank of China
- Bank of New York Mellon
- China Construction Bank
- Groupe BPCE
- Groupe Crédit Agricole
- Industrial and Commercial Bank of China Limited
- ING Bank
- Mizuho FG
- Nordea
- Royal Bank of Scotland
- Santander
- Société Générale
- Standard Chartered
- State Street
- Sumitomo Mitsui FG
- UBS
- Unicredit Group
- Wells Fargo

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Source: NSC from Financial Stability Board data

**Fig. 61: D-SIBs Designated by the Financial Services Agency (As of November 2015)**

- Mitsubishi UFJ Financial Group, Inc.
- Mizuho Financial Group, Inc.
- Sumitomo Mitsui Financial Group, Inc.
- Sumitomo Mitsui Trust Holdings, Inc.
- Norinchukin Bank
- Daiwa Securities Group Inc.
- Nomura Holdings, Inc.

Source: NSC from Financial Stability Board data

**Calculation of performance index and return G-SIBs/D-SIBs Index**

The performance index and return are calculated by using the method used for the NOMURA FIG Index.

The performance index of each index is calculated continuously with a value of 100 for the base date in Fig. 62. For reference, index values have been calculated for the period starting at the end of December 2011 and ending on the base date.

**Fig. 62: NOMURA G-SIBs/D-SIBs Index Base Dates**

Index	Base Date
NOMURA G-SIBs Index :	End of March 2014
NOMURA D-SIBs Index	End of March 2014

Source: NSC

**Calculating Risk Indicators return G-SIBs/D-SIBs Index**

Risk indicators are calculated by using the method used for the NOMURA FIG Index.

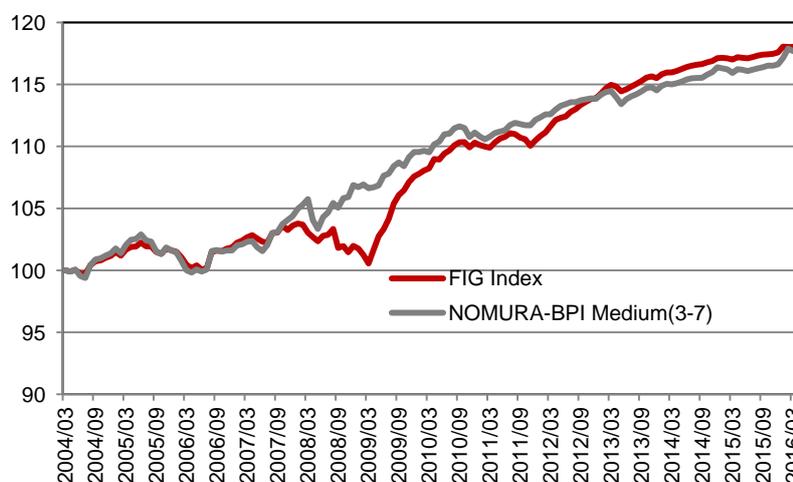
**(4) Comparing the NOMURA FIG Index and the NOMURA-BPI**

Fig. 63 compares the index values of the NOMURA FIG Index and the NOMURA-BPI medium-term (3-7). In the plot below, we assigned a base value of 100 to end-March 2004 and show monthly data through end-April 2016.

Because of the close duration, it is compared to the NOMURA-BPI medium-term (3-7) (Fig. 64).

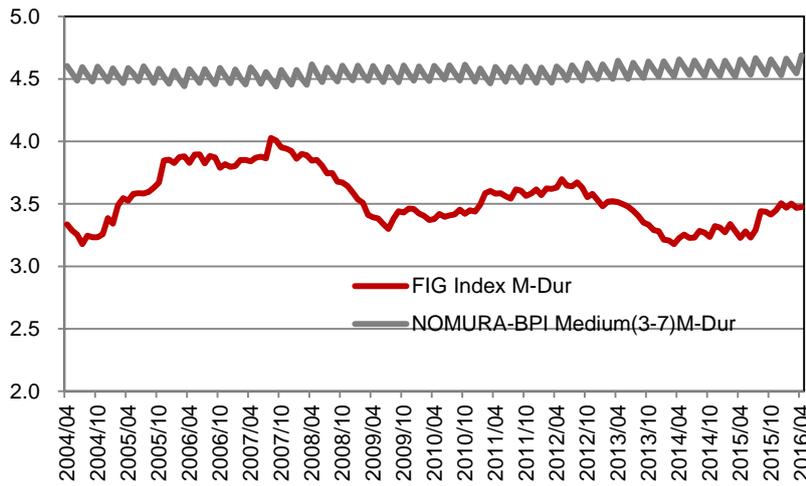
Furthermore, the value of the NOMURA D-SIBs Index and the NOMURA G-SIBs Index are shown Fig. 65.

**Fig. 63: Investment Return Indices of NOMURA FIG Index**



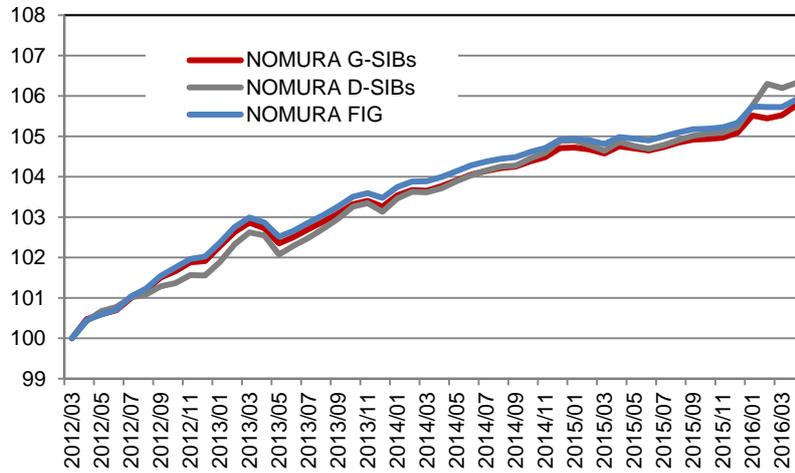
Source: NSC

Fig. 64: Duration of NOMURA FIG Index



Source: NSC

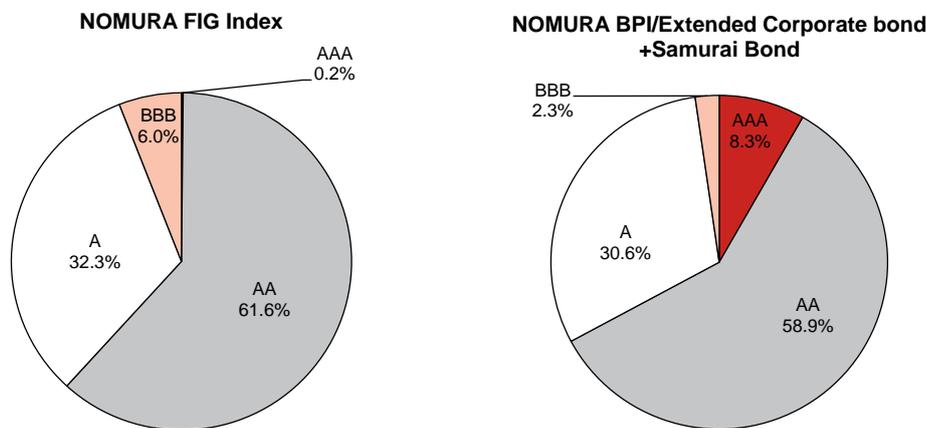
Fig. 65: Investment Return Indices of NOMURAG-SIBs Index,D-SIBs Index



Source: NSC

Fig. 66 shows component ratio by rating of the NOMURA-FIG Index and the NOMURA-BPI/Extended corporate and samurai bond. The ratio of BBB in the NOMURA FIG Index is higher than NOMURA-BPI/Extended corporate and samurai bond because the NOMURA FIG Index includes bonds issued with an initial fixed rate.

Fig. 66: Comparing the weight by BPI Rating



Source: NSC

## 8. NOMURA-BPI/C (Semi-Customized Index)

### (1) Outline of index

#### What is the NOMURA-BPI/C?

The NOMURA-BPI was first released in 1986, more than 25 years ago. Since then, the NOMURA-BPI has become widely used by both domestic and foreign institutional investors as a gauge of Japanese bond performance.

However, the index, which is used to benchmark bond performance, should also be studied in comparison to liability duration for asset management purposes. Unlike equity portfolios, there is generally not an optimal bond portfolio for every kind of investor. Therefore, bond investors should develop their own customized indices based on analysis of their own liabilities to serve as benchmark indices.

However, such customized indices have been individual indices differing for each investor, and the use of customized indices has been extremely unusual. Thus, Nomura Securities Quantitative Research Center (called Economic and Financial Research Center at the time of release) launched the NOMURA-BPI/C in July 1997 as a prototype of a customized index. This is an index with a variety in investment periods – short-, medium-, and long-term – and investors can select an index that meets their own debt attributes.

Though the component issues differ, the calculation methods of risk indicators and index value are the same as with the NOMURA-BPI. A base value of 100 is assigned to the index value base date of end-December 1993.

#### Inclusion criteria

The NOMURA-BPI/C consists of issues selected from the NOMURA-BPI based on set criteria. We released five types of indices: the NOMURA-BPI/C Short, the NOMURA-BPI/C Medium, the NOMURA-BPI/C Long (1), the NOMURA-BPI/C Long (2), and the NOMURA-BPI/C Core 4. The inclusion criteria for each are listed in Fig. 67.

**Fig. 67: NOMURA-BPI/C Inclusion Criteria**

NOMURA-BPI/C Short	An index consisting of JGBs and bank debentures included in the NOMURA-BPI, whose terms to maturity are less than five years
NOMURA-BPI/C Middle	An index consisting of JGBs and bank debentures included in the NOMURA-BPI, whose terms to maturity are less than 10 years
NOMURA-BPI/C Long (1)	An index consisting of 1% of total amount of outstanding JGBs with terms to maturity of 3 to less than 7 years, 3% of those with terms to maturity of at least 7 years, and 1% of all non-government bonds
NOMURA-BPI/C Long (2)	An index consisting of 1% of total outstanding JGBs with terms to maturity of 5 to less than 11 years, 3% of those with terms to maturity of at least 11 years, and 1% of all non-government bonds
NOMURA-BPI/C Core 4	An index consisting of JGBs, government-guaranteed JFM bonds, Tokyo Metropolitan government bonds, and bank debentures (excluding BBB rating or lower bank debentures <sup>16</sup> )

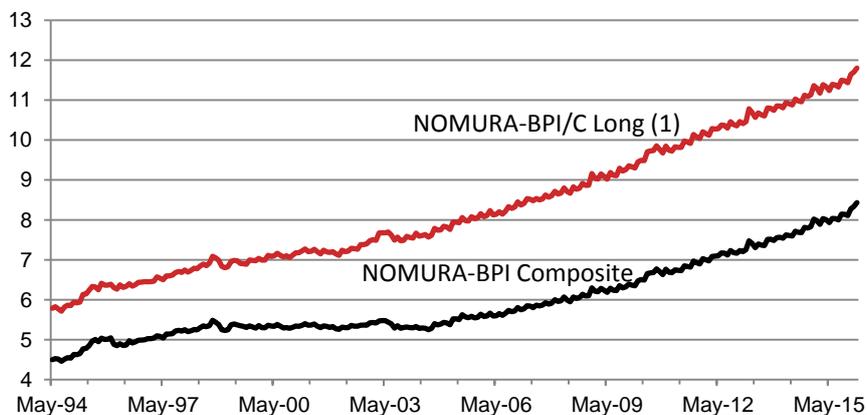
Source: NSC

<sup>16</sup> Bank debentures rated BBB or lower are special financing bonds rated BBB or the equivalent or lower by the four rating agencies on the portfolio inclusion determination date. However, bank debentures that are not rated are evaluated based on the rating of the priority bonds issued by the issuer.

## (2) Comparison with the NOMURA-BPI

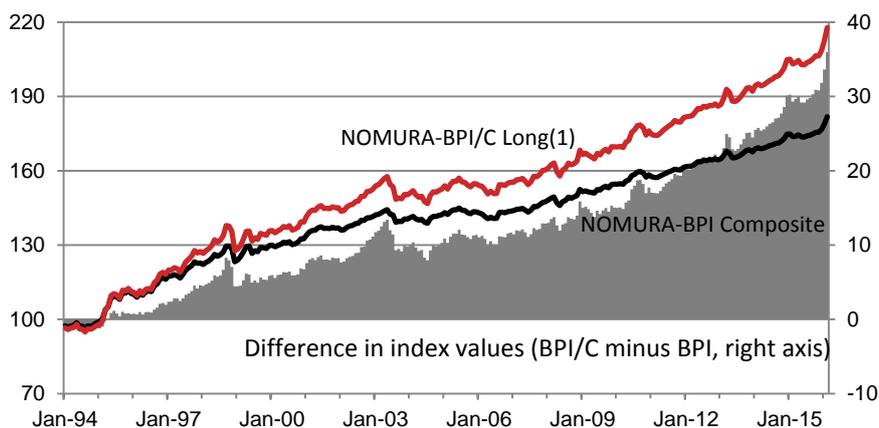
Fig. 68 compares the durations of the NOMURA-BPI and the NOMURA-BPI/C Long (1). Against the NOMURA-BPI, durations are 1.5 to 3 years longer. In particular, the NOMURA-BPI/C Long (1)'s duration lengthened from around 2003, reflecting the increased issuance of super-long term bonds.

**Fig. 68: NOMURA-BPI/C Long (1) Duration**



Source: NSC

**Fig. 69: Comparison of NOMURA-BPI Index Value and NOMURA-BPI/C Long (1) Index Value**



Source: NSC

# 9. Factor Analysis of Returns

This section explains the factor analysis of bond index returns. Because various factors influence bond index returns, simply generating return figures does not allow us to specify main factors. In such cases, it is important to dissect the effects on return and compare the contributions of each factor.

Here, we list four return factors:

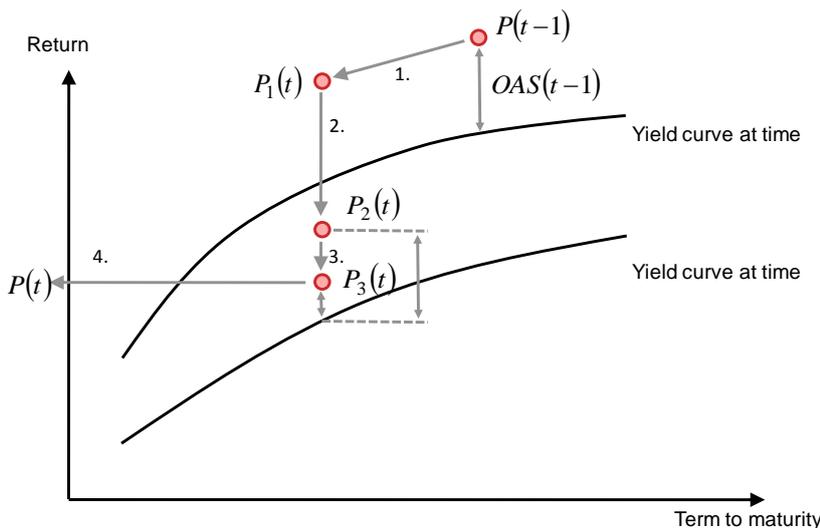
- Time elapsed
- Changes in the yield curve
- Changes in spread (OAS, YCS)
- Changes in volatility<sup>17</sup>

Note that changes in volatility do not affect bonds that do not use interest rate models to calculate prices.

First, we dissect the change from the price of an individual bond at the end of last month  $P(t-1)$  to the price at the end of the current month  $P(t)$  by the following four ways:

- $P(t-1) \rightarrow P_1(t)$  : Change in price due to time elapsed
- $P_1(t) \rightarrow P_2(t)$  : Change in price due to change in yield curve
- $P_2(t) \rightarrow P_3(t)$  : Change in price due to change in spread
- $P_3(t) \rightarrow P(t)$  : Change in price due to change in volatility

**Fig. 70: Price Changes Due to Individual Factors**



Source: NSC

In each of these calculation processes, only the related factor is changed. That is, the parameters outlined in Fig. 71 are used to calculate price  $P_1(t), P_2(t), P_3(t)$  and  $P(t)$ .

**Fig. 71: Price Changes Due to Individual Factors**

	Data used to estimate parameters in Interest Rate Model		Spread
	Yield Curve	Swaption Volatility	
$P_1(t)$	Previous month	Previous month	Previous month
$P_2(t)$	Current month	Previous month	Previous month
$P_3(t)$	Current month	Previous month	Previous month
$P(t)$	Current month	Previous month	Previous month

Source: NSC

<sup>17</sup> This indicates the impact that changes in swaption volatility have on bond prices when passed through parameters.

Each price derived from the above methods can be used to calculate returns for each factor (before annualization) for individual bond. See I-IV below.

**I. Return due to time elapsed factor:  $R_{TIME}$**

With the passage of time, not only does price change from  $P(t-1)$  to  $P_1(t)$ , interest payments and principal redemption must also be considered.

$$R_{TIME} = \frac{P_1F(t) - P(t-1)F(t-1) + CF}{P(t-1)F(t-1)}$$

$F(t)$  : Remaining amount at time  $t$

$CF$  : Interest payments and principal redemption ( $= C/100 \cdot F(t-1) + F(t-1) - F(t)$ )

$C$  : Interest paid during month for JPY100 of face value

**II. Return due to yield curve change factors:  $R_{YC}$**

$$R_{YC} = \frac{(P_2(t) - P_1(t))F(t)}{P(t-1)F(t-1)}$$

Please note that this addresses decline in principal. This applies to III and IV as well.

**III. Return due to change in spread factor:  $R_{SPREAD}$**

$$R_{SPREAD} = \frac{(P_3(t) - P_2(t))F(t)}{P(t-1)F(t-1)}$$

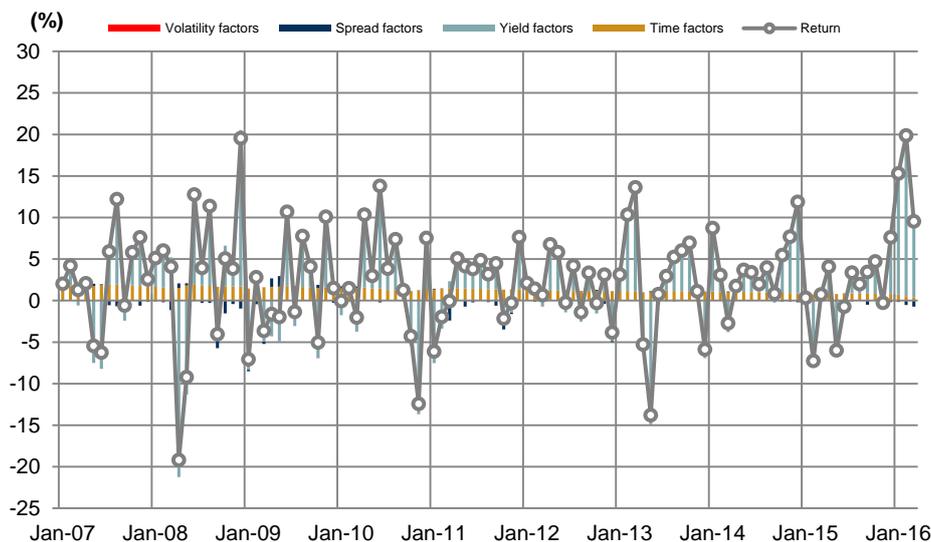
**IV. Return due to change in volatility factor:  $R_{VOL}$**

$$R_{VOL} = \frac{(P(t) - P_3(t))F(t)}{P(t-1)F(t-1)}$$

The return by index factor is calculated by 1) calculating the returns for individual factors of individual bonds using the above methods, and 2) calculating the weighted average of these returns by using the remaining amount of the bond as of the end of the previous month.

The return dissection results are shown below for the NOMURA-BPI, the NOMURA-BPI Corporates, and the NOMURA-BPI MBS. Note that annualized data are shown in Fig. 72-74.

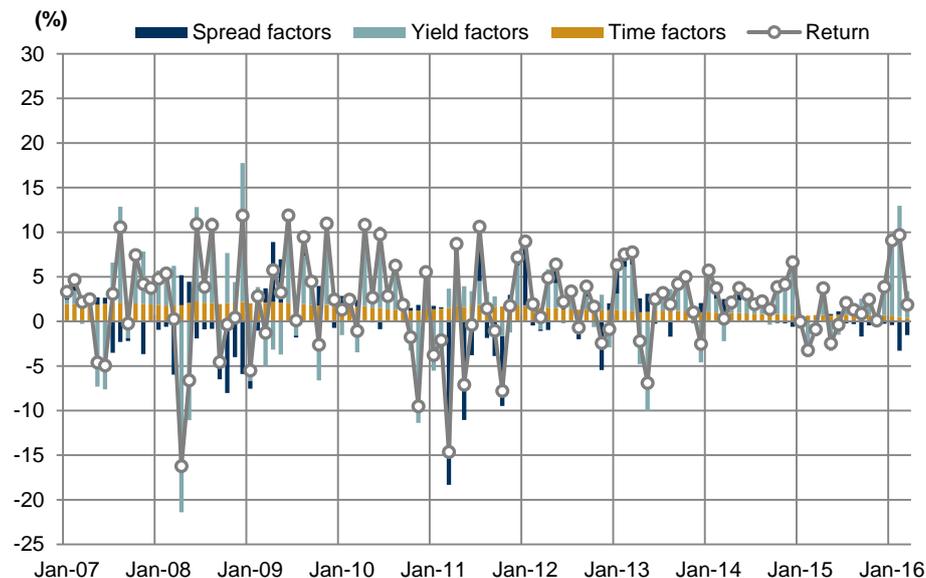
**Fig. 72: Return Factor Analysis of the NOMURA-BPI**



Source: NSC

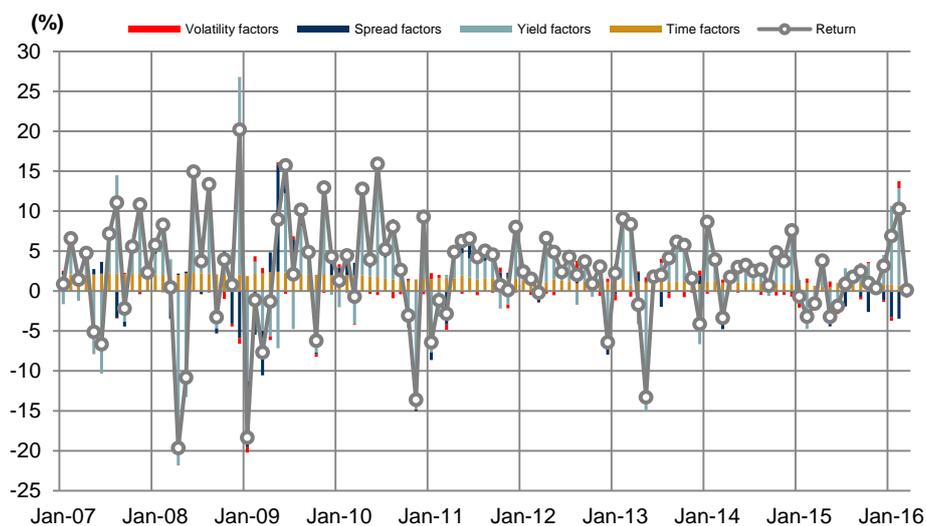
We see that, in the NOMURA-BPI, of which up to 80% consists of JGBs, more than half of the returns are due to yield and time factors. Furthermore, yield factors were especially large from January 2016 to February 2016 due to the negative interest rate policy of BOJ.

**Fig. 73: Return Factor Analysis of the NOMURA-BPI Corporates**



Source: NSC

Fig. 73 shows that, in the NOMURA-BPI Corporates, the yield and time factors have the most influence over time. However, we have seen occasions when the spread factor had a greater impact (e.g., after November 2008 when the credit crisis broke out, and after March 2011 when the Tohoku-Pacific Ocean Earthquake hit Japan).

**Fig. 74: Return Factor Analysis of the NOMURA-BPI MBS**

Source: NSC

Unlike other NOMURA-BPI sub-indices, volatility factors are reflected in the NOMURA-BPI MBS. Although volatility factors are limited over time, they grew slightly from October 2008 through March 2009. This was because swaption volatility movements during this time were relatively big, and this had a commensurate effect on option values embedded in the MBS. Also, the NOMURA-BPI MBS displayed a yield factor, unlike the NOMURA-BPI at times like December 2008. This was due to gaps in the key rate durations (see Fig. 30). Note that, corresponding to the introduction for negative interest rate policy of BOJ, we calculate each factor since January 2016 using an interest rate model that is structured for a negative interest environment. The interest rate model is shown in Section 1.(5).

# 10. Indices and Data Released

## (1) Indices released

The indices we provide as of May 2016 and their base dates are as follows.

Index	Base date
NOMURA-BPI	May 1986
NOMURA-BPI/C	Jul 1997
NOMURA-BPI/Dur	Jul 2012
NOMURA-BPI/Ladder	Nov 2005
NOMURA CMT Index	Oct 2003
NOMURA J-TIPS Index	Oct 2004
NOMURA Swap Index	Dec 2008
NOMURA FIG Index	May 2016

## (2) Data released

As of March 2015, the following data related to the NOMURA Bond Indices are regularly released. Note that daily data are usually released by 8:00 am the following business day, but there may be exceptions due to system failures or other reasons.

### - NOMURA-BPI, NOMURA-BPI/Extended

<http://qr.nomura.co.jp/en/bpi/index.html>

Daily index value and risk indicator data

Monthly index value and risk indicator data

### - Nomura BPI/Ladder

<http://qr.nomura.co.jp/jp/bpil/index.html>

Daily index value and risk indicator data

Monthly index value and risk indicator data

### - NOMURA CMT Index

Daily index value and risk indicator data

<http://qr.nomura.co.jp/jp/cmt/index.html>

### - NOMURA J-TIPS Index

<http://qr.nomura.co.jp/jp/itips/index.html>

Daily index value and risk indicator data

### - NOMURA Swap Index

<http://qr.nomura.co.jp/en/swap/index.html>

From 'Performance'

Daily index value and portfolio indicator

### - NOMURA FIG Index

<http://qr.nomura.co.jp/en/fig/index.html>

Daily index value and risk indicator data

Monthly index value and risk indicator data

### (3) From information terminals

As of May 2016, the following NOMURA bond indices data can be found on information terminals.

#### -Nomura Securities “Nomura Now Japan Rates Monitor”

From ‘NOMURA-BPI’

##### ■NOMURA-BPI

\*What’s new?

\*Daily index value and risk indicator data

\*Monthly index value and risk indicator data

\*Detail data <one-year intervals data>

\*Next portfolio information as for NOMURA-BPI and JGB

\*Inclusion/Exclusion

##### ■NOMURA-BPI/Extended

\*What’s new?

\*Daily index value and risk indicator data

\*Monthly index value and risk indicator data

\*Next portfolio information as for NOMURA-BPI/Extended

\*Inclusion/Exclusion

##### ■NOMURA-BPI/Ladder

\*What’s new?

\*Daily index value and risk indicator data

\*Monthly index value and risk indicator data

\*Detail data <component issue information>

\*Historical data

\*Inclusion/Exclusion

##### ■NOMURA CMT Index

\*What’s new?

\*Daily index value and risk indicator data

\*Monthly index value and risk indicator data

\*Detail data <component issue information>

\*Historical data

##### ■NOMURA J-TIPS Index

\*What’s new?

\*Daily index value and risk indicator data

\*Monthly index value and risk indicator data

\*Detail data <component issue information>

\*Historical data

##### ■NOMURA Swap Index

\*What’s new?

\*Daily index value and risk indicator data

\*Monthly index value and risk indicator data

\*Historical data

■NOMURA FIG Index

\*What's new?

\*Daily index value and risk indicator data

\*Monthly index value and risk indicator data

\*Rulebook

\*Inclusion/Exclusion

\*Repos for reference

**-Quick-IS**

NRIJ001	NOMURA Indices NOMURA Indices guidance
NRIJ100-NRIJ111	NOMURA-BPI
NRIJ112-NRIJ119	NOMURA-BPI/Extended
NRIJ120-NRIJ123	NOMURA-BPI/Ladder
NRIJ124	NOMURA CMT Index
NRIJ125	NOMURA J-TIPS Index

**-Reuters**

NMSBPI Menu	NOMURA-BPI
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**-Bloomberg**

NBPI <GO>	NOMURA-BPI
MEMB <GO>	List of individual issues (from each page)
Ex: BPITTO01 Index <GO> MEMB <GO>	NOMURA-BPI individual issues

*\*Note that the list pages need paid authority.*

**-Jiji Press**

BC84-BC95	NOMURA-BPI
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Note that Reuters and Bloomberg provide historical data, including some sub-index data, from 2000. Further, Nomura Research Institute provides detailed data and historical data prior to 2000.

(Contact)

Nomura Research Institute Investment Information Systems Business Department

e-mail: [ids-sales@nri.co.jp](mailto:ids-sales@nri.co.jp)

**Fig. 75: Bloomberg Ticker Codes**

BPITTO01 Index	NOMURA-BPI	Index value
BPITTO03 Index	NOMURA-BPI	Total return from end of last month
BPITTO04 Index	NOMURA-BPI	Capital return from end of last month
BPITTO05 Index	NOMURA-BPI	Income return from end of last month
BPITTO06 Index	NOMURA-BPI	Total return from last business day
BPITTO07 Index	NOMURA-BPI	Total return from end of last fiscal year
BPITTO08 Index	NOMURA-BPI	Total return from end of last year
BPITTO09 Index	NOMURA-BPI	Number of issues
BPITTO10 Index	NOMURA-BPI	Face value
BPITTO11 Index	NOMURA-BPI	Market price
BPITTO12 Index	NOMURA-BPI	Interest-accrued market price
BPITTO13 Index	NOMURA-BPI	Term to maturity
BPITTO14 Index	NOMURA-BPI	Term to maturity (weighted average life)
BPITTO15 Index	NOMURA-BPI	Coupon rate
BPITTO16 Index	NOMURA-BPI	Direct yield to maturity
BPITTO17 Index	NOMURA-BPI	Simple yield to maturity
BPITTO18 Index	NOMURA-BPI	Compound yield to maturity
BPITTO19 Index	NOMURA-BPI	Duration
BPITTO20 Index	NOMURA-BPI	Modified duration
BPITTO21 Index	NOMURA-BPI	Convexity
BPITTO22 Index	NOMURA-BPI	T-Spread
BPITTO23 Index	NOMURA-BPI	Effective duration
BPITTO24 Index	NOMURA-BPI	Effective convexity
BPITST01 Index	NOMURA-BPI Short	Index value
BPITMT01 Index	NOMURA-BPI Medium	Index value
BPITLT01 Index	NOMURA-BPI Long (7-)	Index value
BPITLL01 Index	NOMURA-BPI Long (7-11)	Index value
BPITUL01 Index	NOMURA-BPI Long (11-)	Index value
BPIJTO01 Index	NOMURA-BPI JGB	Index value
BPMNTO01 Index	NOMURA-BPI Municipal Bonds	Index value
BPGBTO01 Index	NOMURA-BPI Govt Guaranteed Bonds	Index value
BPBDTO01 Index	NOMURA-BPI Bank Debentures	Index value
BPCBTO01 Index	NOMURA-BPI Corporates	Index value
BPYFTO01 Index	NOMURA-BPI Samurai Bonds	Index value
BPMBTO01 Index	NOMURA-BPI MBS	Index value
BPABTO01 Index	NOMURA-BPI ABS	Index value
BPIMTO01 Index	NOMURA-BPI ex-MBS	Index value
BPIATO01 Index	NOMURA-BPI ex-ABS	Index value
BPIDTO01 Index	NOMURA-BPI ex-ABS, MBS	Index value
BPIETO01 Index	NOMURA-BPI ex-JGB	Index value
BPETTO01 Index	NOMURA-BPI/Ex	Index value
BPITDT01 Index	NOMURA-BPI/Dur	Index value
BPCBDT01 Index	NOMURA-BPI Corp/Dur	Index value
BPCBFT01 Index	NOMURA FIG Index	Index value

Source: NSC

# 11. FAQ

## (1) NOMURA Bond Indices Overall

### Q1. What is the market price based on?

The NOMURA Bond Indices currently use Nomura Securities final mid price.

### Q2. What are the base points in time for classifying securities into the short-term, medium-term, and long-term sub-sectors?

The terms to maturity of securities included in each of these sub-indices are determined based on the month-end of the portfolio (including non-business days).

For example, the short-term sector in a September 2009 portfolio covers securities redeemed before September 30, 2012.

### Q3. Can the term classification of securities included in the maturity sub-indices change in mid-month due to a change in term to maturity?

The term classification is fixed throughout the month. This is also true for classifications other than remaining term classifications.

### Q4. How are settlement dates treated for calculating NOMURA indices?

Settlement dates are assumed to be on that day. The calculated market price is based on settlement date, so the price is discounted back to same-day settlement.

### Q5. Is the index calculated only on business days?

The index is calculated only on business days. The index is not calculated on Japanese holidays.

### Q6. Where is the month-end income reflected if the last day of the month is a holiday?

The NOMURA Bond Index indicators are not calculated on Japanese holidays. Therefore, if the last day of the month falls on a Japanese holiday, the income is reflected in the indices and indicators the next business day, the first business day of the following month.

### Q7. How is cash flow generated in mid-month treated?

Cash flow generated in mid-month is treated as non-accrual cash, and will not be reinvested until the end of the month.

### Q8. How are costs and taxes reflected?

The taxes incurred on transactions or on coupon revenue and transaction costs incurred in buying or selling an index security (as reflected in the bid-ask spread) are not priced in for the index calculations.

### Q9. Are taxable and non-taxable bonds distinguished?

The distinction is based on bond-holder classification, which was not reflected in the index calculation, although taxable and non-taxable were abolished in January 2016

### Q10. Are changes in market outstanding due to BoJ rinban operations or MoF buybacks addressed?

As of March 2015, any changes in market outstanding face value due to BoJ rinban operations or MoF buybacks are not addressed.

### Q11. What procedures are necessary in order to use the NOMURA-BPI as a performance benchmark for investments in publicly offered financial products?

Please contact Nomura Securities' Quantitative Research Center at

[bpi@jp.nomura.com](mailto:bpi@jp.nomura.com)

### Q12. We would like to use the NOMURA-BPI data as reference data in our marketing brochures. Please advise.

Please contact Nomura Securities' Quantitative Research Center at

[bpi@jp.nomura.com](mailto:bpi@jp.nomura.com)

### Q13. What is the difference between total index value and capital index value?

Total index value is total accrued-interest market value including income gains accrued from the end of the previous month through the current day. Capital index value is an index figure calculated from outstanding market value not including income gains.

**Q14. Do terms to maturity for the index reflect leap days?**

In accordance with business practice, bonds with less than one year remaining to maturity consider leap days, while bonds with more than one year to maturity do not factor in leap days. The table below shows the number of days in various terms.

from \ to	28 Feb. 2008	29 Feb. 2008	1 Mar. 2008
28 Feb. 2007	365 days	365 days	366 days
1 Mar. 2007	364 days	365 days	365 days

**Q15. The 'at least one year to maturity' inclusion criteria is measured from when to when specifically?**

The bond indices introduced herein, except for the NOMURA-BPI/Ladder, consider term to maturity when adding new issues to the portfolio. 'At least one year to maturity' means there are 365 days or more days to maturity from the last day of the given month. In accordance with business practices, leap days are counted. See below for a specific example.

**Example 1) When a leap day does not fall within the term**

Portfolio	June 2009 portfolio
Last day of given month	June 30, 2009
365 days later	June 30, 2010

Issues with redemption dates of 30 June 2010 or after fulfill the 'at least one year to maturity' criteria, and can be added to the June 2009 portfolio.

**Example 2) When a leap day does fall within the term**

Portfolio	June 2007 portfolio
Last day of given month	June 30, 2007
365 days later	June 29, 2008

Issues with redemption dates of 29 June 2008 or after fulfill the 'at least one year to maturity' criteria. In Example 1), issues with a redemption date of 29 June 2010 would not have been eligible for inclusion in the June 2009 portfolio, but issues with a 29 June 2008 redemption date are eligible for inclusion in the June 2007 portfolio.

**(2) NOMURA-BPI, NOMURA-BPI/Extended****Q1. How are the NRI-BPI and the NOMURA-BPI different?**

NRI-BPI is the forerunner of the NOMURA-BPI. The name of the NRI-BPI index was changed to the NOMURA-BPI on 1 October 1998. The calculation methods and inclusion criteria did not change.

**Q2. Why are JSDA reference prices for OTC bond transactions not used in calculating the NOMURA-BPI?**

Reference prices for OTC bond transactions released by the Japan Securities Dealers Association are not used in calculating NOMURA bond indices.

A previous index, the NOMURA-BPI-S, used standard bond quotations released by the JSDA, but this index was suspended on 30 November 1998.

The NOMURA-BPI includes many issues for which the JSDA did not provide OTC quotations following the latter's suspension of its quotation system for bonds other than those for which it provides standard quotations. The prices of those issues then were not available. As it became impossible to continue the index, it was terminated on 30 October 1998.

**Q3. There seem to be more JGBs than there are in the market.**

When two or more JGB issues are consolidated into a single issue, the total number of outstanding issues is reduced. Even when such case occurs in the real marketplace, original issues continue to exist in the NOMURA-BPI. The same is true with re-opened issues, each of which is counted as a separate issue in the index when issuance dates differ. Likewise, each liquidity-enhancement issue is counted as one issue.

**Q4. How are converted JGBs treated?**

When the debts issued by the Japanese National Railways, Japanese National Railways Settlement Corporation, the Honshu-Shikoku Bridge Authority, and Japan National Oil Corporation were assumed by the Government of Japan, some of the government-guaranteed bonds issued by these bodies were converted to JGBs.

Government-guaranteed Japanese National Railway Settlement Corporation bonds became JGBs as a result of the 1998 Law for Disposal of Debts and Liabilities of the Japanese National Railways Settlement Corporation. Accordingly, these issues became part of the JGB sub-index rather than the government-guaranteed sub-index on the final business day of October 1998.

Some petroleum bonds were taken over by the government following repeal of Japan National Oil Corporation Law and on 1 April 2003 were assumed under the Special Accounts for Coal, Petroleum and Sophisticated Structure of Energy Supply and Demand.

Thus, the government-guaranteed petroleum bonds assumed by this account (excluding those placed with the Trust Fund Bureau and Postal Life Insurance) on 1 April 2003 were re-classified within the NOMURA-BPI as JGBs, instead of government-guaranteed bonds, as on the last business day of April 2003. Since May 2003, these bonds have been considered JGBs within the NOMURA-BPI.

Government-guaranteed petroleum bonds (excluding those placed with the Trust Fund Bureau and Postal Life Insurance) assumed on 1 February 2004 were treated the same way.

**Fig. 76: Petroleum Bonds Shifted to JGB Sector**

Change period	Issue	Coupon	Maturity Date	Face value (JPYmn)
May 2003~	Government-guaranteed No. 36 Petroleum bond	3.1%	28 Feb. 2006	10,050
May 2003~	Government-guaranteed No. 41 Petroleum bond	1.9%	27 Jan. 2009	12,030
Mar 2004~	Government-guaranteed No. 34 Petroleum bond	3.0%	27 Jul. 2005	10,000
Mar 2004~	Government-guaranteed No. 35 Petroleum bond	3.1%	27 Jan. 2006	10,000
Mar 2004~	Government-guaranteed No. 37 Petroleum bond	3.3%	27 Mar. 2006	10,070
Mar 2004~	Government-guaranteed No. 38 Petroleum bond	3.2%	19 Sep. 2006	20,000
Mar 2004~	Government-guaranteed No. 39 Petroleum bond	2.9%	27 Oct. 2006	10,050
Mar 2004~	Government-guaranteed No. 40 Petroleum bond	2.3%	18 Sep. 2007	20,100
Mar 2004~	Government-guaranteed No. 42 Petroleum bond	2.1%	18 Mar. 2009	20,100

Source: NSC

**Q5. How are JGB STRIPS treated for the NOMURA-BPI?**

JGBs that can be stripped into separately tradable principal and coupon securities were first issued in January 2003. Securities firms handle the stripping of the government bonds, and for this reason it is difficult to obtain information on a real-time basis. Moreover, the impact that separated trading of principal and interest has on the government-bond market as a whole is equivalent to that the original coupon-bearing JGBs had. Hence, they are treated for the NOMURA-BPI and other indices the same as before.

**Q6. What are the BBB rating or lower bank debentures in the NOMURA-BPI?**

Bank debentures, regardless of the issuer, are included in the NOMURA-BPI. BBB rating or lower bank debentures are those rated BBB or lower by the four credit agencies as of the rebalancing date. The rating for senior debt issued by the same financial institution is used for unrated bank debentures.

**Q7. What sector are FILP-agency bonds categorized as?**

FILP-agency bonds guaranteed by the government are considered government-guaranteed bonds, while those not guaranteed are classified as corporate bonds.

There is also a FILP-agency bonds sub-sector within the corporate bonds sector, in which bonds issued by non-listed corporations established as authorized by statutory law are included.

**Q8. Are JGBs sold OTC at post offices included?**

JGBs sold OTC at post offices are not included.

The NOMURA-BPI includes only the government bonds publicly offered in the market, and excludes those sold to the former Trust Fund Bureau, the Financial Liberalization Fund in the Postal Savings Special Account, post office OTC sales, placements to postal savings system, the postal life insurance special account, and the GPIF.

Also, OTC sales at Japan Post Bank and private financial institutions are excluded.

**Q9. Why are retail JGBs and corporate bonds not included? Are resident-participatory local government bonds included in the NOMURA-BPI?**

Retail JGBs and JGBs for post office OTC sales are not included in the NOMURA-BPI. Beginning with the April 2014 portfolio determination, “retail investor bonds” will be excluded from the index portfolio (until March 2014, these bonds were within the scope of inclusion provided that they were not exclusively for retail investors).

Similarly, resident-participatory local-government bonds will be excluded from the April 2014 index portfolio and beyond (until March 2014, these bonds were within the scope of inclusion provided that they did not have restrictions on purchasers).

**Q10. What credit ratings are used for the NOMURA-BPI inclusion criteria?**

The NOMURA-BPI inclusion criteria include criteria regarding ratings assigned to separate bonds. When they are considered for inclusion in the portfolios, ratings for long-term senior debt and issuer are not considered.

**Q11. What does a rating of at least A or the equivalent for corporate bonds, Samurai bonds, MBSs and ABSs mean?**

Corporate bonds, Samurai bonds, MBSs and ABSs must have a rating of at least A or the equivalent from R&I, JCR, S&P, or Moody’s to be included in the NOMURA-BPI. Nomura Securities’ Quantitative Research Center determines whether an issue should be included in the NOMURA-BPI based on the credit ratings of the individual corporate bonds, Samurai bonds, MBSs and ABSs.

Sometimes a rating agency may not rate all of the bonds issued by one issuer under the same terms. In this case, the unrated issues are regarded as having the same credit rating as the issuer’s other comparable bonds rated by the agency.

Please see the following example (however, the bond in the example is assumed to meet all the inclusion criteria other than for the rating, and only two credit rating agencies, X Agency and Y Agency, are assumed for the sake of simplicity).

Example: Company A issues a No. 1 bond on 1 July 2009. It is a corporate bond, so is eligible for inclusion in the September 2009 portfolio. But as of 26 August 2009, it is rated BBB by Agency X and has not been rated by Agency Y. Therefore, the bond is not added to the September 2009 NOMURA-BPI index portfolio. Thereafter, the bond’s rating is not upgraded by Agency X.

Company A issues a No. 2 bond on 1 September 2009. As of 26 October 2009, it is rated A by Agency Y and is ranked pari passu with the No. 1 issue and has the same financial covenants.

**Fig. 77: List of Ratings for Company A**

	Agency X	Agency Y
Company A No. 1 issue	BBB	Not rated
Company A No. 2 issue	Not rated	A

Source: NSC

Since both bonds are issued by the same issuer, Company A, with the same terms, the No. 1 bond is regarded as having the equivalent of an A rating from Agency Y and the No. 2 bond is regarded as having the equivalent of a BBB rating from Agency X.

**Fig. 78: Treatment of Bond Ratings in this Example**

	Agency X	Agency Y
Company A No. 1 bond	BBB	Equivalent of A
Company A No. 2 bond	Equivalent of BBB	A

Source: NSC

Accordingly, Company A's No. 1 and No. 2 bonds are both included in the NOMURA-BPI from November 2009.

**Q12. The four Highway-Related Public Corporations were privatized. What is the relationship between the converted bond ratings and the ratings of the bonds issued by the Highway Agency in the NOMURA-BPI?**

The bodies that guarantee payment of principal and interest for converted bonds and JEHDRA bonds are different, so different ratings are assigned.

Four highway corporations – Japan Highway Public Corporation, Metropolitan Expressway Public Corporation, Hanshin Expressway Public Corporation, and the Honshu-Shikoku Bridge Authority – were privatized in October 2005. With this, the Japan Highway Public Corporation was split into three companies, East Nippon Expressway Company, Central Nippon Expressway Company, and West Nippon Expressway Company. The Metropolitan Expressway Public Corporation became the Metropolitan Expressway Company, the Hanshin Expressway Public Corporation became the Hanshin Expressway Company, and the Honshu-Shikoku Bridge Authority became the Honshu-Shikoku Bridge Expressway Company. Highway facilities and debt were transferred to the Japan Expressway Holding and Debt Repayment Agency (JEHDRA), an independent administrative agency.

The bonds issued by the former public corporations (converted bonds) are guaranteed as joint and several debt by both the successor companies to the issuers and the highway JEHDRA. Accordingly, these converted bonds and bonds issued by JEHDRA are different in guarantees.

**Q13. If an issue in the NOMURA-BPI is downgraded in mid-month and thereby no longer meets inclusion criteria, will it be removed from the index mid-month?**

The NOMURA-BPI index portfolio for the following month consists of all those issues that meet the inclusion criteria as of the portfolio rebalance date of the current month. Thus, issues downgraded during the month are not removed from the NOMURA-BPI index portfolio that month.

**Q14. Even an issue that defaults during the month would not be removed from the NOMURA-BPI that month?**

In principle, an issue that defaults mid-month is not removed from that month's the NOMURA-BPI index portfolio. However, if it defaults between the rebalance date of the following month's portfolio and the last business day of the month, or another event on the same scale occurs, that issue will be removed from the component issues.

**Q15. What happens to issues that are subject to effective defeasance?**

Effective defeasance does not affect inclusion determination for the NOMURA-BPI or the NOMURA-BPI/Extended.

However, effective defeasance issues are grouped separately from the uncollateralized senior debt of the issuer, and this determines the rating in the NOMURA-BPI.

**Q16. Can subordinated bonds be part of the NOMURA-BPI?**

There are no inclusion criteria for the NOMURA-BPI or the NOMURA-BPI/Extended based on claim seniority. Issues are not excluded from the indices simply because they are subordinate bonds.

In the past, business corporations were the main issuers of subordinated bonds, and they were included in the NOMURA-BPI if they met the inclusion criteria.

**Q17. Are Basel-iii compliant notes (those with a write-down clause and subordinated clause) included in NOMURA-BPI?**

In case the bail-in events stipulated in the note, as well as the actions to be taken upon the occurrence of these events, are similar to default events of other bonds included in the NOMURA-BPI, the note will not to be excluded from the NOMURA-BPI on the basis of this clause (a write-down or subordinated clause). We will consider including similar

notes issued in the future on an individual basis, but in principle, we will not exclude bonds with any similar clauses from the NOMURA-BPI.

Please see the notices dated 7 April 2014 ([link](#)) and 28 May 2014 ([link](#)) on our Fixed Income Portal for your reference.

**Q18. Can callable or puttable bonds be included?**

There are no inclusion criteria based on call or put provisions. Therefore, if the said issue meets the inclusion criteria of the NOMURA-BPI, it will be added to the index.

**Q19. Can discount bonds be included?**

Discount bonds cannot be included in the index at this time.

**Q20. How are additional issuances from liquidity-enhancement auctions reflected in the index?**

In principle, since 20 April 2006, the MOF has released issuance amounts of additional issues in liquidity-enhancement auctions the day of the auction. Additional issuances from liquidity-enhancement auctions, like newly issued JGBs, can be included in the NOMURA-BPI portfolio from the following month.

**Q21. How are MBS term to maturity calculated and classified?**

There are two types of term to maturity for MBS in the NOMURA-BPI, one based on early redemption and one based on scheduled redemption. The first is the term to maturity calculated using the weighted average of the principle cash flow, and the latter the term remaining until the final redemption date. The NOMURA-BPI uses the latter in its inclusion criteria and term remaining classification.

**Q22. How is the remaining value of MBS used in determining inclusion in the portfolio calculated?**

The NOMURA-BPI refers to the remaining value as of the end of the following month based on data available as of the following month's portfolio determination date. JHF MBS refers to actual factors for the following month when data is available by the date of portfolio formation; and when the data is not available, the remaining value is calculated as of the end of the following month based on scheduled factors.

**Q23. Can durations be extended mid-month?**

The NOMURA-BPI durations usually shorten through the end of the month, and tend to be extended at the beginning of the month, immediately after rebalancing. However, this may not be the case if prices drop sharply mid-month or a large amount of coupon payments occur.

This is because durations are divided by accrued-interest market price. If prices drop sharply or if yield payments are large, the accrued-interest market price figures get smaller and durations can be extended.

In particular, JGB coupon payments are large around the 20th of March, June, September, and December, so durations tend to be extended in those months.

**Q24. Why are duration extensions dispersed over each month?**

Durations extend due to two factors. They extend because issues with terms to maturity of less than one year are removed from the index portfolio (exclusion factor) and also because new issues are added (inclusion factor). JGB redemptions are concentrated in March, June, September, and December, and, because of this, the exclusion factor is larger in February, May, August, and November. Primarily because of this, duration extensions can vary considerably by month.

### **(3) NOMURA-BPI/Ladder**

**Q1. Are redeemed issues included in the calculation of portfolio indicators?**

Redeemed issues are treated the same as cash. Therefore, redeemed issues are not considered in calculating risk indicators. They are considered as redemption proceeds in calculating return, in accordance with definition.

## **(4) NOMURA J-TIPS Index**

### **Q1. Why are JGBs not included in the NOMURA-BPI?**

JGBs have a fixed coupon, but their coupon payments are determined based upon a notional principal value linked to inflation. Thus, nominal coupon payments are not fixed. Nomura Securities Fixed Income Research has therefore concluded that JGBs are not fixed-rate bonds and they cannot be included in the NOMURA-BPI.

## **(5) NOMURA CMT Index**

### **Q1. Why did the key rate duration suddenly get much longer?**

Because there was a 10yr JGB auction.

### **Q2. At present, only 15-year floating rate JGBs are included in this index. If other types of floating-rate bonds are issued, would they be included?**

At present, only 15-year floating rate JGBs are included in this index portfolio, but we will consider allowing bonds with other terms in the future, depending on issuance amount, market outstanding, etc.

# 12. Related analysis

## (1) NOMURA-BPI Tracking Portfolio

In general, there are several methods of structuring portfolios for bond index management, including the full cap method, stratified sampling method, and optimization method. As of April 2016, the NOMURA-BPI has more than 10,500 component issues, including a number that are less liquid. Therefore, the full cap method is not realistic. And the prices of many issues move similarly as approximated by duration. Accordingly, it is easy to make substitutions among issues and it is not necessary to include many issues in the tracking portfolio. We therefore use the stratified sampling method and optimization method.

Here, we first use construct a JGB tracking portfolio using the stratified sampling method, then construct a tracking portfolio using futures contracts and interest rate swaps. Fig. 79 charts the tracking errors in the two different tracking portfolios.

**Fig. 79: Tracking Errors in Two Tracking Portfolios**

	Interest rate swaps	JGB futures	JGBs
Current 10Yr (rebalanced monthly)		5) 79.2	1) 61.5
Current 2Yr+5Yr+10Yr+20Yr (rebalanced monthly)	4) 82.1		2) 25.7
five JGBs (rebalanced every 6 months)			3) 16.6

Note: Tracking errors after converting monthly returns to annualized rate (basis points). Period is October 2006-March 2016

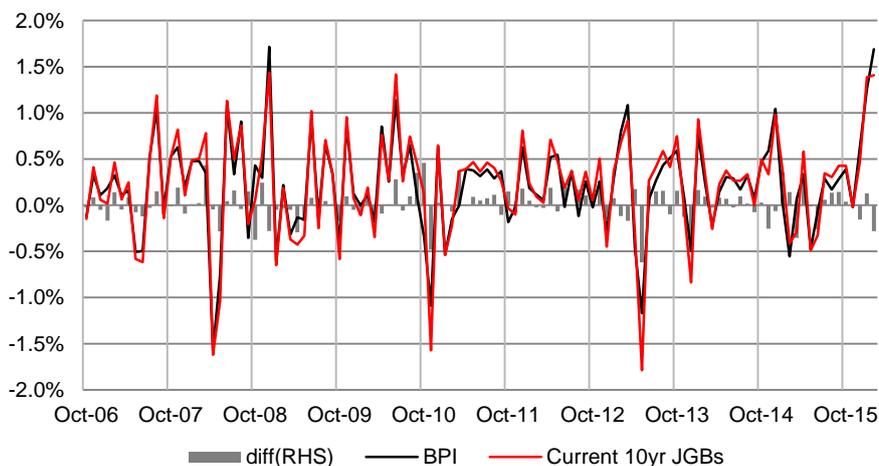
Source: NSC

Below we illustrate the construction method of each type of tracking portfolio, and the monthly returns of the tracking portfolio and NOMURA-BPI (before annualizing) are shown in Fig. 80 to 84.

### 1) Tracking of current 10Yr JGBs (Tracking error 61.5 bps)

The holding amount is determined at the end of every month so that modified duration of the tracking portfolio equals that of the NOMURA-BPI.

**Fig. 80: Tracking Using Current 10Yr JGBs**

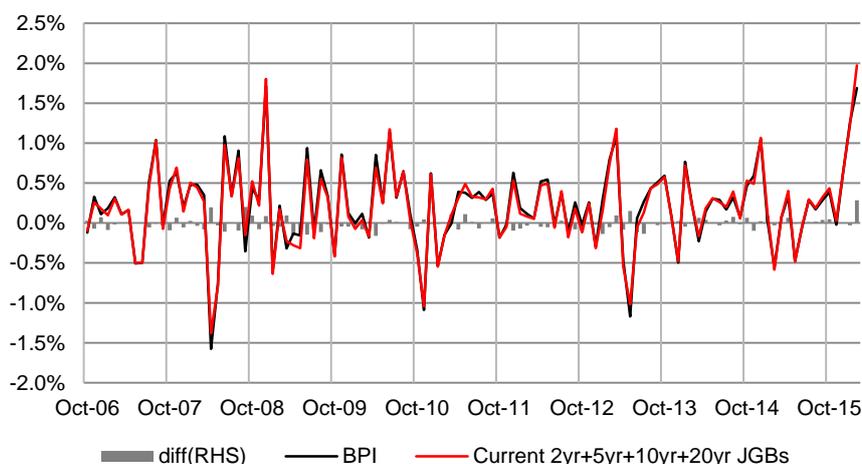


Source: NSC

**2) Tracking of current 2Yr, 5Yr, 10Yr, 20Yr JGBs (Tracking error 25.7 bps)**

Holding amounts are determined so that the modified duration of tracking portfolio matches that of the NOMURA-BPI in its breakdown by remaining maturity (1-3Yrs, 3-7Yrs, 7-11Yrs, 11Yrs and longer) at the end of every month.

**Fig. 81: Tracking Using Current 2Yr+5Yr+10Yr+20Yr JGBs**

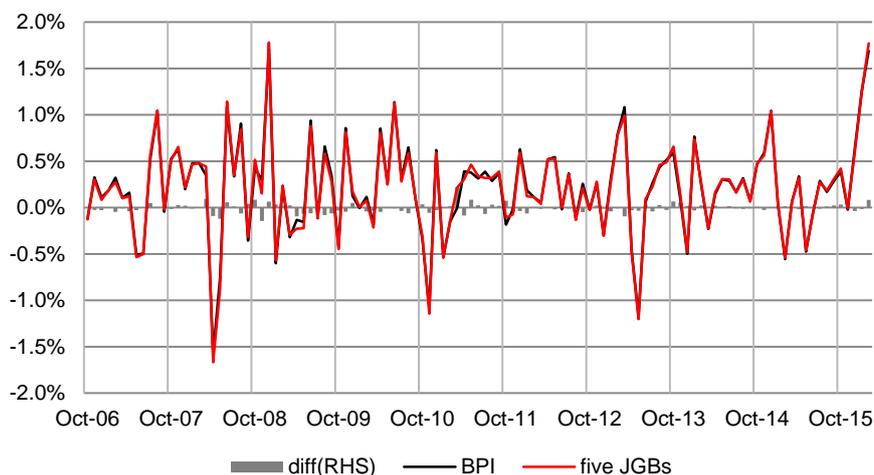


Source: NSC

**3) Tracking of five JGBs (Tracking error 16.6 bps)**

We break down the NOMURA-BPI into five portfolios based upon remaining maturity (1-3Yrs, 3-7Yrs, 7-11Yrs, 11-25Yrs, 25Yrs and longer), and select one JGB issue whose duration is similar to that included the portfolio of respective maturity. Note that portfolios are rebalanced every six months, and the rollover rate is lower than in the cases where current issues are rolled over every month.

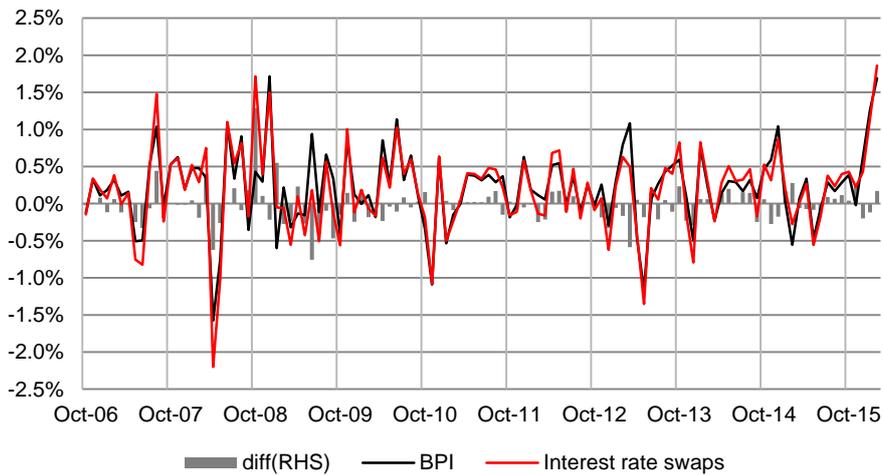
**Fig. 82: Tracking Using five JGBs**



Source: NSC

**4) Tracking Using Interest Rate Swaps (tracking error 82.1 bps)**

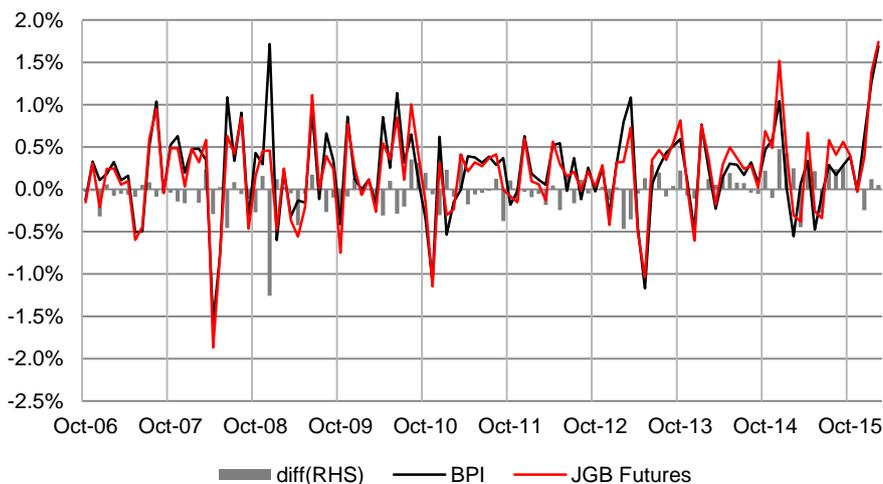
The notional principal of interest rate swaps (for four types of maturity, 2Yr, 5Yr, 10Yr, and 20Yr) is determined so that the interest rate sensitivity of swaps matches the modified duration of the NOMURA-BPI in its breakdown by remaining maturity (1-3Yrs, 3-7Yrs, 7-11Yrs, 11Yrs and longer) Note that the portfolio is rebalanced monthly.

**Fig. 83: Tracking Using Interest Rate Swaps**

Source: NSC

**5) Tracking Using JGB Futures (tracking error 79.2 bps)**

Holding amounts of JGB futures are determined using hedge ratios of JGB futures contracts to the NOMURA-BPI. The hedge ratio is the regression coefficient of a simple linear regression<sup>18</sup> for the NOMURA-BPI monthly return using the JGB futures monthly return, and the hedge ratio is calculated at the end of every month.

**Fig. 84: Tracking Using JGB Futures**

Source: NSC

Tracking using the optimization method requires determining the constraints of optimization in order to align the price movements of the portfolio and the NOMURA-BPI. Therefore, selecting indicators that express the attributes of the portfolio is important. For example, these indicators include;

- Portfolio average duration,
- Portfolio average convexity,
- Sector distributions by term remaining to maturity, type of issue, etc,
- Average durations and average convexity within each sector.

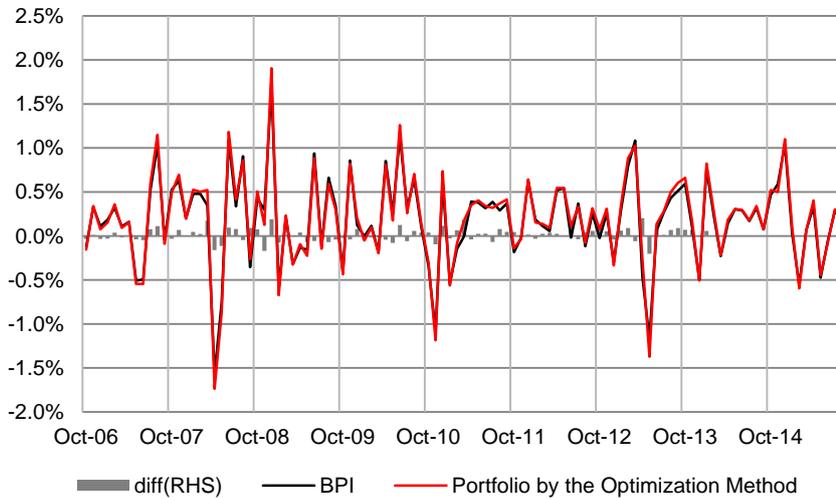
to note some examples.

Here, we consider selecting issues every month in order to maximize the compound yield to maturity of the tracking portfolio, based on constraints to limit the difference

<sup>18</sup> A simple regression based upon daily returns over latest 20 business days.

between risk indicators of the tracking portfolio and the NOMURA-BPI to within a set range. Fig. 85 shows the performances of the tracking portfolio and the NOMURA-BPI and the difference in performance. There are about 30 issues, and tracking error after annualizing of monthly returns was 26.3bp between end October 2006 and end August 2015.

**Fig. 85: Tracking by the Optimization Method**



Source: NSC

## (2) NOMURA-BPI Total Return Swaps

In the previous section, we introduced one example of a way to structure a tracking portfolio, but swap contracts also allow investors to benefit from the returns of the NOMURA-BPI without directly constructing a portfolio. Here, we introduce the NOMURA-BPI Total Return Swaps. NOMURA-BPI Total Return Swaps are swap transaction contracts for the NOMURA-BPI monthly returns and floating or fixed rates. Fig. 86 illustrates an example of a NOMURA-BPI Total Return Swap.

**Fig. 86: NOMURA-BPI Total Return Swap Outline**

Currency	JPY
Receipt by counterparty A	$\frac{\text{NOMURA-BPI index value as of end of current month} - \text{NOMURA-BPI index value as of end of previous month}}{-1}$
Receipt by counterparty B	1m Yen Libor + Spread
Trading frequency	Monthly
Yield calculation method	Actual/360

Source: NSC

## (3) Estimating the NOMURA-BPI Duration Extensions

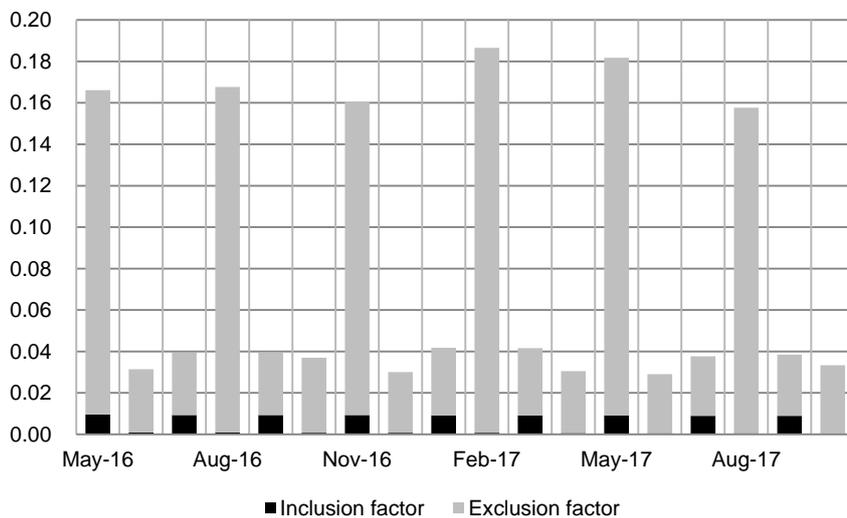
Managing durations<sup>19</sup> is extremely important in bond investment, and an estimate of duration extensions is useful information in considering investment plans. Nomura Securities Quantitative Research Center began estimating duration extensions resulting from inclusion/exclusion of issues to the NOMURA-BPI starting in 2004.

<sup>19</sup> In this report, unless otherwise indicated, 'durations' refers to 'moderated durations'.

Extending durations by rebalance can be achieved in two ways: by excluding issues that no longer meet inclusion criteria due to shortened years to maturity (exclusion factor) or by adding new issues that newly meet inclusion criteria (inclusion factor). Duration extensions can be estimated by establishing some assumptions for these two factors.

Fig. 87 illustrates the results of our estimates between end-May 2016 and end-October 2017. We see that there are extremely big duration extensions (due to exclusions) at the end of February, May, August, and November. This is because JGB redemptions are concentrated in March, June, September, and December.

**Fig. 87: the NOMURA-BPI Duration Extensions (Estimation)**



Source: NSC

## 13. Past Reports

### Handbooks

NOMURA-BPI Handbook. Masaoka Koji; Yamagishi Yoshiteru; Kakuma Kazuo, December 3, 2003.

Development of the NOMURA Swap Index. Fukasawa Hiroe, Masaoka Koji, January 28, 2009.

### Duration extensions

NOMURA-BPI duration extension – Estimates for the period from end-July 2007 to end-February 2009. Fukasawa Hiroe, September 19, 2007.

NOMURA-BPI duration extension – Estimates for the period from end-May 2008 to end-October 2009. Fukasawa Hiroe, May 19, 2008.

NOMURA-BPI duration extension – Estimates for the period from end- January 2009 to end-June 2010. Fukasawa Hiroe, January 21, 2009.

NOMURA-BPI duration extension – Estimates for the period from end-March 2010 to end-August 2011. Fukasawa Hiroe, April 12, 2010

NOMURA-BPI duration extension – Estimates for the period from end-September 2010 to end-February 2012. Fukasawa Hiroe, September 28, 2010

NOMURA-BPI duration extension – Estimates for the period from end-October 2011 to end-March 2013. Fukasawa Hiroe, September 29, 2011

NOMURA-BPI duration extension – Estimates for the period from end-March 2012 to end-August 2013. Fukasawa Hiroe, March 14, 2012

NOMURA-BPI duration extension – Estimates for the period from end-June 2013 to end-November 2014. Horiuchi Tomoya, Ushiyama Fumiaki, June 19, 2013

# Appendix A-1

## Analyst Certification

We, Mayumi Onozawa, Hiroe Fukasawa and Koji Masaoka, hereby certify (1) that the views expressed in this Research report accurately reflect our personal views about any or all of the subject securities or issuers referred to in this Research report, (2) no part of our compensation was, is or will be directly or indirectly related to the specific recommendations or views expressed in this Research report and (3) no part of our compensation is tied to any specific investment banking transactions performed by Nomura Securities International, Inc., Nomura International plc or any other Nomura Group company.

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### Online availability of research and conflict-of-interest disclosures

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