Yield Curve for Japanese Agency Bonds: From 2002 to the Present

Hattori, Takahiro and Miyake, Hiroki

20 May 2016

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Takahiro Hattori [a]
Hiroki Miyake [b]

First version: 2016/05/20

Abstract

In this study, we aim to estimate the daily par yield curve for Japanese agency bonds since 2002. The agency bond market is one of the most practically and academically disputatious areas in terms of whether public agencies as issuers are disciplined by the market. Given the drastic reformation of it public agencies in the 2000s, this topic holds far more importance in Japan than in other countries. To the best of our knowledge, this research is the first to make the par rate of Japanese agency bonds publicly available. Our estimation is based on the well-known parametric and spline methods, of which we found that the latter fits well, as in previous studies. Further, we have posted the estimation data on our website and will continue to update it regularly: http://www.mcnnns77.net.

JEL classification: G12; E43; H81
Keywords: Term structure; Interest rates; Par yield curve; Agency bond; Fiscal Investment and Loan Program; Japan

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* Two authors contributed equally to this work. The corresponding author is Hiroki Miyake. The authors are solely responsible for the contents, so the views expressed in this paper are not our affiliations.
[a] Nomura Securities Co., Ltd., Keio University, Japan. E-mail address: hattori0819@gmail.com
[b] Faculty of Law and Letters, Ehime University, Japan. E-mail address: mcnnns77@gmail.com

Agency bonds are a relatively new segment in the Japanese bond market. The history of the agency bond market dates back a mere 15 years, with the first agency bond issued in 2001. Nevertheless, the market has experienced rapid growth within a short time. As of the end of September 2015, outstanding agency bonds amount to 33.9 trillion yen ($283 billion),[1] which accounts for 16% of the Japanese bond market, excluding government bonds. Clearly, agency bonds have grown to become one of the main bond market segments in Japan.

The agency bond market also holds importance from an academic viewpoint. Agency bonds are issued by government-affiliated financial institutions, incorporated administrative agencies, and special corporations with their own credit. However, the central government, the owner of these public agencies, does not explicitly guarantee bonds. If investors believe that agency bonds issued by an agency with severe fiscal conditions would default, the yield would reflect the issuer's fiscal soundness. On the other hand, if investors expect the government to provide emergency financial support to such agencies, the bond yield would more or less reflect the issuer's fiscal condition. Public agencies' incentive to efficiently conduct their businesses on the basis of financial market estimations varies by the existence of implicit government guarantees in the agency bond market. To this effect, a key academic topic in public finance is the efficient management of the public sector.

In fact, the Fiscal Investment and Loan Program (FILP) reform introduced in 2001, which permitted public agencies to issue agency bonds, was based on the expectation that market discipline would encourage public agencies individually and the government as a whole to manage more efficiently. However, to the best of our knowledge, no study has empirically examined whether this expectation from the reform was satisfied or whether the agency bond yield reflects the soundness of issuers' fiscal conditions, which can be attributed to the lack of yield data. Needless to say, when examining whether investors believe that implicit government guarantees exist in the agency bond market or the amount of credit risk believed to exist in this market, yield levels are the most essential statistics. However, as in the case of other bonds, excluding government ones, yield curve data for agency bonds in the secondary market is not provided by issuers or public agencies. Bloomberg L.P., a well-known financial market data source, estimated Japan's agency bond yield curve, although the estimation period began in 2011 and is relatively short, and the details of the estimation method are not publicly available. In addition, Bloomberg covered only eight public agencies. For example,

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[1] The dollar amount is calculated against the exchange rate as of the end of September (USD 1 = 119.8 yen). This is the outstanding amount for FILP agency bonds, which slightly differs from agency bonds in this paper (*Issuing, Redemption, and Outstanding Amounts of Bonds*, Japan Securities Dealers Association).

the par rates for Japan Expressway Holding and Debt Repayment, one of the largest issuers, those for Japan Finance Corporation, and those for Japan International Cooperation Agency are unavailable.

With an aim to fill the gap between academic importance and the limited availability of fundamental data, we estimate the yield curve of agency bonds in this study. To do so, we extend Hattori and Miyake's [2016] analysis method, which estimates the yield curve for the municipal bond market. However, the history of agency bonds as a market segment is limited and the number of bonds issued by many public agencies is insufficient to serve as sample data. To overcome this, we carefully reviewed the merger and acquisition reform process of public agencies and estimated the yield curve for each "real" issuer (debtor). This provided us with more sample data to estimate the yield curve, which can contribute to the fitness of the estimation.

As in Gürkaynak et al. [2007] and Hattori and Miyake [2016], our estimation results are provided on our website and will be regularly updated[2]. The information will be useful to academic researchers in Japan and various other countries as well as practitioners in the Japanese bond market.

The remainder of this paper is organized as follows. We first briefly summarize the two yield curve estimation models and, then, describe the sample data and "real issuer" concept. Thereafter, we discuss the estimation fitness, followed by concluding remarks.

Yield curve models and estimation

Following Hattori and Miyake [2016], we estimate the par yield using Svensson [1994] and Steeley's [1991] methods. According to the Bank for International Settlements [BIS; 2005], the two methods are widely used by many central banks. Kikuchi and Shintani [2012] show that B-spline best fits Japanese government bonds.

First is the Nelson-Siegel-Svensson (NSS) model that is based on Svensson [1994], which models the forward rate ($\mathrm{f}(x)$) using the following functional form:

$$\mathrm{f}(x) = \alpha_0 + \alpha_1 \exp(-x/\alpha_3) + \alpha_2 (x/\alpha_3) \exp(-x/\alpha_3) + \alpha_4 (x/\alpha_5) \exp(-x/\alpha_5) \qquad (1)$$

[2] We have also been admitted into the Japan Securities Dealers Association (JSDA), the data source of our estimation.

where x is the remaining maturity and $\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$ are the parameters to be estimated. Equation (1) can be converted into the discount function ($\mathrm{d}(x)$).

Second is the B-spline (BS) model based on Steeley's [1991] model, which estimates the discount function using a B-spline function:

$$\mathrm{d(x)} = \sum_{\mathrm{k=-3}}^{\mathrm{n_{knot}}\text{-}1} \mathrm{B(k, x)}\alpha_{\mathrm{k}} \tag{2}$$

where $\mathrm{B}(k, x)$ is the B-spline function and α_{k} is the parameter to be estimated. In the spline model, we set a sequence of points known as knot points. Steeley [1991] sets the knot points as $u_{-3} < \cdots < u_{n_{knot}} < u_{n_{knot}+1} < u_{n_{knot}+2} < u_{n_{knot}+3}$ [3]. $\mathrm{B}(k, x)$ is recursively defined as shown in Equation (3).

$$\mathrm{B(k, x)} = B_D(k, x) := \{\begin{matrix} 1, u_k \leq x \leq u_{k+1} \\ 0, otherwise \end{matrix} \; for\ D = 1$$

$$\mathrm{B}(k, x) = B_D(k, x) = \frac{u_{D+k} - x}{u_{D+k} - u_{k+1}} B_{D-1}(k + 1, x) + \frac{x - u_k}{u_{D+k-1} - u_k} B_{D-1}(k, x)\ for\ D > 1 \tag{3}$$

Steeley [1991] and Kikuchi and Shintani [2012] set D = 4 in Equation (3). From Equation (2) and d(0) = 1, we obtain Equation (4).

$$\sum_{\mathrm{k=-3}}^{\mathrm{n_{knot}}\text{-}1} \mathrm{B(k, 0)}\alpha_{\mathrm{k}} = 1 \tag{4}$$

The discount function can be used to price agency bonds on the basis of the coupon rates and maturity dates. We estimate the parameters by minimizing the weighted sum of the squared deviations between the actual and estimated prices using the NSS and BS models.

Estimation scope and data source

In this study, we estimate the yield curve for agency bonds. Japanese public agencies, such as government-affiliated financial institutions, incorporated administrative agencies, and

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[3] Following Fujii and Takaoka (2007) ,we set the number of knots with $\sqrt{L_t}$ (L_t: number of bonds) and divided each interval by setting knots that had almost the same number of bonds.

special corporations, offer financing by issuing agency and government-guaranteed bonds or borrowing from the FILP. Different from the other two financing tools, agency bonds are based on issuers' credit and are not explicitly guaranteed or financially supported by the central government. In FY 2014, 16 Japanese agencies issued their own agency bonds.

Terms such as "FILP agency" and "FILP agency bond" are generally used in Japan, although they differ slightly from "public agency" and "agency bond" in this paper. FILP agencies borrow money from the FILP in the relevant fiscal year. If an agency borrowed from the FILP in FY 2015, but not in FY 2016, it is considered a "FILP agency" only in FY 2015. Furthermore, the bonds issued by this agency in FY 2015 are categorized as "FILP agency bonds," while those issued in FY 2016 are not. However, from a credit risk viewpoint, bonds issued by the same agencies based on identical covenant provisions should be treated the same, irrespective of them being issued in FY 2015 or FY 2016. "Public agencies," in this paper, are institutions that have borrowed money at least once from the FILP and "agency bonds" are those issued by a public agency on the basis of their own credit.

As in Hattori and Miyake [2016], we estimate the daily yield curve for each public agency. We use only plain vanilla bonds as sample data and exclude floating rates or foreign currency-denominated issues, both of which are rarely issued. Moreover, we exclude bond issues with less than one-year maturity because their price quotes often do not represent real prices. In addition, we focus on straight bonds and exclude asset-backed securities issued by the Japan Housing Finance Agency.

The data source for quotes, maturity dates, and coupon rates is the "Reference Statistical Prices [Yields] for OTC Bond Transactions," released by the Japan Securities Dealers Association (JSDA). Our estimation term ranges from August 2, 2002, when JSDA began data publication, to December 30, 2015.

"Real" issuer or debtor

To estimate the yield curve for agency bonds using the NSS function with six parameters, we need at least six sample issues in the secondary market. However, most of the current public agencies were established or reorganized under the Special Public Institutions Reform implemented in the 2000s and, since then, a majority of them have not issued many bonds. This could limit our estimation scope.

Nevertheless, we overcame this problem by focusing on the "real" issuer (debtor) and not the nominal issuer. For example, Narita International Airport Corporation (NAA), established in April 2004, issued its first bond in March 2005 and sixth in February 2009. In this case, if we focus on the nominal issuer, our estimation term, beginning in February 2009, for NAA's agency bond yield curve would only be six years (2009-2015). However, NAA assumed the agency bond repayment duties of the New Tokyo International Airport Authority. According to the legal lien, agency bonds issued by the New Tokyo International Airport Authority are treated as those issued by NAA itself. Thus, we do not need to distinguish between the bonds as in the case of credit risk. In other words, after NAA was established, the "real" issuer or debtor of New Tokyo International Airport Authority's agency bonds was changed to NAA. Accordingly, we estimate the yield curve using agency bonds by not only NAA, but also New Tokyo International Airport Authority. This estimation policy allowed us to extend our estimation term from six to 10 years, beginning March 2005. We treat the Japan Finance Organization for Municipalities, Urban Renaissance Agency, and Welfare and Medical Service Agency in a similar manner.

The Japan Finance Corporation (JFC) is a typical merger case of two or more agencies. Similar to NAA, JFC assumed agency bond repayment duties from National Life Finance Corporation, Japan Finance Corporation for Small and Medium Enterprise, and Agriculture Forestry and Fisheries Finance Corporation.[4] The holders of these bonds are expected to have the same legal lien as those of JFC's new bonds. Thus, we could deem JFC as the "real" issuer (debtor) of all bonds after the succession in October 2008. A similar case is the Japan Railway Construction, Transport and Technology Agency.

However, this policy could not be adopted for the Development Bank of Japan Inc. (DBJ). In October 2008, DBJ converted its company from a government-affiliated financial institution to a special stock corporation, but retained its original name. In this case, while agency bonds issued by the former DBJ are attached general collateral, those issued by the present DBJ are not. Thus, we were required to differentiate between the two agency bonds from a credit risk viewpoint and could not use the former DBJ's agency bonds as sample data to estimate the present DBJ's yield curve.

Another case in which our basic policy could not be applied is highway public agencies. In October 2005, four highway public corporations—Japan Highway Public Corporation, Metropolitan Expressway Public Corporation, Hanshin Expressway Public Corporation, and

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[4] In October 2008, the former Japan Bank for International Cooperation (JBIC) merged into JFC; however, in April 2012, it spun off from JFC as an independent entity. Treatments of agency bonds issued by JBIC differ from those issued by other incorporated institutions. Thus, we did not use JBIC's agency bonds as sample data.

Honshu-Shikoku Bridge Authority—were privatized and seven new agencies were established. The debt obligations for agency bonds issued by the former four corporations were succeeded by the Japan Expressway Holding and Debt Repayment Agency (JEHDRA), a newly established highway public agency. However, other new agencies jointly guaranteed these bonds with the JEHDRA in several ways and, thus, we differentiated highway agency bonds issued before September 2005 from those issued by the JEHDRA after October 2005.

We took a cautious approach to the reorganization process of public agencies such as those mentioned above. As a result, we were able to use 15 active public agencies and eight retired agencies, or their agency bonds that existed in part of or throughout the estimation term, in the secondary market. Exhibit 1 summarizes our estimation targets and the estimation term for the included public agencies.

Exhibit 1: Public agencies and estimation terms

	("Real") Issuer	Operation Term (Since August 2002)	Estimation Term	Including the Former's Issues
1	National Life Finance Corporation	August 2002 - September 2008	May 2003 - September 2008	No
2	Japan Finance Corporation for Small and Medium Enterprise	August 2002 - September 2008	June 2003 - September 2008	No
3	Former Japan Bank for International Cooperation	August 2002 - September 2008	September 2002 - September 2008	No
4	Japan Finance Corporation	October 2008 - Present	October 2008 - Present	Yes (1, 2, and 3)
5	Japan International Cooperation Agency	October 2008 - Present	December 2010 - Present	No
6	Development Bank of Japan (former)	August 2002 - September 2008	February 2003 - Present	No
7	Development Bank of Japan (present)	October 2008 - Present	October 2008 - Present	No
8	Okinawa Development Finance Corporation	August 2002 - Present	July 2005 - Present	No
9	Japan Housing Finance Agency	April 2007 - Present	April 2007 - Present	Yes (The Government Housing Loan Corporation of Japan)
10	Japan Finance Corporation for Municipal Enterprises	August 2002 - September 2008	February 2003 - September 2008	No
11	Japan Finance Organization for Municipalities	October 2008 - Present	October 2008 - Present	Yes (10)
12	Kansai International Airport Company	August 2002 - June 2012	October 2006 - Present	No
13	New Kansai International Airport Company	July 2012 - Present	September 2013 - Present	No
14	Narita International Airport Corporation	April 2004 - Present	March 2005 - Present	Yes (New Tokyo International Airport Authority)
15	Japan Railway Construction, Transport and Technology Agency	October 2003 - Present	October 2003 - Present	Yes
16	Japan Highway Public Corporation	August 2002 - September 2005	August 2002 - September 2005	No
17	Metropolitan Expressway Public Corporation	August 2002 - September 2005	May 2003 - September 2005	No
18	Japan Expressway Holding and Debt Repayment Agency	October 2005 - Present	February 2006 - Present	No
19	East Nippon Expressway Company	October 2005 - Present	July 2010 - Present	No
20	Central Nippon Expressway Company	October 2005 - Present	February 2009 - Present	No
21	West Nippon Expressway Company	October 2005 - Present	May 2010 - Present	No
22	Urban Renaissance Agency	July 2004 - Present	July 2004 - Present	Yes (Corporation for Advanced Transport and Technology, and Japan Railway Construction Public Corporation)
23	Welfare and Medical Service Agency	October 2003 - Present	June 2005 - Present	Yes (Social Welfare and Medical Service Corporation)

Note: "Operation Term" for the Japan Finance Organization for Municipalities includes that for the Japan Finance Organization for Municipal Enterprises.

Results

To check the fitness of the NSS and BS methods, we use an estimation error, which can be defined as the difference between the actual and model-implied prices. We use the root mean squared error (RMSE) and maximum absolute error (MaxAE), calculated as follows:

$$\mathrm{RMSE} = \sqrt{\frac{1}{\mathrm{N}}\sum_{\mathrm{i}=1}^{\mathrm{N}}(\mathrm{y_i}\text{-}\hat{\mathrm{y}}_{\mathrm{i}})^2} \tag{5}$$

$$\mathrm{MaxAE} = \max_i\{|y_i - \hat{y}_i|\}, \mathrm{i} = 1, \ldots, \mathrm{n} \tag{6}$$

where N is the number of observed bonds, y_i is the actual (observed) yield to maturity, and $\hat{y}_i$ is the par yield estimated using the NSS and BS models.

Exhibit 2 presents the median of the RMSE and MaxAE for each agency on the basis of the BS and NSS models using times series data from August 2002 to December 2015 (data is included when N is greater than or equal to six). Exhibit 2 also shows that the fit of the BS model is better than that of the NSS model, which is consistent with Kikuchi and Shintani [2012] and Hattori and Miyake [2016]. In the BS model, the RMSE is around 0.01%, with some exceptions. The MaxAE of the BS model is still small, that is, 0.01 to 0.04%, although the MaxAE for the JEHDRA is greater than 0.10%.

Exhibit 2: Median of RMSE and MaxAE for sampled agency bonds

Issuer	BS RMSE(a)	BS MaxAE(b)	NSS RMSE(c)	NSS MaxAE(d)	Difference (a – c)	Difference (b – d)
National Life Finance Corporation	0.003%	0.007%	0.006%	0.012%	-0.004%	-0.005%
Japan Finance Corporation for Small and Medium Enterprise	0.009%	0.027%	0.013%	0.038%	-0.018%	-0.010%
Former Japan Bank for International Cooperation	0.012%	0.024%	0.031%	0.075%	-0.012%	-0.052%
Japan Finance Corporation	0.017%	0.041%	0.051%	0.139%	-0.023%	-0.099%
Japan International Cooperation Agency	0.021%	0.040%	0.075%	0.178%	-0.019%	-0.138%
Development Bank of Japan (former)	0.014%	0.034%	0.068%	0.221%	-0.020%	-0.187%
Development Bank of Japan (present)	0.005%	0.011%	0.009%	0.023%	-0.006%	-0.012%
Okinawa Development Finance Corporation	0.009%	0.019%	0.030%	0.079%	-0.010%	-0.059%
Japan Housing Finance Agency	0.016%	0.043%	0.077%	0.169%	-0.027%	-0.127%
Japan Finance Corporation for Municipal Enterprises	0.010%	0.029%	0.096%	0.222%	-0.018%	-0.193%
Japan Finance Organization for Municipalities	0.014%	0.038%	0.085%	0.212%	-0.024%	-0.175%
Kansai International Airport Company	0.016%	0.037%	0.054%	0.137%	-0.021%	-0.100%
New Kansai International Airport Company	0.013%	0.027%	0.025%	0.062%	-0.014%	-0.035%
Narita International Airport Corporation	0.010%	0.019%	0.019%	0.036%	-0.009%	-0.017%
Japan Railway Construction, Transport and Technology Agency	0.008%	0.018%	0.020%	0.045%	-0.010%	-0.027%
Japan Highway Public Corporation	0.017%	0.040%	0.113%	0.316%	-0.023%	-0.276%
Metropolitan Expressway Public Corporation	0.013%	0.023%	0.026%	0.044%	-0.011%	-0.021%
Japan Expressway Holding and Debt Repayment	0.026%	0.100%	0.148%	0.357%	-0.074%	-0.257%
East Nippon Expressway Company	0.002%	0.005%	0.003%	0.006%	-0.002%	-0.001%
Central Nippon Expressway Company	0.006%	0.014%	0.015%	0.039%	-0.008%	-0.025%
West Nippon Expressway Company	0.003%	0.005%	0.005%	0.010%	-0.002%	-0.004%
Urban Renaissance Agency	0.009%	0.028%	0.028%	0.106%	-0.019%	-0.078%
Welfare and Medical Service Agency	0.014%	0.036%	0.041%	0.105%	-0.023%	-0.068%

The larger MaxAE for the JEHDRA can be attributed to the fact that it issued a higher number of over-20-year bonds (see Exhibit 3) and the liquidity of the longer bonds is lower, especially for non-government bonds in Japan's bond market.[5] Exhibit 4 depicts the curve for JEHDRA on May 30, 2014, and that the curve is not smoother, particularly for over-20-year bonds. In addition, in 2009, JEHDRA was the first in Japan to issue deep discount bonds (DDBs), and the curve includes DDBs. If we exclude over-20-year bonds for JEHDRA, the medians of RMSE and MaxAE are 0.011% and 0.034%, respectively, which are almost the same as the errors of the other issuers.

[5] In the JGB market, there are many liquidity maintenance systems, enhancing the liquidity of bonds with longer terms, such as reopening and auctions for enhancing liquidity. However, there is no such liquidity maintenance system for the agency bond market in Japan.

Exhibit 3: Median of RMSE for NSS-fitted curve by maturity and for shares of over 20 years

Issuer	0-2 years	2-4 years	4-6 years	6-8 years	8-10 years	10-15 years	15-20 years	20-30 years	Share of over 20years
National Life Finance Corporation	0.006%	0.005%	0.006%	-	-	-	-	-	0.0%
Japan Finance Corporation for Small and Medium Enterprise	0.009%	0.006%	0.009%	0.015%	0.031%	0.029%	-	-	0.0%
Former Japan Bank for International Cooperation	0.009%	0.009%	0.011%	0.025%	0.026%	0.049%	0.087%	-	0.0%
Japan Finance Corporation	0.007%	0.009%	0.015%	0.030%	0.018%	0.069%	0.114%	0.189%	0.0%
Japan International Cooperation Agency	0.011%	0.008%	0.021%	0.008%	0.019%	0.079%	0.077%	0.182%	4.3%
Development Bank of Japan (former)	0.013%	0.010%	0.013%	0.029%	0.026%	0.069%	0.090%	0.197%	7.9%
Development Bank of Japan (present)	0.006%	0.006%	0.009%	0.015%	0.016%	0.039%	0.050%	-	0.0%
Okinawa Development Finance Corporation	0.009%	0.009%	0.012%	0.023%	0.019%	0.065%	0.087%	-	0.0%
Japan Finance Corporation for Municipal Enterprises	-	0.035%	0.013%	0.039%	0.023%	0.050%	0.090%	0.203%	17.2%
Japan Housing Finance Agency	0.021%	0.012%	0.014%	0.024%	0.024%	0.074%	0.107%	0.214%	1.0%
Japan Finance Organization for Municipalities	0.017%	0.013%	0.017%	0.030%	0.021%	0.064%	0.101%	0.182%	10.5%
Kansai International Airport Company	0.008%	0.008%	0.014%	0.026%	0.027%	0.082%	0.141%	-	0.0%
New Kansai International Airport Company	0.006%	0.010%	0.014%	0.010%	0.012%	0.035%	0.076%	0.074%	0.0%
Narita International Airport Corporation	0.006%	0.009%	0.013%	0.020%	0.024%	0.027%	-	-	0.0%
Japan Railway Construction, Transport and Technology Agency	0.008%	0.008%	0.012%	0.021%	0.026%	0.039%	0.089%	0.138%	0.0%
Japan Highway Public Corporation	0.019%	0.011%	0.021%	0.033%	0.029%	0.046%	0.120%	0.303%	10.7%
Metropolitan Expressway Public Corporation	0.006%	0.008%	0.010%	0.028%	0.036%	-	-	-	0.0%
Japan Expressway Holding and Debt Repayment	0.014%	0.011%	0.016%	0.023%	0.028%	0.078%	0.109%	0.188%	29.7%
East Nippon Expressway Company	0.003%	0.003%	0.003%	-	-	-	-	-	0.0%
Central Nippon Expressway Company	0.007%	0.007%	0.011%	0.016%	0.022%	0.046%	-	-	0.0%
West Nippon Expressway Company	0.003%	0.003%	-	0.006%	0.009%	-	-	-	0.0%
Urban Renaissance Agency	0.007%	0.008%	0.012%	0.023%	0.021%	0.070%	0.122%	-	0.0%
Welfare and Medical Service Agency	0.006%	0.008%	0.016%	0.024%	0.022%	0.076%	0.109%	-	0.0%

Note: “-” indicates there are no data in the grid.

Exhibit 4: Par yield curve of Japan Expressway Holding and Debt Repayment (May 30, 2014)

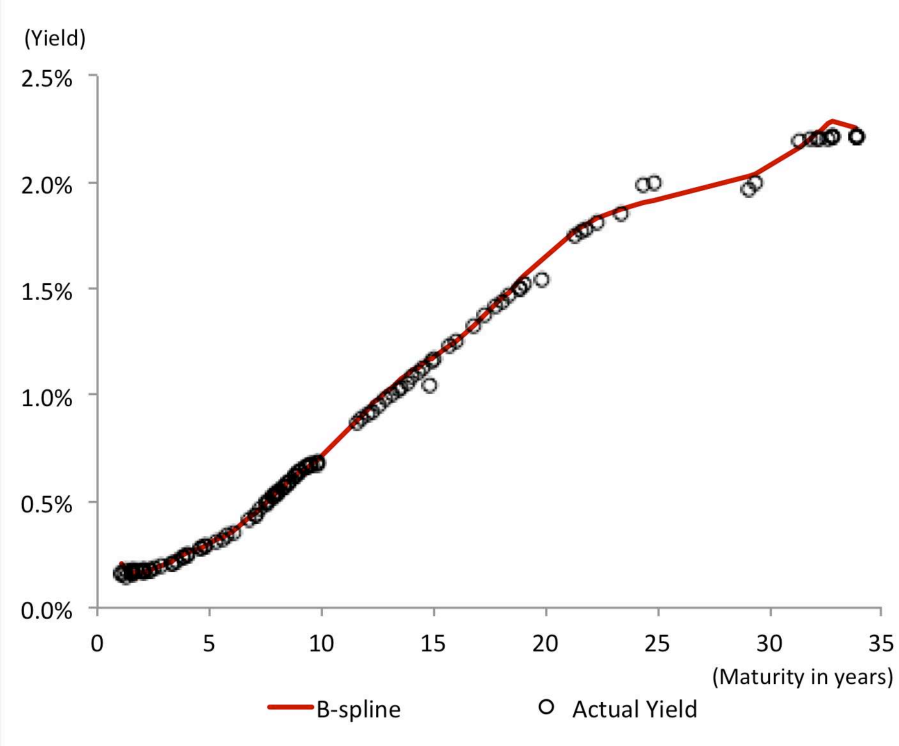

Exhibit 3 shows the medians of RMSE and MaxAE for the NSS model by maturity term and helps us to further understand why the NSS model is not a good fit. It shows that the error for the short and medium terms is about 0.01 to 0.02%, with some exception. On the other hand, the error of an over-10-year bond is much larger (in particular, the error for the 20- to 30-year bond is greater than 0.2%). This result is the same as that for Japan's municipal bond market, analyzed by Hattori and Miyake [2016], thus showing that the NSS model is not a good fit in terms of longer maturity periods.

Conclusion

In this study, we estimated the par rate of Japan's agency bonds and have made the data publicly accessible. Our estimates cover the wide range of agency bonds and are available at daily frequencies for over 10 years, data that has not been provided by leading resources of information such as Bloomberg. We carefully treated mergers and reorganized government-affiliated financial institutions, which is particularly difficult when analyzing Japan's agency bonds. We estimated the yield curve for agency bonds using a B-spline and the Nelson–Siegel–Svensson approach, and found the B-spline method to be a better fit and an academically based, clear method for economists and practitioners conducting similar analyses.

An analysis of agency bonds holds great significance for Japan's bond market and fiscal problems. In the late 20th century, FILP played a significant role in Japan's financial system. In 2001, it drastically reformed in terms of financial liberalization and globalization. The aim of this reform was to reduce the size of the government and ensure the efficient management of government-affiliated financial institutions by introducing market discipline. It has been more than 10 years since the reform and we must consider not only the validity of the reform, but also the empirical research of the agency bond market. However, to the best of our understanding, no empirical research has been conducted and we suspect that the availability of public data underpins this problem. We also believe that our paper can drive empirical research on FLIP. In conclusion, and importantly, the complete dataset is available online (http://www.mcnnns77.net) and will be regularly updated.

Acknowledgements

We thank Koji Matsumoto for the technical support as well as Hajime Fujiwara (Financial Service Agency), Kohei Shintani (Bank of Japan), and Toshiaki Watanabe (Hitotsubashi University) for their helpful comments. The views expressed in this paper are those of the authors alone and not of any affiliation.

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