Recent Trends in the Spread over Libor on the Domestic Straight Bond Trading Market in Japan

Akira Ieda and Toshikazu Ohba

In this paper, we conduct a regression analysis on the spread over Libor (LS) on the domestic straight bond trading market in Japan from May 1997 through March 1998. Our analysis shows that, for non-construction issues, the lower the rating the higher the LS, and that the LS differential among issues with different ratings has expanded since around November 1997 against the background of a growing awareness of credit risk. Our analysis also shows that during the analysis period (May 1997 through March 1998) the coupon rate, which was previously a significant explanatory variable for the LS, lost its significance, and that the coefficient of the remaining maturity, which is also an explanatory variable, switched from negative to positive (the longer the period remaining until maturity, the higher the LS). The heightened awareness of credit risk among investors apparently contributed to both these phenomena, and the latter is particularly noteworthy because it is consistent with the results of empirical analyses in the United States. Finally, for construction issues, our analysis showed that the LS continued to increase following the bankruptcy of several construction companies during the summer of 1997, and that an extremely large premium has arisen for certain issues.

Key words: Domestic straight bonds; LS (spread over Libor); Credit risk

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I. Introduction

In this paper, we analyze the recent price (yield) formation conditions on the domestic straight bond (SB) trading market in Japan utilizing bond yields and spreads over a benchmark interest rate (the spread over Libor is adopted here). Because the spread of SBs is formed reflecting credit risk, liquidity risk, and other factors, the SB price-formation mechanism and the risk outlook in the trading market can be grasped through calculations and analyses of these spreads.[1]

Since the bankruptcies of several major corporations—including construction companies and financial institutions—beginning in the latter part of 1997, there has been a heightened awareness of credit risk in Japanese markets, and this may also be influencing the SB spread formation. From this perspective, a reexamination of the recent spread formation conditions is considered worthwhile.

The analyses in this paper utilize the over-the-counter (OTC) standard bond quotations released by the Japan Securities Dealers Association. With the revision of this quotation system[2] in April 1997, the number of issues reported was greatly increased, making it possible to conduct analyses on a larger number of issues.

Chapter II explains the calculation method for the spread over Libor (LS) and the data utilized. Chapter III demonstrates that the LS on the trading market (excluding construction issues) can still generally be explained by the issue rating, the remaining maturity, and the coupon rate, and also examines the signs (positive or negative) and levels of the coefficients of these explanatory variables. Chapter IV reviews the recent LS levels for construction issues. Finally, Chapter V presents a summary of our analyses.

II. Spread Calculation Method and Data Utilized

A. Spread Calculation Method

The spread on the domestic SBs used for the analyses is the so-called spread over Libor.

The spread over Libor is indicated by α when the issue's cash flows are swapped with a floating interest rate (Libor + α). It is calculated by evaluating the cash flows from the fixed interest rate and the floating interest rate with discount factors determined from the swap rate yield.[3]

$$\alpha = \frac{(1 - V) + \sum_{j=1}^{m} \left(\frac{Cp}{2} - \frac{Sw \cdot n_j}{365} \right) \cdot D(t_j) - AI}{(V_t AI) \cdot \sum_{j=1}^{m} = \frac{n_j}{360} \cdot D(t_j)} \qquad (1)$$

1. Other analyses of spreads on the Japanese corporate bond market include Suzuki (1996) and Muromachi and Asahara (1997).
2. See Footnote 5 for an outline of the system for OTC standard bond quotations.
3. In the actual calculations, slight approximations are used for the number of days of interest payments.

V: The issue's trading price (per ¥1 of par value)
Cp: The issue's coupon rate
Sw: Swap rate with the same remaining maturity as the issue[4]
t_j: The j^{-th} interest payment date
$D(t_j)$: Discount factor at t_j
n_j: Number of days between t_{j-1} and t_j
m: Number of interest payments until maturity
AI: Accrued interest

B. Data Utilized

The SBs used for the analyses are corporate bond issues covered by the OTC standard bond quotations released by the Japan Securities Dealers Association[5] (excluding issues by the Teito Rapid Transit Authority and the Japan Broadcasting Corporation) for which (1) quotations are available throughout the analysis period (specified below); and (2) with a remaining maturity of 10 years or less (a total of 855 issues). These were then classified into non-construction issues (817 issues) and construction issues[6] (38 issues). The analyses of the non-construction issues are presented in Chapter III, and the market valuation of the construction issues is presented in Chapter IV.

The construction issues were placed in a separate category because on the SB trading market the selectivity toward construction issues, in particular, reportedly strengthened following the bankruptcies of large and medium-sized construction companies in the summer of 1997.[7] (In fact, the results of regression analysis using a dummy variable confirmed that whether or not a given issue is a construction issue is significant.)

4. The swap rates used for the calculations were obtained from Bloomberg. The Libor rates are the daily BBA Libor (1M, 3M, 6M, 12M), and the swap rates are the daily New York market closing rates (2Y, 3Y, 4Y, 5Y, 7Y, 10Y).
5. The system for OTC standard bond quotations (revised in April 1997) is summarized as follows.
   - Types of issues: government bonds, municipal bonds, government-guaranteed bonds, bank debentures, corporate bonds, and yen-denominated foreign bonds.
   - Standard bond quotation issues: in principle, all issues that meet all of the following conditions: (1) unlisted, domestic, publicly offered public and corporate bond issues (with a remaining maturity of at least one year); (2) issues with a fixed interest rate from issuance through redemption; and (3) issues with lump-sum redemption upon maturity. (Under the revised system, the number of issues covered by the OTC standard bond quotations increased by approximately three times.)
   - Calculation method for the OTC standard bond quotations: the arithmetic mean of the quotations received from the reporting companies (these quotations represent yield indicators for transactions with a face value of approximately ¥500 million as of 3:00 p.m. on the business day before public release).

     The OTC standard bond quotations are not necessarily based on actual transactions (one of the reasons is that the outstanding volume of certain issues is insignificant), so there are problems with the reliability of the data. Nevertheless, the OTC standard bond quotations have the widest coverage of any public data in Japan, and they are considered to be optimal data for the analyses.
   - Price unit intervals: ¥0.01 per ¥100 par value.
   - Public release of the OTC standard bond quotations: daily (excluding holidays).
   - Number of companies reporting quotations: 28 companies as of April 1997 (previously, 15 companies).
6. Those issued by entities classified as within the construction industry under the new stock market industry classification.
7. Tokai Kogyo Co., Ltd., and Tada Corp. went bankrupt in July 1997, as did Daito Kogyo Co., Ltd., in August 1997.

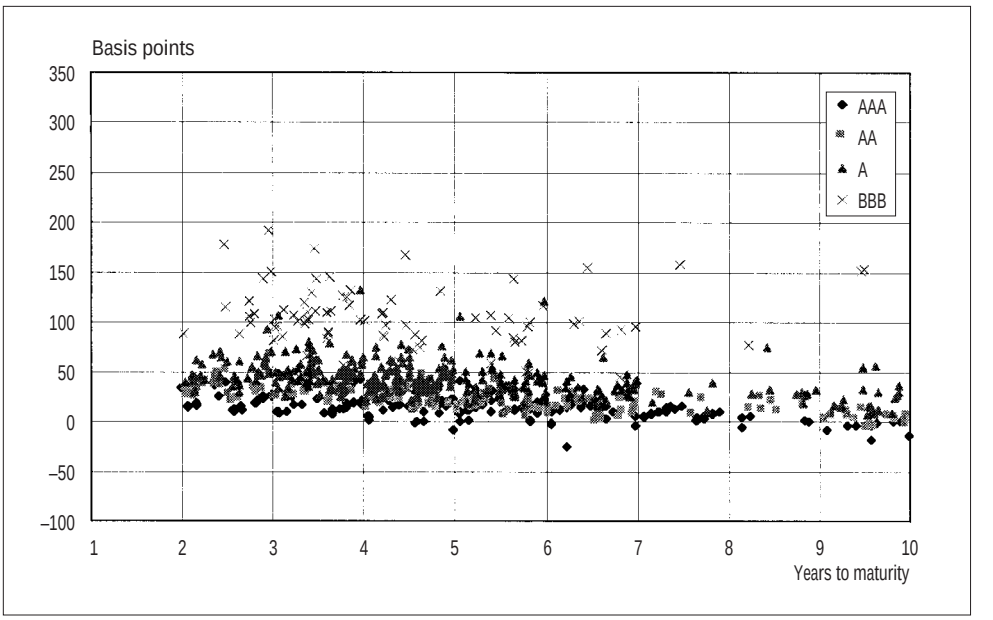
In principle, the ratings issued by domestic rating agencies[8] were utilized for the ratings of each issue.[9] When an issue by the same corporation had ratings assigned by multiple rating agencies and there was a discrepancy among these ratings, the lower rating was adopted.[10]

The analysis period was from May 1997 through March 1998, and the quotation data are the closing quotations on the final business day of each week (48 weeks of weekly data).

III. Spread Calculation and Analysis: Non-Construction Issues

We calculated the weekly LS for the 817 non-construction issues. As specific examples, the following scatter diagrams show the conditions at two points in time: May 2, 1997, which was the initial time of the data series (Figure 1), and November 28, 1997, a month in which several major financial institutions went bankrupt (Figure 2).

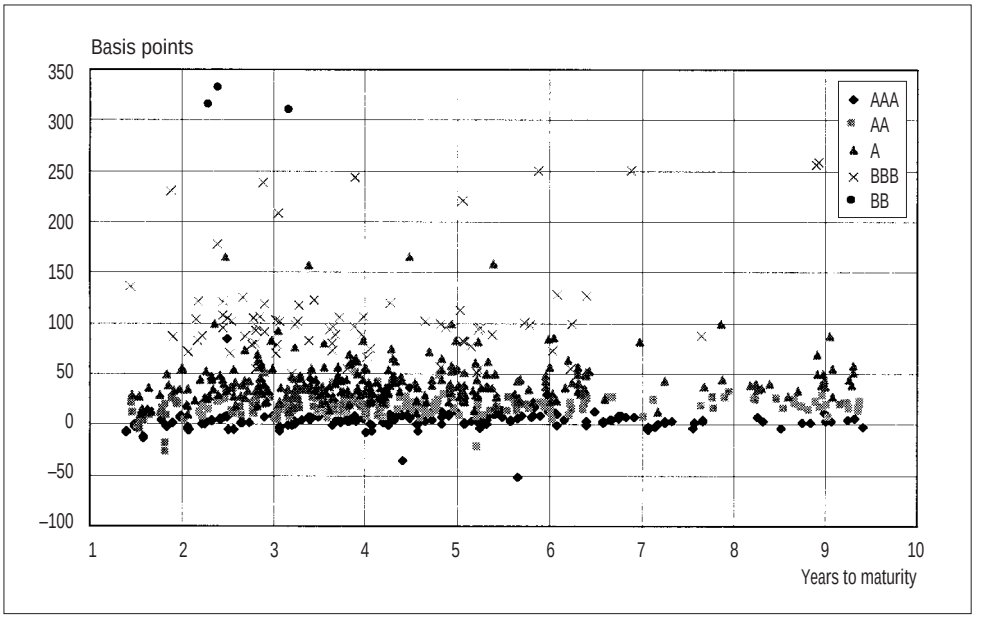
Figure 1 The LSs on 1997/5/2



8. The Japan Bond Research Institute (JBRI), Nippon Investors Service (NIS), and Japan Credit Rating Agency (JCR) (however, JBRI and NIS merged in April 1998 to become Japan Rating and Investment Information [R&I]).
9. In this analysis, for the sake of simplification the plus and minus signs on ratings such as AA+ and A– are ignored.

   Issues that have not been rated by domestic rating agencies but which have received an AAA rating from an overseas agency are handled as if they also have an AAA rating in Japan (however, issues that have not been rated by domestic rating agencies and have received a rating other than AAA from an overseas agency are excluded from this analysis).
10. As of March 27, 1998, the ratings of the non-construction issues (817 issues) were as follows: AAA, 250 issues; AA, 212 issues; A, 278 issues; BBB, 72 issues; and BB, 5 issues.

Figure 2 The LSs on 1997/11/28



There are two items that are immediately apparent from figures 1 and 2. First, the dispersion of the LSs in Figure 2 is larger overall than that in Figure 1. Secondly, while the LSs in Figure 1 are generally declining to the right, those in Figure 2 are essentially flat.

Next, in order to examine the LS formation mechanism, we prepared an LS model using several explanatory variables. Specifically, the model uses the LSs at each point in time as the dependent variable, and remaining maturity, the coupon rate, and the issue rating as the explanatory variables, as follows.

$$LS_i = \alpha + \beta \cdot Mat_i + \gamma \cdot Coup_i + \sum_{n=1}^{4} \pi_n \cdot D_{ni} + \varepsilon_i \qquad (2)$$

LS_i: The LS of issue i
Mat_i: The years remaining until maturity of issue i
$Coup_i$: The coupon rate of issue i
D_{ni}: A dummy variable expressing the rating of issue i
$D_{1i} = 1$ (when the rating of issue i is AA; otherwise $D_{1i} = 0$)
$D_{2i} = 1$ (when the rating of issue i is A; otherwise $D_{2i} = 0$)
$D_{3i} = 1$ (when the rating of issue i is BBB; otherwise $D_{3i} = 0$)
$D_{4i} = 1$ (when the rating of issue i is BB; otherwise $D_{4i} = 0$)
ε_i: Error term
α, β, γ, π_n: Constants

We then applied this model to the LSs calculated for each point in time, and conducted a regression analysis. This demonstrated that, throughout the analysis period, the LS can generally be explained by the explanatory variables. (See Appendix 1; the adjusted R^2 ranged from 0.73 to 0.87.)

As specific examples, the calculation results for the LSs on May 2, 1997 and November 28, 1997 are presented in tables 1 and 2. At these two points in time, the t-statistics of each explanatory variable are sufficiently large.

Table 1 Estimates of Coefficients Using Regression Analysis for the LSs on 1997/5/2

Adjusted R^2	Intercept	Remaining maturity	Coupon rate	AA	A	BBB	BB
0.80	12.97	–3.77	3.90	16.91	37.68	98.44	—
	4.95	–14.56	8.96	10.14	24.47	48.60	—

Note: Numbers in the lower row are t-statistics.

Table 2 Estimates of Coefficients Using Regression Analysis for the LSs on 1997/11/28

Adjusted R^2	Intercept	Remaining maturity	Coupon rate	AA	A	BBB	BB
0.73	–11.83	1.26	1.97	16.07	42.96	110.93	321.05
	–3.02	3.19	2.97	6.49	18.02	35.51	25.46

Note: Numbers in the lower row are t-statistics.

It may be possible to conduct more detailed analyses and valuations of the type of changes to the shape of the scatter diagram seen in figures 1 and 2 by examining the signs and levels of the coefficients of the explanatory variables at each point in time in a time series. Specifically, the following observations can be made from observing the changes in the coefficients of each explanatory variable over time.

A. Rating Dummy Variables

First, we examined the rating dummy variables. These variables remained significant throughout the analysis period, and their significance was relatively high compared with the other explanatory variables. Looking at the level of the coefficients, the lower the rating, the higher the coefficient, and the greater the spread difference versus issues rated AAA. In other words, it may be said that the credit risk of the issuers is rationally incorporated into the spread on the SB trading market, and this phenomenon is stable.

Also, looking at the time series, the spread difference was relatively stable through November 1997 for issues rated AA or A (the spread began to expand around October 1997 for issues rated BBB), but the spread difference increased suddenly from December 1997 through January 1998, and continued to expand thereafter (Figure 3 and Table 3). Moreover, the lower the issue rating, the more conspicuous the expansion of the spread difference (Table 4). This may be attributed to the growing concerns about credit risk following the bankruptcies of major financial institutions in November 1997 (Hokkaido Takushoku Bank, Yamaichi Securities, and Sanyo Securities) as well as the pessimistic outlook regarding future business conditions.

The dummy coefficients for issues rated BB fluctuated greatly from December 1997 through February 1998, but this may have been because only a small number of samples of BB issues were available (five issues as of March 27, 1998).

Figure 3 Coefficients of Rating Dummy Variables

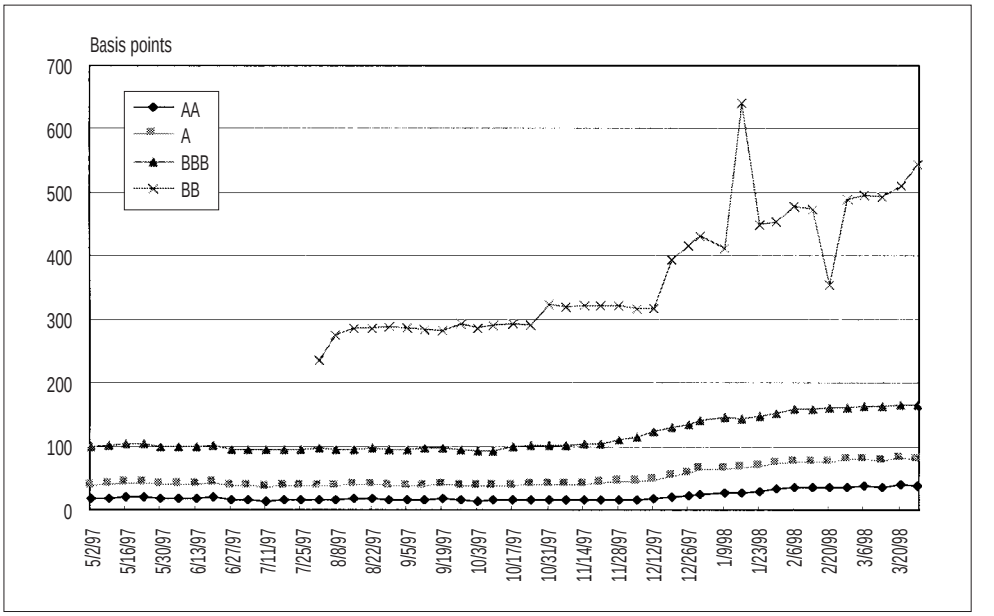


Table 3 Monthly Changes in Coefficients of Rating Dummy Variables

	97/6	7	8	9	10	11	12	98/1	2	3
AA	–2.7	–0.1	1.7	–0.6	0.2	0.4	8.0	8.2	4.0	0.6
A	–1.7	–0.3	1.4	–0.7	2.9	2.8	19.9	9.6	5.9	1.7
BBB	–3.5	–0.8	–0.3	–0.3	7.1	9.5	29.9	11.3	9.6	2.7

Note: The table compares the coefficients using the values nearest to the end of each month. The coefficients for issues rated BB fluctuated greatly during the analysis period, so the BB issues are excluded here.

Table 4 Coefficients of Rating Dummy Variables

	AA	A	BBB	BB
End of September 1997 → End of March 1998	15.5 → 36.9	37.2 → 80.1	94.3 → 164.4	293.7 → 544.0
Changes	21.4	42.9	70.1	250.3

B. Coupon Rate

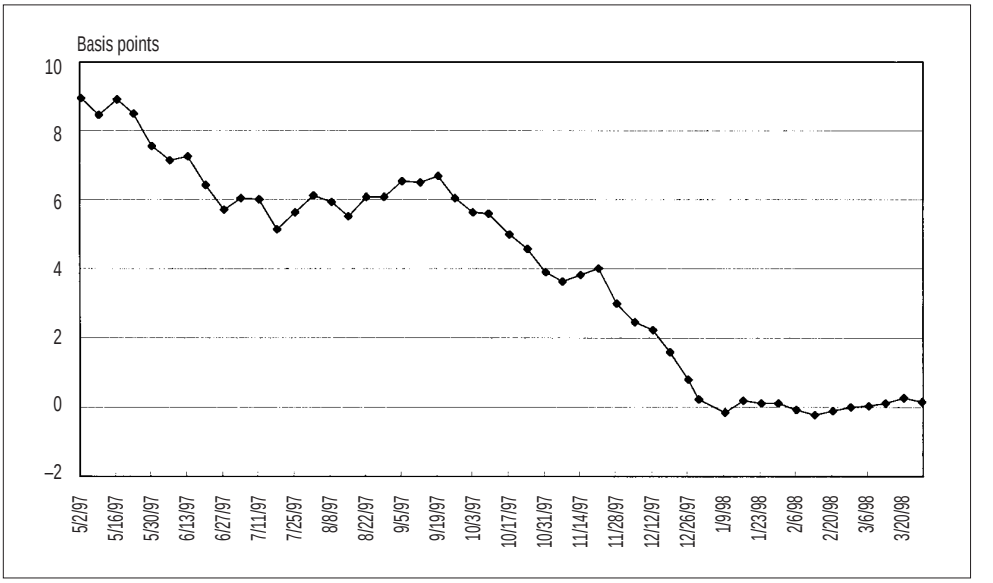
Our analysis showed that the coupon rate was consistently a significant explanatory variable through the middle of December 1997, and that the larger the coupon rate, the higher the spread (the sign of the coefficient was positive). As the background to this, in a phase when interest rates are declining, the price of bonds with a high coupon rate moves increasingly over par, and when bonds are purchased above par the loss that will be realized at the time of redemption needs to be amortized in the

Japanese accounting system, so it appears that investors are not likely to purchase such bonds.

Another factor is that there are still a substantial number of investors in Japan who view the simple interest rate levels as one of their criteria in bond transactions. In other words, even if the yield is the same on a compound interest basis, because for high-coupon bonds the higher the price over par the lower the yield on a simple interest rate basis, one may infer that investors who emphasize simple interest rate levels may hesitate to invest in such bonds.

From the middle of December 1997, the coefficient value—which was nearly 10 basis points during the early part of the analysis period—declined to approach zero. At this stage, the coupon rate was no longer a significant explanatory variable (Figure 4).

Figure 4 Coefficients of Coupon Rate Variable



Apparently the main reason for this was the growing concern regarding credit risk among investors. That is to say, as noted above—especially from around November 1997—investors placed a greater emphasis on bond ratings (creditworthiness), so the level of the coupon rate itself apparently lost importance as a criterion for bond investment judgments.

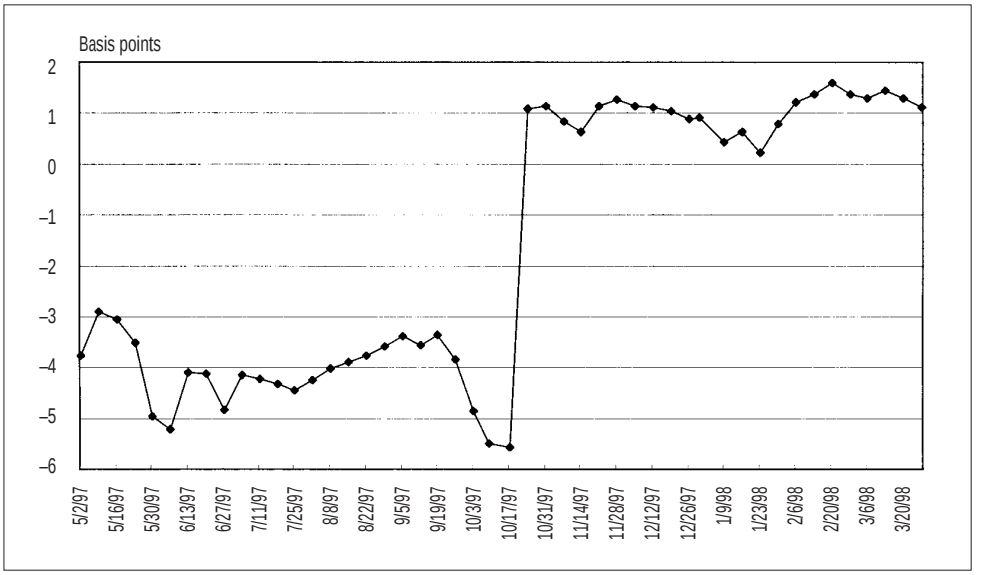
Given the discussions on the introduction of mark-to-market accounting, the investment stance of investors may be shifting toward a compound interest basis or a market price basis. Nevertheless, it is highly unlikely that the majority of investors who emphasized simple interest rate levels to date suddenly changed their investment stance all at once.

C. Remaining Maturity

The remaining maturity was a significant explanatory variable throughout almost all

of the analysis period. However, the analysis showed that the sign of the coefficient, which was negative through the middle of October 1997, turned positive from that time (Figure 5).

Figure 5 Coefficients of Remaining Maturity Variable



In general, for investment-grade issuers, the longer the investment period, the higher the marginal default probability (the probability that an issuer will default on a bond with a given rating in *t* years' time),[11] so the spread for the credit risk on longer-term issues tends to expand. In other words, there is a positive correlation between the spread and the length of the period until maturity, and this has been confirmed through empirical analyses of the U.S. SB trading market.[12]

For investment-grade issuers, the near-term default risk is low, but as time passes they may be influenced by changes in business conditions and the decline of entire industries, so their future financial position may become unstable. Accordingly, the marginal default probability increases over time.

On the other hand, for speculative-grade issuers, the marginal default probability tends to decrease as the investment period becomes longer. For speculative-grade issuers, their financial position is unstable and the near-term default risk is high, but once they overcome this risk without defaulting, their financial positions often become relatively stable compared with the initial period, and thus the marginal default probability decreases.[13]

According to our analyses, the sign of the coefficient for the remaining maturity was negative through the middle of October 1997 (there was a negative correlation

11. In contrast, the probability that an issuer will default on a bond with a given rating *within t* years' time is known as the cumulative default probability.
12. See Fons (1994).
13. See Fons (1994).

between the spread and the remaining maturity), and this is inconsistent with the results of empirical analyses on U.S. markets. The reason why this phenomenon occurred in Japan may be that when bonds are purchased over par the redemption loss must be amortized, and (when amortization is carried out) the amortization burden per year increases as the remaining maturity grows shorter, so one may infer that investors tended to hesitate to invest in these issues.

Meanwhile, the sign of the coefficient of the explanatory variable turned positive from the middle of October 1997, and this shows that the trend on Japanese markets became the same as that in the United States. This is similar to the situation for the coupon rate, because, as investors placed greater emphasis on creditworthiness, the amortization burden itself apparently became relatively less important as a criterion for bond investment judgments. In October 1997, stock prices fell worldwide[14]—especially on Asian markets—and the awareness of credit risk increased in Japanese markets as well. This development may be one of the reasons for the change in the sign of the coefficient. In fact, as shown in Table 3, the spread difference by rating for issues rated BBB clearly expanded from October 1997, indicating that investors gradually began to place a greater emphasis on creditworthiness from that time onward. Nevertheless, the change in the sign of the coefficient for the remaining maturity took place suddenly rather than gradually, and the background to this is not necessarily clear. More detailed analyses, such as those utilizing daily data, would be required to clarify the background to this development, but here we limit our conclusions to noting this change, and leave the explanation of the background as a topic for future research.

IV. Spread for the Construction Issues

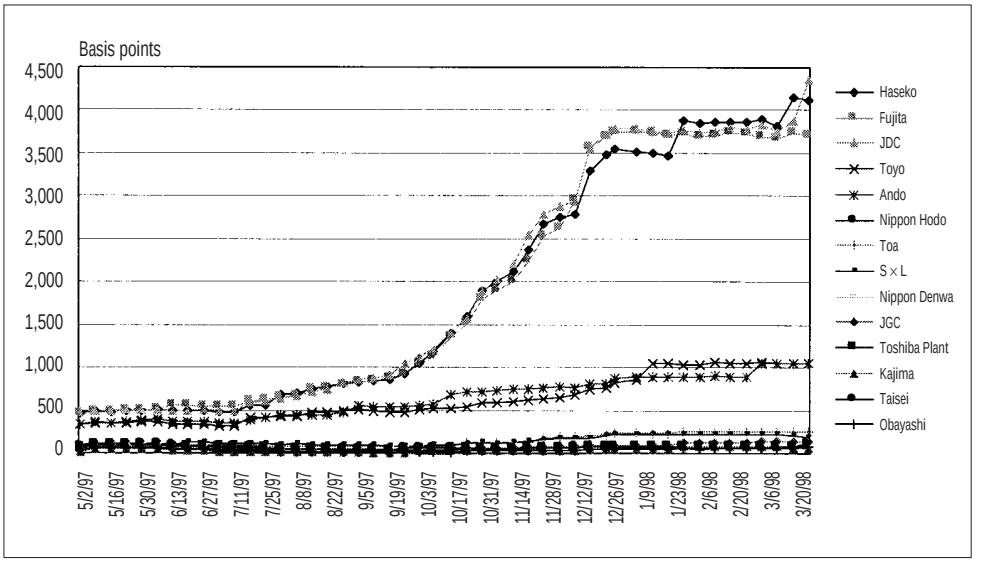
In this chapter, we simply confirm the actual LS level for the construction issues (38 issues, 14 issuers[15]) that were not covered by the analyses in Chapter III. As noted above, on the SB trading market the selectivity toward construction issues in particular reportedly strengthened following the bankruptcies of large and medium-sized construction companies in the summer of 1997. The purpose of this chapter is to confirm this development using the LS as one type of yardstick. The number of issues is small, and we did not carry out the type of regression analysis conducted in Chapter III.

For the sake of simplification, among all the issues from each issuer subjected to analysis, we selected those with the longest remaining maturity, and the LSs for these issues are presented in Figure 6.

See Appendix 2 for the ratings assigned to these issues by domestic rating agencies throughout the analysis period.

14. The percentage declines on key markets from September 30 to October 28, 1997 (to October 27 for the United States) were as follows: Nikkei 225 Average, 8.8 percent; New York Dow, 9.9 percent; and Hong Kong Hang Seng Index, 39.8 percent.
15. The 14 corporations are Haseko Corp.; Fujita Corp.; JDC Corp.; Toyo Construction Co., Ltd.; Ando Corp.; Nippon Hodo Co., Ltd.; Toa Corp.; S × L Corp.; Nippon Denwa Shisetsu Co., Ltd.; JGC Corp.; Toshiba Plant Kensetsu Co., Ltd.; Kajima Corp.; Taisei Corp.; and Obayashi Corp.

Figure 6 LSs of Construction Issues



Based on Figure 6, the LSs of the construction issues can be divided into three groups as follows: (1) Haseko, Fujita, and JDC; (2) Toyo Construction and Ando; and (3) all the other issues. For group 1, the LSs suddenly increased following the bankruptcies of several construction companies[16] around July–August 1997, and have recently been hovering around 4,000 basis points,[17] showing a substantial premium over the LSs for non-construction issues (see Figure 3) with the same ratings (the ratings for group 1 mostly moved from BBB to BB). Similarly, the LSs for group 2 also increased around July–August 1997, and have recently been hovering just above 1,000 basis points. Just as for group 1, these LSs are higher than that for non-construction issues with the same ratings, showing that a premium is being charged for these construction issues as well. In contrast, there was no such premium versus the non-construction issues for group 3.

The ratings of the issues in both group 1 and group 2 mostly moved from BBB to BB during the analysis period (Appendix 2), but the ratings of the issues in group 1 were downgraded earlier, including the + and – signs. (At the end of March, the lowest rating for group 1 was B [Haseko] and the lowest rating for group 2 was BBB– [Ando].) This differential in the rating levels also apparently contributed to the differentials in the LS levels for both groups.

16. See Footnote 7.
17. In terms of the bond price, the level is around ¥40. Also, as noted above, the OTC standard bond quotations are not necessarily based on actual transactions. Especially because it is difficult for actual transactions to be concluded for issues like these for which there is apparently a strong market awareness of the credit risk, the possibility that the quotations are being lowered without actual transactions taking place cannot be denied. Nevertheless, in this analysis we leave this as an outstanding issue and do not examine it in greater detail.

V. Conclusion

In this paper, we conducted analyses on the LS on the domestic SB trading market utilizing the OTC standard bond quotations. In our analysis of non-construction issues, we found that the lower the rating the higher the LS, and that the LS differential among issues with different ratings has expanded since around November 1997 against the background of a growing awareness of credit risk. Our analysis also showed that during the analysis period (May 1997 through March 1998) the coupon rate, which was previously a significant explanatory variable for the LS, lost its significance, and that the coefficient of the remaining maturity, which is also an explanatory variable, switched from negative to positive (the longer the remaining maturity, the higher the LS). As noted above, the heightened awareness of credit risk among investors apparently contributed to both these phenomena, and the latter is particularly noteworthy because it is consistent with the results of empirical analyses in the United States. However, the change in the sign of the coefficient for the remaining maturity took place abruptly, rather than gradually, and the background to this is not necessarily clear. More detailed analyses would be required to clarify the background to this development, but here we limited our conclusions to noting this change, and left the explanation of the background as a topic for future research.

For construction issues, our analysis showed that the LS has been increasing since the bankruptcy of several construction companies during the summer of 1997, and that an extremely large premium has arisen for certain issues.

APPENDIX 1: RESULTS OF THE REGRESSION ANALYSES

	Adjusted R^2	Intercept	Remaining maturity	Coupon rate	AA	A	BBB	BB
97/05/02	0.80	12.97 4.95	–3.77 –14.56	3.90 8.96	16.91 10.14	37.68 24.47	98.44 48.60	— —
97/05/09	0.79	30.46 11.19	–2.91 –10.83	3.81 8.44	17.40 10.05	39.11 24.47	102.09 48.56	— —
97/05/16	0.80	27.15 10.18	–3.06 –11.61	3.94 8.91	18.79 11.07	40.87 26.07	103.54 50.22	— —
97/05/23	0.79	35.05 12.66	–3.51 –12.82	3.91 8.50	19.75 11.19	40.96 25.15	102.63 47.90	— —
97/05/30	0.79	49.10 17.52	–4.95 –17.87	3.51 7.54	17.14 9.59	38.54 23.36	99.15 45.68	— —
97/06/06	0.80	47.71 17.22	–5.21 –19.00	3.29 7.14	17.82 10.08	39.85 24.41	99.58 46.38	— —
97/06/13	0.79	29.56 10.95	–4.09 –15.28	3.26 7.24	17.37 10.07	38.54 24.21	99.31 47.43	— —
97/06/20	0.79	29.79 10.83	–4.12 –15.11	2.93 6.40	18.72 10.65	40.73 25.10	100.42 47.04	— —
97/06/27	0.79	37.95 13.99	–4.83 –17.93	2.58 5.71	14.44 8.32	36.81 22.97	95.70 45.40	— —
97/07/04	0.79	22.63 8.51	–4.16 –15.73	2.67 6.02	14.46 8.49	36.72 23.35	94.98 45.92	— —
97/07/11	0.79	23.36 8.82	–4.23 –16.09	2.65 5.99	14.07 8.29	35.93 22.93	94.21 45.73	— —
97/07/18	0.80	26.21 10.16	–4.31 –16.79	2.22 5.14	14.76 8.92	36.71 24.02	93.87 46.70	— —
97/07/25	0.81	17.37 6.89	–4.44 –17.70	2.37 5.62	14.36 8.87	36.50 24.42	94.93 48.30	— —
97/08/01	0.84	8.53 3.47	–4.26 –17.37	2.51 6.10	15.45 9.90	37.87 25.84	95.99 49.59	235.50 30.14
97/08/08	0.85	8.35 3.41	–4.01 –16.40	2.44 5.94	16.30 10.51	37.54 25.69	94.37 48.93	275.10 35.33
97/08/15	0.86	6.05 2.49	–3.89 –16.05	2.24 5.53	16.71 10.88	38.92 26.88	94.88 49.64	286.65 37.15
97/08/22	0.86	0.92 0.39	–3.77 –16.05	2.40 6.09	17.30 11.67	39.48 28.06	96.57 52.13	285.56 38.19
97/08/29	0.86	–1.66 –0.71	–3.58 –15.37	2.37 6.07	16.08 10.92	37.97 27.17	94.61 51.43	287.56 38.73
97/09/05	0.87	–1.76 –0.78	–3.37 –14.83	2.49 6.53	16.38 11.40	38.31 28.11	94.53 52.68	286.11 39.50
97/09/12	0.86	–4.78 –2.01	–3.57 –15.03	2.59 6.51	16.29 10.86	37.95 26.66	96.38 51.43	283.03 37.41
97/09/19	0.86	–9.02 –3.89	–3.37 –14.51	2.60 6.68	17.24 11.75	38.79 27.87	97.78 53.35	282.07 38.13
97/09/26	0.86	–9.16 –3.96	–3.85 –16.58	2.36 6.05	15.47 10.58	37.24 26.72	94.29 51.43	293.73 39.69
97/10/03	0.86	–6.46 –2.77	–4.87 –20.75	2.21 5.62	13.39 9.06	36.74 26.08	92.11 49.71	286.63 38.31

Note: Upper rows: coefficients; lower rows: t-statistics. The shaded area indicates that the coefficient is not significant at the 5 percent level.

	Adjusted R^2	Intercept	Remaining maturity	Coupon rate	AA	A	BBB	BB
97/10/09	0.87	–2.86 –1.19	–5.49 –22.87	2.25 5.58	14.35 9.48	38.00 26.35	93.18 49.12	291.65 38.09
97/10/17	0.84	–5.37 –1.99	–5.56 –20.48	2.27 4.98	14.49 8.47	38.00 23.29	97.98 45.66	292.48 33.76
97/10/24	0.81	–13.32 –4.71	1.08 3.80	2.18 4.56	15.10 8.42	39.86 23.30	101.88 45.28	289.83 31.91
97/10/31	0.81	–11.60 –3.99	1.14 3.88	1.91 3.88	15.70 8.56	40.13 22.71	101.43 43.79	322.77 34.52
97/11/07	0.81	–11.82 –4.00	0.83 2.80	1.81 3.61	14.57 7.82	39.54 22.03	101.27 43.04	319.89 33.68
97/11/14	0.81	–7.96 –2.71	0.63 2.13	1.89 3.80	14.50 7.81	39.54 22.12	102.68 43.82	322.13 34.06
97/11/21	0.80	–13.04 –4.28	1.14 3.73	2.05 3.98	16.06 8.35	40.76 22.01	103.64 42.69	321.64 32.82
97/11/28	0.73	–11.83 –3.02	1.26 3.19	1.97 2.97	16.07 6.49	42.96 18.02	110.93 35.51	321.05 25.46
97/12/05	0.74	–5.60 –1.42	1.14 2.85	1.65 2.46	16.08 6.44	44.01 18.30	115.45 36.61	317.63 24.95
97/12/12	0.75	–5.56 –1.40	1.11 2.74	1.51 2.23	18.65 7.39	47.33 19.48	122.43 38.44	316.92 24.65
97/12/19	0.78	–0.85 –0.21	1.04 2.49	1.11 1.58	19.28 7.37	52.27 20.76	129.53 39.24	394.23 29.58
97/12/26	0.79	3.92 0.92	0.87 2.02	0.56 0.78	21.95 8.11	57.76 22.16	134.63 39.41	416.18 30.17
97/12/30	0.79	6.86 1.55	0.90 2.02	0.17 0.23	24.10 8.61	62.89 23.32	140.81 39.83	430.74 30.18
98/01/09	0.74	9.87 1.80	0.44 0.78	–0.15 –0.16	25.82 7.42	64.12 19.11	145.56 32.24	411.39 29.63
98/01/16	0.84	5.67 1.28	0.62 1.38	0.15 0.20	27.21 9.64	67.12 24.68	143.01 40.12	640.09 44.48
98/01/23	0.74	6.29 1.11	0.22 0.39	0.10 0.10	28.36 7.89	68.75 19.83	146.84 32.09	448.52 31.30
98/01/30	0.75	6.18 1.09	0.78 1.35	0.11 0.12	32.33 8.94	72.48 20.77	152.07 33.02	453.71 31.46
98/02/06	0.75	2.71 0.46	1.21 2.04	–0.06 –0.06	34.31 9.21	74.05 20.64	157.48 32.62	477.37 32.15
98/02/13	0.76	3.94 0.68	1.37 2.32	–0.21 –0.21	34.73 9.43	75.87 21.39	158.23 33.15	473.63 32.27
98/02/20	0.79	1.01 0.21	1.59 3.24	–0.10 –0.12	36.12 11.76	75.91 25.66	160.53 40.33	353.49 28.87
98/02/27	0.76	3.45 0.59	1.38 2.32	0.02 0.02	36.29 9.76	78.41 21.89	161.67 33.55	489.48 33.02
98/03/06	0.76	3.29 0.56	1.29 2.14	0.05 0.05	37.51 9.94	79.19 21.77	163.86 33.48	495.48 32.92
98/03/13	0.77	2.20 0.39	1.44 2.48	0.12 0.12	36.28 9.96	77.80 22.17	163.51 34.63	493.60 33.99
98/03/20	0.76	0.07 0.01	1.28 2.11	0.28 0.28	38.62 10.16	81.23 22.17	165.92 33.66	511.38 33.73
98/03/27	0.76	3.40 0.55	1.12 1.77	0.16 0.15	36.91 9.34	80.13 21.04	164.40 32.08	544.01 34.51

Note: Upper rows: coefficients; lower rows: t-statistics. The shaded area indicates that the coefficient is not significant at the 5 percent level.

APPENDIX 2: RATINGS OF THE CONSTRUCTION ISSUES (14 ISSUES)

JBRI	97/4	5	6	7	8	9	10	11	12	98/1	2	3
Haseko	BBB–	→	→	→	→	BB–	→	→	→	→	→	→
JDC	BBB–	→	→	→	→	→	→	BB–	→	→	→	→
Fujita	BBB+	BBB–	→	→	→	→	→	→	BB	→	→	→
S × L	A–	→	→	→	→	→	→	→	→	→	→	→
JGC	A–	→	→	→	→	→	→	→	→	→	→	BBB
Toshiba Plant	A–	→	→	→	→	→	→	→	→	→	→	→
Nippon Hodo	A	→	→	→	→	→	→	→	→	→	→	→
Kajima	AA–	→	→	→	→	→	→	→	A+	→	→	→
Taisei	AA–	→	→	→	→	→	→	→	→	→	→	→
JCR	97/4	5	6	7	8	9	10	11	12	98/1	2	3
JDC	BBB–	→	→	→	→	→	→	BB	→	→	→	→
JGC	A–	→	→	→	→	→	→	→	→	→	BBB+	→
Obayashi	AA	→	→	→	→	→	→	→	→	→	→	→
NIS	97/4	5	6	7	8	9	10	11	12	98/1	2	3
Haseko	BBB–	→	→	→	→	→	→	→	→	→	→	B
Ando	BBB–	→	→	→	→	→	→	→	→	→	→	→
Toyo	BBB	→	→	→	→	→	→	→	BB+	→	→	→
Toa	A–	→	→	→	→	→	→	→	→	→	→	→
S × L	A–	→	→	→	→	→	→	→	→	→	→	→
Nippon Denwa	A–	→	→	→	→	→	→	→	→	→	→	→
Toshiba Plant	A	→	→	→	→	→	→	→	→	→	→	→
Taisei	AA	→	→	→	→	→	→	→	→	→	→	→
Kajima	AA	→	→	→	→	→	→	→	→	→	→	→

Note: Each rating is that at the end of the month.

References

Fons, J., "Using Default Rates to Model the Term Structure of Credit Risk," *Financial Analysts Journal*, 1994.

Muromachi, Y., and D. Asahara, "Shinyo Risuku no Keiryoka to Kanri Shuho (Quantification of Credit Risk and Management Techniques)," *Nissei Kiso Kenkyujo Chosa Geppo* (Monthly Survey), 1997 (in Japanese).

Suzuki, S., "Shinyo Risuku to Shasai Hyoka: Deforuto Ritsu to Kaishu Ritsu o Koryo Shita Shasai Hyoka to Nihon Shijo no Jissho Bunseki (Credit Risk and Corporate Bond Valuation: Corporate Bond Valuation Considering Default Ratios and Recovery Ratios, and Empirical Analyses on Japanese Markets)," *Shoken Anarisuto Jyanaru* (Security Analysts Journal), 1996 (in Japanese).