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Credit Spreads on Corporate Bonds and the Macroeconomy in Japan

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Abstract: Using data on corporate bonds issued in Japan for the period between 1997 and 2005, this paper explores possible determinants of credit spreads of corporate bond rates over interest swap rates. We find that credit spreads properly reflected financial factors summarized at the level of individual firms, including debt equity ratios, volatility, and maturity, in particular for longer term bonds. In addition, an economy-wide factor common among bond issues, which cannot be captured by firm-level factors, played an important role in determining credit spreads, and such economy-wide effects cancelled out firm-level factors to a large extent for subsample periods. We also discuss possible reasons for such significant economy-wide effects.

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1. Introduction

This paper investigates empirically possible determinants of credit spreads on corporate bonds using a dataset on corporate bonds issued in Japan for the period between 1997 and 2005.

According to a standard framework for bond pricing models such as Merton (1974), credit risks mainly reflect firm-level financial factors responsible for individual default possibilities, while interest-rate risks are determined only by market-wide factors common among individual firms, such as macroeconomic conditions and monetary policies. One of the most important implications from the above model is that firm-specific and macroeconomic factors responsible for the determination of credit spreads may be summarized by variables at the level of individual firms. Given this conventional prediction, as long as a set of firm-level explanatory variables is chosen properly to reflect both firm-specific and macroeconomic components, credit spreads of corporate bond rates over market interest rates can be explained mostly by firm-level financial conditions, including debt equity ratios, volatility of corporate value, and individual contract clauses of a corporate bond, such as maturity and attached options. In other words, credit spreads should be free from any market-wide effects beyond what can be captured by these firm-level financial variables and contract clauses.

We carefully and rigorously assess the empirical relevance of the above prediction by raising the following questions: (1) whether credit spreads on corporate bonds reflect firm-level financial factors and individual contract clauses in a proper manner, (2) whether there are market-wide effects other than firm-level factors, and (3) if the answer to the second question is yes, which macroeconomic conditions are responsible for market-wide factors.

Our empirical investigation is motivated mainly by the following observation concerning Japanese corporate bond markets. One of the clear and simple predictions available from the standard pricing model of credit risks is a negative correlation between credit spreads and equity prices, which serves as a proxy for corporate valuation; a decrease in equity prices will enhance default risks, and thereby raise credit spreads on corporate bonds. Figure 1 plots the relation between the average credit spreads on corporate bonds rated as A or higher by Moody's, and the average total equity valuation of corresponding issuing firms. According to this figure, there is a negative correlation between credit spreads and equity valuation for both the period between 1997 and 2002, and the period between 2003 and 2005. Between 2002 and 2003, however, credit spreads declined substantially although equity valuation fell heavily. Such a positive correlation of these subsample periods is observed uniformly among the highly rated corporate bonds with different maturities, from less than three years through longer than ten years. Among low-grade corporate bonds, such as Baa or lower, a positive correlation between credit spreads and equity valuation is observed again for the period between 2001 and 2003 (See Figure 2). In addition, for the period between 1997 and 1999, long-term corporate bonds maturing between seven and 10 years show a positive correlation between the two. Credit spreads increased while equity valuation was relatively strong. Such overall consistency and particular inconsistency in the relationship between credit spreads and corporate valuation may help to separate independent market-wide effects on credit spreads from firm-specific factors.

The motivation of our paper is shared with existing empirical literature. Among empirical papers based on corporate bonds issued in the U.S., Collin-Dufresne, Goldstein and Martin (2001), and Delianedis and Geske (2001) divided determinants of credit spreads into market-wide factors and firm-level factors. Collin-Dufresne, Goldstein and Martin (2001) found that firm-level financial factors, including leverage ratios and equity valuation, play little role in determining credit spreads, and that credit spreads are largely subject to market-wide factors possibly associated with overall market liquidity of corporate bonds. Delianedis and Geske (2001) found that firm-level financial factors, including volatility of corporate value, do not contribute to the determination of credit spreads on corporate bonds, and that individual credit spreads are heavily influenced by market risks measured in terms of returns and volatilities of equity market indexes. In addition, Jones, Mason and Rosenfeld (1984), Huang and Huang (2003), and others demonstrated that firm-level financial factors do not contribute to corporate bond pricing.[1] These papers suggest that the determination of credit spreads is seriously inconsistent with the above-mentioned standard bond pricing theory.

Among empirical papers based on corporate bonds issued in Japan, on the other hand, Ueki (1999), Ieda and Ohba (1998), and Ieda (2001) examined possible determinants of credit spreads, and claimed that firm-specific factors are mainly responsible for the determination of credit spreads. However, what is fundamentally different from the above-cited papers based on U.S. corporate bonds and our paper is that they were interested in the relationship between credit spreads and credit ratings, and never investigated possible effects of firm-level financial factors behind such credit ratings.

Our major finding is summarized as follows. First, credit spreads properly reflected firm-level financial factors, including equity valuation, volatility of corporate value and maturity, in particular for corporate bonds with longer than 10-year maturity. Second, economy-wide effects played an important role in determining credit spreads. For the period between 1997 and 1998, and the period between 2001 and 2003, an economy-wide effect dominated and cancelled out firm-level financial conditions, thereby yielding positive correlation between credit spreads and equity valuation at the aggregate level. Third, circumstantial evidence suggests that the overall deterioration of market liquidity in corporate bonds during a financial crisis contributed to a significantly positive market-wide effect on credit spreads from 1997 through 1998, while massive capital inflows into corporate bond markets as a result of aggressive monetary policy generated a significant aggregate impact for the period between 2001 and 2003.

Our paper is organized as follows. Section 2 reviews possible empirical predictions based on the standard credit risk model. Sections 3 and 4 present empirical specifications and estimation results for firm-level or issue-specific effects and market-wide effects respectively. Section 5 offers conclusions.

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[1] As possible exceptions to the findings by those papers, Longstaff, Mithal and Neil (2005) used premiums on credit default swaps (CDS) to identify possible determinants of credit spreads on corporate bonds, and found that credit spreads are largely determined by firm-specific factors associated with credit risks and liquidity premiums.

2. Determinants for credit spreads on corporate bonds

This section briefly reviews a standard model of credit spreads on corporate bonds, which lends a theoretical support to our empirical specification. More concretely, we base theoretical foundations on Merton (1974). A basic idea (Merton 1974) is that a default option assigned to stockholders is considered as a put option that bondholders issue to stockholders.

For review purposes, we make the following simplifying assumptions. First, the term structure of credit-risk-free interest rates (market interest rates) is given exogenously. Second, a firm issues only straight corporate bonds in addition to equities. Third, a form of corporate bond is a discount bond. In other words, coupons on bonds are ignored completely. Fourth, a corporate bond does not carry any options such as conversion or warrants.

Finally, a firm triggers a default option when bond repayment obligations at maturity (corporate liabilities) exceed corporate valuation. Behind this assumption, we make two implicit assumptions. First, stockholders have no incentive to trigger default options before maturity.[2] Second, a default option is triggered when corporate liabilities exceed corporate valuation. In other words, an exercise price in terms of corporate valuation is exactly equal to bonds outstanding.[3] Although the literature following Merton (1974) has relaxed either of these simplifying assumptions in an important manner, most basic predictions based on Merton (1974), including implications on which our empirical specification depends, survive such generalization.

Suppose that a firm issues a straight discount bond at time t whose outstanding K_T matures at time T. A corresponding risk-free interest rate for the T_t $\left(T_t = T - t\right)$ term is equal to r_t. If this bond is completely free of default risks, then its price is equal to the discounted value of K_T ($K_T \exp(-r_t \cdot T_t)$). Therefore, an essential issue for corporate bond pricing is how much a straight corporate bond is further discounted in the presence of credit risks.

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[2] Black and Cox (1976) treated a case in which a default option is triggered before maturity.

[3] Leland (1994), Leland and Toft (1995) and Mella-Barral and Perraudin (1997) analyzed a case in which a trigger point (an exercise price) is determined endogenously as a result of strategic interactions between firms and bondholders.

As mentioned before, Merton (1974) interpreted the issuance of a discount bond with a default option as a case in which bondholders sell stockholders a European put option on corporate valuation (V_t) at time T, whose exercise price is equal to K_T (repayment obligations). Consequently, corporate bond pricing B_t is discounted from $K_T \exp(-r_t \cdot T_t)$ by the corresponding value of this put option.

Merton (1974) applied the Black–Scholes–Merton formula (Black and Scholes, 1973; Merton 1973) to the pricing of the above put option issued to stockholders by bondholders, and derived corporate bond pricing (B_t) as follows:

$$B_t = V_t \cdot N(-z_t) + K_T \cdot \exp(-r_t \cdot T_t) \cdot N(z_t - \sigma_t \sqrt{T_t}),$$

where $z_t = \dfrac{\log\left(\dfrac{V_t}{K_T}\right) + \left(r_t + \dfrac{\sigma_t^2}{2}\right) \cdot T_t}{\sigma_t \sqrt{T_t}}$. In the above derivation, σ_t denotes volatility of returns on corporate valuation V_t. $N(x)$ indicates a standard normal cumulative distribution function at x, and log implies a natural logarithmic operator.

An annual yield on the above corporate bond y_t is defined as

$$y_t = -\frac{1}{T_t} \cdot \log \frac{B_t}{K_T},$$

and a credit spread ($spread_t = y_t - r_t$) is derived as

$$spread_t = -\frac{1}{T_t} \cdot \log\left(\frac{V_t}{K_T \cdot \exp(-r_t \cdot T_t)} \cdot N(-z_t) + N(z_t - \sigma_t \sqrt{T_t})\right). \qquad (1)$$

Equation (1) demonstrates that credit spreads are determined by three firm-level/issue-specific factors such as (i) a corporate leverage ratio defined by $K_T \cdot \exp(-r_t \cdot T_t)/V_t$ (we may call it the present value version of a leverage ratio in the sense that bond repayments are evaluated in terms of present value), (ii) volatility of returns on corporate valuation σ_t, and remaining terms up to maturity T_t as well as one market factor represented by a risk free interest rate r_t.

In terms of firm-level factors, credit spreads are increasing in leverage ratios. This feature immediately implies that credit spreads are decreasing in corporate valuation or equity valuation. With higher leverage ratios, default possibilities are higher, and accordingly credit risks become larger. An increase in corporate volatility σ_t raises the value of the put option (default option) issued to stockholders by bondholders, thereby lowering corporate bond pricing and enhancing credit spreads. On the other hand, an effect of maturity T_t on credit spreads may not be monotonic. As pointed out by Merton (1974) and Leland and Toft (1996), credit spreads depend on the interaction between maturity T_t and firm-level factors such as leverage ratios and corporate volatility in a complicated manner.

In addition to the above firm-level and issue-specific effects, the pattern of coupons on corporate bonds has potential effects on credit spreads. For example, Geske (1977) considered explicitly the effect of coupons on corporate bonds, and regarded both redemption at maturity and coupon payments up to maturity subject to credit risks. However, his specification is highly nonlinear, and does not fit to simple empirical specifications. Like other individual factors, market liquidity may be associated with a particular issue of corporate bonds. As mentioned later, in our empirical specification, firm-level and issue-specific factors other than leverage ratios (or equity valuation), corporate volatility, and maturity are treated as individual effects, such as fixed effects or random effects, in the context of panel data analysis.

One of the most important aspects concerning equation (1) is that firm-specific and macroeconomic factors responsible for the determination of credit spreads can be captured basically by firm-level and issue-specific variables such as leverage ratios, corporate volatilities, and maturity. Although risk-free interest rates of corresponding maturity may serve as a macroeconomic factor, the effect of changes in risk-free interest rates r_t is only indirect to the extent that the present value version of a leverage ratio $K_T \cdot \exp(-r_t \cdot T_t)/V_t$ declines with r_t. It is easy to prove that there is no effect of changes in r_t on credit spreads through z_t ($z_t = \dfrac{\log\left(\dfrac{V_t}{K_T}\right) + \left(r_t + \dfrac{\sigma_t^2}{2}\right) \cdot T_t}{\sigma_t \sqrt{T_t}}$). Among existing papers, Longstaff and Schwartz (1995), and Duffee (1998) adopted Treasury rates as risk-free rates and corporate bonds issued in the U.S., and they found a significant, albeit weak, negative correlation between credit spreads and risk-free rates.

Given the above marginal negative effect of r_t, as long as estimated common factors synchronize negatively with corresponding market interest rates over time, the presence of common factors may be consistent with the underlying structural model. On the other hand, if the time-series pattern of common factors is quite different from that of market interest rates, then there may be other types of time-varying economy-wide effects that cannot be captured by the above structural model. Candidates for such common effects include improvement or deterioration in overall market liquidity of corporate bonds, and dynamic changes in capital flows into corporate bond markets induced by macroeconomic policies, in particular by monetary policy. In the next section, we construct both reduced and structural forms from equation (1) to identify empirically both firm-level and market-wide effects on credit spreads.

3. Empirical specifications and estimation results for firm-level effects

This section explores firm-level and issue-specific effects on credit spreads, and the next section investigates market-wide effects on credit spreads. The first and second subsections empirically examine qualitative implications available from equation (1) in terms of reduced forms, and the third section tests quantitative implications in terms of structural forms.

3-1. Relationship between changes in credit spreads and changes in equity valuation

Several implications for changes in credit spreads driven by firm-level and issue-specific financial conditions are available from equation (1). That is, decreases in leverage ratios lead to decreases in credit spreads. In the case of high frequency movement, most of the changes in leverage ratios come from changes in market valuation of equities, with an improvement (deterioration) in equity valuation resulting in a decrease (increase) in leverage ratios. Therefore, according to equation (1), credit spreads should decrease with equity valuation. We assume that possible other factors responsible for changes in credit spreads may be summarized by changes in credit rating of a corresponding interval.

The preceding argument can be captured by the following specification:

$$spread_t^i - spread_{t-20}^i = intercept + \alpha(ret_{t-20}^i) + \sum_j \beta_j (Rating\text{-}change_{t,j}^i) \\ + \lambda(r_t - r_{t-20}) + \sum_{t=1997Q.2}^{2004Q.4} \gamma_t (time_t) + \varepsilon_t^i \quad , \qquad (2)$$

where $spread_t^i$ is a credit spread of issue i, ret_{t-20}^i is a 20-business-day change (between time *t* and time *t* – 20) in equity valuation of a company which issues corporate bond *i*, and $Rating\text{-}change_{t,j}^i$ is a dummy variable associated with a *j* notch change in credit rating for the corresponding period. In addition to these firm-level variables, we include as economy-wide effects, 20-business-day changes in risk-free interest rates ($r_t - r_{t-20}$) and a quarterly time dummy ($time_t$).

The above dependent and explanatory variables are defined as follows. A credit spread ($spread_t^i$) is a spread of a yield on corporate bond *i* over an interest-rate swap rate of the same maturity. A major reason for using swap rates instead of yields on government bonds as reference safe rates is that, as Fukuta, Saito and Takagi (2002) showed, yields on Japanese government bonds (JGB) earn a sort of convenience, and it is difficult to control effects of such convenience on interest rates. Nevertheless, a choice between swap rates and JGB rates do not affect estimation results at all.

We use as yields on corporate bonds the daily dataset of market-based compound annual rates on corporate bonds compiled by *Nomura Research Institute*. On the other hand, corresponding interest-rate swap rates are computed from the term structure of the average of offer and bid rates quoted by *Yagi Euro* using a linear interpolation method.[4]

A 20-business-day change in market valuation of equities of a company which issues corporate bond i, denoted by $equity_t^i$ and defined by a stock price per issue and the number of stock issues, is computed by $ret_{t-20}^i = \log(equity_t^i) - \log(equity_{t-20}^i)$. To compute equity valuation, we use for both stock prices and the number of stock issues the dataset compiled by *Nomura Research Institute*.[5]

A dummy variable with respect to each change in credit rating of issue *i* for 20 business days ($Rating\text{-}change_{t,j}^i$) is based on rating by *Moody's*, whose rating

[4] For example, a swap rate of a term of two years and eight months is computed from the average of two-year rates with a one-third weight and three years with a two-thirds weight.
[5] More precisely, the number of stock issues we adopt for this empirical investigation is adjusted according to the TOPIX-type computation.

information is compiled by *IN Information Data Service*. We index Moody's rating into 20 (highest rating) through 1 (lowest), compute numerical changes in indexed rating, and construct a dummy variable for each value of a numerical change in rating. A deterioration of rating ranges from $j = -11$ to $j = -1$, and an improvement of rating ranges from $j = +1$ to $j = +3$. Because no change in rating ($j = 0$) serves as a reference point, a dummy variable for no change is excluded from a list of explanatory variables.

In terms of market-wide effects, an interest-rate swap rate of the corresponding maturity of a corporate bond is chosen as a risk-free rate (r_t). With the first quarter of 2005 as a reference point, a quarterly time dummy ($time_t$) is constructed from the second quarter of 1997 through the fourth quarter of 2004.

The full sample period is between April 1, 1997, and January 31, 2005. There were 2305 issues of corporate bonds during this period. We estimate equation (2) and other specifications presented later by subsample periods, by rating, and by maturity. In regard to classification by rating, we call rating as Baa or higher an *investment grade*, and rating as Ba or lower a *speculative grade*.[6] In addition, we estimate equation (2) by A or higher, Aaa, Aa, A, and Baa. On the other hand, we divide the full sample into short term (shorter than three years maturity), middle term (three years or longer and shorter than seven years), long term (seven years or longer and shorter than 10 years), and ultra long (10 years and longer).

Tables 1 to 6 report estimation results of equation (2). Throughout this paper, following Arellano (1987), we compute robust standard deviations with respect to cross-sectional heteroskedasticity as well as serial correlation *within the same issue*. Because a fixed effect model is preferred to a random effect model according to Wu–Hausman test in any case, we report only estimation results based on the former model.

Except for Table 2, we do not report any estimated coefficients on changes in rating. As demonstrated in Table 2, credit spreads decline with rate improvement and increase with rate deterioration during the full sample period.

[6] The yields or credit spreads on speculative grades are missing for the period between August 5, 2002, and September 20, 2002, because low graded corporate bonds were rather illiquid, and their bid/ask prices were not quoted by corporate bond dealers at all. Hence, the estimation of speculative grades excludes the above sample period.

Table 1 reports results for the full sample period. Consistent with qualitative implications from equation (1), estimated coefficients on changes in equity valuation are significantly negative in all cases. That is, increases in leverage ratios through equity devaluation tended to result in larger credit spreads. These results demonstrate that credit spreads reflect firm-level factors, more specifically individual default possibilities at least in a qualitatively consistent manner.[7]

As discussed in the introduction, a positive relationship between equity valuation and credit spreads, sharply inconsistent with theoretical predictions, is observed at aggregated levels for both the period between 1997 and 1999, and the period between 2001 and 2003. Thus, to examine the consistency of firm-level effects for these particular periods, we estimate equation (2) for subsample periods, April 1997 and March 2001 (Table 3) and April 1997 and January 1999 (Table 5), both of which include the former inconsistent period, and April 2001 and January 2005 (Table 4) and October 2001 and December 2002 (Table 6), both of which include the latter inconsistent period. As shown in Tables 3 and 5, coefficients on changes in equity valuation are significantly negative in all cases of the period between 1997 and 1999. As shown in Tables 4 and 6, again, coefficients on changes in equity valuation are significantly negative in all cases of the period between 2001 and 2003. These results clearly demonstrate that firm-level financial factors were not responsible for the positive correlation between credit spreads and equity valuation observed at aggregate levels for the two particular subsamples.

As expected theoretically, an increase in swap rates results in a decrease in credit spreads in most cases. As shown in Table 6, however, a positive effect of changes in swap rates on credit spreads is observed among middle and long-term corporate bonds for the period between October 2001 and November 2002.[8] Section 4 discusses the time series pattern in effects other than that of risk-free rates.

Compared with the estimation results of Collin-Dufresne, Goldstein and Martin

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[7] As discussed above, the firm-level equity valuation reflects both firm-specific and macroeconomic factors.

[8] Such a positive effect of risk-free rates on credit spreads was not observed by Longstaff and Schwartz (1995) and Duffee (1998), who empirically investigated relationships between credit spreads for bonds issued in U.S. and risk-free rates.

(2001), our estimated coefficients on equity valuation are significant in statistical inference and large in the absolute value of point estimates. In our sample of corporate bonds issued in Japan, credit spreads tended to reflect firm-level default possibilities in a qualitatively consistent manner.

3-2. Relationships between credit spreads and firm-level factors

This subsection adopts an econometric specification for levels of credit spreads based on equation (1) rather than changes in credit spreads. As expressed in specification (3), we consider as firm-level or issue-specific determinants for credit spreads on corporate bonds, market-evaluated debt equity ratios (its logarithmic transformation $deratio_t^i$), volatility of returns on corporate valuation (σ_t^i), and remaining years up to maturity (its logarithmic transformation T_t^i), as well as risk-free rates of corresponding maturity (r_t) and quarterly time dummy variables ($time_t$) as market-wide effects.

$$spread_t^i = intercept + \alpha(deratio_t^i) + \beta \log(\sigma_t^i) + \gamma(T_t^i) + \theta(r_t) + \sum_{t=1997Q.2}^{2004Q.4} \lambda_t(time_t) + \varepsilon_t^i \quad (3)$$

As equation (1) implies, credit spreads increase with debt equity ratios (positive α) and corporate volatility (positive β). As discussed before, however, the sign of coefficients on maturity may be ambiguous within a standard framework. As in specification (2), we add risk-free rates and quarterly time dummies to capture market-wide effects on credit spreads. In Section 4, we discuss in detail the pattern of estimated coefficients on these time dummies.

Both debt equity ratios and corporate volatility are constructed as follows. A logarithmic transformation of a debt equity ratio of a firm that issues corporate bond i is defined as $\log\left(debt_t^i / equity_t^i \right)$, where $debt_t^i$ is the total book value of long-term debts consisting of long-term loans, straight bonds, convertible bonds, and warrant bonds, and $equity_t^i$ is the same as the market valuation of equities computed from daily stock prices. To compute daily outstanding of long-term debts, we interpolate loan and debt outstanding in semi-annual or quarterly balance sheets in a linear manner. For this purpose, we use financial statements compiled by *Nomura Research Institute*.

We estimate the historical volatility of returns on corporate value V_t^i ($= equity_t^i + debt_t^i$) in the following steps. First, we estimate GARCH(1,1) specification for daily returns on equity valuation $ret_t = \log(equity_t) - \log(equity_{t-1})$, and obtain daily historical volatility as

$$V(ret_t \mid ret_{t-1}) = eq\text{-}\sigma_t^2 = intercept + \alpha(ret_{t-1}^2) + \beta(eq\text{-}\sigma_{t-1}^2).$$

Then, the estimated daily volatility is expressed at annual rates by $eq\text{-}\sigma_t^2 \times 240$, where one year amounts to 240 business days. Finally, we translate the estimated volatility on equity valuation into the historical volatility on corporate valuation using[9]

$$\sigma_t^2 = \left(eq\text{-}\sigma_t^2 \times 240\right) \times \left(\frac{equity_t}{V_t}\right)^2.$$

Following the above procedure, we estimate the historical volatility on corporate valuation for 174 firms, which issue 2305 straight corporate bonds.

Tables 7 to 11 report estimation results for specification (3).[10] Again, a fixed effect specification is preferred to a random effect specification in all cases. As shown in Table 7, consistent with theoretical predictions, estimated coefficients on debt equity ratios are significantly positive in many cases of the full sample period. However, in the cases of short-term highly rated bonds such as Aaa and Aa, estimated coefficients are significantly negative, in contradiction to theoretical predictions.

On the other hand, the full sample period estimation of coefficients on corporate volatility is mixed. Among investment grades (Baa or higher), estimated coefficients are significantly positive for long-term or ultra long-term bonds, but they are significantly negative for short- and middle-term bonds. Among speculative grades (Ba or lower), however, estimated coefficients are significantly positive for short and middle-term bonds, but they are significantly negative for long-term bonds.

[9] We here implicitly assume that a default probability is rather low given that our sample consists of listed large corporations. As shown by Campbell and Taksler (2003), Schönbucher (2003) and Lando (2004), if a default possibility is relatively high, it is necessary to correct default possibilities using $eq\text{-}\sigma_t = \sigma_t \cdot Call'(V_t) \cdot \left(\frac{V_t}{equity_t}\right)$ where $Call(V_t)$ denotes a call option pricing. In our computation, we implicitly assume $Call'(V_t) = 1$.

[10] Rigorously, as Pagan (1984) and Pagan and Ullah (1988) showed, coefficients on estimated second moments $\log(\sigma_t^i)$ are not consistent.

In terms of effects of maturity, coefficients tend to be negative at both ends of short and ultra long terms, and positive for middle and long terms. These results indicate that the term structure of credit spreads generates a nonlinear shape.

According to estimation by subsample periods (Tables 8 to 11), negative coefficients on debt equity ratios, inconsistent with theoretical predictions, appear among short-term investment grades of the first half of the sample period (April 1997 to March 2001 and April 1997 to January 1999). In addition, negative coefficients on corporate volatility show up for the first half of the sample period. For the second half of the sample period, on the other hand, except for middle-term investment grades, credit spreads properly reflect firm-level financial conditions such as debt equity ratios and corporate volatility.

In terms of market-wide effects, as expected theoretically, credit spreads decrease with swap rates in most cases. As shown in Table 11, however, a positive effect of changes in swap rates on credit spreads is observed among middle, long, and ultra long-term investment grades for the period between October 2001 and November 2002. Section 4 discusses the time series pattern in estimated coefficients on quarterly time dummies.

3-3. Examination of quantitative implications for changes in credit spreads

We have explored qualitative implications from equation (1). Now, we investigate quantitative implications using a structural form derived from equation (1).[11]

We first Taylor-expand equation (1) in the neighborhood of equity valuation $equity_{t-k}$ up to a first order as follows:

$$spread_t \approx spread_{t-k} + f'_{t-k} \cdot (equity_t - equity_{t-k}) \quad ,$$

[11] Among empirical studies concerning credit spreads based on structural forms, Eom, Helwege and Huang (2002) rigorously compared the performance for levels of credit spreads, rather than changes, among five structural models: Merton (1974), Geske (1977), Longstaff and Schwartz (1995), Leland and Toft (1996), Collin-Dufresne and Goldstein (2001). According to their comparison, the model of Merton (1974) tends to underestimate credit spreads, and the other models tend to overestimate credit spreads. More precisely, a model by Longstaff and Schwartz (1995) yields overestimated spreads for riskier bonds and underestimated spreads for safer bonds. A model by Collin-Dufresne and Goldstein (2001) generates similar patterns. On the other hand, a model by Leland and Toft (1996) overestimates credit spreads for overall issues regardless of degrees of credit risks.

where $f'_{t-k} = \dfrac{\partial f}{\partial\, equity_{t-k}}$. More specifically, we obtain $f_t' = -\dfrac{1}{T_t}\cdot\dfrac{1}{B_t}\dfrac{N(-z_t)}{N(z_t)}$, where B_t represents a rational pricing of a corporate bond based on the Black–Scholes–Merton formula.

From the above equation, we derive the following specification:

$$spread_t - spread_{t-k} = intercept + \alpha\left(f'_{t-k} \cdot \Delta eq_{t-k} \right) + \varepsilon_t, \qquad (4)$$

where $\Delta eq_t = equity_t - equity_{t-k}$. If an estimated coefficient α is close to one, then credit spreads are formed both qualitatively and quantitatively, consistently with the above structural form.

A value of f_t' can be computed from the explanatory variables used in the previous estimation procedures. We adopt as safe rates r_t swap rates on corresponding maturity.

Table 12 reports estimation results for both full and subsample periods. In most cases, coefficients on changes in equity valuation are close to zero, or even negative, in contradiction to theoretical predictions. In this regard, our estimation results concerning firm-level effects are largely consistent with qualitative implications based on Merton (1974), as reported in the previous subsections, but seriously inconsistent with quantitative implications.

The only exception to this tendency is cases of ultra long-term bonds. In these cases, estimated coefficients on changes in equity valuation are quite close to one for the full sample period. As reported in Table 12, this estimation pattern comes from that of the first half of the sample period. Credit spread on ultra long-term bonds may be formed differently from those on other term bonds.

4. Empirical specifications and estimation results for market-wide effects

This section investigates market-wide effects on credit spreads.[12] More concretely, we carefully examine the time-series pattern of quarterly time effects captured by λ_t in

[12] Anderson and Sundaresan (2000) adopted an alternative method to identify market-wide effects on credit spreads. Using the average debt equity ratio for the entire nonfinancial sector and volatility of stock market indexes, they found that these variables can explain yields on BBB-rated corporate bonds in the U.S.

equation (3), which is an empirical specification for levels of credit spreads. As mentioned before, the first quarter of 2005 serves as a reference point in measuring time effects.

Figures 3 and 4 plot the time series of estimated coefficients on quarterly time dummies with 95% confidence bounds. We first discuss estimation results common among investment grades (Baa or higher), and then consider implications specific to speculative grades (Ba or lower).[13]

As Figures 3 and 4 clearly demonstrate, market-wide effects contributed to an expansion of credit spreads for the period between early 1997 and late 1998. As discussed in the introduction, long-term corporate bonds rated as Baa or lower grades (Figure 2) yielded increases in credit spreads with rises in stock prices for that period. Given qualitatively reasonable estimation for firm-level effects, it follows that market-wide effects cancelled out decreases in credit spreads induced by firm-level equity valuation to a large extent.

We have two remarks on the above period. First, the 'flight to liquidity' phenomenon emerged during the financial crisis in 1997 and 1998. That is, funds shifted from relatively risky markets such as corporate bond markets to relatively safe markets such as JGB markets or money markets. Such an effect might have been stronger in long or ultra long-term bonds. In addition, an increase in new issues of corporate bonds contributed to market liquidity, thereby adding more liquidity premiums to credit spreads.

Second, two companies which issued corporate bonds went bankrupt. Yaohan (a nation-wide supermarket chain) and Nihon Kokudo Kaihatsu (a large-scale general contractor) were insolvent in 1997. Unlike the previous custom, their main banks never bought back outstanding corporate bonds at face value; consequently, the corporate bonds issued by these companies were in default. Given these incidents, institutional investors revised credit spreads upward, in particular for low-graded corporate bonds.

On the other hand, market-wide effects had contributed to continuous declines in credit spreads among overall issues since early 1999. The flight to liquidity phenomenon,

[13] We confirm that the estimated time effects are similar grade by grade. The estimation result of each grade (Aaa, Aa, A and Baa) is available from the authors on request.

which was responsible for market-wide increases in credit spreads, disappeared after public injections into private banks in early 1999.

As a result of zero interest policy initiated in February 1999, and quantity easing policy implemented in March 2001, rich funds held by public and private financial institutions began to flow into corporate bond markets in search of relatively profitable investment opportunities. As Figure 5 demonstrates,[14] outstanding corporate bonds held by public and private financial institutions increased continuously and substantially from 1999.

The above flow into corporate bond markets was terminated temporarily by bankruptcy of MyCal (a large-scale supermarket chain) in September 2001. As a result of that bankruptcy, all 27 issues of corporate bonds issued by MyCal were in default. At the same time, investors again revised credit spreads upward in particular for long and ultra long-term bonds and speculative grades. On the other hand, credit spreads on short-term bonds were free from such negative effects; they continued to decline.

However, the effect of the default of MyCal was only temporarily. Public and private financial institutions resumed investments in corporate bonds and even in low-grade bonds. As discussed in the introduction, credit spreads declined among overall issues, although equity valuation slumped up to late 2003. That is, a market-wide effect induced by aggressive monetary policy continued to cancel out increases in credit spreads driven by equity devaluation at the level of individual firms for that period.

The finding that credit spreads continued to decline even among speculative grades suggests that credit risks were seriously underevaluated as a result of aggressive monetary policy.

5. Conclusions

Using data on corporate bonds issued in Japan for the period between 1997 and 2005, this paper explores possible determinants for credit spreads of corporate bond rates over

[14] Based on the flow of funds account compiled by the Bank of Japan, Figure 5 depicts the outstanding corporate bonds consisting of straight bonds, convertible bonds, and warrant bonds held by public and private financial institutions. A unit is one trillion yen.

interest swap rates. We find that credit spreads reasonably reflected firm-level financial factors, including debt equity ratios, volatility, and maturity. In addition, credit spreads on ultra long-term bonds (longer than 10 years) reflected default possibilities even in quantitative terms. Overall estimation results indicate that credit spreads are influenced by firm-level and issue-specific factors in a quite reasonable manner.

On the other hand, an economy-wide factor common among bond issues, measured in terms of time effects, played an important role in determining credit spreads. This aspect is seriously inconsistent with a standard model of Merton (1974), in which macroeconomic effects can be mostly captured by firm-level variables. In particular, such a common factor had significant effects on credit spreads observed for both the period between 1997 and 1998, when financial markets were subject to liquidity crises, and the period between 2001 and 2003, during which the Bank of Japan implemented quantity easing policy at zero overnight money market rates. In both periods, an economy-wide effect cancelled out firm-level factors to a large extent. In the former period, credit spreads increased even though individual stock prices (or equivalently corporate value) were still firm, while in the latter period, credit spreads declined substantially although equity valuation fell heavily. The finding about the latter period indicates that credit risks were seriously underevaluated as a result of aggressive monetary policy.

More detailed examination about market-wide effects, in particular fundamental factors responsible for macro effects, will be an important subject of our future research.

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Table 1: Relationship between Changes in Credit Spreads and Firm Equity Returns

Full Period (April 1, 1997–January 31, 2005)

Maturities	Independent Variables	Rating Groups						
		Investment-grade	Speculative-grade	Investment-grade				
				A or Higher	Aaa	Aa	A	Baa
Short	ret^i_{t-20}	-0.018	-0.391	-0.048	-0.292	-0.116	-0.032	-0.017
		(0.008)	(0.033)	(0.017)	(0.220)	(0.031)	(0.007)	(0.008)
	Δr_{t-20}	-0.067	0.135	-0.114	-0.266	-0.122	-0.015	-0.022
		(0.023)	(0.014)	(0.040)	(0.287)	(0.051)	(0.009)	(0.018)
R-sqaures (R^2)		0.006	0.050	0.010	0.016	0.010	0.028	0.007
the number of issues		1365	400	764	108	422	361	727
Middle	ret^i_{t-20}	-0.041	-0.177	-0.039	-0.033	-0.036	-0.048	-0.042
		(0.002)	(0.012)	(0.002)	(0.006)	(0.002)	(0.003)	(0.002)
	Δr_{t-20}	-0.026	0.029	-0.033	-0.019	-0.027	-0.043	-0.022
		(0.001)	(0.005)	(0.001)	(0.019)	(0.001)	(0.001)	(0.001)
R-sqaures (R^2)		0.109	0.112	0.189	0.153	0.210	0.223	0.123
the number of issues		1422	342	823	94	388	446	756
Long	ret^i_{t-20}	-0.024	-0.116	-0.020	-0.193	-0.012	-0.023	-0.031
		(0.001)	(0.022)	(0.002)	(0.026)	(0.001)	(0.002)	(0.002)
	Δr_{t-20}	-0.050	0.002	-0.044	-0.080	-0.033	-0.049	-0.063
		(0.001)	(0.010)	(0.025)	(0.026)	(0.001)	(0.002)	(0.002)
R-sqaures (R^2)		0.197	0.188	0.181	0.073	0.214	0.274	0.281
the number of issues		564	45	430	51	252	206	174
Ultra-long	ret^i_{t-20}	-0.074	-	-0.070	-0.441	-0.065	-0.067	-0.110
		(0.003)	-	(0.003)	(0.017)	(0.002)	(0.058)	(0.010)
	Δr_{t-20}	-0.074	-	-0.072	-0.121	-0.073	-0.063	-0.103
		(0.001)	-	(0.001)	(0.003)	(0.001)	(0.002)	(0.004)
R-sqaures (R^2)		0.177	-	0.186	0.224	0.194	0.248	0.272
the number of issues		239	-	218	46	155	104	35

1. The results are based on fixed effect estimation of equation (2) during the period between April 1, 1997 and January 31, 2005.
2. The number in a parenthesis is a robust standard error of a fixed effect estimate. The reported standard error based on Arellano (1987) is robust with respect to cross-sectional heteroskedasticity and within-issue serial correlation.
3. For esimation of speculative grades, the sample period between August 5, 2002 and September 20, 2002 is excluded because bid/ask prices of speculative grades were not quoted by corporate bond dealers at all.

Table 2: Effects of Changes in Rating on Changes in Credit Spreads for Investment-grade and Speculative-grade Bonds

Full Period (April 1, 1997–January 31, 2005)

Maturities	Rating Groups	Rating Changes: Rating Up +3	+2	+1	Rating Down -1	-2	-3	-5	-6	-10	-11
Short	Investment	-0.416	-0.014	-0.015	0.025	0.012	0.384	-	-	-	-
		(0.028)	(0.003)	(0.009)	(0.006)	(0.046)	(0.122)	-	-	-	-
	Speculative	-0.125	-0.005	-0.022	0.736	0.410	0.067	6.791	6.590	-	-
		(0.052)	(0.005)	(0.027)	(0.028)	(0.049)	(0.185)	(0.364)	(0.354)	-	-
Middle	Investment	-0.643	-0.007	-0.010	0.021	0.075	0.038	-	-	-	-
		(0.015)	(0.001)	(0.001)	(0.002)	(0.005)	(0.020)	-	-	-	-
	Speculative	-	-0.081	-0.025	0.288	0.350	1.368	7.153	6.833	0.022	0.014
		-	(0.012)	(0.015)	(0.017)	(0.031)	(0.243)	(0.248)	(0.244)	(0.005)	(0.005)
Long	Investment	-	-0.010	-0.002	0.001	0.035	0.040	-	-	-	-
		-	(0.001)	(0.001)	(0.001)	(0.002)	(0.008)	-	-	-	-
	Speculative	-	-	-0.025	0.052	0.117	3.110	5.272	5.299	-	-
		-	-	(0.006)	(0.044)	(0.010)	(0.516)	(0.558)	(0.531)	-	-
Ultra-long	Investment	-	-0.027	-0.043	0.024	0.013	0.026	-	-	-	-
		-	(0.002)	(0.009)	(0.002)	(0.004)	(0.008)	-	-	-	-
	Speculative	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-

1. The results are based on fixed effect estimation of equation (2) during the period between April 1, 1997 and January 31, 2005.
2. The number in a parenthesis is a robust standard error of a fixed effect estimate. The reported standard error based on Arellano (1987) is robust with respect to cross-sectional heteroskedasticity and within-issue serial correlation.
3. For esimation of speculative grades, the sample period between August 5, 2002 and September 20, 2002 is excluded because bid/ask prices of speculative grades were not quoted by corporate bond dealers at all.

Table 3: Relationship between Changes in Credit Spreads and Firm Equity Returns

First Period (April 1, 1997–March 31, 2001)

Maturities	Independent Variables	Rating Groups						
		Investment-grade	Speculative-grade	Investment-grade				
				A or Higher	Aaa	Aa	A	Baa
Short	ret^i_{t-20}	-0.013	-0.082	-0.046	-0.292	-0.173	0.003	-0.002
		(0.014)	(0.011)	(0.031)	(0.220)	(0.058)	(0.013)	(0.014)
	Δr_{t-20}	-0.066	0.041	-0.113	-0.266	-0.120	0.005	-0.021
		(0.026)	(0.010)	(0.044)	(0.137)	(0.054)	(0.011)	(0.019)
R-sqaures (R^2)		0.006	0.045	0.010	0.016	0.010	0.030	0.007
the number of issues		806	233	501	108	303	151	351
Middle	ret^i_{t-20}	-0.027	-0.049	-0.029	-0.034	-0.022	-0.040	-0.025
		(0.001)	(0.004)	(0.002)	(0.006)	(0.003)	(0.003)	(0.001)
	Δr_{t-20}	-0.041	-0.003	-0.044	-0.019	-0.045	-0.057	-0.038
		(0.001)	(0.004)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
R-sqaures (R^2)		0.268	0.234	0.248	0.153	0.228	0.333	0.322
the number of issues		958	255	514	91	236	242	521
Long	ret^i_{t-20}	-0.021	-0.011	-0.010	-0.205	0.030	-0.021	-0.027
		(0.002)	(0.006)	(0.003)	(0.027)	(0.003)	(0.003)	(0.003)
	Δr_{t-20}	-0.079	-0.080	-0.079	-0.082	-0.091	-0.078	-0.078
		(0.001)	(0.004)	(0.001)	(0.004)	(0.002)	(0.002)	(0.002)
R-sqaures (R^2)		0.269	0.540	0.227	0.074	0.328	0.346	0.380
the number of issues		379	39	264	49	137	113	143
Ultra-long	ret^i_{t-20}	-0.055	-	-0.041	-0.469	-0.010	-0.048	-0.115
		(0.003)	-	(0.003)	(0.018)	(0.003)	(0.005)	(0.008)
	Δr_{t-20}	-0.102	-	-0.100	-0.124	-0.109	-0.089	-0.114
		(0.001)	-	(0.001)	(0.003)	(0.002)	(0.003)	(0.005)
R-sqaures (R^2)		0.217	-	0.211	0.225	0.210	0.390	0.382
the number of issues		205	-	185	46	137	41	31

1. The results are based on fixed effect estimation of equation (2) during the period between April 1, 1997 and March 31, 2001.
2. The number in a parenthesis is a robust standard error of a fixed effect estimate. The reported standard error based on Arellano (1987) is robust with respect to cross-sectional heteroskedasticity and within-issue serial correlation.

Table 4: Relationship between Changes in Credit Spreads and Firm Equity Returns

Second Period (April 1, 2001–January 31, 2005)

Maturities	Independent Variables	Rating Groups						
		Investment-grade	Speculative-grade	Investment-grade				
				A or Higher	Aaa	Aa	A	Baa
Short	ret^i_{t-20}	-0.025	-0.615	-0.047	-	-0.035	-0.067	-0.036
		(0.007)	(0.059)	(0.006)	-	(0.008)	(0.008)	(0.009)
	Δr_{t-20}	-0.094	0.419	-0.091	-	-0.052	-0.114	-0.087
		(0.006)	(0.065)	(0.006)	-	(0.010)	(0.007)	(0.010)
R-sqaures (R^2)		0.008	0.055	0.011	-	0.013	0.017	0.011
the number of issues		1006	343	500	-	278	288	585
Middle	ret^i_{t-20}	-0.058	-0.439	-0.049	-	-0.038	-0.062	-0.066
		(0.003)	(0.035)	(0.003)	-	(0.002)	(0.006)	(0.004)
	Δr_{t-20}	0.022	0.181	0.013	-	0.031	0.001	0.027
		(0.001)	(0.030)	(0.001)	-	(0.001)	(0.001)	(0.002)
R-sqaures (R^2)		0.064	0.111	0.078	-	0.137	0.078	0.085
the number of issues		875	187	497	-	251	293	458
Long	ret^i_{t-20}	-0.025	-0.586	-0.023	-	-0.018	-0.029	-0.050
		(0.002)	(0.109)	(0.002)	-	(0.002)	(0.003)	(0.005)
	Δr_{t-20}	0.033	0.711	0.035	-	0.047	0.019	0.030
		(0.001)	(0.090)	(0.001)	-	(0.001)	(0.001)	(0.004)
R-sqaures (R^2)		0.102	0.181	0.119	-	0.134	0.138	0.165
the number of issues		403	24	307	-	202	147	108
Ultra-long	ret^i_{t-20}	-0.094	-	-0.096	-	-0.108	-0.085	-0.103
		(0.006)	-	(0.005)	-	(0.003)	(0.011)	(0.030)
	Δr_{t-20}	-0.006	-	-0.006	-	0.005	-0.030	-0.006
		(0.001)	-	(0.001)	-	(0.001)	(0.003)	(0.015)
R-sqaures (R^2)		0.175	-	0.177	-	0.232	0.132	0.261
the number of issues		172	-	166	-	132	82	11

1. The results are based on fixed effect estimation of equation (2) during the period between April 1, 2001 and January 31, 2005.
2. The number in a parenthesis is a robust standard error of a fixed effect estimate. The reported standard error based on Arellano (1987) is robust with respect to cross-sectional heteroskedasticity and within-issue serial correlation.
3. For esimation of speculative grades, the sample period between August 5, 2002 and September 20, 2002 is excluded because bid/ask prices of speculative grades were not quoted by corporate bond dealers at all.

Table 5: Relationship between Changes in Credit Spreads and Firm Equity Returns

Subperiod 1 (April 1, 1997–January 31, 1999)

Maturities	Independent Variables	Rating Groups						
		Investment-grade	Speculative-grade	Investment-grade				
				A or Higher	Aaa	Aa	A	Baa
Short	ret^i_{t-20}	0.122	-0.252	-0.110	-0.288	-2.291	0.091	0.196
		(0.047)	(0.029)	(0.084)	(0.389)	(0.547)	(0.025)	(0.053)
	Δr_{t-20}	-0.157	0.395	-0.239	-0.431	-0.224	-0.014	-0.037
		(0.062)	(0.030)	(0.088)	(0.191)	(0.130)	(0.021)	(0.053)
R-sqaures (R^2)		0.006	0.105	0.010	0.014	0.011	0.026	0.005
the number of issues		448	65	306	102	129	75	169
Middle	ret^i_{t-20}	-0.057	-0.148	-0.033	0.034	0.072	-0.081	-0.084
		(0.003)	(0.009)	(0.004)	(0.008)	(0.009)	(0.005)	(0.003)
	Δr_{t-20}	-0.044	0.115	-0.051	-0.047	-0.048	-0.055	-0.035
		(0.010)	(0.009)	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)
R-sqaures (R^2)		0.122	0.196	0.089	0.088	0.069	0.173	0.176
the number of issues		664	127	372	88	122	165	326
Long	ret^i_{t-20}	-0.059	-0.081	-0.013	0.058	0.012	-0.062	-0.099
		(0.005)	(0.012)	(0.005)	(0.017)	(0.012)	(0.007)	(0.006)
	Δr_{t-20}	-0.106	-0.024	-0.106	-0.120	-0.101	-0.096	-0.107
		(0.002)	(0.008)	(0.002)	(0.004)	(0.003)	(0.004)	(0.003)
R-sqaures (R^2)		0.183	0.185	0.169	0.193	0.186	0.204	0.245
the number of issues		232	19	160	45	48	70	84
Ultra-long	ret^i_{t-20}	-0.071	-	-0.070	-0.162	-0.126	-0.108	-0.129
		(0.007)	-	(0.007)	(0.024)	(0.014)	(0.010)	(0.012)
	Δr_{t-20}	-0.139	-	-0.134	-0.135	-0.140	-0.113	-0.153
		(0.002)	-	(0.002)	(0.003)	(0.003)	(0.005)	(0.006)
R-sqaures (R^2)		0.201	-	0.200	0.211	0.226	0.270	0.307
the number of issues		148	-	131	41	62	29	26

1. The results are based on fixed effect estimation of equation (2) during the period between April 1, 1997 and January 31, 1999.
2. The number in a parenthesis is a robust standard error of a fixed effect estimate. The reported standard error based on Arellano (1987) is robust with respect to cross-sectional heteroskedasticity and within-issue serial correlation.

Table 6: Relationship between Changes in Credit Spreads and Firm Equity Returns

Subperiod 2 (October 1, 2001–December 31, 2002)

Maturities	Independent Variables	Rating Groups						
		Investment-grade	Speculative-grade	Investment-grade				
				A or Higher	Aaa	Aa	A	Baa
Short	ret^i_{t-20}	-0.070	-1.140	-0.068	-	0.006	-0.101	-0.101
		(0.014)	(0.087)	(0.013)	-	(0.007)	(0.017)	(0.020)
	Δr_{t-20}	-0.317	4.633	-0.128	-	-0.013	-0.337	-0.485
		(0.059)	(0.650)	(0.025)	-	(0.019)	(0.062)	(0.105)
R-sqaures (R^2)		0.004	0.044	0.005	-	0.006	0.011	0.005
the number of issues		686	247	331	-	202	130	385
Middle	ret^i_{t-20}	-0.084	-0.856	-0.045	-	-0.025	-0.074	-0.125
		(0.006)	(0.058)	(0.004)	-	(0.002)	(0.010)	(0.010)
	Δr_{t-20}	0.196	1.278	0.155	-	0.208	0.082	0.245
		(0.011)	(0.256)	(0.003)	-	(0.003)	(0.005)	(0.022)
R-sqaures (R^2)		0.058	0.059	0.165	-	0.250	0.180	0.070
the number of issues		615	140	311	-	176	139	334
Long	ret^i_{t-20}	-0.018	-1.050	-0.019	-	-0.011	-0.056	-0.029
		(0.003)	(0.258)	(0.002)	-	(0.002)	(0.008)	(0.012)
	Δr_{t-20}	0.100	3.074	0.090	-	0.093	0.068	0.116
		(0.006)	(0.506)	(0.003)	-	(0.003)	(0.009)	(0.020)
R-sqaures (R^2)		0.103	0.138	0.138	-	0.168	0.146	0.153
the number of issues		264	18	203	-	147	58	66
Ultra-long	ret^i_{t-20}	-0.024	-	-0.049	-	-0.077	-0.020	0.022
		(0.004)	-	(0.004)	-	(0.005)	(0.006)	(0.023)
	Δr_{t-20}	-0.023	-	-0.026	-	-0.035	0.025	-0.027
		(0.004)	-	(0.003)	-	(0.004)	(0.008)	(0.055)
R-sqaures (R^2)		0.205	-	0.243	-	0.246	0.259	0.189
the number of issues		148	-	141	-	119	22	8

1. The results are based on fixed effect estimation of equation (2) during the period between October 1, 2001 and December 31, 2002.
2. The number in a parenthesis is a robust standard error of a fixed effect estimate. The reported standard error based on Arellano (1987) is robust with respect to cross-sectional heteroskedasticity and within-issue serial correlation.
3. For esimation of speculative grades, the sample period between August 5, 2002 and September 20, 2002 is excluded because bid/ask prices of speculative grades were not quoted by corporate bond dealers at all.

Table 7: Regression of Credit Spreads on Debt-equity Ratios, Volatilities, Maturities, and Swap Rates

Full Period (April 1, 1997–January 31, 2005)

Maturities	Independent Variables	Rating Groups						
		Investment-grade	Speculative-grade	Investment-grade				
				A or Higher	Aaa	Aa	A	Baa
Short	$deratio_t^i$	0.067	1.151	-0.003	-0.587	-0.035	0.005	0.047
		(0.002)	(0.024)	(0.003)	(0.081)	(0.007)	(0.002)	(0.003)
	σ_t^i	-0.004	0.075	0.013	0.122	0.0002	-0.013	-0.003
		(0.004)	(0.028)	(0.006)	(0.075)	(0.006)	(0.004)	(0.004)
	T_t^i	-0.082	0.101	-0.036	0.079	-0.049	-0.060	-0.132
		(0.003)	(0.014)	(0.003)	(0.001)	(0.004)	(0.004)	(0.006)
	r_t	-0.119	-0.107	-0.167	-0.217	-0.169	-0.091	-0.094
		(0.013)	(0.037)	(0.021)	(0.074)	(0.025)	(0.014)	(0.015)
R-sqaures (R^2)		0.052	0.271	0.029	0.033	0.028	0.201	0.155
the number of issues		1352	396	750	110	422	344	718
Middle	$deratio_t^i$	0.107	1.173	0.092	0.085	0.007	0.057	0.102
		(0.001)	(0.020)	(0.001)	(0.006)	(0.001)	(0.001)	(0.002)
	σ_t^i	-0.026	0.126	0.006	0.014	0.0014	-0.004	-0.008
		(0.001)	(0.018)	(0.001)	(0.001)	(0.0004)	(0.001)	(0.002)
	T_t^i	0.310	1.242	0.152	-0.006	0.098	0.231	0.449
		(0.008)	(0.142)	(0.011)	(0.009)	(0.017)	(0.010)	(0.011)
	r_t	-0.047	-0.156	-0.035	-0.002	-0.047	-0.054	-0.057
		(0.002)	(0.021)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
R-sqaures (R^2)		0.454	0.430	0.646	0.802	0.800	0.741	0.541
the number of issues		1472	351	846	97	403	448	774
Long	$deratio_t^i$	0.110	0.307	0.049	0.072	0.008	0.040	0.042
		(0.002)	(0.012)	(0.001)	(0.007)	(0.001)	(0.002)	(0.003)
	σ_t^i	0.010	-0.170	0.006	0.016	0.0008	0.0003	-0.007
		(0.002)	(0.021)	(0.001)	(0.002)	(0.0005)	(0.002)	(0.004)
	T_t^i	0.486	1.862	0.560	0.811	0.317	0.596	0.533
		(0.027)	(0.424)	(0.018)	(0.043)	(0.011)	(0.049)	(0.072)
	r_t	-0.071	-0.065	-0.078	-0.084	0.856	-0.051	-0.082
		(0.002)	(0.019)	(0.001)	(0.003)	(0.003)	(0.002)	(0.004)
R-sqaures (R^2)		0.598	0.745	0.682	0.773	0.010	0.819	0.736
the number of issues		679	53	478	55	262	239	238
Ultra-long	$deratio_t^i$	0.198	-	0.101	0.217	0.024	0.109	0.041
		(0.002)	-	(0.002)	(0.020)	(0.001)	(0.005)	(0.010)
	σ_t^i	0.009	-	0.009	-0.003	0.003	0.003	-0.021
		(0.001)	-	(0.001)	(0.004)	(0.001)	(0.002)	(0.007)
	T_t^i	-0.253	-	-0.009	0.926	-0.178	0.040	0.443
		(0.015)	-	(0.023)	(0.050)	(0.039)	(0.036)	(0.119)
	r_t	-0.107	-	-0.099	-0.116	-0.095	-0.065	-0.085
		(0.002)	-	(0.001)	(0.003)	(0.001)	(0.003)	(0.009)
R-sqaures (R^2)		0.556	-	0.663	0.525	0.756	0.803	0.740
the number of issues		473	-	400	74	251	166	86

1. The results are based on fixed effect estimation of equation (3) during the period between April 1, 1997 and January 31, 2005.
2. The number in a parenthesis is a robust standard error of a fixed effect estimate. The reported standard error based on Arellano (1987) is robust with respect to cross-sectional heteroskedasticity and within-issue serial correlation.
3. For esimation of speculative grades, the sample period between August 5, 2002 and September 20, 2002 is excluded because bid/ask prices of speculative grades were not quoted by corporate bond dealers at all.

Table 8: Regression of Credit Spreads on Debt-equity Ratios, Volatilities, Maturities, and Swap Rates

First Period (April 1, 1997–March 31, 2001)

Maturities	Independent Variables	Investment-grade	Speculative-grade	A or Higher	Aaa	Aa	A	Baa
		Rating Groups		Investment-grade				
Short	$deratio_t^i$	0.090	0.225	-0.060	-0.587	-0.084	-0.048	0.043
		(0.005)	(0.010)	(0.008)	(0.081)	(0.016)	(0.011)	(0.005)
	σ_t^i	-0.022	0.134	0.011	0.122	-0.003	-0.046	-0.034
		(0.007)	(0.011)	(0.011)	(0.075)	(0.009)	(0.008)	(0.005)
	T_t^i	-0.027	0.248	0.004	0.079	-0.029	-0.002	-0.089
		(0.006)	(0.020)	(0.006)	(0.011)	(0.008)	(0.010)	(0.015)
	r_t	-0.112	-0.263	-0.177	-0.217	-0.202	-0.083	-0.078
		(0.016)	(0.030)	(0.024)	(0.084)	(0.030)	(0.015)	(0.021)
R-sqaures (R^2)		0.044	0.305	0.029	0.033	0.028	0.183	0.148
the number of issues		808	230	505	110	305	151	349
Middle	$deratio_t^i$	0.149	0.278	0.142	0.085	-0.020	0.030	0.042
		(0.001)	(0.007)	(0.001)	(0.006)	(0.003)	(0.002)	(0.001)
	σ_t^i	-0.018	0.027	0.008	0.014	0.005	-0.007	-0.025
		(0.001)	(0.010)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
	T_t^i	0.151	0.450	0.077	-0.003	-0.004	0.135	0.295
		(0.010)	(0.124)	(0.014)	(0.010)	(0.022)	(0.013)	(0.011)
	r_t	-0.029	-0.123	-0.020	-0.002	-0.041	-0.040	-0.056
		(0.002)	(0.017)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
R-sqaures (R^2)		0.669	0.421	0.704	0.802	0.805	0.819	0.806
the number of issues		1006	259	552	94	256	258	533
Long	$deratio_t^i$	0.142	0.165	0.121	0.076	0.006	0.037	0.033
		(0.002)	(0.004)	(0.002)	(0.007)	(0.002)	(0.002)	(0.002)
	σ_t^i	0.001	-0.026	0.005	0.016	0.004	-0.005	-0.018
		(0.002)	(0.006)	(0.001)	(0.002)	(0.001)	(0.002)	(0.003)
	T_t^i	0.846	2.101	0.582	0.814	0.402	0.544	1.001
		(0.038)	(0.473)	(0.031)	(0.045)	(0.060)	(0.043)	(0.092)
	r_t	-0.091	-0.106	-0.089	-0.086	-0.121	-0.069	-0.097
		(0.003)	(0.011)	(0.002)	(0.003)	(0.002)	(0.003)	(0.004)
R-sqaures (R^2)		0.673	0.875	0.679	0.773	0.839	0.864	0.829
the number of issues		478	46	313	53	146	150	194
Ultra-long	$deratio_t^i$	0.247	-	0.163	0.251	0.003	-0.013	0.035
		(0.004)	-	(0.003)	(0.022)	(0.002)	(0.004)	(0.011)
	σ_t^i	0.006	-	0.012	-0.003	0.008	-0.004	-0.025
		(0.001)	-	(0.001)	(0.004)	(0.001)	(0.003)	(0.007)
	T_t^i	-0.253	-	0.711	0.556	0.826	0.514	0.082
		(0.055)	-	(0.037)	(0.082)	(0.042)	(0.056)	(0.132)
	r_t	-0.126	-	-0.122	-0.117	-0.117	-0.067	-0.078
		(0.002)	-	(0.002)	(0.003)	(0.002)	(0.005)	(0.011)
R-sqaures (R^2)		0.603	-	0.672	0.523	0.737	0.890	0.805
the number of issues		370	-	304	74	182	90	77

1. The results are based on fixed effect estimation of equation (3) during the period between April 1, 1997 and March 31, 2001.
2. The number in a parenthesis is a robust standard error of a fixed effect estimate. The reported standard error based on Arellano (1987) is robust with respect to cross-sectional heteroskedasticity and within-issue serial correlation.

Table 9: Regression of Credit Spreads on Debt-equity Ratios, Volatilities, Maturities, and Swap Rates

Second Period (April 1, 2001–January 31, 2005)

Maturities	Independent Variables	Rating Groups						
		Investment-grade	Speculative-grade	Investment-grade				
				A or Higher	Aaa	Aa	A	Baa
Short	$deratio_t^i$	0.050	1.942	0.018	-	0.019	0.011	0.036
		(0.002)	(0.052)	(0.001)	-	(0.006)	(0.002)	(0.004)
	σ_t^i	0.026	0.205	0.010	-	0.004	0.011	0.027
		(0.003)	(0.049)	(0.002)	-	(0.002)	(0.003)	(0.005)
	T_t^i	-0.110	0.085	-0.065	-	-0.058	-0.082	-0.144
		(0.004)	(0.019)	(0.002)	-	(0.003)	(0.004)	(0.006)
	r_t	-0.153	1.900	-0.187	-	-0.140	-0.215	-0.181
		(0.012)	(0.120)	(0.008)	-	(0.013)	(0.011)	(0.019)
R-sqaures (R^2)		0.111	0.274	0.085	-	0.073	0.162	0.164
the number of issues		990	340	482	-	276	271	577
Middle	$deratio_t^i$	0.072	2.873	0.023	-	0.014	0.105	0.166
		(0.002)	(0.048)	(0.002)	-	(0.001)	(0.003)	(0.004)
	σ_t^i	-0.025	0.407	0.002	-	-0.003	0.005	-0.0003
		(0.002)	(0.042)	(0.001)	-	(0.001)	(0.002)	(0.005)
	T_t^i	0.392	2.842	0.063	-	0.045	0.165	0.550
		(0.012)	(0.225)	(0.007)	-	(0.003)	(0.016)	(0.019)
	r_t	-0.047	-0.196	-0.067	-	-0.054	-0.070	-0.008
		(0.003)	(0.052)	(0.001)	-	(0.001)	(0.002)	(0.005)
R-sqaures (R^2)		0.239	0.465	0.495	-	0.782	0.481	0.348
the number of issues		879	191	484	-	247	280	464
Long	$deratio_t^i$	0.104	2.214	0.028	-	0.001	0.081	0.151
		(0.004)	(0.103)	(0.001)	-	(0.001)	(0.003)	(0.011)
	σ_t^i	0.008	0.158	-0.003	-	-0.006	0.001	0.014
		(0.003)	(0.079)	(0.001)	-	(0.001)	(0.003)	(0.011)
	T_t^i	0.064	-5.400	0.644	-	0.661	0.684	-0.255
		(0.026)	(1.241)	(0.012)	-	(0.009)	(0.028)	(0.098)
	r_t	-0.030	0.250	-0.040	-	-0.052	-0.021	-0.010
		(0.002)	(0.092)	(0.001)	-	(0.001)	(0.002)	(0.008)
R-sqaures (R^2)		0.319	0.772	0.597	-	0.771	0.531	0.441
the number of issues		419	25	306	-	204	142	121
Ultra-long	$deratio_t^i$	0.187	-	0.101	-	0.029	0.192	0.126
		(0.005)	-	(0.004)	-	(0.002)	(0.012)	(0.024)
	σ_t^i	0.006	-	-0.001	-	-0.006	0.002	-0.020
		(0.001)	-	(0.001)	-	(0.001)	(0.003)	(0.019)
	T_t^i	-0.712	-	-0.969	-	-0.956	-0.709	-2.554
		(0.020)	-	(0.013)	-	(0.014)	(0.042)	(0.310)
	r_t	-0.062	-	-0.062	-	-0.051	-0.072	-0.038
		(0.002)	-	(0.001)	-	(0.001)	(0.002)	(0.019)
R-sqaures (R^2)		0.474	-	0.700	-	0.778	0.526	0.551
the number of issues		245	-	231	-	187	93	16

1. The results are based on fixed effect estimation of equation (3) during the period between April 1, 2001 and January 31, 2005.
2. The number in a parenthesis is a robust standard error of a fixed effect estimate. The reported standard error based on Arellano (1987) is robust with respect to cross-sectional heteroskedasticity and within-issue serial correlation.
3. For esimation of speculative grades, the sample period between August 5, 2002 and September 20, 2002 is excluded because bid/ask prices of speculative grades were not quoted by corporate bond dealers at all.

Table 10: Regression of Credit Spreads on Debt-equity Ratios, Volatilities, Maturities, and Swap Rates

Subperiod 1 (April 1, 1997–January 31, 1999)

Maturities	Independent Variables	Rating Groups						
		Investment-grade	Speculative-grade	Investment-grade				
				A or Higher	Aaa	Aa	A	Baa
Short	$deratio_t^i$	-0.002	0.791	-0.327	-0.900	-0.031	0.140	0.109
		(0.026)	(0.035)	(0.034)	(0.154)	(0.169)	(0.019)	(0.016)
	σ_t^i	-0.014	-0.084	0.044	0.158	0.016	-0.010	-0.061
		(0.022)	(0.028)	(0.032)	(0.093)	(0.035)	(0.016)	(0.012)
	T_t^i	0.066	0.588	0.077	0.052	0.068	0.170	0.063
		(0.008)	(0.039)	(0.008)	(0.016)	(0.012)	(0.012)	(0.017)
	r_t	-0.171	0.039	-0.276	-0.433	-0.204	-0.104	-0.074
		(0.039)	(0.061)	(0.053)	(0.114)	(0.073)	(0.027)	(0.049)
R-sqaures (R^2)		0.028	0.422	0.027	0.034	0.026	0.204	0.047
the number of issues		454	64	312	104	131	77	169
Middle	$deratio_t^i$	0.337	0.688	0.268	0.034	-0.018	0.124	0.079
		(0.002)	(0.017)	(0.002)	(0.006)	(0.011)	(0.003)	(0.003)
	σ_t^i	-0.052	-0.163	-0.003	0.014	0.006	-0.030	-0.045
		(0.002)	(0.014)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)
	T_t^i	-0.448	-1.093	-0.170	0.031	-0.197	-0.430	-0.611
		(0.014)	(0.155)	(0.010)	(0.010)	(0.008)	(0.022)	(0.022)
	r_t	-0.012	0.190	-0.006	-0.029	-0.030	0.0004	-0.014
		(0.002)	(0.025)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
R-sqaures (R^2)		0.688	0.588	0.744	0.812	0.772	0.840	0.786
the number of issues		705	126	400	91	129	183	341
Long	$deratio_t^i$	0.336	0.297	0.249	0.030	0.139	0.063	0.191
		(0.005)	(0.017)	(0.004)	(0.008)	(0.005)	(0.006)	(0.007)
	σ_t^i	-0.026	-0.104	0.003	0.032	0.028	-0.005	-0.023
		(0.003)	(0.010)	(0.002)	(0.002)	(0.002)	(0.003)	(0.005)
	T_t^i	-1.435	-6.549	-0.490	0.225	0.147	-2.036	-4.032
		(0.064)	(0.320)	(0.046)	(0.048)	(0.041)	(0.076)	(0.119)
	r_t	-0.026	0.131	-0.046	-0.102	-0.077	-0.028	-0.015
		(0.004)	(0.016)	(0.002)	(0.003)	(0.003)	(0.004)	(0.006)
R-sqaures (R^2)		0.730	0.886	0.772	0.789	0.808	0.883	0.837
the number of issues		300	24	193	48	50	98	120
Ultra-long	$deratio_t^i$	0.505	-	0.320	0.127	-0.051	0.125	0.425
		(0.007)	-	(0.005)	(0.014)	(0.008)	(0.009)	(0.020)
	σ_t^i	-0.006	-	0.015	0.022	0.011	-0.003	-0.057
		(0.002)	-	(0.002)	(0.002)	(0.002)	(0.005)	(0.009)
	T_t^i	-3.454	-	-1.695	0.310	-0.122	-1.825	-2.218
		(0.099)	-	(0.061)	(0.085)	(0.002)	(0.132)	(0.315)
	r_t	-0.087	-	-0.102	-0.126	-0.042	0.008	0.007
		(0.003)	-	(0.002)	(0.003)	(0.003)	(0.007)	(0.013)
R-sqaures (R^2)		0.711	-	0.732	0.721	0.770	0.875	0.827
the number of issues		247	-	199	63	74	63	57

1. The results are based on fixed effect estimation of equation (3) during the period between April 1, 1997 and January 31, 1999.
2. The number in a parenthesis is a robust standard error of a fixed effect estimate. The reported standard error based on Arellano (1987) is robust with respect to cross-sectional heteroskedasticity and within-issue serial correlation.

Table 11: Regression of Credit Spreads on Debt-equity Ratios, Volatilities, Maturities, and Swap Rates

Subperiod 2 (October 1, 2001–December 31, 2002)

Maturities	Independent Variables	Rating Groups						
		Investment-grade	Speculative-grade	Investment-grade				
				A or Higher	Aaa	Aa	A	Baa
Short	$deratio_t^i$	0.034	3.540	0.020	-	-0.018	0.053	0.104
		(0.007)	(0.117)	(0.003)	-	(0.002)	(0.004)	(0.014)
	σ_t^i	0.080	0.174	0.017	-	0.004	0.018	0.083
		(0.007)	(0.067)	(0.004)	-	(0.002)	(0.011)	(0.013)
	T_t^i	-0.224	0.221	-0.099	-	-0.051	-0.232	-0.336
		(0.012)	(0.075)	(0.005)	-	(0.003)	(0.167)	(0.022)
	r_t	-1.595	-4.254	-0.356	-	-0.079	-0.918	-2.372
		(0.113)	(0.776)	(0.040)	-	(0.026)	(0.109)	(0.202)
R-sqaures (R^2)		0.060	0.141	0.090	-	0.125	0.164	0.084
the number of issues		682	246	330	-	202	128	382
Middle	$deratio_t^i$	0.186	2.291	0.085	-	0.008	0.167	0.277
		(0.007)	(0.090)	(0.003)	-	(0.002)	(0.004)	(0.011)
	σ_t^i	0.068	0.316	-0.001	-	0.003	-0.011	0.079
		(0.005)	(0.070)	(0.002)	-	(0.001)	(0.005)	(0.009)
	T_t^i	0.121	-1.862	0.062	-	0.095	0.036	0.241
		(0.028)	(0.432)	(0.009)	-	(0.005)	(0.017)	(0.045)
	r_t	0.070	-4.323	0.089	-	0.130	0.063	0.248
		(0.012)	(0.200)	(0.003)	-	(0.002)	(0.006)	(0.021)
R-sqaures (R^2)		0.084	0.250	0.306	-	0.690	0.338	0.135
the number of issues		617	142	314	-	175	139	333
Long	$deratio_t^i$	0.106	0.172	0.034	-	0.020	0.145	0.177
		(0.006)	(0.151)	(0.003)	-	(0.002)	(0.009)	(0.017)
	σ_t^i	0.029	0.170	-0.001	-	-0.003	0.005	0.100
		(0.005)	(0.108)	(0.002)	-	(0.001)	(0.007)	(0.018)
	T_t^i	-1.600	-15.29	-0.160	-	0.222	-0.823	-2.520
		(0.069)	(1.747)	(0.030)	-	(0.021)	(0.088)	(0.191)
	r_t	0.182	-1.064	0.068	-	0.015	0.215	0.244
		(0.011)	(0.371)	(0.005)	-	(0.003)	(0.021)	(0.033)
R-sqaures (R^2)		0.153	0.574	0.236	-	0.465	0.240	0.338
the number of issues		277	18	209	-	151	58	73
Ultra-long	$deratio_t^i$	0.112	-	0.137	-	0.124	0.182	-0.136
		(0.008)	-	(0.006)	-	(0.004)	(0.009)	(0.039)
	σ_t^i	0.010	-	0.007	-	-0.003	0.046	0.047
		(0.002)	-	(0.001)	-	(0.001)	(0.006)	(0.029)
	T_t^i	-2.012	-	-1.786	-	-1.045	-2.004	-7.333
		(0.060)	-	(0.053)	-	(0.047)	(0.120)	(0.721)
	r_t	0.154	-	0.145	-	0.119	0.113	0.373
		(0.007)	-	(0.004)	-	(0.004)	(0.011)	(0.116)
R-sqaures (R^2)		0.479	-	0.625	-	0.730	0.451	0.301
the number of issues		182	-	174	-	148	26	9

1. The results are based on fixed effect estimation of equation (3) during the period between October 1, 2001 and December 31, 2002.
2. The number in a parenthesis is a robust standard error of a fixed effect estimate. The reported standard error based on Arellano (1987) is robust with respect to cross-sectional heteroskedasticity and within-issue serial correlation.
3. For esimation of speculative grades, the sample period between August 5, 2002 and September 20, 2002 is excluded because bid/ask prices of speculative grades were not quoted by corporate bond dealers at all.

Table 12: Implied Relationship between Changes in Credit Spreads and Changes in Market Values of Equity

Independent Variable: $f'_{t-20} \cdot \Delta eq_{t-20}$

Maturities	Periods	Rating Groups						
		Investment-grade	Speculative-grade	Investment-grade				
				A or Higher	AAA	AA	A	Baa
Short	Full	-0.00027	0.009	-0.001	-19.23	-0.001	-0.023	0.056
		(0.00089)	(0.006)	(0.001)	(487.9)	(0.001)	(0.008)	(0.016)
	First	-0.001	0.0009	-0.0032	-58.21	-0.0034	-0.131	0.070
		(0.019)	(0.0004)	(0.0004)	(9.336)	(0.0005)	(0.113)	(0.017)
	Second	0.0001	0.404	0.00002	-	0.0001	-0.026	0.005
		(0.0002)	(0.231)	(0.00022)	-	(0.0001)	(0.008)	(0.022)
Middle	Full	0.0029	0.049	0.0025	-23.09	0.0024	0.006	0.031
		(0.0005)	(0.015)	(0.0005)	(11.46)	(0.0005)	(0.028)	(0.011)
	First	0.050	0.009	0.033	-30.84	0.112	0.028	0.053
		(0.012)	(0.002)	(0.044)	(8.314)	(0.087)	(0.046)	(0.013)
	Second	0.0020	0.406	0.0023	-	0.0022	-0.024	-0.123
		(0.0004)	(0.145)	(0.0005)	-	(0.0004)	(0.011)	(0.032)
Long	Full	0.0004	0.072	0.0001	-40.18	0.0001	0.082	0.048
		(0.0006)	(0.018)	(0.0006)	(7.700)	(0.0006)	(0.067)	(0.010)
	First	0.060	0.035	0.117	-47.86	0.310	0.088	0.053
		(0.015)	(0.008)	(0.085)	(6.344)	(0.098)	(0.092)	(0.011)
	Second	0.0001	16.62	0.000007	-	0.00002	0.063	-0.114
		(0.0006)	(5.446)	(0.000592)	-	(0.00059)	(0.049)	(0.050)
Ultra-long	Full	**0.897**	-	**0.970**	30.18	**0.996**	**0.913**	**0.490**
		(0.217)	-	(0.146)	(5.964)	(0.149)	(0.341)	(1.273)
	First	**1.061**	-	**0.998**	91.42	**1.062**	**0.899**	**1.443**
		(0.192)	-	(0.142)	(77.80)	(0.139)	(0.338)	(1.020)
	Second	-5.691	-	-1.059	-	-12.67	2.215	-11.08
		(3.890)	-	(2.079)	-	(2.592)	(1.933)	(8.248)

1. This table reports an estimated coefficent α in equation (4). The number in a parenthesis is a robust standard error of a fixed effect estimate. The reported standard error based on Arellano (1987) is robust with respect to cross-sectional heteroskedasticity and within-issue serial correlation.
2. 'Full', 'First', and 'Second' indicate the full period between April 1, 1997 and January 31, 2005, the first period between April 1, 1997 and March 31, 2001, and the second period between April 1, 2001 and January 31, 2005, respectively.
3. For the full and the second period estimations of speculative grades, the sample period between August 5, 2002 and September 20, 2002 is excluded because bid/ask prices of speculative grades were not quoted by corporate bond dealers at all.

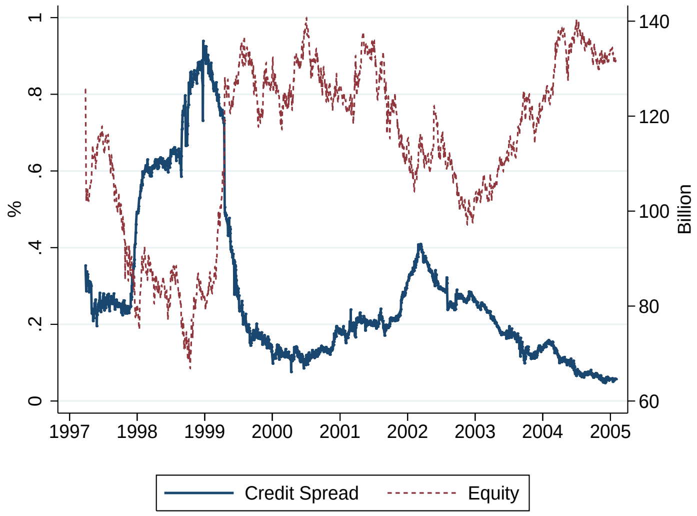

Figure 1. Credit Spreads and Equity Valuation: A or Higher-grade Bonds. The figure plots the average credit spreads on corporate bonds rated as A or higher by Moody's, and the average total equity valuation of corresponding issuing firms.

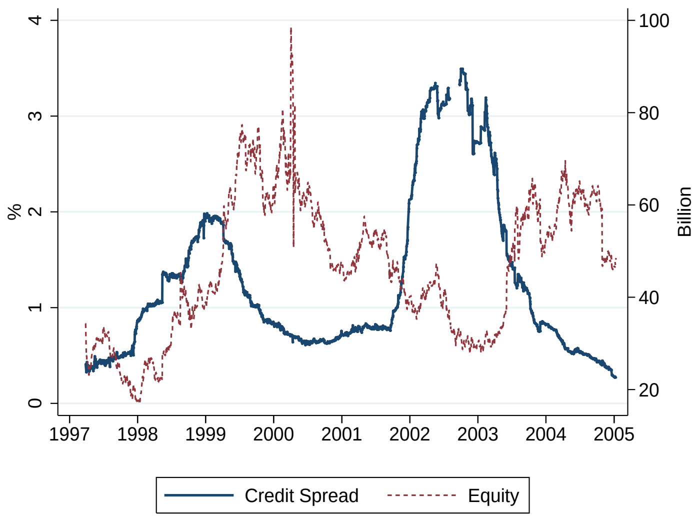

Figure 2. Credit Spreads and Equity Valuation: Baa or lower-grade Bonds with long term. The figure plots the average credit spreads on long term corporate bonds, maturing 7 and 10 years, rated as Baa or lower by Moody's, and the average total equity valuation of corresponding issuing firms. The average credit spreads are missing for the period between August 5, 2002 and September 20, 2002, because low graded corporate bonds were rather illiquid, and their bid/ask prices were not quoted by corporate bond dealers at all.

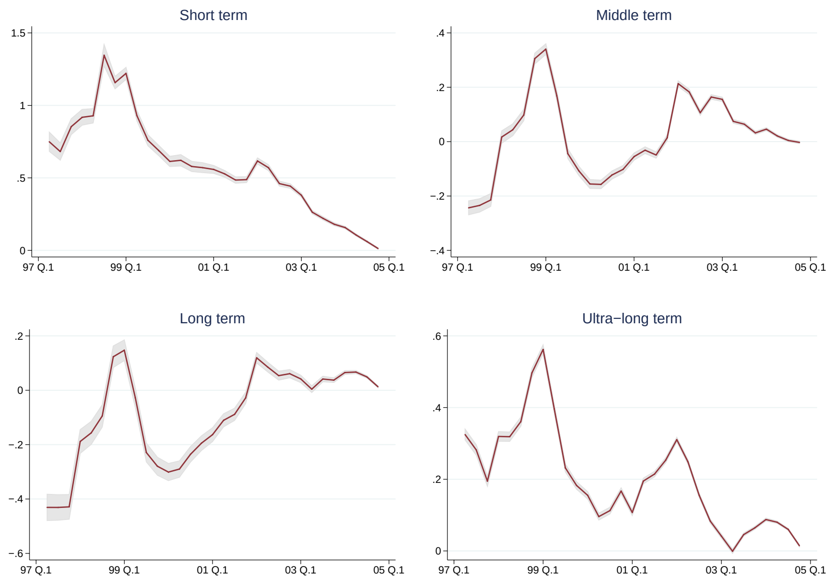

Figure 3. Market-wide Effects for Investment-grade Bonds.
The shaded area represents 95% confidence intervals of estimated coefficients on quarterly time dummies (λ_t) of equation (3).

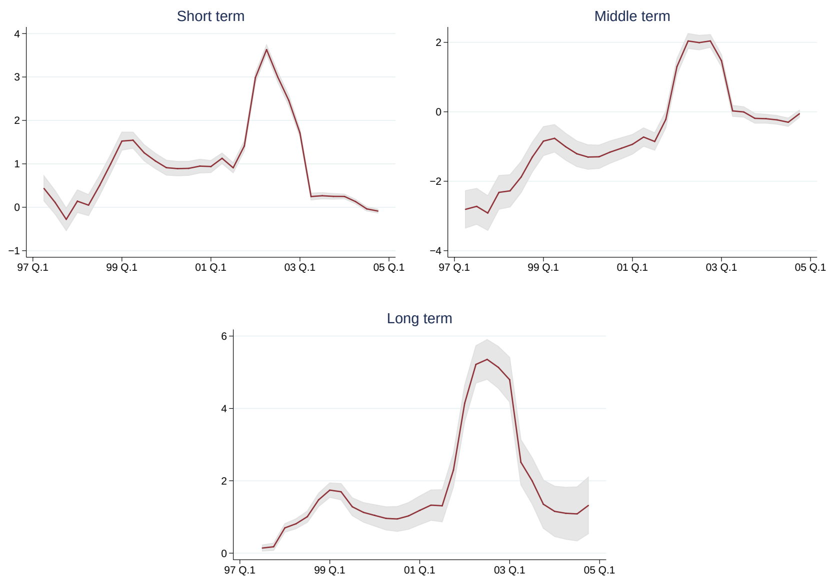

Figure 4. Market-wide Effects for Speculative-grade Bonds.
The shaded area represents 95% confidence intervals of estimated coefficients on quarterly time dummies (λ_t) of equation (3).

Figure 5. Holdings of Corporate Bonds in Financial Institutions.
The figure demonstrates a quarterly time series of outstanding corporate bonds consisting of straight bonds, convertible bonds, and warrant bonds held by public and private financial institutions. The outstanding is based on the flow of funds account compiled by the Bank of Japan.