RIETI Discussion Paper Series 11-E-073

Bank Dependence and Financial Constraints on Investment: Evidence from the corporate bond market paralysis in Japan

UCHINO Taisuke
RIETI

Research Institute of Economy, Trade & Industry, IAA
The Research Institute of Economy, Trade and Industry
http://www.rieti.go.jp/en/

RIETI Discussion Paper Series 11-E-073
November 2011

Bank Dependence and Financial Constraints on Investment: Evidence from the corporate bond market paralysis in Japan[1]

UCHINO Taisuke[2]
(Research Institute of Economy, Trade and Industry)

Abstract

This paper investigates the causal relationship between firms' bank dependence and financial constraints by utilizing the 2008 financial crisis and its impact on the Japanese economy as a natural experiment. Since the Japanese banking sector remained healthy while the corporate bond markets were paralyzed, firms that had reduced bank dependence were hit heavily by the shock. I examined whether firms with large holdings of corporate bonds maturing in 2008 were financially constrained, by comparing the changes in their investment expenditures and borrowing conditions with those of bank-dependent firms. The main empirical results show that (1) firms with large holdings of corporate bonds maturing in 2008 did not cut investment expenditures; (2) instead, they observed higher increments in bank loans; and (3) firms that maintained relatively close bank-firm relationships had more access to bank loans with low borrowing costs, but significant differences in investment expenditures were not found. These findings imply that although there is a cost to reducing bank dependence, it is not very high for Japanese listed firms.

Key words: Global financial crisis, Capital investment, Bank-firm relationships.
JEL Classifications: E22, E32, G21, G31

---

1 I would like to express my gratitude to Etsuro Shioji for his supervision and encouragement. I also thank Yukinobu Kitamura, Kaoru Hosono, Yosuke Takeda, Naohisa Hirakata, Daisuke Miyakawa, and Mitsuhiro Osada for their helpful comments and suggestions on my research. This research is partly supported by the Hitotsubashi University Global COE Grant "Research unit for statistical and empirical analysis in social sciences." Of course, all errors are my own.
2 Research Institute of Economy, Trade and Industry. Email: uchino-taisuke@rieti.go.jp

1 Introduction

The recent global financial crisis did severe damage to almost every economy. It is an urgent task for economists to shed light on the causes and remedies for the crisis. The crisis also provides us the chance to investigate the causal links between financial shocks and the real economy, which are usually difficult to identify. This paper utilizes the crisis as a natural experiment to examine if a close bank-firm relationship mitigates firms' financial constraints. Since the Japanese banking system remained robust even as the commercial paper and corporate bond markets (hereafter referred to as capital markets) experienced a functional decline after the collapse of Lehman Brothers, data from Japanese markets demonstrate how banks reacted to increases in the loan demand from less bank-dependent firms, separate from the banks' health problem.[3]

Before the 1980s, Japanese firms were highly dependent on bank loans and the bank-centered financial system (called the main bank system) was considered to mitigate the problem of asymmetric information between firms and banks. However, firms have incentives to reduce their dependency on their banks because close bank-firm relationships can cause hold-ups through an information monopoly (Sharpe, 1990; Rajan, 1992; Houston and James, 1996; Weinstein and Yafeh, 1998; Pinkowitz and Williamson, 2000). Certainly, after the financial liberalization in the 1980s, the structure of corporate finance in Japan changed dramatically and a number of firms began issuing bonds (Shirasu and Xu, 2007).

Reducing bank dependency is expected to be effective in mitigating hold-ups but it also involves costs. Hoshi, Kashyap, and Scharfstein (1990, hereafter HKS) demonstrate that firms that tried to become less dependent on banks during the 1980s were financially constrained compared to firms that kept close relationships with the banks. That is, if firms reduce bank dependency, their access to bank loans will be limited, making information asymmetries between firms and banks more serious.

It is important for both economists and policy-makers to understand how much it costs the firms to reduce their bank dependency. Following the discussions of

[3] Throughout this paper, the extent of bank dependency is defined by the ratio of bank loan balances to total liabilities with interest. Therefore, less bank-dependent firms are more dependent on bond markets. Similar measures have been used in existing literature such as Hoshi, Kashyap, and Scharfstein (1990), Pinkowitz and Williamson (2000) and Houston and James (2000).

Holmstrom and Tirole (1998), who analyze the role of indirect finance, the main cost of the disintermediation is that firms lose their insurance against liquidity shocks. Certainly, in Japan, it has been suggested that one of the advantages of the main bank system is that firms are supplied with implicit insurance so that they can be rescued by their main banks in the face of liquidity shocks (Osano and Tsutsui, 1985; Sheard, 1989). Therefore, losing such functions in the course of financial liberalization can result in capital market shocks being more easily propagated into the real economy.

Despite its importance, HKS's methodology that measures the extent of financial constraints by the sensitivities of cash flows in reduced form investment functions has been criticized (Kaplan and Zingales, 1997; Hovakimian and Titman, 2006).[4] From an empirical point of view, the simultaneity of the firms' investments and financing decisions makes it difficult for researchers to identify the causal relationship. As Hovakimian and Titman (2006) suggest, the most serious criticism is the possibility that cash flows also reflect investment opportunities that cannot be controlled by Tobin's q. In other words, the reason firms can earn cash flows may be related to the fact that they have profitable investment projects. Since Tobin's average q is measured by the market value, which reflects the investors' evaluations, the sensitivities of cash flows could be larger for firms suffering from severe asymmetric information problems between themselves and their investors.

In order to overcome this limitation, a number of researches have tried to determine the exogenous events wherein firms' cash flows were altered independent of investment opportunities. For example, Blanchard, Lopez-de-Silanes, and Shleifer (1994) focus on the investment activities of firms that experienced cash windfalls in the U.S. Likewise, Lamont (1997) compares the investment expenditures of non-oil subsidiaries of oil companies with those of non-oil companies during the 1986 oil price decline. These studies reject the complete capital market hypothesis, that is, firms are financially

[4] HKS (1990, 1991) follow the method proposed by Fazzari, Hubbard, and Petersen (1988). They examine the differences in the cash flow sensibilities between firms that are *a priori* considered to be suffering from severe asymmetric information (between firms and investors) and firms that not. The basic idea is that if firms are required to set high lemon premiums as a result of asymmetric information, their investment expenditures are restricted to the amount of cash on hand. If close bank-firm relationships reduce the asymmetric information between firms and banks (and consequently lemon premiums), the firms' investment expenditures are expected to be less sensitive to their cash flows. HKS (1990) observed higher cash flow sensitivities among keiretsu firms that had increased their dependency on the bond markets in the 1980s.

constrained when they make capital investments. However, they failed to obtain adequate sample sizes.[5]

Recent empirical literature focuses on large-scale exogenous financial shocks to firms. Chava and Purnanandam (2010) utilize the Russian financial crisis in 1998 as an exogenous shock to the U.S. banking sector in order to show that bank-dependent firms experienced a larger decline in their investment expenditures as compared to those that had access to bond markets during the period. Almeida et al. (2009) try to specify more clearly the firms that may have experienced financial constraints during the recent global financial crisis. They focus on the firm's debt maturity structure and demonstrate that the U.S. firms that had large amounts of maturing long-term debts (more than 20% of existing long-term debts) reduced their investment expenditures significantly.

Following the recent empirical literature, this paper utilizes the 2008 financial crisis as a natural experiment to examine the question of whether it is costly for firms to reduce their bank dependency and, if so, what is the cost. In Japan, it was reported that the corporate bond markets were paralyzed during the crisis, while the banking sector stayed relatively healthy (Bank of Japan, 2009a, 2009b). Firms that had reduced their bank dependency were therefore hit most heavily by the financial shock. The identification strategy of this paper makes use of this fact and focuses on the firms' maturity compositions of liabilities. That is, for "unlucky" firms that had issued large amounts of corporate bonds that matured during the crisis, refinance by issuing new bonds became difficult. As a result of the exogenous shock, their demand for bank loans shifted outward. As discussed in HKS (1990), if the problem of asymmetric information between firms and banks worsens by reducing bank dependency, these unlucky firms would face financial constraints because their banks require high lemon premiums or may possibly reject their loan applications (rationing). As a result, their investment expenditures are expected to decline, other things being equal.

This paper classifies firms that had maturing bonds as "treated groups" and examines whether they were financially constrained. This is done by comparing their investment expenditures and borrowing conditions during the crisis with those of bank-dependent

[5] Blanchard, Lopez-de-Silanes, and Shleifer (1994) and Lamont (1997) obtained only 11 and 39 observations, respectively.

firms, whose economic attributes were considered to be ex-ante identical.[6]

The empirical results of this paper are summarized as follows. First, the firms with large amounts of corporate bonds maturing in 2008 did not cut their investment expenditure, as compared with bank-dependent firms. Second, bank loan balances increased sharply for those firms with less bank dependency. Finally, the treated firms that kept relatively close bank-firm relationships had more access to bank loans with low borrowing costs, but significant differences between their investment expenditure and that of bank-dependent firms were not observed. These findings suggest that it is not that costly for the recent Japanese listed firms to reduce their bank dependency. That is, the problem of asymmetric information between firms and banks is not that serious.

This study contributes to the existing empirical literature on corporate finance and banking with regards to bank-firm relationships and the role of the banking sectors by providing causal evidence. In addition, it adds to the literature on credit channels of monetary policy, such as Gertler and Gilchrist (1994) and Kashyap and Stein (2000), by examining the heterogeneous effects of financial shocks. Finally, this paper is also related to the studies of the Japanese economy. Although Japan was not the epicenter of the 2008 financial crisis, its real economy was the most severely damaged among advanced economies. This paper attempts to examine whether the huge and rapid economic shrinkage that Japan experienced in the last two quarters of FY2008 was related to the shocks in the capital markets.

The rest of the paper is organized as follows. In the second section, I describe the changes in the Japanese capital market during the 2008 financial crisis to explain my identification strategy. Section 3 describes the data set, which is followed by the empirical results described in Section 4. Section 5 discusses the results and their implications, and Section 6 concludes the paper.

2 Identification Strategies

[6] The identification strategy of this paper follows that of Almeida et al. (2009). However, since the Japanese banking sector, unlike its U.S. counterpart, was not so damaged by the global financial shock, it enables an examination of the role of the banking sector separately from bank health problems. In addition, I categorize firms that may have been financial constrained into more than two groups according to their volumes of maturing bonds by extending the methodology to multiple treatment models. This allows greater quantitative results to be obtained.

This paper examines whether the problem of asymmetric information between firms and banks becomes serious if firms reduce their bank dependency. To test the hypothesis, I focus on the changes in the Japanese capital market during the 2008 financial crisis, which had unique characteristics as compared to those of other advanced economies. Here, while the capital markets were paralyzed, the banking sector remained relatively healthy.

Bank of Japan (2009a, 2009b) reports that the capital markets were paralyzed in the last half of FY2008 (2008Q4-2009Q1, see Figure 1). For example, firms with ratings below "A" could not raise bonds at all during the period and even the public sector, like the issuers of government guaranteed bonds and the local governments, decided to postpone their scheduled issuances. The Bank of Japan also reports that this market turmoil was related to the decline in the investors' risk appetites. The most recent empirical analysis on the Japanese capital markets certainly supports this hypothesis (Oyama and Hongo, 2010).[7]

Other countries experienced similar capital market paralysis after the collapse of the Lehman brothers. The banking system in Japan remained healthy unlike other advanced economies. Therefore, in Japan, firms that had reduced bank dependency were hit most heavily by the crisis in terms of financing activities. According to Bank of Japan (2009a, 2009b), the main reason behind Japanese banks escaping the fate of their global counterparts was that their exposure to securitized products was very limited. In this sense, the fact that Japanese banks could not succeed in their investment bank businesses turned out to be a key factor in the preservation of their functions as commercial banks.

In order to examine the above hypothesis, this paper focuses on the maturity compositions of liabilities held by the firms. That is, for firms that had large amounts of corporate bonds maturing in 2008, it became difficult to refinance by issuing new bonds and their demand for bank loans shifted outwards. If the problem of asymmetric information was serious for these less bank-dependent firms, their banks did not extend sufficient loans (or required higher "lemon premiums") and these firms would have

[7] Although the causes of a functional decline in the capital markets and the international propagation of financial market shocks themselves are urgent subjects of empirical analysis, I leave them for the future research.

become financially constrained. Besides, the more the volume of maturing bonds firms had, the more financial constraints they faced, because more finance was needed to repay their debts. Accordingly, they observed both, a decline in their investment expenditures and an increase in the borrowing costs, and the extent of these would be larger in keeping with the greater volume of maturing bonds. Conversely, if the problem of information asymmetries did not become serious, no decline in investment expenditures but an increase in bank loan balances would be observed. Since it is easy for firms to borrow from banks, they use bank loan extensions to cover the cash flow lost through bond repayments. Therefore, I set firms with issued bonds maturing in 2008 as treated groups and estimate the treatment effects on investment expenditures and borrowing conditions, allowing the effects to differ according to the amount of maturing bonds.

This paper employs propensity score matching methods, which are often applied in the analysis of medical science (Rosenbaum and Rubin, 1983; Heckman, Ichimura, and Todd, 1997). In doing so, I take the effect of cigarette smoking on a person's health as an example to understand the basic idea behind the method. Whether a person smokes is called "treatment" and the group composed of smokers is called the "treatment group." Likewise, the group of non-smokers is called the "non-treated group." However, it is impossible to measure the effect of smoking on health by just comparing the average health status between the two groups. This is because people who are stressed are more likely to smoke even as the stress also damages their health.

Now, each smoker is matched with a non-smoker who has the same attributes. This non-smoker is called a "control sample." After conditioning on the factors that affect the decision to smoke (called "covariates"), whether a person smokes is determined randomly. Factors such as damage to health through stress are expected to be the same between the two people. Therefore, the observed average difference in health status, called the average treatment effect on the treated (ATT), has causal effects. However, it is difficult to find control samples as the dimension of covariates becomes larger. Rosenbaum and Rubin's (1983) method proposes to use the estimated probabilities (called "propensity scores") for matching those that are obtained from probit regressions of the treatment status on covariates. Samples with the same propensity scores basically have similar covariates, given the parameter estimates.

This paper assumes that the crisis was highly exogenous to Japanese individual firms, because it is apparent that the investment or financing activities of individual Japanese firms was not the cause of the crisis.[8] However, the assumption does limit the treated firms (or less bank-dependent firms) to those that had ever issued corporate bonds. This means that the distribution of the firms' attributes (such as firm size, investment opportunities, and leverages) might be different between treated and non-treated firms (or bank-dependent firms). Therefore, I need make adjustments to randomize the treatment. For this purpose, I employ the method of matching estimators to calculate the treatment effects (Rosenbaum and Rubin, 1983; Heckman, Ichimura, and Todd, 1997). In the next subsection, I explain the econometric methodologies in detail.

2.1 Matching Estimators

In order to estimate the treatment effects allowing for heterogeneity in the volume of maturing bonds, this paper utilizes the multiple propensity score matching technique proposed by Lechner (2002). Lechner's method is a natural extension of the binomial treatment model introduced by Rosenbaum and Rubin (1983) to multiple treatments.

The applications of Rosenbaum and Rubin's method are basically limited to the case where the treatment status is binomial. Therefore, it is highly restrictive when the actual treatment is continuous or multiple. In the example of cigarette smoking, by defining the treatment status as only whether the person smokes or not, the treatment effects on the "light" smokers are assumed to be the same as on "heavy" smokers.

Lechner's method is aimed at bridging this discrepancy. Although I refer the reader to Lechner (2002) for a detailed discussion on his matching estimator, this paper considers the validity of the so-called strongly ignorable treatment assignment assumption. To do this, the set of covariates, treatment statuses that happen to agents and the corresponding counterfactual outcomes are defined as X, $D=\{1,2,\ldots,M\}$, and $\{Y(1), Y(2),\ldots, Y(M)\}$

[8] As Peek and Rosengren (1997) emphasize, it is difficult to isolate demand and supply shocks in the usual reduced form analysis. They use the Japanese banking crisis in the 1990s as an exogenous negative loan supply shock to the Japanese banks in the U.S. and show the negative real effect on construction activities in the U.S. Their empirical findings also provide evidence of the international propagation of financial shocks.

respectively. We can once again return to the cigarette smoking allegory. Covariates are personal attributes that affect smoking decisions (such as stress and lifestyle) and treatment statuses mean the number of cigarettes that a person smokes per day. Counterfactual outcomes are health statuses that might have been realized according to the treatment status. Then the condition can be expressed as follows.

$$\{Y(1), Y(2), ..., Y(M)\} \perp D \mid X. \tag{1}$$

It means that treatment statuses are independent of outcomes after controlling the attributes. In the smoking example, this assumption implies that smoking decisions are only dependent on personal attributes and never on future health statuses. That is, people whose health is more affected by smoking are not allowed to stop smoking or reduce the number of cigarette. Beyond this example, in many applications of matching estimators, it is doubtful if this condition holds because the treatments themselves are usually dependent on the agents' decisions (agents who expect higher outcomes are more likely to apply for the programs). For the purpose of this paper however, treatments or whether firms had issued corporate bonds that matured during the crisis are predetermined and they could not avoid the shock unless they had already anticipated it.[9] Therefore, it is reasonable to employ matching estimators the factors that affect firms' motives to issue bonds can be controlled. With regard to the treatment status *D*, four categories are defined according to the number of bonds that matured in 2008, and the treatment effects are expected to be larger in accordance with the number.

According to Lechner's method, the concrete estimation steps are as follows, contextualized for the purpose of this study. First, four categories (B0, B1, B2, B3, B4) are set according to the volume of bonds matured in 2008, as shown in Table 1. In the second step, each firm's probabilities of falling into B0, B1, B2, B3, or B4 are estimated, conditional on the firms' attributes (Tobin's q, cash-flows, firm-sizes, default-risks, cash-holdings, leverages, bank-firm-relationships, and industry-dummies) by the multinomial probit model:

[9] Firms could have avoided to be "treated" if they anticipated the crisis in advance, for example, by buying the maturing bonds back and issuing new bonds while the market was normal. It is known although that the strongly ignorable treatment assignment assumption cannot be tested statistically (see Cameron and Trivedi, 2005), but I consider this predictability roughly in the later section.

$$P^k(x) = \Pr(S = k \mid X = x), \quad k = B0, B1, B2, B3, B4. \tag{2}$$

The selection of covariates X follows the method proposed by Almeida et al. (2009). However, Altman's Z score (Altman, 2002) is used as a measure of default risks instead of ratings, because only a select number of firms managed to acquire them from institutes such as Standard and Poor's and Moody's.[10]

In the third step, I make four subsamples, (B1, B0), (B2, B0), (B3, B0), and (B4, B0), and calculate the conditional probability that firms fall into B1, B2, B3 and B4 in each pair using the estimated multinomial probit probabilities. Considering any two different categories $\{l,m\}$ in D, they will be

$$\begin{aligned} P^{l|ml}(x) &\equiv \Pr(S = l \mid S = l, or, S = m, X = x) \\ &= \frac{P^l(x)}{P^l(x) + P^m(x)} \quad . \end{aligned} \tag{3}$$

In this paper, I investigate the effects of the financial crisis on investment expenditures and borrowing conditions of firms with large volumes of maturing bonds by estimating the ATT. This is defined as an average deviation between the actual outcomes of treated firms and their counterfactual outcomes namely, the outcomes that might have been realized if the firms were not treated. In this study, counterfactual outcomes refer to how the treated firms' investment expenditures and borrowing conditions would have evolved after the financial crisis if they had not issued corporate bonds at all. When l and m are set to be a treated group and a non-treated group respectively, the ATT can be expressed as follows.

$$\begin{aligned} \theta^{m,l}_{ATT} &= E_{P^{l|ml}(X)|S=l}[E[Y(l) \mid P^{l|lm}(X), S = l] - E[Y(m) \mid P^{l|lm}(X), S = m]] \\ &= E[Y(l) \mid S = l] - E_{P^{l|lm}(X)|S=l}[E[Y(m) \mid P^{l|lm}(X), S = m]]. \end{aligned} \tag{4}$$

The second term of the right hand side calculates the counterfactual outcome. ATTs as defined above are allowed to be different depending on the selected l and m. Intuitively,

[10] Altman's revisited Z score is defined as $Z = 0.717T_1 + 0.847T_2 + 3.107T_3 + 0.420T_4 + 0.998T_5$. Here T_1 is the ratio of quick asset minus current liability to total assets. T_2 is the ratio of earned reserve to total assets, T_3 is the ratio of pretax net profit plus interest paid to total assets, T_4 is the ratio of net book value to total liabilities, and T_5 is the ratio of sales to total assets. The probability of a firm's bankruptcy is considered to get lower as the Z value becomes larger.

ATTs can purely extract the effects of the maturing bonds because treated firms were matched with control firms, which are ex-ante identical except in the extent of their bank dependence. Therefore, the ATT estimators suggest a “causal effect.”

Practically, ATTs are estimated in the following way.

$$\hat{\theta}_{ATT}^{m,l} = \frac{1}{N_l} \sum_{i \in \{S=l\}} \left[Y_i(l) - \sum_{j \in \{S=m\}} w(i, j) Y_j(m) \right]. \tag{5}$$

Firms in categories B1, B2, B3, and B4 are defined as treatment groups and firms in B0, whose conditional propensity scores are closest to each treated firm, are defined as control firms. For each treated firm, the control firms are matched and differences in the outcome between the two groups are calculated.

There is another important assumption called the balancing condition, which states that, for those firms sharing the same conditional propensity scores, treatment statuses should be independent of covariates. If we suppose the function $1(\cdot)$ to be an indicator, then the condition can be written as

$$1(S = l \mid S = l, or, S = m) \perp X \mid P^{l|lm}(x). \tag{6}$$

It means that there are no differences in the distributions of the covariates between treated and control firms, that is, the treatments are randomized. Unlike a strongly ignorable treatment assignment assumption, these conditions can be tested statistically. This paper therefore checks them to consider the validity of selected covariates.

With respect to the matching methods, caliper matching and 10 nearest neighbors matching is undertaken. In both calculations, the control firms are matched with their replacements and imposed a maximal tolerance level on the maximal propensity score distance (radius matching). The tolerance level is set to the absolute value of 0.01 (or 1%) and the treated samples that cannot find control firms within the radius are discarded. The weights $w(i, j)$ in the above equation are therefore set to 1 or 0.1 for each control firms depending on the matching method.[11]

In order to eliminate the firms’ unobservable factors that affect outcome variables (or fixed effects), differenced outcome variables are used to estimate ATTs. That is to say,

[11] For details of the implementations of propensity score matching estimators, see Caliendo and Kopeinig (2008) for example.

they are propensity score difference-in-differences matching estimators (Hereafter referred to as PSM-DIDs) and they enable us to control both the fixed effects and the aggregate shocks.

3 Data

As mentioned in an earlier section, this paper uses Japanese listed firms' financial statements and corporate information such as market capitalizations and the compositions of major shareholders and the stock market where firms are listed. The former was extracted from the "Nikkei NEEDS CD-ROM" (hereafter, Nikkei-NEEDS) published by Nikkei Inc. and the latter from the "Japanese Company Handbook Quarterly" published by Toyo Keizai Inc. My data set is composed of non-financial and non-agricultural firms listed on the Sapporo, Tokyo, Nagoya, Osaka, and Fukuoka Stock Exchanges and stock markets for emerging firms such as Jasdaq, Mothers, and Hercules, which settle accounts in March.

The treatment statuses (B0, B1, B2, B3, and B4) are classified according to the variable MATURITY, which is defined as the ratio of the amount of corporate bond balances that had matured in FY2008 (2008Q2-2009Q1) to the sum of liabilities with interest (short-term bank loans (Nikkei-NEEDS' FB075), long-term bank loans (FB076+FB101), commercial papers (FB075), and corporate bonds (FB078+FB099)).[12] Firms that had no outstanding balances of bond or commercial paper at the end of FY2007 (therefore, they did not have any maturing bond either) are classified as bank-dependent firms (B0). This definition is similar to those of previous literature such as HKS (1990) and Pinkowitz and Williamson (2000), which examines the effect of bank dependency. The "lucky" firms that had positive outstanding balances of bonds but none of which matured in FY2008 are classified as B1. Firms in category B2 had issued a small number of bonds (less than 5% of total liabilities with interest) that matured in FY2008. Similarly, firms in B3 or B4 had issued a medium number (5–10% of total liabilities with interest) or a large number (more than 10% of total liabilities with interest) of bonds matured in FY2008, respectively. I therefore expected that the latter

[12] In order to specify the amount, I use the reported balances of corporate bond that were scheduled to mature within 1 year (FB078) at the end of FY2007 (March 2008).

categories would have larger treatment effects for firms.

As discussed earlier, in order to estimate PSM-DIDs, this paper controls the Tobin's q, cash flows, firm size, default risks, cash holdings, leverages, bank-firm relationships, and industry-dummies as covariates. Constructions of these variables basically follow Almeida et al. (2009). Tobin's q (Q) is defined as the ratio of market capitalization plus total assets (FB063) minus net assets (FB166) minus differed taxes (FB056) to total assets. Cash flow (CF) is the sum of net income (FC058) plus depreciation (FC046) divided by the lag of fixed tangible assets (FB032). Size (lnASSET) is defined as the natural log of total assets. Default risk (RATING) is calculated according to Altman's definition.[13] Cash holding (CASH) is defined as the ratio of quick assets (FB02) to total assets. Leverage or capital ratio (CAP) is defined as the ratio of net assets to total assets. On the bank-firm relationships (MAINBANK), a dummy variable is constructed, which takes on a value of 1 if there is more than one bank in the list of major shareholders. Industry dummies are constructed by utilizing the 2-digit codes of "Japan Standardized Industrial Classification (JSIC)" ver.12. I also limit the stock markets where the firms are listed: dummy variables MARKET1-MARKET4 stand for Tokyo stock exchange first section; Tokyo stock exchange second section; regional stock exchanges (Sapporo, Nagoya, Osaka and Fukuoka stock exchanges); and stock markets for emerging firms (Jasdaq, Mothers, and Hercules), respectively. Detailed definitions of each variable are shown in Tables 1 and 2. Following Caliendo and Kopeinig (2008), I use lagged values (values at March 2007) of each covariate in the estimation.

When it comes to the outcome variables, this paper focuses not only on the changes in investment expenditures (INVEST) but also on the changes in bank loan balances and borrowing costs. This includes log of total bank loan balances (lnLOAN); log of short and long-term bank loan balances (lnSHORT and lnLONG); and bank loan interest rates (RATE)).[14] Here the variable INVEST is defined as the ratio of capital expenditure (CAPEX, FP01143) to the lag of fixed tangible assets (FB032) and RATE is defined as the ratio of interest paid on bank loans (FC016-FC017-FC018-FC124-FC125) to

[13] See Altman (2002) for details.

[14] In terms of the calculations of lnSHORT and lnLONG, it turns out that some firms had no outstanding balance of short or long-term bank loans. If they are eliminated, quite a few samples will be discarded. To deal with this problem, I add 1 to short and long bank loan balances before taking the logs for firms with positive outstanding balances of total bank loans.

two-year averaged total bank loan balances (FB075+FB076+FB101).[15]

3.1 Descriptive Statistics

Descriptive statistics are shown in Table 3. It indicates that there is a sufficient number of treated and control firms to obtain trustworthy results. Each treated category (B1-B4) has no less than 100 samples and about 60% of total observations are classified as a non-treated group (B0). Table 4.1 and Table 4.2 show the subsample means of each category and indicate that there are differences in covariates between the treated and control firms. For example, Tobin's q is slightly higher for treated firms on average and control firms are, on the whole, smaller in terms of asset size. Against intuition, the average RATING is higher for non-treated firms. As for outcome variables, some variables also show differences among categories. Especially, the average growth of bank loan balances (lnLOAN) for firms in B3 and B4 are about 14% and 23% respectively, while those for non-treated firms are only about 4%. On the other hand, contrary to prior expectations, INVEST and RATE show small differences.

In this paper, observations that are larger or smaller than 99.5 or 0.5 percentile points of each variable are eliminated as outliers. Nevertheless, outcome variables show large heterogeneity. Since the calculations of the ATT estimators are based on averages, they are weak in dealing with outliers. I examine whether the outliers affect the results by adopting alternative econometric methods in the next section.

4 Estimation Results

Table 5.1, Table 5.2 and Table 6 show the main estimation results. First, the marginal effects of MNP (Table 5.2) indicate that firms are more likely to issue bonds as their asset sizes become larger and the levels of cash holdings, capital ratios, and ratings become lower. Although significant differences in investment opportunities (Tobin’s q) and cash flows are not observed, their estimated coefficients differ slightly among the

[15] For example, RATE in FY2008 is calculated as the bank loan interests paid in FY2008, divided by the average bank loan balances from FY2007 to FY2008. This definition allows us to take into account the changes in the bank loan balances for the same period compared to the usual calculation that divides interest expenditures by the lag of loan balances (Caballero, Hoshi, and Kashyap, 2008).

categories (Table 5.1). Therefore, in principle, it enables us to match the control firms whose Tobin's q and cash flows are also close to each treated firm.

Some of above results might be related to reverse causalities. The firms' past bond issuances make recent leverages higher and, consequently, default risks are also heightened by definition. However, the main purpose of MNP estimation is to control the firms' attributes by constructing propensity scores and not to estimate the structural parameters. These problems, therefore, are not fundamentally serious.

The kernel density functions of the conditional propensity scores for the treated and non-treated groups are shown in Figure 2. Here, the conditional propensity scores are calculated as the probabilities of the treatment statuses (B1, B2, B3 or B4) occurring in each subsample, under the condition that two events might occur, (B0, B1), (B0, B2), (B0, B3) and (B0, B4). In each case, firms classified as non-treated group (B0) have lower probabilities, while treated firms (B1, B2, B3, and B4) have relatively higher probabilities. Besides, the distributions of conditional propensity scores for treated and non-treated groups are sufficiently overlapped in all cases. Therefore, it can be interpreted that all the matched non-treated samples have similar propensity scores. The results of PSM-DID are as shown in Table 6. The estimation results from caliper matching are shown in the upper table and those from the nearest neighbor matching are shown in the bottom table in the same way.

The results demonstrate that the treatment effects of INVEST are not so small. The estimated values from caliper matching show that firms in categories B2 and B3 decreased investment rates by 3.1% and 4.1% more than the control firms did. Firms in B4, on the other hand, increased their investment rate by 3.8%. Nevertheless, they remain insignificant and these tendencies were not altered by an alternate matching method.[16] Likewise, the changes in RATE were not different for the treated and control firms. However, the estimation results for bank loan balances (lnLOAN, lnLONG, and lnSHORT) are noteworthy. First, the estimated ATTs of lnLOAN show apparent and significant increments for firms in categories B3 and B4. Specifically, the total bank loan balances rose, on average, by 11% for the former and 18% for the latter. The ATTs of the compositions of bank loans (lnLONG and lnSHORT), on the other hand, are

[16] Since no large differences are observed between the two methods, the results from caliper matching are explained hereafter.

somewhat different between categories. For firms in B3, the short-term bank loan balances increased sharply (44%) while large increments in the long-term bank loan balance (37%) were observed for firms in B4.

The above empirical findings demonstrate that there is no strong evidence that treated firms become financially constrained during the crisis and the more the number of maturing bonds they had, the more bank loans were supplied without a corresponding rise in borrowing costs. This paper interprets these facts as follows: (1) firms that had reduced bank-dependency were also supplied with bank loans without the imposition of high lemon premiums; (2) the bank loan supply was plentiful enough to have prevented firms from being financial constrained; and (3) the problem of asymmetric information between banks and firms is not serious for recent Japanese listed firms.

In the following subsections, I reinforce the empirical evidence. Specifically, I check if the treatment statuses are randomized, whether the findings are unique to the crisis period, and review the predictability of the crisis.

4.1 Balancing Tests

The trustworthiness of above empirical results depends on whether the treatment statuses are randomized or not. In other words, they need to satisfy the conditions shown in (6). To check them statistically, I employ two tests proposed in Caliendo and Kopeinig (2008): the standardized bias (SB) test and the pseudo R-squared test. The former checks whether the differences in each covariate are small on average by calculating the mean and median absolute values of SB indicators defined as follows.

$$SB_{k,l,m} = \frac{\bar{x}_{k,l} - \bar{x}_{k,m}}{\sqrt{0.5*(\mathrm{var}(x_{k,l}) + \mathrm{var}(x_{k,m}))}}. \quad (7)$$

Here l and m indicate the treated and control firms respectively and k stands for the k-th covariates. Their medians or means are required to be less than 5% after matching. The pseudo R-squared test proposed by Sianesi (2004) is similar to the former in its basic ideas. For each l and m, we regress $1(S=l \mid S=l$, or, $S=m)$ on covariates X by probit model after matching to test the null hypothesis that all the coefficients on X are zero. If the balancing condition holds, then the null hypothesis will be rejected and pseudo

R-squared will be adequately small because the covariates no longer have the ability to predict treatment statuses under the condition.

The results of these tests are shown in Table 7. Both tests suggest that the balancing conditions are satisfied after matching; that is, the medians and means of SBs are all less than 5% in absolute value and the null hypothesis is rejected with large p-values for each subsample. These results imply that the selection of covariates is appropriate and the treatments are successfully randomized.

4.2 Treatment Effects in the Normal Time

Another interpretation of the empirical findings of this paper is that the phenomena are not special to the crisis period. That is, firms that have maturing bonds might also borrow from their banks to repay in the "normal time." If this were true, the interpretations of this paper would be misleading. In order to eliminate this possibility, I estimate the same models for FY2005. This period is chosen not only was the Japanese economy enjoying an economic expansion at the time, but it had also recovered from the bad loan problem.

Estimated PSM-DIDs shown in Table 8 are all negligible at the significance level of 5%. This demonstrates that no strong differences in INVEST and the borrowing conditions (RATE, lnLOAN, lnLONG and lnSHORT) between the treated and control firms are observed in FY2005. Therefore, it would suffice to say that the main findings of this paper are unique to the crisis period.

4.3 Could Firms Have Anticipated the 2008 Financial Crisis?

As discussed in section 2, if the firms had anticipated the financial crisis, they could have avoided being "treated," for example, by buying their maturing bonds back while the markets were normal. Then, in such a situation, the strongly ignorable treatment assignment assumption would be invalid. In this subsection, I examine this point by using the firms' maturity schedules reported in the Nikkei-NEEDS database. Here I focus on two items: corporate bonds scheduled to mature in more than one year less than two years (FF044) and corporate bonds scheduled to mature within one year

(FF043). If the global financial crisis were anticipated in March 2008, then the amount of FF043 could be expected to be smaller than of FF044, as reported at the end of FY2007. This paper, therefore, generates variable CHANGE defined as FF043 minus lagged FF044 and compares its descriptive statistics to earlier years.

The results are shown in Table 9. The top section of the table shows that the average changes in maturing bonds were 0.9 billion Yen and its median was zero in FY2008. Besides, no large differences are observed comparing it to earlier years. In the bottom section of the table, the descriptive statistics for the subsamples of nonzero values are shown. This also demonstrates that the average changes were non-negative and its distributions and sample sizes were not so different from those of earlier years. Therefore, no strong evidence that firms could anticipate the crisis beforehand is observed.

5 Robustness Checks and Extensions

The estimation results in Section 2.4 demonstrate that changes in investment expenditures were not different between treated and control firms, while a sharp rise in the bank loan balances was observed for the former. This section goes into the details to check the robustness. First, I check whether the main results are robust to the selection of control groups. Second, I examine whether the outliers of outcome variables affect the estimated treatment effects through matching estimators. At the same time, I also investigate the heterogeneity of the treatment effects.

5.1 Changing Control Groups

In PSM-DID estimations, the treatment sample or the firms that had maturing corporate bonds are compared with the firms that had not issued corporate bonds at all. However, if there exist some unobservable attributes that affect both the decision on bond issue and outcome variables, the estimated treatment effects might be biased. For example, firms might refrain from issuing corporate bonds partly because they are afraid of the freeze in capital markets that might occur in the future. Such firms may have made the prudent decision to reduce their investment expenditures during the crisis period. If this situation were true, the estimated treatment effects in the above section would be erroneous.

To consider this possibility, I re-estimate the PSM-DIDs, limiting the treated and non-treated groups to firms whose outstanding balances of corporate bonds are non-zero. If firms that had issued corporate bonds faced more severe information asymmetries, the investment expenditure for firms that had a large amount of maturing corporate bonds would have declined. Conversely, if the problem of asymmetric information were not severe, increments in bank loan balances were expected to be larger as the magnitude of the shock–namely, the amount of maturing bound–becomes larger. Since both treated firms and non-treated firms are limited to bond issuers in this case, their treatment statuses reflect the firms' "luckiness" more precisely.

In this section, I classified firms in B3 and B4 as treated groups (firms that had a middle or large amount of maturing bonds) while firms in B1 and B2 are combined into one non-treated group (firms that had a small amount of maturing bonds). Therefore, the number of treatment statuses is reduced to 4 in this case. I applied Lechner's (2002) method to this 4-status model following the procedure explained in the previous section. The estimation results are shown in Table 10. Again, the treatment effects of investment expenditures were insignificant for both B3 and B4. However, significant increments in the bank loan balances were observed. Besides, the magnitudes of treatment effects were not so different from previous results. This implies that the problem, which might arise from choosing control firms from B0, is negligible.

5.2 Median Treatment Effects

As discussed in Section 4.1, the first differenced outcome variables show large heterogeneity. Since matching estimators are notorious for their weakness in dealing with outliers, I must check if they did not alter the main results of this paper. For this purpose, I also estimate the median treatment effects, which are known to be robust for outliers. These can be estimated by utilizing the usual median regression model when the treatment is exogenous but after controlling for covariates. However, this method needs functional-form assumptions for the relationship among outcome variables, treatment variables, and covariates. This paper assumes that they are linear and utilize a "dose-response" model (Koenker, 2005) by setting the variable MATURITY as a continuous treatment variable. Thus, the marginal median treatment effect (γ) is the solution of the following M-estimation:

$$(\hat{\gamma}, \hat{\beta}) = \arg\min_{\gamma,\beta} \frac{1}{N} \sum_i | Y_i - \gamma MATURITY_i - X_i \beta | . \quad (8)$$

Another point is on the heterogeneity of treatment effects where the matching estimators indicate the average treatment effect, but treatment effects are probably dependent on the firms' attributes. Especially, those for firms that kept relatively close bank-firm relationships among treated firms might be different, because the problem of asymmetric information between banks and firms are more or less mitigated for them. The literature on the Japanese main bank system also uses capital ties to measure the strength of the bank-firm relationships. Therefore, treated firms, whose banks are one of the major shareholders, are considered to have relatively close bank-firm relationships. Since the median treatment-effect models are more parametric than matching estimators, they enable an examination of this possibility at the same time.[17] To be clearer, I add a cross term (MATURITY*MAINBANK) to the above model and get

$$(\hat{\phi}, \hat{\eta}, \hat{\beta}) = \arg\min_{\phi,\eta,\beta} \frac{1}{N} \sum_i | Y_i - \phi MATURITY_i - \eta MATURITY_i * MAINBANK_i - X_i \beta | . \quad (9)$$

where ϕ indicates the marginal treatment effect for firms whose bank is one of the major shareholders (treated-A) and that for firms whose bank is not one of the major shareholders (treated-B). This is measured by $\phi + \eta$. This paper reports the result from this augmented model.

The estimation results of the median treatment effects are shown in Table 11. To express the results visually, I also present the dose-response functions (DRFs) of each outcome variable with 95% confidence intervals in Figures 3 where the lines with diamonds are the estimated DRFs for treated-A and lines with circles are those for treated-B. The DRFs verify that the results obtained by matching estimators are qualitatively unchanged and that statistical significance is maintained. It demonstrates

[17] This flexibility is also one of the drawbacks of these parametric models because they are not robust to misspecifications (see Drake, 1993). Therefore, results from parametric models and those from matching estimators substitute each other.

that the outliers do not drive the main results of this paper. However, on the issue of heterogeneity of the treatment effects, it shows large differences between the treated-A and treated-B. This indicates that the changes in investment expenditures were not significantly different, while those in total bank loan balances (lnLOAN) and long-term loan balances (lnLONG) were significantly higher for firms with relatively closer bank-firm relationships. If we suppose the value of MATURITY to be 0.2 for example, then the DRFs show that the lnLOAN (lnLONG) rose by 20% (23%) for firms in treated-A, while increments of only 10% (2%) were observed for treated-B. Besides, the DRF of lnLONG for treated-B is insignificant. The changes in borrowing costs, or RATE, also showed interesting results. For firms in treated-A, the DRF is not significant while, on the other hand, they were for treated-B, showing an increment of 18bps when MATURITY was 0.2. In addition, the null hypothesis that the difference between the two DRFs is equal is rejected at a small significance level.

These results show that firms that kept relatively close bank-firm relationships had more access to bank loans; especially long-term bank loans with relatively low borrowing costs. For firms without such close relationships, relatively higher borrowing costs were charged and their access to long-term loans was limited. The changes in INVEST show that these differences in borrowing conditions were not serious enough to cause financial constraints.

6 Conclusions

This paper investigates the causal relationship between a firm's bank dependency and its financial constraints by examining whether the Japanese listed firms with not-so-close bank-firm relationships were financially constrained during the 2008 financial crisis. The empirical results from matching estimators show that firms with large amounts of bonds maturing in 2008 did not cut their investment expenditure compared to bank-dependent firms. In contrast, their bank loan balances rose sharply without simultaneous increments in borrowing costs. However, when the heterogeneity of the treatment effects is taken into account, it comes to light that firms with relatively close bank-firm relationships among treated firms had more access to bank loans, especially to long-term loans with low borrowing costs. Although firms without such close relationship did experience a rise in their borrowing costs, the changes in the investment rates were not statistically different from control firms.

These empirical results imply that there does exist a cost to reducing bank dependency, but it is not so high for recent Japanese listed firms. Existing literature, such as Chava and Purnanandam (2010), shows that the shocks in the banking sector affect bank-dependent firms' performance negatively. Nevertheless, the results of this study demonstrate that the shocks in the capital markets in 2008 were offset by the banking sector and this prevented propagation to the real economy. In terms of policy implications, this research also demonstrates that a robust banking system can mitigate the effect of shocks in the capital markets on the real economy.

The results of this paper also raise additional questions for the future research. First, in order to learn a lesson from the financial crisis, it is an urgent subject for empirical analysis to understand the cause of a capital market paralysis and the mechanism behind an international propagation of shocks. The second point would be to investigate how much it would benefit a firm to reduce its bank dependency. Since one of the main reasons why firms issue bonds is to reduce the banks' monopoly powers, which are unobservable and reflected in the firms' interest payments, we need more elaborate empirical strategies to deal with the possible endogeneity. The last point would be to assess the role of the credit lines. Firms with lines of credit must have relied on them during the crisis but lack of data on this prevented this paper from pursuing this topic. Nonetheless, it can be an important research subject to understand how the lines of credit functioned during the crisis period and what kinds of bank-firm relationships were behind them.

References

[1] Almeida, H., M. Campello, B. Laranjeira, and S. Weisbenner, (2009), "Corporate Debt Maturity and the Real Effects of the 2007 Credit Crisis," NBER Working Paper, No.14990.

[2] Altman, E.I. (2002), "Revisiting Credit Scoring Models in a Basel 2 Environment," Stern School of Business New York University Working Paper.

[3] Bank of Japan (2009a), Financial Markets Report, (March).

[4] Bank of Japan (2009b), Financial System Report, (September).

[5] Blanchard, O. J., F. Lopez-de-Silanes and A. Shleifer, (1994), "What Do Firms Do with Cash Windfalls?," *Journal of Financial Economics*, 36, pp.337-360.

[6] Caballero, R.J., T. Hoshi and A. K. Kashyap, (2008), "Zombie Lending and Depressed Restructuring in Japan," *American Economic Review*, 98, pp. 1943-1977.

[7] Caliendo, M., and S. Kopeinig, (2008), "Some Practical Guidance for the Implementation of Propensity Score Matching," *Journal of Economic Surveys*, 22, pp.31-72

[8] Cameron, C. A. and P. K. Trivedi, (2005), *Microeconometrics*: *Methods and Applications*, Cambridge University Press.

[9] Chava, S., and A. Purnanandam, (2010), "The Effects of Banking Crisis on Bank-Dependent Borrowers," forthcoming in *Journal of Financial Economics*.

[10] Drake, C. (1993), "Effect of Misspecification of the Propensity Score on Estimators of Treatment Effect," *Biometrica*, 49, pp.1231-1236.

[11] Fazzari, S. M., R. G. Hubbard and B.C. Petersen, (1988), "Financing Constraints

and Corporate Investment,” *Brookings Papers on Economic Activity*, 1, pp.141-195.

[12] Gertler, M., and S. Gilchrist, (1994). “Monetary Policy, Business Cycles, and the Behavior of Small Manufacturing Firms.” *Quarterly Journal of Economics*, 109, pp. 309-340.

[13] Heckman, J., H. Ichimura and P. Todd, (1997), “Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme,” *Review of Economic Studies*, 64, pp. 605-654.

[14] Holmström, B., and J. Tirole, (1998), “Private and Public Supply of Liquidity,” *Journal of Political Economy*, 106, pp.1-40.

[15] Hongo, Y. and S. Oyama, (2010), “Nihon no Shasai Hakko Spread no Hendo Yoin (The Determinants of Fluctuations of Spreads on Issued Corporate Bonds in Japan),” Bank of Japan Working Paper Series, No.10-J-10. (in Japanese).

[16] Hoshi, T., A. Kashyap, and D. Scharfstein, (1990), “Bank Monitoring and Investment: Evidence from the Changing Structure of Japanese Corporate banking Relationship, in R.G. Hubbard, ed., *Asymmetric Information, Corporate Finance and Investment*, University of Chicago Press.

[17] Hoshi, T., A. Kashyap, and D. Sharfstein, (1991), “Corporate Structure, Liquidity, Investment, Evidence from Japanese Industrial Groups,” *Quarterly Journal of Economics*, 106, pp. 33-60.

[18] Houston, J., and C.M. James, (1996), “Bank Information Monopolies and the Mix of Private and Public debt choices,” *Journal of Finance*, 51, pp.1863-1889.

[19] Houston, J., and C.M. James, (2001), “Do Relationships Have Limits? Banking Relationships, Financial Constraints, and Investment,” *Journal of Business*, 74, pp.347-374.

[20] Hovakimian, G. and T. Sheridan, (2006), "Corporate Investment with Financial Constraints: Sensitivity of Investment to Funds from Voluntary Asset Sales," *Journal of Money, Credit and Banking*, 38, pp.357-374.

[21] Kaplan, S. N., and L. Zingales, (1997), "Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints?," *Quarterly Journal of Economics,* 112, pp.169-215.

[22] Kashyap A.K., and J. C. Stein**, (**2000), "What Do a Million Observations on Banks Say about the Transmission of Monetary Policy?," *American Economic Review*, 90, pp.407-428.

[23] Koenker, R. (2005), *Quantile Regression,* Cambridge University Press.

[24] Lamont, O. A. (1997), "Cash Flow and Investment: Evidence from Internal Capital Markets," *Journal of Finance*, 52, pp. 83-109.

[25] Lechner, M. (2002), "Program Heterogeneity and Propensity Score Matching: An Application to the Evaluation of Active Labor Market Policies," *Review of Economics and Statistics*, 84, pp.205-220.

[26] Osano, H. and Y. Tsutsui, (1985), "Implicit Contracts in the Japanese Bank Loan Market," *Journal of Financial and Quantitative Analysis*, 20, pp.211-229.

[27] Peek, J., and E. Rosengren, (1997), "The International Transmission of Financial Shocks: The Case of Japan," *American Economic Review*, 87, pp. 495-505.

[28] Pinkowitz, L., and R. Williamson, (2001), "Bank Power and Cash Holdings: Evidence from Japan," *Review of Financial Studies*, 14, pp.1059-1082.

[29] Rajan, R.G. (1992), "Insiders and Outsiders: The Choice between Informed and

Arm's-Length Debt," *Journal of Finance*, 47, pp.1367-1400.

[30] Rosenbaum, P., and D. Rubin, (1983), "The Central Role of the Propensity Score in Observational Studies for Causal Effects," *Biometrika*, 70, pp.41-55.

[31] Sharpe, S.A. (1990), "Asymmetric Information, Bank Lending, and Implicit Contracts: A Stylized Model of Customer Relationships," *Journal of Finance*, 45, pp. 1069-87.

[32] Sheard, P. (1989), "The Main Bank System and Corporate Monitoring and Control in Japan," *Journal of Economic Behavior and Organization*, 11, pp.399-422

[33] Shirasu, Y. and P. Xu, (2007), "The Choice of Financing with Public Debt Versus Private Debt: New Evidence from Japan after Critical Binding Regulations were Removed," *Japan and the World Economy*, 19, pp.393-424.

[34] Sianesi, B. (2004), "An Evaluation of the Active Labour Market Programmes in Sweden," *Review of Economics and Statistics*, 86, pp.133-155.

[35] Weinstein, D.E. and Y. Yafeh, (1998), "On the Costs of a Bank-Centered Financial System: Evidence from the Changing Main Bank Relations in Japan," *Journal of Finance*, 53, pp. 635-672.

Tables and Figures

Table 1: Definitions of treated and non-treated categories

Categories	Definitions
B0	The firms whose balances of corporate bonds were 0 in FY2008.
B1	The firms that had issued corporate bonds but none of them matured in FY2008.
B2	The firms that had issued a small amount (less than 5% of liabilities with interest) of corporate bonds that matured in FY2008.
B3	The firms that had issued a medium amount (5-10% of liabilities with interest) of corporate bonds that matured in FY2008.
B4	The firms that had issued a large amount (more than 10% of liabilities with interest) of corporate bonds that matured in FY2008.

Table 2: Definitions of variables

Variables	Definitions
MATURITY	**Maturing-bond-balances:** the ratio of the amount of outstanding balances of corporate bond that matured in FY2008 to the sum of liabilities with interest (short-term bank loans (Nikkei-NEEDS' FB075), long-term bank loans (FB076+FB101), commercial papers (FB075) and corporate bonds (FB078+FB099)) reported at the end of FY2007.
Q(t-1)	**Tobin's q**: the ratio of market capitalization plus total assets (FB063) minus net assets (FB166) minus differed taxes (FB056) to total assets.
CF(t-1)	**Cash-flows**: the sum of net income (FC058) and depreciation (FC046) divided by the lag of fixed tangible assets (FB032).
lnASSET(t-1)	**Firm-sizes**: the natural log of total assets.
CAP(t-1)	**Leverages**: the ratio of net assets to total assets.
CASH(t-1)	**Cash-holdings**: the ratio of quick assets (FB02) to total assets.
RATING(t-1)	**Default-risks**: Altman's (2002) revised Z-scores.
MAINBANK(t-1)	**Bank-firm-relationships**: the dummy variable that takes 1 if there is more than one bank in the list of major shareholders, otherwise 0.
MARKET1-4	**Stock-market-dummies**: 1:The firms that are listed on Tokyo stock exchange first section; 2:The firms that are listed on Tokyo stock exchange second section; 3:The firms that are listed on regional stock exchanges (Sapporo, Nagoya, Osaka, and Fukuoka stock exchange); 4:The firms that are listed on stock markets for emerging markets (Jasdaq, mothers and Hercules).
INDUSTRY1-15	**Industry-dummies**: 1: Mining; 2: Construction; 3: Manufacture of food; 4: Manufacture of textile; 5: Manufacture of chemical (including petrochemical); 6: Manufacture of primary metal and metal products; 7: Manufacture of machinery; 8: Manufacture of electrical appliances; 9: Manufacture of transportation equipment; 10: Other manufacturing; 11: Electricity, gas and heat supply; 12: Telecommunication; 13:Transportation; 14: Wholesale and Retail trade; 15: others.
Outcome variables	
INVEST	**Investment-rates**: the ratio of capital expenditures (CAPEX, FP01143) to the lag of fixed tangible assets (FB032).
RATE	**Bank-loan-interest-rates**: the ratio of interest paid on bank loans (FC016-FC017-FC018-FC124-FC125) to two-year averaged total bank loan balances (FB075+FB076+FB101).
lnLOAN	**Bank-loan-balances**: the natural log of total bank loan balances
lnLONG	**Long-term-bank-loan-balances**: the natural log of long-term bank loan balances.
lnSHORT	**Short-term-bank-loan-balances**: the natural log of short-term bank loan balances.

Notes: Codes in parentheses indicate the items of Nikkei-NEEDs.

Table 3: Descriptive statistics

	N. of Obs.	Mean	Std.dev.	min	max
MATURITY	1880	0.0226	0.0647	0.0000	0.8824
B0	1880	0.6043	0.4891	0.0000	1.0000
B1	1880	0.0798	0.2710	0.0000	1.0000
B2	1880	0.1771	0.3819	0.0000	1.0000
B3	1880	0.0729	0.2600	0.0000	1.0000
B4	1880	0.0660	0.2483	0.0000	1.0000
Q(t-1)	1880	1.1795	0.4915	0.4685	8.1068
CF(t-1)	1880	0.1880	1.0115	-9.8500	18.6022
lnASSET(t-1)	1880	10.8398	1.5964	6.4052	15.7568
CAP(t-1)	1880	0.4405	0.1798	0.0211	0.8960
CASH(t-1)	1880	0.3691	0.1604	0.0078	0.8934
RATING(t-1)	1880	2.0441	0.8362	0.1009	6.4509
MAINBANK(t-1)	1880	0.7590	0.4278	0.0000	1.0000
MARKET1	1880	0.5277	0.4994	0.0000	1.0000
MARKET2	1880	0.1351	0.3419	0.0000	1.0000
MARKET3	1880	0.1085	0.3111	0.0000	1.0000
MARKET4	1880	0.2287	0.4201	0.0000	1.0000
Outcome variables					
INVEST	1880	-0.0282	0.3236	-5.6283	2.0107
RATE	1880	0.0003	0.0195	-0.2844	0.3025
lnLOAN	1880	0.0689	0.4860	-2.0867	2.8463
lnLONG	1880	0.0341	1.1540	-6.3986	7.5501
lnSHORT	1880	0.0810	1.4879	-9.4873	10.1581

Table 4.1: Subsample descriptive statistics (covariates)

	All	Subsample				
		B0=1	B1=1	B2=1	B3=1	B4=1
MATURITY	0.0226	0.0000	0.0000	0.0202	0.0712	0.2094
Q(t-1)	1.1795	1.1696	1.1951	1.1652	1.2369	1.2255
CF(t-1)	0.1880	0.2449	0.0735	0.1222	0.0540	0.1300
ASSET(t-1)	227.93	100.41	360.98	447.94	560.97	276.53
CAP(t-1)	0.4405	0.4814	0.4398	0.3286	0.3566	0.4588
CASH(t-1)	0.3691	0.3993	0.3230	0.3010	0.3242	0.3809
SCORE(t-1)	2.0441	2.2393	1.8268	1.6398	1.6983	1.9864
MAINBANK(t-1)	0.7590	0.7544	0.8000	0.7508	0.7664	0.7661
MARKET1	0.5277	0.4877	0.6867	0.5976	0.5255	0.5161
MARKET2	0.1351	0.1549	0.0733	0.1111	0.1241	0.1048
MARKET3	0.1085	0.1162	0.1000	0.0871	0.1022	0.1129
MARKET4	0.2287	0.2412	0.1400	0.2042	0.2482	0.2661
N. of Obs.	1880	1136	150	333	137	124

Notes: The unit of ASSET is billion Yen.

Table 4.2: Subsample descriptive statistics (outcome variables)

	All	Subsample				
		B0=1	B1=1	B2=1	B3=1	B4=1
INVEST	-0.0282	-0.0272	-0.0321	-0.0357	-0.0435	0.0046
RATE	0.0003	0.0002	0.0011	0.0003	-0.0007	0.0012
lnLOAN	0.0689	0.0449	0.1250	0.0373	0.1385	0.2283
lnLONG	0.0341	-0.0092	0.1246	-0.0041	0.1027	0.3487
lnSHORT	0.0810	0.0584	0.2561	-0.0808	0.3163	0.2515
N. of Obs.	1880	1136	150	333	137	124

Table 5.1: Multinomial probit estimation (parameter estimates)

Multinomial probit model
Dependent variable: 0,1,2,3,4

	coef.	p>|z|	std.err.	coef.	p>|z|	std.err.	coef.	p>|z|	std.err.	coef.	p>|z|	std.err.
	B1			B2			B3			B4		
Q	0.0959		0.1338	-0.0734		0.1377	0.2013		0.1630	0.0874		0.1592
CF	-0.1297		0.1494	0.0203		0.0918	-0.1038		0.0832	-0.0544		0.0628
lnASSET	0.3305	***	0.0609	0.3147	***	0.0483	0.4052	***	0.0578	0.2591	***	0.0591
CAP	-0.4032		0.4905	-3.6601	***	0.4297	-2.4441	***	0.5182	-0.1349		0.5900
CASH	-0.9180	*	0.5578	-1.8435	***	0.4056	-0.9797	**	0.4779	0.0415		0.6177
RATING	-0.3760	***	0.1466	-0.2647	**	0.1096	-0.2689	*	0.1414	-0.3684	***	0.1305
MAINBANK	0.0222		0.1603	-0.2534	**	0.1256	-0.1113		0.1654	0.0616		0.1768
const.	-4.2253	***	0.7782	-2.1283	***	0.6142	-4.2584	***	0.7678	-4.2103	***	0.8449
Market_dummies	Yes			Yes			Yes			Yes		
Industry_dummies	Yes			Yes			Yes			Yes		
N. of Obs.	1896											
Wald chi2(96)	511.41											
p-value	(0.000)											
Log-likelihood	-1956.04											

Notes: *,**,*** indicate significance levels of 10%, 5% and 1%, respectively. Standard errors are estimated by BHHH method.

Table 5.2: Multinomial probit estimation (marginal effects)

Multinomial probit model
Dependent variable: 0,1,2,3,4

	m.e.	p>|z|	std.err.	m.e.	p>|z|	std.err.	m.e.	p>|z|	std.err.	m.e.	p>|z|	std.err.	m.e.	p>|z|	std.err.
	B0			B1			B2			B3			B4		
Q	-0.0152		0.0271	0.0094		0.0154	-0.0215		0.0237	0.0200		0.0166	0.0073		0.0170
CF	0.0159		0.0183	-0.0138		0.0173	0.0100		0.0165	-0.0088		0.0084	-0.0033		0.0065
lnASSET	-0.0982	***	0.0121	0.0231	***	0.0067	0.0351	***	0.0078	0.0280	***	0.0056	0.0120	**	0.0058
CAP	0.5984	***	0.0952	0.0723		0.0550	-0.5973	***	0.0713	-0.1705	***	0.0495	0.0972		0.0607
CASH	0.3292	***	0.0960	-0.0533		0.0634	-0.2913	***	0.0686	-0.0521		0.0469	0.0674		0.0640
RATING	0.0943	***	0.0251	-0.0299	*	0.0164	-0.0255		0.0184	-0.0132		0.0139	-0.0258	*	0.0134
MAINBANK	0.0323		0.0309	0.0094		0.0169	-0.0475		0.0229	-0.0071		0.0167	0.0128		0.0167
Market_dummies	Yes			Yes			Yes			Yes			Yes		
Industry_dummies	Yes			Yes			Yes			Yes			Yes		
N. of Obs.	1896														
Wald chi2(96)	511.41														
p-value	(0.000)														
Log-likelihood	-1956.04														

Notes: *,**,*** indicate significance levels of 10%, 5% and 1%, respectively. The marginal effects are evaluated at mean values of explanatory variables. Standard errors are estimated by the delta method.

Table 6: Estimation results of PSM-DIDs (Year 2008)

		Method: Caliper Matching											
		Treated=B1 Control=B0			Treated=B2 Control=B0			Treated=B3 Control=B0			Treated=B4 Control=B0		
		DID	p>|z|	std.err.	DID	p>|z|	std.err.	DID	p>|z|	std.err.	DID	p>|z|	std.err.
INVEST	t+1	-0.009		0.026	-0.031		0.030	-0.041		0.035	0.038		0.027
RATE	t+1	0.001		0.002	0.000		0.002	-0.001		0.002	0.002		0.002
lnLOAN	t+1	0.027		0.047	-0.014		0.038	0.113	**	0.052	0.180	***	0.060
lnLONG	t+1	0.096		0.105	0.042		0.089	0.152	*	0.092	0.367	**	0.143
lnSHORT	t+1	0.048		0.128	-0.177		0.109	0.436	***	0.158	0.164		0.150

		Method: 10 Nearest Neighbor Matching											
		Treated=B1 Control=B0			Treated=B2 Control=B0			Treated=B3 Control=B0			Treated=B4 Control=B0		
		DID	p>|z|	std.err.	DID	p>|z|	std.err.	DID	p>|z|	std.err.	DID	p>|z|	std.err.
INVEST	t+1	-0.016		0.023	-0.035		0.025	-0.036		0.035	0.031		0.028
RATE	t+1	0.000		0.002	0.000		0.002	-0.001		0.002	0.002		0.002
lnLOAN	t+1	0.024		0.046	-0.011		0.036	0.115	**	0.052	0.194	***	0.062
lnLONG	t+1	0.085		0.102	0.050		0.083	0.122		0.084	0.395	***	0.148
lnSHORT	t+1	0.023		0.130	-0.150		0.108	0.471	***	0.161	0.206		0.155

Notes: *,**,*** indicate significance levels of 10%, 5% and 1% respectively. Standard errors are calculated following the method proposed by Lechner (2002). Estimation results from caliper matching are shown in the upper table. Results from 10-nearest-neighbor matching are shown in the bottom table.

Table 7: Balancing tests

(a) Standardized bias test

	Treated=B1 Control=B0		Treated=B2 Control=B0		Treated=B3 Control=B0		Treated=B4 Control=B0	
	mean	median	mean	median	mean	median	mean	median
Unmatched	18.220	12.560	18.974	9.201	15.806	8.613	10.204	8.533
Matched	4.724	2.810	3.983	3.105	4.920	3.917	2.597	2.100

(b) Sianesi's pseudo R squared test

	Treated=B1 Control=B0			Treated=B2 Control=B0			Treated=B3 Control=B0			Treated=B4 Control=B0		
	R_squared	LR chi2	p-value	R_squared	LR chi2	p-value	R_squared	LR chi2	p-value	R_squared	LR chi2	p-value
Unmatched	0.136	127.99	0.000	0.228	360.41	0.000	0.174	151.80	0.000	0.065	53.19	0.001
Matched	0.019	7.14	1.000	0.007	6.34	1.000	0.014	4.92	1.000	0.004	1.23	1.000

Notes: In the upper table, mean and median absolute values of Standardized Bias (SB) are shown. In the bottom table, the values of Pseudo R squared and the Likelihood Ratio tests for the null hypothesis that all the coefficients from the probit regression of 1($S=l|S=l$,or, $S=m$) on X are zero.

Table 8: Estimation results of PSM-DIDs (Year 2005)

Method: Caliper Matching

		Treated=B1 Control=B0			Treated=B2 Control=B0			Treated=B3 Control=B0			Treated=B4 Control=B0		
		DID	p>|z|	std.err.	DID	p>|z|	std.err.	DID	p>|z|	std.err.	DID	p>|z|	std.err.
INVEST	t+1	-0.002		0.017	-0.012		0.018	-0.100	*	0.055	-0.022		0.015
RATE	t+1	-0.001		0.001	-0.001		0.001	-0.001		0.001	0.004		0.005
lnLOAN	t+1	0.062	*	0.034	0.055	*	0.033	0.071		0.055	0.054		0.054
lnLONG	t+1	0.049		0.068	0.034		0.065	0.057		0.101	0.018		0.093
lnSHORT	t+1	-0.058		0.090	-0.070		0.108	-0.139		0.142	0.082		0.110

Method: 10 Nearest Neighbor Matching

		Treated=B1 Control=B0			Treated=B2 Control=B0			Treated=B3 Control=B0			Treated=B4 Control=B0		
		DID	p>|z|	std.err.	DID	p>|z|	std.err.	DID	p>|z|	std.err.	DID	p>|z|	std.err.
INVEST	t+1	-0.002		0.015	-0.019		0.018	-0.097	*	0.054	-0.014		0.018
RATE	t+1	-0.001		0.001	-0.001		0.001	-0.001		0.001	0.004		0.005
lnLOAN	t+1	0.049		0.034	0.057	*	0.031	0.062		0.053	0.055		0.055
lnLONG	t+1	0.045		0.068	0.029		0.063	0.042		0.093	0.033		0.096
lnSHORT	t+1	-0.073		0.092	-0.078		0.107	-0.143		0.140	0.092		0.115

Notes: *, **, *** indicate significance levels of 10%, 5% and 1% respectively. Standard errors are calculated following the method proposed by Lechner (2002). Estimation results from caliper matching are shown in the upper table. Results from 10-nearest-neighbor matching are shown in the bottom table.

Table 9: Changes in the maturity schedules

	CHANGE (Overall)					
	Mean	25 percentile	Median	75 percentile	Std.dev.	N. of Obs.
FY2008	0.927	0.000	0.000	0.000	15.215	688
FY2007	1.138	0.000	0.000	0.020	20.838	669
FY2006	1.136	0.000	0.000	0.060	19.326	646
FY2005	0.846	0.000	0.000	0.054	14.981	595
	CHANGE (Subsample: CHANGE≠0)					
	Mean	25 percentile	Median	75 percentile	Std.dev.	N. of Obs.
FY2008	3.021	-0.060	0.048	0.200	27.405	211
FY2007	3.239	0.010	0.068	0.200	35.111	235
FY2006	2.879	0.020	0.100	0.240	30.715	255
FY2005	2.064	0.020	0.081	0.206	23.369	244

Notes: The unit is 1 billion Yen. The variable CHANGE is defined as “corporate bonds scheduled to mature within one year” minus lagged “corporate bonds scheduled to mature in more than one year less than two years.”

Table 10: Estimation results from PSM-DIDs after changing control groups

		Method: Caliper Matching									
		Treated=B3 Control=B1, B2					Treated=B4 Control=B1,B2				
		Treated	Control	DID	p>|z|	std.err.	Treated	Control	DID	p>|z|	std.err.
INVEST	t+1	-0.0435	-0.0365	-0.0070		0.0310	0.0046	-0.0420	0.0466		0.0297
RATE	t+1	-0.0007	0.0006	-0.0013		0.0008	0.0012	0.0009	0.0003		0.0021
lnLOAN	t+1	0.1385	0.0557	0.0828	**	0.0412	0.2283	0.0665	0.1618	***	0.0584
lnLONG	t+1	0.1027	0.0310	0.0716		0.0524	0.3487	0.0579	0.2908	**	0.1325
lnSHORT	t+1	0.3163	0.0596	0.2567	*	0.1552	0.2515	0.0077	0.2438		0.1835

Notes: *,**,*** indicate significance levels of 10%, 5% and 1% respectively. Standard errors are calculated following the method proposed by Lechner (2002).

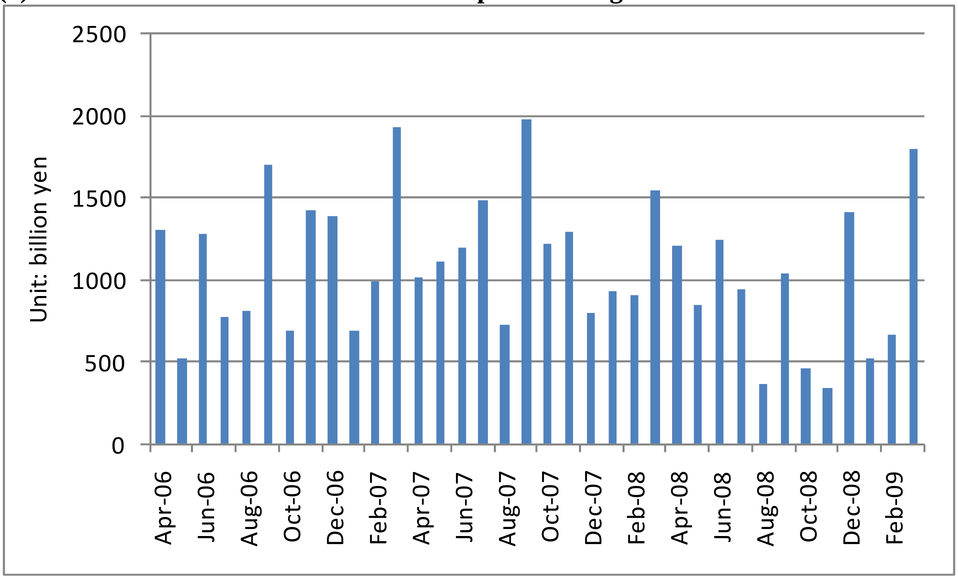
Table 11: Median treatment effects

	INVEST			RATE			lnLOAN			lnLONG			lnSHORT		
	coef.	p>|z|	std.err.	coef.	p>|z|	std.err.	coef.	p>|z|	std.err.	coef.	p>|z|	std.err.	coef.	p>|z|	std.err.
MATURITY	-0.0164		0.0368	0.0091	***	0.0021	0.5125	***	0.1689	0.1072		0.1532	0.3369	**	0.1552
MATURITY*MAINBANK(t-1)	0.0200		0.0458	-0.0066	**	0.0026	0.5488	***	0.2089	1.0493	***	0.1904	0.3633	*	0.1923
Q(t-1)	-0.0131	***	0.0032	-0.0002		0.0002	0.0291	**	0.0146	0.0183		0.0132	0.0107		0.0124
CF(t-1)	-0.0013		0.0014	-0.0001		0.0001	-0.0147	**	0.0068	0.0016		0.0057	-0.0051		0.0059
lnASSET(t-1)	-0.0003		0.0013	0.0000		0.0001	0.0083		0.0059	0.0149	***	0.0053	0.0016		0.0054
CAP(t-1)	-0.0400	***	0.0109	-0.0001		0.0007	-0.0847	*	0.0496	0.0345		0.0449	-0.1642	***	0.0450
CASH(t-1)	-0.0020		0.0112	-0.0002		0.0007	-0.0663		0.0508	-0.0127		0.0460	-0.0666		0.0464
RATING(t-1)	0.0016		0.0026	-0.0001		0.0002	0.0082		0.0119	0.0005		0.0108	0.0150		0.0108
MAINBANK(t-1)	0.0042		0.0037	0.0005	**	0.0002	0.0189		0.0170	0.0177		0.0153	0.0192	**	0.0153
const.	0.0210		0.0170	-0.0004		0.0011	-0.1163		0.0783	-0.2926	***	0.0706	0.0602		0.0711
Market_dummies	Yes			Yes			Yes			Yes			Yes		
Industry_dummies	Yes			Yes			Yes			Yes			Yes		
N. of Obs.	1880			1880			1880			1880			1880		
Pseudo R-squared	0.0086			0.0116			0.0411			0.0121			0.0075		
F-Test(1)	F(26,1853)=2.6			F(26,1853)=4.01			F(26,1853)=7.64			F(26,1853)=7.76			F(26,1853)=5.29		
(P-Value)	(0.000)			(0.000)			(0.000)			(0.000)			(0.000)		
F-Test(2)	F(1,1853)=0.02			F(1,1853)=2.32			F(1,1853)=72.47			F(1,1853)=102.06			F(1,1853)=37.07		
(P-Value)	(0.897)			(0.128)			(0.000)			(0.000)			(0.000)		

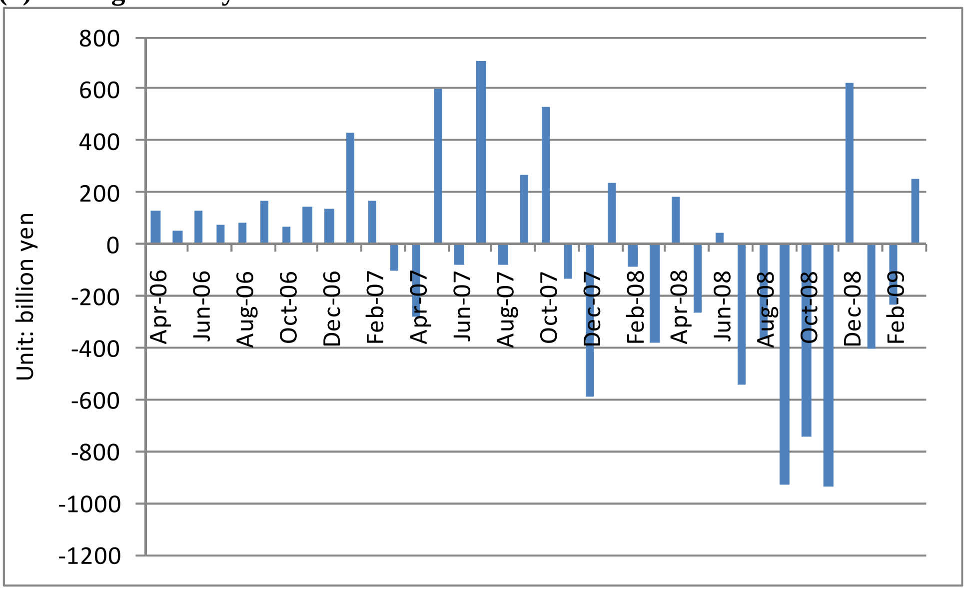
Notes: *,**,*** indicate significance levels of 10%, 5% and 1%, respectively. F-Test (1) tests the null hypothesis that all the coefficients are zero and F-Test (2) tests respectively the null hypothesis that the sum of coefficients on MATURITY and MATURITY*MAINBANK are zero.

Figures 1: The volume of bonds issued

(a) The amounts of Yen-denominated corporate straight bonds issued

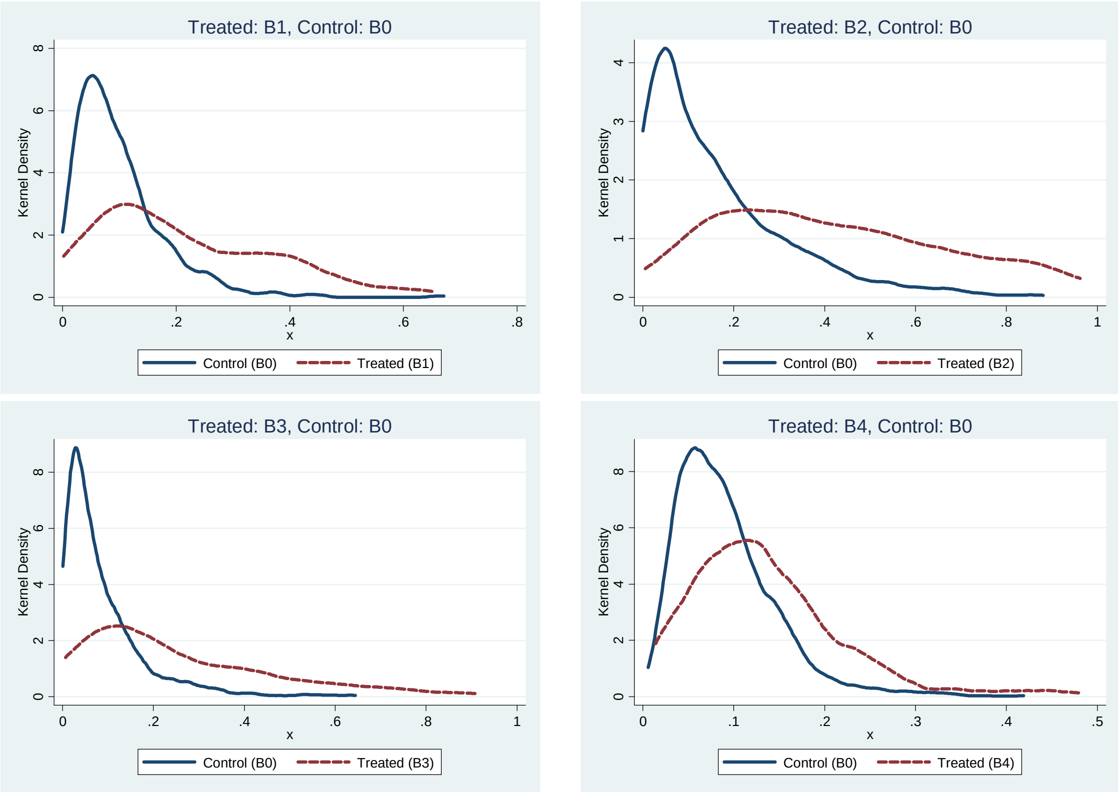


(b) Changes from year-earlier month



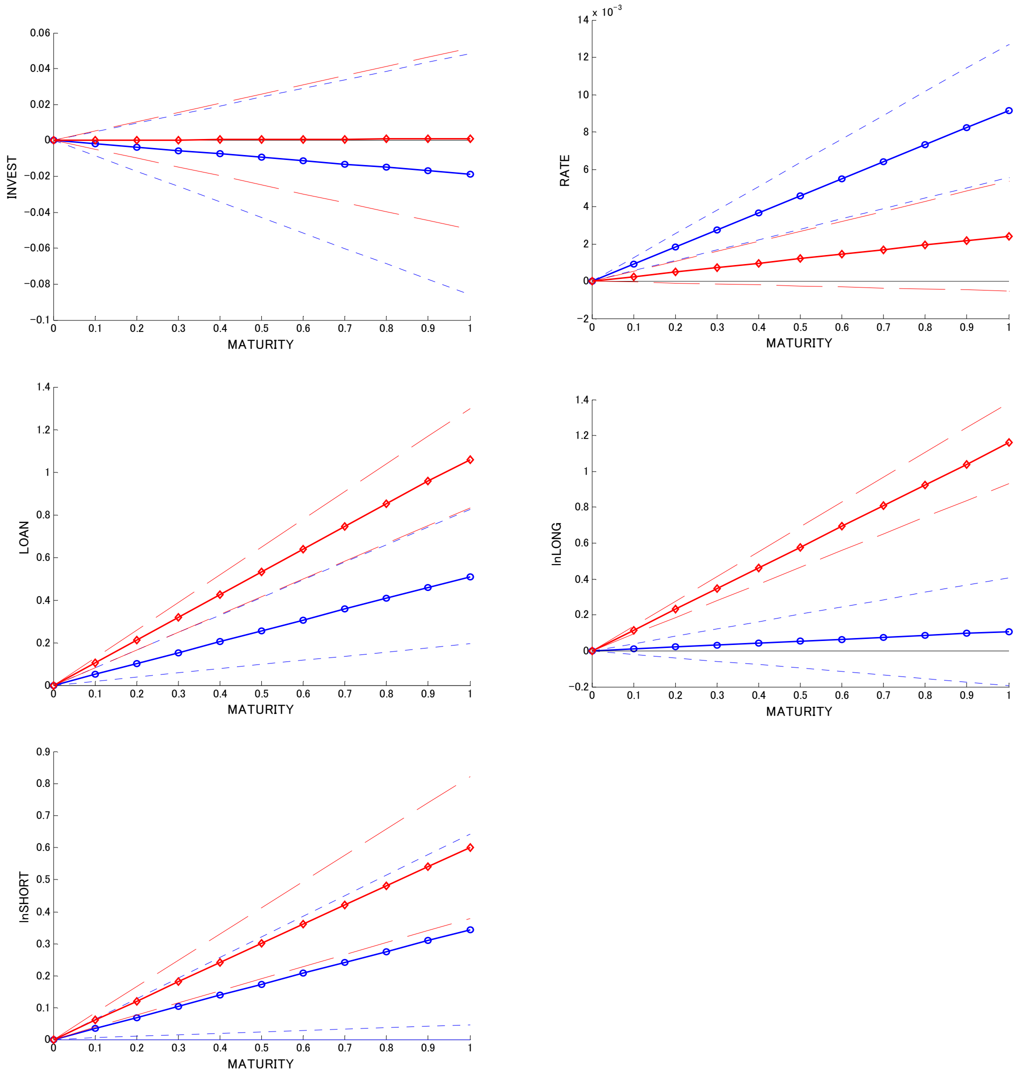
Notes: The data sources are the Bank of Japan and the Japan Security Dealers Association (JSDA). The bonds that were issued in overseas markets and private placement bonds are also included.

Figures 2: Kernel density functions of conditional propensity scores



Notes: The dotted lines and solid lines respectively indicate the estimated distribution functions for treated samples and control samples in each subsample.

Figures 3: Dose-response functions
(Lines with diamonds: treated-A; Lines with circles: treated-B)



Notes: The dashed lines indicate 95% confidence intervals for treated-A and the dotted lines indicate those for treated-B. Standard errors for treated-B are calculated by the delta method.