# The Real Effects of Bank-Driven Termination of Relationships: Evidence from Loan-level Matched Data

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# The Real Effects of Bank-Driven Termination of Relationships: Evidence from Loan-level Matched Data *

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Abstract. We examine the effects of bank-driven terminations of bank–borrower relationships on the investments of borrowing firms by exploiting a matched dataset of Japanese banks and listed firms from 1991 to 2010. We find that while bank-driven terminations do not always affect investment, they do when the firms facing termination have difficulty in either establishing a new relationship or increasing borrowings within their existing relationship. Our findings coincide with the prediction of existing theoretical models whereby financial frictions in a matching process in credit markets play an important role in firm investment.

*JEL classification*: G01, G21, G28

*Keywords*: matched lender–borrower data, relationship termination, switching of relationships, establishment of new relationships.

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## 1. Introduction

Of all recent financial crises in developed economies, that in Japan in the 1990s following the bursting of the bubble economy was unprecedented in terms of the length and depth of the subsequent economic downturn. As shown in Figure 1, bank lending and private investment declined continuously throughout the early 1990s to the early 2000s. The existing literature on Japan's financial depression has already investigated the existence of a credit crunch during this period and its impact on firm investment.[1] During this period, however, not only did aggregate bank loans decrease but also the number of relationship terminations between firms and their banks increased, as shown in Figure 2.[2]

This paper addresses empirically the above coexistence of the increase in relationship terminations, and the decline in bank loans and firm investment by investigating whether the impairment of bank capital conditions is responsible, and if so, whether the lender-side shocks involved in these terminations impact upon firm investment behavior.

By using a matched dataset, we find that poorly capitalized banks, with large exposures to the real estate industry, are more likely to terminate their relationships. Moreover, we show that bank-driven terminations decreased firm investment in the early 2000s, when Japanese banks were compelled to dispose of nonperforming loans. Moreover, we show that one of the reasons for the significant effects of these terminations in the early 2000s was that borrowing firms facing termination were having difficulties in immediately obtaining other sources of funds. In other words, these firms were either unable to establish a new borrowing relationship or to increase their borrowings within their existing banking relationship. Furthermore, in the early 2000s, a decrease in bank loans caused by such terminations had a more significant effect on firms' investment than a mere change of loans in continuing relationships. Conversely, we find that in the late 1990s, the termination effects

[1] For instance, Woo (2003) and Watanabe (2007) use bank-level panel data to conclude that there was a credit crunch during the late 1990s. Conversely, using loan-level matched data, Peek and Rosengren (2005) found evidence that during the 1990s, Japanese banks with impaired capital instead provided more loans to distressed borrowing firms. For empirical studies in the US, see Bernanke and Lown (1991), Peek and Rosengren (1995), and Berrospide and Edge (2010).

[2] See Section 2 for the definition of bank relationship termination.

on a firm's investment were not significant, as the affected firms were able to locate other investment financing. Together, these findings provide evidence that financial frictions in the matching process between borrowing firms and lending banks play an important role in a firm's investment decisions.

Our paper contributes to the debate on whether the prolonged stagnation of the past two decades is the result of low productivity growth or the breakdown of the post-bubble economy financial system, for which there is currently no consensus (see Motonishi and Yoshikawa (1999), Hayashi and Prescott (2002), Hoshi and Kashyap (2004), and Caballero et al. (2008)). In this study, we evaluate quantitatively the effects of termination to help us to understand better the role of financial frictions during periods of economic contraction in Japan.

Moreover, we extend the premise of a "bank balance sheet channel," signifying that the impairment of a bank's balance sheet works as a mechanism that amplifies adverse economic shocks.[3] For the most part, the extant literature has considered the role of the bank balance sheet channel from the viewpoint of firms or banks and not the relationships between them. This means that the literature does not explicitly distinguish between changes in bank loans derived from creating new relationships and those resulting from terminating or maintaining existing relationships. However, when we take into account the role of relationship banking in mitigating asymmetric information problems between banks and borrowing firms, which prior studies have investigated, termination of a relationship has a more significant impact on firms' performance than a mere decrease in bank loans within continuing relationships, as it would destroy some relation-specific assets.[4] In this paper, we consider the effect of terminations on the real economy, in terms of the bank

[3] Theoretical literature about the balance sheet channel includes Bernanke and Gertler (1989), Holmström and Tirole (1997), Kiyotaki and Moore (1997), Bernanke et al. (1999), Diamond and Rajan (2005), and Gertler and Kiyotaki (2010). For the empirical literature that particularly focuses on a bank balance sheet's effect on a firm's investment and export behavior in Japan, see Gibson (1995; 1997), Kang and Stulz (2000), Chapter 4 in Ogawa (2003; 2007), Gan (2007), and Amiti and Weinstein (2011; 2013). Of these, Gan (2007) and Amiti and Weinstein (2011; 2013) employed bank–borrower matched data, whereas the remaining studies used firm-level panel data.

[4] For example, the existence of a relation-specific asset in Japan is studied by Miyakawa (2010) and Nakashima and Takahashi (2016), using bank-firm matched data. Furthermore, evidence of the existence

balance sheet channel, considering relation-specific assets between banks and borrowing firms. To our knowledge, ours is the first study to investigate the bank balance sheet channel by focusing on the dynamic borrowing and lending relationships between firms and banks.[5]

Some recent theoretical studies, including Den Haan et al. (2003), Wasmer and Weil (2004), and Becsi et al. (2005; 2013), have proposed a mechanism for prolonging the effect of relationship terminations on the real sector from the perspective of matching lenders and borrowers in the credit market. In these theoretical frameworks, a credit expansion and firm investment cannot immediately react in response to a positive aggregate shock because it takes time to identify a profitable project owing to frictions and asymmetric information in the credit market. Meanwhile, a credit contraction that causes relationship terminations can occur immediately following a negative aggregate shock.[6] According to these models, the real effect of terminations on firms depends on whether those that have experienced relationship terminations can immediately find an alternative funding source. In other words, even if a borrowing firm faces the termination of a relationship, it can alleviate any decrease in loans by switching to a new relationship or by increasing its borrowings in its existing relationships. In this paper, we examine this prediction by exploiting the matching structure of our dataset.

Of course, there are some difficulties in establishing empirically the effects of bank-driven relationship termination. The first arises because bank relationship terminations occur for many different reasons. For example, the lending bank may be unwilling to maintain the relationship with the firm, or the borrowing firm may wish to terminate the relationship with the bank, or both. The central challenge tackled by this paper is to disentangle the

of relation-specific assets in a contracting relationship is not limited to bank-firm relationships. For example, Kellogg (2011) finds that such assets exist in business contracts in the U.S. oil and gas industry.

[5] While Khwaja and Mian (2007) used Pakistani bank–borrower matched data, unlike our study, they attempted to identify the causal effects on borrowing firms of bank liquidity shocks associated with the withdrawal of deposits induced by Pakistan's Nuclear Weapons Program in 1998.

[6] Dell'Ariccia and Garibaldi (2005) demonstrated empirically that a credit contraction is more volatile than a credit expansion within the US banking industry, thus making particular note of the search process as a driving factor in generating the asymmetric volatility of the credit.

lender-driven relationship terminations from other reasons for termination using a bank–borrower matched sample and to estimate the effect of these terminations.[7] To isolate the bank-driven factors in relationship terminations, we specify a bank's predetermined financial variables as instrumental variables likely to affect its decision whether to terminate an existing relationship. By employing instrumental variable estimation, we thus are able to measure the causal effect of the exogenous lender-side shock of termination on firm investment.

A second difficulty in examining bank-driven termination involves preparing a loan-level matched sample and identifying relationship termination. We prepare the matched sample for the period from 1991 through to 2010. This contrasts with other studies of bank–borrower relationships in Japan, including Peek and Rosengren (2005), Gan (2007), and Tsuruta (2014), which have employed matched samples only for the late 1990s. The difficulty in preparing the matched sample and identifying relationship terminations after the late 1990s is mainly because the Japanese banking sector was subject to extensive merger and acquisition (M&A) and divestiture activity throughout the late 1990s and into the early 2000s. Prior to our empirical analysis, we checked whether succeeding banks took over the credit claims of the eliminated or consolidated banks before and after the relevant M&As and divestitures. Thus, we constructed our matched sample for the period after the late 1990s.

Using a matched dataset for Japanese lending banks and listed firms in Japan from 1991 to 2010, we address two specific questions. First, to what extent and for how long did the bank-driven shock of relationship terminations impede the investment behavior of the borrowing firms? Second, in response to these exogenous termination shocks, were firms immediately able to establish new relationships or to increase bank borrowings within their existing relationships in order to finance investment?

[7] Tsuruta (2014) exploited firm changes in main banks over the 1990s in Japan and thus identified the borrower-driven effect of main-banking relationship terminations on firm performance but not their lender-driven effect.

Exploiting the matched dataset, we find that bank-driven terminations do not always influence firm investment, except when the borrowing firm facing termination is experiencing difficulty in immediately finding investment financing by establishing a new borrowing relationship or by increasing its borrowings within its existing banking relationships. These findings coincide with the prediction of current theoretical models whereby financial frictions in a matching process in credit markets play an important role in firm investment.

The remainder of the paper is organized as follows. Section 2 discusses our loan-level matched dataset and proposes a method for the estimation of the bank-driven termination effect. Section 3 reports the estimation results for the termination effect on firm investment, and Section 4 explores the background mechanism. Section 5 extends the analysis of the bank driven terminations by conducting a robustness check. Section 6 provides some concluding comments. The Appendix explains how we define a relationship termination in the cases of M&A, business transfer, and divestiture.

**2. Matched Data and the Estimation Method** In Subsection 2.1, we introduce a firm-level equation for outcome variables, including firm investment. We then explain our loan-level matched dataset in Subsection 2.2. In our explanation of the loan-level matched data, we discuss how we define a relationship termination. In Subsection 2.3, we explain our outcome variable and control variables used in estimations. Subsection 2.4 describes an estimation method for identifying the causal effect of bank-driven terminations on a firm's outcome variables.

2.1. **Firm-level Equation for an Outcome Variable** To investigate the effect of relationship terminations on firms, we specify a firm-level equation for an outcome variable $y_{i,t}$ as follows:

$$y_{i,t} = a + b_y y_{i,t-1} + b_{cut}\text{CUT}_{i,t} + \mathbf{b_f'FIRM_{i,t-1}} + \mathbf{b_d'D_t} + \epsilon_{i,t}, \tag{1}$$

where $\text{CUT}_{i,t}$ indicates firm $i$'s termination variable, which varies depending on the relationship terminations between the borrowing firm $i$ and some of its lending banks, occurring in fiscal year $t$. $\mathbf{FIRM_{i,t-1}}$ indicates the borrower-side covariates that control for the firm's attributes and characteristics, including its financial condition, profitability, funding sources, and relationships with its lending banks, at the end of fiscal year $t-1$. $\mathbf{D_t}$ denotes a vector of year dummies. $\varepsilon_{i,t}$ is a stochastic error term.

The outcome variable for firm $i$, $y_{i,t}$, can include proxies for the firm's financial condition and profitability. Throughout this analysis, we pay special attention to the effects of the termination variable, $\mathrm{CUT}_{i,t}$, on firm investment because it is a driving force in short- and long-run macroeconomic output. The difficulty of quantifying the effect of the termination variable, $b_{cut}$, involves disentangling the lender-side shocks from the borrower-side shocks; in other words, an endogeneity problem arises if a borrowing firm takes the initiative of terminating its own bank relationships.[8] In Subsection 2.3, we explore an estimation method for identifying the causal effect of lender-driven relationship terminations.

2.2. **Matched Data and Relationship Termination** The empirical analysis developed in this paper rests on a loan-level dataset comprising a matched sample of Japanese banks and their borrowing firms listed in Japan. We construct our loan-level data based on the Corporate Borrowings from Financial Institutions Database compiled by Nikkei Digital Media Inc. This database assembles information on the outstanding amounts of bank loans classified by maturity (long-term debt with a maturity of more than one year and short-term debt with a maturity of one year or less) and by each bank. The database includes some 350,000 observations, comprising more than 130 Japanese banks, 2,000 listed borrowing firms and 17,000 relationships for our sample period from fiscal year 1991 to 2010 (see Table 1). We combined the Nikkei database with the financial statement data of the Japanese banks and their listed borrowing firms, also compiled by Nikkei Digital Media Inc.[9]

[8] Note that there are also other cases that an endogeneity problme arises. For example, if a bank terminated its relationship with a poorly performing firm because of the firm's increasing risk of insolvency, a simple OLS regression would generate an estimation bias.

[9] The fiscal year-end for Japanese banks is March 31, but this is not necessarily the case for the borrowing firms. When combining the Nikkei database with the financial statement data, we match bank-side information to borrower-side information in the same fiscal year.

To quantify the fluctuations in the investments of the borrowing firms resulting from the lender-driven termination of bank relationships, we start by identifying a terminated bank–borrower relationship. In this analysis, we define the termination of a relationship in fiscal year $t$ as the case where firm $i$ borrowed from bank $j$ at the end of year $t-1$ but not at the end of year $t$.

As discussed earlier, the Japanese banking sector experienced extensive M&A, business transfer, and divestiture activity from the late 1990s to the early 2000s. Consequently, some Japanese banks are missing from the original Nikkei database at the end of our sample period. Therefore, to identify properly a terminated bank–borrower relationship, we took into account these eliminations and consolidations of Japanese banks. In other words, we thoroughly scrutinized whether succeeding banks took over the credit claims of eliminated or consolidated banks on their borrowing firms before and after the relevant restructuring event. The Appendix details how we define a terminated relationship in the cases of M&A, business transfer, and divestiture.

As for exits of some firms from our loan-level dataset in the middle of our full-sample period, we cannot identify whether the relationships with the firm were post-exit terminated, as these datasets are only for listed firms.[10] Therefore, we adopt the strategy of dropping a firm's observation from our dataset in year $t$ if the firm exited from the original data after year $t$. Thus, if a firm's last observation in the original dataset was in $t$, our adjusted sample includes the firm's observations until year $t-1$. While this strategy could lead to the underestimation of the real effects of relationship termination, as termination could induce a crucial consequence for the firm such as bankruptcy, it is plausible because it provides a more conservative estimate of any termination effects.

In addition to a terminated relationship, we identify a "new relationship" and thereby examine whether borrowing firms that experienced bank-driven terminations were able to alleviate negative shocks on investment by establishing new relationships. We define a new

[10] There are many possible reasons for firm exit from our sample, including bankruptcy, management buyout, termination of all the firm's relationships, etc.

relationship as the situation in which a new relationship is established or a terminated relationship is revived. We do not distinguish between these two cases. In other words, a new relationship in year $t$ is simply defined as the case where firm $i$ borrowed from bank $j$ at the end of year $t$ but had not borrowed from that bank at the end of year $t-1$.

Figure 2 illustrates the historical paths of the average number of new relationships and terminations for listed firms for each period. As shown, new relationships and terminations gradually increased from the middle of the 1990s until the early 2000s.

Based on the identified terminations, we define a termination variable, $\text{CUT}_{i,t}$, to be included in the firm outcome equation (1). We define the termination variable as the rate of change in the bank borrowings caused by relationship termination as follows:

$$\text{CUT}_{i,t} = -100 \times \frac{\sum_{j \in B_{i,t-1}} \text{X}_{i,j,t-1} \delta_{i,j,t}}{\sum_{j \in B_{i,t-1}} \text{X}_{i,j,t-1}}, \quad (2)$$

where $\text{X}_{i,j,t-1}$ indicates the loan amount that firm $i$ borrowed from bank $j$ at the end of year $t-1$, and $\delta_{i,j,t}$ is a dummy variable that takes a value of one if firm $i$ borrowed from bank $j$ at the end of year $t-1$ but not at the end of year $t$. $B_{i,t-1}$ is the set of banks lending to firm $i$ at the end of year $t-1$. This termination variable has a value ranging from $-100$ to 0, with a larger negative value implying a greater negative contribution of relationship terminations to the firm's outstanding borrowings.

Figure 3 plots the historical path of the sample averages for the termination variable ($\text{CUT}_{i,t}$) by period against the growth rate of aggregate bank loans. As shown, the rate of decrease in outstanding bank borrowings caused by relationship terminations appears to increase continuously after the early 1990s.

2.3. **Firm's Outcome Variable and Covariates** For the outcome variable $y_{i,t}$, we pay special attention to firm investment ($\text{INVEST}_{i,t}$), as discussed in Subsection 2.1. We define the firm's investment as the first difference in log tangible fixed assets after adjusting for amortization, being the growth rate in percentage terms.

To control for a firm's characteristics, we include nine attributes of the firm in the covariates $\mathbf{FIRM_{i,t-1}}$: the firm's book leverage ratio ($\text{LEV}_{i,t-1}$), the liquidity ratio ($\text{LIQUID}_{i,t-1}$), Tobin's $q$ ($\text{Q}_{i,t-1}$), the return on assets ($\text{ROA}_{i,t-1}$), sales growth ($\text{SALE}_{i,t-1}$), firm size ($\text{SIZE}_{i,t-1}$), firm age ($\text{AGE}_{i,t-1}$), the number of banks lending to firm $i$ ($\text{NUMBER}_{i,t-1}$), and a vector of industry dummy variables ($\mathbf{INDUSTRY}_i$) that indicates the industry to which borrowing firm $i$ belongs.

The book leverage ratio for borrowing firms is:

$$\text{LEV} \quad = \quad 100 \times \left(1 - \frac{\text{Book Value of Equity}}{\text{Book Value of Total Assets}}\right).$$

We construct the liquidity ratio by dividing the book values of a firm's liquid assets by its total assets. The liquidity ratio is in percentage terms. We include each financial ratio to control for a borrowing firm's ability to meet its financial obligations, assuming the leverage ratio and the liquidity ratio proxy for the firm's ability to meet its long- and short-term debt obligations, respectively.

Tobin's $q$ is the ratio of the market value of firm $i$ to its book value, where the market value of the borrowing firm is the market value of its equity plus the book value of its total liabilities.[11] The return on assets is the firm's net profits divided by the book value of its total assets. Sales growth is the growth rate of the firm's gross sales. We include Tobin's $q$ to control for the firm's long-term profitability, while we use the return on assets and sales growth to control for the firm's short-term profitability.

We define firm age ($\text{AGE}_{i,t-1}$) as the number of years that have elapsed up to the end of fiscal year $t-1$, or the number of years since a borrowing firm $i$ started business. Firm size is the logarithm of the book value of its assets. The firm's number of relationships is the logarithm of the number of firm $i$'s relationships with banks. We include the number of relationships to control for the intensity of the bank–borrower relationships. The industry

[11] We calculate the market value of equity by multiplying the end-of-year stock price by the number of shares. Firm book value is the book value of total assets.

dummy variables are set up according to the 33 industry sectors defined by the Securities Identification Code Committee (SICC) in Japan.

In addition to the nine borrower-side factors, we include those funding source variables that indicate the dependence of a firm's external funding on alternative sources other than bank loans, such as equities and corporate bonds. This is because we predict that a firm's funding dependence on each external funding source should affect both its relationships with lending banks and its investment behavior.[12] In our analysis, we consider three alternative funding sources to bank loans: equity, corporate bonds, and commercial paper. For the increase in equity of borrowing firm $i$, we specify an increase in equity dummy variable ($\text{EQUITY}_{i,t-1}$), which takes a value of one if the number of issued stocks increases in fiscal year $t-1$. For the remaining two sources, we calculate the variations in the total amount of issues over the previous year, normalized by the firm's book value of total liabilities, to prepare two additional funding variables; namely, corporate bonds ($\text{CB}_{i,t-1}$) and commercial paper ($\text{CP}_{i,t-1}$). Corporate bonds include both straight and convertible bonds.

Table 2 provides descriptive statistics for each covariate. As shown, the mean firm leverage ratio (LEV) consistently decreased from 1991 to 2010. For funding sources, the number of relationships (NUMBER) exhibited a downward trend after 1991. The equity variable (EQUITY) decreased gradually through the early 2000s but recovered somewhat in the second half of the 2000s. The corporate bond ratio (CB) decreased sharply in the second half of the 1990s and remained negative over the sample period. Given that the termination variable (CUT) and the firm-leverage ratio (LEV) decreased continuously, the listed firms may have opted consistently for deleveraging.

[12] Leary (2009) exploited the US experience of two changes in bank-funding constraints–the 1961 emergence of the market for certificates of deposit and the 1966 credit crunch–thereby demonstrating that the changes in the composition of financing sources affected the role of bank lending support and thus firm capital structure choices. Uchino (2014) utilized Japan's experience during the 2008 financial crisis, thus demonstrating that firms with large holdings of corporate bonds that matured in 2008 increased bank borrowings to finance firm investment.

In the next subsection, we discuss the estimation method used to identify the causal effects of a lender-side driven relationship termination.

2.4. **Estimation Method** We use the instrumental variables method to disentangle supply shocks from demand shocks in relationship terminations by exploiting the turmoil that occurred in the real estate market and the capital crunches faced by banks in Japan following the collapse of the bubble economy.

The bursting of the Japanese bubble economy in the early 1990s severely damaged the capital positions of Japanese banks. Accordingly, some researchers have studied the lending behavior of these capital-impaired Japanese banks. Among these, Woo (2003) and Watanabe (2007) empirically demonstrated evidence of a bank credit crunch in the late 1990s. Here, impaired bank capital impeded bank lending regardless of whether the borrowing firms themselves were distressed. In contrast, Peek and Rosengren (2005) showed that capital-impaired Japanese banks in fact increased their loans to distressed borrowing firms during the 1990s because of window-dressing accounting motives.

Despite the differing implications of the effect of impaired capital for Japanese banks on their lending behavior, these studies share a common premise that impaired banks will change their lending attitudes toward their borrowing firms. Thus, the next question to be studied in the literature is why the "quality" of Japanese bank capital was impaired. Put differently, why did the nonperforming loans of banks increase after the bursting of the bubble economy in the early 1990s?

Ueda (2000), Hoshi (2001), and Ogawa (2003, Chapters 1 and 2) examined Japanese bank lending behavior over the period from the mid to the late 1980s. These studies demonstrated empirically that Japanese banks decreased loans to the manufacturing industry. However, they also indicate that banks increased loans to the real estate industry amid the rapid progression of financial deregulation and continuous increases in land prices during that period. The suggestion is that the shift in bank lending to the real estate industry resulted in an increase in the number of nonperforming loans after the bursting of the land price bubble and that this caused severe damage to the capital of Japanese banks.[13]

Gan (2007) and Watanabe (2007) exploited these findings to identify the causal effect of impaired capital for banks on their lending and borrowing firm investment for a period from the mid to the late 1990s. Both studies utilized the exposure of Japanese banks to the real estate industry during the late 1980s as an instrumental variable determining the quality of bank capital, thereby attempting to separate the impact of loan supply and loan demand shocks. One promising extension of their instrumental variable estimation method would be to use the exposure of banks to the real estate industry in the late 1980s as an instrumental variable for our termination variable (1) in order to isolate the lender-side shock in relationship terminations. To construct the instrumental variable, we first calculate the exposure of bank $j$ to the real estate industry in fiscal year 1989, according to the following equation:

$$\text{EXP}_{j,89}^{\text{Estate}} = 100 \times \frac{\text{Loans to Real Estate}_{j,1989}}{\text{Total Amount of Loans}_{j,1989}},$$

where "Loans to Real Estate$_{j,1989}$" indicates bank $j$'s outstanding loans to the real estate industry at the beginning of fiscal year 1989. "Total Amount of Loans$_{j,1989}$" denotes the total amount of bank $j$'s outstanding loans at the beginning of fiscal year 1989.

Note that a firm outcome model is specified at the firm level, to examine the fluctuations in firm's outcome variables that are caused by lender-driven relationship terminations, as expressed in equation (1). This requires us to aggregate the lender-side information for each firm, including the exposure of the bank to the real estate industry. To aggregate the lender-side factors, we assume that the effect of a bank's capital condition on the borrowing firm is proportional to the firm's dependence on each bank. Given this assumption, we calculate

[13] Ueda (2000) and Hoshi (2001) found that increases in the number of loans to the real estate industry contributed to the increase in the number of nonperforming loans. Ogawa (2003, Chapters 1 and 2) showed that increases in the number of loans to small- and medium-sized business enterprises, to the construction industry, to the finance and insurance industry, and to the real estate industry were largely responsible for the increase of nonperforming loans.

the weighted average of the lender-side variables, using firm $i$'s borrowing exposure to bank $j$ in fiscal year $t-1$ defined as:

$$w_{i,j,t-1} = \frac{\mathrm{X}_{i,j,t-1}}{\sum_{j \in B_{i,t-1}} \mathrm{X}_{i,j,t-1}},$$

where $\mathrm{X}_{i,j,t-1}$ is firm $i$'s outstanding borrowings from bank $j$ in fiscal year $t-1$, and $B_{i,t-1}$ is the set of banks that lend to firm $i$ in fiscal year $t-1$.

Using this weighting, we then calculate an instrumental variable for the termination variable (2) as expressed by the weighted average of each bank's exposure to the real estate industry in 1989:

$$\mathrm{WEXP}_{i,t}^{\mathrm{Estate}} = \sum_{j \in B_{i,t-1}} w_{i,j,t-1} \times \mathrm{EXP}_{j,89}^{\mathrm{Estate}}. \tag{3}$$

This instrument would be valid if the variation in the bank's exposure to the real estate industry, across firms in 1989, was uncorrelated with the demand shocks that took place in the 1990s and 2000s. This assumption would be reasonable as long as we controlled fully for other factors such as the variations across industries. However, we can also argue that firms that were borrowing from banks with a higher exposure to the real estate industry in 1989 were more vulnerable to the demand shocks of the 1990s and 2000s. In Section 3, we discuss the validity (or orthogonality) of the instruments in a more rigorous statistical manner.

If we regard the past bank exposure to the real estate industry as a proxy for the "quality" of bank capital, another candidate for an instrument of the termination variable ($\mathrm{CUT}_{i,t}$) is the "quantity" of bank capital. Given that Japanese banks struggled to meet their regulatory capital requirements in response to the gradual decline in land and stock prices from the early 1990s to the late 1990s (see Fukao (2003) and Hoshi and Kashyap (2004)), a past value of the bank's capital position is one of the most promising instruments for the termination variable. Hence, we adopt the one-period lag of the book leverage ratio of lending bank $j$, $\mathrm{BANKLEV}_{j,t-1}$, as a proxy for the "quantity" of bank capital. We then prepare the following second instrument as the weighted average of each bank's leverage ratio:

$$\text{WLEV}_{i,t} = \sum_{j \in B_{i,t-1}} w_{i,j,t-1} \times \text{BANKLEV}_{j,t-1}, \tag{4}$$

where the book leverage ratio of the lending banks ($\text{BANKLEV}_{j,t-1}$) is constructed in the same way as that of the borrowing firms ($\text{LEV}_{i,t-1}$) defined in the previous subsection. In the following analysis, we utilize both instruments, $\text{WEXP}_{i,t}^{\text{Estate}}$ and $\text{WLEV}_{i,t}$, thereby measuring the causal effect of bank-driven terminations on firm investment.[14]

Table 2 provides descriptive statistics for the two instruments. To avoid estimation bias arising from the correlation between the loan demand shocks and the bank instrument variables, we excluded firms in the four finance- and insurance-related sectors.[15]

We conduct two types of estimations using the two instrumental variables, $\text{WEXP}_{i,t}^{\text{Estate}}$ and $\text{WLEV}_{i,t}$. The first is a simple model without firm fixed effects, as shown in equation (1), and estimated by pooling the dataset. The second is a dynamic panel data model with firm fixed effects. If Japanese banks with impaired capital and greater exposure to the real estate industry have loaned to firms that are more vulnerable to demand shocks, as argued by Peek and Rosengren (2005) and Caballero et al. (2008), our two instrumental variables could correlate with borrower-side negative shocks by capturing the insolvency risk of the distressed firms. Consequently, the instrumental variable method with a pooled data setting may result in the overestimation of the coefficient on the termination variable $\text{CUT}_{i,t}$. Therefore, we also use the dynamic panel specification incorporating firm fixed effects as the output model (1), thereby attempting to control for unobserved factors in determining the relationships between the (financially distressed) borrowing firms and their

[14] We do not use the regulated capital ratios and nonperforming loans as instrumental variables, because the definition of each variable differs markedly over time.

[15] Our dataset includes firms in 29 different sectors after excluding the following finance and insurance sectors: banks, securities and commodity futures, insurance, and other financing business industry.

(capital-impaired) lending banks. For estimation of the dynamic panel model, we employ the generalized method of moments estimation suggested by Arellano and Bond (1991).

In the next section, we report the estimation results obtained by employing the instrumental variable methods.

**3. Estimation Results** This section reports the estimation results obtained by employing the instrumental variable method. Section 3.1 conducts a rolling-window estimation and thereby demonstrates the possibility that the mechanism governing the terminations and their effects varies over time. Based on the rolling estimation results, we then divide the full sample period into subsample periods to investigate the effects of bank-driven relationship terminations. Section 3.2 discusses the termination mechanisms for each subsample, reporting estimation results obtained from the first-stage regression in our pooled-sample estimation. Section 3.3 examines how and whether bank-driven relationship terminations affected firm investment. Section 3.4 discusses the validity of our instrumental variables by testing the orthogonality assumption.

3.1. **Rolling Estimation** Theoretical models that contain a matching structure in a credit market, including Den Haan et al. (2003), Wasmer and Weil (2004), and Becsi et al. (2005; 2013), suggest that credit market conditions could change the termination mechanism and its effects on the real economy. In order to incorporate this into our estimation of the firm outcome equation (1), we start by conducting a rolling regression over a five-year window and then identify subsample periods in which the termination mechanism and its effects differ substantially.

In our estimation with a pooled sample, the first-stage instrumental variable regression for the termination variable ($\mathrm{CUT}_{i,t}$) is specified as follows:

$$\mathrm{CUT}_{i,t} = a^* + b_y^* y_{i,t-1} + \mathbf{b}_{\mathbf{IV}}^{*'} \mathbf{IV}_{\mathbf{i,t}} + \mathbf{b}_{\mathbf{f}}^{*'} \mathbf{FIRM}_{\mathbf{i,t-1}} + \mathbf{b}_{\mathbf{d}}^{*'} \mathbf{D}_{\mathbf{t}} + e_{i,t}, \qquad (5)$$

where $\mathbf{IV}_{\mathbf{i,t}}$ denotes a $2 \times 1$ vector of our instrumental variables, being the two proxies for the bank's capital condition, $\mathrm{WEXP}_{i,t}^{\mathrm{Estate}}$ and $\mathrm{WLEV}_{i,t}$. For the second-stage regression, we specify the firm's outcome equation (1) including firm investment ($\text{INVEST}_{i,t}$) as a dependent variable $y_{i,t}$. Below we report estimates of the coefficients $\mathbf{b}^*_{\mathbf{IV}}$ on the two instrumental variables in the first stage, and the coefficient $b_{cut}$ on the variable $\text{CUT}_{i,t}$ in the second stage. By doing so, we explore periods during which the termination mechanism and its effect on firm investment have changed.

Figure 4 details the estimated coefficients for the two instrumental variables of $\text{WEXP}^{\text{Estate}}_{i,t}$ and $\text{WLEV}_{i,t}$ in the first-stage regression (5). The solid line plots the point estimates based on the five-year subsample from year $t$ through to $t+4$, and the dotted line indicates the 90% confidence interval for each estimate. The estimated coefficients in this figure provide an overview of the possible changes in the relationship termination mechanism in the Japanese bank loan market. The estimated coefficients for both of the instruments are negative in almost all periods, implying that a bank with greater exposure to the real estate industry and a higher leverage ratio is associated with larger decreases in bank loans owing to relationship terminations. However, the two instruments illustrate a clear contrast between the 1990s and the 2000s. In the 1990s, the bank leverage ratio ($\text{WLEV}_{i,t}$) more significantly affected the termination variable, whereas in the early 2000s, it was the bank exposure to the real estate industry ($\text{WEXP}^{\text{Estate}}_{i,t}$).[16]

Figure 5 plots the estimated coefficients for the termination variable $\text{CUT}_{i,t}$ obtained in the second-stage regression (1). From this figure, we can see that the estimated coefficients are negative in the early 1990s, albeit not significantly. Furthermore, the estimated coefficients start increasing from the late 1990s and are clearly positive by the early 2000s. However, as the confidence intervals become wider in the late 2000s, the estimated coefficients are statistically insignificant in this period.

The rolling estimation results reported in Figures 4 and 5 imply that the termination mechanism and its effect on firm investment change over time, particularly in the late 1990s and the early 2000s. To examine further the reasons for these changes, we divide

[16] To consider these differences in the estimation results between the 1990s and the early 2000s, Section 4 discusses the difference in the financial situation of Japanese banks in the two sample periods.

our matched sample into four different subsample periods based on the above results and consider three other important macro variables relating to the Japanese bank loan market; namely, the growth rate of aggregate bank loans, the average number of terminations, and the termination variable (CUT). The four-subsample periods consist of period I, from fiscal year 1991 to 1995; period II, from 1996 to 2000; period III, from 2001 to 2005; and period IV, from 2006 to 2010. Each of these subsample periods well illustrates different developments in Japanese credit market conditions, as shown in Figures 2 and 3.

The first period from 1991 to 1995 corresponds with the time immediately after the collapse of the bubble economy, as stock and land prices peaked in 1989 and 1990, respectively (See Hoshi and Kashyap (2004)). During this period, although asset prices continued to decline, the aggregate growth rates of bank loans remained positive or around zero (see Figure 3). Furthermore, as shown in Figures 2 and 3, the increase in relationship terminations was relatively moderate: the average number of terminations for each firm was approximately 0.35, and the termination variable ($\text{CUT}_{i,t}$) fluctuated around $-1$.

The second period from 1996 to 2000 is characterized by the beginning of the decrease in aggregate bank loans and the increase in relationship terminations. During this time, Japan's bank loan market began to contract clearly: as shown in Figures 2 and 3, aggregate bank loans decreased by approximately $-1.5\%$, the average number of relationship terminations spiked around 1 in 1999, and the termination variable decreased from $-1.5$ to $-3$. After this, the attitude of the Japanese government and regulatory authorities toward Japanese banks changed, which was probably one of the reasons for the shrinking of the bank loan market. In Section 4, we discuss some regulation changes that affected Japanese bank behavior from the late 1990s and the early 2000s in detail.

The third period is distinct from the earlier two periods in that the Japanese bank loan market contracted significantly: the aggregate growth rates of bank loans decreased to approximately $-5\%$, as shown in Figure 3. In addition, as shown in Figures 2 and 3, the average number of terminations remained high at around 0.6, and the termination variable continued to decrease to $-3.5$ or less.

The final period of the late 2000s includes a period of boom as well as the turmoil of the 2008 financial crisis. However, as shown in Figure 3, the aggregate growth rate of bank loans during this period remained relatively high, at least when compared with that in periods II and III. In addition, the termination variable began to increase to around $-2$ in the pre- and post-turmoil periods.[17]

In the remainder of the paper, for the sake of simplicity, we focus on the estimation results from these four subsample periods instead of the rolling estimates in order to provide more detailed analysis of the relationship terminations.[18] In the next subsection, we report the estimation results from the first-stage instrumental variable regression for each subsample period.

3.2. **Estimation Results for Termination** Table 3 details the estimated coefficients for each subsample period from the first-stage regression for the pooled-sample model (5), as introduced in the previous subsection. Below we report the estimated coefficients, not only in order to examine the relevance of our two instruments ($\mathrm{WEXP}_{i,t}^{\mathrm{Estate}}$ and $\mathrm{WLEV}_{i,t}$) for the termination variable but also to show how a firm's characteristics are associated with relationship terminations.[19]

In terms of the estimated coefficients for our instrumental variables, bank exposure to the real estate industry during the land price boom of the late 1980s ($\mathrm{WEXP}_{i,t}^{\mathrm{Estate}}$) has a significantly negative estimate in period III of the early 2000s. On the other hand, the bank book leverage ratio ($\mathrm{WLEV}_{i,t}$) yields a significantly negative estimate for periods I and II of the overall period of the 1990s. These results imply that banks that had increased loans to the real estate industry during the land price boom of the late 1980s were more likely

[17] The Bank of Japan (2009) and Uchino (2013) pointed out that Japanese banks that had so far improved their capital condition remained financially sound and thus retained their financial intermediation function in response to firm funds demand amid the turmoil of the 2008 financial crisis.
[18] Conducting rolling estimations does not change our main conclusion from that derived from the four-subsample analysis.
[19] Miyakawa (2010) and Nakashima and Takahashi (2015) explored the reason for relationship terminations using a matched dataset for Japanese lending banks and listed firms. Ongena and Smith (2001) used Norwegian bank–borrower matched data to examine the effect of the duration of bank–borrower relationships on relationship terminations.

to terminate relationships with their borrowing firms during the early 2000s, while banks with less capital were more likely to do this during the 1990s. In Section 4, we suggest that this difference in estimation results may be attributable to the differing financial situation of Japanese banks in the two periods.

As for the relevance of our instrumental variables to the termination variable, we conducted a $F$ test for weak instruments. Table 3 reports the $F$ statistics for the null hypothesis that the instrumental variables are weak, based on the critical values presented by Stock and Yogo (2005). In subsample periods II and III, our instrumental variable estimations do not suffer from the problem of weak instruments because the null hypothesis is rejected at the desired maximal sizes of 25% and 10%, respectively. On the other hand, in subsample periods I and IV, the null hypothesis is not rejected. Therefore, we note that at least in periods I and IV, we cannot correctly estimate the effect of lender-driven terminations.

Regarding the estimation results for the firm characteristics, the one-period lag of firm investment ($\mathrm{INVEST}_{i,t-1}$) has a significantly positive estimate only for period II. This positive estimate implies that an increase in firm investment led to its maintaining its existing relationships, thus reducing the decrease in bank borrowings caused by the termination of its bank–borrower relationships.

The firm covariates of $\mathbf{FIRM_{i,t-1}}$, being the book leverage ratio ($\mathrm{LEV}_{i,t-1}$), the return on assets ($\mathrm{ROA}_{i,t-1}$), and firm age ($\mathrm{AGE}_{i,t-1}$) all display significantly positive estimates. These indicate that a highly leveraged and currently profitable firm of advanced age is associated with a smaller rate of decrease in its termination-related bank borrowings. In other words, such a firm has a greater tendency to maintain its existing bank–borrower relationships.

On the other hand, the liquidity ratio ($\mathrm{LIQUID}_{i,t-1}$), Tobin's $q$ ($\mathrm{Q}_{i,t-1}$), and firm size ($\mathrm{SIZE}_{i,t-1}$) provide significantly negative estimates. The negative estimates for these variables indicate that a smaller firm holding less liquid assets with diminished future profitability is more likely to maintain its bank–borrower relationships.

For the number of firm relationships with its banks ($\text{NUMBER}_{i,t-1}$), we observe that the estimated coefficients are significantly negative for periods II, III, and IV. From these significant negative estimates, we infer that a borrowing firm that more intensively depends on particular relationships is more likely to maintain its existing relationships.

For the equity increase ($\text{EQUITY}_{i,t-1}$), its coefficients were estimated to be significantly negative for the period from 1996 to 2010. As for the two debt funding sources, the result shows a significantly negative estimate for corporate bonds ($\text{CB}_{i,t-1}$) and a significantly positive estimate for commercial paper ($\text{CP}_{i,t-1}$) but only in period II. From the negative estimates for the equity increase and corporate bonds, we can infer that a firm that had more limited access to such external funding sources was more likely to maintain its existing relationships, particularly during the late 1990s. In contrast, the positive estimate for commercial paper indicates that a borrowing firm that had more limited access to the commercial paper market is more likely to terminate its relationships with lending banks. Given that only financially healthy firms can issue commercial paper, this could serve as a suitable proxy for the issuing firm's credit condition. If this were the case, for a firm that could not easily issue commercial paper, its bank–borrower relationships would be more likely to be terminated because of its relatively poor credit condition.

Summing up our estimation results for the firm covariates in the termination equation, a "vulnerable" firm is more likely to maintain its existing bank–borrower relationships. In other words, a smaller and older firm that is financially fragile with lower expected future profitability but that is currently profitable and that does not have easy access to external funding sources other than its particular lending banks has a greater tendency to maintain its existing bank–borrower relationships.

3.3. **Estimation Results for Investment** The previous subsection provides the following findings for our instrumental variables. First, our instruments are not weak for periods II and III, corresponding to the period between 1996 and 2005. Second, the bank leverage ratio ($\text{WLEV}_{i,t}$) significantly affected relationship terminations for most of the 1990s, while its exposure to the real estate industry in 1989 ($\text{WEXP}_{i,t}^{\text{Estate}}$) led to relationship terminations in the early 2000s. In this subsection, we report the estimation results for the firm outcome equation (1) that includes investment as its outcome $y_{it}$.

Tables 4 and 5 report estimation results using two instrumental variables ($\text{WLEV}_{i,t}$and $\text{WEXP}_{i,t}^{\text{Estate}}$) on the pooled sample and the dynamic panel model, respectively. Table 5 reports estimation results obtained using the year dummy variables (Year) and the interaction terms between the industry and year dummy variables (Year $\times$ Ind) in columns (i) and (ii), respectively.[20]

The two tables show that the termination variable ($\text{CUT}_{i,t}$) has significantly positive estimates only for period III (2001 to 2005), implying that the decrease in firm investment was significantly affected by bank-driven relationship terminations. Regarding the magnitude of the effect on firm investment, the point estimate is approximately 0.3 in the dynamic panel model, as shown in Table 5. This means that a 10% decline in bank loans as a result of lender-driven terminations led to a decrease in firm investment on average by 3%. Given the macroeconomic conditions of the early 2000s, as reported in Table 2, this estimate implies a substantial effect on the real economy. The sample average firm investment was only 0.42% during this period, but the average impact of bank-driven terminations on firm investment is approximately $-1.03\%$.[21]

As for period II (1996 to 2000), Tables 4 and 5 show that all estimated coefficients for the termination variable are not significant, except in the dynamic panel estimation with the industry-year dummies. We should note that the dynamic panel estimation for this period does not suffer from the weak instrument problem, as demonstrated in the previous subsection. These estimation results for period II imply that bank-driven terminations did not decrease firm investment in the late 1990s, even though some existing studies, including Woo (2003) and Watanabe (2007), have purportedly found evidence of a credit

[20] The $p$-values of the Arellano–Bond test for autocorrelation in the first-differenced errors are reported in the bottom rows of Table 5. The results support the estimation assumption that there is no serial correlation in the original error, $\epsilon_{i,t}$.

[21] The average impact is calculated by $b_{cut} \times \text{CUT}_{i,t}$ in firm outcome equation (1). As reported in Table 2, the sample averages of the termination variable ($\text{CUT}_{i,t}$) and firm investment ($\text{INVEST}_{i,t}$) from 2001 to 2005 are $-3.43\%$ and 0.42%, respectively.

crunch during this period. In Section 4, we consider why bank-driven terminations led to a decrease in firm investment in the early 2000s but not in the late 1990s.

For periods I and IV, Tables 4 and 5 suggest that the termination variable does not yield significant estimates. Given that bank exposure to the real estate industry ($\text{WEXP}_{i,t}^{\text{Estate}}$) and the bank book leverage ratio ($\text{WLEV}_{i,t}$) would be weak instruments for the termination variable in these periods, as demonstrated in the previous subsection, we cannot correctly infer the effect of relationship terminations during these periods.

Table 4 also reports the $p$-value of the Anderson–Rubin test statistic for the pooled-data estimation to show the robustness of the significance of the termination variable ($\text{CUT}_{i,t}$). The Anderson–Rubin test allows us to test the significance of the termination variable ($b_{cut}$) in equation (1), ensuring robustness with respect to the weak instrument problem. More concretely, we ran a regression of firm investment on our two instruments and the other firm control variables. We then conducted an $F$ test for the two instruments. In this paper, following a restricted efficient bootstrap method proposed by Davidson and MacKinnon (2014), we calculated the bootstrap $p$-value of the Anderson–Rubin test statistic with 5,000 replications.[22] The Anderson–Rubin test statistics show that for period III, the effects of relationship terminations are significant at the 10% level, even after considering the weak instrument problem, while for periods I, II and IV, they are not significant at any conventional level.

We should note that compared with the results from the pooled sample estimation, the results from the panel fixed effects model demonstrate the more moderate effect of the termination variable in period III. This could be because the pooled data (nonpanel setting) estimation does not control for unobserved factors in bank–borrower relationships, and thus the estimates would have overstated the termination effect on firm investment,

[22] Note that we do not use the bootstrap method to deal with the problem of a small sample size. Davidson and MacKinnon (2014) proposed that one should not use confidence sets obtained by simply inverting the Anderson–Rubin test because these would not have correct coverage, irrespective of the sample size. They demonstrated that the confidence sets obtained by the restricted efficient bootstrap method provided better coverage than that obtained by simply inverting the Anderson–Rubin test. See Davidson and MacKinnon (2014) for restricted efficient bootstrap procedure.

as discussed in Subsection 2.4. After considering such estimation bias arising from the unobserved factors in a firm's relationships with its lending banks, we report the estimation results based on the dynamic panel model with firm fixed effects.

As for the firm covariates ($\mathbf{FIRM_{i,t-1}}$) in periods II and III, the estimates are significant only for the liquidity ratio ($\text{LIQUID}_{i,t-1}$), firm size ($\text{SIZE}_{i,t-1}$), and commercial paper ($\text{CP}_{i,t-1}$) in both year dummy specifications. For the liquidity ratio, its estimated coefficients are positive, indicating that firms with a higher liquid asset ratio were more likely to increase their investment. The negative estimates for firm size imply that smaller firms tended to invest more. The commercial paper variable displays positive estimates, indicating that firms that increased their dependence on corporate bonds were more likely to increase investment.

3.4. **Validity of Instrumental Variables** In our estimations thus far, we used the weighted average of the bank book leverage ratio ($\text{WLEV}_{i,t}$) and bank exposure to the real estate industry ($\text{WEXP}_{i,t}^{\text{Estate}}$) as instrumental variables. However, as discussed in Subsection 2.4, we remain skeptical about whether these instrumental variables satisfy the validity assumption in terms of their orthogonality to errors in the firm outcome equation.

To investigate whether our instrumental variables satisfy the validity condition in estimating the dynamic panel model with fixed effects, we conduct a variant of the Hansen test of the overidentification restrictions on the bank instrumental variables. This test is known as the $C$ test and is designed to test a subset of the original set of overidentification restrictions (see e.g. Hayashi (2000, Chapter 3)).

The $C$ test statistic is the difference between two $J$ statistics: one based on the full set of overidentification restrictions and the other based on the subset of the restrictions in which only the tested instrumental variables are removed. Under the condition that the subset of the restrictions is satisfied, we test the null hypothesis that the removed instruments are orthogonal to the error terms. The $C$ test statistic has a $\chi^2$ distribution with degrees of freedom equal to the number of instruments being tested under the null hypothesis.

Table 6 reports the $C$ test statistics for the orthogonality of our two instrumental variables in the dynamic panel model with firm fixed effects.[23] The $C$ test statistics for the two instruments show that the null hypothesis of their orthogonality is not rejected at the five percent level of significance for all subsample periods. This indicates that our estimation results thus far are not contaminated by the endogeneity problem of the two bank instrumental variables.[24]

**4. Background Mechanism for the Termination Effects** In the previous section, we found the following evidence. First, in the first-stage regression, the bank leverage ratio was a significant determinant of relationship terminations in the 1990s, while the bank exposure to the real estate industry in 1989 was significant in the period of the early 2000s. As for the late 2000s, both instrumental variables were not significant determinants. Additionally, only in periods II and III did we reject the weak instrument hypothesis. Second, the lender-driven relationship terminations had significant negative effects on firm investment but only in the early 2000s.

In this section, we explore the reasons for the differences in estimation results across the subsample periods. In particular, in Subsection 4.1, we discuss the financial background that likely invoked the differences in estimation results. In Subsection 4.2, we examine whether firms were able to establish new relationships for financing investment after experiencing bank-driven termination. In Subsection 4.3, we address whether firms were immediately able to increase bank borrowings from their existing relationships. In

[23] For the dynamic panel model with firm fixed effects, we used the lagged values of the dependent and independent variables as instruments in addition to the two bank instruments. Hence, as reported in Tables 5 and 6, the number of instruments is much larger than that of unknown parameters, which enables us to conduct the $C$ test. For example, if we use the full set of instruments, the number of the orthogonality restrictions in the dynamic panel data model with yearly dummy variables is 202, as reported in Tables 5 and 6. On the other hand, the number of restrictions for the subset of instruments is 200 ($= 202 - 2$) because we removed the two bank-related instrumental variables.

[24] Tables 4 and 5 report the $p$-values for a Hansen test of the orthogonality condition in the pooled sample and dynamic panel specifications, respectively. The $p$-values indicate that the orthogonality condition is not rejected for almost all cases (the exceptions are the dynamic panel specifications including the time dummy variables (Year) reported in Table 5).

Subsection 4.4, we provide an insight into the background mechanism underpinning the bank-driven termination effect on firm investment.

4.1. **Financial Background** One promising explanation of the difference in the estimation results across each subsample period is that Japanese banks faced low capital levels relative to the regulatory minimum in the 1990s, whereas from the early 2000s onwards, they struggled to write off nonperforming loans after meeting their capital standards.

In 1988, bank regulators in major industrial countries agreed to standardize capital requirements internationally, through the so-called Basel Accord. Subsequent to this, all Japanese banks struggled to meet these capital standards for much of the 1990s. During this period in Japan, land and stock prices fell continuously. Consequently, many loans granted during the bubble period of the late 1980s became nonperforming, and bank capital gains, which are a component of Tier II capital, decreased. Accordingly, banks that were more impaired and had less capital issued additional subordinated debt to inflate their bank capital. They were able to do so because, within the local Japanese rule governing capital requirements, subordinated debt can be counted as Tier II capital, as pointed out by Ito and Sasaki (2002) and Montgomery (2005).[25]

In the 1990s, this regulatory forbearance policy had caused Japanese banks to engage in a "patching up" of their capital ratios (see, e.g., Shrieves and Dahl (2003)). In the late 1990s, the attitude of the Japanese government and regulatory authorities toward Japanese banks started to change by allowing them to enter bankruptcy and by conducting capital injections. In evidence, in 1998 and 1999, the government of Japan decided to infuse a large amount of capital into poorly capitalized banks in order to increase their capital adequacy ratios. These large-scale public capital injections allowed almost all Japanese banks to meet their capital standards (see, e.g., Watanabe (2007), Allen et al. (2011), and Nakashima (2015) for the Japanese bank recapitalization programs). However, the amount

[25] As shown by Skinner (2008), Japanese banks have also used deferred tax assets to compensate for capital losses arising from unrealized losses on their holding stocks. This is because the government allowed banks to account for their deferred tax assets as Tier I capital in 1998. Bank managers at their discretion estimated subjectively the total amount of deferred tax assets.

of nonperforming loans in Japanese banks only started to decrease after the Financial Revitalization Program (hereafter, FRP), or the so-called Takenaka Plan, was executed in 2002 (see Sakuragawa and Watanabe (2009) for details).

Before the execution of the FRP, the amount of nonperforming loans increased continuously from the early 1990s to the late 1990s. In 2002, the maximum was about 53 trillion yen. Generally speaking, in the 1990s, especially during the credit crunch period of the late 1990s, Japanese banks suffered from low capital levels and thus struggled to increase their capital ratios, while they did not completely solve the problem of nonperforming loans. Such a financial background in the 1990s is probably one of the reasons that the bank leverage ratio was a determinant of the relationship terminations that took place during the 1990s but not the early 2000s, as demonstrated in Subsection 3.2.

It also explains why these terminations had significant effects in the 2000s but not in the 1990s, as demonstrated in Subsection 3.3. Japanese banks were able to support some firms that were in need of funds by accumulating nonperforming loans in the 1990s (see Peek and Rosengren (2005)). During this period, the decrease in the aggregate amount of bank loans caused by terminations was relatively small compared with those in the 2000s (see the sample average of the termination variable in Figure 3). This also meant that it was more likely that less important bank–firm relationships were terminated in the 1990s.

The FRP did not allow the banks to meet their capital requirement by engaging in regulatory capital arbitrage. It instead requested that the banks apply a stricter standard than before when disclosing the amount of nonperforming loans on their books. After the execution of the FRP in 2002, banks with impaired capital actively pursued the write-off of their nonperforming loans. Consequently, by 2005, the amount of nonperforming loans drastically decreased to about 20 trillion yen. This difference in bank financial background during the 1990s and the early 2000s should be responsible for the estimation results that point to the effect of bank-driven terminations on firm investment during the early 2000s, but not the 1990s.

Japanese banks had improved their capital quality and quantity before the late 2000s. Thus, during the late 2000s, they remained financially sound and retained their financial intermediation function in response to firm funds demand amid the turmoil of the 2008 financial crisis (see Bank of Japan (2009) and Uchino (2013)). Such soundness of Japan's banking system is responsible for the estimation results indicating that our two instrumental variables—as proxies for the impairment of bank balance sheets—were not associated with the termination of bank–borrower relationships.

4.2. **New Relationships** As discussed in the introduction, another possible explanation for the differences in the bank-driven termination effects involves the following question: were firms immediately able to establish new relationships in response to these terminations? The bank-driven termination effects should be mitigated if the borrowing firms that faced these bank-driven terminations were immediately able to switch to other borrowing relationships. To investigate this question, we introduce the following discrete choice probit model of the establishment of a firm's new relationships in response to existing relationship terminations:

$$\text{MARRY}_{i,t} = \begin{cases} 1 & \text{if } z_{i,t} \geq 0, \\ 0 & \text{if } z_{i,t} < 0, \end{cases}$$

$$z_{i,t} = \alpha + \beta \text{MARRY}_{i,t-1} + \gamma_1 \text{CUT}_{i,t} + \gamma_2 \text{CUT}_{i,t-1} + \mathbf{\Gamma}'\mathbf{FIRM_{i,t-1}} + \mathbf{\Lambda}'\mathbf{D_t} + u_{i,t}, \qquad (6)$$

where $\text{MARRY}_{i,t}$ denotes an indicator variable that takes a value of one if firm $i$ establishes a new relationship in fiscal year $t$. $\text{CUT}_{i,t}$ denotes termination variable (2): the decreasing rate of firm $i$'s outstanding bank borrowings caused by relationship terminations in fiscal year $t$. $\mathbf{FIRM_{i,t-1}}$ and $\mathbf{D_t}$ indicate a vector of borrower-side covariates and year dummy variables, respectively.

We specify the model for relationship terminations and establishments as shown in equations (5) and (6), respectively.[26] To estimate the relationship switching system, we employ the bank leverage ratio ($\text{WLEV}_{i,t}$) and bank exposure to the real estate industry in 1989 ($\text{WEXP}_{i,t}^{\text{Estate}}$) as instruments for the termination variable.

Table 7 reports the estimation results for relationship establishment equation (6). This table clearly shows that the termination variable ($\text{CUT}_{i,t}$) yields significantly negative estimates for period II but not for period III. These results imply that in the early 2000s, firms that faced bank-driven terminations did not establish new relationships, while in the late 1990s, they were likely to do so immediately.

These estimation results for the switching system provide a clearer picture of the working mechanism linking bank–borrower relationships and firm investment during the period from the late 1990s to the early 2000s. The results reported in the previous section show that lender-driven relationship terminations affected firm investment in the early 2000s but not in the late 1990s. The results for the switching system in this section imply that in the late 1990s, finding new relationships was likely to mitigate the negative shocks of bank-driven terminations on investment. On the other hand, in the early 2000s, firm investments were exposed to the negative shocks of bank-driven terminations, because they did not establish new relationships. In the next subsection, we examine a background mechanism of the lender-driven termination effect on firm investment in terms of whether firms facing a relationship termination were immediately able to increase bank borrowings within their continuing relationships during the subsample periods.

Regarding period IV, the termination variable has a significantly positive estimate. This implies that firms facing terminations experienced difficulties in finding new relationships. However, as discussed in Subsection 3.2, we are unable to infer correctly the effects of the terminations in period IV because of the weak instrument problem. Even though the positive coefficient on the termination variable suggests the existence of financial frictions

[26] For the switching system, we assume that the stochastic error terms ($e_{it}$, $u_{it}$) in equations (5) and (6) follow an identically distributed multivariate normal distribution $N(\mathbf{0},\ \mathbf{\Sigma})$ for all firms $i$, where $\mathbf{\Sigma}$ is not block diagonal between $e_{it}$ and $u_{it}$.

in the late 2000s, we defer the further analysis of bank loan markets during this period to future study.

The estimates of the coefficient on the one-period lag of the termination variable ($\text{CUT}_{i,t-1}$) are significantly negative for subsample periods II, III, and IV. This result indicates that firms were able to establish new relationships at least one year subsequent to experiencing relationship termination. In Subsection 5.2, we reconsider the implications of the estimation results for the two termination variables, $\text{CUT}_{i,t}$ and $\text{CUT}_{i,t-1}$, when we analyze for how long the bank-driven termination shocks lasted.[27]

For the one-period lag of the new relationship indicator ($\text{MARRY}_{i,t-1}$), we estimate the coefficients to be significantly positive. These positive estimates imply that firms that were able to establish new relationships in year $t-1$ were more likely to establish new relationships in year $t$; that is, the relationship establishment of borrowing firms exhibits some persistence.

For firm covariates ($\mathbf{FIRM_{i,t-1}}$), the one-period lag of the firm investment ($\text{INVEST}_{i,t-1}$) and the return on assets ($\text{ROA}_{i,t-1}$) have significant positive estimates only in period II. The positive estimates imply that an increase in firm investment demand and higher profitability would lead to the establishment of new borrowing relationships in the late 1990s. For the other firm covariates, the book leverage ratio ($\text{LEV}_{i,t-1}$), sales growth ($\text{SALE}_{i,t-1}$), and firm size ($\text{SIZE}_{i,t-1}$) have significantly positive estimates for periods I–III, indicating that a highly leveraged, currently profitable, and large-sized company has a greater tendency to establish new relationships.

On the other hand, the liquidity ratio ($\text{LIQUID}_{i,t-1}$), Tobin's $q$ ($\text{Q}_{i,t-1}$), and firm age ($\text{AGE}_{i,t-1}$) provide significantly negative estimates. The negative estimates for these firm characteristics indicate that a younger firm with less liquid assets and a lower Tobin's q is associated with a higher probability of establishing new relationships. We observe that the

[27] We also estimated equations (5) and (6), by replacing the new relationship variable in year $t$ ($\text{MARRY}_{i,t}$) with that in year $t+1$ ($\text{MARRY}_{i,t+1}$) as a dependent variable in equation (6). Then we obtained the evidence that the coefficients on the termination variable in year $t$ ($\text{CUT}_{i,t}$) are significantly negative for periods II and III. This implies that a firm that faced bank-driven termination was able to establish a new relationship one year after the termination.

estimated coefficients for the number of borrowing firm's relationships with lending banks ($\mathrm{NUMBER}_{i,t-1}$) are not significant except for period IV.

For the three alternative funding sources, the positive coefficient of the equity increase ($\mathrm{EQUITY}_{i,t-1}$) indicates that a firm that was able to raise funds through equity was more likely to make new relationships, particularly in the 2000s. On the other hand, the negative coefficients for corporate bonds ($\mathrm{CB}_{i,t-1}$) suggests that a firm that issued corporate bonds was less likely to establish new relationships. This result implies that corporate bonds have some effects that are substitutionary to bank loans, whereas equity finance involves complimentary effects.

Summing up our estimation results for the firm covariates in switching equation (6), a firm that has a relatively strong funding need–that is, large and highly leveraged with a low liquid assets ratio, but young with a high growth rate of sales–is more likely to establish new bank–borrower relationships.

4.3. **Continuing Relationships** In the previous subsection, we found that firms that faced bank-driven terminations in the late 1990s immediately established new relationships, whereas in the early 2000s, it took those firms at least a year to find and establish new relationships. The other possible alternative strategy for firms experiencing terminations is to increase their borrowing from their existing relationships.

In this section, we investigate the following question: were firms that faced bank-driven terminations immediately able to increase bank borrowings within their existing relationships? To address this question empirically, we include the log-difference of the outstanding amount of bank loans defined in continuing relationships ($\mathrm{CONTINUE}_{i,t}$) in the outcome variable $y_{i,t}$ in equation (1).

To estimate firm outcome equation (1), we additionally include the one-period lag of firm investment ($\mathrm{INVEST}_{i,t-1}$) and the log difference of firm's total borrowings outstanding ($\mathrm{LOAN}_{i,t-1}$) in the firm covariates ($\mathbf{FIRM_{i,t-1}}$). Then we conduct instrumental variable estimation based on the dynamic panel specification with firm fixed effects, using the same instruments ($\mathrm{WLEV}_{i,t}$ and $\mathrm{WEXP}^{\mathrm{Estate}}_{i,t}$) as earlier.

Table 8 reports the estimation results for each subsample period. Focusing on the difference between the financially distressed periods II and III, the termination variable ($\text{CUT}_{i,t}$) has a significantly negative estimate in period II but not in period III. From these estimation results, we infer that in the late 1990s, firms that faced bank-driven terminations were able to increase bank borrowings promptly within their existing relationships, while in the early 2000s, similar firms were unable to do the same. Based on the above estimation results, the next subsection provides insight into the background mechanism underpinning the bank-driven termination effect.

The estimation results for firm characteristics show that the one-period lag of the log difference of bank loans ($\text{CONTINUE}_{i,t-1}$) yields significantly negative estimates for all periods. This indicates that firms did not continuously increase bank loans within their existing relationships. The leverage ratio ($\text{LEV}_{i,t-1}$) also provides negative estimates, which implies that highly leveraged firms were associated with a decrease in bank borrowings from existing relationships.

For period I, the return on asset ($\text{ROA}_{i,t-1}$) and the firm size ($\text{SIZE}_{i,t-1}$) have significantly negative values. This indicates that currently profitable large firms displayed the tendency to decrease their borrowings in their existing relationships in the early 1990s.

As for the number of relationships ($\text{NUMBER}_{i,t-1}$) and corporate bonds ($\text{CB}_{i,t-1}$), the estimated coefficients are significantly negative in all subsample periods. From these estimation results, we can infer that firms with more diversified debt financing were more likely to decrease their borrowings in their existing relationships, and they therefore probably avoided financing hold-ups in their dealing with particular banks.[28]

[28] Many studies have investigated the pros and cons of the relationship between lending banks and their borrowing firms. A negative aspect of the strong relationship from the borrower viewpoint includes the hold-up problem. As demonstrated by Petersen and Rajan (1995), a strong relationship between a lending bank and its borrowing firm can result in the bank's having stronger bargaining power. However, a positive outcome of the strong relationship includes the mitigation of the problem of asymmetric information between lending banks and their borrowing firms. Hoshi et al. (1991) demonstrated that the investments of a borrowing firm with a strong relationship with its lending bank are less sensitive to the firm's cash flows than otherwise.

Summing up the estimation results for the firm covariates, we note that a highly leveraged firm with diversified debt financing that has many relationships and easy access to corporate bond markets, was more likely to decrease its bank borrowings within its continuing relationships.

4.4. **A Background Mechanism for Termination Effect** The above estimation results provide a clearer insight into the background mechanism for the bank-driven termination effect on firms facing relationship terminations. In the late 1990s, when the bank-driven relationship terminations had no significant effects on firm investment, firms facing relationship terminations were able to switch to new relationships immediately or to increase their borrowings within their existing relationships to meet their demand for loans. Meanwhile, in the early 2000s, when bank-driven relationship terminations exerted significant effects on firm investment, these firms were unable to make up for the lack of funding resulting from relationship termination.

As discussed, there is controversy regarding whether Japan's prolonged stagnation resulted from low productivity growth or from the breakdown of the financial system following the bursting of the Japanese bubble economy. Regarding the financial intermediation function, we infer that Japan's credit market of the late 1990s had not deteriorated so severely for listed borrowing firms. This is evidenced in the fact that firms facing lender-driven terminations were able to locate alternative financing for their investments. As for the early 2000s, when Japanese banks were chiefly engaged in the disposal of nonperforming loans, the credit market was so tight that firms could neither find other banks nor increase borrowings from their existing relationships after experiencing termination.

**5. Extensions and Robustness Check** This section extends our analysis of the bank-driven terminations of relationships by conducting a robustness check. In particular, we develop our empirical analysis in this section in period III, or the sample period from 2001 to 2005, when the decrease in borrowings because of lender-side terminations led to a decrease in firm investment. All analyses of firm investment in this section employ the dynamic panel model with firm fixed effects.

5.1. **Bank Loan Changes in Terminations and Continuing Relationships** In Section 3, we found that bank-driven terminations negatively affected firm investment. However, these results do not necessarily imply that a termination has a more significant effect on firms' investment than a change in the borrowing within continuing relationships.

To show more clearly that the termination variable contains more important information about financial frictions that firms are facing, we run the dynamic panel regression by adding bank loan growth rates, within continuing relationships ($\text{CONTINUE}_{i,t}$) to the baseline model including firm fixed effects. To mitigate the endogeneity problem that arises from the inclusion of the loan growth rates within continuing relationships, we used its lag variables as instruments in the GMM estimation.

The estimation result shown in Table 9 indicates that the termination variable, $\text{CUT}_{i,t}$, has a significant effect on a firm's investment, whereas changes in borrowings within continuing relationships, $\text{CONTINUE}_{i,t}$, does not. This result coincides with the prediction of theoretical models, where a termination of relationships provokes a prolonged effect on firm investment, while a simple change in loans within continuing relationships has a relatively small effect, because firms may increase borrowings through continuing relationships without suffering from search frictions. In fact, our results in Section 4 also support the hypothesis that a termination has a more significant effect on a firm's investment, because firms that experienced terminations in the early 2000s were not able to increase borrowings from continuing relationships or establishing new relationships.

5.2. **Sample of Decreasing Bank Loans** Another concern is that results for the negative effect of the termination variable, as shown in Section 3, may have been obtained because our termination variable, $\text{CUT}_{\text{i,t}}$, served as a dummy variable that picked up distressed firms whose bank borrowings decreased. If this is the case, then estimation results merely show evidence of the capital crunch already investigated by the existing literature in the late 1990s (Woo, 2003; Gan, 2007; and Watanabe, 2007).

We conduct another analysis to show that the termination variable is more than a simple label for firms whose outstanding borrowing decreases. We only use a selected sample of firms with decreasing bank loans in year $t$. If bank-driven terminations still exert significant effects on a firm's investment for this selected sample, it implies that financial frictions arise in the matching process in bank loan markets.

Table 10 details the estimation results obtained using the selected sample. The estimated coefficient on the termination variable ($\mathrm{CUT_{i,t}}$) is smaller than that reported in Subsection 3.3 (see also Table 5). Nonetheless, the estimated coefficient is significantly positive even in the selected sample. This indicates that the financial constraints caused by bank-driven terminations would have larger effects on firm investment than the decrease in bank borrowings.

5.3. **Asymmetric Information Problem and the Termination Effect** In Sections 3 and 4, we estimated the average effect of terminations on firm investment and showed that the effect was significant in the early 2000s, when firms facing termination were generally unable to find alternative funding sources. However, theoretical models such as Den Haan et al. (2003), Wasmer and Weil (2004), and Becsi et al. (2005; 2013) predict that the effect of terminations should vary depending on the extent of asymmetric information problems. To investigate this point, we estimate the termination effect by dividing our sample into different subsamples based on two proxies for the degree of asymmetric information problem that a firm faces. The first proxy is firm size, defined as the total book value of assets, and the second proxy is the issue of corporate bonds.

The reason that we use corporate bond issues to proxy the degree of asymmetric information problem is that in Japan, not all firms are easily able to issue corporate bonds because there is no liquid junk bond market. Accordingly, Japanese firms need to have established a good reputation in financial markets before they can issue bonds. Therefore, the issue of corporate bonds serves as a proxy for the degree of establishment of a firm's reputation in funding markets; in other words, we can consider Japanese firms issuing corporate bonds to be those relatively less affected by asymmetric information problems.

Table 11 reports the estimated coefficients obtained by dividing our sample for 2001–05 based on firm size or the issue of corporate bonds.[29] For firm size, we split the sample into three different subsamples based on the total book value of assets as of the beginning of fiscal year 2001, and report the estimation results for each subsample in the first to third columns. The estimated effects of termination are significant for small- and medium-sized firms but not for large firms. This coincides with the prediction of the theoretical models: large firms suffer less from asymmetric information problems and hence are relatively easily able to find an alternative funding source. This suggests the mitigation of the effect of bank-driven terminations for large firms.

The estimation results for the subsamples of firms with and without corporate bonds are in the fourth and fifth columns in Table 11, respectively. The estimate for the termination variable is not significant for firms issuing corporate bonds but is significant for firms without them. These results imply the mitigating effects of bank-driven terminations for firms that have established some reputation in credit markets by issuing corporate bonds. Our empirical analysis conducted in this subsection reveals the importance of the asymmetric information problem in examining the effect of bank-driven terminations.

5.4. **Persistence of the Termination Effect** In this subsection, we examine how long the bank-driven termination effects last. This experiment is then the flip side of that hypothesis developed in Subsections 4.2 and 4.3, in which we sought to determine whether firms that face bank-driven terminations could find alternative funding for their investments by establishing new relationships or increasing their borrowings within their existing relationships. If bank-driven termination effects on firm investment disappear within a year after termination, we could infer that these firms are able to finance their

[29] We report the estimation results based on period III of the early 2000s only. For the other subsample periods I, II and III, we did not identify any significant effect on firm investment, even if we split the subsamples based on the two asymmetric information proxies.

investments by establishing new relationships or increasing their borrowings within their existing relationships. To estimate the persistence of the bank-driven termination effect, we include firm investment in year $t+1$ as a dependent variable.

Table 12 reports the estimated effect of bank-driven termination in year $t$ on firm investment in years $t$ and $t+1$. As shown in the right-hand side column, the estimated termination effect on one-period-ahead investment is not significant. From this estimation result, we suggest that the bank-driven termination effect on firm investment lasts for no longer than a year. This implies that firms facing relationship terminations can obtain financing for investment by establishing new relationships or increasing borrowings within their existing relationships at least one year later.

**6. Conclusion** This paper exploits the characteristics of a matched sample that allows us to identify the terminations of bank–borrower relationships, thereby examining the effect of terminations driven by lending banks on the investment of borrowing firms. Using a matched dataset for Japanese lending banks and listed firms from 1991 to 2010, we obtain two substantive conclusions.

First, the bank-driven terminations had about a one-year lasting effect on firm investment in the early 2000s, such that a 10% decline in bank borrowings because of bank-driven terminations would decrease firm investment by 3.0%. The impact of terminations on a firm's investment then is substantial and more significant, compared with the impact of changes in borrowings within continuing relationships. While firm investment in the early 2000s increased by only 0.42% on average, the average impact of the bank-driven terminations was $-1.03\%$ (calculated as $-0.30 \times 3.43\%$).

Second, this bank-driven termination effect is significant during the period when borrowing firms that faced termination had difficulty in immediately locating other financing sources for investment by establishing a new relationship or increasing borrowings within their existing relationships. We derive this conclusion from the contrasting results for the late 1990s and the early 2000s. In the early 2000s, Japanese borrowing firms were exposed to lender-driven termination shocks, thereby decreasing their investments. This was also the period when the Japanese government obliged banks to dispose of their nonperforming loans promptly. On the other hand, in the late 1990s, bank-driven terminations did not affect the investments of listed firms. In this period, listed firms that faced bank-driven terminations were able to find alternative financing for investment by either switching to a new bank relationship or increasing borrowings within their existing relationships. In the late 1990s, Japan's credit market would have not been so severely tight that listed firms were immediately unable to finance their investments after experiencing bank-driven terminations.

Our findings coincide with the prediction of existing theoretical models whereby financial frictions in a matching process in credit markets play an important role in firm investment. However, two related issues were not covered in our empirical investigation. First, some studies suggest the broader effect of relationship termination on firm performance, such as corporate capital structure, return on assets, and Tobin's $q$.[30] As this paper has focused on the bank-driven termination effect on firm investment, the switching of relationships, and borrowing from existing relationships because of its importance in macroeconomic fluctuations, we have deferred the study of the termination effect on other firm outcomes to future research.

Second, the matched sample that we used for investigating the effect of the bank-driven terminations includes few small- and medium-sized enterprises because the dataset only includes domestic listed companies. As implied by the exercise in Subsection 5.2, we expect bank-driven terminations to influence smaller firms more significantly because they depend on a smaller number of lending banks and funding sources (See, e.g., Berger and Udell (1995)). Consequently, using a dataset including small- and medium-sized enterprises could lead to a conclusion that supports the stronger effects of bank-driven terminations.[31] One possibility is to extend our analysis along these lines.

[30] See, e.g., Leary (2009) for the effect of a credit supply shock on capital structure. See Tsuruta (2014) for the effect of firms changing their main bank on their return on assets and Tobin's $q$.

[31] Berger et al. (2001) discuss the effect of bank distress on small-sized firms.

**Appendix A: Construction of Loan-level Matched Sample with M&A, Business Transfer, and Divestiture Activity** As discussed, the Japanese banking sector experienced significant M&A, business transfer, and divestiture activity over the late 1990s and early 2000s. To construct our loan-level dataset, we checked whether succeeding banks took over the merged or eliminated bank's credit claims on its borrowing firms before and after the relevant M&A, business transfer, or divestiture. This Appendix explains how we define the termination of a bank–borrower relationship in the case of M&A, business transfer, and divestiture.

**The Case of M&A** Here, we consider the case of an absorption-type merger. If a surviving bank took over a merged bank's loan lent to a borrowing firm after the absorption merger, we assume that the pre-M&A relationship between the merging bank and the borrowing firm continues in the post-M&A relationship between the surviving bank and the firm. That is, the pre-M&A relationship did not terminate at the time of the absorption merger. On the other hand, if no bank took over the loan of the merging bank, we assume that the pre-M&A relationship terminated at the time of the absorption merger.

**The Case of Business Transfer** Next, we consider the case in which a bank transferred its business to other banks. In this case, we define a relationship termination as the case of M&A. If we find that the transferee bank took over the loans of the transferor bank, we suppose that the transferor bank also held over pre-transfer relationships between the transferor bank and its borrowing firms, and that the pre-transfer relationships did not terminate. As long as we find that the transferee banks did not take over loans of the transferor bank, we assume that the pre-transfer relationships between the transferor bank and its borrowing firms terminated. We adopt the above way of defining a relationship termination, whether the accepting banks had enjoyed relationships with those borrowing firms before the business transfer or not.

**The Case of Merger and Divestiture** We consider the case in which banks merged and then divested. In this case, we should identify which banks formed after the merger and divestiture, and whether they took over the loans of the merging banks. If a firm had enjoyed relationships with one of the merging banks before the merger and divestiture, and the firm had a relationship with at least one of the surviving banks after the merger and divestiture, we consider that the relationships between the merging banks and the firm were preserved. That is, the relationships did not terminate. If the firm did not have any relationships with the surviving banks after the merger and divestiture, we consider that the relationships between the merged banks and the firm terminated at that time.

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**Table 1: Number of Observations: Average per Year**

| Number of observations | Full Sample | 1991–1995 | 1996–2000 | 2001–2005 | 2006–2010 |
|---|---|---|---|---|---|
| Firms | 2,061 | 1,559 | 2,324 | 2,263 | 2,099 |
| Banks | 137 | 151 | 147 | 131 | 121 |
| Relations | 17,042 | 18,331 | 21,693 | 15,751 | 12,394 |

1. This table shows sample averages of the numbers of observations for borrowing firms, lending banks, and relationships, each calculated per year.

2. "Full Sample" indicates the sample period from fiscal year 1991 to 2010.

## Table 2: Summary Statistics

| | Full Sample | | | | 1991–1995 | | 1996–2000 | | 2001–2005 | | 2006–2010 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **Std.** | **Min.** | **Max.** | **Mean** | **Std.** | **Mean** | **Std.** | **Mean** | **Std.** | **Mean** | **Std.** |
| **Termination Variable** | | | | | | | | | | | | |
| CUT | -2.617 | 8.926 | -99.27 | 0.000 | -1.087 | 5.417 | -2.256 | 7.559 | -3.427 | 10.45 | -3.284 | 10.36 |
| **Firm Outcome** | | | | | | | | | | | | |
| INVEST | 2.746 | 23.29 | -858.6 | 543.7 | 5.900 | 14.74 | 3.421 | 14.30 | 0.420 | 23.91 | 2.050 | 33.33 |
| **Instrumental Variables** | | | | | | | | | | | | |
| $\text{WEXP}^{Estate}$ | 11.27 | 1.883 | 0.000 | 24.56 | 11.66 | 1.662 | 11.30 | 1.645 | 11.17 | 1.921 | 11.05 | 2.183 |
| WLEV | 96.41 | 1.012 | 87.26 | 149.1 | 96.85 | 0.372 | 96.67 | 1.012 | 96.42 | 1.021 | 95.78 | 1.012 |
| **Firm Covariates** | | | | | | | | | | | | |
| LEV | 60.20 | 19.41 | 0.91 | 835.4 | 64.05 | 17.84 | 61.36 | 19.87 | 59.90 | 20.47 | 56.38 | 18.11 |
| LIQUID | 51.05 | 19.67 | 0.60 | 99.37 | 56.65 | 18.14 | 53.43 | 18.86 | 48.70 | 19.65 | 46.18 | 20.35 |
| Tobin's $q$ | 180.1 | 66.11 | 20.76 | 2537 | 208.8 | 51.34 | 179.1 | 61.62 | 167.9 | 65.91 | 172.4 | 74.11 |
| ROA | 0.572 | 7.781 | -372.9 | 157.2 | 1.112 | 4.331 | 0.597 | 6.412 | 0.364 | 8.608 | 0.386 | 9.902 |
| SALE | 0.000 | 0.254 | -4.689 | 7.305 | 0.010 | 0.170 | 0.019 | 0.174 | 0.022 | 0.278 | -0.022 | 0.342 |
| SIZE | 10.48 | 1.441 | 4.522 | 16.46 | 10.98 | 1.382 | 10.52 | 1.391 | 10.29 | 1.422 | 10.26 | 1.481 |
| AGE | 3.792 | 0.575 | -0.695 | 4.862 | 3.893 | 0.347 | 3.803 | 0.460 | 3.762 | 0.616 | 3.732 | 0.741 |
| NUMBER | 1.882 | 0.699 | 0.000 | 4.560 | 2.243 | 0.695 | 2.019 | 0.668 | 1.754 | 0.629 | 1.591 | 0.623 |
| EQUITY | 0.263 | 0.441 | 0.000 | 1.000 | 0.399 | 0.492 | 0.272 | 0.441 | 0.198 | 0.395 | 0.222 | 0.419 |
| CB | -0.282 | 6.719 | -75.41 | 78.43 | 0.303 | 8.351 | -0.753 | 7.328 | -0.247 | 5.725 | -0.263 | 5.442 |
| CP | 0.013 | 1.087 | -32.03 | 26.25 | 0.050 | 0.793 | 0.012 | 1.247 | -0.019 | 1.064 | 0.000 | 1.121 |
| **New Relationships** | | | | | | | | | | | | |
| MARRY | 0.245 | 0.424 | 0.000 | 1.000 | 0.213 | 0.412 | 0.200 | 0.403 | 0.265 | 0.442 | 0.271 | 0.452 |

1. Except for firm size (SIZE), firm age (AGE), the equity increase (EQUITY), firm sales growth (SALE), and the number of relationships (NUMBER), all variables are expressed in percentage terms.
2. For definition of each variable, see subsection 2.2.

## Table 3: Estimation Results for the Relationship–Termination Equation

| Period | (I) 1991–1995 | (II) 1996–2000 | (III) 2001–2005 | (IV) 2006–2010 |
|---|---|---|---|---|
| Dependent variable: CUT | | | | |
| Independent variables: | | | | |
| $WEXP^{Estate}$ | 0.0002 | -0.020 | -0.347*** | -0.055 |
| | (0.0489) | (0.051) | (0.059) | (0.053) |
| WLEV | -0.654* | -0.482*** | -0.0064 | -0.029 |
| | (0.335) | (0.123) | (0.113) | (0.141) |
| Lag INVEST | 0.0003 | 0.022* | -0.0001 | 0.005 |
| | (0.0026) | (0.013) | (0.0081) | (0.006) |
| NUMBER | 0.185 | -0.300* | -0.416** | -1.481*** |
| | (0.126) | (0.161) | (0.200) | (0.222) |
| LEV | 0.014*** | 0.029*** | 0.049*** | 0.038*** |
| | (0.005) | (0.006) | (0.009) | (0.008) |
| ROA | 0.013 | 0.047 | 0.107*** | 0.087*** |
| | (0.013) | (0.033) | (0.031) | (0.025) |
| SIZE | -0.071 | -0.193*** | -0.201* | -0.218** |
| | (0.060) | (0.0703) | (0.107) | (0.106) |
| SALE | 0.276 | 0.272 | -0.246 | 0.691 |
| | (0.278) | (0.480) | (0.534) | (0.578) |
| AGE | 0.992*** | 0.119 | 1.250*** | 1.191*** |
| | (0.254) | (0.209) | (0.305) | (0.259) |
| Q | -0.002 | -0.005** | -0.009*** | -0.006** |
| | (0.002) | (0.002) | (0.002) | (0.003) |
| LIQUID | -0.024*** | -0.020*** | -0.020** | -0.014* |
| | (0.005) | (0.006) | (0.008) | (0.008) |
| EQUITY | -0.073 | -0.426** | -0.886*** | -1.462*** |
| | (0.145) | (0.188) | (0.323) | (0.340) |
| CB | -0.012 | -0.038*** | 0.023 | -0.005 |
| | (0.009) | (0.011) | (0.022) | (0.040) |
| CP | 0.013 | 0.148*** | 0.056 | 0.081 |
| | (0.032) | (0.057) | (0.112) | (0.123) |
| Dummy | Year and Ind. | Year and Ind. | Year and Ind. | Year and Ind. |
| $N$ | 7510 | 10322 | 10365 | 9551 |
| F-stat | 2.09 | $8.57^{\dagger}$ | $20.50^{\ddagger}$ | 1.11 |

1. We conduct the ordinary least squares estimation for estimating termination equation (5) by including year and industry dummy variables.
2. Robust standard errors are in parentheses.
3. *, ** and *** indicate 10%, 5% and 1% levels of significance, respectively.
4. † and ‡ indicate a 5% level of significance based on the critical values at sizes 25% and 10%, respectively, as reported in Stock and Yogo (2005).

## Table 4: Estimation Results for Firm Investment Equation: The Pooled Instrumental Variable Estimation Method

| Period | (I) 1991–1995 | (II) 1996–2000 | (III) 2001–2005 | (IV) 2006–2010 |
|---|---|---|---|---|
| Dependent variable: INVEST | | | | |
| Independent variables: | | | | |
| CUT | -0.960 | -0.205 | 0.626* | 0.186 |
| | (0.973) | (0.401) | (0.365) | (1.331) |
| Lag INVEST | -0.0003 | 0.108*** | 0.065*** | -0.023 |
| | (0.0742) | (0.027) | (0.021) | (0.029) |
| NUMBER | -0.165 | 0.068 | -0.291 | 0.373 |
| | (0.368) | (0.311) | (0.522) | (1.889) |
| LEV | 0.013 | -0.023 | -0.074*** | -0.047 |
| | (0.022) | (0.018) | (0.028) | (0.050) |
| ROA | 0.429*** | 0.256*** | 0.191*** | 0.432*** |
| | (0.139) | (0.062) | (0.067) | (0.146) |
| SIZE | 0.166 | -0.499*** | -0.041 | 0.016 |
| | (0.162) | (0.156) | (0.218) | (0.393) |
| SALE | 3.070* | 2.790* | 3.500*** | 3.339 |
| | (1.578) | (1.493) | (1.336) | (2.341) |
| AGE | -0.723 | -1.312** | -4.448*** | -5.495*** |
| | (1.186) | (0.519) | (0.874) | (1.587) |
| Q | 0.005 | 0.010 | 0.013 | 0.022** |
| | (0.006) | (0.006) | (0.010) | (0.009) |
| LIQUID | 0.040 | 0.035** | 0.075*** | 0.017 |
| | (0.026) | (0.017) | (0.023) | (0.034) |
| EQUITY | 1.808*** | 1.649*** | 1.821** | 2.409 |
| | (0.463) | (0.464) | (0.857) | (2.464) |
| CB | 0.017 | 0.022 | 0.125* | -0.032 |
| | (0.025) | (0.021) | (0.068) | (0.069) |
| CP | -0.067 | 0.200** | 0.055 | -0.053 |
| | (0.126) | (0.0856) | (0.143) | (0.279) |
| Dummy | Year and Ind. | Year and Ind. | Year and Ind. | Year and Ind. |
| $N$ | 7510 | 10322 | 10365 | 9551 |
| Hansen $J$ test ($p$-value) | 0.915 | 0.904 | 0.444 | 0.766 |
| Anderson Rubin test ($p$-value) | 0.212 | 0.602 | 0.080 | 0.8948 |

1. We conduct the pooled-instrumental-variable estimation to estimate firm outcome equation (1) and include firm investment into a firm outcome variable $y_{i,t}$.
2. Robust standard errors are in parentheses.
3. *, **, and *** indicate 10%, 5%, and 1% levels of significance, respectively.
4. The $p$-value of Anderson-Rubin test is calculated by a bootstrap method, following Davidson and MacKinnon (2014).

## Table 5: Estimation Results for the Firm Investment Equation: The Dynamic Panel Estimation Method with Fixed Effects

| Period | (I) 1991–1995 | | (II) 1996–2000 | | (III) 2001–2005 | | (IV) 2006–2010 | |
|---|---|---|---|---|---|---|---|---|
| | (i) | (ii) | (i) | (ii) | (i) | (ii) | (i) | (ii) |
| Dependent variable: INVEST | | | | | | | | |
| Independent variables: | | | | | | | | |
| CUT | 0.268 | 0.180 | -0.169 | -0.186* | 0.231** | 0.302** | 0.229 | 0.157 |
| | (0.186) | (0.177) | (0.107) | (0.113) | (0.118) | (0.119) | (0.234) | (0.186) |
| Lag INVEST | -0.009 | -0.006 | 0.029 | 0.037* | -0.020 | -0.017 | 0.029 | 0.030 |
| | (0.057) | (0.053) | (0.020) | (0.019) | (0.020) | (0.020) | (0.028) | (0.031) |
| NUMBER | -2.572 | -3.389 | 1.167 | 0.136 | 1.691 | 0.914 | -3.506* | -3.509 |
| | (3.386) | (3.366) | (1.620) | (1.714) | (1.895) | (1.966) | (1.988) | (2.155) |
| LEV | -0.350** | -0.293** | -0.211* | -0.166 | -0.058 | -0.062 | -0.021 | -0.075 |
| | (0.162) | (0.134) | (0.118) | (0.120) | (0.156) | (0.157) | (0.235) | (0.237) |
| ROA | 0.104 | 0.045 | -0.067 | -0.092 | -0.021 | -0.024 | 0.086 | 0.037 |
| | (0.198) | (0.116) | (0.065) | (0.067) | (0.061) | (0.057) | (0.130) | (0.106) |
| SIZE | -28.50*** | -37.33*** | -19.45*** | -18.89*** | -9.006** | -12.88** | -20.73*** | -30.35*** |
| | (5.066) | (6.004) | (5.293) | (5.553) | (4.457) | (5.216) | (8.015) | (8.667) |
| SALE | 0.436 | -0.041 | 1.058 | 1.004 | 0.777 | 0.467 | 1.266 | 1.155 |
| | (0.948) | (0.846) | (0.857) | (0.845) | (1.189) | (1.202) | (2.270) | (2.268) |
| AGE | 5.397 | 6.211 | -12.68 | -8.052 | -19.42* | -13.25 | -8.322 | -12.37 |
| | (17.34) | (17.31) | (10.78) | (11.77) | (11.62) | (13.47) | (10.86) | (14.25) |
| Q | -0.005 | -0.008 | -0.013 | -0.011 | -0.011 | -0.011 | 0.0009 | -0.003 |
| | (0.005) | (0.006) | (0.013) | (0.014) | (0.021) | (0.020) | (0.0074) | (0.007) |
| LIQUID | 1.167*** | 1.094*** | 0.904*** | 0.801*** | 0.345** | 0.298* | 0.242 | 0.180 |
| | (0.151) | (0.145) | (0.194) | (0.191) | (0.155) | (0.171) | (0.264) | (0.278) |
| EQUITY | 0.401 | 0.348 | 0.327 | 0.379 | 0.757 | 0.549 | -0.159 | 0.250 |
| | (0.424) | (0.466) | (0.340) | (0.351) | (0.790) | (0.799) | (0.879) | (0.987) |
| CB | -0.022 | -0.029** | -0.0002 | 0.0005 | 0.032 | 0.044 | 0.132** | 0.102 |
| | (0.014) | (0.014) | (0.0133) | (0.0134) | (0.028) | (0.027) | (0.066) | (0.066) |
| CP | -0.030 | -0.0007 | 0.099* | 0.109* | 0.214* | 0.240** | 0.110 | 0.045 |
| | (0.132) | (0.1440) | (0.056) | (0.059) | (0.120) | (0.118) | (0.103) | (0.112) |
| Dummy | Year | Year× Ind. | Year | Year× Ind. | Year | Year× Ind. | Year | Year× Ind. |
| $N$ | 7258 | 7258 | 8970 | 8970 | 9330 | 9330 | 8699 | 8699 |
| Numb. of IVs | 202 | 337 | 202 | 337 | 202 | 337 | 202 | 337 |
| Hansen test (p-value) | 0.009 | 0.104 | 0.551 | 0.545 | 0.024 | 0.337 | 0.087 | 0.169 |
| Arellano-Bond test for AR(1), p-value | 0.018 | 0.020 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Arellano-Bond test for AR(2), p-value | 0.407 | 0.388 | 0.926 | 0.989 | 0.389 | 0.491 | 0.426 | 0.419 |

1. We conducted the instrumental variable estimation of Arellano and Bond (1991), based on the dynamic panel specification with firm fixed effects to estimate firm outcome equation (1) including firm investments in a firm outcome variable $y_{i,t}$.
2. We used the lagged values of the firm covariates ($\text{FIRM}_{i,t-k}$, $k = 2, \ldots, 4$), the outcome variable ($y_{i,t-k}$, $k = 2, \ldots, 4$), the termination variable ($\text{CUT}_{i,t-k}$, $k = 2, \ldots, 4$), the bank leverage ratio ($\text{WLEV}_{\text{i,t}-1}$), and exposure to the real estate industry in 1989 (${\text{WEXP}_{\text{i,t}-1}}^{\text{Estate}}$) as instrumental variables.
3. Year and Year × Ind. indicate time dummy variables and the cross terms of the time dummy and industrial dummy variables, respectively.
4. Robust standard errors are in parentheses.
5. *, **, and *** indicate 10%, 5%, and 1% levels of significance, respectively.

**Table 6: Validity of Instruments**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Period | (I)1991–1995 | (II)1996–2000 | (III)2001–2005 | (IV)2006–2010 |
| $C$ test (p-value) with year dummies | 0.988 | 0.081 | 0.567 | 0.643 |
| $C$ test (p-value) with year-industry dummies | 0.537 | 0.239 | 0.918 | 0.210 |

1. The $C$ statistic is calculated on the basis of the estimation results shown in Table 5.

## Table 7: Estimation Results for the New–Relationship Equation

| Period | (I) 1991–1995 | (II) 1996–2000 | (III) 2001–2005 | (IV) 2006–2010 |
|---|---|---|---|---|
| Dependent variable: MARRY | | | | |
| Independent variables: | | | | |
| CUT | -0.117 | -0.063* | -0.006 | 0.099*** |
| | (0.072) | (0.038) | (0.021) | (0.017) |
| Lag CUT | -0.010 | -0.016* | -0.014*** | -0.019*** |
| | (0.012) | (0.0090) | (0.003) | (0.007) |
| MARRY | 0.369* | 0.293*** | 0.357*** | 0.306*** |
| | (0.218) | (0.0901) | (0.040) | (0.110) |
| Lag INVEST | 0.0001 | 0.004*** | -0.0005 | -0.0006 |
| | (0.0012) | (0.001) | (0.0006) | (0.0007) |
| NUMBER | -0.056 | -0.007 | -0.005 | 0.131*** |
| | (0.046) | (0.040) | (0.032) | (0.037) |
| LEV | 0.009*** | 0.007*** | 0.008*** | -0.001 |
| | (0.002) | (0.001) | (0.001) | (0.003) |
| ROA | 0.007 | 0.013*** | 0.004 | -0.006 |
| | (0.005) | (0.004) | (0.003) | (0.005) |
| SIZE | 0.055** | 0.035** | 0.033** | 0.026* |
| | (0.028) | (0.017) | (0.013) | (0.015) |
| SALE | 0.233** | 0.309*** | 0.175** | -0.051 |
| | (0.116) | (0.099) | (0.077) | (0.059) |
| AGE | 0.014 | -0.249*** | -0.190*** | -0.132* |
| | (0.107) | (0.055) | (0.042) | (0.070) |
| Q | -0.0011** | -0.0007** | -0.0003 | 0.0004* |
| | (0.0005) | (0.0003) | (0.0003) | (0.0002) |
| LIQUID | -0.003* | -0.003** | -0.005*** | -0.00005 |
| | (0.002) | (0.001) | (0.001) | (0.00175) |
| EQUITY | 0.051 | -0.002 | 0.085** | 0.165*** |
| | (0.041) | (0.037) | (0.041) | (0.045) |
| CB | -0.009*** | -0.010*** | -0.006** | -0.0005 |
| | (0.003) | (0.002) | (0.003) | (0.0038) |
| CP | 0.012 | 0.001 | -0.004 | -0.007 |
| | (0.017) | (0.013) | (0.013) | (0.013) |
| Dummy | Year | Year | Year | Year |
| $N$ | 7507 | 10320 | 10345 | 9533 |

1. We conducted the pooled-instrumental-variable estimation to estimate the relationship-switching model (6).
2. Robust standard errors are in parenthesis.
3. *, **, and *** indicate 10%, 5%, and 1% levels of significance, respectively.

## Table 8: Estimation Results for the Firm Borrowing in a Continuing Relationship

| | (I) 1991–1995 | (II) 1996–2000 | (III) 2001–2005 | (IV) 2006–2010 |
|---|---|---|---|---|
| Dependent variable: CONTINUE | | | | |
| Independent variables: | | | | |
| CUT | 0.573 | -0.880** | -0.141 | -0.319 |
| | (0.828) | (0.387) | (0.365) | (0.428) |
| Lag CONTINUE | -0.120** | -0.150*** | -0.113*** | -0.146*** |
| | (0.047) | (0.056) | (0.034) | (0.031) |
| LOAN | 0.048 | 0.089* | 0.042 | 0.046 |
| | (0.048) | (0.053) | (0.034) | (0.034) |
| Lag INVEST | 0.063 | 0.048 | 0.012 | 0.005 |
| | (0.045) | (0.042) | (0.032) | (0.017) |
| NUMBER | -24.72** | -30.78*** | -23.14*** | -16.81*** |
| | (10.80) | (7.606) | (6.339) | (5.735) |
| LEV | -0.838* | -1.98*** | -1.60*** | -1.85*** |
| | (0.446) | (0.491) | (0.501) | (0.451) |
| ROA | -0.728** | -0.144 | -0.169 | -0.0418 |
| | (0.294) | (0.198) | (0.165) | (0.203) |
| SIZE | -41.10** | 2.667 | 4.851 | -20.56 |
| | (17.75) | (19.89) | (16.42) | (15.13) |
| SALE | -0.266 | 4.524 | 0.792 | -0.921 |
| | (2.382) | (3.238) | (2.555) | (2.293) |
| AGE | 36.62 | -5.739 | -44.32 | -14.99 |
| | (54.41) | (38.82) | (29.41) | (18.67) |
| Q | -0.022 | 0.026 | 0.049 | 0.003 |
| | (0.020) | (0.040) | (0.055) | (0.032) |
| LIQUID | 0.230 | 0.301 | -0.142 | 0.527 |
| | (0.393) | (0.477) | (0.383) | (0.342) |
| EQUITY | -1.686 | 1.123 | -0.116 | -2.503 |
| | (1.642) | (1.421) | (2.164) | (2.278) |
| CB | -0.489*** | -0.672*** | -0.649*** | -0.584*** |
| | (0.081) | (0.091) | (0.111) | (0.117) |
| CP | -0.267 | -0.498 | 0.370 | 0.373 |
| | (0.403) | (0.326) | (0.407) | (0.512) |
| Dummy | Year × Ind. | Year × Ind. | Year × Ind. | Year × Ind. |
| $N$ | 7265 | 9229 | 9668 | 9023 |
| Hansen Test (p-value) | 0.029 | 0.095 | 0.078 | 0.009 |
| Num. of IVs | 292 | 292 | 292 | 292 |

1. We conducted the instrumental variable estimation with dynamic panel model of Arellano and Bond (1991), to estimate firm outcome equation (1), and included firm borrowings within its continuing relationships in a firm outcome variable $y_{i,t}$.
2. We used the lagged values of the firm covariates ($\text{FIRM}_{i,t-k}$, $k = 2, 3$), the independent variable ($y_{i,t-k}$, $k = 2, 3$) and the termination variable ($\text{CUT}_{i,t-k}$, $k = 2, 3$), and two bank variables ($\text{WLEV}_{\text{i,t}-1}$ and $\text{WEXP}_{\text{i,t}-1}{}^{\text{Estate}}$) as instrumental variables.
3. Year × Ind. indicate time dummy variables and the cross terms of the time dummy and industrial dummy variables, respectively.
4. Robust standard errors are in parentheses.
5. *, **, and *** indicate 10%, 5%, and 1% levels of significance, respectively.

## Table 9: Estimation Results for Firm Investment Model including bank loans in continuing relationships

| | (III) 2001–2005 |
|---|---|
| Dependent variable: INVEST | |
| Independent variables: | |
| CUT | 0.246** |
| | (0.113) |
| CONTINUE | 0.046 |
| | (0.030) |
| Lag INVEST | -0.022 |
| | (0.020) |
| NUMBER | 1.443 |
| | (1.898) |
| LEV | 0.041 |
| | (0.162) |
| ROA | -0.008 |
| | (0.067) |
| SIZE | -8.497* |
| | (4.540) |
| SALE | 0.243 |
| | (1.137) |
| AGE | -13.94 |
| | (11.79) |
| Q | -0.008 |
| | (0.023) |
| LIQUID | 0.394** |
| | (0.161) |
| EQUITY | 1.080 |
| | (0.809) |
| CB | 0.084** |
| | (0.039) |
| CP | 0.176 |
| | (0.112) |
| $N$ | 9330 |
| Num. of IVs | 217 |
| Hansen test (p-value) | 0.105 |
| Arellano-Bond test for AR(1), p-value | 0.000 |
| Arellano-Bond test for AR(2), p-value | 0.393 |

1. We conducted the instrumental variable estimation of Arellano and Bond (1991), based on the dynamic panel specification with fixed effects to estimate firm outcome equation (1) including firm investment in the firm outcome variable $y_{i,t}$.
2. We used the lagged values of the firm covariates ($\text{FIRM}_{i,t-k}$, $k = 2, ..., 4$), the outcome variable ($y_{i,t-k}$, $k = 2, ..., 4$), the the termination variable ($\text{CUT}_{i,t-k}$, $k = 2, ..., 4$), the log-difference of the outstanding amount of bank loans within continuing relationships ($\text{CONTINUE}_{i,t-k}$, $k = 2, ..., 4$) and two bank variables ($\text{WLEV}_{\text{i,t}-1}$ and ${\text{WEXP}_{\text{i,t}-1}}^{\text{Estate}}$) as instrumental variables.
3. Robust standard errors are in parentheses.
4. *, **, and *** indicate 10%, 5% and 1% levels of significance, respectively.

## Table 10: Estimation Results for Firm Investment Model Based on a Subsample with Decreasing Loans

| | (III) 2001–2005 |
|---|---|
| Dependent variable: INVEST (with $\Delta$LOAN < 0) | |
| Independent variables: | |
| CUT | 0.224** |
| | (0.098) |
| Lag INVEST | -0.042* |
| | (0.025) |
| NUMBER | 1.980 |
| | (2.482) |
| LEV | -0.135 |
| | (0.144) |
| ROA | -0.014 |
| | (0.035) |
| SIZE | -13.01** |
| | (6.345) |
| SALE | -0.649 |
| | (1.367) |
| AGE | -40.40** |
| | (16.06) |
| Q | 0.003 |
| | (0.031) |
| LIQUID | 0.326* |
| | (0.191) |
| EQUITY | 0.661 |
| | (0.754) |
| CB | 0.041 |
| | (0.038) |
| CP | 0.372* |
| | (0.206) |
| Dummy | Year |
| $N$ | 5972 |
| Num. of IVs | 392 |
| Hansen test (p-value) | 0.102 |
| Arellano-Bond test for AR(1), p-value | 0.005 |
| Arellano-Bond test for AR(2), p-value | 0.257 |

1. We conducted the instrumental variable estimation of Arellano and Bond (1991), based on the dynamic panel specification with fixed effects to estimate firm outcome equation (1) including firm investment in the firm outcome variable $y_{i,t}$.
2. We used the lagged values of the firm covariates ($\text{FIRM}_{i,t-k}$, $k = 2, ..., 7$), the outcome variable ($y_{i,t-k}$, $k = 2, ..., 7$), the termination variable ($\text{CUT}_{i,t-k}$, $k = 2, ..., 6$) and two bank variables ($\text{WLEV}_{\text{i,t}-1}$ and $\text{WEXP}_{\text{i,t}-1}{}^{\text{Estate}}$) as instrumental variables.
3. *, **, and *** indicate 10%, 5% and 1% levels of significance, respectively.

**Table 11: Termination Effect with Different Firm Size and Corporate Bond Market Access in 2001–2005**

| | Firm Size | | | Corporate Bond | |
|---|---|---|---|---|---|
| | Small | Medium | Large | Without Corporate Bond | With Corporate Bond |
| Dependent variable: INVEST | | | | | |
| Independent variable: CUT | 0.300* | 0.424* | 0.083 | 0.344** | 0.092 |
| | (0.178) | (0.225) | (0.120) | (0.144) | (0.098) |
| Dummy | Year | Year | Year | Year | Year |
| N | 2779 | 3108 | 3215 | 5843 | 3487 |
| Hansen test (p-value) | 0.112 | 0.496 | 0.234 | 0.095 | 0.278 |
| Arellano-Bond test for AR(1), p-value | 0.009 | 0.016 | 0.030 | 0.000 | 0.067 |
| Arellano-Bond test for AR(2), p-value | 0.050 | 0.589 | 0.824 | 0.103 | 0.200 |

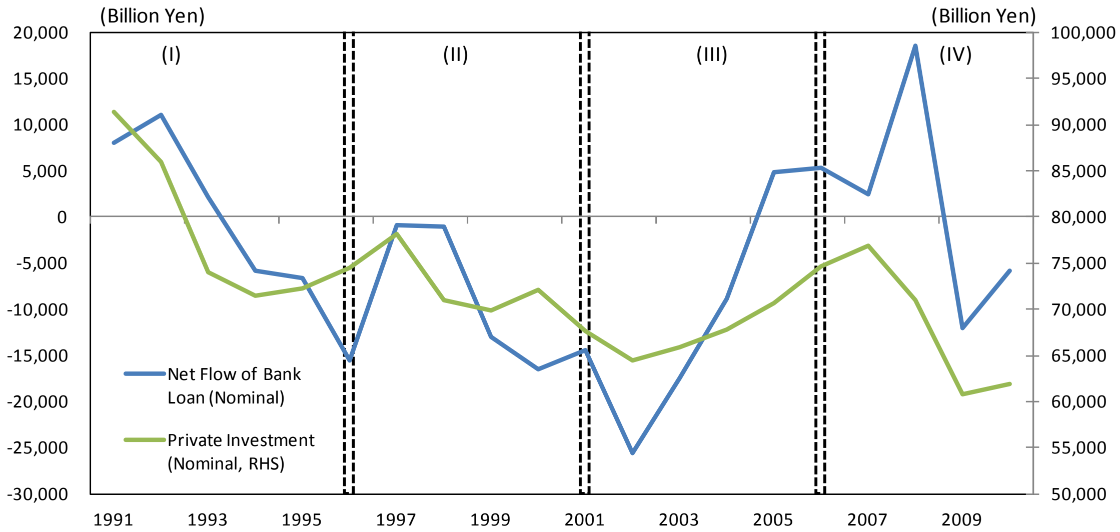
1. We conducted the instrumental variable estimation of Arellano and Bond (1991), based on the dynamic panel specification with firm fixed effects to estimate firm outcome equation (1) including firm investments in a firm outcome variable $y_{i,t}$.
2. We used the lagged values of the firm covariates, the outcome variable, and the termination variable as instrumental variables.
3. Parameter estimates are obtained by using also the bank leverage ratio ($\mathrm{WLEV}_{i,t-1}$) and bank exposure to the real estate industry in 1989 ($\mathrm{WEXP}_{i,t-1}{}^{\mathrm{Estate}}$) as instruments.
4. Other independent variables are included in our estimation but not reported in the table.
5. *, **, and *** indicate 10%, 5%, and 1% levels of significance, respectively.
6. Corporate bonds includes both straight and convertible bonds.

## Table 12: Persistence of the Bank-driven Relationship Terminations in 2001–2005

| | Investment(t) | Investment(t+1) |
|---|---|---|
| Dependent variable: INVEST | | |
| Independent variable: CUT | 0.231** | 0.0536 |
| | (0.118) | (0.131) |
| Dummy | Year | Year |
| N | 9330 | 8672 |
| Numb. of IVs | 202 | 202 |
| Hansen test (p-value) | 0.024 | 0.263 |
| Arellano-Bond test for AR(1), p-value | 0.000 | 0.000 |
| Arellano-Bond test for AR(2), p-value | 0.389 | 0.046 |

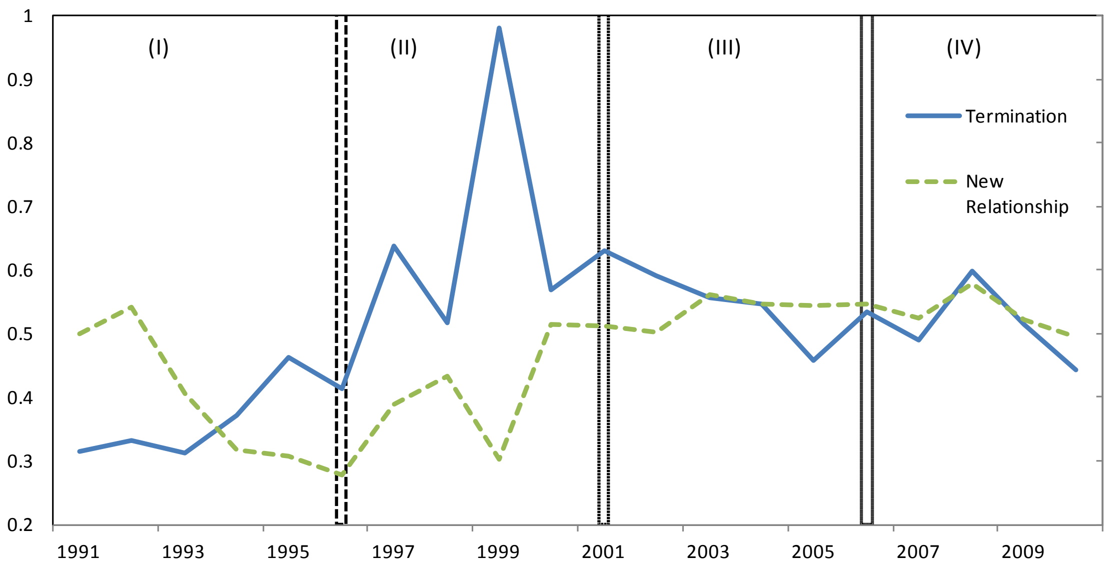
1. We conducted the instrumental variable estimation of Arellano and Bond (1991), based on the dynamic panel specification with firm fixed effects to estimate firm outcome equation (1) including firm investments in a firm outcome variable $y_{i,t}$.
2. We used the lagged values of the firm covariates ($\text{Firm}_{i,t-k}$, $k = 2, ..., 4$), the outcome variable ($y_{i,t-k}$, $k = 2, ..., 4$), and the termination variable ($\text{CUT}_{i,t-k}$, $k = 2, ..., 4$) as instrumental variables.
3. Parameter estimates are obtained by using also the bank leverage ratio ($\text{WLEV}_{\text{i,t}-1}$) and bank exposure to the real estate industry in 1989 ($\text{WEXP}_{\text{i,t}-1}{}^{\text{Estate}}$) as instruments.
4. Other independent variables are included in our estimation but not reported in the table.
5. *, **, and *** indicate 10%, 5%, and 1% levels of significance, respectively.

**Figure 1: Bank Loans and Private Investment**



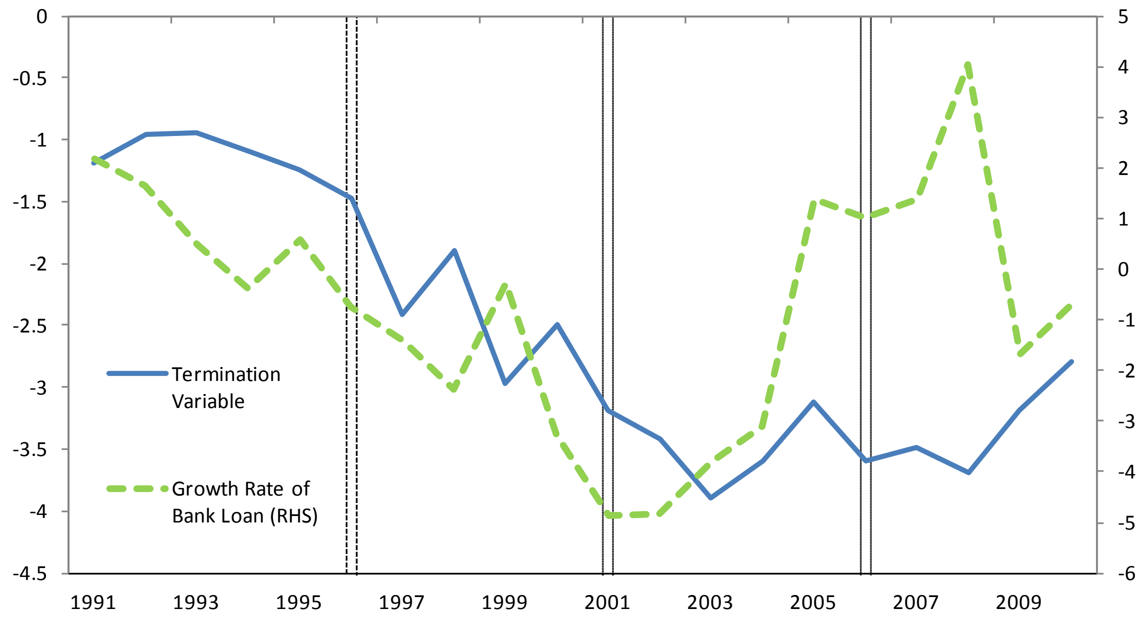

1. The net flow of bank loans is the amount of bank loans that flow from private banks to non-financial private firms from the Flow of Funds.
2. Private Investment is the gross nominal value of private domestic investment in GDP.
3. A dotted vertical line indicates the starting year of each subsample period.

**Figure 2: The Number of New Relationships and Termination**




1. New Relation and Termination indicate sample averages that are calculated period-by-period using the numbers of new relationships and terminations, and are normalized by the number of listed firms.
2. A dotted vertical line indicates the starting year of each subsample period.

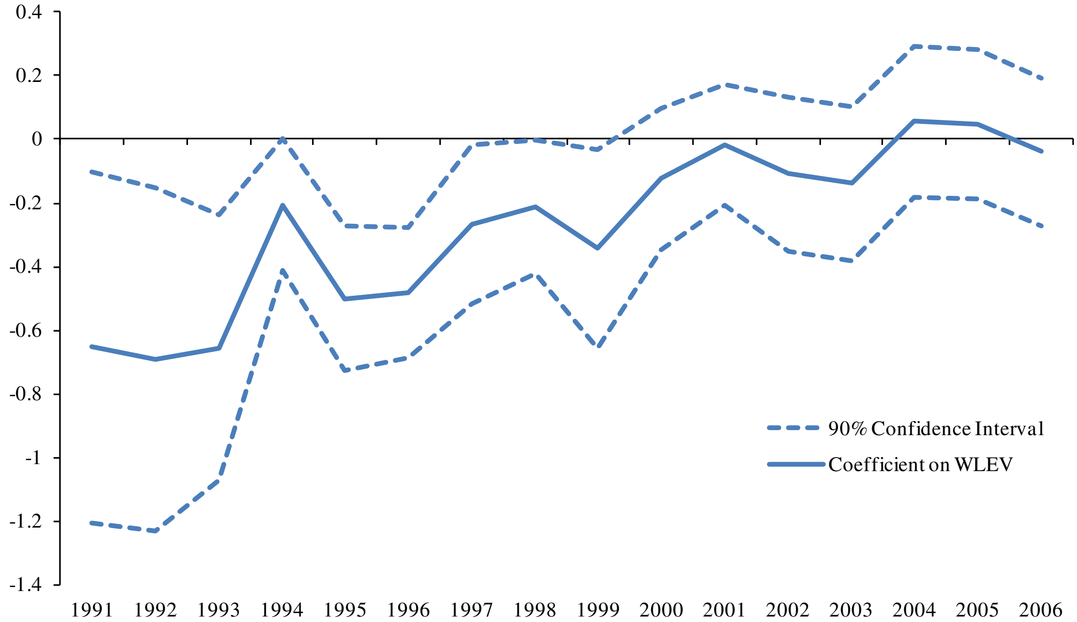
**Figure 3: Termination Variable and the Growth Rate of Bank Loans**



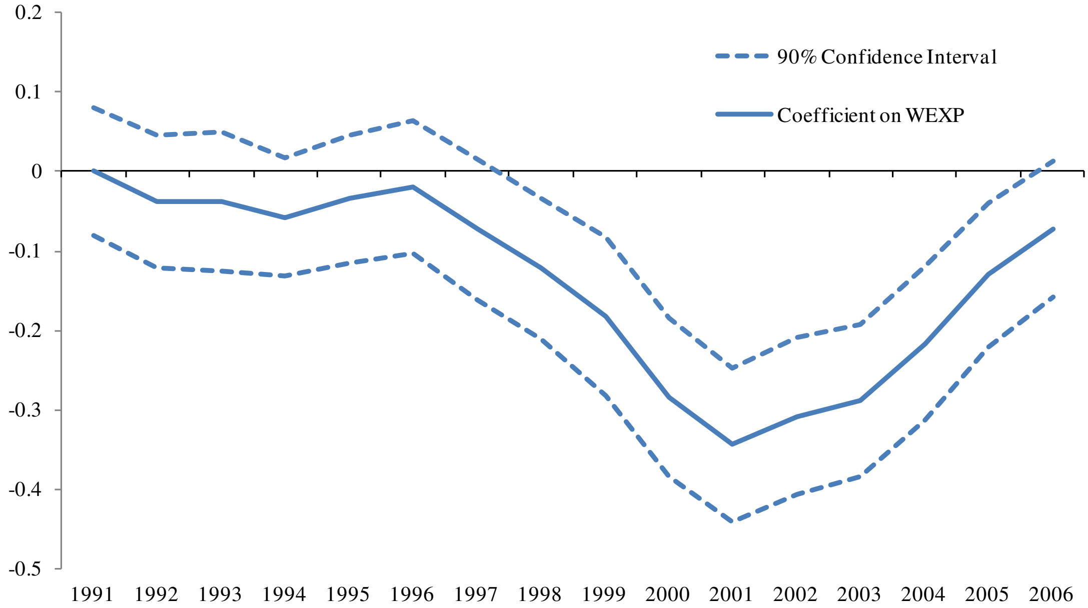

1. The historical path of the termination variable plots a sample average of the termination variable calculated at each period.
2. The bank-loan growth rate is calculated as the chage rate of outstanding amount of bank loans from the Bank of Japan bank-lending survey and is shown in percentage terms.
3. A dotted vertical line indicates a starting year of each subsample period.

**Figure 4: Estimated Coefficients on the Instruments in Rolling Window Estimations**

**WLEV**

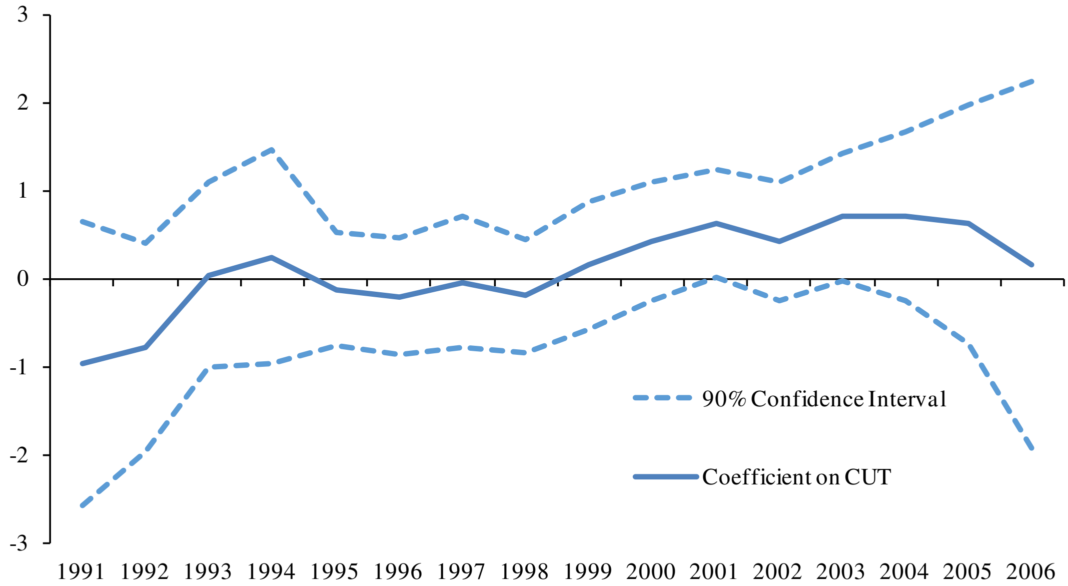



**$WEXP^{Estate}$**




1. The solid lines indicate the point estimates of the coefficients on the book leverage ratio (top) and the weighted exposure to the real estate industry (bottom) of banks, based on the 5-year rolling window estimation in the first stage regression.
2. The X-axis indicates a starting year of each subsample period: A plot in year t shows an estimate based on the subsample period from year t through t+4.

**Figure 5: Estimated Coefficient on the Termination Variable in Rolling Window Estimations**




1. The solid line indicates a point estimate of the coefficient on the termination variable, CUT, based on the 5-year rolling window estimation.
2. The parameters are estimated by using the two instrumental variables with a pooled sample.
3. The X-axis indicates a starting year of each subsample period: A plot in year t shows an estimate based on the subsample period from year t through t+4.