Inter-firm Relationships and Leverage Adjustment*

Kazuo Yamada**

Ritsumeikan University

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** College of Business Administration, Ritsumeikan University. 1-1-1 Noji Higashi, Kusatsu, Shiga 525-8577, JAPAN, E-mail: k-yamada@fc.ritsumei.ac.jp, (+81) 77-561-4801

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Abstract

This paper investigates the impact of inter-firm relationships on a firm's incentive to adjust its capital structure. We predict that firms with tight business relationships with other firms have less incentive to adjust their capital structure because their information would be propagated through the inter-firm relationships and they could seek assistance when they had a problem with liquidity. We use multiple measurements of inter-firm relationships in the Japanese economy, such as industry group (*keiretsu*) membership, president's council (*shacho-kai*) membership, and cross-shareholding. Using three measurements of the inter-firm relationships, we find that the firms that have tight relationships with others have higher financial leverage both in terms of book and market leverage. Furthermore, we estimate the adjustment speed of capital structure by dynamic panel estimations and find that the adjustment speed of firms with tight relationships is slower than that of those without such relationships. Lastly, we explore whether the adjustment speed increased after Japan's financial market was deregulated. The speed increased after the series of deregulations of the stock market. These results are consistent with our prediction that inter-firm relationships affect a firm's incentive to adjust its capital structure.

Keywords: Capital structure; Speed of adjustment; Firm network
JEL Classification: G32

1. Introduction

Capital structure has been the central topic in corporate finance studies for more than a half century, since the seminal work of Modigliani and Miller (1958). Throughout the history of capital structure research, static specification has been mainly used in empirical research. However, the weak explanatory power of such static specification is recently pointed out (for example, by Rajan and Zingales, 1995; Lemmon, Roberts, and Zender, 2008), and there have been a growing number of attempts to use dynamic panel models. These previous studies using dynamic models have reported a relatively slow adjustment speed.[1]

In most empirical studies, the firm's fundamental characteristics are used as explanatory variables. These are selected on the basis of the traditional theoretical literature, such as asymmetric information between the firm and its investors (Myers and Majluf, 1984), default costs (Miller, 1977), and agency problems (Jensen, 1986). However, as Lemmon, Roberts, and Zender (2008) argue, other unknown factors affect the determination of the firm's capital structure. They use a panel dataset and compare the explanatory power of various estimations and show that the explanatory power increases dramatically when using the fixed-effect panel estimates compared to when using pooled ordinary least squares (OLS), and argue that there are still unknown factors that affect the firm's capital structure. Then, what are the unknown factors?

One of the possible unknown factors would be the firm's relationships with others. If the information regarding the firm's quality propagates directly through a bank-to-firm relationship or indirectly through an inter-firm relationship, the firm's availability of the funds will increase, and then the firm will have less incentive to adjust its capital structure. Based on this idea, some researchers have investigated whether country specific factors, such as the development of the financial market or style of the legal system, affect the firm's adjustment speed (Antonios, Yilmaz, and Krishna, 2009; Oztekin and Fleinery, 2012). Antonios, Yilmaz, and Krishna (2009) compare the adjustment speed of the capital structure and find the adjustment speed of the firms in banking oriented countries to be slower. Oztekin and Fleinery (2012) use an international dataset and reveal that the institutional characteristics of the country affect the adjustment speed of the capital structure of the firms belonging to that country. However, such literature using international datasets relies on

[1] In the United States, the speed of adjustment to the target ratio is only 20 to 25% (Fama and French, 2002; Huang and Ritter, 2008; Lemmon, Roberts and Zender, 2008).

between country comparisons and estimates that would suffer from the unobservable country-fixed effect. Then, using a single country dataset and comparison *within* the country would be required.

Recent literature on corporate finance emphasizes the importance of inter-firm relationships with respect to the firm's fundraising choice (Johnson, Kang, Masulis, and Yi, 2011). For example, Johnson, Kang, Masulis, and Yi (2011) argue that the features of the supplier–customer relationship affect the fundraising choice. They view seasoned equity offers (SEOs) as providing negative information about a firm or its market and find that when firms issue SEOs, their customers' stock prices react negatively. They interpret the negative reactions as indicative of concerns about the supplier and the market in which the firm's customer sells. Furthermore, Itzkowitz (2012) reveals that the supplier–customer relationship affects the suppliers' cash holdings.[2]

Based on these arguments, it would be possible to say that the firm's information would propagate through the inter-firm relationship. A firm with tight relationships with others has less incentive to adjust its capital structure. Thus, we predict that firms with tight relationships can access external financing more easily than firms that have fewer relationships and higher financial leverage and a lower adjustment speed of their capital structure.

Furthermore, we predict that if the firm has a tight relationship with another firm, it will have incentive to collect the data of the other firm, and the information of the firm would propagate through the relationships among the firms. In the field of network theory, it is thought that the information of the agent propagates through the network (Jackson, 2009; Cohen, L, and Frazzini. 2008; Hertzel, Li, Officer, and Rodgers, 2008; Huck, Lunser, and Tyran, 2010). We use the degree of cross-shareholding as a measurement of inter-firm relationships.

In the context of this research, the Japanese dataset has several merits. First, two types of firms exist in Japan: firms belonging to the business group and those that do not. This setting enables us to investigate the effect of inter-firm relationships on decision makers around capital structure using a single country dataset. This approach can avoid injecting unobservable country specific factors that can arise in studies that employ

[2] Other streams of the literature investigate the interaction between the characteristics of products and the fundraising characteristics (e.g., Titman, 1984; Banerjee, Dasgupta, and Kim, 2008). Titman (1984) argues that firms that produce unique products have less debt. Furthermore, Banerjee, Dasgupta, and Kim (2008) reveal that the characteristics of the suppliers' products also affect the firm's financial behavior.

multi-country datasets. As shown by Hoshi, Kashyap, and Sherfstein (1991), the bank–firm relationship of *keiretsu* firms is different from that of independent firms.

The second merit of using the Japanese dataset is that we can use a relatively long-period dataset that includes the deregulations of the financial market. The dataset used in this research covers more than 30 years (from 1978 to 2010). Furthermore, in this period, as we will explain, several deregulations were introduced in the Japanese financial market, especially in the late 1990s. Excluding the United States, it would be rare to observe such a long-period dataset. Furthermore, the deregulations in the 1990s enable us to investigate the impact of structural changes on the capital structure decision. Recent literature argues the impact of the deregulations in the financial market on the firm's behavior. For example, Ekkayokkaya and Pengniti (2012) use Thailand dataset and reveal that the reform in the IPO pricing changes the price formation of IPO stock.

Some features of the Japanese economic system, such as *keiretsu* and *mochiai*, are recognized as sources of the rapid growth in the Japanese economy through the 1970s and 1980s. In this system, the firms in the *keiretsu* can access external financial sources with less friction. In the Japanese economy, it is well known that firms in industry groups can access external financing more easily (Hoshi, Kashyap, and Sherfstein, 1991). However, not every company belongs to the *keiretsu*, and the behavior of the *keiretsu* and independent firms are different.[3] Hence, the Japanese dataset enables us to investigate whether having a tight relationship affects the firm's incentive to adjust its capital structure to the target ratio using single country dataset. Moreover, it is known that Japanese banks help firms even though they are unproductive (Peek and Rosengren, 2005; Caballero, Hoshi, nd Kashyap, 2008).

Furthermore, Japanese firms have traditionally owned equity in each other. Such cross-shareholding is known as *mochiai*. If a firm has another firm's equity, it has an incentive to collect information about the firm. Conversely, this information propagates through the firms that own equity in that firm. Thus, the information of the firm with a high degree of cross-shareholding would propagate rapidly.

Overall, those above characteristics enable us to address the following question: Does a relationship with a bank or other firms affect the adjustment speed of the capital structure? In the period of the examined dataset, the Japanese economy shifted from a bank-oriented system to an equity-market-oriented system. As argued by

[3] According to Titman, Wei, and Xie (2009), the investment-stock return sensitivity of *keiretsu* firms differed during the period. They show that the uniqueness of the *keiretsu* diminished in the late 1990s.

Antonios, Yilmaz, and Krishna (2009) and Oztekin and Fleinery (2012), institutional characteristics affect the adjustment speed of the capital structure when an international dataset is used. This paper investigates the impact of institutional characteristics on the capital structure choice using a single country dataset.

We investigate the impact of the deregulations on the capital structure choice. In the late 1990s, Japan experienced numerous changes in its financial and economic systems, the collapse of the *keiretsu*, and the deregulation of the financial market, and these changes enable us to determine whether institutional change affects the adjustment speed of the firm's capital structure. Japan suffered a long-term recession after the land price bubble burst. According to Nitta (2008), the degree of cross-shareholding declined in the early 2000s.

We use the following three measurements of the inter-firm relationships: (i) *keiretsu* (Japanese industry group) membership, (ii) *shacho-kai* (presidents' council) membership, and (iii) degree of cross-shareholding. The *keiretsu* has been regarded as a central feature of the Japanese economy. We hypothesize that the information of the firms in the *keiretsu* would spread through the business group. Then a firm in the *keiretsu* can raise funds as the need arises and have less incentive to adjust its capital structure quickly. We identify whether each firm is a member of the six largest banks' central *keiretsu* group and make a dummy variable that takes the value of one if the firm is a member of the *keiretsu*. Second, we use a *shacho-kai* dummy. The *shacho-kai* (presidential council) is a meeting held by the CEOs of the representative firms in the *keiretsu* group. The six largest banking-oriented firms in the *keiretsu* group have their own *shacho-kai*, and the members are thought of as core members in the *keiretsu.* Third, the degree of *mochiai* is used as a proxy of the inter-firm network. We obtain the dataset from NIES, which collected the Japanese cross-shareholding dataset. We divide the sample on the basis of whether the firms are in the top (bottom) one quartile every year and regard them as a high-*mochiai* (low-*mochiai*) subsample.

The empirical results are as follows. First, we compare whether the leverage of firms with tight business relationships with other firms is higher than those with fewer business relationships. Based on the specification by Rajan and Zingales (1995) and using the firm fixed-effect model, we find that firms with tight relationships with others have a higher capital structure. This indicates that firms in the *keiretsu* group, core members of the *keiretsu* (or members of the *shacho-kai*), with high cross-shareholding with other firms highly depend on debt-type fund raising. These results are the same as those of simple previous studies, such as Gul

(1999) and Hirota (1999), reporting that the *keiretsu* firms tend to have higher financial leverage than the *non-keiretsu* firms.

Next, we investigate whether inter-firm relationships affect the adjustment speed of the firm's capital structure. Overall, the evidence indicates that a firm with tight relationships with others slowly adjusts its capital structure. As dynamic panel estimates, we use the least squared dummy variable corrected (LSDVC), and the system generalized method of moments (GMM) by Blundell and Bond (1998). In most of the estimations, the interaction term between the lagged leverage and the dummy variable of the inter-firm relationships are statistically significant. The results do not change, even though we use the book leverage and market leverage as a definition of the firm's leverage.

This paper makes several contributions to the fields of capital structure and finance. First, this paper reveals the impact of the institutional characteristics on the adjustment speed of capital structure using a single country dataset. Estimating the speed of adjustment of capital structure has been the central topic in the study of capital structure. Recent studies investigate whether the firm's incentive affects its speed for adjusting its capital structure to the optimal level.[4] Our empirical results indicate that firms with tight relationships with others have slow adjustment speeds.

Second, this is the first paper to reveal that the structural change of inter-firm relationships enhances the speed of adjustment of the firm's capital structure. International datasets reveal that a firm's speed for adjusting its capital structure is caused by the institutional features of the country to which the firm belongs. Oztekin and Flannery (2012) find evidence that the adjustment speed of banking oriented countries is slower than that of stock market-oriented countries. This study employs the dataset of Japan, where the power of banks has reduced and the equity market has developed. Thus, our findings support the argument that the adjustment speeds of Japanese firms have increased, reflecting the development of the equity market.

Third, this paper contributes to the growing body of literature about the role of networks in an economy. Recent studies reveal that networks or relationships affect the decision making of the firm. Jackson (2009) reviews network theory and its theoretical argument in game theory, as well as the empirical work in

[4] For example, Faulkender, Flannery, Hankins, and Smith (2012) reveal that firms with enough cash flow have less incentive to adjust their capital structure, since their default risk is low. Oztekin and Flannery (2012) reveal that the country's characteristics affect the adjustment speed of the firm's capital structure.

sociology, economics, and other fields. Although we do not use the network measurement proposed in graph theory, our research reveals the importance of the inter-firm relationships in the corporate finance research.

The rest of this paper is organized as follows. In section 2, we briefly review the literature on the adjustment speed of capital structure and overview the characteristics of the Japanese economy, especially concerning the *keiretsu* and *mochiai*, and then discuss the deregulation of the Japanese IPO market during the 1990s. Next, in section 3, we provide the frameworks of the empirical methodology used in the subsequent sections. The definitions of the key variables and the summary statistics are shown in section 4. We report the results of the regressions inspired by Rajan and Zingales (1995) and the dynamic panel estimations in section 5. Lastly, section 6 concludes this paper.

2. Background

2.1 Japanese economic system and the role of business groups

Before the 1990s, Japan experienced rapid growth, and the original Japanese economic system is thought to have been a source of that growth. Especially, the *mochiai* and the *keiretsu* systems were credited for having produced the rapid growth in the Japanese economy up to the 1980s (Hoshi, Kashyap, and Sherfstein, 1990, 1991; Aoki, Patrick, and Sheard, 1994; Kaplan and Minton, 1994; Kang and Shivdasani, 1997).

The cross-shareholding system is one of the characteristics of the Japanese economy (La Porta, López de Silanes, and Shleifer, 1999). In that system, firms in the same industry group (*keiretsu* network) own each other's shares to maintain the relationship. This can be regarded as a proxy for the closeness of one firm to another.

Hoshi, Kashyap, and Sherfstein (1990) provide evidence that is consistent with an efficient rationale for group as well as main bank lending to distressed firms. Hoshi, Kashyap, and Sherfstein (1991) show that firms with a strong firm–bank relationship can access external financing easily. They conclude that such strong relationships decrease information asymmetry between the firms and the banks, which reduces the cost of capital. Aoki, Patrick, and Sheard (1994) find that firms affiliated with a *keiretsu* are more efficiently monitored by the main bank.

However, after the corruption of the land price bubble in the late 1980s, Japan experienced a long recession. To stimulate the economy, various deregulations were introduced.[5] In the same period, the cross-shareholding system collapsed. According to Nitta (2008), the degree of cross-holding declined after 2000, which we also observe in our dataset.

2.2 Definitions of the three proxies of inter-firm relationships

We use the following three measurements as the proxies of inter-firm relationships.

2.2.1 *Keiretsu* (Industry group)

Keiretsu, or the Japanese industry group, is considered to be one source of the rapid growth of the Japanese economy up to the 1990s. Following the work of Hoshi, Kashyap, and Sherfstein (1990, 1991), we identify the *keiretsu* member firms from *Kigyou Keiretsu Soran*, which were published annually by *Toyo-Keizai Publishings* until 2000. This reports the names of the *keiretsu* member firms. We obtain the data for only 1980 and 1990, and we collect the names of the firms belonging to the six largest banks' central *keiretsu*.

2.2.2 *Shacho-kai* (President's council)

As a proxy of the firm's bank relationship, we identify *shacho-kai* (president's council) membership. In Japan, the central firms in the industrial group (*keiretsu*) conduct meetings every month. The six largest banks' *keiretsu* groups have their own president's council. The members of this council are regarded as the core group members and have a close relationship with the main bank. Accordingly, it is expected that the firms in the *shacho-kai* will have a tight relationship with their main bank and have less incentive to adjust their market-based financing. We use various issues of *Kigyo Keiretsu Soran* to identify the members of the *shacho-kai*. In our sample, 169 firms are members of the *shacho-kai*.

2.2.3 *Mochiai* (Cross-shareholding)

Cross-shareholding is defined as the condition that exists when two public companies own each other's stock. We apply the cross-shareholding database obtained from Nihon Life Insurance Research Institutes (NLRIs) that reports the percentage of cross-shareholding between firms between 1989 and 2008. This dataset

[5] The details of the process, especially about the banking system, are summarized in Hoshi and Kashyap (2010). Furthermore, the deregulations in the financial markets can be summarized as follows: stock purchase was widely used after 2001 (Kato, Lemmon, Luo, and Schallheim, 2005), the banks and investment banks merged after 1999 (Suzuki and Yamada, 2012), and the number of IPOs increased after the mid-1990s.

defines cross-shareholding as two firms that hold each other's shares, reported using both public information and interviews to gather the shareholdings.

3. Empirical frameworks

The dynamic panel model used to test for the adjustment speed of a firm's target debt ratio can be summarized in the following two estimations. We assume that a firm's target ratio is determined by the firm's fixed effect and characteristics.

$$L_{\mathrm{it}} - L_{it-1} = \rho(TL_{it} - L_{it-1}) + \epsilon_{it}\ , \tag{1}$$

and

$$TL_{it} = \alpha_i + \beta X_{it-1}\ , \tag{2}$$

where L_{it} is the leverage ratio of firm *i* at the end of year *t*. TL_{it} is the target leverage ratio of firm *i* at the end of year *t*. X_{it-1} contains a vector of the lagged characteristics of firm *i* to control the change of leverage, macro variables, and year dummies. Furthermore, α shows the firm fixed effects, and ρ indicates the speed of the adjustment. If firms perfectly adjust their capital structure to their target ratio, then ρ equals 1.

We cannot observe the target leverage (*TL*). Therefore, we must rely on a reduced form specification:

$$L_{it} = \rho\ \alpha_i + (1-\rho)L_{it-1} + (\rho\beta)X_{it-1} + \epsilon_{it}\ . \tag{3}$$

Furthermore, to examine whether there exists a difference between the two subsamples, we conduct the following estimation. First, ρ is separated into $\rho = \rho_i + d\rho_d$. The binary variable d takes the value of one if the firm has tight relationships with other firms (e.g., *keiretsu* membership, *shacho-kai* membership, high degree of cross-shareholdings). Then the adjustment speed of such firms with tight relationships is $\rho_{\mathrm{i}} + \rho_d$ and the speed of others is ρ_{i}.

Then estimation (3) can be rewritten as follows:

$$L_{it} = \rho\ \alpha_i + \left(1-\rho_{\mathrm{i}}\right)L_{it-1} - d\rho_d L_{it-1} + ((\rho_{\mathrm{i}} - d\rho_d)\beta)\ X_{it-1} + \epsilon_{it}\ . \tag{4}$$

Our purpose is to investigate whether the coefficient of L_{it-1} is statistically different from zero. The coefficient of L_{it-1} is $-d\rho_d$ indicates that the adjustment speed of this subsample is higher when the coefficient takes a negative value.

Estimations (3) and (4) are known as a dynamic panel model because the lagged dependent variable, L_{it-1}, is used as an explanatory variable. In our dataset, we use at max 34-year data. It is well known that a dynamic panel model with a short time period leads to biased estimates when using simple OLS or fixed-effect OLS estimates. To avoid the bias, we use two procedures. The first one is the two-stage system generalized method of moments introduced by Blundell and Bond (1998) (BB-GMM). This is the modified version of Arellano and Bond's difference GMM. The second one is the bias-corrected least squares dummy variable approach, LSDVC (least squared dummy variable correction).

There has been argument over the appropriate procedure to use for the dynamic panel estimation. Judson and Owen (1999) report that the LSDVC exhibits less biased estimates when using simulation in a short-period panel dataset. However, in their simulated model, they use balanced panel data and only one explanatory variable. Flannery and Hankins (2013) also report that the LSDVC is the best procedure in a balanced panel dataset. Furthermore, they extent the model in two ways: (1) by simulating the unbalanced panel data and (2) by producing multiple explanatory variables. The authors argue that these two extensions would be more preferable in corporate finance research, since most of the datasets used in this field are unbalanced and most of the estimates in the field use multiple explanatory variables. Their simulations indicate that both the LSDVC and BB-GMM show less biased estimates. The assumption in the LSDVC is that all explanatory variables are exogenous. Furthermore, the weakness of the BB-GMM is that it reports biased estimates when there exists second-order serial correlation. According to Flannery and Hankins' (2013) Monte Carlo simulation, the bias with an endogenous independent variable is small when using the LSDVC. However, the bias of the BB-GMM using the second order correlation is not large.

As a definition of leverage (L), we use both the book and market leverage. We define the book leverage ratio of firm *i* in year *t* as follows.

$$Book\ leverage_{it} = \frac{DLTT_{it}+DLC_{it}}{TA_{it}}, \quad (5)$$

where *DLTT* is the amount of long-term debt exceeding maturity of one year and *DLC* is debt in current liabilities, including long-term debt due within one year.[6] *TA* indicates the total assets. We define the market leverage ratio of firm *i* in year *t* as

[6] The book leverage ratio is similarly defined within most recent capital structure papers (e.g., Lemmon, Roberts, and

$$Market\ leverage_{it} = \frac{DLTT_{it}+DLC_{it}}{DLTT_{it}+DLC_{it}+CSHO_{it}\times PRC_{it}}, \quad (6)$$

where PRC is the fiscal year-end common share price and *CSHO* is the fiscal year-end number of shares outstanding.

For X_{it-1}, the following variables are used: return on assets (*ROA*), Tobin's Q ratio (*Tobin's Q*), natural logarithm of total assets (ln(*Assets*)), depreciation assets divided by total assets (*Dep. Assets*), tangible assets divided by total assets (*Tan. Assets*), mean financial leverage in the industry (*Ind. Leverage*), capital expenditure (*Capital Expenditure*), corporate tax rate (*Taxes*), and growth rate of the GDP (*Growth GDP*).[7]

4. Definition and summary statistics of the four inter-firm variables

4.1 Sample selections and source of datasets

Financial and stock price data are obtained from NEEDs Financial Quest and Portfolio Master, provided by Nikkei Media Marketing. The NEEDs Financial Quest dataset covers the firm-level financial dataset after 1970 and the Portfolio Master database covers the firm-level stock price data after 1978. Therefore, our dataset consists of the listed firms from 1978 to 2010. Utilities (Nikkei industry codes 67 and 69) and financial firms (Nikkei industry codes 47, 48, 49, and 51) are excluded because they were regulated during most of the sample period. All nominal values are converted into yen values at year 2011, using the CPI index from the Statistic Bureau of the Ministry of Internal Affairs and Communications.

4.2 Summary statistics

Table 1 presents the summary statistics of the main variables per year. The left column reports the number of listed firms. The number of IPOs increased gradually. Columns 2 to 5 report the mean and median of the two leverage measurements. The book leverage decreased gradually. The leverage ratio in 1997 was 76.2% (mean) and dropped to 50% in 2010. The market leverage also decreased. Furthermore, we can see that the market leverage is negatively correlated with the stock market conditions. The mean of market leverage dropped to 32.8% in 1990, before Japan's land price bubble burst. The market leverage increased after the bubble burst; in fact, it increased to 56.8% in 1998, when Japanese banks suffered a liquidity shortage.

Zender, 2008; Graham and Leary, 2010; Leary and Roberts, 2005; Lemmon and Zender, 2010).

[7] Most literature uses the R&D to assets ratio as an explanatory variable. However, there was no requirement to report R&D costs before 1998 in Japan. Therefore, we cannot use it in our estimations.

The number of listed *keiretsu* firms varies over time due to the IPOs, delisting, and merger activities. Approximately 33.2% (478/1,438) of the listed firms were members of *keiretsu* in 1977, and the ratio declined to 11.3% (416/3,669) in 2010.

Columns 7 to 9 report the summary statistics of the degree of cross-shareholding. Due to data limitations, the variable is covered between 1989 and 2008 and coverage of the firms is below the total number of listed firms (reported in column 1). We can see that the degree of cross-shareholding dissolved. In 1989, the mean degree of cross-shareholding was 13.69%, indicating that, on average, about 14% of the shares in a firm are held by another firm where the firms has the share. However in 2007, it declined to 7.76%, or about one half of that in 1989.

Table 2 reports the difference of the book leverage and absolute change in leverage by the subsample divided by the degree of the inter-firm relationships. Panel A of Table 2 reports the subsample mean (median) of leverage. We divide the sample by the degree of cross-shareholding and *keiretsu* membership. In the upper two rows, we divide the sample by the degree of cross-shareholding for each year. The subsample *high cross-shareholding* consists of the firm whose degree of cross-shareholding is greater than 75% each year, and the subsample *low cross-shareholding* consists of the firms whose degree of cross-shareholding is less than 25% each year. The mean book leverage (60.6%) of the *high cross-shareholding* subsample is higher than that of the *low cross-shareholding* subsample and the difference is statistically different from zero.

In the lower two columns, we report the mean and median leverages of the *keiretsu* and *non-keiretsu* member subsamples. The result is almost the same for both the *high* and *low cross-shareholding* subsamples. The leverage of the *keiretsu* firms is higher than that of the *non-keiretsu* firms, and the difference is statistically significant.

Panel B of Table 2 reports the subsample mean of the absolute value of the change in leverage, defined as the absolute value of the difference between leverage at the end of the year and leverage at the beginning of the year. The definitions of the subsamples are the same as those used in Panel A. From the result in the upper two rows, we find that the absolute change of the *high cross-shareholding* subsample (2.8%) is lower than that in the *low cross-shareholding* subsample (4.7%) and statistically significant. The lower two rows report the absolute change of the two subsamples (*keiretsu member* and *non-keiretsu member*). The absolute change of

the *keiretsu* subsample (3.6%) is lower than that in the *non-keiretsu* subsample (6.0%) and statistically significant.

Overall, these results show that the firms with tight relationships have higher financial leverage and less fluctuation of the leverage than the firms with weaker relationships. Thus, it can be interpreted that the firms with higher inter-firm relationships have higher financial leverage and less movement in financial leverage.

Figure 1 shows the distribution of leverages at period *t* and period *t–1* for the *high cross-shareholding subsample* firms and others. The band is tight in the *high cross-shareholding* subsample. This indicates that firms in the *high cross-shareholding* subsample change their debt leverage slower.

The definitions of the variables are as follows. *ROA* is defined as the ratio of the operating profit divided by total assets at the beginning of the period. *Tobin's Q* is defined as the ratio of the sum of the market capitalization and the book value of debt divided by total assets. ln(*Assets*) is the natural logarithm of total assets. *Dep. Assets* is defined as depreciating assets divided by total assets. *Tan. Assets* is defined as tangible assets divided by total assets. *Capital Expenditure* is defined as capital expenditure divided by total assets. *Ind. Leverage* is the median financial leverage in the same industry/year to which that firm belongs. *Tax* is the statutory corporate tax rate during year *t*. To control the macro factor, *Growth_GDP*, defined as the real GDP growth in the year *t*, is used.

The descriptive statistics of the explanatory variables are shown in Table 3.

5. Empirical Results

5.1 Rajan and Zingales type regressions

Before exploring the adjustment speed of the capital structure, we report the Rajan and Zingales (1995) type regression in Table 4. The simple comparison by Gul (1999) and Hirota (1999) reports that the financial leverage of *keiretsu* firms is higher than that of the independent firms. Using the estimating procedure by Rajan and Zingales (1995), we investigate the comparison of the financial leverage.

The dependent variables are book leverage in columns 1 to 4 and market leverage in columns 5 to 8. To calculate the standard errors, two-way clustering (firm and year) is used (Petersen, 2009).[8] The dependent

[8] This is not strictly a replication of Rajan and Zingales' (1995) model, since they use the simple cross-section procedure for the estimations.

variable is the book leverage of the firm, and the independent variables are tangible assets divided by total assets, Tobin's Q ratio, the natural logarithm of sales, and ROA that is defined as the net profit divided by total assets. Column 1 of Table 4 reports the result using the estimate model used by Rajan and Zingales (1995). The explanatory power of the model is low (Adjusted R^2 = 11.2%), indicating that the model has little power to explain the firm's capital structure. The coefficient of tangible assets is positive and statistically significant at the 1% level. This indicates that the firm's composition of assets affects its capital structure. The coefficient of Tobin's Q is positive, but statistically insignificant. This is different from the results of Rajan and Zingales, who obtained a negative and statistically significant coefficient.

In columns 2 to 4, in addition to the four explanatory variables used by Rajan and Zingales (1995), we add three proxy variables of the inter-firm relationships. We predict that the firms with tight relationship with others have higher financial leverage. The results are almost consistent with the prediction. In column 2, we add *Keiretsu* dummy, which takes the value of one if the firm belongs to one of the six largest *keiretsu* and the coefficient of the variable is positive and statistically significant. The estimate of the coefficient is 0.054, indicating that the financial leverage of *keiretsu* firms is 5.4% higher than that of *non-keiretsu* firms. In column 3, we add the *Mochiai Share* variable, which is the percentile value of the degree of cross-shareholdings. The estimate coefficient is positive (0.001) and statistically significant at the 5% level. Lastly, we add the *Shacho-kai* dummy variable that takes the value of one if the firm is a member of a president's council. The estimate coefficient is positive and statistically significant at the 1% level. The estimate of the *Shacho-kai* dummy is 8.4% and higher than that of the *Keiretsu* dummy, 5.4%. This result indicates that the core members of the *shacho-kai* have higher financial leverage than the members of the *keiretsu.*

We use market leverage instead of book leverage and estimate the same models with columns 1 to 4. The results are reported in columns 5 to 8. The result is almost the same as that obtained with the book leverage as a dependent variable. The coefficients of the *Keiretsu* and *Shacho-kai* dummy variables are statistically significant at the 1% level, indicating that a member of the *keiretsu* or the *shacho-kai* has higher financial leverage than other firms. However, the estimate of the coefficient of *Mochiai Share* is not statistically significant here.

The estimates of the control variables when using market leverage as a dependent variable are almost the same as those when using book leverage. However, the estimate of *Tobin's Q* is negative, which is consistent

with the results of Rajan and Zingales (1995) in all estimations, and statistically significant in column 7, where *Mochiai Share* is used as a proxy variable of the inter-firm relationships.

5.2 Estimating adjustment speed

We estimate the adjustment speed of capital structure for the entire sample using both the LSDVC and BB-GMM estimates. Book leverage is used as a dependent variable in Panel A and market leverage is used in Panel B. For each Panel, the LSDVC is used in columns 1 to 3 and the BB-GMM is used in columns 4 to 6. The three measurements of inter-firm relationships are used. For each panel, the *Keiretsu* dummy is used in columns 1 and 4, the *Shacho-kai* dummy in columns 2 and 5, and the *High-* and *Low-Mochiai* dummy variables in columns 3 and 6.

Panel A of Table 5 reports the adjustment speed of capital structure using book leverage as a measurement of financial leverage. Overall, we find that the adjustment speed of the firms with tight relationships is slower than that of the firms with weaker relationships. Using *keiretsu* as a measurement of the firm relationship (column 1), the adjustment speed of the *keiretsu* firms is 5.1% slower than the independent firms (*non-keiretsu* subsample) when LSDVC is used. The coefficient of the variable *Leverage* * *Keiretsu* is +0.051 and statistically significant at the 1% level (*t*-statistics = 4.82). Notice that in equation (4), the coefficient of the variable $d\rho_d L_{it-1}$ is negative; then a positive coefficient indicates that the effect of the interaction term is averse and negative. Moreover, ρ = 0.22 (= 1 − 0.780), indicating that the adjustment speed of the *non-keiretsu* firms is 22% per year. Then the adjustment speed of the *keiretsu* subsample is 16.9% (22% − 5.1%). However, we cannot find the difference when using the BB-GMM in column 4. The coefficients of the *Leverage* * *Keiretsu* are close to zero (−0.0002 or −0.02%) and not statistically significant (*t*-statistics = −0.06).

Next, we use *shacho-kai* membership as a measurement of inter-firm relationships. When using the LSDVC (column 2), we find that the adjustment speed of a *shacho-kai* member is 1% slower (coefficient of *Leverage* * *Shacho-kai* is 0.010), but the difference is not statistically significant (*t*-statistics = 0.69). We can find the difference when using BB-GMM. In column 5, the estimated coefficient is 0.017 and statistically significant (*t*-statistics = 3.13).

Lastly, we use the degree of the *mochiai* (cross-shareholding) as a measurement of inter-firm relationships. The number of observations declines from 74,839 to 43,383 due to the data restrictions: we can use the data

concerning the cross-shareholdings between 1989 and 2008. The sample is divided by the degree of the cross-shareholding. For each year, we divide the sample by the degree of cross-shareholding. The firms in the top quartile are defined as the high-cross-shareholdings subsample.

The result shown in column 3, the interaction term *Leverage * High Cross-shareholdings* is +0.013 and is statistically significant at the 1% level (*t*-statistics = 4.01), indicates that the adjustment speed of the high-cross-shareholdings subsample is 1.3% slower than other firms when using the LSDVC procedures. Furthermore, the difference is still observed when using the BB-GMM (column 6). The difference is 2.7% and statistically significant (*t*-statistics = 5.08).

In Panel B, we report the results when market leverage is used as the dependent variable. In most of the estimations, we find that the firms with tight relationships with others have a slower adjustment speed. In five of the six estimations, the interaction term between the proxy variable of inter-firm relationships and the lagged leverage is positive and statistically significant.

Overall, the above results indicate that the firms with tight relationships with a bank or other firms have less incentive to adjust their capital structure.

5.3 Impact of deregulations on adjustment speed

The second purpose of this research is to investigate the impact of the deregulation of the financial market on the firm's adjustment speed. We predict that the deregulation reduces the firm's cost of adjusting its capital structure and then increases the adjustment speed. Table 6 reports the results of the following equation that is the modified version of equation (4).

$$L_{it} = \rho\,\alpha_i + \left(1 - \rho_{i_i}\right)L_{it-1} - Dummy\ After\ 2000 \times \rho_d L_{it-1} + ((\rho_i - Dummy\ After\ 2000 \times \rho_d)\beta)\,X_{it-1} + \epsilon_{it}, \quad (4)'$$

where $Dummy\ After\ 2000$, which takes the value of one if the firm-year is after 2000, is used instead of d in equation (4). In Panel A, the *Keiretsu* dummy is used as a proxy of the firm relationship. We report the results of using book leverage as a dependent variable. In columns 1 and 2, the LSDVC is used. Column 1 reports the *keiretsu* firms subsample. The interaction term between the lagged dependent variable and *Dummy After 2000* is negative (−0.035) and statistically significant at the 1% level (*t*-statistics = −7.54). We can find that the *non-keiretsu* firms also increase their adjustment speed. The estimated coefficient of the interaction term is −0.048

and statistically significant at the 1% level (*t*-statistics = −13.75). In the estimations with the LSDVC, the *keiretsu* firms seem to decrease their adjustment speed than the *non-keiretsu* firms. However, it is the reverse when using the BB-GMM. Columns 3 and 4 report the results using the BB-GMM. The acceleration of the adjustment speed of the *keiretsu* firms (4.9%) is faster than that of the *non-keiretsu* firms (3.3%)

The results are very similar when the sample is divided by the *shacho-kai* dummy. The interaction term is still negative and statistically significant. However, ρ in column 3 is −0.008 (= 1 − 1.008), indicating that the firms in the *shacho-kai* moves their capital structure against their target ratio. One reason for this may be the inconsistency due to the small number of observations. In our period, only 4,583 firms are considered to have *shacho-kai* membership. However, other subsample estimations do not appear to suffer due to the small number of observations, and these estimations show results that are consistent with our prediction. We believe that the inconsistency in Panel B does not lead to any significant problems in our study.

Lastly, we estimate the subsample analysis divided by the degree of cross-shareholding. The interaction term between the lagged leverage and *Dummy After 2000* is negative and statistically significant at the 1% level. Overall, these results indicate that deregulation of the financial market stimulated the firm's incentive to adjust its capital structure. On average, in our estimations, firms increase their adjustment speed by 3–4% per year.

5.4 Robustness check: characteristics of the firms

As shown in Table 3, the fundamentals of the *keiretsu* and *non-keiretsu* firms are different. Therefore, it is possible that unobservable characteristics affect the firm's adjustment speed, even after controlling for firm characteristics as vector X_{it-1} in equation (2). In Table 7, we restrict the sample in numerous ways and control for these characteristics.

First, we restrict the sample to only listed firms on the first and second sections of the Tokyo Stock Exchange (TSE). It would be plausible to state that small firms make the difference between those firms with tight relationships and those with fewer relationships. Furthermore, the difference in size may account for the difference in the adjustment speed. Of course, we control for firm size by including the natural logarithm of the total assets on vector X_{it-1}. To further control for the size of the firm, we restrict the sample to those firms

that are listed on the stock exchanges in Japan with the highest listing requirements. Several stock exchanges exist in Japan, and the listing requirements of the TSE are higher than those of the other exchanges.

Panel A of Table 7 reports the result. The estimation model is equation (4). Three measurements of the inter-firm relationship are used, as are both the LSDVC and BB-GMM. In five of the six estimations, the interaction term between the lagged leverage and inter-firm relationship measurement is positive and statistically significant at at least the 5% level. The entire sample estimation in Table 5 is not statistically significant, as shown in column 2, where *shacho-kai* is used as a proxy of inter-firm relationships and LSDVC is used. However, in this time, the interaction term is statistically significant at the 1% level. Column 4, where the *keiretsu* dummy variable is used as a proxy of inter-firm relationships and the BB-GMM is used, reports statistical insignificance.

Next, we exclude IPO firms. Brav (2009) argues that the capital structure of unlisted firms is different from that of listed firms. Thus, it would be reasonable to state that a firm's adjustment behavior right after an IPO is different from that of a firm that is already listed. Then, as a second robustness check, we exclude the firm year within five years after IPO.

The results are shown in Panel B of Table 7. We exclude the firm year for those within five years after IPO. The same as the results in Panel A, the estimate coefficient of the interaction term in column 4 is negative and statistically insignificant. However, in other estimates, the estimate coefficients of the interaction term are positive and statistically significant at at least the 5% level, which is consistent with the predictions.

Overall, the results indicate that firms with tight relationships slowly adjust their capital structure, even though excluding the short-live firms or IPOs.

6. Conclusion

We estimate the adjustment speed of the capital structure using the Japanese long-term panel dataset for 1978 to 2011. According to previous papers, a country's institutional setting, such as whether the system is banking oriented, affects the adjustment speed of the capital structure. However, our work is novel in that we used a single country dataset. We use three measurements of inter-firm relationships: the *keiretsu* (industry group membership) firm dummy variable, *shacho-kai* (president's council) member dummy variable, and high cross-shareholdings dummy variable. Furthermore, to conduct our dynamic panel estimation, we use both the

LSDVC and BB-GMM approaches. We find strong evidence that the firms with tight relationships adjust their capital structure slowly, and we obtain evidence of this in both the market-valued and book-valued leverage measures.

The evidence is robust when we divide the sample by the degree of the inter-firm network and show that the adjustment speed of the firms with a high degree of cross-shareholding leads to a slower adjustment speed. Further, the result is robust when the interaction term approach is used.

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TABLE 1

Summary Statistics of the Leverage and Firm Relationship Measurement

This table reports the number of firms and the summary statistics of the leverage ratio and various measurements of inter-firm networks. Due to the data restriction, we can use the cross-shareholding dataset between 1989 and 2008.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		Book leverage		Market leverage		keiretsu	Degree of cross-shareholding		
year	n. of firms	mean	median	mean	median	n. of firms	n. of firms	mean (%)	median (%)
1977	1438	0.764	0.802	0.659	0.699	478			
1978	1481	0.754	0.793	0.622	0.652	493			
1979	1517	0.742	0.783	0.585	0.614	496			
1980	1566	0.739	0.780	0.611	0.641	503			
1981	1572	0.727	0.766	0.608	0.636	501			
1982	1680	0.713	0.756	0.590	0.636	504			
1983	1726	0.701	0.741	0.548	0.598	512			
1984	1746	0.705	0.740	0.514	0.554	515			
1985	1768	0.698	0.724	0.492	0.508	518			
1986	1841	0.682	0.705	0.444	0.451	517			
1987	1979	0.678	0.701	0.424	0.430	511			
1988	1968	0.670	0.687	0.369	0.361	489			
1989	2032	0.654	0.670	0.342	0.331	486	1429	13.69	12.72
1990	2260	0.637	0.652	0.328	0.318	536	1489	13.68	12.67
1991	2433	0.630	0.645	0.371	0.369	544	1656	14.06	12.92
1992	2515	0.622	0.642	0.449	0.459	542	1809	14.22	13.25
1993	2566	0.617	0.636	0.464	0.480	548	1866	14.44	13.51
1994	2677	0.605	0.621	0.432	0.438	552	1921	14.21	13.29
1995	2802	0.603	0.618	0.466	0.484	549	1953	14.22	13.41
1996	2996	0.599	0.611	0.442	0.451	558	2025	13.94	13.14
1997	3120	0.593	0.602	0.508	0.533	561	2069	13.72	12.95
1998	3230	0.590	0.601	0.567	0.612	560	2128	13.33	12.55
1999	3281	0.580	0.590	0.561	0.616	547	2161	12.57	11.69
2000	3372	0.571	0.582	0.555	0.616	544	2219	11.95	10.86
2001	3499	0.573	0.588	0.571	0.633	535	2341	11.17	9.73
2002	3582	0.559	0.574	0.576	0.635	523	2407	10.60	8.80
2003	3618	0.553	0.569	0.582	0.637	501	2428	9.61	7.81
2004	3663	0.540	0.556	0.491	0.521	478	2455	9.21	7.29
2005	3763	0.527	0.537	0.447	0.460	469	2552	8.31	6.22
2006	3846	0.517	0.526	0.408	0.412	463	2613	8.02	5.55
2007	3927	0.518	0.530	0.454	0.466	454	2701	7.79	5.18
2008	3889	0.513	0.523	0.525	0.559	441	2690	7.76	5.08
2009	3789	0.511	0.517	0.566	0.618	432			
2010	3669	0.502	0.508	0.527	0.564	416			
Average	2670.9	0.598	0.618	0.500	0.519		2145.6	11.45	10.04

TABLE 2

Comparison of Leverages Between Subsamples

This table reports the subsample mean and median of the book leverage. The sample is divided by the degree of cross-shareholding and *keiretsu* membership. *High (Low) cross-shareholdings* consist of the firms above the 75th percentile (lower than the 25th percentile) for each year. The *t*-statistics of the mean test for the subsample are reported. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. *Keiretsu member* consists of the firms that belong to the *keiretsu* (Japanese business group).

	Panel A				Panel B			
	Book leverage				Absolute change in leverage			
	Obs.	Mean	Median	t-value	Obs.	Mean	Median	t-value
High cross-shareholding	11424	0.606	0.623	15.41***	10973	0.028	0.019	-26.58***
Low cross-shareholding	10665	0.555	0.567		10665	0.047	0.025	
Keiretsu member	17135	0.692	0.720	64.89***		0.036	0.018	-5.82***
Non-keiretsu member	68687	0.574	0.588			0.060	0.022	

TABLE 3

Descriptive Statistics of Explanatory Variables

This table reports the summary statistics of the variables used in the subsequent estimations. *ROA* is defined as the ratio of the operating profit divided by the total assets at the beginning of the period. *Tobin's Q* is defined as the ratio of the sum of the market capitalization and the book value of debt divided by total assets. ln(*Assets*) is the natural logarithm of total assets. *Dep. Assets* is defined as depreciating assets divided by total assets. *Tan. Assets* is defined as tangible assets divided by total assets. *Capital Expenditure* is defined as capital expenditure divided by total assets. *Ind. Leverage* is the median financial leverage in the same industry/year to which that firm belongs. *Tax* is the statutory corporate tax rate during year t. *Growth_GDP* is the GDP growth during year *t* and is used to control the macro factor. The number of observations of the entire sample is 78,210; the number of observations in the *keiretsu* subsample is 15,866; and the number of observations in the *non-keiretsu* subsample is 74,839. *** indicates significance at the 1% level.

	Entire sample					Keiretsu	Non-keiretsu		
	Mean	St. Dev	25%	Median	75%	Mean	Mean	*t*-statistics	
ROA	0.05	0.06	0.02	0.04	0.08	0.051	0.043	16.51	***
Tobin's Q	1.29	0.69	0.93	1.11	1.42	1.295	1.287	1.26	
ln(Assets)	10.38	1.42	9.42	10.29	11.23	10.384	11.525	-89.83	***
Dep. Assets	0.18	0.12	0.08	0.16	0.25	0.179	0.189	-9.15	***
Tan. Assets	0.28	0.17	0.16	0.26	0.39	0.284	0.272	8.13	***
Ind. Leverage	0.01	0.03	-0.01	0.00	0.02	0.007	0.004	9.70	***
Capital Expenditure	0.60	0.11	0.52	0.59	0.66	0.596	0.647	-50.91	***
Taxes	0.38	0.54	0.26	0.43	0.53	0.376	0.394	-3.62	***
Growth GDP	0.01	0.03	0.00	0.02	0.03	0.014	0.020	-27.43	***

TABLE 4
Rajan and Zingales (1995) Type Regression

This table reports Rajan and Zingales' (1995) estimation. *Keiretsu Dummy* takes the value of one if the firm belongs to one of the six largest banking oriented business groups. *Mochiai Share* is the ratio of cross-shareholdings divided by the total shares outstanding. *Shacho-kai Dummy* is the variable that takes the value of one if the firm is a member of the president's council. The *t*-values using the two-way cluster method shown by Petersen (2009) are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	Book leverage				Market leverage			
	RZ (1995)				RZ (1995)			
Keiretsu dummy		0.054***				0.035***		
		(7.32)				(5.02)		
Shacho-kai dummy			0.084***				0.058***	
			(6.26)				(4.93)	
Mochiai share				0.001**				0.000
				(2.02)				(1.48)
Tan. Assets	0.287***	0.292***	0.286***	0.318***	0.280***	0.283***	0.279***	0.298***
	(16.86)	(17.41)	(16.71)	(15.88)	(11.76)	(12.01)	(11.63)	(10.53)
Tobin's Q	0.001	0.001	0.001	0.014***	-0.005	-0.005	-0.005	-0.016***
	(0.73)	(0.69)	(0.62)	(5.17)	(-1.13)	(-1.14)	(-1.14)	(-2.85)
ln(Sales)	0.018***	0.013***	0.013***	0.019***	0.017***	0.014***	0.013***	0.017***
	(8.26)	(6.05)	(5.64)	(7.26)	(8.90)	(7.13)	(6.73)	(7.42)
ROA	-0.400**	-0.386**	-0.392**	-0.819***	-0.763***	-0.748***	-0.750***	-0.818***
	(-2.48)	(-2.47)	(-2.48)	(-5.66)	(-10.10)	(-9.99)	(-9.92)	(-8.26)
Constant	0.018	0.051**	0.066***	-0.027	0.022	0.043**	0.055***	0.004
	(0.91)	(2.50)	(3.04)	(-1.17)	(1.12)	(2.13)	(2.58)	(0.20)
Number of observations	81,482	81,482	81,482	45,954	81,824	81,824	81,824	46,039
Adj R-sq	0.112	0.122	0.120	0.152	0.162	0.167	0.167	0.197

TABLE 5

Impact of the Degree of the Network Measurement on the Speed of Adjustment

This table reports the impact of the inter-firm network on the adjustment speed. The specification is

$$L_{it} = \rho\,\alpha_i + (1-\rho_i)L_{it-1} - d\rho_d L_{it-1} + ((\rho_i - d\rho_d)\beta)\,X_{it-1} + \epsilon_{it}\,.$$

Book leverage is used as a dependent variable in Panel A, and market leverage in Panel B. For each Panel, the LSDVC is used in columns 1 to 3 and the BB-GMM is used in columns 4 to 6. The three measurements of inter-firm relationships are used. For each panel, the *keiretsu* dummy is used in columns 1 and 4, the *shacho-kai* dummy is used in columns 2 and 5, and the *high*- and *low-Mochiai* dummies are used in columns 3 and 6. The last row reports the adjustment speed of the capital structure. *ROA* is defined as the ratio of the operating profit divided by total assets at the beginning of the period. *Tobin's Q* is defined as the ratio of the sum of market capitalization and the book value of debt divided by total assets. ln(*Assets*) is the natural logarithm of the total assets. *Dep. Assets* is defined as depreciating assets divided by total assets. *Tan. Assets* is defined as tangible assets divided by total assets. *Capital Expenditure* is defined as capital expenditure divided by total assets. *Ind. Leverage* is the median financial leverage in the same industry/year to which that firm belongs. *Tax* is the statutory corporate tax rate in year *t*. *Growth_GDP* is the GDP growth during year *t* and is used to control the macro factor. The adjustment R-squared in the LSDVC is when the OLS with the firm level fixed effect is used. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A Book leverage is used as a dependent variable

Book leverage	(1) Keiretsu LSDVC		(2) Shacho-kai LSDVC		(3) Mochiai LSDVC		(4) Keiretsu BB-GMM		(5) Shacho-kai BB-GMM		(6) Mochiai BB-GMM	
	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value
Leverage (1- ρ)	0.780	152.37 ***	0.791	153.98 ***	0.860	110.23 ***	0.943	150.98 ***	0.932	0.01 ***	0.921	86.81 ***
Leverage * Keiretsu	0.051	4.82 ***					0.000	-0.06				
Leverage * Shacho-kai			0.010	0.69					0.017	3.13 ***		
Leverage * High cross-shareholdings					0.013	4.01 ***					0.027	5.08 ***
ROA	-0.123	-10.60 ***	-0.115	0.69 ***	-0.142	-10.60 ***	0.054	5.71 ***	0.009	0.66	-0.012	-0.64
Tobin's Q	0.005	6.03 ***	0.005	-11.97 ***	0.006	6.99 ***	0.018	20.92 ***	0.004	4.50 ***	0.007	5.34 ***
ln(Assets)	0.013	8.82 ***	0.014	7.34 ***	0.014	9.88 ***	0.002	7.44 ***	0.001	3.29 ***	0.000	1.56
Dep. Assets	-0.007	-0.55	-0.012	11.95	-0.012	-1.01	-0.030	-5.04 ***	-0.007	-1.15	-0.011	-1.42
Tan. Assets	-0.004	-0.47	0.001	-1.17	-0.004	-0.47	0.026	5.39 ***	0.015	3.03 ***	0.013	1.90 *
Capital Expenditure	0.172	13.14 ***	0.167	0.17 ***	0.169	12.04 ***	0.090	8.19 ***	0.068	6.20 ***	0.082	5.99 ***
Ind. Leverage	0.073	7.18 ***	0.056	15.61 ***	0.104	12.81 ***	0.018	4.22 ***	0.046	7.05 ***	0.052	5.87 ***
Tax	0.003	4.09 ***	0.003	6.81 ***	0.002	3.80 ***	0.004	7.39 ***	0.003	5.99 ***	0.003	3.98 ***
Growth_GDP	-0.126	-7.28 ***	-0.135	4.69 ***	-0.426	-21.43 ***	-0.148	-11.25 ***	-0.128	-10.96 ***	-0.303	-15.39 ***
Number of observations	74839		74839		43383		74839		74839		43383	
Ajd-R2	0.6512		0.6509		0.6085							
Wald-test							83126.91		42710.88		18777.87	
AB-test for AR(1) (*p* -val.)							0.000		0.000		0.000	
AB-test for AR(2) (*p* -val.)							0.613		0.621		0.731	
Sargan test (*p* -val.)							0.000		0.000		0.000	

Panel B Market leverage is used as a dependent variable

Market leverage	(1) Keiretsu LSDVC		(2) Shacho-kai LSDVC		(3) Mochiai LSDVC		(4) Keiretsu BB-GMM		(5) Shacho-kai BB-GMM		(6) Mochiai BB-GMM	
	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value
Leverage (1- ρ)	0.782	154.54 ***	0.845	78.50 ***	0.789	154.45 ***	0.945	147.13 ***	0.932	66.62 ***	0.921	86.81 ***
Leverage * Keiretsu	0.048	2.72 ***					-0.002	-0.50				
Leverage * Shacho-kai			0.023	6.85 ***					0.027	5.08 ***		
Leverage * High cross-shareholdings					0.042	1.84 *					0.017	3.13 ***
ROA	0.048	2.72 ***	-0.165	-12.10 ***	-0.056	-3.50 ***	0.054	5.71 ***	-0.012	-0.64	0.009	0.66
Tobin's Q	-0.057	2.72 ***	0.013	11.98 ***	0.008	6.65 ***	0.018	21.02 ***	0.007	5.34 ***	0.004	4.50 ***
ln(Assets)	0.008	-2.90 ***	0.019	12.89 ***	0.020	10.36 ***	0.002	7.77 ***	0.000	1.56	0.001	3.29 ***
Dep. Assets	0.020	5.40 ***	-0.029	-2.28 **	-0.020	-1.16	-0.030	-4.95 ***	-0.011	-1.42	-0.007	-1.15
Tan. Assets	-0.021	8.43	-0.012	-1.24	0.002	0.19	0.025	5.22 ***	0.013	1.90 *	0.015	3.03 ***
Capital Expenditure	0.003	-1.01	0.205	13.47 ***	0.180	10.04 ***	0.089	8.23 ***	0.082	5.99 ***	0.068	6.20 ***
Ind. Leverage	0.180	0.19 ***	0.002	0.22	-0.002	-0.15	0.017	4.29 ***	0.052	5.87 ***	0.046	7.05 ***
Tax	-0.003	8.24	0.003	4.39 ***	0.003	3.25 ***	0.004	7.43 ***	0.003	3.98 ***	0.003	5.99 ***
Growth_GDP	0.003	-0.14 ***	-0.557	-23.13 ***	-0.175	-7.43 ***	-0.149	-11.30 ***	-0.303	-15.39 ***	-0.128	-10.96 ***
Number of observations	74839		74839		43383		74839		74839		43383	
Ajd-R2	0.6512		0.6509		0.6085							
Wald-test							83126.91		42710.88		18777.87	
AB-test for AR(1) (*p* -val.)							0.000		0.000		0.000	
AB-test for AR(2) (*p* -val.)							0.000		0.000		0.126	
Sargan test (*p* -val.)							0.000		0.000		0.000	

TABLE 6
Impact of the Deregulations in the late 1990s

This table reports the impact of the inter-firm network on the adjustment speed. The specification is

$$L_{it} = \rho\,\alpha_i + (1-\rho_i)L_{it-1} - DummyAfter2000 \times \rho_d L_{it-1} + ((\rho_i - DummyAfter2000 \times \rho_d)\beta)\,X_{it-1} + \epsilon_{it}\,,$$

where *d* is a dummy variable that takes the value of one if the firm-year is after 2000, and zero otherwise. Book leverage is used as a dependent variable. The adjustment R-squared in the LSDVC is when the OLS with the firm-level fixed effect is used. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A Keiretsu dummy is used as a proxy of the firm-relationship measurement

Book leverage	(1) Keiretsu LSDVC		(2) Non-keiretsu LSDVC		(3) Keiretsu BB-GMM		(4) Non-keiretsu BB-GMM	
	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value
Leverage (1- ρ)	0.894	71.99 ***	0.874	187.89 ***	0.996	92.97 ***	0.968	154.50 ***
Leverage * Dummy after 2000	-0.035	-7.54 ***	-0.048	-13.75 ***	-0.049	-9.93 ***	-0.033	-7.63 ***
ROA	-0.140	-7.65 ***	-0.082	-8.51 ***	0.040	1.50	0.042	3.51 ***
Tobin's Q	0.004	2.66 ***	0.002	3.92 ***	0.003	1.77 *	0.002	2.12 **
ln(Assets)	0.009	4.30 ***	0.010	8.43 ***	0.002	4.44 ***	0.001	3.10 ***
Dep. Assets	-0.032	-1.70 *	-0.036	-2.91 ***	-0.042	-3.15 ***	-0.021	-3.12 ***
Tan. Assets	0.007	0.45	0.040	4.57 ***	0.029	2.83 ***	0.018	3.40 ***
Capital Expenditure	0.201	11.89 ***	0.144	13.24 ***	0.093	3.99 ***	0.057	4.48 ***
Ind. Leverage	0.045	4.76 ***	0.002	0.19	0.002	0.27	0.011	2.25 **
Tax	0.002	2.16 **	0.002	2.29 **	0.003	3.44 ***	0.003	4.31 ***
Growth_GDP	-0.237	-8.03 ***	-0.061	-3.58 ***	-0.304	-13.12 ***	-0.108	-8.03 ***
Number of Observations	15866		58973		15866		58973	
Ajd-R2								
AB-test for AR(1) (*p* -val.)					0.000		0.000	
AB-test for AR(2) (*p* -val.)					0.804		0.368	
Sargan test (*p* -val.)					0.000		0.000	

Panel B Shacho-kai dummy is used as a proxy of firm relationship measurement

Book leverage	(1) Shacho-kai LSDVC		(2) Non shacho-kai LSDVC		(3) Shacho-kai BB-GMM		(4) Non shacho-kai BB-GMM	
	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value
Leverage (1- ρ)	0.880	19.10 ***	0.876	177.43 ***	1.008	57.50 ***	0.973	170.59 ***
Leverage * Dummy after 2000	-0.041	-3.55 ***	-0.045	-11.31 ***	-0.047	-6.92 ***	-0.036	-9.32 ***
ROA	-0.060	-1.20	-0.091	-9.42 ***	0.105	2.36 **	0.042	3.71 ***
Tobin's Q	0.002	0.60	0.003	3.75 ***	0.004	1.03	0.002	2.34 **
ln(Assets)	0.019	2.86 ***	0.010	7.92 ***	0.002	3.41 ***	0.001	3.90 ***
Dep. Assets	-0.071	-1.65	-0.032	-3.18 ***	-0.060	-2.42 **	-0.022	-3.58 ***
Tan. Assets	-0.006	-0.18	0.035	5.05 ***	0.031	1.53	0.019	3.83 ***
Capital Expenditure	0.185	4.70 ***	0.152	17.03 ***	0.069	2.02 **	0.062	5.37 ***
Ind. Leverage	0.020	0.82	0.010	1.27	-0.002	-0.12	0.008	1.89 *
Tax	0.003	1.39	0.002	3.00 ***	0.004	3.40 ***	0.003	4.75 ***
Growth_GDP	-0.326	-6.55 ***	-0.084	-6.22 ***	-0.335	-9.14 ***	-0.135	-10.92 ***
Number of Observations	4583		70256		4583		70256	
Ajd-R2								
AB-test for AR(1) (*p* -val.)					0.000		0.000	
AB-test for AR(2) (*p* -val.)					0.765		0.447	
Sargan test (*p* -val.)					0.000		0.000	

Panel C Cross-shareholdings is used as a proxy of firm relationship

Book leverage	(1) High Crossshare. LSDVC		(2) Low Crossshare. LSDVC		(3) High Crossshare. BB-GMM		(4) Low Crossshare. BB-GMM	
	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value
Leverage (1- ρ)	0.866	22.63 ***	0.826	82.30 ***	0.987	65.43 ***	0.969	112.64 ***
Leverage * Dummy after 2000	-0.039	-4.53 ***	-0.042	-9.58 ***	-0.046	-6.97 ***	-0.036	-7.16 ***
ROA	-0.209	-6.10 ***	-0.130	-6.63 ***	-0.043	-1.52	0.021	1.13
Tobin's Q	0.009	3.89 ***	0.003	2.18 **	0.006	3.26 ***	0.005	2.96 ***
ln(Assets)	0.008	1.59	0.012	4.67 ***	0.001	2.16 **	0.000	0.64
Dep. Assets	-0.046	-1.74 *	-0.027	-1.58	-0.048	-4.00 ***	-0.017	-1.70 *
Tan. Assets	0.031	1.63	0.033	3.15 ***	0.040	4.10 ***	0.014	1.76 *
Capital Expenditure	0.139	6.21 ***	0.166	10.97 ***	0.050	1.76 *	0.075	4.51 ***
Ind. Leverage	0.043	1.86 *	0.067	4.33 ***	0.018	1.64	0.031	4.61 ***
Tax	0.002	1.55	0.001	0.93	0.002	2.54 **	0.002	2.23 **
Growth_GDP	-0.276	-6.66 ***	-0.328	-11.28 ***	-0.266	-9.10 ***	-0.309	-13.05 ***
Number of Observations	11608		31775		11608		31775	
Ajd-R2								
AB-test for AR(1) (*p* -val.)					0.000		0.000	
AB-test for AR(2) (*p* -val.)					0.217		0.289	
Sargan test (*p* -val.)					0.000		0.000	

TABLE 7

Robustness Estimations

This table reports the impact of the inter-firm network on the adjustment speed. The specification is the same as that used in Table 5. Panel A restricts the firm-year listed on the Tokyo Stock Exchange (TSE) and Panel B excludes the firm-year 5 years after IPO. Book leverage is used as a dependent variable. The adjustment R-squared in the LSDVC is when the OLS with the firm-level fixed effect is used. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A Estimations with TSE listed firms

	(1)		(2)		(3)		(4)		(5)		(6)	
Book leverage	Keiretsu		Shacho-kai		Mochiai		Keiretsu		Shacho-kai		Mochiai	
	LSDVC		LSDVC		LSDVC		BB-GMM		BB-GMM		BB-GMM	
	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value
Leverage (1- ρ)	0.800	146.52 ***	0.807	141.67 ***	0.801	127.47 ***	0.926	77.04 ***	0.923	80.33 ***	0.930	68.21 ***
Leverage * Keiretsu	0.034	2.59 ***					-0.002	-0.31				
Leverage * Shacho-kai			0.038	2.19 **					0.016	2.72 ***		
Leverage * High cross-shareholdings					0.013	3.15 ***					0.029	5.04 ***
ROA	-0.154	-8.64 ***	-0.151	-12.65 ***	-0.192	-13.34 ***	-0.029	-1.91 *	-0.028	-1.84 *	-0.048	-2.45 **
Tobin's Q	0.005	4.08 ***	0.005	5.91 ***	0.007	6.40 ***	0.005	4.51 ***	0.005	4.45 ***	0.007	5.45 ***
ln(Assets)	0.014	5.57 ***	0.014	8.49 ***	0.022	9.33 ***	0.002	6.96 ***	0.001	4.91 ***	0.001	3.32 ***
Dep. Assets	-0.006	-0.31	-0.007	-0.55	-0.030	-2.06 **	-0.007	-0.86	-0.008	-0.99	-0.013	-1.45
Tan. Assets	-0.007	-0.45	-0.005	-0.49	0.007	0.73	0.017	2.57 **	0.017	2.61 ***	0.015	1.96 *
Capital Expenditure	0.191	9.77 ***	0.188	13.75 ***	0.172	12.36 ***	0.084	6.65 ***	0.084	6.74 ***	0.089	6.18 ***
Ind. Leverage	0.077	5.52 ***	0.073	8.16 ***	0.116	9.94 ***	0.052	7.04 ***	0.050	6.76 ***	0.054	5.94 ***
Tax	0.003	2.36 **	0.003	3.31 ***	0.002	3.83 ***	0.003	5.36 ***	0.003	5.37 ***	0.003	3.83 ***
Growth_GDP	-0.148	-5.79 ***	-0.152	-8.59 ***	-0.386	-17.99 ***	-0.147	-11.31 ***	-0.148	-11.41 ***	-0.292	-14.22 ***
Number of Observations	49401		49401		34094		49401		49401		34094	
Ajd-R2												
AB-test for AR(1) (*p* -val.)							0.000		0.000		0.000	
AB-test for AR(2) (*p* -val.)							0.351		0.351		0.000	
Sargan test (*p* -val.)							0.000		0.000		0.000	

Panel B Excluding IPO firms

Book leverage	(1) Keiretsu LSDVC		(2) Shacho-kai LSDVC		(3) Mochiai LSDVC		(4) Keiretsu BB-GMM		(5) Shacho-kai BB-GMM		(6) Mochiai BB-GMM	
	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value
Leverage (1- ρ)	0.780	265.15 ***	0.787	208.98 ***	0.824	105.90 ***	0.940	81.15 ***	0.940	83.80 ***	0.949	76.00 ***
Leverage * Keiretsu	0.043	7.34 ***					-0.004	-0.62				
Leverage * Shacho-kai			0.037	2.16 **					0.014	2.28 **		
Leverage * High cross-shareholdings					0.008	2.40 **					0.026	4.85 ***
ROA	-0.157	-20.88 ***	-0.153	-13.03 ***	-0.170	-12.62 ***	0.017	1.17	0.020	1.35	-0.007	-0.32
Tobin's Q	0.003	5.83 ***	0.004	3.02 ***	0.006	6.08 ***	0.004	3.66 ***	0.004	3.58 ***	0.008	5.10 ***
ln(Assets)	0.015	17.54 ***	0.015	11.38 ***	0.021	11.66 ***	0.001	4.70 ***	0.001	3.36 ***	0.001	2.25 **
Dep. Assets	0.004	0.57	0.002	0.14	-0.021	-1.71 *	-0.003	-0.50	-0.005	-0.68	-0.015	-1.87 *
Tan. Assets	-0.007	-1.45	-0.005	-0.60	0.005	0.59	0.010	1.87 *	0.010	1.91 *	0.012	1.79 *
Capital Expenditure	0.166	19.83 ***	0.164	12.13 ***	0.169	14.30 ***	0.056	4.79 ***	0.056	4.78 ***	0.081	5.79 ***
Ind. Leverage	0.110	22.20 ***	0.104	11.66 ***	0.091	8.54 ***	0.048	7.12 ***	0.046	6.68 ***	0.043	5.47 ***
Tax	0.003	6.07 ***	0.003	4.30 ***	0.002	3.73 ***	0.003	5.99 ***	0.003	5.99 ***	0.003	4.70 ***
Growth_GDP	-0.131	-11.49 ***	-0.138	-8.25 ***	-0.422	-18.44 ***	-0.125	-10.09 ***	-0.125	-10.12 ***	-0.324	-15.82 ***
Number of Observations	61767		61767		39704		61767		61767		39704	
Ajd-R2												
AB-test for AR(1) (*p* -val.)							0.000		0.000		0.000	
AB-test for AR(2) (*p* -val.)							0.944		0.941		0.649	
Sargan test (*p* -val.)							0.000		0.000		0.000	

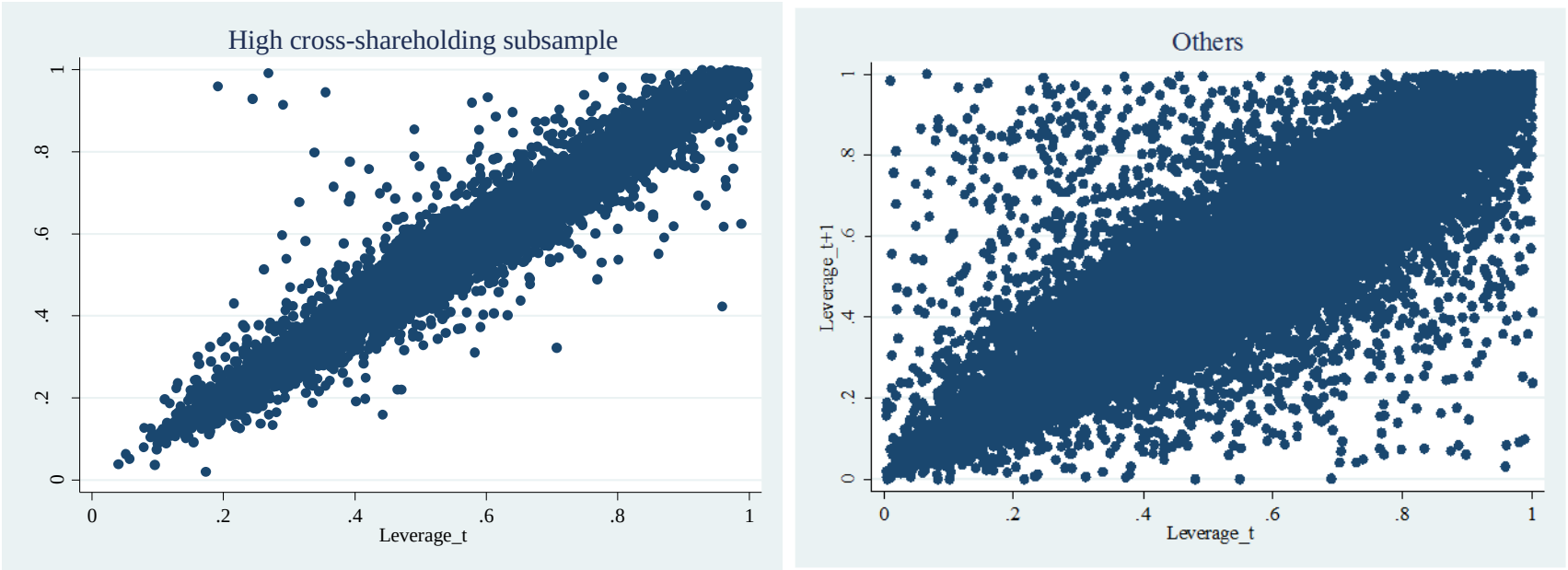

Fig. 1: Distribution of the leverage and one-year lagged leverage

This figure plots the lagged financial leverage and the financial leverage. The sample is divided by the degree of cross-shareholding.