The Journal of Real Estate Finance and Economics
https://doi.org/10.1007/s11146-021-09874-w

The Revival of Business Groups' Risk Sharing: Evidence from Japanese Real Estate Investment Trust Market

Masaki Mori[1] · **Seow Eng Ong**[2] · **Joseph T. L. Ooi**[2]

Accepted: 12 October 2021

Abstract

We examine the business groups' risk-sharing hypothesis in the Japanese Real Estate Investment Trust (REIT) market in which the unique external management system seems to be reinforcing power relationships among firms affiliated with the modern Japanese business groups, called keiretsu. We find that REITs whose sponsors belong to one of the keiretsu groups (keiretsu REITs) have significantly lower volatility of profitability than REITs whose sponsors do not belong to the keiretsu groups (non-keiretsu REITs). There is no significant difference in profitability between keiretsu REITs and non-keiretsu REITs, controlling for firm and property characteristics. The abnormal portion of the profitability unexplained by firm characteristics is also significantly lower with keiretsu REITs. We also find that the keiretsu affiliation reduces the systematic volatility of affiliated REITs, while such an effect is not observed with the idiosyncratic volatility, suggesting that the risk-sharing effect may be beneficial for the value of REITs. Using the difference-in-differences design with propensity score matching, we find that the negative impact of the Great East Japan Earthquake on the profitability was significantly smaller with keiretsu REITs than with non-keiretsu REITs. Keiretsu REITs were also able to stabilize their capital structure by shifting some short-term debts to long-term debts without increasing the cost of loans under the uncertain situation caused by the Earthquake. Keiretsu REITs were able to borrow money from their affiliated group banks even right after the earthquake, while non-keiretsu REITs seem to have struggled to secure loans from those banks.

✉ Masaki Mori
masaki.mori@ehl.ch

Seow Eng Ong
BIZONGSE@NUS.EDU.SG

Joseph T. L. Ooi
joseph.ooi@nus.edu.sg

[1] Ecole hôtelière de Lausanne, HES-SO University of Applied Sciences and Arts Western Switzerland, Route de Cojonnex 18, 1000 Lausanne, Switzerland

[2] National University of Singapore, Singapore, Singapore

Published online: 07 January 2022

Keywords Business group affiliation · Risk-sharing hypothesis · REITs

Introduction

Business groups that share a common historical background, or are linked to their governments, are often observed in Asian and Latin American countries such as Japan, South Korea, Thailand, Indonesia, India, Singapore, China, Brazil, Chile, and Mexico. The corporate finance literature has documented the effects of business groups on corporate structure and financial performance (Khanna & Rivkin, 2000; Bertrand et al., 2002; Khanna & Yafeh, 2005; Claessens et al., 2006; Almeida & Wolfenzon, 2006; Carney et al., 2011; Byun et al., 2013; Gaur et al., 2014; Mahmood et al., 2017).[1]

In this study, we examine the effects of business group affiliation on business performance focusing on the Real Estate Investment Trusts in Japan (J-REITs) with the expectation that business groups still play important roles for J-REITs mainly because of their unique external management system, which seems to have reinforced the power relationships within the modern Japanese business groups.

Risk-sharing is one of the most significant effects of business group affiliation on the business operations of its member firms (Yafeh, 2003). The risk-sharing hypothesis posits that business groups enable member firms to share risks by smoothing income flows and reallocating money from one affiliate to another (Aoki, 1988). Member firms try to rescue other member firms when they are in trouble, while such firms might also exploit other members, for example, by receiving a premium for intra-group transactions (e.g. sale of real estate properties and lending). In this way, business group affiliation provides mutual insurance arrangements among member firms, especially when a firm's access to highly developed capital markets is limited. Member firms thus try to ensure stable growth as a group in the long run through mutual insurance arrangements. Because of this risk-sharing behavior, member firms are expected to have lower variance in operating profitability, while member firms may not enjoy higher profitability or may even have lower profitability, compared with firms not affiliated with major business groups.

The empirical evidence from the literature suggests that the variance in operating profitability and growth rates is generally lower for business group-affiliated companies than for unaffiliated firms. The evidence also shows that profitability itself is lower for business group-affiliated companies than for unaffiliated firms, although the difference in profitability is often statistically insignificant (Nakatani, 1984; Ferris et al., 2003; Yafeh, 2003; Khanna & Yafeh, 2005; Chen et al., 2010; Jia et al., 2013).

[1] More recently, the literature examined the effects of business groups on corporate social responsibility (CSR) strategies and found that, in general, group affiliation is associated with higher CSR and that CSR works as a means of enhancing reputational capital to buffer any bad events, especially among group affiliated firms (Choi et al., 2018; Ray & Ray, 2018).

As a result of a decrease in stable shareholding within business groups and a general move toward a more market-based financial system, the significance of business groups is reported to have weakened over time, for example, in the Japanese economy (Khanna & Yafeh, 2005).[2] However, we argue that the introduction of the REIT market in Japan has reemphasized the importance of business groups among firms affiliated with REITs. Kim et al. (2004) propose that although the *keiretsu* system entails the risk-sharing benefits, it is unlikely that these benefits accrue equally to all the members. They argue that *keiretsu* member firms possessing stronger power in their *keiretsu* are able to place more emphasis on growth in pursuing product and international diversification, whereas less powerful *keiretsu* members are subject to strong monitoring and emphasize stable profitability. The introduction of the REIT market might have reinforced this power relationship into the modern Japanese *keiretsu* groups and, as a result, the risk-sharing effect should be strongly evident among REITs, because REITs, as less powerful *keiretsu* members, should emphasize stable profitability instead of growth. Regardless of the weakening significance of business groups along with the economic development and modernization in many countries, it does seem possible that business groups still play important roles for REITs, especially those in Asian and Latin American countries, for several reasons.

First, REITs in these countries are managed by external asset management companies.[3] As summarized in Fig. 1, a REIT asset management company selects properties, executes investment strategies, and hires property managers to handle the leasing, management, maintenance, and operational aspects of properties owned by a REIT. In return, the REIT pays asset management fees to the asset management company. In this structure, both the asset management company and the property management company are usually wholly or partly owned by a REIT sponsor. A REIT sponsor is a large company that develops and/or manages commercial real estate properties.[4] A REIT sponsor is an entity that sources the properties placed into the REIT at the time of the initial public offering (IPO).[5] Thus, the external management structure of REITs naturally strengthens the control of the sponsor over the whole process of REIT management, potentially enhancing the power relationship within *keiretsu* groups if REIT sponsors belong to *keiretsu* groups. Therefore, whether or not a sponsor belongs to a business group should have a significant effect on the business operation of an externally managed REIT (e.g. in property acquisition, leasing arrangements, and debt financing), especially on the stability of

[2] Khanna and Yafeh (2005) show that the effect of business group affiliation on profit volatility for the post-war period between 1984 and 1992 was about one-tenth of the effect observed for the pre-war period.

[3] Based on market capitalization as of August 2017, the proportions of REITs managed externally in the United States, United Kingdom, and Australia were only 3%, 9%, and 10%, respectively. In contrast, all existing REITs in Japan, Singapore, and Hong Kong are externally managed; all 8 REITs in Mexico are also externally managed. Internally managed REITs employ investment managers and support staff that manage the operations of the company's day-to-day activities without outsourcing asset management tasks to an external management company.

[4] Examples of REIT sponsors include real estate developers, real estate service companies, retail companies, financial service companies, and trading companies.

[5] REITs with this structure are sometimes called captive REITs.

profitability of REITs, since REITs, if affiliated with *keiretsu* groups, are placed as less powerful members of *keiretsu* groups.[6,7]

Second, many Asian and Latin American REIT markets began in the early 2000s,[8] and most of them are yet young and small, and only a few have credit ratings from S&P and/or Moody's. REITs, therefore, have limited access to public capital markets and often have to rely heavily on bank loans. The relationships with banks (through a direct relationship or via a REIT sponsor) will also affect the REITs' corporate financing decisions.[9] This further highlights the importance of business group affiliation of REIT sponsors, because major banks are also commonly affiliated with business groups and this business group affiliation translates into an excellent relationship with banks. In summary, the unique external management system and immaturity of Asian and Latin American REITs warrants a reexamination of the effects of business group affiliation on the financial performance of REITs.

The main purpose of this study is to test the business group risk-sharing hypothesis with J-REITs based on the assertion that the introduction of the REIT market in Japan has reemphasized the importance of business groups among firms affiliated with REITs. In Japan, we can still observe groups of independently managed firms, called *keiretsu*, that used to be family-owned conglomerates, called *zaibatsu*, before the end of World War II.[10] Some J-REITs have sponsors who belong to *keiretsu* groups (defined as *keiretsu* REITs), while others' sponsors do not belong to any *keiretsu* groups (defined as non-*keiretsu* REITs). Because J-REITs adopt the external management system and the J-REIT market is still at the growth stage, we expect that whether or not a sponsor is affiliated with a *keiretsu* group should have significant effects on the financial performance of a J-REIT. Testing the risk-sharing hypothesis with J-REITs is especially interesting because a weakening effect of the *keiretsu* groups on general corporations in Japan has also been reported. The unique external management system and immaturity of the J-REIT market might have enhanced the power relationships within *keiretsu* groups to which some REIT sponsors belong. More specifically, we test if the volatility of operating profitability

[6] In the United States, the external management system of REIT was almost proven to be worse than the internal management system, because it faced greater agency cost due to sponsor–shareholder relationship, and earlier studies found that the performance of externally-managed REITs tended to be worse than that of internally-managed REITs (Hsieh & Sirmans, 1991; Cannon & Vogt, 1995; Wei et al., 1995; Capozza & Seguin, 2000). However, more recent studies showed the benefits of an external management system for Asian REITs (Wong et al., 2013; Downs et al., 2016; Li & Chuen, 2018).

[7] If a REIT is managed internally, it is difficult for any single company to have a dominant influence over its management of the REIT because of the ownership requirements of REITs.

[8] The first REITs were listed in Japan, Singapore, and Hong Kong in 2001, 2002, and 2005, respectively. The first REIT in India was listed in 2019 and it is reported that China is in the process of listing the first REIT as of May 2019. The Mexican and the Brazilian REIT markets started in 2004 and 1993, respectively, but these started to grow only after regulation changes initiated in 2007 and 2008, respectively.

[9] The evidence suggests that the group's '*main bank*', which provides debt financing to the firm, owns some of the group firm equity, may even place bank executives in top management positions and plays an important role especially in rescuing financially distressed group firms to reduce the cost of such financial distress (Sheard, 1989; Hoshi et al., 1990; Hoshi & Kashyap, 2001).

[10] Section 2 provides details of the pre-war conglomerates and post-war business groups observed in Japan.

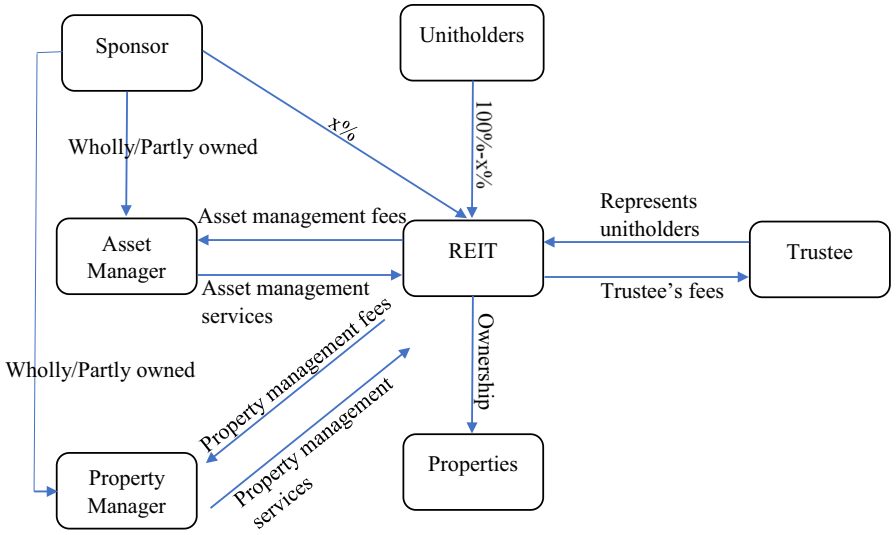

Fig. 1 External management system of REITs

of *keiretsu* REITs is significantly lower than that of non-*keiretsu* REITs. In addition to the simple test of the volatility of operating profitability, we also compare the abnormal profits and the REIT stock return volatility between *keiretsu* REITs and non-*keiretsu* REITs. Finally, we examine how *keiretsu* REITs and non-*keiretsu* REITs responded to an external shock focusing on its impacts on profitability and capital structure.

This study contributes to the corporate finance literature by showing the case in which business group affiliation still plays an important role even in a country where the significance of business group has generally weakened. Although prior studies (e.g., Ferris et al., 2003; Chen et al., 2010; Jia et al., 2013,) have shown the evidence of risk-sharing effect with general corporations, our study is the first to test the risk-sharing hypothesis considering the effect of the management system on the power relationships among *keiretsu* members. This study contributes to the REIT literature by adding a new perspective on the current discussion of the external management system for REITs. By linking business group affiliation with the external management system of REITs, this study attempts to reveal a situation where the external management system might bring benefits to REITs. Newer REIT markets have been developing in countries such as Brazil, China, India, Mexico, Singapore, South Korea, and Thailand[11] where business groups are observed and most REITs are (or expected to be) externally managed. The examination of the potential effects of business group affiliation on the operation of REITs is thus of global importance.

[11] In Brazil, India, Mexico, South Korea, and Thailand, we observe business groups that are characterized by conglomerates, similar to Japanese *keiretsu*. In China and Singapore, we observe groups of corporations linked closely to their governments.

First, we find that Japanese REITs, whose sponsors belong to one of the 6 major *keiretsu* groups, have significantly lower volatility of profitability than REITs whose sponsors do not belong to any of the major *keiretsu* groups, even after controlling for firm and property characteristics. On the other hand, there is no significant difference in profitability between *keiretsu* REITs and non-*keiretsu* REITs with the same controls. Secondly, focusing on the abnormal portion of profitability, we find that the portion of profitability unexplained by firm characteristics (conditional variance of profitability) is significantly lower with *keiretsu* REITs than with non-*keiretsu* REITs. Thirdly, we find that the *keiretsu* affiliation reduces the systematic volatility of affiliated REITs compared with non-affiliated REITs, while it does not affect the idiosyncratic volatility, the result contrary to the finding of Chen et al. (2010) with general corporations. The systematic volatility of *keiretsu* REITs was significantly reduced compared with that of non-keiretsu REITs, especially when the J-REIT market experienced poor conditions, implying that when REITs are in trouble, *keiretsu* REITs may receive supports from firms in other industries in the affiliated *keiretsu* groups. Finally, we find that *keiretsu* REITs and non-*keiretsu* REITs, which share similar firm and property characteristics, responded quite differently to the exogenous shock (the Great East Japan Earthquake): the negative impact of the earthquake on profitability was significantly smaller with *keiretsu* REITs than with non-*keiretsu* REITs. *Keiretsu* REITs were also able to stabilize their capital structure by shifting some short-term debts to long-term debts without increasing the cost of loans under the uncertain situation caused by the earthquake. It is also evident that *keiretsu* REITs were still able to borrow money from their affiliated group banks even right after the earthquake. On the other hand, non-*keiretsu* REITs seem to have struggled to secure loans from these *keiretsu* banks after the earthquake.

Zaibatsu and Keiretsu in Japan

Introduction

The Japanese term "*keiretsu*" is widely recognized in the corporate finance literature. It refers to clusters of independently managed firms that used to be family-owned conglomerates called *zaibatsu* before the end of World War II. A *zaibatsu* is a family-run conglomerate (multi-layered and industrially diversified business entity), controlled by a singular holding company structure and owned by families and/or clans of wealthy Japanese (Lincoln & Shimotani, 2009). The formation of *zaibatsu* groups started in the late 1800s, while *zaibatsu* became a popular term in the late 1920s. In the *zaibatsu* structure, the holding company was the overwhelmingly largest shareholder of the member companies and the member companies held more than half of the holding company's stock. The stock shares of members were rarely sold by other members to third parties. Under this structure, *zaibatsu* drove the finance, heavy industry, and shipping sectors that led Japan's economy. It is reported that in 1930, 4 large *zaibatsu* groups (Mitsubishi, Sumitomo, Yasuda, and Mitsui) controlled approximately 75% of Japan's economy GDP (Kensy, 2001). After World War II, the American occupational forces decided to dissolve the *zaibatsu*, claiming

that the groups were responsible for the war through the close connection between their group subsidiaries in heavy industry and the Imperial Japanese Army. Shares owned by controlling families of *zaibatsu* were confiscated and sold to individuals.[12]

However, after the Tokyo Stock Exchange reopened in 1949, former leading member companies of the *zaibatsu*, especially banks, eventually started buying shares of former member companies from individuals to form informal groups, marking the beginning of postwar *keiretsu*. Today, six large *keiretsu* groups exist, each of which has a large commercial bank as a general coordinator of its group: Mitsubishi (*Kinyo-kai)*, Sumitomo (*Hakusui-kai*), Mitsui (*Nimoku-kai*), Fuyo (*Fuyo-kai*), the former Dai-ichi Kangyo (*Sankin-kai*), and Sanwa (*Sansui-kai*).[13] Approximately 20–40 companies from various industries belong to each of these 6 *keiretsu* groups, some of which are sponsors of J-REITs. In the 1990s, firms associated with the largest 6 *keiretsu* groups, which represented only 0.007% of the total number of all Japanese firms, accounted for approximately 4% of employment, 13% of assets, 15% of capital, 14% of sales, and 12% of profits (Peng et al., 2001). An important governance structure associated with *keiretsu* is the President's Council (*shacho-kai*), which is now considered an informal Executive Committee wherein the *main bank* typically hosts monthly meetings to strengthen the connection among the group members and share information within the group.

Some of the anecdotal evidence suggests that the *keiretsu* system is an important aspect of the corporate governance of J-REITs. Indeed, 23 of the 75 J-REITs in our study sample have sponsors from one of the 6 major *keiretsu* groups for the study period from 2004 to 2018. During the global financial crisis, 1 J-REIT (New City Residence, non-*Keiretsu* REIT) filed for bankruptcy in 2008, and 8 J-REITs (all non-*keiretsu* J-REITs) experienced changes in their sponsors from 2008 to 2010, due to the bankruptcy or financial difficulty of their original sponsors. None of the J-REITs with *keiretsu* sponsors (*keiretsu* REITs) experienced bankruptcy or any change in their sponsors.

Theories of Effects of Keiretsu System

Researchers have proposed theories that explain the potential benefits of *keiretsu* affiliation mainly from three perspectives: governance perspective, internal market perspective, and power-dependence perspective. First, Aoki (1994) and Berglof and Perotti (1994) propose that *keiretsu* systems represent an effective corporate governance structure and monitoring mechanism that can mitigate incentive, information, and control problems associated with agency conflicts. In the typical *keiretsu* system, the main bank is usually the largest lender and holds substantial equity stakes in the member firms. With significant stakes as both a shareholder and a debt holder, the main bank has a strong incentive to monitor group members closely to safeguard its own interests as both a lender and an equity holder, thus mitigating agency

[12] The history behind the emergence of *keiretsu* is well summarized in Yafeh (2003).

[13] Texts in parentheses are the names of the President's Councils (*shacho-kai*) of *keiretsu* groups, which are often used to refer to these 6 *keiretsu* groups.

conflicts. The main bank can maintain a legal maximum of only 5% ownership in a member firm. However, extensive cross-ownership within the *keiretsu* group allows the main bank to mobilize shareholdings of other member firms for concerted voting, constituting a collective enforcement mechanism (Berglof & Perotti, 1994).

Secondly, the *keiretsu* group performs the role of an internal market resource allocator (Khanna & Palepu, 1997, 2000a, 2000b). *Keiretsu* member firms from every major industrial sector prefer to transact with one another on a long-term basis than with outside firms, engaging in extensive internal purchasing and selling of goods and services (Gerlach, 1992). Since a *keiretsu* group usually includes members in all the major sectors, the *keiretsu* can provide a broad scope of benefits especially when and where market mechanisms are less functional (e.g., in developing countries and under economic crises). Therefore, *keiretsu* member firms can mobilize resources embedded in a web of relationships in the *keiretsu*, creating group-based resource allocation advantages over independent firms that do not belong to *keiretsu* groups.

Thirdly, Kim et al. (2004) propose that although the *keiretsu* system entails governance and internal market benefits, it is unlikely that these benefits accrue equally to all the member firms because embedded power-dependence relationships within a *keiretsu* represent a potential factor in the relative appropriation of group affiliation benefits. Instead, *keiretsu* member firms possessing stronger power in their *keiretsu* are able to place more emphasis on growth in pursuing product and international diversification, whereas less powerful *keiretsu* members are subject to strong monitoring and emphasize stable profitability. We argue that REITs in Japan are typical examples of less powerful *keiretsu* members subject to strong monitoring from more powerful member firms such as the main banks and REIT sponsors because of their external management system. As a result, we expect that the risk-sharing effect is clearer among REITs than among general corporations, because REITs, as less powerful *keiretsu* members, should emphasize stable profitability instead of growth potential.

Data and Methodology

Data

Our study period runs from January 2004 to December 2018. Although the first 2 J-REITs were listed in 2001, the number of J-REITs and their market size started to increase after 2004. Thus, we begin our analysis in that year. The number of J-REITs increased to 42 in 2007, decreased to 34 as of November 2011 as a result of bankruptcies and mergers, and kept increasing up to 61 as of December 2018. In our final study sample, there are 75 unique J-REITs, including ones that were delisted during the study period for some reason (e.g. bankruptcy of sponsor, change of sponsor, or merger). The list of J-REITs along with the information on their sponsors is provided in Appendix 1.

We identify REIT sponsors using information taken from the websites of the J-REITs and their asset management companies. We identify the *keiretsu* sponsors using several sources, including *Industrial Grouping in Japan* (GJ) published by

Dodwell Marketing Consultants. Corporate data are taken from S&P Global Market Intelligence (formerly SNL), DATASTREAM, and companies' semi-annual reports.[14] Among 75 REITs, 23 have sponsors that belong to one of the 6 *keiretsu* groups (*keiretsu* REITs*)*, and 52 have sponsors that do not belong to any *keiretsu* group (non-*keiretsu* REITs).

Volatility of Profitability and Profitability

We begin with a simple test of the risk-sharing hypothesis that, compared with non-*keiretsu* REITs, *keiretsu* REITs are expected to have lower variance in operating profitability (Eq. (1)), while *keiretsu* REITs may not enjoy higher profitability or may even have lower profitability (Eq. (2)):

$$\begin{aligned} \mathrm{vFFOA_i} = {} & \text{constant} + \beta_0\left(\mathrm{Keiretsu_i}\right) + \beta_1\left(\mathrm{Size_i}\right) + \beta_2\left(\mathrm{Size}_i^2\right) \\ & + \beta_3\left(\mathrm{FFOA_i}\right) + \beta_4\left(\mathrm{REITAge}_i\right) + \beta_5\left(\mathrm{LTV_i}\right) \\ & + \beta_6\left(\mathrm{PropAge_i}\right) + \beta_7\left(\mathrm{OccuRate_i}\right), \end{aligned} \tag{1}$$

$$\begin{aligned} \mathrm{FFOA_{it}} = {} & \text{constant} + \beta_0\left(\mathrm{Keiretsu_i}\right) \\ & + \beta_1\left(\mathrm{Size_{it}}\right) + \beta_2\left(\mathrm{Size}_{it}^2\right) + \beta_3\left(\mathrm{REITAge}_{it}\right) \\ & + \beta_4\left(\mathrm{LTV_{it}}\right) + \beta_5\left(\mathrm{PropAge_{it}}\right) + \beta_6\left(\mathrm{OccuRate_{it}}\right), \end{aligned} \tag{2}$$

where $\mathrm{vFFOA_i}$ is the standard deviation of each REIT's funds from operations (FFO)[15] divided by each REIT's total assets calculated over all years for which we have data.[16,17] $\mathrm{Keiretsu_i}$ is the dummy variable that takes the value of one for REITs whose sponsors are affiliated with *keiretsu* groups and the value of zero otherwise. $\mathrm{Size_i}$ is the log of market capitalization, $\mathrm{Size_i}^2$ is the quadratic term of the centered size variable, $\mathrm{FFOA_i}$ is the funds from operations divided by total assets, $\mathrm{REITAge_i}$ is the number of years since each REIT's initial public offering date, $\mathrm{LTV_i}$ is the loan-to-value ratio, $\mathrm{PropAge_i}$ is the average age of properties, and $\mathrm{OccuRate_i}$ is the average occupancy rate of $\mathrm{REIT_i}$. Equation (1) is a cross-sectional regression where all control variables are the averages over all years for which we have data for each REIT. Since the standard deviation of profit is calculated based on the time series of

[14] J-REITs have a fiscal period that ends in different months. We mimic the COMPUSTAT convention and assign REITs with a fiscal period ending in March through August to the first half of the year and REITs with a fiscal period ending in September through February to the second half of the year.

[15] FFO is equal to a REIT's net income, excluding gains or losses from sales of property, and adding back real estate depreciation. FFO is considered as a more suitable measure of the profitability of REITs than GAAP earnings, because many investment properties increase in value over time, while GAAP earnings calculation requires that all REITs depreciate their investment properties. FFO also subtracts any gains on sales of property because they are considered to be non-recurring.

[16] The volatility regressions were also run for rolling 10-year periods (i.e. 20 half-year periods) as a robustness check to examine if the effect is stable over time.

[17] The regressions were run with the additional control variables for the proportions of office, residential, retail, and logistics properties, and the results are shown in the section of Robustness checks.

different lengths for different REITs, the standard deviation of the error term may not be constant over all observations. Therefore, we adopt the method of weighted least squares where we use the number of observations per REIT as weights assuming that the number of observations reflects the amount of the information contained in the standard deviation of profit of each REIT to maximize the efficiency of parameter estimation. Equation (2) is an unbalanced panel regression where all control variables are the values for each half-year period for each REIT.

Conditional Variance of Profitability

This test focuses on the possible risk-sharing in which *keiretsu* REITs receive support from other firms in the affiliated groups when their profitability is lower than usual, while REITs assist other group firms when REITs' profitability is above normal. We first regress profitability on size, half-year, and REIT-fixed effects, which capture all time-invariant REIT attributes including *keiretsu* affiliation. We then test whether unexplained changes in profitability, which are deviations from the regression line, are smaller for *keiretsu* REITs than for non-*keiretsu* REITs, by regressing the squared residuals from the first regression (i.e. the conditional variance of profitability) on the *keiretsu* dummy and control variables (size, the quadratic term of size, the ratio of FFO to total assets, REIT age, loan-to-value ratio, the age of properties, the occupancy rate, and half-year fixed effects).

Stock Return Volatility

While the risk-sharing hypothesis is associated with the effect of *keiretsu* affiliation on variance in operating profitability of REITs, we also examine if the same effect is evident from the shareholders' perspective by using the volatility of each REITs' share price total returns as a dependent variable for three reasons. First, the use of the share price information allows us to conduct panel-based analyses, although measuring variance in operating profitability prevents us from conducting such analyses. Secondly, we are able to examine if and how *keiretsu* affiliation is perceived by REITs' shareholders. Thirdly, we are able to examine if the effect of *keiretsu* affiliation is more meaningful among REITs than among general corporations, as we hypothesize, especially because we conduct this part of the analyses by decomposing the total volatility into the idiosyncratic volatility and the systematic volatility. By testing the risk-sharing hypothesis with the general corporations in Japan, Chen et al. (2010) found that the risk-sharing among *keiretsu* firms reduces the idiosyncratic risk but increases the market-level systematic risk. Since it is the systematic risk, not the idiosyncratic risk, that is priced (i.e., important for well-diversified investors), this result suggests that the risk-sharing among *keiretsu* firms may actually have a detrimental effect on the value of *keiretsu* firms. However, we argue that the risk-sharing among *keiretsu* REITs should have a beneficial effect on the value of *keiretsu* REITs, because the benefits of *keiretsu* affiliation are amplified by the external management system of REITs as we explained earlier. The analyses based on the decomposition of REIT stock volatility shed light on this assertion.

We measure the idiosyncratic volatility and the systematic volatility based on the Capital Asset Pricing Model (CAPM) as follows:

$$R_{it} = \text{constant}_i + \beta_i MKT_t + \varepsilon_{it}, \tag{3}$$

where R_{it} is the excess return on REIT i on day t. MKT_t is the excess return on the Japanese REIT index on day t. Total volatility of REIT i is measured by the standard deviation of R_{it}, denoted by σ_i. The idiosyncratic volatility of REIT i is proxied by the standard deviation of ε_{it} in Eq. (3), denoted by $\sigma_{\varepsilon,i}$. $\sigma_{\varepsilon,i}$ is estimated by running 3-month rolling regressions following Eq. (3). The systematic volatility of REIT i is defined as the difference between total and idiosyncratic volatility, $\sigma_{S,i} = \sigma_i - \sigma_{\varepsilon,i}$. These volatilities are measured for each half-year period based on the daily total returns and are annualized. Then, to test the risk-sharing hypothesis based on the stock return volatility, we run the following panel regressions for the idiosyncratic volatility (Eq. (4)) and the systematic volatility (Eq. (5)) where $_{hy}$ represents each half-year period:

$$\begin{aligned}\sigma_{\varepsilon,i,hy} = {} & \text{constant} + \beta_0\left(\text{Keiretsu}_i\right) + \beta_1\left(\text{Size}_{i,hy}\right) \\ & + \beta_2\left(\text{Size}^2_{i,hy}\right) + \beta_3\left(\text{FFOA}_{i,hy}\right) + \beta_4\left(\text{REITAge}_{i,hy}\right) \\ & + \beta_5\left(\text{LTV}_{i,hy}\right) + \beta_6\left(\text{PropAge}_{i,hy}\right) + \beta_7\left(\text{OccuRate}_{i,hy}\right),\end{aligned} \tag{4}$$

$$\begin{aligned}\sigma_{S,i,hy} = {} & \text{constant} + \beta_0\left(\text{Keiretsu}_i\right) + \beta_1\left(\text{Size}_{i,hy}\right) + \beta_2\left(\text{Size}^2_{i,hy}\right) \\ & + \beta_3\left(\text{FFOA}_{i,hy}\right) + \beta_4\left(\text{REITAge}_{i,hy}\right) + \beta_5\left(\text{LTV}_{i,hy}\right) \\ & + \beta_6\left(\text{PropAge}_{i,hy}\right) + \beta_7\left(\text{OccuRate}_{i,hy}\right).\end{aligned} \tag{5}$$

Response of Profitability to Exogenous Shock

The purpose of this test is to examine if *keiretsu* groups assist member firms (i.e. *keiretsu* REITs) that are subject to an exogenous shock, by examining the possible difference in the impact of the exogenous shock on the profitability between *keiretsu* REITs and non-*keiretsu* REITs.

We choose the Great East Japan Earthquake, the most powerful earthquake ever recorded in Japan and the fourth most powerful earthquake in the world, as a shock that is purely exogenous and has affected REITs' profitability directly and indirectly. The earthquake was a magnitude 9.0 undersea megathrust earthquake and happened at 14:46 on March 11, 2011. The epicenter was approximately 43 miles east of the Oshika Peninsula of the Tohoku region, which is approximately 230 miles from the center of Tokyo, and the hypocenter was at an underwater depth of approximately 18 miles. In terms of the seismic intensity (SI) level,[18] the Tohoku area near the

[18] According to the definitions set by the Japan Meteorological Agency, in the case of SI:4, most people feel the earthquake, and most sleeping people wake up. With SI:5–, the majority of people feel fear and try to hang on to something. With SI:5+, most people feel difficulty walking. With SI:6–, it becomes difficult to stand. With SI:6+ and 7, it becomes impossible to move, and people get thrown off balance.

epicenter experienced SI:7 and the areas within Tokyo experienced SI:5+ or SI:5–. The earthquake was followed by tsunami waves and resulted in 15,897 deaths and 2534 people missing according to the Japanese National Police Agency, confirmed as of December 2018. The tsunami waves also caused nuclear accidents (level 7 meltdowns) at three reactors in the Fukushima Daiichi Nuclear Power Plant complex, which is approximately 137 miles from the center of Tokyo. As a result, residents within a 12-mile radius of the Fukushima Daiichi Nuclear Power Plant and a 6.2-mile radius of the Fukushima Daini Nuclear Power Plant were evacuated. The economic loss of the earthquake was estimated to be US$ 235 billion according to the World Bank.

While Japanese REITs did not own many properties within the proximity of the epicenter and none of the REITs' properties were severely damaged, the profitability of REITs was affected by the earthquake. For example, the earthquake caused minor physical damage to some REITs' properties in Tokyo and other big cities, forced REITs to implement additional seismic assessments and upgrade their earthquake insurance, or led some tenants to move to properties that were more robust against earthquakes. *Keiretsu* REITs might have enjoyed preferential pricing with property transactions, repairing works, or financing via member firms in different industries, while such "rescue" arrangements might not have been available for non-*keiretsu* REITs. As a result, the negative effect of the earthquake could be significantly smaller among *keiretsu* REITs than among non-*keiretsu* REITs.

For this test, it is essential to examine the impact difference due to *keiretsu* affiliation while controlling for the strength of properties against earthquakes along with other control variables. J-REIT publishes, in its semi-annual financial reports, an earthquake risk measure called Probable Maximum Loss (PML), assessed by a third party with expert knowledge for each property it holds as well as for the whole portfolio. The PML is reported as the ratio of the expected physical loss amount as a proportion of the building's replacement costs, corresponding to the kind of huge earthquake that could happen once every 475 years (i.e. 10% probability of occurrence in 50 years). The PML is calculated based on factors such as a building's earthquake resistance, soil environment, earthquake history of a location, and proximity to an active fault. The portfolio PML for a REIT is calculated also considering the geographical diversification of its properties. We hand-collected the published portfolio PML of each REIT from semi-annual financial reports.

We select the closest match among non-*keiretsu* REIT for each *keiretsu* REIT focusing on portfolio PML and other variables that seem to affect the impact of the earthquake on profitability (size, loan-to-value ratio, occupancy rate, and the proportion of properties in Tokyo) based on the data during the pre-event period between the second half of 2009 and the second half of 2010.[19] We use one-to-one matching with the closest propensity score to improve covariate balance and reduce bias. Using the matched sample, we employ a difference-in-differences (DID) analysis.

[19] We choose this pre-test period to minimize the potential influence of the Global Financial Crisis.

This technique calculates the effect of a treatment on a treatment group versus a control group. To examine the effect of the earthquake on REITs' profitability, there are two treatment effects: *keiretsu* with mutual insurance arrangements versus non-*keiretsu* without mutual insurance arrangements and before versus after the earthquake. The effect of these treatments is analyzed as follows:

$$\mathrm{FFOA}_{it} = \text{constant} + \beta_0\left(\mathrm{Post}_{it}\right) + \beta_1\left(\mathrm{Keiretsu}_i\right) + \beta_2\left(\mathrm{Post}_{it}\right) \times \left(\mathrm{Keiretsu}_i\right), \quad (6)$$

where FFOA_{it} is the funds from operations divided by total assets for each REIT_i at a semi-annual period of t. Post_{it} is the dummy variable that takes the value of one for the post-event period during the first half of 2011 and the second half of 2011 and the value of zero for the pre-event period during the second half of 2009 and the second half of 2010. $\mathrm{Keiretsu}_i$ is the dummy variable that takes the value of one for REITs whose sponsors are affiliated with *keiretsu* groups and the value of zero otherwise. β_2 is the DID estimator and the parameter of interest.[20]

Results

Summary Statistics

Table 1 shows the summary statistics of 75 REITs (23 *keiretsu* REITs and 52 non-*keiretsu* REITs) for the overall period. First, the volatility of profitability is significantly lower with *keiretsu* REITs than with non-*keiretsu* REITs. The volatility of profitability of *keiretsu* REITs is only about 60% of that of non-*keiretsu* REITs, measured both by FFO/Asset and ROA. The profitability itself is significantly higher with *keiretsu* REITs than with non-*keiretsu* REITs when measured by FFO/Asset, while there is no significant difference when measured by ROA. The smoother profitability observed with *keiretsu* REITs implies the existence of the risk-sharing of the business group affiliation, while the lower profitability, often observed with general corporations affiliated with business groups (e.g., see Table 3 in Yafeh, 2003), is not evident with *keiretsu* REITs.

Although smoother profitability is observed with *keiretsu* REITs, it may be the result of differences in firm and property characteristics between *keiretsu* REITs and non-*keiretsu* REITs.[21] For example, compared with non-*keiretsu* REITs, *keiretsu* REITs tend to exhibit higher firm value (or growth opportunity) measured by Tobin's Q, higher market capitalization, lower dividend yield, lower leverage, lower loan cost, and be older. *Keiretsu* REITs own properties with a larger leasable area, higher occupancy rate, and lower PML (i.e. stronger against earthquakes) compared with properties owned by non-*keiretsu* REITs. The property portfolios of *Keiretsu* REITs consist more of office, retail, and logistics properties and less of residential properties. Properties owned by *keiretsu* REITs are more concentrated in the big 3 cities (Tokyo 23 wards, Osaka, and Nagoya). Shares of *keiretsu* REITs are held more

[20] To obtain correct standard errors with our panel data, we use a Gaussian generalized linear model (GLM) with identity link and exchangeable correlation structure (i.e. assuming that that within a cluster any two observations are equally correlated, but there is no correlation between observations from different clusters).

[21] With the more formal regression analyses, we control important firm and property characteristics.

by financial institutions and less by individuals, non-financial institutions, and foreign investors compared with shares of non-*keiretsu* REITs.

Test of Volatility of Profitability and Profitability

Table 2 summarizes the results of the regressions that examine the impact of *keiretsu* affiliation on the volatility of profitability and profitability. In Panel A, a dependent variable is the standard deviation of the ratio of FFO to total assets (VFFOA), as shown in Eq. (1). In Panel B, a dependent variable is the ratio of FFO to total assets (FFOA), as shown in Eq. (2). The risk-sharing hypothesis suggests that *keiretsu* REITs are expected to have lower variance in operating profitability, while *keiretsu* REITs may not enjoy higher profitability or may even have lower profitability, compared with REITs not affiliated with major *keiretsu* groups.

Panel A shows that REITs whose sponsors belong to one of the 6 major *keiretsu* groups have significantly lower volatility of profitability than REITs whose sponsors do not belong to any of the major *keiretsu* groups. This *keiretsu* affiliation effect is still significant at the 5% level even after controlling for firm and property characteristics (Models 2 and 3). Based on Model 3, the result shows that if a REIT has a *keiretsu* sponsor, the volatility of profitability is reduced by 0.46%, which is 30% of the average volatility of profitability among non-*keiretsu* REITs (1.51%) as shown in Table 1, keeping other variables constant. This result implies that a *keiretsu* REIT indeed enjoys the mutual insurance of *keiretsu* group affiliation by having a *keiretsu* member firm as its sponsor.

Panel B of Table 2 shows that *keiretsu* REITs have significantly higher (by 0.27%) profits than non-*keiretsu* REITs without control variables (Model 1). However, after adding firm and property characteristics control variables, this effect disappears and there is no significant difference in profitability between *keiretsu* REITs and non-*keiretsu* REITs. This result in Panel B suggests that the higher profitability observed with *keiretsu* REITs is coming not from their sponsors' affiliation with *keiretsu* groups, but from the firm and property characteristics of *keiretsu* REITs, such as larger size, lower LTV, newer properties, and higher occupancy rates. Earlier studies suggest that the effect of business group affiliation on profitability itself is often insignificant, or even negative, which is consistent with the result we obtain with J-REITs.

While the results with both standard deviation (volatility) and the mean of profitability seem to support the risk-sharing hypothesis, a difference in profitability between *keiretsu* REITs and non-*keiretsu* REITs is significant with the tails (abnormal portion) of profitability distribution as shown in Fig. 2. Figure 2 shows that the skewness of non-*keiretsu* REITs (−3.07) is much lower (i.e. more negatively skewed) than that of *keiretsu* REITs (−0.01) and the kurtosis of non-*keiretsu* REITs (50.58) is much higher than that of *keiretsu* REITs (11.94). A two-sample Kolmogorov–Smirnov test rejects the equal distribution hypothesis ($p = 0.000$). It thus seems important to examine the profitability difference between *keiretsu* REITs and non-*keiretsu* REITs, focusing on the tail portions

Table 1 Summary statistics

	Keiretsu REITs		NonKeiretsu REITs		Diff (Keiretsu - NonKeiretsu)		
	Mean	Std. Dev.	Mean	Std. Dev.	Diff	*t-value*	*Sig.*
Firm Characteristics							
FFO/Asset	3.85%	0.95%	3.57%	1.57%	0.28%	3.86	***
V(FFO/Asset)	0.89%	0.44%	1.51%	1.36%	−0.62%	−11.51	***
ROA	2.65%	1.42%	2.60%	2.10%	0.05%	0.46	
V(ROA)	1.19%	1.45%	1.96%	2.12%	−0.78%	−7.52	***
Tobin's Q	103.04%	31.06%	96.57%	36.46%	6.46%	3.26	***
V(Tobin's Q)	26.26%	7.45%	29.29%	10.36%	−3.03%	−5.87	***
Size	199,367	204,960	113,127	110,385	86,241	8.25	***
DIVYIELD	5.05%	2.91%	5.90%	5.27%	−0.85%	−3.57	***
Leverage	42.23%	10.72%	45.41%	6.85%	−3.18%	−5.66	***
Age of REITs	6.93	4.36	5.40	3.99	1.53	6.20	***
Loan cost	1.07%	0.33%	1.14%	0.48%	−0.07%	−3.01	***
Property Characteristics							
Age of Properties	13.82	5.39	14.27	5.70	−0.45	−1.37	*
Leasable Area	623,938	611,751	377,470	487,146	246,468	7.28	***
Occupancy Rate	98.03%	1.91%	96.96%	3.02%	1.07%	7.50	***
% office	41.94%	42.03%	37.52%	37.81%	4.43%	1.83	**
% residential	16.98%	34.71%	31.97%	40.40%	−14.99%	−6.80	***
% retail	22.00%	32.31%	11.60%	20.67%	10.41%	6.13	***
% logistics	9.66%	27.14%	6.31%	22.06%	3.35%	2.22	**
% in Tokyo	19.05%	15.15%	18.26%	13.31%	0.79%	0.91	
% in BIG3 cities	94.19%	6.13%	87.93%	20.73%	6.26%	7.68	***
Portfolio PML	4.61%	2.72%	5.75%	2.14%	−1.14%	−5.44	***
Shareholder Characteristics							
% Individual	14.57%	10.83%	18.85%	14.28%	−4.28%	−5.85	***
% Financial	58.34%	11.09%	44.73%	15.51%	13.61%	17.60	***
% Institution	8.07%	4.03%	13.97%	10.86%	−5.90%	−13.33	***
% Foreign	18.80%	9.19%	22.43%	14.49%	−3.63%	−5.28	***
# of REITs	23		52				
# of observations	453		744				

Table 1 reports summary statistics of the whole study sample of 75 REITs (23 *keiretsu* REITs and 52 non-*keiretsu* REITs). FFO/Asset is the ratio of funds from operation to total assets, V(FFO/Asset) is the standard deviation of FFO/Asset, ROA is the return on assets, V(ROA) is the standard deviation of ROA. FFO- and ROA-related variables are based on semi-annual numbers and annualized. Tobin's Q is calculated by dividing the market capitalization by the appraised value of properties plus the book value of current assets minus the book value of debt, following Capozza and Seguin (2003). Size is the market capitalization, DIVYIELD is the annualized dividend yield, Leverage is the loan-to-value ratio. Age of REITs is the number of years since the dates of initial public offerings. Loan cost is the average cost of bank loans. Portfolio PML is the portfolio-level Probable Maximum Loss, a measure of the average strength of properties against earthquakes calculated based on factors such as a building's earthquake resistance, soil environment, earthquake history of a location, proximity to an active fault, and the geographical diversification of its properties. BIG3 cities are Tokyo 23 wards, Osaka city, and Nagoya city. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level

Table 2 Test of the volatility of profitability and profitability

	Model 1			Model 2			Model 3		
	B	*t*		*B*	*t*		*B*	*t*	
Panel A: Volatility of Profitability (VFFOA)									
Keiretsu	−0.625	−2.39	**	−0.464	−2.00	**	−0.458	−2.01	**
Size				−0.473	−1.90	*	−0.482	−1.82	*
Size_squared				−0.036	−0.39		−0.036	−0.38	
FFOA				−0.293	−0.77		0.118	1.32	
REIT_age				0.118	1.39		−0.290	−0.74	
LTV				−0.903	−0.50		−0.672	−0.34	
Property_age							0.013	0.59	
Occupancy_rate							1.211	0.22	
Constant	1.509	6.27	***	7.628	2.75	***	6.251	1.26	
R-squared	0.070			0.225			0.228		
Number of observations	75			75			75		
Panel B: Profitability (FFOA)									
Keiretsu	0.270	3.82	***	0.050	0.87		−0.019	−0.33	
Size				0.326	5.58	***	0.288	5.29	***
Size_squared				0.246	2.90	***	0.227	2.68	***
REIT_age				−0.039	−3.95	***	−0.033	−3.26	***
LTV				−4.366	−10.25	***	−3.708	−8.90	***
Property_age							−0.014	−2.35	**
Occupancy_rate							8.901	3.58	***
Constant	3.593	63.72	***	2.039	3.05	***	−6.292	−2.42	**
R-squared	0.010			0.165			0.195		
Number of observations	1184			1184			1184		
Number of REITs	75			75			75		

Table 2 shows the results of the regressions that examine the impact of *keiretsu* affiliation on the volatility of profitability and profitability. In Panel A, a dependent variable is the standard deviation of the ratio of FFO to total assets (VFFOA) as shown in Eq. (1). In Panel B, a dependent variable is the ratio of FFO to total assets (FFOA) as shown in Eq. (2). Both FFOA and VFFOA are annualized and multiplied by 100. In both panels, the main independent variable is the *Keiretsu* dummy variable that takes the value of one for REITs whose sponsors are affiliated with *keiretsu* groups and zero otherwise. Size is the log of market capitalization, Size_squared is the quadratic term of centered size, REIT_age is the number of years since the date of the initial public offering, LTV is the loan-to-value ratio, Property_age is the average age of properties, and Occupancy_rate is the average occupancy rate of each REIT. Model 1 includes only the *Keiretsu* dummy and the constant term. Model 2 adds controls for firm characteristics. Model 3 also adds controls for property characteristics. We use the number of observations per REIT as weights because variables are based on the times series of different lengths for different REITs. T-statistics are based on heteroscedasticity-consistent standard errors. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level

of the distribution. The following analyses examine the abnormal profits and the response to an external shock to profitability, comparing those between *keiretsu* REITs and non-*keiretsu* REITs.

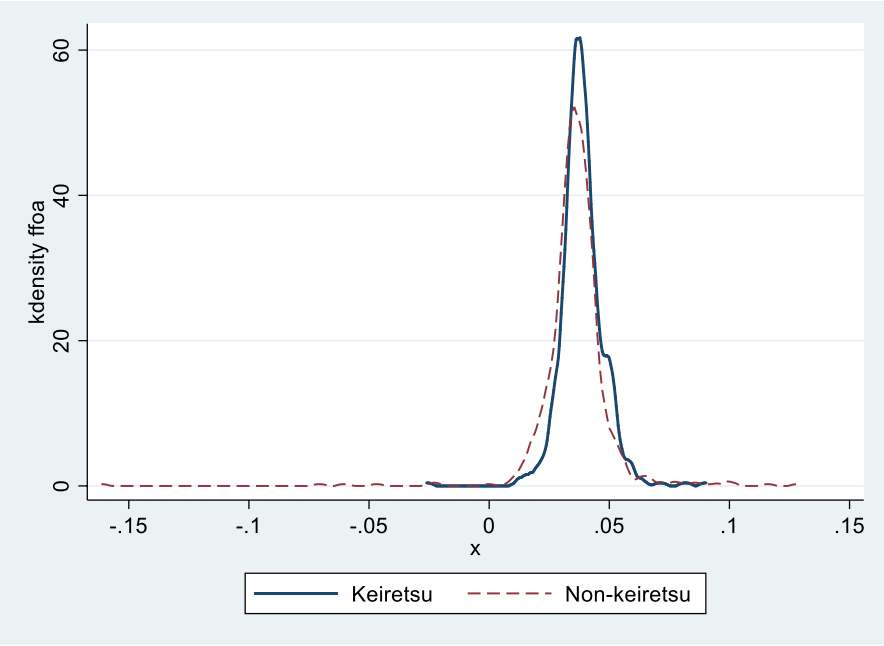

Fig. 2 Distributions of profitability: *Keiretsu* REITs vs. non-*keiretsu* REITs

Test of Conditional Variance of Profitability

Keiretsu REITs may receive support from other firms in the affiliated group (thanks to their sponsors' affiliation), especially when their profitability is lower than usual, while REITs may assist other group firms when REITs' profitability is above normal. To test this implication, in the regressions summarized in Table 3, a dependent variable is the squared residual from the regression (i.e. conditional variance of profitability) in which a dependent variable is the profitability (FFOA) and independent variables are size, half-year, and REIT-fixed effects.

The results show that the conditional variance of profitability is significantly lower with *keiretsu* REITs than with non-*keiretsu* REITs, even with firm and property characteristics controls as well as half-year fixed effects (Model 3). This result implies that *keiretsu* REITs may be considered as sub-members of *keiretsu* groups and *keiretsu* REITs are part of mutual insurance arrangements by which member firms rescue other member firms (are rescued by other member firms) when they experience unexpected positive (negative) surprises that affect profitability. The result is consistent with the observation in Fig. 2 that the tails of the profitability distribution are much thinner with *keiretsu* REITs than with non-*keiretsu* REITs.

We also examine if the degree of the reduction of the conditional variance of profitability differs among *keiretsu* REITs based on shareholders' composition (i.e. proportions of shares held by individuals, financial institutions, non-financial institutions, and foreign investors) by including the interaction term

Table 3 Test of conditional variance of profitability

	Model 1			Model 2			Model 3		
	B	*t*		*B*	*t*		*B*	*t*	
Keiretsu	−0.011	−2.37	**	−0.009	−2.58	**	−0.009	−2.45	**
Size				0.003	0.57		0.002	0.56	
Size_squared				0.015	1.73	*	0.015	1.75	*
FFOA				−0.035	−1.38		−0.036	−1.39	
REIT_age				0.000	−0.64		0.000	0.84	
LTV				−0.161	−1.75	*	−0.144	−1.78	*
Property_age							−0.001	−1.09	
Occupancy_rate							0.173	1.41	
Half-year fixed effects	No			No			Yes		
Constant	0.014	3.22	***	0.176	1.96	**	0.014	0.20	
R-squared	0.003			0.215			0.238		
Number of observations	1184			1184			1184		
Number of REITs	75			75			75		

Table 3 shows the results of the regressions that examine the impact of *keiretsu* affiliation on conditional variance of profitability. We first regress profitability (FFOA) on size, half-year, and REIT-fixed effects, which capture all time-invariant REIT attributes including *keiretsu* affiliation. The squared residuals from the first regression (i.e. conditional variance) is a dependent variable of these regressions. The main independent variable is the *Keiretsu* dummy variable that takes the value of one for REITs whose sponsors are affiliated with *keiretsu* groups and zero otherwise. Size is the log of market capitalization, Size_squared is the quadratic term of centered size, FFOA is the ratio of FFO to total assets, REIT_age is the number of years since the date of the initial public offering (IPO), LTV is the loan-to-value ratio, Property_age is the average age of properties, and Occupancy_rate is the average occupancy rate of each REIT in each half-year. Model 1 includes only the *Keiretsu* dummy and the constant term. Model 2 adds controls for firm characteristics. Model 3 also adds controls for property characteristics and half-year fixed effects. T-statistics are based on heteroscedasticity-consistent standard errors. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level

between a shareholding variable and *keiretsu* dummy along with other variances in each regression. We find that the proportion of shares held by non-financial (domestic) institutions is the only shareholding variable that affects, to some extent, the degree of the reduction of conditional variance of profitability among *keiretsu* REITs: among *keiretsu* REITs, if shares are held more by non-financial institutions, those *keiretsu* REITs exhibit even lower ($B = -0.17$; $p = 0.087$) conditional variance of profitability, suggesting that they enjoy a greater *keiretsu* affiliation mutual insurance effect. If more shares of a *keiretsu* REIT are held by domestic non-financial institutions, the chance that some of these institutions are also members of the same *keiretsu* group may be higher. Such a *keiretsu* REIT may therefore enjoy a stronger mutual insurance agreement effect through these group members/shareholders.

Test of Stock Return Volatility

Table 4 summarizes the results of the panel regressions that examine if the *keiretsu*'s risk-sharing effect is evident from the shareholders' perspective by using the volatility of each REITs' share price total returns as a dependent variable. Panel A shows the descriptive statistics, Panel B shows the results of the regressions where a dependent variable is the idiosyncratic volatility, and Panel C is for the results of the regressions where a dependent variable is the systematic volatility.

First of all, with the overall period, the risk-sharing effect of *keiretsu* is not evident with the idiosyncratic volatility (Panel B), while it is evident with the systematic volatility (Panel C), even after controlling for firm and property characteristics as well as year fixed effects. This result is opposite to the result found by Chen et al. (2010) with general corporations. Chen et al. (2010) found that the idiosyncratic volatility is reduced due to the risk-sharing of *keiretsu*, while the systematic volatility increases among *keiretsu*-affiliated general corporations. The results of Chen et al. (2010) suggest that risk-sharing of *keiretsu* may deteriorate the value of the firms because the idiosyncratic volatility anyway becomes insignificant for well-diversified investors and the systematic volatility is priced and important for such investors. To the contrary, we found that the systematic volatility is significantly smaller among *keiretsu* REITs than non-*keiretsu* REITs, while there is no significant difference in the idiosyncratic volatility regardless of the *keiretsu* affiliation of REITs. This result suggests that the risk-sharing of *keiretsu* may bring more benefits than harm to Japanese REITs.

The results in Panel B and C are also shown for different conditions of the J-REIT market. Up market is defined as the periods when the overall J-REIT market experienced positive returns and Down market is defined as the periods when the overall J-REIT market experienced negative returns. Panel C clearly shows that the systematic volatility of *keiretsu* REITs was significantly reduced compared with that of non-keiretsu REITs, especially when the J-REIT market experienced poor conditions (Down market). This result implies that when REITs are in trouble, *keiretsu* REITs may receive supports from firms in other industries in the affiliated *keiretsu* groups.

The examination of the effects of risk-sharing of *keiretsu* focusing on the idiosyncratic volatility and the systematic volatility suggests that the risk-sharing effect may be beneficial for the value of REITs, while it may deteriorate the value of general corporations. We argue that this stark and important difference of the effect comes from the external management system of REITs. This result is important because it suggests that there is a certain governance structure in which business group affiliation results in more benefits than harm. In addition, the result emphasizes the importance of the consideration of cultural factors including the existence of business groups when discussing the suitable management structure (i.e., internal vs. external) for newly developing REIT markets in different countries.

Table 4 Test of stock return volatility

Panel A: Descriptive statistics

	Keiretsu		Non-Keiretsu	
	Mean	Std. Dev.	Mean	Std. Dev.
Idiosyncratic volatility	0.1681	0.1135	0.1513	0.1044
Systematic volatility	0.1800	0.1053	0.2142	0.1561

Panel B: Idiosyncratic volatility

	Overall period			Up market			Down market		
	B	*t*		*B*	*t*		*B*	*t*	
Keiretsu	0.001	0.17		−0.003	−0.72		0.008	1.32	
Size	0.023	9.27	***	0.020	7.82	***	0.030	9.36	***
Size_squared	0.003	1.91	*	−0.004	−1.33		0.010	4.51	***
FFOA	−0.002	−1.00		0.001	0.72		−0.007	−2.04	**
REIT_age	0.002	3.38	***	0.003	4.05	***	0.001	1.59	
LTV	−0.038	−1.44		0.004	0.18		−0.133	−2.29	**
Property_age	0.002	4.49	***	0.001	4.06	***	0.003	4.47	***
Occupancy_rate	0.018	0.19		0.048	0.63		0.006	0.03	
Year fixed effects	Yes			Yes			Yes		
Constant	−0.191	−2.02	**	−0.198	−2.65	**	−0.149	−0.75	
R-squared	0.656			0.659			0.694		
Number of observations	1183			795			388		

Panel C: Systematic volatility

	Overall period			Up market			Down market		
	B	*t*		*B*	*t*		*B*	*t*	
Keiretsu	−0.014	−1.93	*	−0.007	−0.54		−0.016	−3.08	***
Size	−0.016	−3.11	***	−0.037	−4.60	***	−0.003	−0.82	
Size_squared	0.030	4.37	***	0.034	2.62	**	0.014	3.18	***

Table 4 (continued)

FFOA	−0.012	−3.03	***	−0.017	−2.32	*	−0.008	−3.11	***
REIT_age	−0.001	−0.66		0.001	0.37		−0.001	−1.09	
LTV	−0.139	−3.22	***	−0.196	−2.20	**	−0.094	−2.94	***
Property_age	0.000	−0.50		0.000	0.10		0.000	−0.88	
Occupancy_rate	−0.264	−1.81	*	−0.787	−2.89	***	−0.103	−1.07	
Year fixed effects	Yes			Yes			Yes		
Constant	0.631	4.25	***	1.474			0.313	3.07	***
R-squared	0.642			0.578	5.47	***	0.672		
Number of observations	1183			795			388		

Table 4 summarizes the results of the panel regressions where a dependent variable is the volatility of each REITs' share price total return. Panel A shows the descriptive statistics, Panel B shows the results of the regressions where a dependent variable is the idiosyncratic volatility, and Panel C is for the results of the regressions where a dependent variable is the systematic volatility. The main independent variable is the *Keiretsu* dummy variable that takes the value of one for REITs whose sponsors are affiliated with *keiretsu* groups and zero otherwise. Size is the log of market capitalization, Size_squared is the quadratic term of centered size, FFOA is the ratio of FFO to total assets, REIT_age is the number of years since the date of the initial public offering (IPO), LTV is the loan-to-value ratio, Property_age is the average age of properties, and Occupancy_rate is the average occupancy rate of each REIT in each half-year. Up market is defined as the periods when the overall J-REIT market experienced positive returns and Down market is defined as the periods when the overall J-REIT market experienced negative returns. T-statistics are based on standard errors clustered at the REIT level. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level

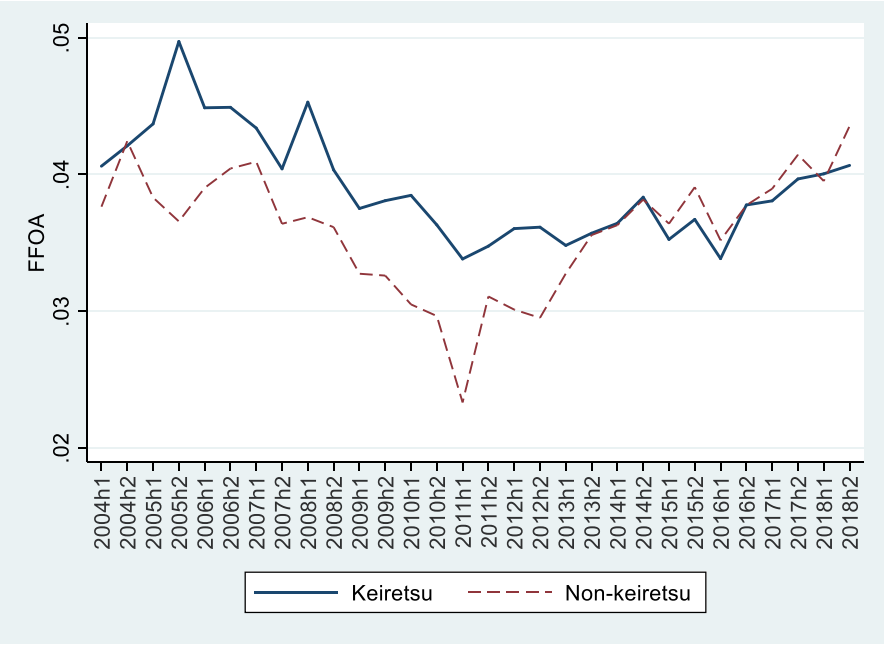

Fig. 3 Time series change of FFO: *Keiretsu* REITs vs. non-*keiretsu* REITs in the unmatched sample

Response of Profitability to Exogenous Shock

To test the risk-sharing hypothesis focusing on abnormal profitability further, we examine if *keiretsu* group affiliation of sponsors affects the profitability of REITs that are subject to an exogenous shock. As a shock that is purely exogenous and has affected REITs' profitability, we use the Great East Japan Earthquake. Figure 3 compares the profitability of *keiretsu* REITs and non-*keiretsu* REITs before matching for the overall study period. It shows that the Great East Japan Earthquake negatively affected the profitability of REITs in general, especially in the first half of 2011, and that the negative impact was much smaller with *keiretsu* REITs than with non-*keiretsu* REITs. However, this observation based on the unmatched sample may be simply a result of differences in firm and property characteristics between *keiretsu* REITs and non-*keiretsu* REITs. We, therefore, examine the possible difference in the impact of the exogenous shock on the profitability between *keiretsu* REITs and non-*keiretsu* REITs, focusing on the matched pairs of *keiretsu* REIT and non-*keiretsu* REIT that share similar firm and property characteristics.

Table 5 shows the quality of the matched sample of 30 REITs (15 *keiretsu* REITs and 15 non-*keiretsu* REITs) in Panel A and summarizes the statistics of the profitability variables in Panel B. Panel A confirms that, as a result of matching, our treatment group (*keiretsu* REITs) and the comparison group (non-*keiretsu* REITs) are highly homogeneous with respect to size, LTV, occupancy

Table 5 Summary statistics of propensity score matching (PSM) sample

		Treatment: Keiretsu	*Comparison: Non-keiretsu*	*Difference*	*% reduction*	*Difference inmeans asproportion of standarddeviation*	*Cochran's rule of thumb*
Panel A: Firm and property characteristic variables							
Size (log)	Unmatched	11.21	10.39	0.82			
	Matched	11.21	11.42	−0.21	74.4%	0.240	y
LTV	Unmatched	0.44	0.47	−0.03			
	Matched	0.44	0.45	−0.01	65.5%	0.139	y
Occupancy_ rate	Unmatched	0.97	0.95	0.02			
	Matched	0.97	0.97	0.00	96.8%	0.038	y
PML	Unmatched	4.34	5.57	−1.23			
	Matched	4.34	4.73	−0.39	68.3%	0.189	y
% Tokyo	Unmatched	0.19	0.21	−0.02			
	Matched	0.19	0.18	0.01	40.5%	0.081	y
Panel B: Profitability variables							
FFO/Asset	Unmatched	3.85%	3.57%	0.00			
	Matched	3.74%	3.84%	0.00	63.4%	0.953	n
V(FFO/Asset)	Unmatched	0.89%	1.51%	−0.01			
	Matched	0.91%	1.53%	−0.01	0.2%	0.835	n
ROA	Unmatched	2.65%	2.60%	0.00			
	Matched	2.45%	3.81%	−0.01	−2815.2%	1.108	n
V(ROA)	Unmatched	1.19%	1.96%	−0.01			
	Matched	0.93%	1.51%	−0.01	25.1%	0.7747	n

Table 5 compares the statistics of the unmatched sample of 34 REITs (15 *keiretsu* REITs and 19 non-*keiretsu* REITs) that were listed for the pre-event during the second half of 2009 and the second half of 2010 and those of the matched sample of 30 REITs (15 *keiretsu* REITs and 15 non-*keiretsu* REITs). Panel A shows the firm and property characteristics to verify the quality of the matching procedure. Panel B summarizes the profitability variables of unmatched and matched samples. FFO/Asset is the ratio of funds from operation to total assets, V(FFO/Asset) is the standard deviation of FFO/Asset, ROA is the return on assets, V(ROA) is the standard deviation of ROA. To estimate the propensity score, we use the logit model, in which the dependent variable is the Keiretsu dummy (1 for *keiretsu* REITs and 0 for non-*keiretsu* REITs) and the independent variables are size (log), LTV, occupancy rate, PML, and the proportion of properties in Tokyo. One-to-one matching is done with replacement. The column "% reduction" shows the percentage reduction in the mean difference between *keiretsu* REITs and non-*keiretsu* REITs. "Cochran's rule of thumb" reports whether the mean difference of a variable with the matched sample is less than a quarter of a standard deviation of the respective variable ("y" indicates that the mean difference is smaller than this threshold, suggesting that good balance is achieved after matching).

rate, PML, and the proportion of properties owned in Tokyo. The mean differences of these variables were reduced by 41%–97%. Furthermore, all variables satisfy Cochran's rule of thumb. This means that none of these variables differs by more than a quarter of a standard deviation of the respective variable between the treatment and comparison groups, suggesting that our matched sample is well

balanced (Cochran, 1968; Ho et al., 2007).[22] Therefore, we have a panel of reasonably balanced treatment and comparison REITs, which allows us to claim that any observed treatment effect on profitability is not biased by differences between treatment and comparison groups in firm and property characteristics. In Panel B of Table 5, it is notable that, even in the matched sample, the volatilities of FFO ratio and ROA are still much lower among *keiretsu* REITs than among non-*keiretsu* REITs, which again seems to support the risk-sharing hypothesis of business group affiliation.

Table 6 summarizes the result of the difference-in-differences (DID) regression based on the matched sample of 15 *keiretsu* REITs and 15 non-*keiretsu* REITs. A dependent variable is the ratio of FFO to total assets (annualized and multiplied by 100). The pre-event period is from the second half of 2009 to the second half of 2010. The post-event period is from the first half of 2011 to the second half of 2011. A coefficient for Time#Keiretsu is the DID estimator and the parameter of interest. Figure 4 compares the profitability of *keiretsu* REITs and non-*keiretsu* REITs in the matched sample for the overall study period. It first shows that the profitability of *keiretsu* REITs and non-*keiretsu* REITs has been more similar to each other in the matched sample compared with the trend observed with the unmatched sample, as shown in Fig. 3, which further verifies the quality of matching and seems to support the parallel trend assumption in the pre-event period. However, even within the matched sample, the negative impact of the earthquake is much larger with non-*keiretsu* REITs than with *keiretsu* REITs.

In Table 6, the DID estimator shows a significantly large positive effect ($B = 1.09$; $z = 2.60$), suggesting that while the earthquake negatively affected both *keiretsu* REITs and non-*keiretsu* REITs, this negative impact was much smaller with *keiretsu* REITs than with non-*keiretsu* REITs. As the coefficient of the Time variable shows, the earthquake reduced the profitability of non-*keiretsu* REITs by 1.4%, while the DID estimator shows that the negative effect with *keiretsu* REITs was smaller than the negative effect with non-*keiretsu* REITs by 1.1%. Thus, *keiretsu* REITs were, in fact, not greatly affected by the Earthquake. Since we conduct the DID analysis with the matched sample, the result suggests that the mutual insurance of *keiretsu* group affiliation played some role in absorbing the shock to the profitability of *keiretsu* REITs.

Although understanding the detailed mechanism of the risk-sharing of *keiretsu* group affiliation is beyond the scope of this study, we run analyses to gain insights for future study, focusing on the change in the capital structure after the Great East Japan Earthquake. During crisis periods, REITs can easily have a liquidity issue because they are not allowed to retain a large amount of cash due to the distribution requirement. The liquidity issue in crisis periods is amplified if REITs rely heavily on short-term debt, because banks may not be willing or able to refinance this debt when banks are also in a difficult situation. REITs with liquidity problems may not be able to execute proper property management, including repairs and renovations, which may affect the long-term stability of profitability. Thus, the capital structure especially during crisis

[22] A t-test of the mean difference for each of these variables confirms that the differences are not statistically significant. However, we do not report the results of the t-tests, because balance is a characteristic of the observed sample and not a hypothetical population. Thus, *t* statistics below 2, for example, have no special relevance for assessing balance.

periods may be one of the mechanisms behind the observed risk-sharing effect of *keiretsu* group affiliation, because a *keiretsu* REIT may be able to receive preferential financing arrangements from a bank that is also a member of the same *keiretsu* group during crisis periods. To compare the change in the capital structure during crisis periods between *keiretsu* REITs and non-*keiretsu* REITs, we run DID regressions similar to those in Table 6 with the same matched sample, using capital structure variables as dependent variables to examine what kind of differences in the capital structure can be observed between *keiretsu* REITs and non-*keiretsu* REITs after the earthquake.

Panel A of Table 7 summarizes the results.[23] While there is no significant difference in the change in LTV between *keiretsu* REITs and non-*keiretsu* REITs (Model 1), *keiretsu* REITs reduced the amount of short-term debt significantly more (Model 2) and increased the amount of long-term debt significantly more (Model 3), compared with these changes among non-*keiretsu* REITs during the crisis period. These results suggest that only *keiretsu* REITs were able to stabilize their capital structure to alleviate the liquidity concern when the earthquake created a greater amount of uncertainty in the Japanese economy. Furthermore, the result of Model 4 shows that *keiretsu* REITs stabilized their capital structure without having an excessively higher cost of debt compared with the cost of debt of non-*keiretsu* REITs, even though long-term debts usually carry higher costs of debt. While the investigation into more direct evidence is warranted, the results in Table 7 imply that *keiretsu* REITs may have received preferential financing arrangements from banks affiliated with the same *keiretsu* groups after the earthquake that may have affected the long-term stability of their profitability.

To deepen the understanding of the possible mechanism in which how *keiretsu* affiliation can reduce the volatility of profitability further, Panel B of Table 7 summarizes the statistics of the new loans originated by banks affiliated with *keiretsu* groups for 15 *keiretsu* REITs and 15 non-*keiretsu* REITs in the matched sample.[24] For each *keiretsu* REIT, we summarize the loans from a bank affiliated with the same *keiretsu* group. For non-*keiretsu* REITs, we summarize loans from banks affiliated with any of 6 major *keiretsu* groups. Thus, the definition of *keiretsu* banks differs for *keiretsu* REITs and non-*keiretsu* REITs. Nevertheless, the results in Panel B are meaningful because our definition should work against our hypothesis that *keiretsu* REITs benefited more from *keiretsu* banks during the crisis period. Compared with the pre-earthquake period, the total amount of the loans originated by *keiretsu* banks for *keiretsu* REITs was reduced by 54% after the Great East Japan Earthquake, while this amount with non-*keiretsu*

[23] Short-term debts are debts with maturities equal to or shorter than 1 year and long-term debts are those with maturities longer than 1 year. Statistics shown in Panel B exclude bonds issued by REITs. Note that the average maturity of the bank loans originated during the period between the second half of 2009 and the second half of 2011 (shown in Panel B of Table 7) is exceptionally short. For the overall study period between 2004 and 2018, the average maturities of bank loans and corporate bonds used by these J-REITs are 1309.98 days (3.59 years) and 2615.87 (7.17 years), respectively, which are in line with statistics reported for the U.S. REITs.

[24] We collected data from the loan release database provided by Japan REIT DB.

Table 6 Response of profitability to exogenous shock

	FFOA		
	B	*z*	
Time	−1.358	−3.35	***
Keiretsu	−1.205	−3.39	***
Time#Keiretsu	1.092	2.60	***
Constant	4.963	16.03	***
Prob > Wald chi2	0.000		
Number of observations	142		
Number of REITs	30		

Table 6 summarizes the result of the difference-in-differences (DID) regression based on the matched pair of 15 *keiretsu* REITs and 15 non-*keiretsu* REITs. A dependent variable is the ratio of FFO to total assets (annualized and multiplied by 100). The pre-event period is from the second half of 2009 to the second half of 2010. The post-event period is from the first half of 2011 to the second half of 2011. Time is the dummy that takes the value of one for the post-event period and the value of zero for the pre-event period. Keiretsu is the dummy variable that takes the value of one for *keiretsu* REITs and the value of zero otherwise. A coefficient for Time#Keiretsu is the DID estimator and the parameter of interest. We use a Gaussian generalized linear model (GLM) with identity link and exchangeable correlation structure. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level

REITs was reduced by 92%,[25] indicating that *keiretsu* REITs were still able to borrow money from their affiliated group banks even right after the earthquake. On the other hand, non-*keiretsu* REITs seem to have struggled to secure loans from these *keiretsu* banks after the earthquake. It is also interesting to note that the new bank loans originated right after the earthquake for *keiretsu* REITs carried lower interest rates (0.478% vs. 0.763%) and longer maturities (54.22 days vs. 37.39 days) compared with loans made for non-*keiretsu* REITs. Thus, *keiretsu* banks seem to have prioritized their lending activities for REITs affiliated with the same *keiretsu* groups, which must have contributed to reducing the volatility of profitability of these *keiretsu* REITs.

Robustness Checks

First, different property types have different typical lease lengths and Table 2 shows that there are significant differences in the property portfolio composition between *keiretsu* REITs and non-*keiretsu* REITs. Therefore, the reduced volatility of profitability may

[25] During the post-earthquake period (2011 h1 and 2011 h2), only 4 out of 15 non-*keiretsu* REITs were able to take out the new loans from *keiretsu* banks, while 10 out of 15 *keiretsu* REITs were able to take out the new loan from the *keiretsu* banks. This fact also prevents us from conducting formal regression analyses meaningfully.

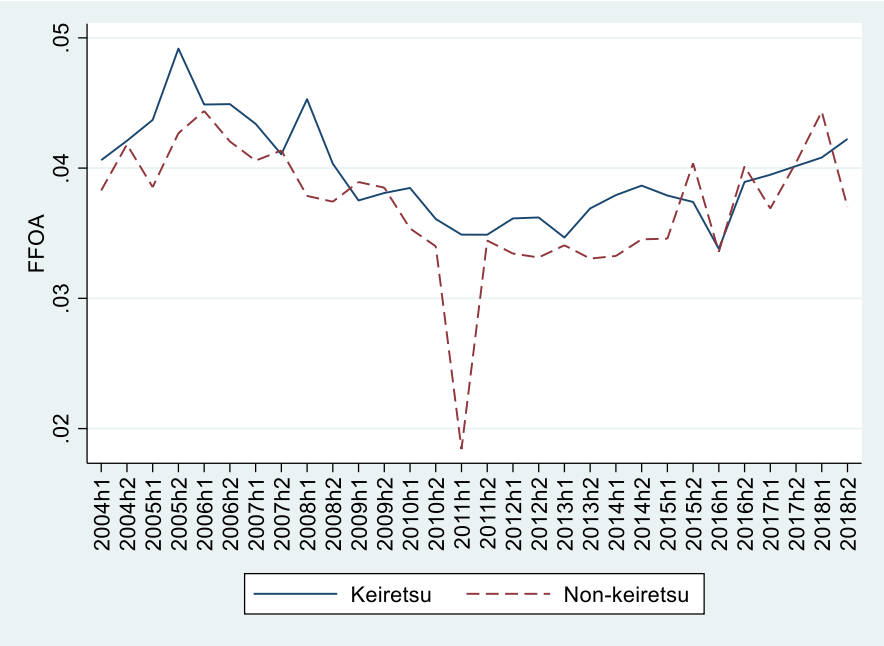

Fig. 4 Time series change of FFO: *Keiretsu* REITs vs. non-*keiretsu* REITs in the matched sample

be attributable to the different property types that REITs hold. The degree of diversification in terms of property type may also affect the volatility of profitability. We test whether our estimation results are robust if we add property type variables along with the firm and property characteristic control variables already included. More specifically, based on Eq. (1) whose results are shown in Model 3 of Panel A in Table 2, we further add the average proportions of office, residential, retail, and logistics properties held by each REIT. Panel A of Appendix 2 confirms that the *Keiretsu* variable remains significant at the 10% level ($B=-0.446$; $t=-1.74$), while the addition of these property type variables increased the R-squared measure by 10%.

Secondly, we re-run our analyses again based on Eq. (1) using rolling 10-year periods (i.e. 20 half-year periods) to examine if the risk-sharing effect has been stable over time or period specific. In each regression, we also add property type variables. Panel B of Appendix 2 shows that the coefficient and the standard error are quite stable and that the expected negative effect of the *Keiretsu* variable is always significant at the 5% level, regardless of the estimation period.

Thirdly, to address any potential omitted variable concerns, we run the regression where a dependent variable is the volatility of FFO ratio (VFFOA) and an independent variable is the *keiretsu* dummy, using the matched sample of 15 *keiretsu* REITs and 15 non-*keiretsu* REITs, which were confirmed to be quite homogeneous in Table 5. We run the cross-sectional regression for the overall study period. Panel C of Appendix 2 shows that, even with the matched sample, the volatility of profitability is significantly lower among *keiretsu* REITs than among non-*keiretsu* REITs.

Table 7 Response of capital structure variables to exogenous shock

Panel A: Results of the difference-in-differences regressions

	Model 1			Model 2			Model 3			Model 4		
Dependent variable	LTV			Short Debt			Long Debt			Cost of Debt		
	B	*z*		*B*	*z*		*B*	*z*		*B*	*z*	
Time	0.218	1.66	*	0.226	0.48		−0.101	−0.23		−0.077	−8.79	***
Keiretsu	−0.968	−0.39		3.585	1.87	*	−4.670	−2.76	***	−0.084	−1.31	
Time#Keiretsu	1.097	1.43		−5.181	−2.28	**	5.786	2.58	***	−0.006	−0.22	
Constant	44.853	79.85	***	12.007	11.89	***	40.055	37.80	***	1.536	40.62	***
Prob > Wald chi2	0.1155			0.151			0.006			0.000		
Number of observations	142			142			142			142		
Number of REITs	30			30			30			30		

Panel B: Statistics of new loans made by *keiretsu* banks

	Keiretsu REITs (15)			Non-*Keiretsu* REITs (15)		
	Amount (million JPY)	Loan rate (%)	Maturity (days)	Amount (million JPY)	Loan rate (%)	Maturity (days)
Pre-Earthquake: 2009 h2-2010 h2	934,225	0.826	166.24	1,079,596	1.394	213.92
Post-Earthquake: 2011 h1-2011 h2	431,875	0.478	54.22	91,030	0.763	37.39

Panel A of Table 7 summarizes the result of the difference-in-differences (DID) regressions based on the matched pair of 15 *keiretsu* REITs and 15 non-*keiretsu* REITs. A dependent variable is LTV, the ratio of short-term debt to total assets, the ratio of long-term debt to total assets, and cost of debt in Model 1, 2, 3, and 4, respectively. The pre-event period is from the second half of 2009 to the second half of 2010. The post-event period is from the first half of 2011 to the second half of 2011. Time is the dummy that takes the value of one for the post-event period and the value of zero for the pre-event period. Keiretsu is the dummy variable that takes the value of one for *keiretsu* REITs and the value of zero otherwise. A coefficient for Time#Keiretsu is the DID estimator and the parameter of interest. We use a Gaussian generalized linear model (GLM) with identity link and exchangeable correlation structure. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level. Panel B shows the summary statistics of the new loans (total amount, average loan rate, and average maturity in days) originated by banks affiliated with *keiretsu* groups. For each *keiretsu* REIT, we summarize loans from a bank affiliated with the same *keiretsu* group. For non-*keiretsu* REITs, we summarize loans from banks affiliated with any of the 6 major *keiretsu* groups

Finally, the important argument in this study is that the external management system of the J-REITs is unique and helps reinforce power relationships among firms affiliated with business groups. To support this argument, we examine the effect of the sponsor ownership of REITs' shares on the relationship between the *keiretsu* affiliation and the volatility of profitability.[26] The average and the standard deviation of the sponsor ownership ratio among J-REITs in the sample are 10.29% and 9.22%, respectively. Specifically, we added the interaction term between *keiretsu* dummy variable and the sponsor ownership variable along with all the control variables to the regression (volatility regression) where a dependent variable is the volatility of FFO ratio (VFFOA) and to the regression where a dependent variable is the conditional variance of profitability (conditional variance regression). With the volatility regression, the interaction term is negative and significant at the 5% level ($\beta = -0.45$; $t = -2.12$). With the conditional variance regression, the interaction term is also negative and significant at the 10% level ($\beta = -0.01$; $t = -1.65$). These results suggest that when the relationship between sponsors and REITs is reinforced as evident with the higher sponsor ownership, the risk-sharing effect of *keiretsu* affiliation is indeed stronger resulting in the reduced volatility of profitability and the conditional variance of profitability.

Concluding Remarks

We examine the business groups' risk-sharing hypothesis with Japanese REITs with the expectation that the business groups still play important roles for REITs even in a country where the significance of such groups is reported to have weakened with general corporations. We argue that this revival of the risk-sharing effect is caused mainly by the external management system of REITs, which reinforced the power relationship within the modern Japanese *keiretsu* groups.

First, we find that REITs, whose sponsors belong to one of the 6 major *keiretsu* groups, have significantly lower volatility of profitability than REITs whose sponsors do not belong to any of the major *keiretsu* groups, even after controlling for firm and property characteristics. On the other hand, there is no significant difference in profitability between *keiretsu* REITs and non-*keiretsu* REITs with the same controls. Secondly, focusing on abnormal profitability, we find that the portion of profitability unexplained by firm characteristics (conditional variance of profitability) is significantly lower with *keiretsu* REITs than with non-*keiretsu* REITs. This result implies that *keiretsu* REITs may be considered as sub-members of *keiretsu* groups and *keiretsu* REITs are part of mutual insurance arrangements among *keiretsu* group member firms. Thirdly, we find that the *keiretsu* affiliation reduces the systematic volatility of affiliated REITs compared with non-affiliated REITs, while it does not affect the idiosyncratic volatility. Since it is the systematic volatility that is priced and important for well-diversified investors, the result suggests that the risk-sharing of *keiretsu* may bring more benefits than harm to Japanese REITs. The systematic volatility of *keiretsu* REITs is reduced especially when the J-REIT market experienced poor conditions, implying that

[26] We thank the anonymous referee for suggesting this additional analysis.

when REITs are in trouble, *keiretsu* REITs may receive supports from firms in other industries that also belong to the affiliated *keiretsu* groups.

Finally, we find that *keiretsu* REITs and non-*keiretsu* REITs, which share the similar firm and property characteristics, responded quite differently to the exogenous shock (the Great East Japan Earthquake): the negative impact of the Earthquake on profitability was significantly smaller with *keiretsu* REITs than with non-*keiretsu* REITs. This result seems to suggest that the mutual insurance of *keiretsu* group affiliation played some role in absorbing the earthquake shock to the profitability of *keiretsu* REITs. *Keiretsu* REITs were also able to stabilize their capital structure by shifting some short-term debt to long-term debt without increasing the cost of loans, under the uncertain situation caused by the earthquake. The data also reveals that *keiretsu* REITs were still able to borrow money from their affiliated group banks even right after the earthquake. On the other hand, non-*keiretsu* REITs seem to have struggled to secure loans from these *keiretsu* banks after the earthquake.

The results of this study suggest that business group affiliation may have significant effects on REITs, especially when they are externally managed and are still at the developing stage. Such REIT markets are often observed in countries where business groups similar to Japanese *keiretsu* are also present, such as Brazil, China, India, Mexico, Singapore, South Korea, and Thailand. Thus, the examination of the potential effects of business group affiliation on profitability, management style, and impacts of economic shocks on REITs is of global importance.

Appendix 1

No.	REIT name	Sponsor name	Keiretsu	Type
1	Activia Properties Inc.	Tokyu RE	0	diversified
2	Advance Residence Investment Corporation	Itochu Corporation	1	residential
3	Advance Residence Investment Corporation (old)	Itochu Corporation	1	residential
4	AEON REIT Investment Corporation	AEON	0	retail
5	Comforia Residential REIT, Inc	Tokyu RE	0	residential
6	CRE Logistics REIT, Inc.	CRE	0	logistics
7	Daiwa House REIT Investment Corporation	Daiwa House	0	diversified
8	Daiwa House REIT Investment Corporation (old)	Daiwa House	0	retail
9	Daiwa Office Investment Corporation	Daiwa Securities	0	office
10	Frontier Real Estate Investment Corporation	Mitsui RE	1	retail
11	Fukuoka REIT Corporation	Fukuoka RE	0	diversified
12	Global One Real Estate Investment Corp.	Meiji Yasuda Life	1	office
13	GLP J-REIT	GLP	0	logistics
14	Hankyu Hanshin REIT, Inc.	Hankyuu Rail	1	diversified
15	Healthcare & Medical Investment Corporation	Mitsui Sumitomo Bank	1	health care
16	Heiwa Real Estate REIT, Inc.	Heiwa RE	0	diversified

No.	REIT name	Sponsor name	Keiretsu	Type
17	Hoshino Resorts REIT, Inc.	Hosino Resort	0	hotel
18	Hulic Reit, Inc.	Hulic	0	diversified
19	Ichigo Hotel REIT Investment Corporation	Ichigo Group	0	hotel
20	Ichigo Office REIT Investment Corporation	Ichigo Group	0	office
21	Ichigo REIT (old)	Creed	0	office
22	Industrial & Infrastructure Fund Investment Corporation	Mitsubishi Corporation	1	logistics
23	Invesco Office J-REIT, Inc.	Invesco	0	office
24	Invincible Investment Corporation	Fortress	0	diversified
25	Japan Excellent, Inc.	Shinnittetsu Kowa RE	0	office
26	Japan Hotel and Resort, Inc.	Goldman Sachs	0	hotel
27	Japan Hotel REIT Investment Corporation	SC Capital	0	hotel
28	Japan Logistics Fund, Inc.	Mitsui Corporation	1	logistics
29	Japan Prime Realty Investment Corporation	Tokyo Tatemono	1	diversified
30	Japan Real Estate Investment Corporation	Mitsubishi RE	1	office
31	Japan Rental Housing Investments Inc.	Daiwa Securities	0	residential
32	Japan Retail Fund Investment Corporation	Mitsubishi Corporation	1	retail
33	Japan Senior Living Investment Corporation	Kenedix	0	health care
34	Japan Single-residence REIT Inc.	Invoice	0	residential
35	Kenedix Office Investment Corporation	Kenedix	0	office
36	Kenedix Residential Next Investment Corp.	Kenedix	0	residential
37	Kenedix Retail REIT Corporation	Kenedix	0	retail
38	LaSalle Japan REIT Inc.	LaSalle	0	diversified
39	LaSalle LOGIPORT REIT	LaSalle	0	logistics
40	LCP Investment Corporation	LCP	0	residential
41	Marimo Regional Revitalization REIT, Inc.	Marimo	0	diversified
42	MCUBS MidCity Investment Corporation	Mitsubishi Corporation	1	office
43	Mirai Corporation	Mitsui Corporation	1	diversified
44	Mitsubishi Estate Logistics REIT Investment Corporation	Mitsubishi RE	1	logistics
45	Mitsui Fudosan Logistics Park Inc.	Mitsui RE	1	logistics
46	Mori Hills REIT Investment Corporation	Mori Building	0	office
47	MORI Trust Hotel REIT, Inc	Mori Trust	0	hotel
48	MORI TRUST Sogo Reit, Incorporation	Mori Trust	0	diversified
49	New City Residence Investment Corporation	CBRE	0	residential
50	Nippon Accommodations Fund Inc.	Mitsui RE	1	residential
51	Nippon Building Fund Incorporation	Mitsui RE	1	office
52	Nippon Commercial Investment Corporation	Pacific	0	office
53	Nippon Healthcare Investment Corporation	Daiwa Securities	0	health care
54	Nippon Prologis REIT, Inc.	Prologis	0	logistics
55	NIPPON REIT Investment Corporation	Soujitsu	1	office
56	Nippon Residential Investment Corporation	Pacific	0	residential
57	Nomura Real Estate Master Fund, Inc.	Nomura RE	0	diversified
58	Nomura Real Estate Master Fund, Inc. (old)	Nomura RE	0	diversified

No.	REIT name	Sponsor name	Keiretsu	Type
59	Nomura Real Estate Office Fund, Inc.	Nomura RE	0	office
60	Nomura Real Estate Residential Fund, Inc.	Nomura RE	0	residential
61	One REIT, Inc	Mizuho Trust Bank	1	office
62	Ooedo Onsen REIT Investment Corporation	Ooedo Onsen	0	hotel
63	ORIX JREIT Inc.	ORIX	0	diversified
64	Premier Investment Corporation	NTT	0	diversified
65	Prospect Reit Investment Corporation	Prospect	0	residential
66	Sakura Sogo REIT	Galileo	0	diversified
67	Samty Residential Investment Corporation	Samty-Daiwa	0	residential
68	Sekisui House Reit, Inc.	Sekisui House	1	diversified
69	Sekisui House Residential Investment Corporation	Sekisui House	1	residential
70	Star Asia Investment Corporation	Star Asia	0	diversified
71	Starts Proceed Investment Corporation	Starts Corporation	0	residential
72	Tokyu REIT, Inc.	Tokyu Rail	0	diversified
73	Top REIT, Inc.	Mitsui Sumitomo Bank	1	diversified
74	Tosei REIT Corporation	Tosei	0	diversified
75	United Urban Investment Corporation	Marubeni	1	diversified

#There are 75 distinct REITs in terms of distinct security codes because some REITs experienced a change of sponsor and/or mergers. The Keiretsu variable takes the value of 1 if the sponsor belongs to one of six *keiretsu* groups and zero otherwise. There are 23 *keiretsu* REITs and 52 non-*keiretsu* REITs

Appendix 2

Panel A: VFFOA regression with property type variables (overall period)

	B	*t*	
Keiretsu	-0.446	−1.74	*
Size	−0.446	−1.32	
Size_squared	−0.057	−0.56	
FFOA	−0.577	−1.36	
REIT_age	0.173	1.67	
LTV	−0.554	−0.26	
Property_age	0.026	0.72	
Occupancy_rate	−10.704	−1.46	
% office	−2.128	−1.83	*
% residential	−1.666	−1.56	
% retail	−1.155	−1.29	
% logistics	−0.853	−0.98	
Constant	17.587	2.37	**
R-squared	0.321		
Number of observations	75		

Panel B: VFFOA rolling regressions with all control variables

Start	End	N_obs	R2	beta_Keiretsu	se_Keiretsu	*t*	
2004	2013	50	0.160	−0.436	0.190	−2.29	**
2005	2014	55	0.199	−0.314	0.154	−2.04	**
2006	2015	60	0.200	−0.300	0.149	−2.02	**
2007	2016	67	0.165	−0.323	0.156	−2.08	**
2008	2017	72	0.223	−0.298	0.139	−2.14	**
2009	2018	73	0.156	−0.320	0.136	−2.36	**

Panel C: VFFOA regression with the matched sample

	VFFOA		
	B	*t*	
Keiretsu	−0.369	−1.91	*
Constant	1.195	7.12	***
R-squared	0.077		
Number of observations	30		

Appendix B summarizes the results of the robustness checks based on additional control variables and different methodologies. Panel A shows the result of the cross-sectional regression where a dependent variable is the standard deviation of the ratio of FFO to total assets (VFFOA) as shown in Eq. (1). Based on Model 3 of Panel A of Table 2, this regression adds four property type variables: the proportions of office, residential, retail, and logistics properties (averaged over all years for each REIT). Panel B summarizes the results of the profitability volatility regressions the same as the one in Panel A of Appendix B, but for rolling 10-year periods (i.e. 20 half-year periods). All control variables are included, but the only results with the Keiretsu variable are shown. In Panel C, we use the matched sample (15 *keiretsu* REITs and 15 non-*keiretsu* REITs) we constructed for Table 5. It shows the result of the cross-sectional regression run with the matched sample for the overall sample period where a dependent variable is VFFOA

Funding Open access funding provided by University of Applied Sciences and Arts Western Switzerland (HES-SO).

References

Almeida, H., & Wolfenzon, D. (2006). A theory of pyramidal ownership and family business groups. *Journal of Finance, 61*(6), 2637–2681.

Aoki, M. (1988). *Information, incentives and bargaining in the Japanese economy*. Cambridge University Press.

Aoki, M. (1994). Monitoring characteristics of the main bank system: An analytical and developmental view. In *The Japanese Main Bank system*. Oxford University Press.

Berglof, E., & Perotti, E. (1994). The governance structure of the Japanese financial keiretsu. *Journal of Financial Economics, 36*(2), 259–284.

Bertrand, M., Mehta, P., & Mullainathan, S. (2002). Ferreting out tunneling: An application to Indian business groups. *Quarterly Journal of Economics, 117*(1), 121–148.

Byun, H., Choi, S., Hwang, L., & Kim, R. (2013). Business group affiliation, ownership structure, and the cost of debt. *Journal of Corporate Finance, 23*(5), 311–331.

Cannon, S. E., & Vogt, S. C. (1995). REITs and their management: An analysis of organizational structure, performance, and management compensation. *Journal of Real Estate Research, 10*(3), 297–317.

Capozza, D. R., & Seguin, P. J. (2000). Debt, agency, and management contracts in REITs: The external advisor puzzle. *Journal of Real Estate Finance and Economics, 20*(2), 91–116.

Capozza, D. R., & Seguin, P. J. (2003). Inside ownership, risk sharing and Tobin's q-ratios: Evidence from REITs. *Real Estate Economics, 31*(3), 367–404.

Carney, M., Gedajlovic, E. R., Heugens, P. P., Van Essen, M., & Van Oosterhout, J. (2011). Business group affiliation, performance, context, and strategy: A meta-analysis. *Academy of Management Journal, 54*(3), 437–460.

Chen, C. R., Guo, W., & Tay, S. P. (2010). Are member firms of corporate groups less risky? *Financial Management, 39*(1), 59–82.

Choi, J. J., Jo, H., Kim, J., & Kim, M. S. (2018). Business groups and corporate social responsibility. *Journal of Business Ethics, 153*(3), 931–954.

Claessens, S., Fan, J. P., & Lang, L. H. (2006). The benefits and costs of group affiliation: Evidence from East Asia. *Emerging Markets Review, 7*(1), 1–26.

Cochran, W. G. (1968). The effectiveness of adjustment by subclassification in removing bias in observational studies. *Biometrics, 24*(2), 295–313.

Downs, D. H., Ooi, J. T. L., Wong, W. C., & Ong, S. E. (2016). Related party transactions and firm value: Evidence from property markets in Hong Kong, Malaysia, and Singapore. *Journal of Real Estate Finance and Economics, 52*(4), 408–427.

Ferris, S. P., Kim, K. A., & Kisabunnarat, P. (2003). The cost (and benefits?) of diversified business groups: The case of Korean chaebols. *Journal of Banking & Finance, 27*(2), 251–273.

Gaur, A. S., Kumar, V., & Singh, D. (2014). Institutions, resources, and internationalization of emerging economy firms. *Journal of World Business, 49*(1), 12–20.

Gerlach, M. L. (1992). *Alliance capitalism: The social organization of Japanese business*. University of California Press.

Ho, D. E., Imai, K., King, G., & Stuart, E. A. (2007). Matching as nonparametric preprocessing for reducing model dependence in parametric causal inference. *Political Analysis, 15*(3), 199–236.

Hoshi, T., & Kashyap, A. (2001). *Corporate financing and governance in Japan*. MIT Press.

Hoshi, T., Kashyap, A., & Scharfstein, D. (1990). The role of banks in reducing the costs of financial distress in Japan. *Journal of Financial Economics, 27*(1), 67–88.

Hsieh, C.-H., & Sirmans, C. F. (1991). REITs as captive-financing affiliates: Impact on financial performance. *Journal of Real Estate Research, 6*(2), 179–189.

Jia, N., Shi, J., & Wang, Y. (2013). Coinsurance within business groups: Evidence from related party transactions in an emerging market. *Management Science, 59*(10), 2295–2313.

Kensy, R. (2001). *Keiretsu economy-new economy? Japan's multinational enterprises from a postmodern perspective*. Palgrave.

Khanna, T., & Palepu, K. (1997). Why focused strategies may be wrong for emerging markets. *Harvard Business Review, 75*(4), 41–51.

Khanna, T., & Palepu, K. (2000a). Is group membership profitable in emerging markets? An analysis of diversified Indian business groups. *Journal of Finance, 55*(2), 867–891.

Khanna, T., & Palepu, K. (2000b). The future of business groups in emerging markets: Long run evidence from Chile. *Academy of Management Journal, 43*(3), 268–285.

Khanna, T., & Rivkin, J. (2000). Ties that bind business groups: Evidence from an emerging economy. Harvard Business School Working Paper.

Khanna, T., & Yafeh, Y. (2005). Business groups and risk sharing around the world. *Journal of Business, 78*(1), 301–340.

Kim, H., Hoskisson, R. E., & Wan, W. P. (2004). Power dependence, diversification strategy, and performance in keiretsu member firms. *Strategic Management Journal, 25*(7), 613–636.

Li, Q., & Chuen, D. L. K. (2018). Government ownership and firm value: Evidence from Singapore REITs. Working Paper, University of Florida.

Lincoln, J. R., & Shimotani, M. (2009). Whither the *Keiretsu*, Japan's business networks? How were they structured? What did they do? Why are they gone? Working paper series, Institute for Research on Labor and Employment, .

Mahmood, I. P., Zhu, H., & Zaheer, A. (2017). Centralization of intergroup equity ties and performance of business group affiliates. *Strategic Management Journal, 38*(5), 1082–1100.

Nakatani, I. (1984). The economic role of financial corporate grouping. In M. Aoki (Ed.), *The economic analysis of the Japanese firm*. North-Holland.

Peng, M. W., Lee, S., & Tan, J. J. (2001). The keiretsu in Asia: Implications for multilevel theories of competitive advantage. *Journal of International Management, 7*(4), 253–276.

Ray, S., & Ray, C. B. (2018). Business group affiliation and corporate sustainability strategies of firms: An investigation of firms in India. *Journal of Business Ethics, 153*(4), 955–976.

Sheard, P. (1989). The main bank system and corporate monitoring and control in Japan. *Journal of Economic Behavior & Organization, 11*(3), 399–422.

Wei, P., Hsieh, C. H., & Sirmans, C. (1995). Captive financing arrangements and information asymmetry: The case of REITs. *Real Estate Economics, 23*(3), 385–394.

Wong, W.-C., Ong, S.-E., & Ooi, J. T. L. (2013). Sponsor backing in Asian REIT IPOs. *Journal of Real Estate Finance and Economics, 46*(2), 299–320.

Yafeh, Y. (2003). Japan's corporate groups: Some international and historical perspectives. In M. Bloomstrom, J. Corbett, F. Hayashi, & A. Kashyap (Eds.), *Structural impediments to growth in Japan*. University of Chicago Press.