Grant-in-Aid for Scientific Research (S)

Real Estate Markets, Financial Crisis, and Economic Growth

: An Integrated Economic Approach

Working Paper Series No.53

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March, 2016

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The Effect of Real Estate Prices on Banks' Lending Channel*

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March 13, 2016

Abstract

The shocks to real estate prices potentially have effects on banks' balance sheets, their lending behavior, and eventually economic activities. We examine the existence of the bank lending channel in Japan during the 2007–2013 global financial crisis. We identify the heterogeneous shocks to real estate prices that affect banks by summarizing the land prices of their borrowing firms. We use a comprehensive database on firm-bank relationships as well as information on land prices for more than 20,000 locational points in Japan. We find that after controlling for fixed effects, a bank that faces a rise in land prices increases its capital, total loans, real estate loans, and loans backed by real estate collateral. We also find that the increased land prices do not significantly change the amount of non-real estate loans or loans without real estate collateral. Further, after controlling for time-varying firm fixed effects, increased land prices cause banks to reduce their transactional relationships with firms both in terms of extensive and intensive margins. We provide several possible explanations for the difference in the results between bank-level estimations and matched bank-firm estimations.

Key Words: Bank Lending Channel, Real Estate Prices, Portfolio Reallocation.

JEL Classification Numbers: E44, E51, G21.

* This study is conducted as a part of the Project on Corporate Finance and Firm Dynamics undertaken at the Research Institute of Economy, Trade and Industry (RIETI) and the Hitotsubashi Project on Real Estate, Financial Crisis, and Economic Dynamics (HIT-REFINED). We are grateful for fruitful discussion with Takashi Hanagaki. We also thank Michio Suzuki, Arito Ono, Masahiko Shibamoto, Chihiro Shimizu, Peng Xu, and participants at the JEA Meeting (2015 Autumn), 9th Regional Banking Conference, and the Hitotsubashi-RIETI International Workshop for valuable comments. I. Uesugi gratefully acknowledges financial support from the Grant-in-Aid for Scientific Research (S) No. 25220502, JSPS.
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1. Introduction

Massive fluctuations in real estate prices have frequently created booms (or sometimes bubbles) and have triggered a number of financial crises. Some of the recent crises are the US subprime mortgage and subsequent global financial crisis that started in 2007, the Japanese banking crisis in the 1990s, and the Norwegian and Swedish banking crises in the early 1990s. The research observes a link between the downturns in real estate prices and financial crises not only in developed but also in developing economies. Analyzing the banking crises that occurred in emerging markets in the past 30 years, Reinhart and Rogoff (2009, pp. 280) find that the most important predictor of a crisis is the change in housing prices. If not triggering financial crises, even moderate fluctuations in real estate prices affect real economic activities. Crowe et al. (2011), for example, report that recessions subsequent to the burst of real estate booms are longer and deeper than recessions without such booms.

Real estate prices are likely to affect the real economy through the availability and cost of credit. Bernanke and Gertler (1989) and Kiyotaki and Moore (1997), among others, formalize such a financial link in their general equilibrium models by focusing on a borrower's net worth (Bernanke and Gertler) or the value of collateral that a borrower pledges to obtain credit (Kiyotaki and Moore). These two studies show that shocks to net worth or the value of collateral affect capital investment, which amplifies the initial shocks. In tandem with the borrowers' net worth and collateral values, real estate prices affect banks' balance sheets and play a very significant role in the amplification mechanisms (Holmström and Tirole, 1997; Stein, 1998; Gertler and Kiyotaki, 2010). In particular, a large decline in real estate prices increases banks' nonperforming loans, deteriorates their balance sheets and lending capacity, and eventually results in a smaller loan supply and tighter loan conditions.

In order to examine the predictions made by the above theoretical models, a great deal of

literature empirically examines the role of real estate prices in the collateral and lending channels. The studies on the collateral channel almost unanimously find a positive effect of the market value of firms' collateral on their amount of borrowing and investments (Ogawa et al., 1996; Ogawa and Suzuki, 1998; Gan, 2007a, Chaney, Sraer, and Thesmar, 2012). However, the studies on the bank lending channel have mixed results. Some studies find that an increase in real estate prices has a positive impact on banks' lending capacity, which then increases lending, firms' investment, and overall economic activities (Peek and Rosengren, 1997; Gan, 2007b; Puri, Rocholl, and Steffen, 2011). But, some others find that the impact is not necessarily positive. Hoshi (2000) finds an increase in loans by Japanese banks in the 1990s when real estate prices were falling. Hoshi points to the forbearance lending by Japanese banks that were hit by the downturn in real estate prices and that were motivated to underreport nonperforming loans.

Given these mixed results, this study provides new evidence on the lending channel by focusing on Japanese banks during the global financial crisis. This study makes two contributions to the literature. First, we identify the heterogeneous shocks from real estate prices that affect banks. The measurement of these bank-level shocks might be a possible explanation for the mixed results of the existing studies. Our procedure is similar to that of two recent studies by Chakraborty et al. (2014) and Cuñat et al. (2014) in which the authors construct a deposit-weighted housing price index that they aggregate at either the US state or MSA/CBSA (metropolitan statistical area/core-based statistical area) level. However, we use information on land prices for more than 20,000 locations nationwide in Japan, which is much finer than the US price indices at the state or MSA/CBSA level.[1] Our index matches land prices with the locations of the banks' customer firms that make use of substantial fluctuations in real estate prices over time as well as their heterogeneity across banks.

[1] There are 50 states, 269 MSAs, and 369 CBSAs in the United States.

Second, we focus on the lending behavior of Japanese banks in the 1990s and 2000s (Weinstein and Yafeh, 1998; Peek and Rosengren, 2005, and Caballero, Hoshi, and Kashyap, 2008). The banks suffered from a collapse in asset price bubbles including real estate prices in the 1990s and postponed the realization of nonperforming loans by forbearance lending. Since we focus on the period before and after the recent financial crisis, we observe substantial fluctuations in real estate prices during the period that are comparable in scale to the 1990s. Hence, it is worthwhile examining if the Japanese banks behaved in a similar manner as they did in the 1990s and early 2000s.

Matching land price data with banks' balance sheet data, we construct a bank-level panel data set that covers slightly less than 400 banks (major banks, regional banks, second-tier regional banks, and *Shinkin* banks) over the period from 2007 to 2013. Using this data set and controlling for bank fixed effects, we find that a rise in land prices increases the banks' capital and total loans. Further, we find that a rise in land prices leads to a significant increase in real estate loans and loans backed by real estate collateral, while this rise leads to no significant increase in non-real estate loans or loans without real estate collateral.

Further, in order to deal with the possibility that the specification we use for the bank-level estimation is not enough to fully control for the firms' time-varying demand for loans, we construct a matched bank-firm panel and attempt to control for the time-varying shocks. For dependent variables, we focus on the existence of bank-firm transactions and on the ranking of each bank in the order of relative importance among the banks that a firm borrows from. Using this data set and controlling for firm-year fixed effects, we find a negative association between the development of land prices and the evolution of bank-firm relationships. Specifically, a bank that faces an increase in land prices not only reduces the number of relationships with firms but also moves down in the order of importance on the list of the banks that the firm transacts with.

We provide several possible reasons for such a negative association. One conjecture is that banks are likely to supply a larger amount of loans in anticipation of a future recovery in land prices even as they decline. Taken together, our findings indicate that we need to modify the view on the effect of real estate prices on the banks' lending channel, that is, a bank that experiences an increase in real estate prices immediately increases its loan supply.

The reminder of this paper is structured as follows. Section 2 reviews the related literature and presents the hypotheses. Sections 3 and 4 describe the method and report the results, respectively. Section 5 provides the interpretation of the results and states how we will extend the current version.

2. Literature Review and Hypotheses

2.1 Collateral and Bank Lending Channels

Two channels exist through which an increase (a decrease) in real estate prices relaxes (tightens) the financial constraints that borrowers face and stimulates (deters) consumption and investment. The collateral channel hypothesis posits that an increase in the value of borrowers' assets that they can pledge as collateral relaxes borrowing constraints and increases bank loans and other types of credit. However, the bank lending channel hypothesis posits that an increase in real estate prices improves a bank's ability to originate loans by increasing the bank's net worth or liquidity. For example, if a bank has abundant capital due to high real estate prices, then the bank can set aside sufficient loan-loss reserves and increase loans. If a fall in real estate prices decreases the bank's capital, then the bank is likely to reduce loans. Because regulatory authorities impose a minimum capital level as a ratio to the total amount of risky assets that banks have, banks with smaller capital ratios are likely to reduce larger amounts of loans.

The class of assets that plays the most important role both in the collateral and bank

lending channels is real estate. Although firms and households can pledge various classes of assets other than real estate, such as deposits, machinery and equipment, accounts receivable, and inventories, the most frequently pledged asset is real estate in many countries.[2] Real estate prices affect banks not only because banks often demand real estate as collateral but also because banks also own land and buildings for business purposes. Moreover, banks have recently begun to hold securitized products based on real estate. When real estate prices fall, the banks' capital decreases because of the losses from the charge-offs of these products.

2.2 Previous Empirical Studies

A great deal of literature exists on the effect of real estate prices on the collateral and bank lending channels. Most of the studies focus on the countries that experience big fluctuations in real estate prices such as Japan in the 1980s and 1990s and the United States in the 1990s and 2000s.

The studies on the collateral channel include Ogawa et al. (1996), Ogawa and Suzuki (1998), and Gan (2007a) on the Japanese economy and Chaney, Sraer, and Thesmar (2012) on the US economy. These studies evaluate the market value of the land that firms own based on the information in their balance sheets and by estimating investment functions. The studies unanimously find a positive and significant coefficient for the estimated market value of the firms' land.

A number of studies also exist that examine the bank lending channel, such as Peek and Rosengren (1997), Hoshi (2000), Ogawa (2003), Gan (2007b), Puri, Rocholl, and Steffen (2011), Chakraborty, Goldstein and MacKinlay (2014), and Cuñat, Cvijanović, and Yuan (2014). Using

[2] A survey conducted by the Small and Medium Enterprise Agency of Japan in 2001 (*Surveys of the Financial Environment*) reports that among the firms that pledged collateral to their main banks, 96% of firms pledged real estate as collateral, followed by deposits (23%) and stocks (9%).

either Japanese or US bank-level data or matched firm-bank data, these studies examine the effect of real estate shocks on the banks' lending and the client firms' borrowing and investment. However, the literature on the bank lending channel has mixed results. For example, Peek and Rosengren (1997), Ogawa (2003), Gan (2007b), Puri, Rocholl, and Steffen (2011), and Cuñat, Cvijanović, and Yuan (2014) find a positive association between real estate prices and bank loans, firm investment, and other economic activities. Hoshi (2000) and Chakraborty, Goldstein and MacKinlay (2014) find a negative association. Hoshi (2000) points out that bank loans to real estate industries continued to increase until 1998 after the collapse of the real estate bubble in 1991. This study argues that Japanese banks, especially those with weak balance sheets, extended forbearance lending to nonperforming borrowers to underreport these loans. In this case, a negative association exists between real estate prices and real estate loans due to the motivation of the banks.

Chakraborty et al. (2014) examine US bank lending from 1988 to 2006. They find that an increase in housing prices in the areas where banks operate reduces the borrowing and investment of firms that transact with the bank. They argue that an increase in equity due to an increase in real estate prices does not lead to the overall increase in lending but results n more lending in real estate than in other sectors. Such substitution, they argue, occurs either because the investment in bubble assets raises interest rates and consequently crowds out investment in physical capital (Farhi and Tirole, 2012), or because firms that face resource constraints shift resources among sectors in the internal capital market (Stein, 1997; Sharfstein and Stein, 2000). In this case, a negative association exists between real estate prices and the total amount of loans, while a positive relation still exists between prices and real estate loans.

The inconsistency in these studies demands the examination of the banks' lending in other countries or periods. Further, these studies suggest that we need to examine not only the total

loans but also loans by sector.

2.3 Hypotheses

We present two hypotheses based on the preceding studies on the bank lending channel. The first hypothesis is on the relation between real estate prices and the amount of net worth and total loans.

Hypothesis 1. An increase in real estate prices increases banks' net worth and total loans.

The second hypothesis is on the relation between real estate prices and loans of different types. Specifically, we examine how an increase (a decrease) in prices affects loans secured by real estate and those that are not secured by real estate.[3] There are two distinct mechanisms that determine the relation between real estate prices and loans of different types.

The first one is the crowding-out effect of bubbles (Farhi and Tirole, 2012) or the substitution effect within internal capital markets (Stein 1997; Scharfstein and Stein, 2000). When these effects occur, an increase in real estate prices has a positive impact on real estate loans, while the increase has a negative impact on non-real estate loans. The second one is the effect of forbearance lending (Hoshi, 2000; Peek and Rosengren, 2005), which indicates that a decrease in real estate prices leads to an increase in real estate-related loans to hide losses from loans due to the decline in real estate prices, and to a decrease in other types of loans. Forbearance loans indicate that banks anticipate a mean reversion in real estate prices, that is, banks assume that real estate prices will move back to the average over time even when they

[3] Hereafter, we use the term "real estate loans" for loans to the construction and real estate sectors and for loans collateralized by real estate, and the term "non-real estate loans" for loans to industries other than construction and real estate businesses and for loans that are not collateralized with real estate.

deviate downward for a short period of time. These arguments lead to the following hypothesis.

Hypothesis 2. If the substitution effect is in play, then an increase in real estate prices leads to an increase in real estate loans, while it results in a decrease in non-real estate loans. Alternatively, if banks use forbearance lending, then a decrease in real estate prices leads to an increase in real estate loans and results in a decrease in non-real estate loans.

In the following sections, we will examine these two empirical hypotheses using a bank-level panel data set and a firm-bank match level panel data set.

3. Data and Method

3.1 Data

We use bank-level data on financial statements and loans outstanding by sector, firm-level data on locations, matched bank-firm data on borrowing relationships, data on real estate prices, and regional data on economic activities.

First, we analyze the information on the banks' balance sheets and loans by sector to examine their lending behavior and their operating environments. We obtain this information from the Nikkei Needs Financial Quest for the period from 2006 to 2014. The banks comprise city banks, trust banks, regional banks, second-tier regional banks, and *Shinkin* banks.[4] The information on financial statements comprises the total assets, operating income, and other balance sheet and income statement items. The loans outstanding by sector include total loans, loans by industry, and loans with and without real estate collateral.[5] The number of banks that

[4] *Shinkin* banks are cooperative regional financial institutions serving small and medium enterprises and local residents. They are smaller in size than regional banks but larger than credit unions (*Shinyo-kumiai*).
[5] We supplement some missing information on loans by sector in the Nikkei FQ by using the disclosure brochures of each bank.

file this information decreases from 393 (in 2006) to 377 (in 2013). This decrease is due to mergers and acquisitions.

Second, we use the data on real estate prices to analyze the impact of real estate markets on the banks' lending behavior. We use appraisal-based land prices (Public Notice of Land Prices: PNLPs). The PNLPs are land prices published by the Land Appraisal Committee of the Ministry of Land, Infrastructure, and Tourism (MLIT) of Japan for more than 20,000 locational points in Japan as of January 1 every year. The PNLPs are different from transaction prices. Specifically, two real-estate appraisers separately examine the location on site, analyze the recent trading examples and prospects for returns from the land, evaluate it, and report it to the Land Appraisal Committee. Then the Committee considers the balance among locational points and regions and authorizes the PNLP. The Committee discloses various pieces of information on the land such as the address, the frontal road, the nearest station, and the distance from it, the square meters and the shape of the land, the intended purpose under urban planning, the building-to-land ratio, and the floor-to-area ratio.

We aggregate the PNLPs at the municipality level, that is, city, ward, town, or village level. We use a hedonic approach to adjust for different attributes of various types of land pieces. Specifically, we use the following regression:

$$\ln(P_{it}) = X_{it}\beta + \lambda_{j(i)t} + \varepsilon_{it} \qquad (1)$$

where P_{it} and X_{it} are the PNLP and the attributes, respectively, of location *i* in year *t*, $\lambda_{j(i)t}$ is the year-municipality dummy, and ε_{it} is the disturbance term. The attributes, X_{it}, are the square meters, the width of the road, the distance from the nearest station, the latitude, the latitude squared, the longitude, the longitude squared, the building-to-land ratio, the floor-to-area ratio, a dummy for running water, a dummy for a sewage line, a dummy for gas,

dummies for the area for the intended purpose, and dummies for the class of intended purposes. The adjusted land price is defined as

$$P_{jt} \equiv \exp(\hat{\lambda}_{j(i)t}) \quad (2)$$

Third, to conduct the bank-firm data analyses, we construct the real estate price shocks with the data on the firm's location and the matched bank-firm data on the borrowing relationships. Specifically, we use data summarized by Hazama, Hosono, and Uesugi (2013) from a database of a private credit bureau that has information on more than 1.2 million firms in Japan. This coverage is quite high as the total number of incorporations in Japan is approximately 1.8 million as of 2009 (Economic Census, Ministry of Internal Affairs and Communications). These data show how many firms that borrow from a specific bank are located in a specific municipality in a specific year.

Fourth, we use data on regional economic activities to control for region-specific shocks. These data consist of the unemployment rate for each prefecture from the Statistics Bureau of Japan. We average the unemployment rates by using two different weights to construct a bank-level unemployment rate. One weight is the municipalities and prefectures where banks headquarter and their branches are located, and a second weight that reflects where the borrowing firms are located.

3.2 Construction of Two Data Sets

We construct a bank panel data set to conduct the following analyses. First, we construct a panel based on the data on banks' financial statements and loans by type for each year. Second, we construct a municipality-year panel data set of real estate prices. The data set is adjusted for quality based on the hedonic estimation. The data set is then converted to the bank-year panel data set by averaging the municipality-year and quality-adjusted land prices for each bank by

using the distribution of the locations of the borrowing firms as a weight. Third, we match the first and second bank-year panel data sets. Fourth, we match these bank-year panel data sets with the prefecture-level unemployment rate. The result is a bank-year panel data set spanning from 2007 to 2013 that contain 2,686 observations.

Further, we also construct a bank-firm panel data set to conduct match-level analyses. This data set contains information on the list of the firms' lending banks. We order the list based on the relative importance of each bank to the firm. The number of observations is over 9 million in total.

3.3 Bank-level Estimation

Using a bank-level data set, we estimate the following fixed effect model:

$$BANKASSET_{jt} = \alpha_j + \delta_t + \beta_1 PRICE_{jt-1} + \beta_2 BANK_{jt-1} + \beta_3 MACRO_{jt-1} + \varepsilon_{jt} \quad (3)$$

The equation contains a year fixed effect δ_t to capture macroeconomic shocks as well as a bank fixed effect α_j.

We use several alternative loans as the dependent variable, $BANKASSET$. Specifically, we use total loans outstanding, loans with and without real estate collateral, and loans to construction and real estate industries, and to other industries. We regard loans with real estate collateral and loans in the construction and real estate industries as real estate loans. These firms are more likely to purchase and hold real estate either for their own business or for inventories to be developed and sold. Because these firms are likely to pledge real estate as collateral, their loans are likely to be closely associated with real estate markets. We use either the log of these

loan variables or divide them by the previous year's end-of-period total assets to identify whether substitution or complementarity between the real estate and non-real estate loans exists because of the amount outstanding or the ratio to total assets. We also use the book-value equity as a ratio of total assets as a dependent variable to examine whether changes in the real estate prices affect the banks' lending thorough their impact on the banks' net worth.

Among the explanatory variables, real estate prices, denoted by *PRICE* in Eq. (3), are the most important. We use the one-year lagged value of the PNLP that is aggregated at the bank level. We alternatively use its logarithm to consider the possibility that real estate prices affect the banks' lending nonlinearly. A vector of the variables for characteristics, *BANK*, is lagged one year and is used for the control variables. Specifically, we use the logarithm of total assets, capital ratio, operating income-to-asset ratio, and the ratio of interest payments on deposits to the total amount of deposits. Following Chakraborty et al. (2014), we capture the aggregate macroeconomic shocks, *MACRO*, with the one-year unemployment rate averaged for each bank by using the prefecture weight.

One important qualification is that the above specification, even though it uses variables that represent regional and macroeconomic activities, is not enough to control for the factors that affect the availability of loans for individual firms, especially those that are related to the change in real estate prices. Because a fluctuation in real estate prices changes the firm's net worth, real estate prices affect the firm's loan availability through the "collateral channel." In order to precisely identify the impact of real estate prices on a bank's loan supply, we control for the collateral channel's effect with a different data set.

3.4 Bank-firm Match-level Estimation

Using the bank-firm data set, we conduct two analyses. First, we estimate the following equation with a dependent variable for "extensive margin":

$$\Delta \mathrm{Re}\,lationship_{jft} = \alpha_{ft} + \Delta \mathrm{PRICE}_{jt-1} + \Delta BANK_{jt-1} + \varepsilon_{jft} \quad (4)$$

The dependent variable is the change in the dummy, $\mathrm{Re}\,lationship_{jft}$, that equals one if bank j is in the list of banks that firm f borrows from in year t and zero otherwise. The α_{ft} is a firm-year fixed effect that captures the firm's time-varying shocks and the changes in the firm's demand for loans. The $\Delta \mathrm{PRICE}_{jt}$ and $\Delta BANK_{jt-1}$ are changes in the PNLP of bank j and bank j's characteristics, respectively.

Next, using the observations of the changes in $\mathrm{Re}\,lationship_{jft}$ for two consecutive years, we estimate the following equation that adds the dependent variable "intensive margin":

$$\Delta Ranking_{jft} = \alpha_{ft} + \Delta \mathrm{PRICE}_{jt-1} + \Delta BANK_{jt-1} + \varepsilon_{jft} \quad (5)$$

The dependent variable denotes the position of bank j in year t, $Position_{jft}$, among the banks that firm f transacts with relative to the total banks that firm f transacts with, N_{ft}. We define $Ranking_{jft}$ as

$$Ranking_{jft} = (N_{ft} - Position_{jft})/(N_{ft} - 1) \quad \text{if} \quad N_{ft} \geq 2$$

$$1 \quad \text{if} \quad N_{ft} = 1 \quad (6)$$

4 Estimation Results

4.1 Descriptive Statistics

Table 1 shows the definition and descriptive statistics. The average share of total loans to total assets is 55% (LOAN_r). The loans collateralized by real estate and uncollateralized loans as a share of total loans are 16% (LOAN_COLL_r) and 39% (LOAN_NONCOLL_r), respectively. The loans to construction and real estate industries and loans to other industries, both of which are measured as a ratio of total assets, are 12% (LOAN_RE_r) and 43% (LOAN_NONRE_r). The equity ratio (B_CAPRATIO) is 5.3% on average, with a variation across banks and years from 0.4% at the minimum to 17.1% at the maximum.

The aggregated land price is 33,000 yen per square meter on average. Due to a large variation in land prices across regions, the standard deviation is larger than its average. Among the other explanatory variables, the unemployment rate aggregated for each bank (UNEMP) has a substantial variation from 2.2% at the minimum to the 7.6% at the maximum.

Table 2 shows the sample statistics for the main variables, the loan variables, and the real estate price variables year-by-year from 2007 to 2013. The table shows that the loan-to-asset ratios (LOAN_r) and the logs of the loans (lnLOAN) move differently. The average loan-to-asset ratio (LOAN_r) peaks in 2009 and then shows a declining trend afterwards, while the logs of total loans (lnLOAN) shows a mild increasing trend during the sample period. The table also shows that the PNLP-based land prices (PRICE) peak in 2008.

We present Figures 1 and 2 to show the heterogeneity in the PNLP real estate prices. Figure 1 shows the heterogeneity in the real estate prices for Japanese major cities of Tokyo, Yokohama, Kawasaki, Saitama, and Chiba. Even within a relatively small square area with approximately 200km on each side, we observe quite sizable heterogeneity across the municipalities in their real estate prices. Moreover, the figure substantially fluctuates from year

to year. By comparing the upper panel with the lower one, we see a substantial change in the color in that the lower panel becomes "paler." This change indicates that real estate prices in Japan dropped substantially after the outbreak of the global financial crisis.

Figure 2 shows the heterogeneity in real estate prices across banks and years in Japan. The figure emphasizes that the heterogeneity across banks as well as the fluctuations across time appear to be quite sizable.[6] The banks whose borrower firms are in metropolitan areas tend to face higher but more volatile fluctuations in real estate prices than banks whose borrowers are in local areas.

4.2 Effects of Real Estate Prices on Bank Loans: Bank-Level Analyses

Total loans and capital ratio

Table 3 shows the estimation results from the baseline specifications in which the dependent variable is either the total loan-to-asset ratio (Columns 1 and 2), the log of total loans (Columns 3 and 4), or the capital ratio (Columns 5). For the loan variable estimations, we use either the price level (Columns 1 and 3) or its logarithm (Columns 2 and 4) as the land price variables.

Columns 1–4 show that in the regressions of total loans, irrespective of whether they are measured in terms of log levels or ratios to total assets, the coefficients on *PRICE* (Columns 1 and 3) are positive, though not significant, and those on log of *PRICE* (we label it as ln*PRICE* hereafter) (Columns 2 and 4) are positive and significant. Column 2 shows that a one percent increase in *PRICE* increases the bank's loan-to-asset ratio by 0.06 percentage points, while Column 4 indicates that a one percent increase in *PRICE* increases the bank's total loans by 0.11

[6] Note that we omit *Shinkin* banks from the figure due to a space constraint.

percent. One standard deviation in ln*PRICE* (0.67) increases the loan-to-asset ratio by 4.0 percentage points and the loans by 7.3 percent, both of which are economically significant.

Column 5 shows that in the regression of the capital ratio, the coefficient on ln*PRICE* is positive and significant. An increase in *PRICE* by one percent raises the capital ratio by 0.008 percentage points, which means that a one standard deviation in ln*PRICE* increases the capital ratio by 0.5 percentage points. These results show that an increase in real estate prices substantially increases the bank's capital and thus total loans.

The year dummies, whose reference year is 2007, peak in 2009 and turn to negative values after 2010. This trend indicates that loans decrease both in terms of their level and ratio to total assets from the fiscal year ending in March 2010 due to the sharp recession stemming from the 2008 global financial crisis. The coefficient on the unemployment rate is positive and significant. Although the positive impact of this rate on loans might be counterintuitive, this result might reflect the demand for loans arising from the tight cash flow due to a fall in sales or from the start-ups of new businesses.[7] The log of total assets has a negative and significant coefficient in the regressions on the loan-to-asset ratios (Columns 1 and 2), while the log of total assets has a positive and significant coefficient in the regressions on the log of total loans (Columns 3 and 4). These coefficients show that as assets increase, loans also increase, but to less of an extent due to a relatively large increase in other business besides loans. The interest rate on deposits has a positive and significant coefficient in Columns 1 and 2 that show that banks with high interest rates, which are often small banks, have limited access to investment opportunities other than loans and consequently increase the loan-to-asset ratio. The capital ratio has no significant coefficients in Columns 1–4. In contrast, the capital ratio is significantly affected by ln*PRICE* (Column 5), a change in capital ratios arising from the factors other than

[7] Okamuro (2005) examines the factors for the start-ups of businesses in Japan and finds a positive correlation between the unemployment rate and the rate of start-ups.

real estate prices may not have a significant impact on loans. Finally, the net operating income ratio has positive and significant coefficients in Columns 3 and 4.

Real estate loans and non-real estate loans

This subsection contains the results from the regressions of the real estate loans and non-real estate loans. Table 4 shows the results from loans with and without real estate collateral, while Table 5 shows the results from real estate loans and non-real estate loans.

Columns 1–4 of Table 4 show the results from loans collateralized by real estate. The dependent variable is either the ratio of loans collateralized by real estates to total asset (LOAN_COLL_r in Columns 1 and 2), or the log of loans collateralized by real estates (lnLOAN_COLL in Columns 3 and 4). Columns 2 and 4 show that ln*PRICE* has positive and significant coefficients. The *PRICE* also has a positive coefficient in Column 1, though not significant. The quantitative effect of land prices on loans collateralized by real estate is also substantial. An increase in *PRICE* by one percent increases the share of loans collateralized by real estates to total assets by 0.07 percentage points (Column 2) and increases the loan amount by 0.34 percent (Column 4), both of which are larger than the baseline results from the total loans. Columns 5–8 in Table 4 show the results from loans without real estate collateral. The dependent variable is either the ratio of loans not collateralized by real estates to total asset (LOAN_NONCOLL_r in Columns 1 and 2), or the log of loans not collateralized by real estates (lnLOAN_NONCOLL in Columns 3 and 4). They indicate that while *PRICE* has positive coefficients and ln*PRICE* has negative coefficients, they are not significant.

Columns 1–4 in Table 5 show the results from real estate loans. The dependent variable is either the ratio of loans to construction and real estate industries to total asset (LOAN_COLL_r in Columns 1 and 2), or the log of loans to these industries (lnLOAN_COLL in Columns 3 and

4). The results indicate that *PRICE* and ln*PRICE* both have positive and significant coefficients in all of the specifications. Column 4, for example, indicates that a one percent increase in *PRICE* leads to an increase in real estate loans of 0.30 percent. But, Columns 5–8 in Table 5 show different results. The dependent variable in these columns is either the ratio of loans to other industries to total asset (LOAN_NONRE_r in Columns 1 and 2), or the log of loans to other industries (lnLOAN_NONRE in Columns 3 and 4). The results from non-real estate loans indicate that although *PRICE* and ln*PRICE* have positive coefficients, they are not significant.

The results in this subsection show that an increase (a decrease) in land prices has a positive (negative) impact on the total loans both in terms of the level and the ratio to total assets. Thus, we infer that an increase (a decrease) in real estate prices has a positive (negative) impact on the total loans by increasing (decreasing) the banks' lending capacity. This inference supports Hypothesis 1. Further, an increase (a decrease) in land prices has a significant and relatively large impact on real estate loans, while a change in land prices does not have a significant effect on the level of non-real estate loans. Given these results, we cannot infer that the substitution effect actually works between these two types of loans due to a rise in lending interest rates or through the internal capital market, which does not support Hypothesis 2.[8]

4.3 Effects of Real Estate Prices on Bank Loans: Matched Firm-Bank Analyses

Extensive margin

Table 6 shows the results for the extensive margin estimations represented in Eq. (4). In addition to the results for the whole sample of firms (in Columns 1 and 2), we report those for the real estate and construction industries (in Columns 3 and 4) and those for the other industries (in Columns 5 and 6).

[8] To test the forbearance lending in Hypothesis 2, we need an additional investigation that analyzes the effect of a fall in real estate prices by focusing on the period of their declining trend.

The results from the whole sample (Columns 1 and 2) show that the coefficients for Δ*PRICE* and $\Delta \ln$*PRICE* are both negative, and the latter is marginally significant. The results in Columns 3–6 show that while the coefficients for Δ*PRICE* and $\Delta \ln$*PRICE* are negative for both subsamples, they are significant only for the real estate and construction industries.

We provide several explanations for these seemingly counterintuitive results. First, banks might extend loans to firms based on the predicted value of real estate prices in the future rather than the real estate prices in the past. When land prices fall (rise), banks might anticipate a conversion of the trend in the near future and extend a larger (smaller) amount of loans. Given that the operational performance of the real estate and construction industries is more susceptible to changes in land prices than that of other industries, a significantly negative effect is a reasonable observation for the industries related to real estate. Second, banks that face a decline in land prices and consequently a decline in their net worth might aggressively establish new transaction relationships with firms that used to transact with banks that face an increase in land prices. As a result, the banks that face increasing land prices might lose some of the old transaction relationships.

The changes in capital ratios have negative and significant coefficients in Columns 1, 2, and 6, which supports our conjecture that the banks whose capital decreases tend to aggressively acquire more customers. The changes in the interest rates for deposits have positive and marginally significant coefficients in Columns 3 and 4. These coefficients suggest the following two possibilities: The banks that face tough competition in deposit markets might try to acquire more customers to compensate for a rise in deposit costs. Alternatively, the banks that adopt aggressive management strategies might try to attract a larger amount of deposits and lend to a larger number of borrowers.

Intensive margin

Table 7 shows the results for the intensive margin estimations from Eq. (5). We report the results for the whole sample of firms (in Columns 1 and 2), those for the real estate and construction industries (in Columns 3 and 4), and those for the other industries (in Columns 5 and 6).

The results from the whole sample (Columns 1 and 2) show that the coefficients for Δ*PRICE* and $\Delta \ln$*PRICE* are both negative and significant. The results from the subsamples (Columns 3–6) show that the coefficients for Δ*PRICE* and $\Delta \ln$*PRICE* are negative for both subsamples and that they are significant except for the coefficient on Δ*PRICE* for the real estate and construction industries (Column 3).

We provide three explanations for the negative association between land prices and the intensive margin. First, the portfolio substitution effect in Hypothesis 2 might work because the coefficient for Δ*PRICE* is insignificant for the real estate and construction industries while it is significantly negative for the other industries. However, this argument does not hold when we focus on the coefficients for $\Delta \ln$*PRICE*. These coefficients are not substantially different between the real estate and construction industries (Columns 4) and the other industries (Columns 6). Second, the forbearance lending in Hypothesis 2 might apply because our empirical results show that the ranking of a bank does have an effect, and hence its loan share is likely to increase when land prices decline. Third, a technical factor regarding how we define ΔRANKING might bias our results. Because our measure of the intensive margin is not the amount of loans but the bank's ranking for each firm, even if top-ranked (lowest-ranked) banks increase (decrease) their loan amounts, their rankings do not change. For example, megabanks in Tokyo and other metropolitan areas that faced an increase in land prices in 2006 to 2007

might have increased loans during this period. However, they were top-ranked for a number of firms and hence their ranking might not have changed.

We find that changes in the capital ratio have negative and significant coefficients in Columns 1–6, while changes in interest rates have positive and marginally significant coefficients in Columns 1, 2, 5, and 6. These results are qualitatively similar to those for the extensive margin estimation. In addition, the changes in assets have a negative and marginally significant coefficient in Column 3.

Thus, we find that an increase in land prices has a significantly negative impact on the evolution of bank-firm relationships. Specifically, a bank that faces an increase in land prices not only reduces the number of relationships with firms but also moves down in the order of importance on the list of the banks that the firm borrows from. This finding does not support Hypothesis 1 and is the opposite in sign from the results in the previous subsection.

5 Discussion and Conclusion

We examine the effect of real estate price shocks on the bank lending channel and the substitution effect on real estate loans and non-real estate loans (Chakraborty et al., 2014; Cuñat et al., 2014). Using Japanese data in the 2007–2013 global financial crisis, we identify heterogeneous real estate price shocks that affect each bank by summarizing the land prices of firms with which the bank has transaction relationships. Using bank-level data and controlling for bank fixed effects, we obtain evidence that is overall in line with the prediction of the bank lending channel in that a rise in land prices increases banks' capital and total bank loans.

However, our bank-level estimation, even though it uses variables for regional and macroeconomic activities, is not enough to control for the factors that affect loan availability for individual firms, especially those that are related to the change in real estate prices. In order to

precisely identify the impact of real estate prices on a bank's loan supply, we use a matched firm-bank data set. After controlling for firms' time-varying fixed effects, we find that a bank that faces an increase in land prices not only reduces the number of relationships with firms but also moves down on the list of the banks that the firm transacts with. This finding does not support the hypothesis of the bank lending channel and contradicts the bank-level estimation results. While we do not identify a precise mechanism for the negative impact of land prices on the loan supply, we leave this to future work. However, our findings indicate that we need to modify our overly simplistic view on the function of the bank lending channel in real estate prices, that is, a bank that experiences an increase in real estate prices immediately increases its loan supply.

References

Bernanke, B.S. (1983) “Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression,” *American Economic Review*, 73, pp. 257-276.

Bernanke, B. and M. Gertler (1989) “Agency Costs, Net Worth, and Business Fluctuations,” *American Economic Review*, 79 (1), pp. 14-31.

Chakraborty, I., I. Goldstein, and A. MacKinlay (2014) “Do asset price booms have negative real effects?” Working Paper.

Chaney, T., D. Sraer, and D. Thesmar (2012) “The collateral channel: How real estate shocks affect corporate investment, *American Economic Review*, 102(6), pp. 2381-2409.

Cuñat, V., D. Cvijanović, and K. Yuan (2014) “Within-bank transmission of real estate shocks,” Working Paper.

Farhi, E. and J. Tirole (2012) “Bubbly liquidity,” *Review of Economic Studies*, 79, pp. 678-706.

Gan, J. (2007a) “Collateral, debt capacity, and corporate investment: Evidence from a natural experiment,” *Journal of Financial Economics*, 85, pp. 709-734.

Gan, J. (2007b) “The real effects of asset market bubbles: loan- and firm-level evidence of a lending channel,” *Review of Financial Studies*, 20(5), pp. 1941-1973.

Holmström, B. and J. Tirole (1997) “Financial Intermediation, Loanable Funds, and the Real Sector,” *Quarterly Journal of Economics*, 112(3), pp. 663-691.

Hoshi, T. (2000) “Why cannot Japan escape from the liquidity trap,” (in Japanese) M. Fukao and H. Yoshikawa eds, *The Zero Interest Rate and the Japanese Economy*, Nihon Keizai Shinbun sha.

Hosono, K. and D. Miyakawa (2014) “Bank Lending and Firm Activities: Overcoming Identification Problems,” T. Watanabe, I. Uesugi, A. Ono eds, *The Economics of Interfirm Networks*, Chapter 12, Springer, forthcoming.

Hosono, K., D. Miyakawa, T. Uchino, M. Hazama, A. Ono, H. Uchida, and I. Uesugi (2012) “Natural Disasters, Damage to Banks, and Firm Investment,” RIETI Discussion Paper Series 12-E-062.

Miyakawa, D., K. Hosono, T. Uchino, A. Ono, H. Uchida, and I. Uesugi (2014) “Natural Disasters, Financial Shocks, and Firm Export,” RIETI Discussion Paper 14-E-010.

Ogawa, K. (2003) *Economic Analysis of the Great Depression*, Nippon Keizai Shinbun sha.

Ogawa, K., S. Kitasaka, H. Yamaoka, and Y. Iwata (1996) “Borrowing constraints and the role of land asset in Japanese corporate investment decision,” *Journal of the Japanese and International Economies* 10 (2), pp. 122-149.

Ogawa, K. and K. Suzuki (1998) “Land value and corporate investment: evidence from Japanese panel data,” *Journal of the Japanese and International Economies* 12 (3), pp. 232-249.

Okamuro, H. “Regional factors for the start-up rats of manufacturing firms: A comparative analysis between high-tech and low-tech industries,” (in Japanese) RIETI Discussion Paper Series 06-J-049.

Paravisini, D. (2008) “Local bank financial constraints and firm access to external finance,” *Journal of Finance*, 63, pp. 2161-2193.

Peek, J. and E.S. Rosengren (1997) “The International Transmission of Financial Shocks: The Case of Japan,” *American Economic Review*, 87(4), pp. 495-505.

Peek, J. and E.S. Rosengren (2000) “Collateral Damage: Effects of the Japanese Bank Crisis on Real Activity in the United States,” *American Economic Review*, 90, pp. 30-45.

Peek, J. and E.S. Rosengren (2005) “Unnatural Selection: Perverse Incentives and the Misallocation of Credit in Japan,” *American Economic Review*, 95, pp. 1144-1166.

Puri, M., J. Rocholl, and S. Steffen (2011) “Global retail lending in the aftermath of the US financial crisis: Distinguishing between supply and demand effects,” *Journal of Financial Economics*, 100, pp. 556-578.

Scharfstein, D.S. and J.C. Stein (2000) “The dark side of internal capital markets: Divisional rent-seeking and inefficient investment,” *Journal of Finance*, 55, pp. 2537-2564.

Schnabl, P. (2012) “The International Transmission of Bank Liquidity Shocks: Evidence from an Emerging Market,” *Journal of Finance*, 67, pp. 897-932.

Stein, J.C. (1997) “Internal capital markets and the competition for corporate resources,” *Journal of Finance*, 52, pp. 111-133.

Stiglitz, J.E. and A. Weiss (1981) “Credit rationing in markets with imperfect information,” *American Economic Review*, 71, pp. 393-410.

Tokumitsu, S. (2006) *A Guide for the Evaluation of Collateral* (in Japanese), Kinyu-Zaisei Jijo Kenkyukai, Tokyo.

Table 1. Definitions and descriptive statistics of variables

Variable names	Definitions	N	mean	sd	min	p25	p50	p75	max
Dependent variables									
Total loan amount									
LOAN_r	Total loan amount outstanding/Total asset	2647	0.5502	0.1256	0.0744	0.4639	0.5409	0.6413	1.5624
lnLOAN	ln(Total loan amount outstanding) (Unit of loan amount outstanding: million yen)	2647	12.5720	1.5206	9.2460	11.3640	12.3364	13.7027	18.1210
Loans related to real estate									
LOAN_COLL_r	Amount of loans collateralized by real estate/Total asset	2635	0.1613	0.0932	0.0000	0.0973	0.1511	0.2123	0.7856
lnLOAN_COLL	ln(Amount of loans collateralized by real estate) (Unit: million yen)	2499	11.1853	1.3959	7.7890	10.1403	11.0674	12.1188	15.7465
LOAN_RE_r	Amount of loans to construction and real estate industries/Total asset	2647	0.1225	0.0562	0.0000	0.0849	0.1142	0.1523	0.4355
lnLOAN_RE	ln(Amount of loans to construction and real estate industries) (Unit: million yen)	2597	11.0145	1.5069	7.4657	9.9163	10.9187	12.0895	16.1279
Loans not related to real estate									
LOAN_NONCOLL_r	Amount of loans not collateralized by real estate/Total asset	2635	0.3883	0.1336	0.0744	0.3021	0.3630	0.4640	1.1745
lnLOAN_NONCOLL	ln(Amount of loans not collateralized by real estate) (Unit: million yen)	2635	12.1824	1.5945	8.6620	10.9040	11.9012	13.3266	18.0412
LOAN_NONRE_r	Amount of loans to other industries/Total asset	2647	0.4277	0.1173	0.0669	0.3452	0.4090	0.5088	1.1828
lnLOAN_NONRE	ln(Amount of loans to other industries) (Unit: million yen)	2647	12.3103	1.5417	9.0614	11.0553	12.0325	13.4212	17.9909
Capital ratio									
B_CAPRATIO	Capital ratio	2647	0.0533	0.0197	0.0035	0.0397	0.0501	0.0633	0.1710
Explanatory variables (all the variables are lagged by one year)									
Real estate prices									
PRICE	Public notice of land price (公示地価) (Unit: yen per square meter)	2647	33006.51	31225.08	7711.324	15707.97	21381.89	34582.48	208020.5
lnPRICE	ln(public notice of land price)	2647	10.1326	0.6690	8.9504	9.6619	9.9703	10.4511	12.2454
Bank characteristics									
lnB_ASSET	ln(bank's total asset)	2647	13.1978	1.4115	10.5242	12.0920	13.0019	14.1671	18.8997
B_CAPRATIO	Capital ratio	2647	0.0533	0.0197	0.0035	0.0397	0.0501	0.0633	0.1710
B_ROA	Business profit（業務純益）/Total asset	2647	0.0014	0.0052	-0.0649	0.0010	0.0021	0.0036	0.0300
B_DEPOSITCOST	Interest payment amount to deposits/Deposits	2647	0.0020	0.0012	0.0002	0.0010	0.0017	0.0027	0.0207
Local economic conditions									
UNEMP	Unemployment rate in the prefectures where bank branches are located (Unit: %)	2647	4.2384	0.9023	2.2000	3.6099	4.2000	4.8000	7.6000

Table 2. Changes in bank loan variables (2007-2013) and real estate price variables (2006-2012)

	year	N	mean	sd	min	p25	p50	p75	max
LOAN_r(t)	2007	392	0.5694	0.1393	0.1275	0.4907	0.5533	0.6447	1.5624
	2008	384	0.5573	0.1157	0.1018	0.4767	0.5532	0.6416	0.8643
	2009	378	0.5681	0.1264	0.0927	0.4792	0.5557	0.6611	1.3351
	2010	376	0.5548	0.1190	0.0931	0.4663	0.5418	0.6518	0.8428
	2011	374	0.5417	0.1207	0.0809	0.4581	0.5300	0.6293	0.8392
	2012	372	0.5356	0.1240	0.0770	0.4494	0.5204	0.6269	0.8286
	2013	371	0.5233	0.1262	0.0744	0.4346	0.5029	0.6123	0.8335
lnLOAN(t)	2007	392	12.5037	1.5186	9.2460	11.3105	12.2488	13.6435	18.0379
	2008	384	12.5401	1.5194	9.7896	11.3518	12.2948	13.6861	18.0697
	2009	378	12.5906	1.5186	9.8523	11.3899	12.3403	13.7108	18.1167
	2010	376	12.5876	1.5151	9.8331	11.3809	12.3281	13.6873	18.0512
	2011	374	12.5854	1.5211	9.7957	11.3814	12.3424	13.7174	17.9896
	2012	372	12.5957	1.5230	9.8071	11.3792	12.3770	13.7219	18.0552
	2013	371	12.6047	1.5382	9.7985	11.3690	12.3987	13.7450	18.1210
PRICE(t-1)	2006	392	32563.8	26812.9	8037.4	17296.7	22975.4	34582.5	151746.4
	2007	384	34071.1	31081.4	9265.2	16929.6	22472.2	35781.1	178263.0
	2008	378	36169.7	36309.0	8868.0	16659.4	22371.0	36814.9	208020.5
	2009	376	34355.6	33622.3	8414.6	15882.3	21410.5	35431.1	200521.9
	2010	374	32123.2	30425.4	7711.3	14992.0	20881.9	33391.9	177045.0
	2011	372	31216.4	29891.2	8098.7	14334.6	20050.0	32958.4	172525.0
	2012	371	30467.6	29509.7	7924.7	13677.1	19394.5	32384.2	167854.1

Table 3. Estimation results for total loans and bank capital

Fixed effect estimation result using PRICE_PNLP (Public notice of land price or Koji Chika)

	Dependent variable									
	(1)		(2)		(3)		(4)		(5)	
	LOAN_r		LOAN_r		lnLOAN		lnLOAN		B_CAPRATIO	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
PRICE	4.76E-07	1.4			8.20E-07	1.51				
lnPRICE			0.0591	2.42 **			0.1096	2.74 ***	0.0079	1.75 *
lnB_ASSET	-0.3856	-6.12 ***	-0.3896	-6.2 ***	0.4491	7.02 ***	0.4414	6.98 ***	-0.0232	-3.03 ***
B_CAPRATIO	0.0740	0.41	0.0529	0.29	-0.1010	-0.29	-0.1397	-0.4	0.2321	3.08 ***
B_ROA	0.0869	0.5	0.1229	0.72	0.6773	2.34 **	0.7451	2.59 ***	-0.8235	-1.48
B_DEPOSITCOST	2.6716	2.01 **	2.9647	2.13 **	3.0583	1.16	3.6137	1.37	-0.0004	-0.58
UNEMP	0.0122	3.81 ***	0.0101	3.43 ***	0.0225	3.8 ***	0.0187	3.41 ***	-0.0038	-6.27 ***
YEAR2008	-0.0040	-2.15 **	-0.0038	-2.07 **	-0.0051	-1.58	-0.0048	-1.52	-0.0076	-5.15 ***
YEAR2009	0.0066	1.77 *	0.0068	1.72 *	0.0101	1.54	0.0103	1.55	0.0001	0.08
YEAR2010	-0.0119	-2.57 **	-0.0080	-1.72 *	-0.0232	-2.75 ***	-0.0161	-1.98 **	-0.0014	-0.99
YEAR2011	-0.0152	-3.57 ***	-0.0088	-1.78 *	-0.0370	-5.08 ***	-0.0250	-3.25 ***	0.0009	0.78
YEAR2012	-0.0060	-1.29	0.0012	0.21	-0.0271	-4.04 ***	-0.0134	-1.67 *	0.0047	3.85 ***
YEAR2013	-0.0018	-0.27	0.0069	0.82	-0.0274	-3.3 ***	-0.0111	-1.08	0.2833	2.62 ***
Constant	5.5674	6.77 ***	5.0424	6.36 ***	6.5361	7.84 ***	5.5651	6.17 ***		
NOB	2647		2647		2647		2647		2647	
F-value	36.92		36.49		15.97		15.38		59.73	
Prob> F	0		0		0		0		0	
R-sq: within	0.4321		0.4358		0.239		0.2461		0.2151	
between	0.1574		0.1582		0.9765		0.9684		0.0068	
overall	0.1508		0.1512		0.9752		0.9666		0.0126	

Table 4. Estimation results for loans collateralized by real estate and other loans

Fixed effect estimation result using PRICE_PNLP (Public notice of land price or Koji Chika)

	Dependent variable							
	(1)		(2)		(3)		(4)	
	LOAN_COLL_r		LOAN_COLL_r		lnLOAN_COLL		lnLOAN_COLL	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
PRICE	1.66E-07	1.26			-3.18E-07	-0.28		
lnPRICE			0.0744	4.01 ***			0.3409	3.53 ***
lnB_ASSET	-0.0924	-2.46 **	-0.0998	-2.75 ***	0.5028	4.6 ***	0.4670	4.45 ***
B_CAPRATIO	-0.2367	-1.9 *	-0.2605	-2.06 **	-1.0771	-1.69 *	-1.2119	-1.9 ***
B_ROA	0.0928	0.72	0.1434	1.12	-0.0412	-0.07	0.2260	0.35
B_DEPOSITCOST	-2.0572	-1.58	-1.5948	-1.21	-10.1345	-0.75	-9.6767	-0.71 ***
UNEMP	-0.0074	-1.14	-0.0096	-1.46	-0.0109	-0.58	-0.0200	-1.18 ***
YEAR2008	-0.0049	-2.63 ***	-0.0051	-2.7 ***	-0.0188	-1.52	-0.0185	-1.53 ***
YEAR2009	-0.0039	-1.19	-0.0051	-1.54	-0.0404	-1.29	-0.0439	-1.42 ***
YEAR2010	-0.0010	-0.12	0.0030	0.35	-0.0721	-1.84 *	-0.0506	-1.4 ***
YEAR2011	-0.0068	-0.89	0.0014	0.17	-0.1139	-3.79 ***	-0.0725	-2.81 ***
YEAR2012	-0.0152	-2.97 ***	-0.0053	-0.84	-0.1606	-7.66 ***	-0.1108	-5.95 ***
YEAR2013	-0.0193	-3.83 ***	-0.0071	-1.13	-0.1943	-9.74 ***	-0.1336	-6.45 ***
Constant	1.4294	2.95 ***	0.7840	1.61	4.8210	3.35 ***	1.8541	1.05
NOB	2635		2635		2499		2499	
F-value	15.21		16.68		11.77		12.53	
Prob> F	0		0		0		0	
R-sq: within	0.1648		0.1783		0.1639		0.1769	
between	0.0484		0.0941		0.8602		0.8619	
overall	0.0325		0.0779		0.8521		0.8597	

Fixed effect estimation result using PRICE_PNLP (Public notice of land price or Koji Chika)

	Dependent variable							
	(5)		(6)		(7)		(8)	
	LOAN_NONCOLL_r		LOAN_NONCOLL_r		lnLOAN_NONCOLL		lnLOAN_NONCOLL	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
PRICE	2.69E-07	0.82			7.77E-07	1.23		
lnPRICE			-0.0177	-0.7			-0.0536	-0.92
lnB_ASSET	-0.2941	-7.72 ***	-0.2907	-7.64 ***	0.3785	5.72 ***	0.3888	5.88 ***
B_CAPRATIO	0.3127	1.65	0.3168	1.66 *	0.5381	1.18	0.5507	1.21
B_ROA	-0.0069	-0.05	-0.0234	-0.16	0.5882	1.74 *	0.5388	1.57
B_DEPOSITCOST	4.6024	2.65 ***	4.4319	2.51 **	9.5236	2.61 ***	9.0146	2.43 **
UNEMP	0.0195	3.01 ***	0.0197	2.95 ***	0.0464	3.27 ***	0.0471	3.25 ***
YEAR2008	0.0011	0.44	0.0014	0.57	0.0036	0.65	0.0046	0.81
YEAR2009	0.0104	2.35 **	0.0117	2.49 **	0.0271	2.83 ***	0.0308	3.07 ***
YEAR2010	-0.0106	-1.21	-0.0109	-1.19	-0.0189	-1.03	-0.0198	-1.04
YEAR2011	-0.0083	-1.07	-0.0103	-1.15	-0.0208	-1.27	-0.0269	-1.42
YEAR2012	0.0092	1.71 *	0.0063	0.92	0.0164	1.41	0.0076	0.5
YEAR2013	0.0175	3.42 ***	0.0136	2.01 **	0.0284	2.63 ***	0.0167	1.11
Constant	4.1475	8.44 ***	4.2905	7.53 ***	6.9150	8.13 ***	7.3491	6.85 ***
NOB	2635		2635		2635		2635	
F-value	19.21		18.8		20.12		20.38	
Prob> F	0		0		0		0	
R-sq: within	0.2144		0.2143		0.2092		0.2092	
between	0.266		0.2547		0.9505		0.9621	
overall	0.2358		0.2244		0.9445		0.9575	

Table 5. Estimation results for loans to construction and real estate industries and loans to others.

Fixed effect estimation result using PRICE_PNLP (Public notice of land price or Koji Chika)

	Dependent variable							
	(1)		(2)		(3)		(4)	
	LOAN_RE_r		LOAN_RE_r		lnLOAN_RE		lnLOAN_RE	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
PRICE	4.46E-07	2.48 **			2.85E-06	2.82 ***		
lnPRICE			0.0291	1.84 *			0.3021	3.77 ***
lnB_ASSET	-0.0938	-4.3 ***	-0.0946	-4.36 ***	0.4700	5.34 ***	0.4550	5.3 ***
B_CAPRATIO	0.1124	1.16	0.1008	1.01	-0.1905	-0.34	-0.3216	-0.56
B_ROA	-0.0394	-0.28	-0.0249	-0.18	0.3400	0.64	0.5131	0.97
B_DEPOSITCOST	-1.0215	-1.03	-0.9178	-0.96	-11.2349	-1.12	-9.8294	-1
UNEMP	0.0051	1.38	0.0039	1.04	0.0225	1.51	0.0113	0.78
YEAR2008	0.0025	1.74 *	0.0027	1.94 *	0.0109	1.22	0.0122	1.38
YEAR2009	0.0068	2.63 ***	0.0076	3.02 ***	0.0402	1.72 *	0.0425	1.83 *
YEAR2010	0.0046	0.93	0.0070	1.4	0.0598	2.06 **	0.0807	2.8 ***
YEAR2011	0.0038	0.87	0.0069	1.39	0.0411	1.69 *	0.0737	2.95 ***
YEAR2012	0.0043	1.28	0.0075	1.73 *	0.0325	1.87 *	0.0689	3.57 ***
YEAR2013	0.0065	1.96 *	0.0101	2.23 **	0.0297	1.72 *	0.0725	3.63 ***
Constant	1.3164	4.63 ***	1.0502	3.11 ***	4.6291	4.03 ***	1.8941	1.34
NOB	2647		2647		2597		2597	
F-value	6.53		6.64		10.75		11.42	
Prob> F	0		0		0		0	
R-sq: within	0.0638		0.063		0.1206		0.1291	
between	0.0004		0.0014		0.9307		0.9196	
overall	0.0003		0.0012		0.9263		0.9172	

Fixed effect estimation result using PRICE_PNLP (Public notice of land price or Koji Chika)

	Dependent variable							
	(5)		(6)		(7)		(8)	
	LOAN_NONRE_r		LOAN__NONRE_r		lnLOAN_NONRE		lnLOAN_NONRE	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
PRICE	3.00E-08	0.1			1.05E-07	0.17		
lnPRICE			0.0300	1.16			0.0413	0.77
lnB_ASSET	-0.2918	-5.73 ***	-0.2950	-5.83 ***	0.4633	6.22 ***	0.4592	6.22 ***
B_CAPRATIO	-0.0383	-0.2	-0.0478	-0.24	-0.3014	-0.71	-0.3149	-0.73
B_ROA	0.1263	0.66	0.1478	0.78	0.8333	2.09 **	0.8619	2.17 **
B_DEPOSITCOST	3.6930	2.3 **	3.8825	2.38 **	5.8821	2.15 **	6.1306	2.21 **
UNEMP	0.0071	1.66 *	0.0062	1.48	0.0165	1.84 *	0.0153	1.75 *
YEAR2008	-0.0064	-3.33 ***	-0.0066	-3.35 ***	-0.0135	-3.47 ***	-0.0136	-3.48 ***
YEAR2009	-0.0003	-0.06	-0.0009	-0.19	-0.0022	-0.29	-0.0028	-0.37
YEAR2010	-0.0165	-2.51 **	-0.0150	-2.31 **	-0.0396	-3.21 ***	-0.0374	-3.1 ***
YEAR2011	-0.0190	-3.48 ***	-0.0157	-2.53 **	-0.0541	-5.17 ***	-0.0495	-4.21 ***
YEAR2012	-0.0103	-2.2 **	-0.0063	-1.03	-0.0428	-4.76 ***	-0.0373	-3.22 ***
YEAR2013	-0.0083	-1.45	-0.0032	-0.43	-0.0469	-4.59 ***	-0.0401	-2.93 ***
Constant	4.2510	6.41 ***	3.9922	5.74 ***	6.1543	6.34 ***	5.7957	5.15 ***
NOB	2647		2647		2647		2647	
F-value	30.43		30.14		13.53		13.54	
Prob> F	0		0		0		0	
R-sq: within	0.3082		0.3097		0.1422		0.1431	
between	0.1745		0.1823		0.9736		0.9695	
overall	0.1623		0.1702		0.971		0.9667	

Table 6. Estimation results for the existence of bank-firm relationships

	Dependent variable: ⊿RELATION											
	(1)		(2)		(3)		(4)		(5)		(6)	
	All		All		Construction & Real estate		Construction & Real estate		Others		Others	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
⊿PRICE	-4.64E-08	-1.29			-6.44E-08	-2.78 ***			-4.34E-08	-1.1		
⊿lnPRICE			-0.0073115	-1.85 *			-0.011731	-3.73 ***			-0.00659	-1.57
⊿lnB_ASSET	-0.0005	-0.49	-0.0004	-0.31	0.0001	0.09	0.0004	0.22	-0.0007	-0.59	-0.0005	-0.44
⊿B_CAPRATIO	-0.0977	-1.65 *	-0.0987	-1.66 *	-0.0431	-1.16	-0.0459	-1.24	-0.1077	-1.65	-0.1083	-1.65 *
⊿B_ROA	0.0627	1.23	0.0650	1.31	0.0551	0.8	0.0571	0.86	0.0642	1.29	0.0665	1.37
⊿B_DEPOSITCOST	0.2249	1.56	0.2213	1.55	0.2127	1.94 *	0.2044	1.9 *	0.2266	1.49	0.2237	1.48
⊿UNEMP	-0.0011	-1.64	-0.0010	-1.63	-0.0011	-1.54	-0.0010	-1.56	-0.0011	-1.62	-0.0010	-1.6
Constant	0.0011	8.18 ***	0.0010	6.15 ***	0.0014	7.34 ***	0.0012	6.01 ***	0.0011	7.84 ***	0.0010	5.8 ***
Firm-year dummy	yes		yes		yes		yes		yes		yes	
NOB	7023225		7023225		1077052		1077052		5946173		5946173	
F-value	2.82		2.68		3.17		3.2		2.35		2.36	
Prob> F	0.0108		0.0146		0.0049		0.0045		0.0307		0.0301	
Adj R2	0.047		0.047		0.0265		0.0265		0.0504		0.0504	
Root MSE	0.0993		0.0993		0.0956		0.0956		0.0999		0.0999	

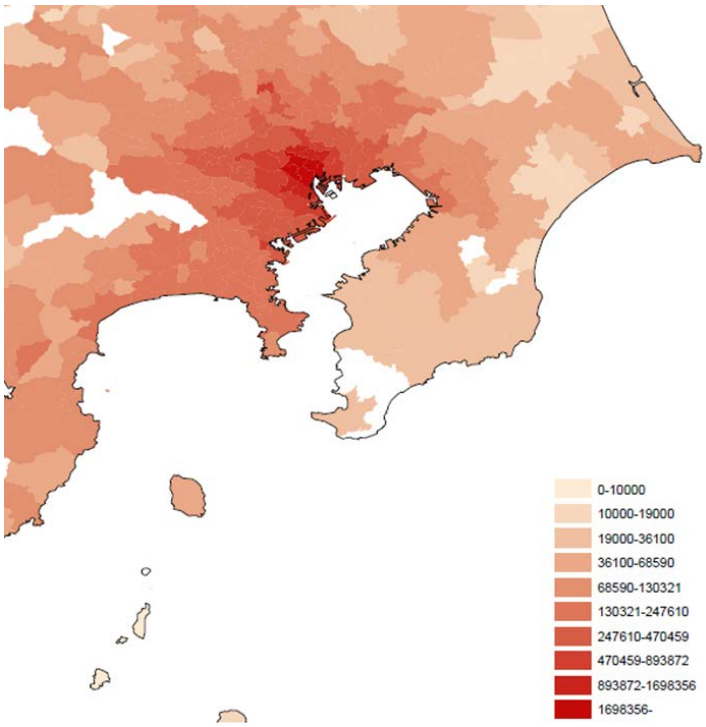
Note: *t*-values are based on standard errors clustered at the bank level.

Table 7. Estimation results for the ranking of a bank for each firm

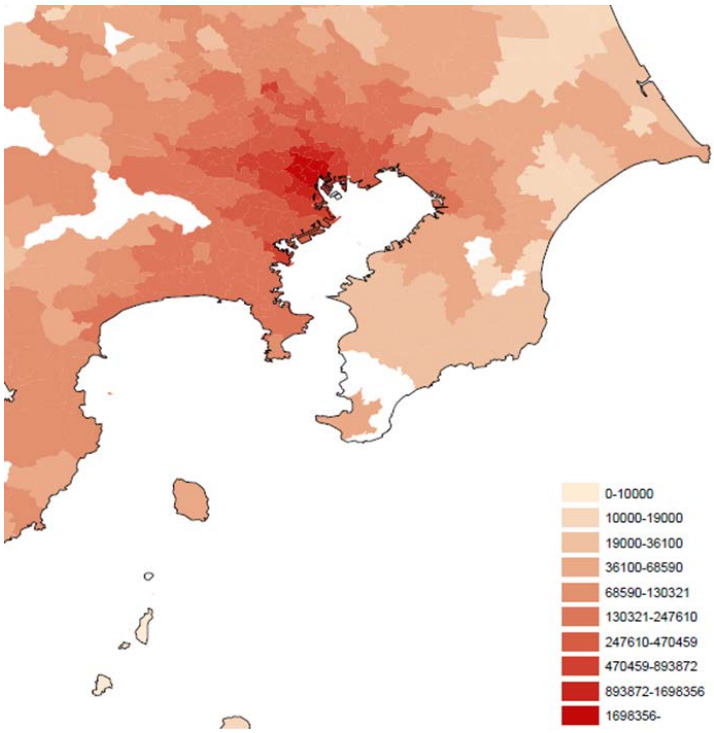
	Dependent variable: ⊿RANKING											
	(1)		(2)		(3)		(4)		(5)		(6)	
	All		All		Construction & Real estate		Construction & Real estate		Others		Others	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
⊿PRICE	-2.26E-07	-1.97 **			-1.87E-07	-0.86			-2.34E-07	-2.31 **		
⊿lnPRICE			-0.0339239	-2.94 ***			-0.046875	-1.82 *			-0.0318601	-3.27 ***
⊿lnB_ASSET	-0.0042	-1.59	-0.0037	-1.5	-0.0092	-1.78 *	-0.0085	-1.58	-0.0032	-1.22	-0.0029	-1.16
⊿B_CAPRATIO	-0.1754	-3.99 ***	-0.1737	-4.26 ***	-0.2267	-2.01 **	-0.2390	-2.25 **	-0.1648	-4.32 ***	-0.1603	-4.54 ***
⊿B_ROA	0.0351	0.47	0.0444	0.57	0.0313	0.21	0.0186	0.11	0.0348	0.42	0.0458	0.55
⊿B_DEPOSITCOST	0.3863	3.27 ***	0.3833	3.28 ***	0.3255	1.6	0.2950	1.44	0.3956	3.65 ***	0.3968	3.69 ***
⊿UNEMP	0.0005	0.42	0.0006	0.55	-0.0005	-0.22	-0.0006	-0.28	0.0007	0.54	0.0008	0.67
Constant	0.0009	1.49	0.0006	0.95	0.0010	1.17	0.0005	0.64	0.0009	1.56	0.0006	1
Firm-year dummy	yes		yes		yes		yes		yes		yes	
NOB	734705		734705		127091		127091		607614		607614	
F-value	6.83		9.15		1.72		3.33		7.96		9.22	
Prob> F	0		0		0.1166		0.0037		0		0	
Adj R2	0.0416		0.0416		-0.012		-0.0119		0.0503		0.0503	
Root MSE	0.1506		0.1506		0.1396		0.1396		0.1528		0.1528	

Note: *t*-values are based on standard errors clustered at the bank level.

Figure 1. Spatial distributions of real estate prices for municipalities in 2008 and 2009 (Areas that include entire prefectures of Tokyo, Kanagawa, Saitama, and Chiba)



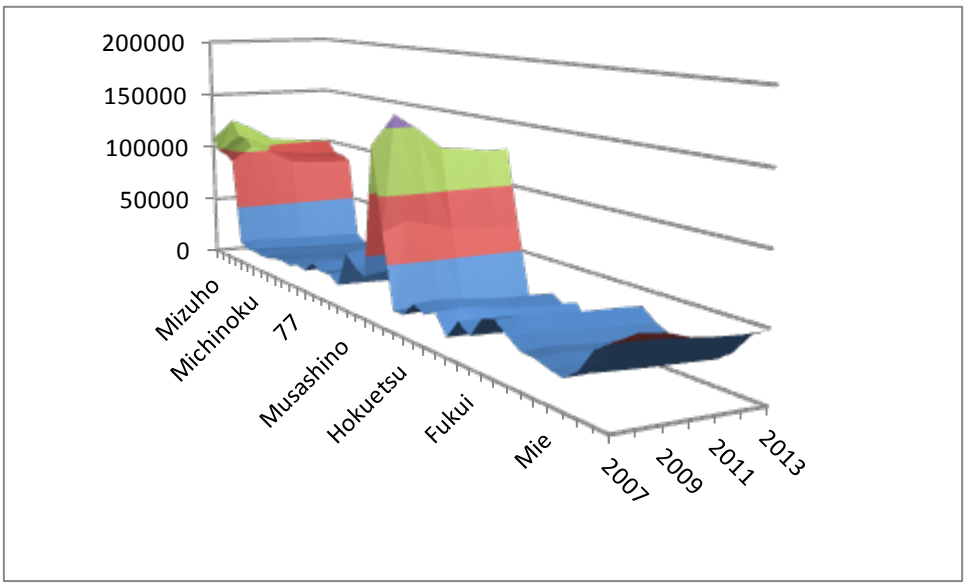
Year 2008



Year 2009

Note: For each local municipality, we use different colors for different real estate price ranges for 2008 and 2009. Areas without color indicate no reporting locations for PNLP. The unit of measurement is the yen.

Figure 2. Development of real estate prices for each bank (city banks, regional banks, and second-tier regional banks)



Note: For each bank, we plot the development of real estate prices during the period of 2006--2013. The unit of measurement along the vertical axis is the yen.