論　　文

# The Effects of Housing Price on the Banking Sector Performance*
# —Evidence from MSA data in the US—

Sung Wook JOH** and Seongjun JEONG**

**Abstract**

This paper examines the factors affecting bank activities before and after the crisis in 2007. Using banking sector information in metropolitan statistical areas (MSAs) in the US from 2001 to 2014, we find that credit supply and performance of banking sectors depend on MSA level-economic conditions, controlling for other factors. Before the crisis, banks in MSAs with higher real estate market prices show more lending and better accounting performance. After the crisis however, total bank loans do not depend on real-estate prices while MSAs with higher real-estate price indices provide more bank loans to households but fewer loans to commercial and industrial borrowers. MSAs with more household loans show higher non-performing loan ratios (NPLs). In contrast, MSAs with more commercial and industrial loans show lower NPLs. Consequently, the banking sectors in MSAs with lower real-estate price indices have higher rates of return on assets (ROA). These results suggest that the recovery of real-estate markets does not necessarily lead to better performance by the surviving banks.

JEL Classification Codes: G01, G20, G21

Keywords:  Credit supply, Bank Performance, Real estate market, Non-Performing Loan,

* We are grateful to comments and suggestions from S. Fukuda, K. Shimizu and the participants of the 2016 conference organized by the Economic and Social Research Institute.

** Sung Wook Joh: Seoul National University
Seongjun Jeong: Seoul National University

# 住宅価格が銀行部門のパフォーマンスに与える影響
## ――米国における MSA データから得られる証拠――

Sung Wook JOH and Seongjun JEONG

〈要 旨〉

本論文では、2007 年の危機前後における銀行の行動に影響を与えた要因を検証している。2001～2014 年にわたる米国の MSAs（Metropolitan Statistical Areas）における銀行部門のデータを用いることで、銀行部門の信用供給（credit supply）やパフォーマンスは、他の要因をコントロールした場合、各地区レベルでの経済状況に依存することを発見した。危機以前、不動産価格指数がより高い地区の銀行では、より多くの貸出とより高い企業業績を示していた。しかし、危機以降、貸付の合計は不動産価格指数に依存しなくなる一方、不動産価格指数がより高い地区の銀行では、家計に対してより多くの貸付を行い、商業・産業部門に対してはより少ない貸付を行っていた。家計への貸付がより多い地区では、より高い不良債権比率が見られている。対照的に、商業・産業部門への貸付がより多い地区では、より低い不良債権比率が見られている。その結果、不動産価格指数がより低い地区における銀行部門では、より高い ROA（総資本利益率）となっている。こうした結果は、不動産市場の回復は、必ずしも存続している銀行のパフォーマンの改善に結びついていないことを示唆している。

JEL Classification Codes: G01, G20, G21
Keywords: 信用供給、銀行パフォーマンス、不動産市場、不良債権

## 1. Introduction

The 2007 subprime mortgage crisis in the US triggered a sharp decline in the economy and the financial sector. The collapse of the real-estate market followed by the collapse of the mortgage-backed securities and derivatives market jeopardized the solvency of financial institutions.

The US government has intervened with various monetary and fiscal policies to help the economy, but the real-sector economy has not quickly recovered. The US government ran large deficits during the post-crisis period and the Federal Reserve's monetary stimulus provided capital to banks and set historically low interest rates. While the economy has passed its trough in the middle of 2009, until recently the real-sector economy has not fully recovered; unemployment rates were higher than before the crisis; per capita GDP has exceeded the pre-crisis level only recently; the price level of real-estate markets in 2014 remains below that of pre-crisis.

The long lasting recession led to the failure of about 2,000 financial institutions from 2007 to 2014 including the failure of 740 US commercial banks during 2009−2012 (FDIC, 2015). However, as poorly performing banks exited the market, surviving banks increased their total lending, improved their accounting returns and reduced their non-performing loans.

In this study, we analyze the factors affecting banking sector activity and performance in the US during 2001−2014. Specifically, we examine how macro-economic and real-estate market conditions affect banks' lending (credit supply) to households and commercial borrowers. In addition, we test how real-market conditions affect the performance of surviving banks. As business conditions and real-sector conditions differ across metropolitan statistical areas (MSA)[1], we analyze the US banking sector, using quarterly banking sector information across 370 MSAs.

We find that banking sector activities depend on the economic and real-estate market conditions in MSAs. Before the crisis, total bank loans, especially loans to households, were higher in MSAs with higher real-estate prices. This is consistent with past studies showing that before

[1] In the United States, a metropolitan statistical area (MSA) is a geographical region with a relatively high population density at its core and close economic ties throughout the area. A typical metropolitan area is centered on a single large city that wields substantial influence over the region (e.g., Chicago or Atlanta). However, some metropolitan areas contain more than one large city with no single municipality holding a substantially dominant position (e.g., Dallas−Fort Worth metroplex, Norfolk-Virginia Beach (Hampton Roads), Riverside−San Bernardino or Minneapolis−Saint Paul). MSAs are defined by the Office of Management and Budget (OMB) and used by the Census Bureau and other federal government agencies for statistical purposes (Nussle, 2008).

the crisis, household debt increased sharply, partially due to land price increases (Mian and Sufi, 2014; Rajan and Ramcharan, 2015). After the crisis however, banks in MSAs with higher real-estate price indices did not show more lending activity. While they still tend to show more bank loans to households, they have lower commercial and industrial (hereafter C&I) loans. Furthermore, bank loans to households lead to higher non-performing loans (NPLs) while C&I loans lead to lower NPLs. Consequently, the banking sectors in MSAs with lower real-estate price indices have higher rates of return on assets (ROA). These results suggest that the recovery of real-estate markets does not necessarily lead to better performance by the surviving banks.

The US experience suggests that the performance of surviving banks during the post-crisis period does not depend on the recovery of real-estate markets. As shown by the failure of 740 commercial banks, a large number of failing banks exited the market during 2009−2012. Our study suggests that the relatively strong, surviving banks increased their lending to commercial borrowers after the crisis. Furthermore, the aggregate total lending of these surviving banks surpassed that of all banks. In sum, the banking sector regained its vitality and its activity.

Such findings shed light on the importance of restructuring for the recovery of a troubled banking sector. For the banking sector to recover from a banking crisis, poorly performing banks must be restructured.

Our empirical findings yield important implications for the recovery of the Japanese banking sector. Both the Japanese banking sector and the US banking sector experienced a real-estate market bubble and subsequent financial crisis (in the 1990s and in 2007, respectively). Like US banks in the 2000s, Japanese banks made loans taking real-estate market property as collateral, and the collapse of real-estate property values led to bank losses. Unlike the US banking sector which has recovered, however, the recovery of the Japanese banking sectors is very slow. The slow recovery of real-estate markets in Japan still adversely affects the soundness of the balance sheets of creditor banks, and their new lending is lower. Some would argue that the recovery of the Japanese banking sector is slow due to the slow recovery of the real-estate market. However, our study shows that the real-estate market price level does not contribute to the performance of the banking sector, raising doubts about the necessity of real-estate market recovery for banking sector recovery. Instead, the differences in restructuring might help account for the slow recovery of the Japanese banking sector.

The rest of the paper proceeds as follows. Section 2 reviews related literature. Section 3 describes background information on the banking sector in the US and Japan. Section 4 presents

our hypotheses. Section 5 describes the data and methodology used in our analysis. Section 6 presents empirical results and Section 7 concludes.

## 2. Related Literature

Previous studies showed that Japanese banking sector activities are related to the burst of real-estate market bubble (Gan, 2004, 2006; Hoshi and Kashyap, 2004; Peek and Rosengren, 2000). A decline in the asset markets yields a negative shock to a financial health of banks, which negatively affects their ability to lend to existing and potential borrowing firms and consequently the real-sector economy. In Japan, the exposure of top lenders to the real-estate market negatively affects the investment and market valuation of borrowing firms (Gan, 2007).

The effects of the 2007 subprime mortgage crisis on the banking sector in the US are similar to those of the 1990 collapse of the real-estate bubble in Japan. After the onset of the financial crisis, US and non-US banks both reduced their lending to corporate firms in the US (Ivashina and Scharfstein, 2010; Chari *et al.*, 2008). For example, in Germany, US crisis-affected savings banks were more likely than non-affected banks to reject loan applications (Puri *et al.*, 2011). Santos (2011) also finds that banks raised their loan prices as measured through the spreads on loans to firms. Moreover, banks that incurred larger losses had larger loan spreads. As the credit supply tightened, corporate investments declined (Duchin *et al.*, 2010).

The collapse of the stock and real estate markets distorted incentives of banks as well. After the bubble burst in Japan, banks faced perverse incentives to reduce non-performing loans by providing additional credit to the weakest borrowing firms (*evergreening*, Peek and Rosengren, 2005). Evergreening is more prevalent among weak banks that barely meet the required minimum capital ratios and have extensive corporate affiliations (Peek and Rosengren, 2005).

Previous studies showed that bank performance before and after a crisis depend on several factors. They include bank-specific variables such as its operational efficiency, growth of total loans, funding costs and business model (Dietrich and Wanzenried, 2011). In addition, the upper phase of the business cycle has a positive effect on bank performance (Staikouras and Wood, 2004; Athanasoglou *et al.*, 2008). While the ex-ante effects of banking concentration are still not clear, theoretical and empirical studies argue that market concentration would affect credit supply and their profits (Keeley, 1990, Demsetz *et al.*, 1996, Jiménez *et al.*, 2013, Boyd and De Nicolo, 2005).

## 3. Background information on the banking sector in US and Japan

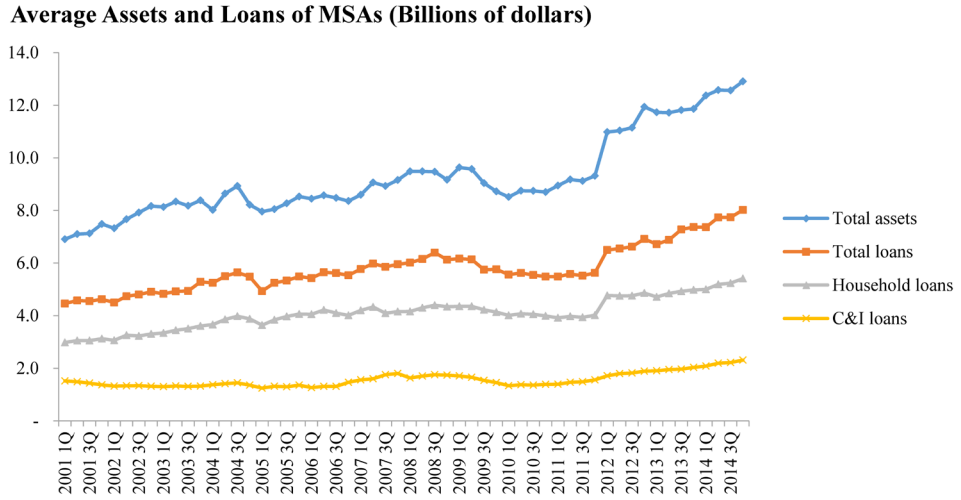
### 3. 1. Real estate market and banking sector in US

Before the subprime mortgage crisis, the US banking sector had grown quickly in the 2000s. The average of total aggregate assets in MSAs increased from $6.9 billion in 2001 to $9.5 billion in 2008. Furthermore, aggregate loans in MSAs grew before the 2007 mortgage crisis (see Table 1). Household loans (especially those secured by real-estate properties) increased dramatically from $3.0 billion to $4.4 billion during January 2001−June 2007. This rapid increase in household loans added to the real-estate market bubble. In contrast, commercial and industrial loans increased from $1.5 billion to $1.8 billion during this time.

During the crisis from 2007 to 2009,[2] the average Housing Price Index (HPI) across MSAs dropped by over 11.4%, causing the real-estate market bubble to burst (see Figure 2).

The collapse of the real-estate markets drove down the value of collaterals and increased the non-performing household loans secured by real-estates. Reflecting this collapse, a sharp drop in the mortgage-backed securities and derivatives market jeopardized the solvency of financial institutions. Household loans (especially those secured by real-estate properties) declined

Figure 1 Quarterly trends of the average of aggregate assets and loans of 370 Metropolitan Statistical Areas (MSA).




[2] We divide the period into three sub-periods based on the 2007 subprime mortgage crisis. The pre-crisis period is from 2001:1Q to 2007:2Q, the during-crisis period is from 2007:3Q to 2009:2Q and the post-crisis period is from the 2009:3Q to 2014:4Q.

Figure 2 Quarterly trends of the Average Housing Price indices of 370 Metropolitan Statistical Areas (MSA)

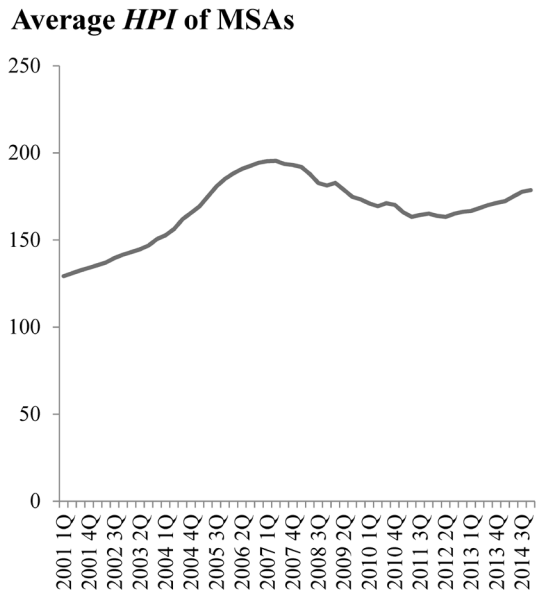
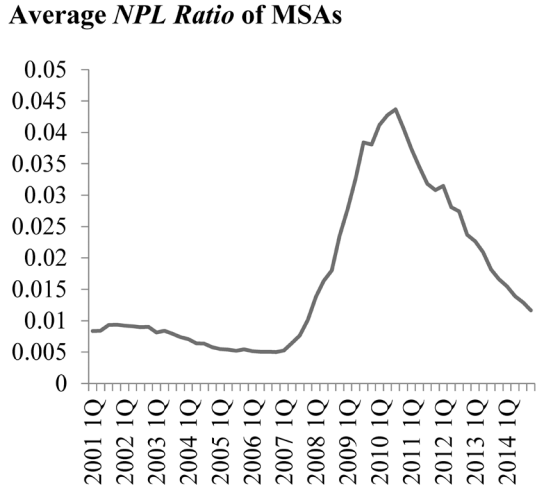



Figure 3 Quarterly trends of the average Non-Performing Loan Ratio (*NPL ratio*) in all MSAs.




slightly after the 2007 subprime mortgage crisis from $4.3 billion in the third quarter of 2008 to $4.0 billion in the last quarter of 2009 (see Figure 1). During the crisis, non-performing loan (*NPL)* ratios rose to 4.2% (see Figure 3), resulting in lower average rates of return on assets

Figure 4　4 quarter moving average rate of return on assets (*ROA*) of all banks in all MSAs.

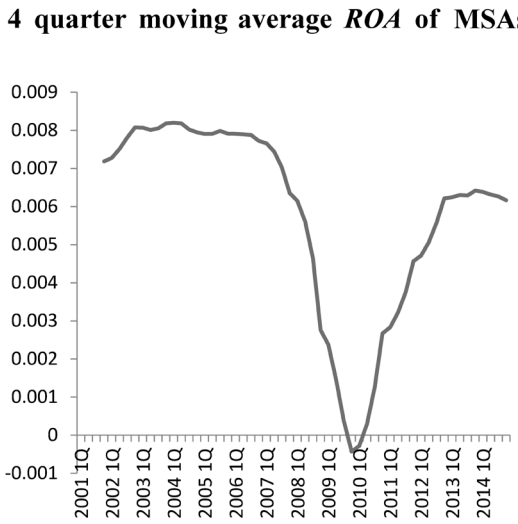
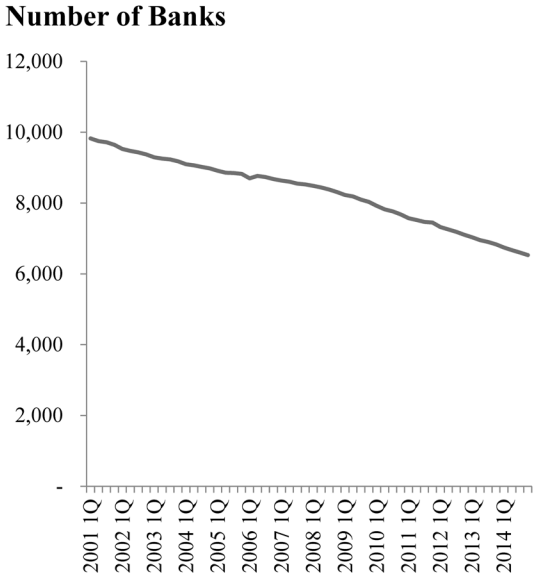


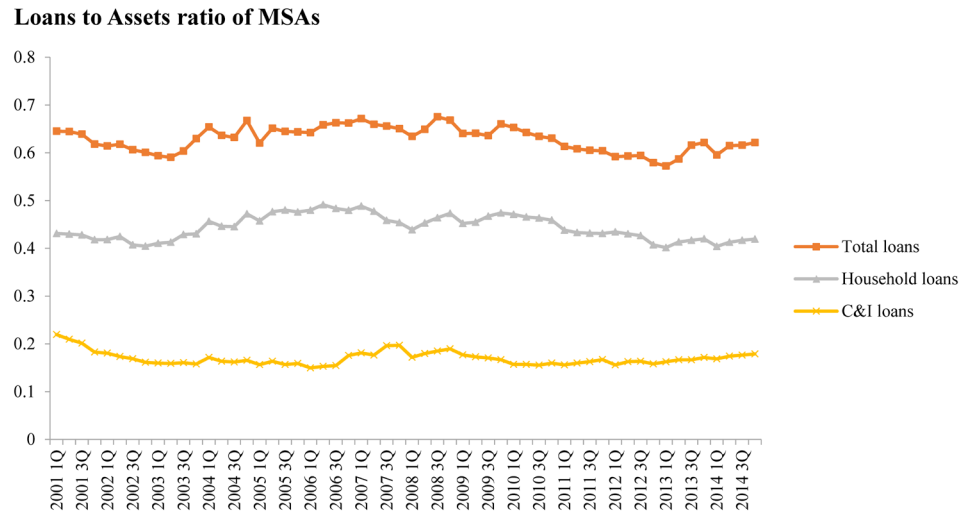

Figure 5　Quarterly trends of total number of banks.




(*ROA)* (see Figure 4).

Many banks went bankrupt during and after the crisis. Before the crisis, the number of banks fell from 9,826 in the first quarter of 2001 to 8,605 in the second quarter of 2007 (−2.1% per year; see Figure 5), in part due to takeovers by other banks. Compared to the

Figure 6 Quarterly trends of the average ratios of the loans over the assets of the banking sector in all MSAs.




pre-crisis period, the number of banks drops further during and after the crisis from 8,551 in the third quarter of 2007 to 6,528 in the last quarter of 2014 (−3.7% per year). Many of these disappearing banks were eventually liquidated.

The US banking sector has recovered after the crisis. Its aggregate loans increased from $4.5 billion in 2001 to $6.4 billion in 2008, fell to $5.5 billion in 2011, and rose to $8.0 billion in 2014. As bank assets grew faster than total loans however, the ratio of loans over assets has decreased after the crisis (see Figure 6). Although they slightly decreased to $8.5 billion in the first quarter of 2010 immediately after the crisis, they have gradually increased to $12.9 billion in December 2014. After the crisis, the profitability of the banking sector has improved.

### 3. 2. Real estate market and banking sector in Japan

The US banking sector's experience with the 2008 financial crisis partially resembles the Japanese banking sector's experience with the real estate market bubble and stock market bubble in the early 1990s. The land price index of all urban land had more than doubled from 1980 to 1991, and the Nikkei 225 Stock Price Index had more than tripled from 1986 to 1989. Then, land prices had fallen sharply and stock prices also dropped. After the real estate bubble burst however, Japanese banking reforms and the behavior of its banks differed from those of the US. The 2008 crisis reduced the number of US commercial banks from 8,637 in 2007 to 6,528 in 2014.

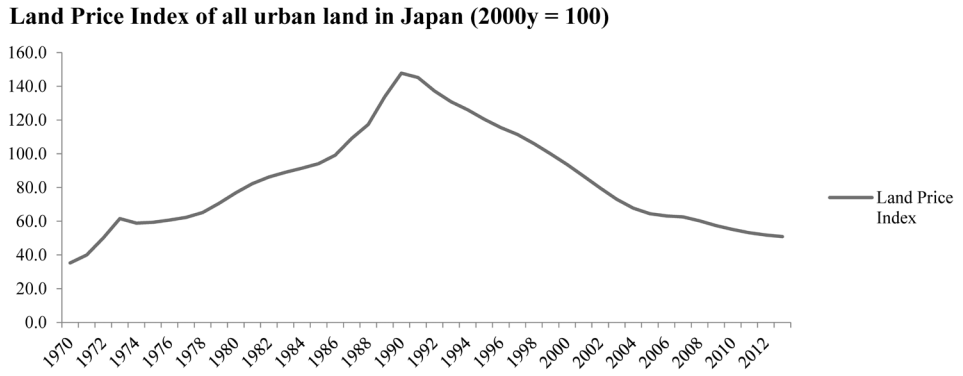
To contrast with the experience of the US banking sector around the 2008 crisis, we briefly describe the Japanese banking sector over the course of pre-crisis with high growth, the crisis in the late 1980s and early 1990s (bubble burst), and post-crisis (post-bubble period). The discussion is largely based on the past studies on the Japanese banking sector including Ozawa (1999), Ueda (2000) and Peek and Rosengren (2005).

First, Japanese banks experienced a high growth from the late 1970s to the mid 1980s even with the start of financial deregulation and liberalization. During this period, banks still provided an abundance of liquidity to borrowers which led to rising stock prices and real estate prices. However, there was a structural change in major borrowers from banks. With deregulation in the capital markets, large non-financial firms switched their financing sources from bank borrowings to bond and equity issuances. As financial products based on bond and equity markets did not grow sharply for retail investors, banks still received a large portions of the investment funds in a fast-growing economy. In addition, banks had financed through CDs whose interest rates were deregulated. With abundant but more costly funding than before, large banks filled the vacuum of large corporate borrowers with small borrowers (that moved to large banks from small banks), and small banks filled the vacuum of small borrowers with real-estate-related loan borrowers. From the bank perspectives, real-estate-related loans were easy lending opportunities with low screening costs and low credit analysis techniques. As the land prices had increased, banks might have perceived a low risk of such loans.

Second, before the bubble burst period (the mid to late 1980s), the banking sector was characterized by substantially rising asset prices supported by massive bank lending. With booming real-estate and stock markets, low domestic interest rates, and a strong yen, Japanese banks expanded aggressively during the late 1980s increasing their domestic loans and commercial and industrial loans to foreign countries. For example, borrowers located in the US accounted for 18 percent of all commercial and industrial loans of Japanese banks (Peek and Rosengren, 1997). By 1988, all of the world's 10 largest banks were Japanese banks headquartered in Japan.

Third, the 1990 crisis period was characterized by dramatically falling asset prices, leading to problems in the banking sector. In December 1989, the discount rate rose to 4.25 percent. The Nikkei stock price index plummeted with a 63 percent decline by the summer of 1992. Land prices also fell precipitously and presently continue to fall (see Figure 7). Many real estate firms and construction companies went bankrupt, sharply increasing loan defaults and bank losses. Moreover, falling stock prices threatened the ability of banks to meet the capital adequacy requirement. As a result, banks reduced their loans, creating a credit crunch in the

Figure 7　Quarterly trends of the average Land Price Index of all urban land in Japan.




Source: Japan Real Estate Institute (JREI)

Japanese economy.

Fourth, after the bubble burst, the Japanese economy and the banking sector experienced a prolonged stagnation. In contrast to the US experience, financial hardships of Japanese banks were compounded by a continuous rise in non-performing loans caused by the prolonged recession. All these situations ended up as a vicious circle of the banking crisis. Business bankruptcies increased non-performing loans and depressed the stock prices of banks, which in turn further weakened the capacity of banks to make loans and worsened the credit crunch. Bad loans of banks are estimated to be around $1 trillion (Ozawa, 1999). In contrast, US banks experienced a short term credit crunch during the crisis in 2008. However, the aggregate lending of US banks has recovered and even increased beyond the level before the crisis.

Failed reform during the post-crisis (post-bubble burst) period in Japan explains the prolonged problems of the Japanese banking sector. In general, in order to reform the banking sector suffering from large non-performing loans (due to the collapse of real-estate markets and stock markets), the government needs to restructure troubled banks, and to inject equity into solvent but undercapitalized banks.[3] The Japanese government allocated ¥60 trillion to reform the banking sector, but it was insufficient. The governments allowed or encouraged banks to continue evergreening.[4] Weak banks had extended additional credit to troubled firms so that the firms could make interest payments on outstanding loans. In order to maintain re-

[3] As a banking sector reform would incur write-off non-performing loans (i.e., no more revolving loans to failing borrowers), financial loss to investors (both equity holders and unprotected creditors to banks) and a failure of insolvent banks, a short term economic set-back (such as a surge in failing borrowers, their business partners, and unemployment in the failing banks) was inevitable.

[4] Facing a growing budget deficit and a voting public weary of funding bank bailouts, the Japanese governments have an incentive to avoid an even larger surge in unemployment and firm bankruptcies, as well as limiting the financial costs associated with massive bank bailouts or failures.

quired capital ratios, and to limit the growth in reported problem loans on their own balance sheets, troubled banks made such evergreening loans and avoided or delayed the bankruptcy of borrowing firms (Peek and Rosengren, 2005). As a result, after the bankruptcy of three large banks and securities companies in 1997, the Japanese banking sector experienced no more large failures. However, failed reform in the Japanese banking sector led to its slow recovery.

## 4. Hypothesis

Compared to past literature on banking and financial crises, we analyze the factors affecting banking sector activity and performance in the US during 2001−2014, including both pre- and post-crisis periods. In particular, we examine the factors affecting the recent recovery of the banking sectors. Our paper tries to identify the effects of macro-economic conditions (especially real-estate market prices) and the risks of banks on their activities before and after the crisis. We have developed four hypotheses as below.

H1: Macro-economic conditions affect the lending volume of banks.

Specifically, we test how real-estate market price levels affect aggregate credit supply (to households and corporations) even after controlling for macro-economic conditions. As a large credit supply is linked to asset price increases before banking crises in other countries and in other time periods (Mian and Sufi, 2014; Rajan and Ramcharan, 2015), we expect that total loans and household loans would increase with housing price increases. Real-estate market price is expected to influence bank approval of loans secured by real-estate.

H2: The effects of the real-estate market on lending depend on lending channels.

We examine whether banks in an MSA with a large negative shock to its real-estate market reduce lending to households and corporations separately. Their credits and the size of bank loans are expected to differ depending on borrowers.

H3: The economic crisis would affect the profitability of the banking sector.

We examine how the economic crisis affects the profitability of the banking sector across MSAs. The large negative economic shock would yield a lot of non-performing loans, which would affect the profitability of the banking sector.

H4: The effects of bank risks and macro-economic conditions on bank activities would

change before, during and after the 2007 crisis.

As there have been structural changes in the economy after the 2007 crisis, we separate the period into three sub-periods based on the 2007 subprime mortgage crisis and examine the above hypotheses in each sub-period. The pre-crisis period is from 2001:1Q to 2007:2Q, the during-crisis period is from 2007:3Q to 2009:2Q and the post-crisis period is from 2009:3Q to 2014:4Q.

## 5. DATA and Methodology

### 5. 1. DATA sources

We construct a quarterly banking sector dataset for 370 Metropolitan Statistical Areas (MSA) from the first quarter of 2001 through the fourth quarter of 2014.

Our data come from several sources. We collect bank information from Consolidated Reports of Condition and Income (Call Reports) from the Federal Financial Institutions Examination Council (FFIEC). We also collect branch-level deposits from Summary of Deposits (SOD) database of the FDIC. In addition, MSA-level macro-economic conditions such as population and real GDP per capita are from Bureau of Economic Analysis (BEA). The Housing Price Index (HPI) is collected from Federal Housing Finance Agency (FHFA). Treasury bill rates are obtained from Federal Reserve Economic Data (FRED) and monetary aggregate variables are retrieved from Federal Reserve Board (FRB).

We construct banking information for each MSA by aggregating all information of bank-branches located in the given MSA. When a bank has multiple branches in multiple MSAs, we assume that the branch in an MSA has the bank's property (assets, loans, capital, and so on) in proportion of its deposits over the total deposits of the bank. We assume that proportion of deposit of a branch over the total deposits of the bank is constant for a given year.

We exclude banks with zero total asset and branches with zero total deposit. We also exclude banks and branches which have no MSA information. We winsorize the deposit, bank-level, and MSA-level variables at the top and bottom 1% of the distribution of each variable. The final sample consists of 20,720 MSA-quarter observations.

Table 1 provides definitions and constructions of all the variables used in this study along with their sources.

Table 1　Definitions of the variables and data sources

Each variable is measured at the level specified at the source[5]

| Variable | Definition | Source | level |
|---|---|---|---|
| *Total assets ($1000)* | The amounts of the assets of all bank branches in MSA. | FFIDC | Bank |
| *ROA* | The weighted average of the return on asset of all bank branches in MSA. | FFIDC | Bank |
| *BIS Ratio* | The weighted average of equity capital to its total risk-weighted assets of all bank branches in MSA. It represents the financial soundness of banks in MSA. | FFIDC | Bank |
| *Core deposit Ratio* | The weighted average of the core deposit to the sum of the core deposit and wholesale funding of all bank branches in MSA.[6] It represents the financial stability of banks in MSA. | FFIDC | Bank |
| *NPL Ratio* | The weighted average ratio of a bank's non-performing loans to the total loans of all bank branches in MSA. | FFIDC | Bank |
| *Household loans ($1000) (Ratio)* | The amounts of the household loans (the loans secured by real estate and individual loans.) of all bank branches in MSA. (The ratio is household loans divided by Total assets.) | FFIDC | Bank |
| *C&I loans ($1000) (Ratio)* | The amounts of the commercial and industrial loans of all bank branches in MSA. (The ratio is C&I loans divided by Total assets.) | FFIDC | Bank |
| *Total loans ($1000) (Ratio)* | The amounts of the sum of household loan, the commercial & industrial loan and other loans of all bank branches in MSA. (The ratio is Total loans divided by Total assets) | FFIDC | Bank |
| *HPI* | The house price index of the MSA | FHFA | MSA |
| *Population* | The population of the MSA | BEA | MSA |
| *Per capita GDP* | The per capita real GDP of the MSA | BEA | MSA |
| *HHI* | Herfinahl-Hirschman Index based on the sum of squared value of each bank's share of deposits compared to total deposits in each MSA. | FDIC SOD | MSA |
| *T-Bill* | The three month treasury bill rate | FRED | Macro |
| *M2/GDP* | Money supply, measured as M2 divided by GDP | FRB | Macro |

Note: Consolidated Reports of Condition and Income (Call Reports); Federal Financial Institutions Examination Council (FFIEC); Summary of Deposits (SOD); Bureau of Economic Analysis (BEA); Federal Housing Finance Agency (FHFA); Federal Reserve Economic Data (FRED); Federal Reserve Board (FRB)

## 5. 2　Methodology

Bank activities are measured through their credit supply to borrowers. A lending decisions depends on macro-economic conditions as well as banking sector conditions in each MSA. The following fixed effects model is used to test bank lending decision.

$$Total\ loan\ Ratio_{it}=\beta_0+\beta_1\cdot\boldsymbol{B}_{it-1}+\beta_2 HHI_{jt}+\beta_3\cdot\boldsymbol{X}_{it}+\omega_i+\mu_t+\varepsilon_{jt} \quad (1)$$

[5] For example, Total assets is the bank level variable and is calculated by summing of assets of all banks in each MSA. But HPI is defined at the MSA level. Each MSA has a unique HPI value. T-Bill and M2/GDP are macro level variables, so all MSAs have the same T-bill and M2/GDP values.

[6] Wholesale funding refers to the sum of federal funds purchased, securities sold under agreements to repurchase, subordinated notes and debentures, brokered deposits, other borrowed money, deposits in foreign offices, and uninsured long-term deposits (Kim, 2015).

*Total loan ratio*$_{it}$ is the value of the aggregate credit supply to households, firms and others over aggregate bank assets for MSA *i* at time *t*. $\boldsymbol{B}_{it-1}$includes banking sector level variables such as *Total assets*, *ROA*, *BIS ratio*, *Core deposit Ratio* and *NPL Ratio* for each MSA. To reduce endogeneity issues, we use lagged variables. $HHI_t$ is the Herfinahl-Hirschman Index as a proxy of the banking sector market structure variable. $\boldsymbol{X}_{it}$ denotes MSA and macro level variables which include *HPI*, *Population*, *Per capita GDP*, *T-bill* and *M2/GDP* for MSA *i* at time *t*. $\omega_i$ is an unobserved MSA-fixed effect, $\mu_t$ is a time-fixed effect, and $\varepsilon_{jt}$ is assumed to be serially and cross-sectionally uncorrelated error term.

We also test different lending channels. The following two fixed effects models are used to test lending decisions for different lending channels to households and business borrowers.

$$Household\ loan\ ratio_{it} = \beta_0 + \beta_1 \boldsymbol{B}_{it-1} + \beta_2 \cdot HHI_{jt} + \beta_3 \cdot \boldsymbol{X}_{it} + \omega_i + \mu_t + \varepsilon_{jt} \quad (2)$$

$$C\&I\ loan\ ratio_{it} = \beta_0 + \beta_1 \boldsymbol{B}_{it-1} + \beta_2 \cdot HHI_{jt} + \beta_3 \cdot \boldsymbol{X}_{it} + \omega_i + \mu_t + \varepsilon_{jt} \quad (3)$$

*Household loan ratio*$_{it}$ is the value of the aggregate credit supply to households over aggregate bank assets for MSA *i* at time *t*. It includes household loans secured by real-estate properties, car loans and credit card loans. The portion of household loans secured by real-estate properties accounts for almost 89% of household loans. Similarly, *C&I loan ratio*$_{it}$ is the value of the aggregate credit supply to corporations over aggregate bank assets for MSA *i* at time *t*.

We also estimate the effects of the macro-economic conditions and banking sector conditions to the non-performing loan. *NPL Ratio* is the aggregate non-performing loan ratio over total aggregate loans of its MSA. It represents financial health and risk-taking of the banking sector in MSA. As equation (4) shows, we use the lagged lending ratios of the banking sector.

$$\begin{aligned} NPL\ Ratio_{it} = {} & \beta_0 + \beta_1 \cdot \boldsymbol{B}_{it-1} + \beta_2\ HHI_{jt} + \beta_3 \cdot \boldsymbol{X}_{it} + \beta_4 \cdot Household\ loan\ ratio_{it-1} \\ & + \beta_4 \cdot C\&I\ loan\ ratio_{it-1} + \omega_i + \mu_t + \varepsilon_{jt} \end{aligned} \quad (4)$$

Finally, we estimate the effects of the macro-economic conditions and banking sector conditions on banking sector profitability. *ROA* is the return on aggregate assets of banks in an MSA, which represents their profitability. And loan ratio variables are included to test how the lending activity of a banking sector affects its profitability.

$$\begin{aligned} ROA_{it} = {} & \beta_0 + \beta_1\ HHI_{jt} + \beta_2 \cdot \boldsymbol{B}_{it\text{-}1} + \beta_3 \cdot \boldsymbol{X}_{it} + \beta_4 \cdot Household\ loan\ ratio_{it-1} \\ & + \beta_4 \cdot C\&I\ loan\ ratio_{it-1} + \omega_i + \mu_t + \varepsilon_{jt} \end{aligned} \quad (5)$$

In order to see the effects of the subprime mortgage crisis, we separate the period into three sub-periods based on the crisis and we implement the four regressions above for each period.

Table 2　Summary Statistics

| | Whole period (20,720 observation) | | | | Pre-crisis Period (9,620 obs.) | During–crisis Period (2,960 obs.) | Post-crisis Period (8,140 obs.) |
|---|---|---|---|---|---|---|---|
| Variable | MEAN | STD | MIN | MAX | MEAN | MEAN | MEAN |
| *Total assets (Millions)* | 9,240 | 16,336 | 113 | 361,695 | 8,111 | 9,363 | 10,530 |
| *Household loans (Millions)* | 4,084 | 5,863 | 54 | 74,528 | 3,644 | 4,270 | 4,535 |
| *C&I loans (Millions)* | 1,566 | 3,479 | 3 | 92,203 | 1,374 | 1,718 | 1,739 |
| *Total loans (Millions)* | 5,793 | 9,772 | 72 | 214,234 | 5,154 | 6,102 | 6,437 |
| *ROA* | 0.0058 | 0.0046 | - 0.0377 | 0.0362 | 0.0076 | 0.0035 | 0.0046 |
| *BIS Ratio* | 0.1313 | 0.0245 | 0.0158 | 0.3365 | 0.1288 | 0.1250 | 0.1364 |
| *Core deposit Ratio* | 0.6933 | 0.0924 | 0.3265 | 0.9206 | 0.6636 | 0.5895 | 0.7662 |
| *NPL Ratio* | 0.0171 | 0.0140 | 0.0008 | 0.1341 | 0.0070 | 0.0188 | 0.0283 |
| *HPI* | 167.7 | 34.3 | 108.8 | 333.5 | 160.4 | 186.5 | 169.4 |
| *Population* | 466,497 | 645,506 | 59,106 | 4,441,890 | 446,524 | 471,500 | 488,281 |
| *Per capita GDP* | 39,882 | 10,290 | 18,729 | 78,564 | 39,612 | 40,461 | 39,991 |
| *HHI* | 0.1511 | 0.0649 | 0.0398 | 0.6309 | 0.1575 | 0.1500 | 0.1438 |
| *T-Bill* | 0.0141 | 0.0161 | 0.0001 | 0.0494 | 0.0267 | 0.0097 | 0.0007 |
| *M2/GDP* | 0.5533 | 0.0575 | 0.4802 | 0.6604 | 0.5039 | 0.5387 | 0.6169 |

This table provides the descriptive statistics for the variables used in the analysis. The definition and construction of each variable is explained in Table 1. Variables except for *T-BIll* and *M2/GDP* are winsorized at 1st and 99th percentiles. The Pre-crisis period is from 2001:1Q to 2007:2Q, The During-crisis period is from 2007:3Q to 2009:2Q and The Post-crisis period is from 2009:3Q to 2014:4Q.

### 5. 3. Variables

Table 2 provides detailed statistics of variables at the MSA level. Assets and loans have steadily increased regardless of the crisis. *ROA* is highest before the crisis and lowest during the crisis, recovering somewhat after the crisis. *NPL Ratio* sharply increases from the during-crisis period. In the post-crisis period, *NPL Ratio* is four times higher than that in the pre-crisis period. *HPI* is the highest value in the during-crisis period. In the post-crisis period, HPI is not fully recovered to the level in the during-crisis period.

## 6. Empirical Results

### 6. 1. Univariate test

To examine the relation between a credit supply and bank risks or HPI, we run univariate tests for *Total loan ratio*. First, we sorted MSAs into five groups according to the *HPI*, *Total assets and Total loan ratios*. Then, we compare the group mean of the highest quintile group with that of the lowest quintile group.

Table 3 shows the differences in the highest quintile group and the lowest quintile group based on whole periods and sub-periods. The mean differences of some of bank-related variables vary across time. When MSAs are sorted based on their housing price indices, the mean of *total loan ratio* of the highest group is higher than the lowest group in the pre-crisis and the during-crisis periods. However, in the post-crisis period, the mean of *total loan ratio* of the highest group is lower than the lowest group the in pre-crisis. This suggests that during the post-crisis period, banks in MSAs with lower housing price indices lend more loans to borrowers than those in higher housing price indices. In addition, during the crisis, ROA and NPL are lower in MSAs with higher HPIs than those with lower HPIs. Before and after the crisis periods, the MSAs with the high *HPI* have higher *ROA* values and lower NPL ratios. But during the crisis, the MSAs with the high *HPI* have a lower *ROA* value and higher NPLs.

This can be interpreted that the high housing price yields negative effects to the profitability during the crisis. Although the profitability has improved after the crisis, bank profitability is still lower in MSAs with high HPIs. Average *NPL Ratio* has increased in both high *HPI* MSAs and low *HPI* MSAs. The effect of housing price to non-performing loans is reversed during the crisis.

When we sort MSAs into quintiles based on the size of *total assets*, the average of some of the bank-related variables in MSAs with high total assets and low total assets also change

Table 3 Difference-in-means estimates

| | Sorted by : | *HPI* | | | | *Total asset* | | | | *Total loan ratio* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Variable | High | Low | H-L | T-value | High | Low | H-L | T-value | High | Low | H-L | T-value |
| *Whole period* | *Total assets* | 13,257 | 6,895 | 6,362 | 14.40 | 30,644 | 1,550 | 29,094 | 39.39 | 6,161 | 11,959 | -5,797 | -12.47 |
| | *Total loan ratio* | 0.6439 | 0.6318 | 0.0121 | 5.19 | 0.6297 | 0.6398 | -0.0101 | -6.99 | 0.7167 | 0.5550 | 0.1617 | 114.48 |
| | *ROA* | 0.0060 | 0.0056 | 0.0004 | 4.24 | 0.0061 | 0.0058 | 0.0003 | 3.02 | 0.0059 | 0.0064 | -0.0005 | -2.08 |
| | *BIS Ratio* | 0.1284 | 0.1315 | -0.0031 | -3.44 | 0.1293 | 0.1311 | -0.0018 | -5.42 | 0.1255 | 0.1409 | -0.0154 | -27.18 |
| | *Core deposit Ratio* | 0.6875 | 0.6936 | -0.0062 | -3.82 | 0.6728 | 0.7056 | -0.0328 | -29.94 | 0.6824 | 0.7052 | -0.0228 | -9.03 |
| | *NPL Ratio* | 0.0168 | 0.0186 | -0.0018 | -4.92 | 0.0171 | 0.0180 | -0.0009 | -6.46 | 0.0172 | 0.0161 | 0.0011 | 3.02 |
| *Pre-crisis period* | *Total assets* | 11,498 | 5,680 | 5,817 | 33.77 | 26,639 | 1,394 | 25,245 | 76.08 | 5,914 | 9,266 | -3,352 | -8.29 |
| | *Total loan ratio* | 0.6545 | 0.6293 | 0.0251 | 15.10 | 0.6309 | 0.6463 | -0.0153 | -8.23 | 0.7236 | 0.5583 | 0.1653 | 108.32 |
| | *ROA* | 0.0081 | 0.0073 | 0.0008 | 8.00 | 0.0080 | 0.0078 | 0.0002 | 2.03 | 0.0082 | 0.0078 | 0.0005 | 4.96 |
| | *BIS Ratio* | 0.1238 | 0.1326 | -0.0089 | -25.60 | 0.1272 | 0.1289 | -0.0017 | -8.57 | 0.1215 | 0.1396 | -0.0181 | -41.01 |
| | *Core deposit Ratio* | 0.6580 | 0.6696 | -0.0116 | -6.05 | 0.6420 | 0.6791 | -0.0371 | -30.68 | 0.6458 | 0.6854 | -0.0395 | -16.17 |
| | *NPL Ratio* | 0.0063 | 0.0075 | -0.0012 | -12.65 | 0.0068 | 0.0071 | -0.0002 | -3.77 | 0.0069 | 0.0071 | -0.0002 | -2.61 |
| *During-crisis period* | *Total assets* | 12,646 | 7,484 | 5,161 | 9.64 | 30,503 | 1,632 | 28,871 | 84.15 | 5,130 | 13,552 | -8,422 | -19.56 |
| | *Total loan ratio* | 0.6840 | 0.6609 | 0.0231 | 8.31 | 0.6556 | 0.6752 | -0.0196 | -15.57 | 0.7553 | 0.5828 | 0.1725 | 52.67 |
| | *ROA* | 0.0027 | 0.0032 | -0.0006 | -2.95 | 0.0031 | 0.0036 | -0.0005 | -2.61 | 0.0029 | 0.0043 | -0.0013 | -1.72 |
| | *BIS Ratio* | 0.1225 | 0.1254 | -0.0029 | -4.12 | 0.1250 | 0.1254 | -0.0004 | -1.84 | 0.1198 | 0.1315 | -0.0117 | -18.60 |
| | *Core deposit Ratio* | 0.5713 | 0.5875 | -0.0161 | -4.09 | 0.5668 | 0.6054 | -0.0386 | -16.45 | 0.5810 | 0.5938 | -0.0128 | -5.08 |
| | *NPL Ratio* | 0.0207 | 0.0186 | 0.0021 | 5.04 | 0.0192 | 0.0191 | 0.0001 | 0.62 | 0.0211 | 0.0166 | 0.0044 | 3.88 |
| *Post-crisis period* | *Total assets* | 15,478 | 8,061 | 7,417 | 7.12 | 35,247 | 1,698 | 33,548 | 26.50 | 6,816 | 14,438 | -7,622 | -10.24 |
| | *Total loan ratio* | 0.6172 | 0.6240 | -0.0068 | -4.80 | 0.6189 | 0.6196 | -0.0008 | -0.61 | 0.6949 | 0.5412 | 0.1537 | 92.43 |
| | *ROA* | 0.0048 | 0.0046 | 0.0002 | 3.23 | 0.0050 | 0.0044 | 0.0006 | 4.95 | 0.0043 | 0.0056 | -0.0014 | -2.79 |
| | *BIS Ratio* | 0.1359 | 0.1325 | 0.0034 | 3.05 | 0.1331 | 0.1357 | -0.0025 | -3.23 | 0.1321 | 0.1457 | -0.0137 | -13.81 |
| | *Core deposit Ratio* | 0.7632 | 0.7595 | 0.0037 | 2.60 | 0.7464 | 0.7723 | -0.0259 | -22.59 | 0.7608 | 0.7682 | -0.0074 | -3.61 |
| | *NPL Ratio* | 0.0274 | 0.0312 | -0.0039 | -7.12 | 0.0281 | 0.0301 | -0.0021 | -18.49 | 0.0275 | 0.0261 | 0.0013 | 2.18 |

We sort all MSAs each quarter into quintiles and show the average values of high and low groups. The table also shows the mean differences between the highest MSA group and the lowest MSA group in quintiles. The definition and construction of each variable is explained in Table 1. T-value is for the differences between the high MSA group and the low MSA group. The Pre-crisis period is from 2001:1Q to 2007:2Q, The During-crisis period is from 2007:3Q to 2009:2Q and The Post-crisis period is from 2009:3Q to 2014:4Q.

qualitatively across time. During the crisis, average ROA in MSAs with large assets is lower than that in MSAs with small assets. In contrast, in pre and post-crisis periods, average ROA in MSAs with large assets is higher than that in MSAs with small assets.

When we sort MSAs into quintiles based on the size of *total loan ratios*, the average of some of the bank-related variables in MSAs with high total loan ratios and low total loan ratios also change qualitatively across time. For example, in the pre-crisis period, MSAs with higher total loan ratios show lower NPLs than MSAs with lower total loan ratios. However, during-crisis and post-crisis periods, MSAs with higher total loan ratios show higher NPLs than MSAs with lower total loan ratios. In addition, in the the pre-crisis period, MSAs with higher total loan ratios show higher ROAs than MSAs with lower total loan ratios. But, in during-crisis and post-crisis periods, MSAs with higher total loan ratios show lower ROAs. This result suggests that heavy bank-lending turned into non-performing loans and led to lower ROAs for banks.

The analysis suggests that market conditions and bank-related variables such as HPI, total assets and total loan ratios in MSAs affect loan ratios and performance differently across time periods. Consequently, we need to run multivariate regressions across time separately.

### 6. 2. Multivariate Regression

Table 4 shows the effects of bank risks and macro-economic conditions on bank lending decisions. We measure the lending decisions of banks through total loan ratios, household loan ratios and C&I loan ratios.

Panel A shows that *HPI* has positive effects on *Total loan ratio* (see column 1), showing that banks in MSAs with high real-estate prices increase their lending to their borrowers. ROA has a positive and significant coefficient. The coefficient of *Total assets* is negative, showing that banks do not increase their lending when their size increases. This suggests that banks with large assets have higher 'charter value' and try to protect the value by taking fewer risks. Banks with higher reliance on Deposits for their funding have lower lending.

Panel A also shows that the effects of *HPI* vary depending on the lending channels. The coefficients of *HPI* for *Household loan ratio* are positive values while the coefficients of *HPI* for *C&I loan ratio* are negative values and significant. However, the effects of some bank characteristics remain qualitatively the same. The coefficients of *Total assets* and those of core-deposit ratio are all negative regardless of lending channels.

Panels B to D show that some of our results vary across time periods. In Panel B, in pre-cri-

Table 4　Effects of bank risks and macro-economic conditions to the lending decisions

| Period | Panel A : Whole period | | | Panel B : Pre-Crisis Period | | |
|---|---|---|---|---|---|---|
| variable | *Total loans Ratio (1)* | *Household loan ratio (2)* | *C&I loans Ratio (3)* | *Total loans Ratio (1)* | *Household loan ratio (2)* | *C&I loans Ratio (3)* |
| *Log(HPI)* | 0.0480*** | 0.0773*** | -0.0378*** | 0.0193** | 0.0461*** | -0.0695*** |
| | (6.87) | (10.41) | (-6.14) | (2.08) | (4.84) | (-8.95) |
| *Log(Population)* | -0.0618*** | -0.0340* | 0.0819*** | 0.0903*** | 0.1254*** | 0.0762** |
| | (-2.77) | (-1.65) | (4.50) | (3.07) | (3.97) | (2.53) |
| *Log(Per capita GDP)* | 0.0210* | -0.0236* | 0.0903*** | 0.0061 | -0.0365* | 0.0503*** |
| | (1.71) | (-1.89) | (8.65) | (0.31) | (-1.69) | (2.89) |
| *HHI* | -0.0912** | -0.1133*** | 0.0475* | -0.0289 | 0.0188 | -0.0377 |
| | (-2.47) | (-3.17) | (1.65) | (-0.51) | (0.40) | (-0.78) |
| *T-Bill* | 2.8592 | 0.7468 | -6.4101 | -3.7881 | -3.2493 | -2.5477 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *M2/GDP* | 0.5085 | 0.2726 | -0.8129 | 0.0944 | 0.0483 | 0.0368 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *Log(Total assets)* | -0.0280*** | -0.0548*** | -0.0350*** | -0.0386*** | -0.0576*** | -0.0511*** |
| | (-7.10) | (-14.29) | (-7.74) | (-5.95) | (-9.39) | (-10.86) |
| *ROA* | 0.5839** | 0.1736 | 0.3650** | 2.8899*** | 1.4075** | 0.7241** |
| | (2.24) | (0.71) | (1.99) | (3.97) | (2.35) | (2.25) |
| *BIS Ratio* | -0.6777*** | -0.4180*** | -0.1622*** | -1.1053*** | -0.6477*** | -0.6573*** |
| | (-14.85) | (-9.36) | (-4.53) | (-8.75) | (-5.75) | (-7.16) |
| *Core deposit Ratio* | -0.1969*** | -0.1358*** | -0.1380*** | -0.2162*** | -0.1099*** | -0.1467*** |
| | (-9.63) | (-6.49) | (-8.19) | (-6.90) | (-3.91) | (-6.24) |
| *NPL Ratio* | -0.4556*** | -0.4060*** | -0.1043 | -1.4595*** | -1.2789*** | -0.6672** |
| | (-3.93) | (-3.73) | (-1.30) | (-3.56) | (-3.59) | (-2.46) |
| Observations | 20,350 | 20,350 | 20,350 | 9,250 | 9,250 | 9,250 |
| $R^2$ | 0.6977 | 0.7737 | 0.7690 | 0.7951 | 0.8631 | 0.8449 |

This table provides the effects of bank risks and macro-economic conditions on total loan ratio, household loan ratio and C&I loan ratio as a proxy for the lending decisions of banks. Pre-crisis period is from 2001:1Q to 2007:2Q, During-crisis period is from 2007:3Q to 2009:2Q and Post-crisis period is from the 2009:3Q to 2014:4Q. Each regression includes quarterly dummies and MSA dummies to control for time and MSA fixed effects. T-statistics based on standard errors clustered by MSA and robust to heteroskedasticity are reported in the parentheses. ***, **, * represent significance at the 1%, 5%, 10% levels, respectively.

sis period, *HPI* has a positive effect on *Total loan ratio* (see column 1). But *HPI* does not have a significant effect during and after the crisis. These results suggest that real-estate price is an important determinant before the crisis but not afterwards. However, when we consider lending channels, HPI has positive effects on household loans and negative effects on loans to commercial and industrial loans. Note that the coefficient size of HPI on Household loans de-

Table 4 (Continued)

| Period | Panel C : During Crisis Period | | | Panel D : Post-Crisis Period | | |
|---|---|---|---|---|---|---|
| variable | *Total loan Ratio (1)* | *Household loan ratio (2)* | *C&I loan Ratio (3)* | *Total loan Ratio (1)* | *Household loan ratio (2)* | *C&I loan Ratio (3)* |
| *Log(HPI)* | 0.0029 | 0.0443*** | -0.0573*** | 0.0227 | 0.0284** | -0.0347*** |
| | (0.26) | (4.20) | (-4.89) | (1.40) | (1.97) | (-3.38) |
| *Log(Population)* | 0.1342 | -0.0824 | 0.2361*** | -0.2457*** | -0.0567 | 0.0810* |
| | (1.35) | (-0.82) | (3.53) | (-5.13) | (-1.04) | (1.90) |
| *Log(Per capita GDP)* | -0.0387** | -0.0254 | 0.0406** | 0.0330* | 0.0454*** | 0.0195 |
| | (-2.50) | (-1.36) | (2.51) | (1.81) | (2.77) | (1.44) |
| *HHI* | 0.1277** | 0.1457** | 0.0599 | -0.1637*** | -0.2220*** | 0.0804** |
| | (2.40) | (2.40) | (0.83) | (-3.32) | (-4.66) | (2.44) |
| *T-Bill* | 0.2273 | -0.1058 | 0.3223 | -6.6130 | -1.4122 | 2.2852 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *M2/GDP* | 0.2318 | -0.1442 | 0.4953 | 0.3493 | 0.1155 | -0.1382 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *Log(Total assets)* | -0.0419*** | -0.0552*** | -0.0336*** | -0.0015 | -0.0325*** | -0.0353*** |
| | (-3.39) | (-5.43) | (-2.59) | (-0.26) | (-5.70) | (-6.49) |
| *ROA* | 0.1427 | 0.2467 | 0.3954*** | -0.8531*** | -0.8554*** | 0.3487*** |
| | (0.70) | (1.39) | (2.62) | (-4.75) | (-4.63) | (3.03) |
| *BIS Ratio* | -0.3786** | -0.2936** | -0.0495 | -0.2378*** | -0.0926*** | -0.0846*** |
| | (-2.10) | (-2.04) | (-0.34) | (-7.31) | (-3.20) | (-3.62) |
| *Core deposit Ratio* | -0.0622* | -0.0200 | -0.1103*** | -0.1302*** | -0.1723*** | -0.0889*** |
| | (-1.95) | (-0.51) | (-3.33) | (-4.09) | (-5.74) | (-3.95) |
| *NPL Ratio* | -0.5932*** | -0.3346** | -0.4224** | -0.0307 | 0.2571** | -0.2211*** |
| | (-4.22) | (-2.20) | (-2.55) | (-0.26) | (2.01) | (-3.48) |
| Observations | 2,960 | 2,960 | 2,960 | 8,140 | 8,140 | 8,140 |
| $R^2$ | 0.9190 | 0.9500 | 0.9307 | 0.8995 | 0.8419 | 0.8989 |

clines over time. The effects of ROA also change over time. While ROA has positive and significant effects in the pre-crisis period in Panel B, it has negative and significant effects in the post-crisis period in Panel D. Before the crisis, banks with high profitability have more loans than banks with low profitability. But after the crisis, the coefficients of ROA for *Total loan ratio* and *Household loan ratio* become negative and significant while ROA has a positive and significant effect on commercial loans. These results suggest that more profitable banks have lowered their exposure to household loans after the crisis.

Table 5 provides the effects of bank risks and macro-economic conditions to the non-performing loans. First, the coefficient of HPI is negative before and during the crisis. However, it

Table 5　Effects of bank risks and macro-economic conditions to non-performing loans

| Period | Panel A : Whole period | Panel B : Pre-Crisis | Panel C : During Crisis | Panel D : Post-Crisis |
|---|---|---|---|---|
| Variable | *NPL Ratio* | *NPL Ratio* | *NPL Ratio* | *NPL Ratio* |
| *Log(HPI)* | -0.0077*** | -0.0018*** | -0.0192*** | 0.0020 |
| | (-10.65) | (-3.61) | (-7.98) | (0.78) |
| *Log(Population)* | 0.0180*** | -0.0101*** | 0.0706*** | -0.0524*** |
| | (9.17) | (-5.64) | (3.95) | (-4.68) |
| *Log(Per capita GDP)* | -0.0075*** | -0.0033*** | -0.0136*** | 0.0178*** |
| | (-4.37) | (-3.24) | (-3.59) | (5.01) |
| *HHI* | -0.0091 | 0.0002 | -0.0215 | -0.0093 |
| | (-1.40) | (0.06) | (-1.60) | (-0.53) |
| *T-Bill* | -0.9065 | 0.2838 | 14.7440 | -143.5130 |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| *M2/GDP* | -0.1488 | -0.0070 | 0.1622 | 0.0839 |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| *Household loan ratio* | -0.0018 | -0.0028*** | -0.0020 | 0.0164*** |
| | (-1.00) | (-2.62) | (-0.45) | (3.16) |
| *C&I loans Ratio* | -0.0045*** | -0.0032*** | -0.0211*** | -0.0106** |
| | (-2.58) | (-3.20) | (-6.24) | (-2.37) |
| *Log(Total assets)* | -0.0020*** | -0.0004 | -0.0027*** | -0.0015 |
| | (-4.87) | (-1.36) | (-3.82) | (-1.58) |
| *ROA* | -0.9540*** | -0.1121*** | -0.4893*** | -0.6478*** |
| | (-22.71) | (-4.82) | (-6.64) | (-12.36) |
| *BIS Ratio* | 0.0049 | 0.0089* | 0.0067 | 0.0048 |
| | (0.43) | (1.79) | (0.50) | (0.59) |
| *Core deposit Ratio* | -0.0053 | -0.0044*** | -0.0241*** | -0.0347*** |
| | (-1.52) | (-2.71) | (-3.24) | (-4.13) |
| Observations | 20,350 | 9,250 | 2,960 | 8,140 |
| $R^2$ | 0.8800 | 0.6827 | 0.8970 | 0.8827 |

This table shows the effects of bank risks and macro-economic conditions to the non-performing loan ratio in equation (4). Pre-crisis is from 2001:1Q to 2007:2Q, During-crisis is from 2007:3Q to 2009:2Q and Post-crisis is from the 2009:3Q to 2014:4Q. Each regression includes quarterly dummies and MSA dummies to control for time and MSA fixed effects. T-statistics based on standard errors clustered by MSA and robust to hetero-skedasticity are reported in the parentheses. ***, **, * represent significance at the 1%, 5%, 10% levels, respectively.

Table 6 Effects of bank risks and macro-economic conditions to the profitability

| Period | Panel A : Whole period | Panel B : Pre-Crisis | Panel C : During-Crisis | Panel D : Post-Crisis |
|---|---|---|---|---|
| variable | *ROA* | *ROA* | *ROA* | *ROA* |
| *Log(HPI)* | 0.0004 | 0.0008** | 0.0078*** | -0.0083*** |
| | (1.31) | (2.54) | (5.67) | (-7.54) |
| *Log(Population)* | -0.0003 | 0.0001 | -0.0298*** | 0.0225*** |
| | (-0.31) | (0.14) | (-4.00) | (5.47) |
| *Log(Per capita GDP)* | 0.0007 | 0.0001 | -0.0032* | -0.0043*** |
| | (1.27) | (0.09) | (-1.84) | (-2.65) |
| *HHI* | -0.0032* | 0.0014 | -0.0160** | -0.0177*** |
| | (-1.83) | (0.74) | (-2.06) | (-3.93) |
| *T-Bill* | 0.0220 | -0.0319 | -4.7342 | 0.5798 |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| *M2/GDP* | 0.0049 | 0.0009 | -0.0697 | -0.0330 |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| *Household loan ratio* | -0.0009 | 0.0036*** | 0.0004 | -0.0134*** |
| | (-0.95) | (2.86) | (0.15) | (-6.90) |
| *C&I loans Ratio* | 0.0027*** | 0.0028*** | 0.0037 | 0.0017 |
| | (3.29) | (4.01) | (1.36) | (0.77) |
| *Log(Total assets)* | -0.0002 | 0.0001 | 0.0001 | -0.0013*** |
| | (-1.27) | (0.53) | (0.19) | (-3.77) |
| *BIS Ratio* | 0.0024 | -0.0017 | 0.0081 | 0.0083*** |
| | (0.81) | (-0.47) | (0.94) | (3.28) |
| *Core deposit Ratio* | 0.0061*** | 0.0006 | 0.0024 | 0.0165*** |
| | (5.24) | (0.62) | (0.75) | (6.15) |
| *NPL Ratio* | -0.1843*** | -0.0826*** | -0.2442*** | -0.1497*** |
| | (-16.55) | (-6.40) | (-10.80) | (-12.27) |
| Observations | 20,350 | 9,250 | 2,960 | 8,140 |
| $R^2$ | 0.7745 | 0.8959 | 0.7832 | 0.7197 |

This table shows the effects of bank risks and macro-economic conditions on bank profitability in equation (5). Pre-crisis is from 2001:1Q to 2007:2Q, During-crisis is from 2007:3Q to 2009:2Q and Post-crisis is from the 2009:3Q to 2014:4Q. Each regression includes quarterly dummies and MSA dummies to control for time and MSA fixed effects. T-statistics based on standard errors clustered by MSA and robust to heteroskedasticity are reported in the parentheses. ***, **, * represent significance at the 1%, 5%, 10% levels, respectively.

is positive but not significant after the crisis. As a result, banks in MSAs with high HPIs do not necessarily show lower non-performing loans. Second, before the crisis, more loans reduce *NPL* Ratio regardless of lending channels. But during the crisis, the coefficient of *Household loan ratio* is insignificant. In the post-crisis period, the coefficient of *Household loan ratio* is a positive and significant value after the crisis. After the crisis, banks with high exposure to household loans show a higher non-performing loan ratio. Third, the coefficients of *C&I loan ratio* are negative and significant regardless of time period. Fourth, banks with higher reliance on deposits show lower NPLs.

Table 6 shows the factors affecting bank profitability. Banks in MSAs with higher HPI show lower ROAs. MSAs with high household loans show lower ROAs in the post-crisis period while they showed higher ROAs in the pre-crisis period. The coefficients of NPL Ratio are largely negative and significant for every period. One interesting point is that BIS Ratio and Core deposit Ratio are positive and significant only after the crisis. These results suggest that the financial soundness and stability of bank funding structure become more important for surviving banks

## 7. Conclusion

This paper examines the factors affecting bank activities before and after the crisis in 2007 using quarterly information on all commercial banks in the US from 2001 to 2014. Our analysis shows that banking sector activities in MSAs depend on MSA-level economic conditions. After the crisis, MSAs with higher real-estate price indices show still higher bank loans to households while they show lower commercial and industrial loans. NPLs are higher in MSAs with higher household loans. In contrast, NPLs are lower in MSAs with lower commercial and industrial loans. Consequently, ROA of the banking sector is higher in MSAs with lower real-estate price indices.

Our analysis provides important implications for the recovery and financial health of surviving banks after experiencing a crisis. In the post-crisis period, surviving banks show large credit supply and improved performance. Furthermore, even without the recovery of the real-estate markets, some surviving banks show improved performance. As US banks have experienced large failures of weak banks in the post-crisis period, the recovery might be the outcome of restructuring in the financial sector.

This study also yields important implications for the Japanese banking sector. While both the US and Japan experienced a bubble burst in the real-estate market and suffering of financial firms, the recovery trajectory of the banking sector in each country differed. While the US

and Japanese banking sector shared similarities in their lending before the bubble burst, the US banking sector restructured, but the Japanese banking sector did not. Such differences might have led to different recovery processes.

To be clear, our interpretation of the results does not establish causation as it is possible that originally stronger banks survived. Future studies can use bank-level information to examine the factors affecting the cause of high credit supply before the 2008 crisis and factors affecting the recovery after the crisis.

## References

Athanasoglou, P., Brissimis, S. and Delis, M. (2008). "Bank-specific, industry-specific and macroeconomic determinants of bank profitability," *Journal of International Financial Markets, Institutions and Money*, 18 (2), pp. 121−136.

Boyd, J. H., and De Nicolo, G. (2005). "The theory of bank risk taking and competition revisited," *The Journal of finance*, 60(3), pp. 1329−1343.

Brissimis, S. N., Delis, M. D. and Papanikolaou, N. I. (2008). "Exploring the nexus between banking sector reform and performance: evidence from newly acceded EU countries," *Journal of Banking and Finance*, 32 (12), pp. 2674−2683.

Chari, V., Christiano, L. and Kehoe, P. (2008). "Facts and myths about the financial crisis of 2008." Unpublished Working Paper.

Demsetz, R. S., Saidenberg, M. R., and Strahan, P. E. (1996). "Banks with something to lose: The disciplinary role of franchise value," *Economic Policy Review*, 2(2).

Dietrich, A. and Wanzenried, G. (2011). "Determinants of bank profitability before and during the crisis: Evidence from Switzerland," *Journal of International Financial Markets, Institutions &Money*, 21(3), pp. 307−327.

Duchin, R., Ozbas, O. and Sensoy, B. (2010). "Costly external finance, corporate investment, and the subprime mortgage credit crisis," *Journal of Financial Economics*, 97, pp. 418−435.

Federal Deposit Insurance Corporation (2015). "Failed bank list" (https://www.fdic.gov/bank/individual/failed/banklist.html)

Gan, J. (2004). "Banking Market Structure and Financial Stability: Evidence from the Texas Real Estate Crisis in the 1980s," *Journal of Financial Economics*, 73, pp. 567−601.

Gan, J. (2006). "Collateral, Debt Capacity, and Corporate Investment: Evidence from A Natural Experiment," *Journal of Financial Economics*, 85, pp. 709−734.

Gan J. (2007). "The Real Effects of Asset Market Bubbles: Loan- and Firm-Level Evidence of a Lending Channel," Review of Financial Studies.

Hoshi, T., and A. Kashyap. (2004). "Japan's Financial Crisis and Economic Stagnation," *Journal of Economic Perspectives*, 18, pp. 3−26.

Ivashina, V. and Scharfstein, D., (2010). "Bank lending during the financial crisis of 2008," *Journal of Financial Economics*, 97, pp. 319−338.

Jiménez, G., Lopez, J. A., and Saurina, J. (2013). "How does competition affect bank risk taking?"

*Journal of Financial Stability*, 9(2), pp. 185−195.

Keeley, M. C. (1990). "Deposit insurance, risk, and market power in banking." *The American Economic Review*, pp. 1183−1200.

Kim, Jeongsim (2015). Essays on market discipline in the capital market. Seoul National University.

Mian, Atif and Amir Sufi (2014), House of Debt: How They (And You) Caused the Great Recession, and How We Can Prevent It from Happening Again, 2014/5/21, The University of Chicago Press.

Nussle, Jim (2008). Update of Statistical Area Definitions and Guidance on Their Uses. Office of Management and Budget.

Ozawa, T. (1999). "The Rise and Fall of Bank-Loan Capitalism: Institutionally Driven Growth and Crisis in Japan," *Journal of Economic Issues*, 33(2), pp. 351−358.

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

Peek, J., and E. Rosengren (2005). "The international transmission of financial shocks: The case of Japan," *American Economic Review*, 87(4), pp. 495−505.

Puri, M., Rocholl, J., and Steffen, S. (2011). "Global retail lending in the aftermath of the US financial crisis: Distinguishing between supply and demand effects," *Journal of Financial Economics*, 100(3), pp. 556−578.

Rajan, Raghuram and Rodney Ramcharan (2015), "The Anatomy of a Credit Crisis: The Boom and Bust in Farm Land Prices in the United States in the 1920s," *American Economic Review*, 105(4), pp. 1439−1477.

Santos, J. A. (2011). "Bank corporate loan pricing following the subprime crisis," *Review of Financial Studies,* 24(6), pp. 1916−1943.

Staikouras, C. and Wood, G. (2004). "The determinants of European bank profitability," *International Business and Economics Research Journal*, 3(6), pp. 57−68.

Ueda, K. (2000). Crisis and Change in the Japanese Financial System, Chapter 3: Causes of Japan's Banking Problems in the 1990s, pp. 59−81.