

Macroeconomic and Bank-Specific Determinants of the U.S. Non-Performing Loans: Before and During the Recent Crisis

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Table of Contents

| | |
|--|----|
| Abstract | 4 |
| Acknowledgements | 5 |
| 1. Introduction | 6 |
| 2. Literature Review | 7 |
| 3. Determinant factors of NPLs | 9 |
| 3.1 Macroeconomic factors | 9 |
| 3.2 Bank specific determinants | 10 |
| 4. Data Sample and Econometric Methodology | 13 |
| 4.1 Banking Data | 13 |
| 4.2 Econometric model | 13 |
| 5. Model estimation and results | 14 |
| 5.1 Model Estimation | 14 |
| 5.2 Results | 15 |
| 5.2.1 Pre-financial Crisis Period | 15 |
| 5.2.2 Financial Crisis Period | 17 |
| 6. Conclusions | 18 |
| References | 19 |
| Appendix | 21 |

Abstract

Both macroeconomic and bank-specific factors are correlated to the occurrence of Non-Performing Loans (NPL). We use a sample of U.S. banks over two distinct time periods to provide empirical evidence of various key macroeconomic and bank-specific determinants' effects on NPLs.

Keywords: Non-performing loans; Macroeconomic determinants; Bank specific determinants; Crisis; the U.S. banking system

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1. Introduction

The sub-prime mortgage crisis has cast attention on Non-Performing Loans (NPL) as a signal of an economic crisis. Because of NPLs correlation to the health of an economy, financial regulatory bodies across the globe are increasingly viewing NPLs as a significant factor in managing risk. NPLs, which are typically defined as loans that have been in default for 90 days, are garnering an increasing amount of literature in its relation to macroeconomic and bank-specific determinants.

Louzis, Vouldis, and Metaxas (2011) used the GMM method to examine the macroeconomic and bank-specific determinants of NPLs in Greece for mortgage, business, and consumer loan portfolios. This paper complements this literature by using the Ordinary Least Square (OLS) method to verify the key determinants of NPLs in the U.S. banking system over two distinct time periods – one in a period of economic stability (2002 – 2006), and one in recession (2007-2010). This paper hypothesizes that both macroeconomic factors (GDP growth, unemployment rate, and federal fund rate) and bank-specific factors (solvency ratio, inefficiency ratio, return on equity, bank size, non-interest income) are correlated to NPLs.

There are two key differentiators of this paper. First, we use two distinct time periods - one period before the onset of an economic crisis (2002 – 2006), and another during an economic crisis (2007-2010).

Secondly, we focus on the U.S. banking system as the economic crisis in study (2007-2010) was initially caused by factors in the U.S. banking industry.

2. Literature review

Academic scholars and researchers have been increasingly aware of non-performing loans as a signal of credit risk. This awareness has increased the amount of research in understanding the key determinants of NPLs. This paper takes various ideas and concepts from this literature and applies these concepts to a different environment.

Salas and Saurina (2002) examined the effect of both macroeconomic and individual bank level variables of problem loans in Spanish commercial and savings banks in their literature. Their focus was on the importance of individual bank factors such as growth policies and managerial incentives. They found evidence that the effect of these individual factors held true even when macroeconomic variables were held constant. In our paper, we take several variables from their test as our determinants of NPLs such as the GDP growth rate, inefficiency, size, and capital ratio. While their study examined two different types of banks – commercial and savings, our paper studies three types of loans.

Quagliariello (2007) investigated the cyclical nature of banks' risk in Italy. The literature shows that loan risk, is significantly impacted by recessionary economic cycles, and banks' tendencies to clamp down on lending during these recessionary times, causes a decrease in earnings, further contributing to the recession. In our literature, we have divided our data into two distinct time periods – one during normal economic times and one during recessionary times.

Carey (1998) studied the determinants of the loss on both private and public issued large bond portfolio. They conclude that the profitability and risk quality of both private and public loans is affected by both specific factors such as diversification and the riskiness of individual portfolio assets.

Berge and Boye (2007) mentioned the economic cyclical sensitivity of the problem loans including NPLs. NPLs are highly sensitive to macroeconomic variables and have a tendency to increase during economic contraction periods. Similar to their literature, we have included in our test variables, the unemployment rate and real interest rate (federal fund rate) as well as GDP growth rate.

Demsetz and Strahan (1997) tested the effect of a bank's size on diversification benefit. From the literature, large bank holding companies' lower capital ratios and larger C&I loan portfolio is offsetting the diversification benefit. They conclude that this is due to larger banks' ability to pursue riskier loans and operate with a greater amount of leverage. Similarly, we test the bank-size in our paper as the bank-specific variable to verify the result in the U.S. banking system over two time periods.

Stiroh (2002) focuses on the trend of increasing non-traditional business activities in the U.S. banking industry and tested the diversification benefit from non-interest income. The literature determines that non-interest income does not provide obvious diversification benefits. Similar to this literature, we test the impact of noninterest income as a bank-specific variable.

Nkusu (2011) showed a negative correlation between NPLs and various macroeconomic variables through his study. He finds that slowing economic growth, a

higher unemployment rate, or decreasing asset prices are directly related to increases in NPLs. Macroeconomic variables are important indicators in the measurement of loan quality, which in turn directly affects NPLs.

Podpiera and Weill (2008) showed that two of the key determinants that result in bank failures are reduced cost efficiency and an increase of NPLs. In examining the causality between the two determinants, they verify that reduced costs efficiency usually precedes the onset of increased NPLs. However, they find no strong evidence that an increase in NPLs have any effect on reduced cost efficiency.

Campbell (2007) mentions that bank insolvency is one of the primary reasons of recent bank failures. The literature focuses on delivering the framework for preventing and controlling NPLs to properly manage regulatory and supervisory issues on bank insolvency. The study stresses the importance of building an effective system to minimize the problem of NPLs through a prudent internal control system combined with enforcement power.

3. Determinant factors of NPLs

3.1 Macroeconomic factors

The effects of specific macroeconomic factors in the performance of NPLs are being increasingly studied by academic researchers. These studies have led us to apply these specific factors to the U.S. economy, in order to determine the magnitude of their effect on NPLs. We will do empirical testing on the GDP growth rate, unemployment rate, and federal fund rate.

The macroeconomic cycle, as measured by the GDP growth rate, is a strong indicator of loan quality. During periods of economic expansion, the individual's and corporation's ability to sufficiently fund their debt obligations results in relatively low NPLs. And in the event of sustained economic stability, NPLs will remain low. However, the ability to fund debt decreases when the economy enters a period of contraction, thus resulting in increasing NPLs. Salas and Saurina (2002) find a negative correlation between GDP growth and NPLs.

Unemployment rates are directly related to the consumer's ability to generate cash-flow to service debt. Due to the lower consumption of goods during periods of high unemployment, the cash-flow of corporations is also negatively impacted. This decrease in cash-flow signals a positive correlation between unemployment rates and NPLs.

Lending rates have a direct cause on the serviceability of loans. As rates become higher, there is increased difficulty in meeting debt obligations. Lawrence (1995) and Rinaldi and Sanchis-Arellano (2006) find negative correlations between both the unemployment rate and lending rate, and NPLs.

3.2 Bank specific determinants

The performance of loans cannot be solely determined by macroeconomic factors. Factors that are specific to each individual bank also have a measurable effect on NPLs. Among individual-specific factors, we test solvency ratio, inefficiency ratio, return on equity, bank-size and non-interest income.

The solvency ratio is defined as the ratio of total equity to total assets. The solvency ratio is negatively correlated to NPLs. Highly leveraged capital results in a tendency

towards higher risk-taking due to the necessity of generating higher profits with lower capital. Berger and DeYoung (1997) and Salas and Saurina (2002) find a negative correlation between solvency ratios and NPLs.

The inefficiency ratio can be either positively or negatively correlated with NPLs. On the one hand, the inefficiency ratio is positively correlated to NPLs. As the inefficiency ratio is an indicator of the bank's efficiency in carrying out due diligence in the application, control, and monitoring of loans. Berger and DeYoung (1997) find a positive correlation between a bank's inefficiency and NPLs.

On the other hand, the inefficiency ratio is negatively correlated to NPLs. Conversely, high cost efficiency may be indicative of a lack of devoting resources to carrying out due diligence in the application, control, and monitoring of loans, therefore increasing the risk of these loans. Salas and Saurina (2002) find a negative correlation between inefficiency and NPLs.

The return on equity is defined as the ratio of net income to total equity. The return on equity also can be either positively or negatively correlated with NPLs. Due to pressures to improve reported financial performance, the bank may sacrifice long term profitability, by creation of higher-risk, lower quality loans, in order to achieve short-term profitability. So the return on equity is positively correlated to NPLs. Rajan (1994) find a positive correlation between return on equity and NPLs.

However, the return on equity is possibly negatively correlated to NPLs. In the long term, past financial out-performance is a likely indicator in the bank's ability to generate profitable loans.

The bank's size is defined as the logarithm of total assets. The bank's size can be either positively or negatively correlated with NPLs. The reason of size has positively correlation with NPLs is because a bank's larger size gives the bank further ability to pursue higher risk loans and utilize higher levels of leverage. Stiroh (2004) did not find a diversification benefit determined by bank size. However, Stern and Feldman (2004) find that large banks are able to take excessive risk by using leverage to extend loans.

Meanwhile, the bank's size can be negatively correlated to NPLs. A bank's size indicates a higher likelihood of a diversified loan portfolio, thereby lowering risk and a higher probability of achieving target returns. Salas and Saurina (2002) find a negative correlation between bank size and NPLs.

The non-interest income is defined as the ratio of non-interest income to net operating income. The non-interest income ratio can be either positively or negatively correlated to NPLs. Due to NPLs tendency to generate increasing amounts of fee and penalty based revenue, a higher ratio of this non-interest income signals a higher percentage of NPLs. So it has positively relationship with NPLs. Stiroh (2002) finds a positive correlation between the non-interest income ratio, and NPLs.

The non-interest income ratio also can be negatively correlated to NPLs. A higher non-interest income ratio indicates a diversified portfolio consisting of multiple income-streams from other business operations. Due to the stable cash-flow generated from other operations, the likelihood of engaging in high-risk loans is decreased. Rajan and Dhal (2003) find a negative correlation between diversified income, including the non-interest income ratio, and NPLs.

4. Data Sample and Econometric Methodology

4.1 Banking Data

All information used in this study is in the public domain. This empirical analysis aims to investigate the impact of macroeconomic and bank-specific factors to non-performing loans for three types of loans (real-estate, commercial and industrial, and consumer) in two distinct sub-sample periods (2002-2006 and 2007-2010). This paper draws its data from Wharton Research Data Services (WRDS). It includes annual data from 2670 banks, which represents the vast majority of U.S banks. The sources of information for our macroeconomic variables (Table 2) are the Bureau of Economic Analysis, Bureau of Labor Statistics and Federal Reserve.

4.2 Econometric model

In accordance with previous research studies, we define the structure of non-performing loan type i (Real Estate, Commercial and Industrial, and Consumer) in year t as:

$$\begin{aligned} NPL_{i,t} = & \beta_0 + \beta_1 \text{ GDP growth rate}_{i,t-1} \\ & + \beta_2 \text{ Unemployment rate}_{i,t-1} + \beta_3 \text{ Federal funds rate}_{i,t-1} \\ & + \beta_4 \text{ Bank specific variables}_{i,t-1} + \varepsilon_{i,t} \end{aligned} \quad \text{Eq.(1)}$$

Where β_0 is a constant variable, β_1 β_2 β_3 β_4 are the coefficients for the lagged determinant factors, respectively. $\varepsilon_{i,t}$ is the error term.

The OLS regression analysis used in this paper is carried out using a simple

estimation strategy. We estimate the empirical model with some adjustments to generate a more robust result. It commences with a linear regression and all variables are winsorized at 1% and 99% to reduce the impact of outliers.

We measure the magnitude of macroeconomic impact by using the GDP growth rate and unemployment rate. To gauge the timing effect, we use one-year lag data and we expect negative coefficients. The Federal fund rate reflects the monetary policy of U.S., and thus is an important factor in banks' determination of lending rates. Each of the bank-specific indicators in Table 1 are then added to Eq.(1) to further explain the impact of different bank ratios to non-performing loans. The bank specific variables that are implemented in this paper are Return on Equity (ROE), solvency ratio, inefficiency, bank size and non-interest income.

5. Model estimation and results

5.1 Model Estimation

Tables 3 and 4 present the descriptive statistics for each category of Nonperforming Loans (NPLs) for the two time periods. In the period 2002 to 2006, Commercial and Industrial loans (C&I) have on average the highest NPLs, while NPLs in Consumer loans have on average the lowest NPLs with Real Estate loan NPL levels very close to but slightly higher than Consumer loans. The standard deviations of NPLs for all three types of loans are close. However, Real Estate NPLs are the most volatile exhibiting the highest positive skewness and extra kurtosis. In the period 2007 to 2010, the NPLs of Real Estate loans increased by 210.68%, becoming the highest among these three types of loans. As this time period includes the heyday of the 2008 sub-prime financial crisis, it is an

understandable and highly expected result and also reveals the link between non-performing loans and macroeconomic performance.

Figure 3 depicts the NPL ratios for all loan types over the studied time periods. All three NPL categories exhibit a drastic upward trend from mid-2007 and from late 2009 onwards show either a decrease or are constant. The NPL ratio in Real Estate significantly displayed this behavior as it climbed to almost 0.09, which was about 9 times its ratio for the pre-crisis period. Moreover, commercial and industrial loans are showing a steady downward trend before 2007, which is abruptly reversed after the financial crisis started.

5.2 Results

5.2.1 Pre-financial Crisis Period

From tables 5, we find that the majority of variables have a coefficient of the expected sign, but they are not always statistically significant.

As predicted by our hypothesis, the GDP growth rate is statistically significant and negatively affects the NPL ratio among all three types of loans. This result points to the conclusion that a strong economic cycle influences the business' ability to repay its loans. With the exception of consumer loans, the NPL ratio is negatively affected by an upward trend of the unemployment rate and implies that fluctuations in the economy quickly translate to meaningful effects on NPLs. As well, the coefficients for the Federal Funds rate are negative. Compare with the research that Louzis, Vouldis and Metaxas (2011) provided, we have different coefficient results in the unemployment rate and Federal Funds rate (real lending rate). We think the possible explanations for the differences are

as follows: firstly, the increases in employment rate and real lending rate can cause less people or business has the ability to borrow money, which decreases the amount of loans, then reduces the problem loans. Secondly, we believe it takes time for the non-performing loan ratios reflect the changes in those two macroeconomic indicators so we attribute it to the lag effect.

The Return on Equity has a significant impact on all NPL categories with Commercial and Industrial NPLs being the most sensitive. Taking into account the fact ROE is a ratio that used to measure the profitability of the business, the negative relationship between this variable and the occurrence of problem loans meets our anticipation.

The solvency indicator is statistically significant and negatively correlated to the Real Estate and Consumer and Industrial NPLs, while being statistically insignificant for Consumer NPLs. Therefore, for the first two types of loans, if the bank has solvency problems, it is can relatively easily adopt riskier loan policies. In contrast, the higher the solvency ratio, the lower the incentives to take riskier loan policies, and consequently, the less prevalent problem loans become.

Inefficiency has a noticeable impact on Real Estate and Consumer NPLs, while displaying an insignificant coefficient on Commercial and Industrial NPLs. According to Louzis, Vouldis and Metaxas (2011), one possible explanation could be the Skimping hypothesis, which states that low inefficiency causes increasing number of NPLs. and therefore the higher probability of “skimping” on costs related to due diligence in the administration of loans. The logic is that as a bank devotes more effort (and therefore

resulting in higher costs and lower efficiency) to the credit vetting process, the amount of potential NPLs will be decrease.

Size does not seem to affect the level of NPLs. Our assumption that larger banks tend to have fewer problem loans than smaller banks, is not true during good economy periods.

For all loan types, non-interest income has a positive and significant effect on NPLs. This is likely due to the significant contribution to service and penalty fees generated from NPLs.

5.2.2 Financial Crisis Period

The GDP growth rate, unemployment rate and ROE all have a negative impact on all NPL categories in the crisis period while the federal fund rate is no longer significant in determining all three types of NPLs.

The coefficients for the solvency rate are statistically significant and negative in Real Estate and Commercial and Industrial Loans in this period, which suggests that highly leveraged capital has higher risks.

The coefficients of the inefficiency ratio for the crisis period are insignificant among all types of loans, so the level of management is not correlated to NPLs in this period.

Size allows for more diversification opportunities as larger banks can compose less concentrated portfolios that include borrowers from different industries, geographical locations, capital size and other customer segments. According to Demsetz and Strahan (1997), larger sized banks may assume more risk than the smaller ones because they willing to gain more profit by using their diversification advantages.

In contrast with the pre-crisis period, NPLs and noninterest rate displays a negative relationship in the crisis period in Real Estate Loan. One possible explanation could be that during the period that a lot of mortgage loans default, the increasing fees or penalties do not help or have a negative impact on the collectability of these loans.

In the pre-crisis period, for all the three types of loans, NPLs in Commercial and Industrial are the most easily affected by all the variables. On the other hand, during the crisis period, the NPLs in Real Estate are most volatile due to the quickly increased bad debts in mortgages.

6. Conclusion

This paper displays the empirical evidence that the correlation between non-performing loans and the economic and bank-specific factors are observable. Using the U.S bank data, we observe that before the recent financial crisis, commercial and industrial loan were the most vulnerable to all the determinants. However, under times of economic recession, real estate loans are significantly exposed to the studied macroeconomic and bank-specific determinants, supporting the view that the U.S mortgage market is still weak and susceptible to economic cycles.

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Appendix

Figure 1.

Each loan amount by type

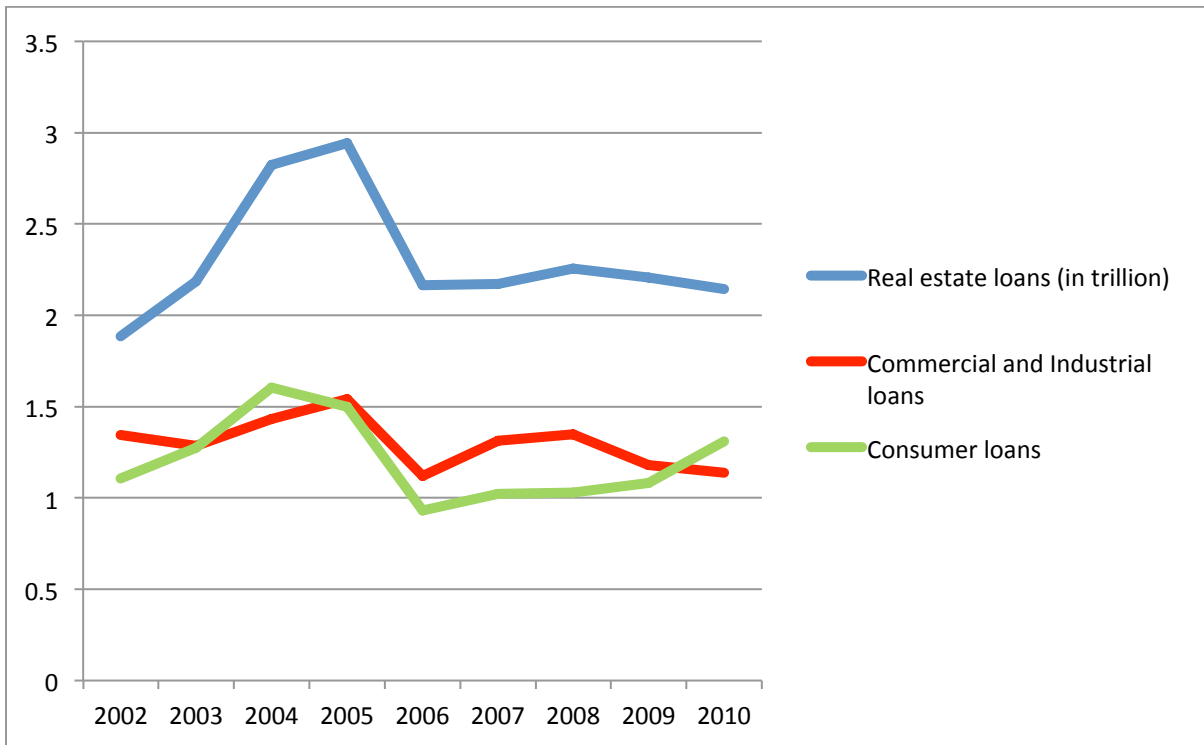


Figure 2.

Total loan amount by type

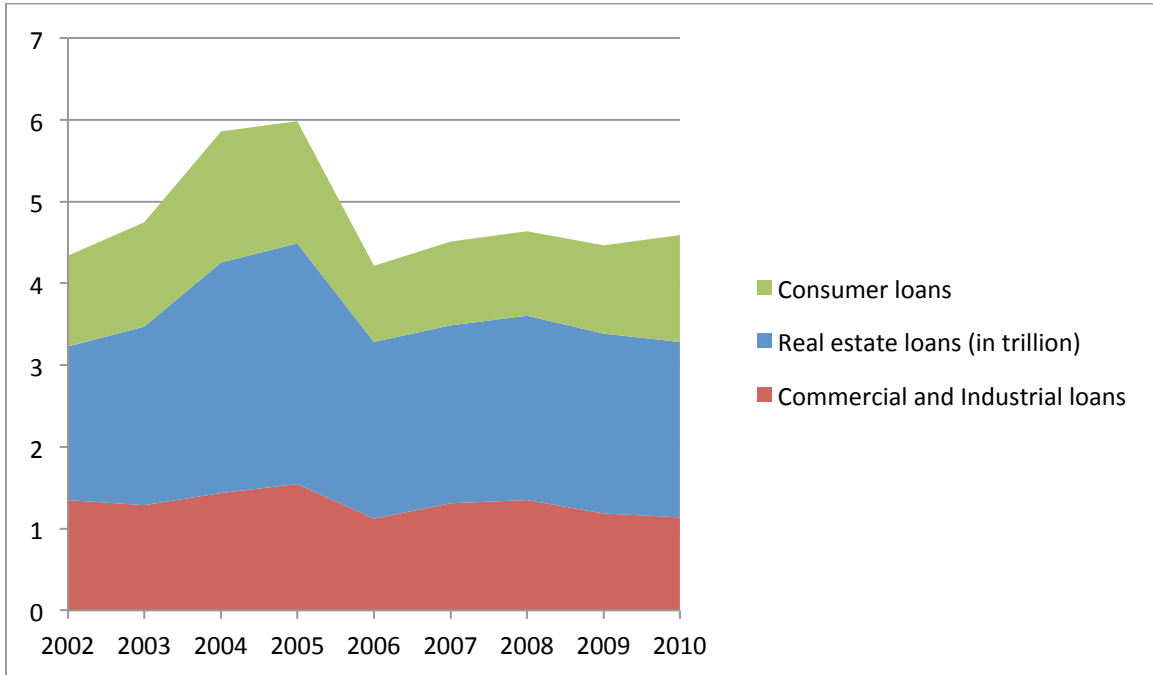


Figure 3.

NPL ratio of different types of loan

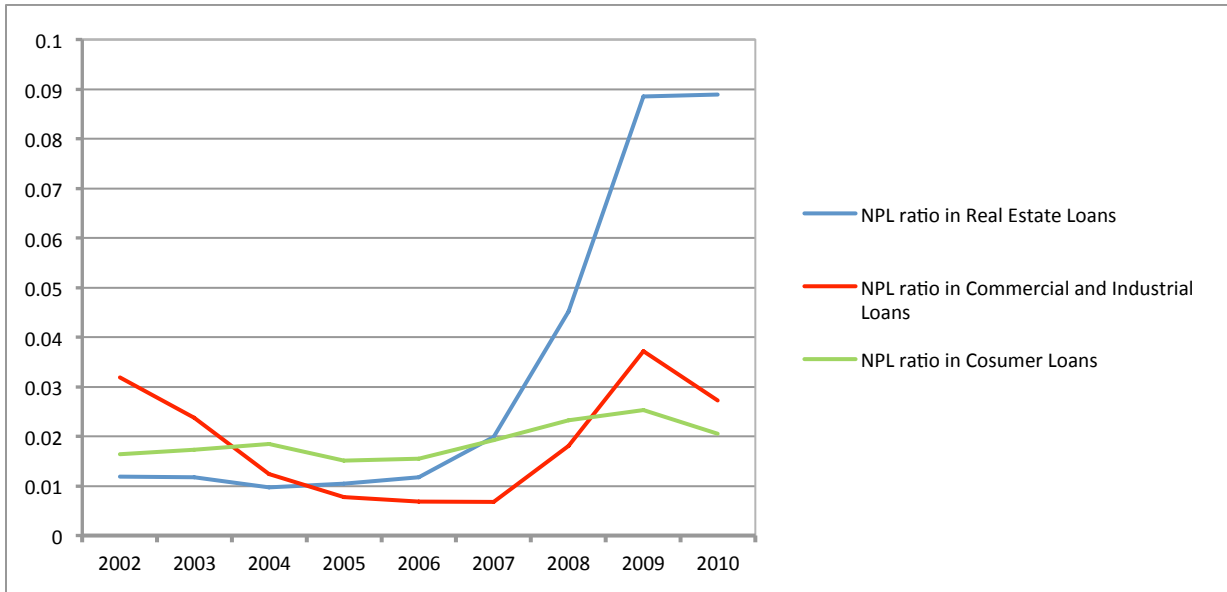


Table 1. Definition of Variables

| Variable | Definition | Expectation |
|---------------------------|---|-------------|
| GDP growth rate | | (-) |
| Unemployment rate | | (+) |
| Federal Funds rate | | (+) |
| Solvency Ratio | Total Equity/Total Assets | (-) |
| Inefficiency Ratio | Non-interest expense/Net operating Income | (+) (-) |
| Return on Equity | Net Income/Total Equity | (+) (-) |
| Bank Size | Log(Total Assets) | (-) |
| Non-interest Income Ratio | Non-interest Income/Net Operation Income | (+) (-) |

Table 2 Macroeconomic rates

| Year | GDP_Growth_Rate(real) | Unemployment_Rate | Federal_funds_Rate |
|------|-----------------------|-------------------|--------------------|
| 2002 | 1.8 | 5.78 | 1.67 |
| 2003 | 2.5 | 5.99 | 1.13 |
| 2004 | 3.5 | 5.54 | 1.35 |
| 2005 | 3.1 | 5.08 | 3.22 |
| 2006 | 2.7 | 4.61 | 4.97 |
| 2007 | 1.9 | 4.62 | 5.02 |
| 2008 | -0.3 | 5.80 | 1.92 |
| 2009 | -3.5 | 9.28 | 0.16 |
| 2010 | 3.0 | 9.63 | 0.18 |

Table 3 Summary Statistics of Nonperforming Loan Ratio by Loan Type(2002-2006)

| 2002-2006 | Real Estate | C&I | Consumer |
|-----------|-------------|---------|----------|
| Maximum | 0.1162 | 0.1274 | 0.0684 |
| Minimum | 0.0000 | 0.0000 | 0.0000 |
| Mean | 0.0073 | 0.0118 | 0.0061 |
| Median | 0.0042 | 0.0051 | 0.0032 |
| St.Dev | 0.0107 | 0.0191 | 0.0093 |
| Skewness | 4.4477 | 3.3064 | 3.7769 |
| Kurtosis | 33.8110 | 16.5763 | 21.8112 |
| Obs. | 9726 | 9730 | 9741 |

Table 4 Summary Statistics of Nonperforming Loan Ratio by Loan Type (2007-2010)

| 2007-2010 | Real Estate | C&I | Consumer |
|-----------|-------------|--------|----------|
| Maximum | 0.1162 | 0.1274 | 0.0684 |
| Minimum | 0.0000 | 0.0000 | 0.0000 |
| Mean | 0.0226 | 0.0194 | 0.0077 |
| Median | 0.0128 | 0.0104 | 0.0036 |
| St.Dev | 0.0269 | 0.0257 | 0.0124 |
| Skewness | 2.0165 | 2.4372 | 3.0981 |
| Kurtosis | 6.7613 | 9.4329 | 13.6418 |
| Obs. | 3945 | 3956 | 3949 |

Table 5 Pre-financial Crisis Period

| Variables | 2002-2006 | | |
|--------------------|-------------|---------|----------|
| | Real Estate | C&I | Consumer |
| GDP growth rate | -.0015* | -.0035* | -.0011* |
| | (.0004) | (.0007) | (.0004) |
| Unemployment rate | -.0037* | -.0059* | -.0023 |
| | (.0016) | (.0029) | (.0014) |
| Federal Funds rate | -.0011 | -.0023* | -.0012* |
| | (.0006) | (.0010) | (.0005) |
| ROE | -.0310* | -.0352* | -.0106* |
| | (.0068) | (.0081) | (.0025) |
| Solvency | -.0179* | -.0340* | .0222* |
| | (.0090) | (.0112) | (.0065) |
| Inefficiency | -.0092* | -.0045 | -.0067* |
| | (.0033) | (.0042) | (.0018) |
| Size | -.0001 | -.0002 | -.0001 |
| | (.0001) | (.0002) | (.0001) |
| Noninterest Income | .0062* | .0067 | .0034* |
| | (.0021) | (.0028) | (.0014) |
| Number of obs. | 7184 | 7178 | 7195 |

*indicates significant at 5% level, please see table 1 for definition of variables.

Table 6 Financial Crisis Period

| Variables | 2007-2010 | | |
|--------------------|-------------|---------|----------|
| | Real Estate | C&I | Consumer |
| GDP growth rate | -.0088* | -.0065* | -.0024* |
| | (.0011) | (.0010) | (.0006) |
| Unemployment rate | -.0072* | -.0060* | -.0020* |
| | (.0009) | (.0009) | (.0005) |
| Federal Funds rate | .0016 | .0004 | .0007 |
| | (.0009) | (.0009) | (.0005) |
| ROE | -.0445* | -.0375* | -.0103* |
| | (.0047) | (.0053) | (.0022) |
| Solvency | -.0592* | -.0458* | -.0094 |
| | (.0163) | (.0152) | (.0081) |
| Inefficiency | -.0039 | -.0029 | -.0031 |
| | .0042 | (.0046) | (.0020) |
| Size | .0028* | .0004 | .0011* |
| | (.0004) | (.0004) | (.0002) |
| Noninterest Income | -.0094* | .0001 | -.0023 |
| | (.0046) | (.0041) | (.0020) |
| Number of obs. | 3696 | 3703 | 3699 |

*indicates significant at 5% level, please see table 1 for definition of variables.