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DETERMINANTS OF BANK CAPITAL: EVIDENCE FROM THE U.S.

by

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Abstract

This paper analyses factors that affect bank capital. We use a sample of U.S. banks over the period 1996 to 2012. According to bank size, we separate the whole sample into small banks, medium banks and large banks. These three groups have different abilities to manage risks and access capital markets. To see the impact of the recent financial crisis, we further separate the whole sample into two subsamples: 1996 to 2006 and 2007 to 2012. Making use of an advanced estimation method (GMM), we find that bank capital is influenced by risk, profitability, deposits, loan loss provision, and size.

Key words: Bank Capital; Financial Crisis; GMM

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Table of Contents

Introduction

A bank's capital structure influences its ability to offer liquidity and credits (Diamond and Rajan , 2000). As a healthy banking system plays crucial role in the rapid growth of economy, it is significant to understand factors driving banks capital.

According to buffer theory, a certain buffer of regulatory capital greater than the regulatory minimum (8% of risk-weighted assets) should be maintained by banks. Regulations impact bank capital a lot, because regulators believe that capital is essential to ensure bank safety. In this paper, we try to find some other factors that also affect bank capital. In particular, we examine the impact of risk, profitability, deposits, loan loss provision, and size.

Because banks of different size have different abilities to manage risks and access capital markets, we divide banks in our sample into three groups. The first group is small banks, with each having total assets of less than 1 billon. The second group is medium banks, with each having total assets between 1 billion and 3 billion. The third group is large banks, with each having total assets of more than 3 billion. Although all the U.S. banks are supervised by the same agency and subject to the same capital requirements, banks of different size may have different determinants of capital.

The recent financial crisis significantly affected bank performance. Bank credit to private sector and asset growing rate declined dramatically. Making the year of 2007 the cut-off point,

we divide the whole sample into two subsamples: 1996-2006 and 2007-2012. We do so to examine whether the recent financial crisis has changed the determinants of bank capital.

Because we include an explanatory variable “lagged capital” to see the relationship between capital of current year with that of previous year, we use the Generalized Method of Moments (GMM) to estimate the results. This method allows us to control for the endogeneity of the explanatory variables and improve the accuracy of our regression results.

We find that bank capital of the current year is positively related with that of the previous year. This result is consistent with findings in Kleff and Weber (2008), which use a sample of German banks. We also find that higher profitability is associated with higher capital. On the other hand, the effect of deposits, loan loss provision, and size on bank capital is dependent on bank size and sample period.

Risk is an important factor that we examine. Theory has different predictions with regard to the relationship between bank capital and risk. For example, Furlong and Keeley (1989) predict that the well-capitalized banks are less willing to increase risk. However, Kahane, Koehn and Santomero (1980) predict the opposite opinion. We find that the relationship is dependent on bank size. For small banks, risk is negatively related to capital. For large banks, risk is positively related to capital.

The rest of this paper is organized as follows. Section 2 is literature review. Section 3 includes

hypotheses we test. Section 4 introduces the dataset. Section 5 is the detailed descriptions of our regression model. Section 6 reports the results. We conclude in Section 7.

Literature Review

There have been several capital structure theories so far. First of all, agency theory (Jensen and Meckling, 1976) links capital structure choice to agency costs, which are the cost due to the conflict of interests between shareholders and managers. Moreover, the pecking-order theory (Myers, 1984; Myers and Majluf, 1984) proposes that the degree of information asymmetry between firm insiders and outside investors influences capital structure choice. Additionally, it is stated in the static trade-off theory (Myers, 1984) that each firm has an optimal debt ratio, and moves to it over time.

The regulation makes commercial banks different from non financial firms. Marques and Santos (2003) point out that capital regulation is the most important external determinant of bank capital structure. There are opposite views between the regulators and the bankers. For regulators, safety is of the first consideration, banks need to hold more capital to make the financial markets stable. Higher levels of capital can not only increase bank liquidity, but also reduce the likelihood of failure. For banks, they prefer to hold less capital to increase the profits. The more debt a bank uses, the greater the leverage. High leverage coverts a normal return on assets into a high return on equity (Koch, 2004).

Alfon et al (2004) shows that the possible determinants of bank capital can be grouped into three categories: banks' internal considerations, market discipline and the regulatory framework. These three groups correspond to the three parties involved in determining banks' capital structure: the bank, the market and the regulator. Knapp, Gart and Chaudhry (2006) find that bank profitability exhibits mean reversion. They show that after adjusting for mean reversion, the post-merger results in the banking industry significantly exceed those in the other industries.

Kleff and Weber (2008) use a sample of German banks, and find four major factors that influence bank capital. The first factor is profitability, which is measured using the return on assets. The second factor is bank deposits from non-bank customers. Gupta and Walker (1975) point out that the more bank deposits from non-bank customers, the more positive earnings expectations in the future years. The third factor is loan loss provision. They use provision over total assets as a measure of the target capital ratio, because this ratio measures the financial health of a bank. Shrieves and Dahl (2003) put up a new idea that the good earning management may reduce the relationship between provision and capital. The fourth factor is regulatory pressure. Banks have an incentive to increase capital when the regulatory capital ratio is close to the regulatory minimum.

Lin (2002) studies the relationship between bank capital and cost efficiency. Theory suggests that banks with lower capital have a stronger incentive to improve cost efficiency. However, Lin (2002) empirically finds that empirically banks with lower capital don't improve cost

efficiency.

Brown (2008) studies determinants of bank capital structure in developing countries, and finds that size, profitability, and market-to-book ratio are important determinants of bank capital. Specifically, leverage has a positive relationship with size and market-to-book ratio, and a negative relationship with profitability and tangibility in developing countries.

Lee and Hsief (2013) study the relationship between a bank's risk and capital using the Generalized Method of Moments (GMM) technique. This technique resolves the possible simultaneity between the degree of capital and profitability, and takes the causal effect of the exogenous component into consideration.

Helberg and Lindset (2013) point out that the difference between required capital and optimal capital incurs cost to shareholders, and at the same time gives banks the incentive of regulatory arbitrage. As a result, the reliability of the regulations is reduced, which undermines the effectiveness of formal capital requirements to be an important policy tool. Higher minimum capital requirements force banks to increase capital. Meanwhile, debt regulations, such as depositor preference, also encourage banks to increase capital.

Wong, Choi and Fong (2005) find that there are three strategic reasons for banks to hold more capital. The first is financing growth, the second is adjusting cost, and the third is for the downward rigidity of capital.

Theories have identified a few subtle effects of bank capital. Myers and Rajan (1998) propose that the optimal leverage of a financial firm is based on the liquidity of assets. Diamond and Rajan (2000) propose that the trade-off between liquidity creation, costs of bank distress, and the ability to force borrower repayment leads to an optimal bank capital structure. Allen et al. (2007) propose that a bank's capital affects its incentive to monitor borrowers.

Koehn and Santomero (1980), Kim and Santomero (1988) and Rochet (1992) argue that, because capital is relatively expensive, the forced reduction in leverage lowers banks' expected returns. As a consequence, bank owners will choose high risk in order to increase returns. They conclude that higher capital requirements can be associated with higher risk.

Hypotheses

Before we carry out empirical analysis, we state several hypotheses according to our knowledge.

Hypothesis 1：Capital ratio is positively correlated with the lagged capital ratio.

We assume that a bank incurs an adjustment cost when it changes its capital ratio rapidly. Thus, the bank changes its capital ratio gradually over time (Kleff and Weber, 2008). This implies that the capital ratio in the current period is positively associated with the lagged capital ratio.

Hypothesis 2: Capital ratio is positively correlated with profitability.

When a bank has higher profits in a given year, it is able to increase its capital ratio through retained earnings.

Hypothesis 3: Capital ratio is positively correlated with bank deposit ratio (BDR).

We defined bank deposit ratio as total deposits divided by total assets. Bank deposit from non-bank customers is a good sign to show the reliability of a bank. We expect that banks with higher BDR are able to raise capital more easily. In other word, banks that already have more customers are more likely to gain new customers in the future. Such banks can more easily increase capital.

Data

We obtain data for U.S. banks from the Wharton Research Data Services (WRDS). Our sample contains ROA, Risk, Probability, Provisions, and Size data from 1996 to 2012 for almost all the banks in the US.

Our sample contains 1,309 banks. Berger and Bouwman (2013) divide banks into three subsamples according to total assets with the cut-point 1 billion and 3 billion. Following that paper, we divide the sample into three subsamples. The first subsample consists of small

banks, with each having total assets of less than 1 billion. The second subsample comprises the medium banks, with each having total assets from 1 billion to 3 billion. The third subsample consists of the large banks, with each having total assets exceeding 3 billion. We use the year-end financial data reported in the Consolidated Financial Statements for Bank Holding Companies.

To account for the impact of the recent financial crisis that began in 2007, we divide the whole sample period into two sub-periods. The first is from 1996 to 2006, and the second is from 2007 to 2012.

To analyze the relationship between bank capital and the bank financial indicators, we choose several variables：Bank capital, Risk, Profitability, Bank deposits, Provision and Size. All of the variables will be explained in the following.

Variables

Dependent variable

Bank capital

We define capital ratio (CAP) as (equity / total assets). Our objective in this paper is to identify variables that influence capital ratio.

Explanatory variables

Risk

Researchers have measured bank risk using several variables, such as the standard deviation of stock returns, Z-score, distance to default and nonperforming loan ratio. Following Kleff and Weber (2008), we define RISK as (total risk-weighted assets / total assets). Measuring bank risk in this way does not require stock price information.

Profitability

According to our hypothesis, profitability affects bank capital. We use return on asset (ROA) to measure profitability. ROA is defined as (net income / total assets).

Bank deposits

We define bank deposit ratio (BDR) as (deposits / total assets). An important channel for banks to raise funds is to use bank deposits, because the interest rates on deposits are usually lower than those on borrowed funds. Deposits are crucial for banks to increase competitiveness and profit. We expect that banks with higher BDR to have higher capital ratio.

Provision

The loan loss provision also affects a bank's capital ratio. We define PROV as (loan loss provision / total assets). A larger loan loss provision indicates a bad financial situation, and bank may have difficulty to ask loans back. Loan loss provision can also influence banks' ability to generate profit, but this effect has been controlled as ROA is included in our regression equation.

Size

Large banks are usually better diversified, and have lower capital ratios. To control for bank size, we define SIZE as the natural log of total assets.

Our empirical equation is as follows:

$$CAP_{j,t} = \beta_0 + \beta_1 CAP_{j,t-1} + \beta_2 RISK_{j,t} + \beta_3 ROA_{j,t} + \beta_4 BDR_{j,t} + \beta_5 PROV_{j,t} + \beta_6 SIZE_{j,t} + \theta_t + \mu_{j,t}$$
$$\mu_{j,t} = \mu_j + \varepsilon_{j,t}$$
$$\mu_j \sim IID(0, \sigma_\mu^2)$$
$$\varepsilon_{j,t} \sim IID(0, \sigma_\varepsilon^2)$$

Year dummies (θ_t) are included in the equation to control for the factors that influence all the banks in a given year. For example, a change of bank regulation in a given year affects all the banks in that year. $\mu_{j,t}$ is the bank fixed effect. It controls factors of a bank do not change over time, such as the registration state.

Change of variables over time

Figure 1-4 show how the mean of each variable changes over time.

The mean of CAP fluctuated from 1996 to 2007, and then decreased quickly to the lowest point at 0.0840. After the year 2009, CAP rose dramatically and peaked at 0.098 in 2012. One possible reason for the increase of CAP after 2009 is that, after the recent financial crisis, regulators pressured banks to increase their capital. Another possible reason is that banks have learned a lesson from the recent financial crisis and decided to voluntarily hold more capital.

The mean of RISK had an upward trend from 1996 to 2009, reaching the maximum point. Then, it went down slightly.

The mean of ROA remained almost constant before 2005. Under the influence of the financial crisis, it declined sharply to the valley at -0.0036 in 2009. It gradually increased to 0.007 in 2012.

The year 2008 was the turning point for BDR. Before 2008, the mean of BDR had a declining trend. After 2008, it had an increasing trend.

The mean of PROV was around 0.002 before 2006. When the recent financial crisis

began in 2007, the mean of PROV went up substantially, reaching 0.0140 in 2009.

Taken together, these graphs demonstrate that the variables used in our sample had significant change during the crisis period. Therefore, we divide our sample into two sub-periods: 1996-2006, and 2007-2012.

Summary statistics and correlation matrix

Table 3 reports the summary statistics. Each variable has 25,090 observations. This large number of observations ensures the reliability of our regression results. RISK has higher standard deviation, compared with CAP, ROA, PROV and BDR.

Table 4 reports the correlation matrix. We find that the correlation between any two explanatory variables is not very high. This means that multicollinearity is not a concern in the regressions.

The correlation between an explanatory variable and the dependent variable (capital ratio) has not controlled for the impact of other explanatory variables. Therefore, to understand the effect of an explanatory variable on capital ratio, we estimate the empirical equation.

Considering the panel structure

In the empirical equation, we have included the lagged dependent variable ($CAP_{j,t-1}$) as an explanatory variable. This variable is correlated with the error term. Thus, the usual estimation method such as Ordinary Least Squares (OLS) cannot be used. Therefore, we use the GMM technique. This technique is very popular in the dynamic panel analysis. In addition, we treat all the explanatory variables to be endogenous. The application of GMM exactly caters to our needs.

Results

GMM regression results are reported in table 5 through 7.

Lagged CAP

We find a remarkably positive relationship between CAP and CAP_{t-1}, which is consistent with hypothesis 1. For the whole sample, the coefficient on CAP_{t-1} is 0.8897. For small, medium, and large banks, the coefficients on CAP_{t-1} are 0.8859, 0.8681 and 0.9032, respectively. For all these coefficients, the p values are 0, which means the results are highly significant.

These results suggest that a bank's capital ratio in the previous year affects its capital ratio in the current year. The amount of capital is the results of the accumulation year after year, and can not change in a short time period. Consequently, previous year capital directly determines current year capital.

Does financial crisis affect this result? The answer is no. It is shown that coefficient after the crisis almost stays the same, just 0.02 lower than that before crisis. We conclude that CAP_{t-1} is a crucial factor determining CAP.

Risk

The coefficients on risk are different across the three size groups. For the whole sample, the coefficient is -0.0038 (p value is 0). For the small and large banks groups, the coefficients are -0.0054 (p value is 0) and -0.0020 (p value is 0.9766). For medium banks, the coefficient is 0.000012 (p value is 0.3616).

Thinking of the statistics in detail, the p values of large bank and medium bank are so large, suggesting that these two coefficients are not statistically significant. Therefore, for such banks, there is no reliable relationship between risk and capital.

The p value of the coefficient on risk in the small bank group is very small, suggesting that there is a negative relationship between risk and capital for small

banks. A possible explanation is as follows. Small bank tend to be vulnerable to risk. The decline of risk helps to raise capital. On the other hand, when risk increases, a small bank may find it difficult to raise capital.

Before 2006, the coefficient on risk for the whole sample is -0.0029. After 2006, it becomes -0.0063. Obviously, the financial crisis raises the impact of risk on bank capital. The catalyst of financial crisis is ignorance of potential risks, and it alarms banks to emphasize more heavily on the risk. As a consequence, risks become more important in determining bank capital.

Profitability

ROA is a measure of bank profitability, and it shows a clear positive impact on CAP. For the whole sample, the coefficient on ROA is 0.5211. The coefficients on ROA for the small, medium, and large banks are 0.5501, 0.4919 and 0.4518, respectively. All the p values indicate the statistical significance of the results. These results are consistent with hypothesis 2.

Small banks have the highest coefficient, while large banks have the lowest. Profit increase bank capital. Small banks have relatively smaller profit than large banks, and so a rise in profit increases their capital more greatly. In all the regressions, the coefficient on ROA is the second largest, which is just behind that of lagged CAP. So

the impact of ROA on CAP can not be ignored.

After the financial crisis, coefficient of ROA rises from 0.5322 to the post-crisis level at 0.6230. Therefore, the positive relationship between ROA and CAP shows an upward trend due to financial crisis. Profitability is still a strong support for sufficient bank capital.

Bank deposits

The portion of bank deposits in total assets is also relevant to bank capital. Coefficients of small and medium banks are both negative, -0.0084 and -0.0037. That is to say, the lower the percentage of deposits over total assets, the higher the increase of small and medium bank capital is. In contrast, BDR has a not significant positive effect on CAP for large banks, with the coefficient of 0.0012 and p value 0.5989. Our test rejects the hypothesis 3.

In theory, a bank can fund its assets with deposits, borrowed funds, and equity capital. Because small and medium banks do not have easy access to financial markets, they fund their assets mainly with deposits and equity capital. Thus, a lower deposit ratio implies a higher capital ratio. In contrast, large banks often have significant amount of borrowed funds. Thus, deposit ratio has no significant impact on a large bank's capital ratio.

After the financial crisis, the coefficient changes from -0.04 to -0.115, which means that bank deposit's impact on CAP increases. Deposit is one of the attractive ways to fund banks. Making best use this relatively cheap resource can promote banks' competitiveness.

Provision

We find a positive relationship between provision and capital. The coefficients on PROV are 0.1285 for small banks, 0.0533 for medium banks, and 0.2201 for large banks. The p-value for medium banks is a little higher.

Large banks have the largest coefficient. Large banks have the ability to absorb more bad loans, and in turn, put aside larger portion of loan loss provision in case of borrowers fail to pay back the full amount. In this situation, the loan loss provision suggests that large banks keep more capital to prepare for the expected loss.

Also, the effect of loan loss provision on capital becomes stronger during and after the financial crisis, with coefficient rising from 0.0763 to 0.1061.

Size

The coefficients on SIZE are 0.000025 for small banks (p value 0.8705), 0.0016 for medium banks (p value 0.0096), and 0.0002 for large banks (p value 0.5799). Except

for medium banks, the p values of the other two groups suggest the effect is not statistically significant. Consequently, we cannot draw a definite conclusion with regard to the relationship between size and capital. But for medium banks, the relationship is positive and statistically significant.

In terms of subsamples, the year 1996-2006 and 2007-2012, the p value of the year 2007-2012 is less significant.

Conclusions

We find evidence that CAP_{t-1} and ROA have significantly positive effect on capital ratio. CAP_{t-1} has a stronger influence with coefficient greater than 0.8 in each group. For ROA, the coefficients are also significant. So the lagged capital and profitability play important roles in driving bank capital.

We have several other findings. First of all, risk of small banks is negatively related with capital. Secondly, deposit ratio of small and medium banks also have negative effect on capital. Thirdly, there is a positive relationship with small and large banks' loan loss provision and capital. Fourthly, size is positively related with capital ratio at medium banks. Finally, regarding the effect of financial crisis, except for SIZE, all the variables' impact of capital is strengthened.

To conclude, we have found several important determinants of bank capital.

Appendix

Figure 1 Mean of CAP

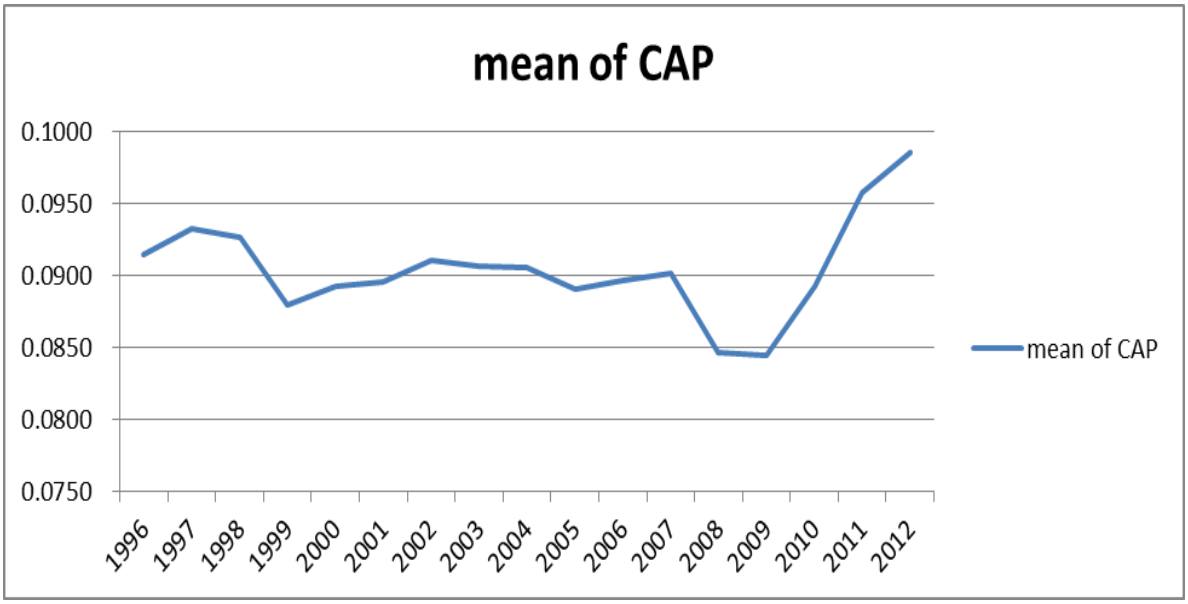

Figure 2 Mean of RISK

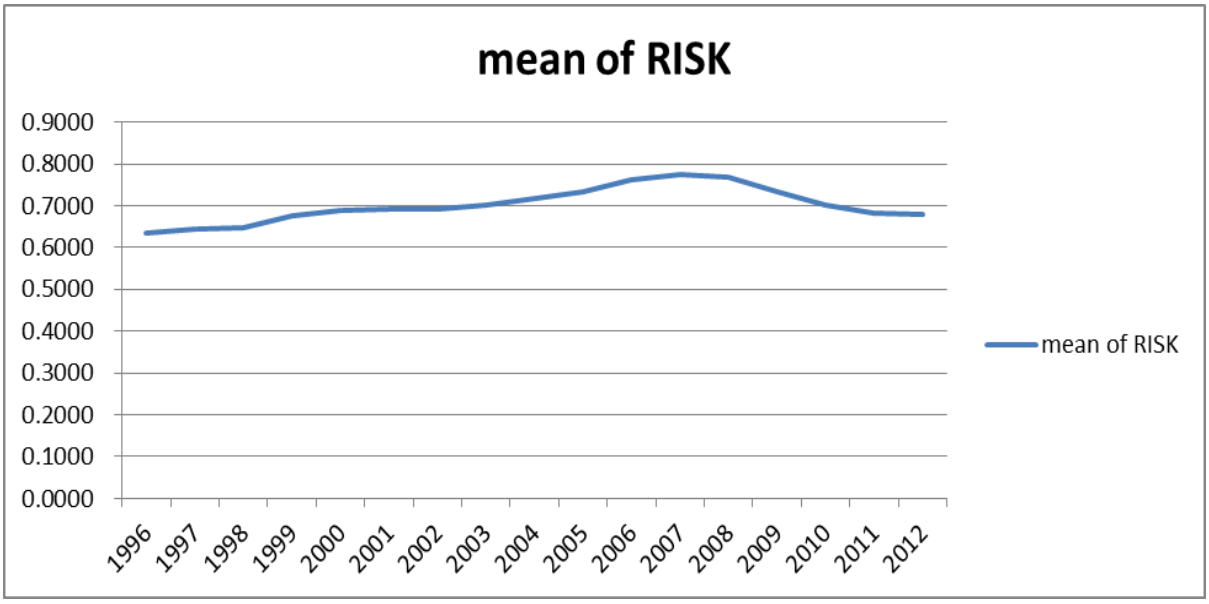

Figure 3 Mean of ROA

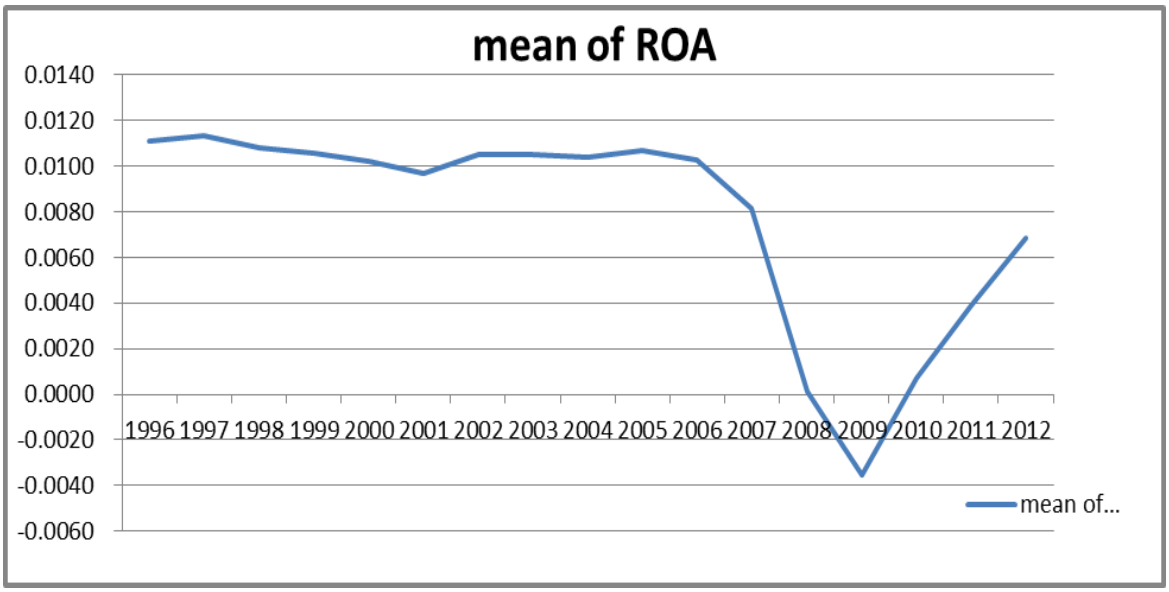

Figure 4 Mean of BDR

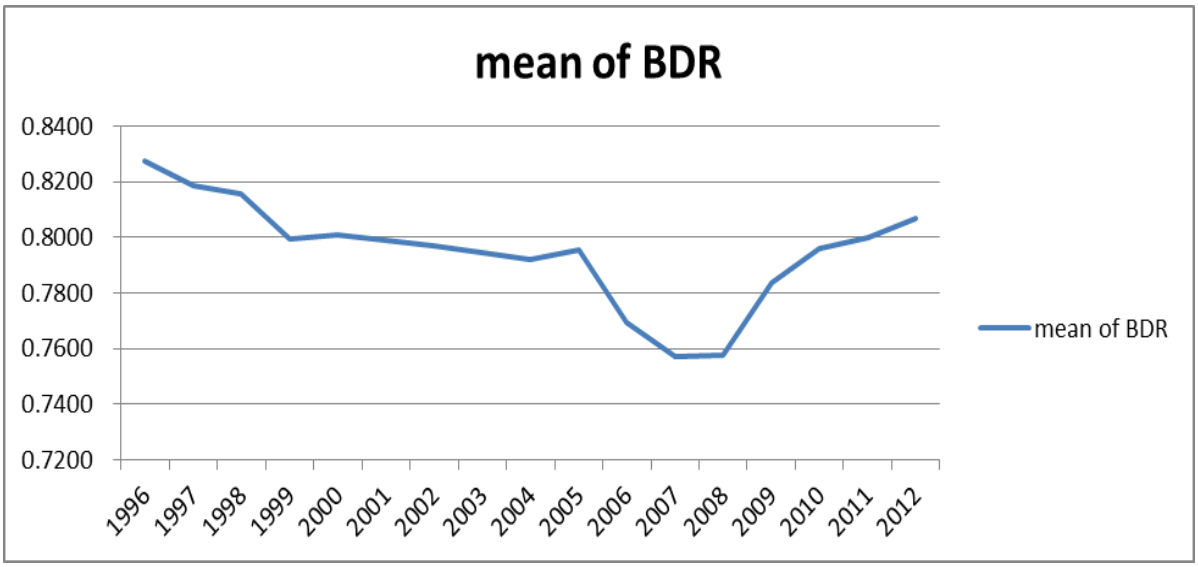

Figure 5 Mean of PROV

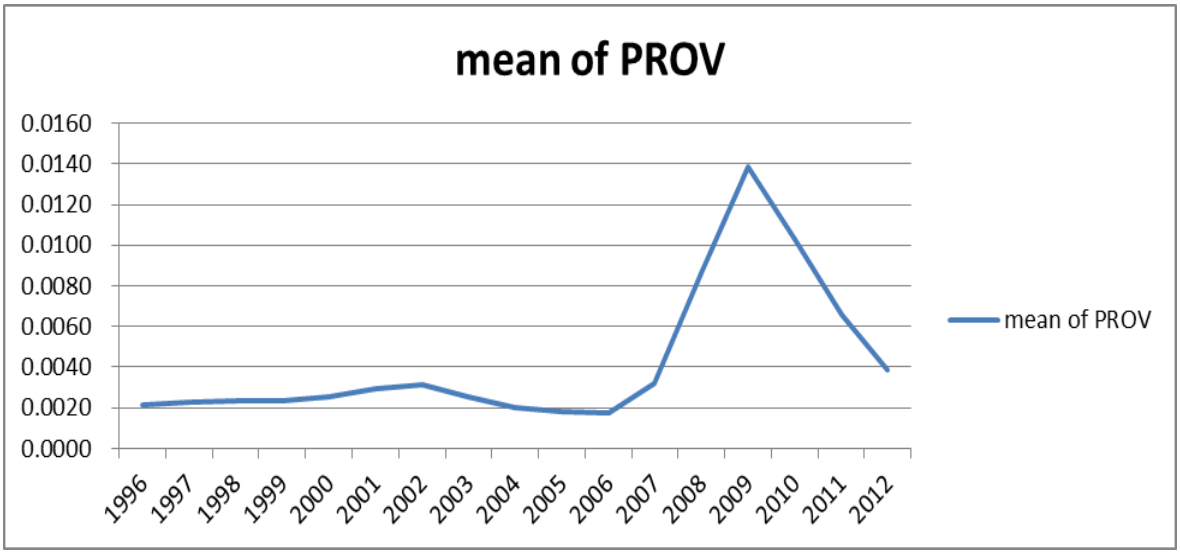

Table 1

Definition of Variables

Dependent Variable	**Definition**
CAP	equity/ total assets

Explanatory Variables	**Definition**
Lagged CAP	CAP of the previous year
RISK	Total risk-weighted assets / total assets
ROA	Net income / total assets
BDR	Deposits / total assets
PROV	Loan loss provision / total assets
SIZE	Log(total assets)

Table 2

Number of banks in our sample by year

Year	Number of banks
1996	1309
1997	1418
1998	1525
1999	1638
2000	1725
2001	1850
2002	1984
2003	2132
2004	2258
2005	2270
2006	986
2007	966
2008	973
2009	1015
2010	1009
2011	1017
2012	1015

Table 3

Summary Statistics

	Obs.	Mean	Median	Std. Dev.
Dependent variable				
CAP	25,090	0.0904	0.0871	0.0289
Explanatory variables				
RISK	25,090	0.6992	0.7047	0.1171
ROA	25,090	0.0087	0.0097	0.0085
BDR	25,090	0.7966	0.8209	0.1023
PROV	25,075	0.0037	0.0019	0.0058
SIZE	25,090	13.3832	13.1016	1.3114

Table 4

Table 4.1 Correlation Matrix of whole sample

	CAP	RISK	ROA	BDR	PROV	SIZE
CAP	1					
RISK	-0.1620	1				
ROA	0.3383	-0.0714	1			
BDR	-0.1329	0.0400	-0.0134	1		
PROV	-0.1423	0.2049	-0.6401	0.0031	1	
SIZE	-0.0196	0.1333	-0.0954	-0.5149	0.1567	1

Table 4.2 Correlation Matrix of small banks

	CAP	RISK	ROA	BDR	PROV	SIZE
CAP	1					
RISK	-0.2179	1				
ROA	0.3793	-0.0836	1			
BDR	-0.2021	0.0272	-0.0065	1		
PROV	-0.1736	0.2067	-0.6071	0.0357	1	
SIZE	-0.0991	0.1584	-0.1793	-0.1849	0.1686	1

Table 4.3 Correlation Matrix of medium banks

	CAP	RISK	ROA	BDR	PROV	SIZE
CAP	1					
RISK	-0.0792	1				
ROA	0.3269	-0.0767	1			
BDR	-0.1714	0.1688	-0.1319	1		
PROV	-0.1456	0.1613	-0.7178	0.0890	1	
SIZE	0.0038	0.0247	-0.0138	-0.0598	0.0672	1

Table 4.4 Correlation Matrix of large banks

	CAP	RISK	ROA	BDR	PROV	SIZE
CAP	1					
RISK	0.0702	1				
ROA	0.1461	0.0471	1			
BDR	0.0798	0.1859	-0.0264	1		
PROV	0.0024	0.1972	-0.6398	0.0792	1	
SIZE	-0.0224	0.1972	0.0152	-0.5808	0.0510	1

Table 5

Regression Results: whole sample

	β	P value
Intercept	0.0072	0.3248
Cap_{t-1}	0.8897	0.0000
RISK	-0.0038	0.0000
ROA	0.5211	0.0000
BDR	-0.0040	0.0000
PROV	0.1284	0.0000
SIZE	0.0003	0.0002

Table 6

Regression results: subsample by size

	Small Banks (<1 Billion)		Medium Banks (1-3 Billion)		Large Banks (>3 Billion)	
	β	**P Value**	**β**	**P Value**	**β**	**P Value**
Intercept	0.0150	0.3242	-0.0130	0.0674	0.0033	0.7676
Cap_{t-1}	0.8859	0.0000	0.8681	0.0000	0.9032	0.0000
RISK	-0.0054	0.0000	0.000012	0.9766	-0.0020	0.3616
ROA	0.5501	0.0000	0.4919	0.0000	0.4518	0.0000
BDR	-0.0084	0.0000	-0.0037	0.0894	0.0012	0.5989
PROV	0.1285	0.0000	0.0533	0.1880	0.2201	0.0000
SIZE	0.000025	0.8705	0.0016	0.0096	0.0002	0.5799

Table 7

Regression results: subsample by period

	1996-2006		2007-2012	
	β	**P Value**	**β**	**P Value**
Drift	0.0132	0.1549	0.0214	0.7532
Cap_{t-1}	0.8890	0.0000	0.8678	0.0000
RISK	-0.0029	0.0001	-0.0063	0.0000
ROA	0.5322	0.0000	0.6230	0.0000
BDR	-0.0040	0.0000	-0.0115	0.0000
PROV	0.0763	0.0035	0.1061	0.0002
SIZE	-0.0003	0.0002	0.0001	0.5098

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