AN EMPIRICAL STUDY OF BANK CAPITAL AND RISK TAKING: EVIDENCE FROM THE RECENT FINANCIAL CRISIS

by

Yuanyuan Zheng

and

Zhen Liu

RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF FINANCIAL RISK MANAGEMENT

BEEDIE SCHOOL OF BUSINESS

SIMON FRASER UNIVERSITY

Summer 2011

Approval

Name: **Yuanyuan Zheng and Zhen Liu**

Degree: **Master of Financial Risk Management**

Title of Project: **An Empirical Study of Bank Capital and Risk Taking: Evidence from the Recent Financial Crisis**

Supervisory Committee:

_____

Dr. Jijun Niu
Assistant Professor, Faculty at Beedie School of Business
Senior Supervisor

_____

Dr. Yasheng Chen
Assistant Professor, Faculty at Beedie School of Business
Second Reader

Date Approved: August 5th, 2011

Abstract

In this paper, we examine the relationship between bank capital and risk taking in the United States. We use bank capital data in 2007, and bank risk-taking data in 2008. We measure risk taking in three ways: allowance for loan and lease losses, net charge-offs, and provision for loan and lease losses. We measure capital also in three ways: tier 1 leverage ratio, tier 1 risk-based capital ratio, and total risk-based capital ratio. Overall, our results suggest that banks with higher capital ratios take more risk.

Keywords: bank; capital ratio; risk taking; financial crisis

Acknowledgement

We would like to express our sincere gratitude to our Supervisor, Dr. Jijun Niu, for his encouragement, guidance and support from the beginning to the end. We would also like to thank Dr. Yasheng Chen for his insightful comments and suggestions.

Contents

1 Introduction

The relationship between bank capital and risk taking over the past few decades has inspired a number of theoretical and empirical studies. Some people argue that there is a negative relationship between bank capital and risk taking. For instance, Furlong and Keeley (1989) find that relatively well-capitalized banks are less inclined to increase asset risk, because the option value of deposit insurance decreases with capitalization, which in turn reduce incentives for excessive risk taking. Blum (1999) argues that under-capitalized banks tend to increase risk in order to meet regulatory requirements.

Other people argue that there is a positive relationship between bank capital and risk taking. For instance, Kahane, Koehn and Santomero (1980) claim that increased regulatory capital requirements have the opposite effect that cause banks to increase their portfolio risk. Jeffrey and Sugata (2010) find that larger loan loss reserve increases in 2007 are associated with an increased risk of failure in 2008-2009. They suggest that the increase in regulatory capital creates the illusion of financial health, which allows banks to avoid taking the actions necessary to reduce risk.

Still, other people believe that the relationship between bank capital and risk taking can be either positive or negative, depending on different situations. For example, Jeitschko and Jeung (2005) argue that the relationship depends on the relative forces of three entities: regulatory agencies, shareholders and management. Each entity influences the risk taking decisions of a bank either directly or indirectly.

Although a substantial number of studies have been done on the relationship between bank capital and risk taking, relatively few studies have examined the relationship during the financial crisis of 2007-2008. Numerous banks and financial institutions failed during the recent financial crisis as a result of excessive risk taking. In this paper, we investigate how bank capital ratio in 2007 affected bank credit risk in 2008. We also examine how bank size and loan portfolio composition are related to bank credit risk.

We use the method of OLS regressions, in which, we define bank capital ratio, bank size and shares of different types of loans as our independent variables, and we define credit risk as our dependent variable. We measure credit risk in three ways: allowance for loan and lease losses ratio, charge-offs ratio, and provision for loan and lease losses ratio. We measure bank capital ratio also in three ways: tier 1 leverage ratio, tier 1 risk-based capital ratio, and total risk-based capital ratio.

We conduct a total of nine regressions with different measures of credit risk and capital ratio. Four of the regressions indicate that bank capital is significantly and positively related to credit risk, while the other five show non-significant relationship. We do not find any negative relationship between the two. These results suggest that banks with higher capital ratio take higher credit risk. Our results support the findings of Jeffrey and Sugata (2010), who claim that capital level increases in 2007 are associated with an increased risk of bank failure in 2008-2009. In addition, we find that bank size and real estate loan ratio always demonstrate positive relationships with credit risk.

We add to the existing literature in two ways. First, the provision for loan and lease losses ratio is frequently used in measuring credit risk. Our study adds to the literature by using the allowance ratio and the net charge-offs ratio as additional measures of bank credit risk. We conduct estimations using each of the three ratios and compare the results. We also contribute to the existing literature by focusing our research on the period of the recent financial crisis. Our results challenge the notion that increasing bank capital lowers bank risk taking, and raise questions about the rationale of recent regulatory proposals to increase capital requirements to prevent banks from taking excessive risk.

The rest of this paper is organized as follows. The next section discusses the previous studies. Section 3 explains the sample, variables and methodology that we used in this study. Section 4 presents the results, and Section 5 provides the conclusions.

2 Related literature

2.1 Prior research on bank risk taking

A substantial number of studies have been done on the relationships between bank capital, risk-taking and bank performance. However, both theoretical studies and empirical studies do not reach an agreement on these issues.

Furlong and Keeley (1989) argue that an increase in capital requirements would reduce the put-option value of the deposit insurance, and thus reduce the incentives for banks to increase the level of portfolio risk. This implies that strict capital requirements can reduce

excessive risk taking. However, using the same option pricing framework, Gennotte and Pyle (1991) show that capital regulation may increase portfolio risk and the probability of bank failure, because an increase in the capital requirement encourages a bank to decrease the size of its portfolio and at the same time increase its portfolio risk by taking on higher risky assets.

Gorton and Winton (1995) study the risk and capital relationship from the aspect of the costs of capital standards. They conclude that an increase in bank capital requirements will lower the risk of bank failure, but at the same time lower the amount of bank deposits, which is costly to the society.

Blum (1999) studies capital standards in a dynamic framework, in which, the bank's capital varies with its profits. He believes there exists an intertemporal effect of capital regulation, and he finds that banks tend to take more risk when required to increase capital level. One reason is that under-capitalized banks tend to increase risk in order to meet higher regulatory requirements.

Calem and Rob (1999) base their research on the data of US banking industry over 1984-1993. They find a U-shaped relationship between bank capital and risk taking. Banks first reduce risk taking to meet capital requirements, and then increase risk taking after meeting capital requirements.

Bichsel and Blum (2004) study a panel of Swiss banks over the period 1990-2002. They find a positive relationship between changes in capital and changes in risk taking. However, they do not find any significant relationship between the default probability and the

capital ratio.

2.2 Studies of the recent financial crisis

Several papers have studied the relationships between bank capital ratio, risk taking and performance during the recent financial crisis.

Jin, Kanagaretnama and Lobo (2011) study how bank capital ratio, loan growth and bank size affect banks' performance during the crisis. They find negative coefficients on capital and loan growth, and they conclude that banks with lower capital ratios and lower loan growth are more likely to fail. Besides, they find positive relationship between bank size and bank risk.

Beltratti and Stulz (2011) use multiple regressions to examine the hypothesis that lax regulations lead banks to take excessive risks during the crisis. They have not found convincing evidence that tighter regulation is associated with better bank performance during the crisis, or with less risky banks before the crisis.

Fahlenbrach and Stulz (2011) find that bank performance in crisis period is not related to CEO compensation. However, Chesney, Stromberg and Wagner (2010) present evidence that suggests CEO compensation is a contributing factor to some banks' poor performance. In particular, they document that institutions whose CEOs had stronger risk taking incentives, weak ownership incentives and independent boards prior to the crisis had the highest write-downs ratios during the crisis.

Cheng, Hong and Scheinkman (2010) provide evidence on the link between compensation and risk-taking over the period 1992-2008. They find that executive compensation is correlated with price based risk-taking measures including firm beta, return volatility, the sensitivity of firm stock price to the ABX subprime index, and tail cumulative return performance. They suggest that the correlation between compensation and firm risk taking is due to investors with heterogeneous short-term preferences investing in different firms and incentivizing them to take different levels of risks.

3 Sample and variables

3.1 Data sources

In this study, we use the panel data set and OLS regression to investigate the relationship between bank capital and credit risk. To select the sample, we start from the Federal Reserve's Consolidated Financial Statements for Bank Holding Companies (FR Y-9C) at the Wharton Research Data Services. We obtain 2007 year-end accounting data of capital ratio, bank size, and loan portfolio composition, and 2008 year-end accounting data of credit risk. We drop observations with incomplete data. Our sample includes 915 observations. To mitigate the impact of extreme observations on the estimation results, we winsorize all the variables at the 1% and 99% levels.

3.2 Measuring bank credit risk

We use the following three ratios to measure bank credit risk:

Allowance ratio: Allowance ratio is defined as the Allowance for Loan and Lease Losses (ALLL) divided by total loans and leases. ALLL is the capital that a bank reserves for bad loans in the future. It comes from a bank's operating income and is used to cover the bank's uncollectible loans and leases. As it is a forecast of a bank's future losses, usually it is higher than charge-offs ratio.

Charge-offs ratio: Charge-offs ratio is defined as the net charge-offs divided by total loans and leases. A charge-off is the declaration by a creditor that certain amount of debt cannot be collected. Traditionally, creditors declare a charge-off when the consumer is behind six months in payment. Thus, this ratio captures bank credit risk that actually happened. However, it does not reflect the credit risk on a timely basis.

Provision ratio: Provision ratio is defined as the provision for loan and lease losses divided by total loans and leases. Provision is the banks' non-cash expense to cover expected future losses on loan defaults. It is the amount added to the allowance loan in the current reporting period.

We conduct three sets of regressions using each credit risk measure as the dependent variable, and we will compare the results in Section 4.

3.3 Measuring bank capital

We collect the bank capital data at the end of 2007, and we use the following three different ratios to measure bank capital. These three ratios are also used by regulators in bank examinations.

Tier 1 leverage ratio: This ratio is defined as tier 1 capital divided by the average total assets for leverage capital purposes. Tier 1 capital, which consists primarily of common stock and retained earnings, is the core measure of a bank's financial strength from a regulator's viewpoint. The minimum requirement for tier 1 leverage ratio is 3 percent, in case that the bank is highly rated by its supervisors.

Tier 1 risk-based capital ratio: This ratio is defined as tier 1 capital over total risk-weighted assets. This ratio attempt to measure capital relative to the bank's risk profile by adjusting individual asset values relative to their risk. Usually, this ratio is higher than the tier-1 leverage ratio. Banks are required to maintain a minimum tier 1 risk-based capital ratio of 6 percent.

Total risk-based capital ratio: This ratio is defined as total risk-based capital over total risk-weighted assets. Total risk-based capital includes tier 1, tier 2 and tier 3 capitals. Banks are required to maintain a minimum total risk-based capital ratio of 8 percent.

We will use different capital ratios in different regressions, and we will compare the results in Section 4.

3.4 Other control variables

We control for bank size, real estate loans ratio, commercial & industrial (C&I) loans ratio and consumer loans ratio, and we examine how they are related to bank credit risk.

Bank Size: We measure size as the natural logarithm of total assets.

Real estate loans ratio: We measure real estate loans ratio as the ratio of total real estate loans to total loans.

C & I loans ratio: We measure C & I loans ratio as the ratio of commercial and industry loans to total loans.

Consumer loans ratio: We measure consumer loans ratio as the ratio of consumer loans to total loans.

It is commonly believed that larger banks are better diversified. Demsetz and Strahan (1997) find that large banks use this advantage to operate with higher leverage. As a result, better diversification does not translate into reduction in total risk. Another reason for larger banks tend to take more risk comes from the "too-big-to-fail" hypothesis. If large banks expect support from the government in the event of difficulties, they tend to invest in riskier assets to pursue higher profit. Authors like Berger, Ofek and Yermack (1997) also find a positive relationship between bank size and leverage.

Tarazi (2009) finds that real estate loans have negative impact on the undercapitalized bank's risk taking ability. As the default rate on real estate mortgages increased dramatically

during the recent financial crisis, we expect the real estate loans ratio to be positively associated with bank credit risk in our study.

3.5 Summary statistics

Table 1 and Table 2 report the summary statistics and the correlation matrix of the ten variables used in our analysis. The sample consists of 915 bank observations. Table 1 presents the mean, standard deviation, minimum value and maximum value of each variable. Table 2 shows the correlations among the variables.

The allowance ratio has a mean of 1.7315% and a standard deviation of 0.8080%. In comparison, the charge-offs ratio has a lower mean of 0.9163% and a higher standard deviation of 1.0533%. The provision ratio, with a mean of 1.2898%, has the highest standard deviation of 1.3411%. As we expected, the correlations among the three risk taking measures are significantly positive.

Comparing the three capital factors, we find that the tier 1 leverage ratio demonstrates the smallest mean of 9.104% and a standard deviation of 2.053%. The tier 1 risk-based capital ratio has a higher mean of 11.6397% and a standard deviation of 3.373%, and the total risk-based capital ratio has the highest mean of 13.162% and a standard deviation of 3.311%. Correlations among the three capital ratios are significantly positive, as we would expect.

The means of the real estate loans ratio, the C&I ratio and the Consumer ratio are

74.668%, 15.097%, 5.209% respectively, suggesting that at the end of 2007, a majority of bank loans are real estate loans.

In addition, we observe the following significant correlations among the variables.

- The tier 1 leverage ratio is positively correlated to the allowance ratio. However, the tier 1 risk-based ratio is negatively correlated to the charge-offs ratio and the provision ratio.

- Bank size shows positive correlations with all risk factors and negative correlations with all capital ratio factors, implying that banks that are larger in size have lower capital ratio and take more risk.

- The C&I loans ratio has negative correlations with the capital ratios, while the consumer loans ratio has positive correlations with the capital ratios.

- There exists a positive correlation between the C&I ratio and the consumer ratio, and they both demonstrate negative correlations with the real estate loans ratio.

4 Empirical results

4.1 Methodology

Most of prior empirical studies in this area argue that bank capital and risk taking are jointly determined. They usually utilize a simultaneous equations method to evaluate the

relationship between bank capital and risk taking.

Shrieves and Dahl (1992) emphasize that capital and risk decisions are made simultaneously and are interrelated. They develop a simultaneous equations model and apply it on data for 1,800 U.S. banks over the period 1983-1987. They find that most banks limit their total risk exposure when they are required to increase their capital. However, these banks will invest in riskier assets to offset the negative effect on profitability.

Jacques and Nigro (1997) follow and further extend the simultaneous equations model used by Shrieves and Dahl. They believe that risk-based capital standards have an impact on both capital and risk. They use a simultaneous equations framework, where risk-weighted capital standards are introduced to measure bank capital.

Building on the work by Shrieves and Dahl, and Jacques and Nigro, Rime (2001) uses a simultaneous model and partial adjustment framework for capital and risk to analyze adjustments in capital and risk for Swiss banks over the period 1989-1995. He finds regulatory pressure induces banks to increase their capital, but that does not affect the level of risk.

Boubacar Camara, Laetitia Lepetita and Amine Tarazia (2009) divide banks into 3 categories: undercapitalized, adequately capitalized and highly capitalized. They utilize the generalized method of moments to estimate the coefficients of their model, and they conclude that undercapitalized banks tend to decrease risk when an increase in capital is required. However, they obtain an opposite result for adequately and highly capitalized banks.

In the present case, we conduct multiple regressions through a one-equation specification. To address the concern that capital ratio and risk taking may be simultaneously determined, we use lagged independent variables. We measure risk taking data in 2008, and capital ratio data in 2007, since we believed that bank risk taking in 2008 is a result of bank risk decisions that were made in 2007. Specifically, we estimate the following equation:

$$Risk_{i,2008} = \beta_0 + \beta_1 * Capital\ ratio_{i,2007} + \beta_2 * Size_{i,2007} + \beta_3 * Real\ estate\ loans_{i,2007} + \beta_4 * C\&I\ loans_{i,2007} + \beta_5 * Consumer\ loans_{i,2007} + \varepsilon_i$$

In this equation, β1 is the coefficient on the capital ratio, and it shows the relationship between capital and risk; β2 is the coefficient on bank size, β_3 is the coefficient on the real estate loans ratio, β_4 is the coefficient on the C&I loans ratio, and β5 is the coefficient on the consumer loans ratio.

We conduct three groups of regressions using respectively the allowance ratio, the charge-offs ratio and the provision ratio to measure credit risk. Each group of the regressions consists of three regressions using respectively the tier 1 leverage ratio, the tier 1 risk-based l ratio, and the total risk-based ratio to measure bank capital. Thus, we conduct a total of nine separate regressions with different risk and capital measures. In the following section, we will report and compare the results of different regressions and discuss the implications of the results.

4.2 Results

Table 3 reports the regression results when using the allowance ratio to measure risk. Column (1) shows the result when using the tier 1 leverage ratio as an independent capital factor. Here the coefficient on the capital ratio β_1 is positive and significant, indicating that banks with higher tier 1 leverage ratio take more risk. Column (2) shows the result when using the total risk based capital ratio as capital factor, and here β_1 is also positive and significant, indicating that banks with higher total risk based capital ratio take more risk. Column (3) shows the result when using the tier 1 risk based capital ratio as capital factor, and here β_1 is not significant.

We can see that the coefficient on bank size β2 is positive and significant in all these three regressions, showing that larger banks tend to take more risk. The coefficients on real estate loans β3, C&I loans β4 and consumer loans β5 are also positive and significant in all these three regressions, indicating that banks with more of these loan types will be exposed to greater credit risk. This is consistent with our expectation.

Table 4 reports the regression results when using the charge-offs ratio as the risk factor. We find that when using tier 1 leverage ratio as the capital factor, β_1 is positive and significant. However, when using the tier 1 risk based ratio and total risk-based ratio as capital factors, β_1 is not significant. Besides, the coefficient on bank size β_2 is always positive and significant, presenting the same result with the prior regressions. We also notice that the coefficient on the real estate loans β_3 is significant, while β_4 and β_5 are not significant. This might be due to the fact that most defaulted loans are real estate loans during

the recent financial crisis. Recall that charge-offs are loans that are six months behind in payment and cannot be collected.

Table 5 presents the regression results in which risk is measured by the provision ratio. When we use the tier 1 leverage ratio as the capital factor, β_1 is positive and significant. When using tier 1 risk based ratio and total risk-based ratio, β_1 is not significant. The coefficient on size β_2 is positive and significant all the time, presenting the same result with previous regressions. The coefficient on the real estate loans β_3, again, is significant. The coefficient on the C&I loans β_4 is significant in two of the three regressions, and the coefficient on the consumer loan β_5 is not significant.

To summarize, as we conduct regressions with different risk factors and capital factors, the results indicate that the tier 1 leverage ratio is positively related to all three risk factors, while total risk based capital ratio is only positively related to the allowance ratio. The tier 1 risk based ratio is not significantly related to credit risk. In addition, among the three different loans, real estate loans demonstrate a strong positive relationship to risk. In general, our result supports Bichsel and Blum's finding that a positive correlation exists between changes in capital and changes in risk. However, our results differ from those reported by Jin, Kanagaretnama, and Lobo, who find negative coefficients on capital and loan growth.

5 Discussion

Our findings, focusing on the period of financial crisis, suggest that banks that are larger in size, with higher levels of capitalization and with more real estate loans before the crisis, are exposed to more risk during the crisis. One possible reason for the positive relationship between capital and risk taking is that capital is costly, so banks with higher capital ratio tend to incur higher risks to receive higher risk premium, which implies an increase of credit risk as a result of capital increase. Another possible reason is that higher capital can create an illusion of financial health, which may allow banks to avoid taking prudent actions to restrict risk taking.

Our results are based on the data from the financial crisis period. The effect of bank capital on risk during financial crisis may differ from that during normal times, thus, it is not clear whether our result can be generalized to normal times. However, our study adds to the banking literature that examines the relationship of bank capital and risk taking during the recent financial crisis.

In the aftermath of the financial crisis, Basel Committee on Banking Supervision proposed to “strengthen the resilience of the banking sector” and issued the Basel III rules on December 16, 2010. The new regulatory standard strengthens bank capital requirements by increasing the existing capital levels and introducing additional capital buffers and a minimum leverage ratio. Leverage ratio, as it captures both on-balance-sheet assets and off-balance-sheet assets, is considered to be a supplement to risk-adjusted capital measures.

Our results raise some concern about Basel III's rationale that increasing capital requirements prevents banks from excessive risk taking, as our findings demonstrate positive relationship between the two. We admit that higher capital requirements may better ensure a bank to meet its obligations in the event of sudden liquidation of its assets. However, a higher capital requirement does not necessarily reduce bank risk taking, instead, may motivate banks to take excessive risk. Thus, the new regulatory proposals to increase capital requirements may not address the problem of excessive risk taking.

Lastly, we find that among real estate loans, C&I loans and Consumer loans, it is real estate loans that influence bank credit risk most significantly during the recent financial crisis. We therefore suggest that regulators focus more closely on bank loan portfolio composition.

Reference List

Beatty, A., and Liao, S. (2009) " Regulatory Capital ratios, loan loss provisioning and procyclicality " , working paper.

Beltratti, A., and Stulz, R.M. (2011) " The credit crisis around the globe: Why did some banks perform better? " Fisher College of Business WP 2010-03-005

Bichsel, R., and Blum, J. (2004) " The relationship between risk and capital in Swiss commercial banks:a panel study " Applied Financial Economics14, 591–597

Camaraa, B., Lepetita, L., and Tarazia, A.(2009) " Changes in capital and risk: an empirical study of European banks " a Université de Limoges, LAPE, 5 rue Félix Eboué, 87031 Limoges Cedex, France,preliminary draft: October 2009.

Cannata, F., and Quagliariello, M.(2006) " Capital and risk in Italian banks:A simultaneous equation approach " Journal Of Banking Regulation Vol: 7, 3/4 ,283-297

Christophe, J.G. (2005) " Bank capital and credit risk taking in emerging market economies " Journal of Banking RegulationVol. 6, No. 2,128–145

Fahlenbracha, R., and Stulz, R.M. (2011) " Bank CEO incentives and the credit crisis " Journal of Financial Economics 99 (2011) 11–26

Gale, D. (2010) " Capital Regulation and Risk Sharing " International Journal of Central Banking Vol. 6 No. 4,187-203

Jin, J.Y., Kanagaretnama, K., and Lobo, G.J. (2011) " Ability of accounting and audit quality variables to predict bank failure during the financial Emilia Peni & Sami Vähämaa crisis " Journal of Banking & Finance 2011.03.005.

Koziola, C., and Lawrenzb, J. (2009) " What makes a bank risky? Insights from the optimal capital structure of banks " Journal of Banking & Finance 33,861–873

Lindquist, K. (2004) " Banks' buffer capital: how important is risk " Journal of International Money and Finance23,493–513

Liu, M.Y. (2009) " Financial risk and capital adequacy: The moral hazard problem " Journal of Risk Management in Financial Institutions Vol. 2, No.3, 306–323

Peni, E., and Vähämaa, S. (2011) " Did Good Corporate Governance Improve Bank Performance during the Financial Crisis? " J Financ Serv DOI 10.1007/s10693-011–0108 -9

Porter, R.L. (2009) " The impact of bank capital requirements on bank risk: an econometric puzzle and a proposed solution " Banks and Bank Systems, Volume 4, Issue 1.

Shrieves, R. E., and Dahl, D. (1992) " The relationship between risk and capital in commercial banks " . Journal of Banking and Finance: 16 439–457.

Appendix: Tables

Table 1: Summary statistics

This table reports summary statistics for the variables used in our analysis. The sample consists of 915 observations. The table presents the mean, standard deviation, minimum value and maximum value for each variable. All the variables are winsorized at the 1% and 99% levels to mitigate the impact of extreme observation on the estimation results.

Variable	Obs	Mean	Std. Dev.	Min	Max
allowance	915	1.731501	.8080262	.5522649	5.355584
charge_off	915	.9163416	1.053341	.0029434	5.57091
provision	915	1.28975	1.341146	.0429296	6.682594
leverage_r~o	915	9.103923	2.052642	5.12	17.59
total_capi~l	915	13.16208	3.311158	9.48	29.7
tier_1	915	11.63973	3.372722	6.44	27.15
size	915	14.13789	1.244244	12.41915	19.10296
real_estate	963	74.6679	14.59022	19.54291	98.77681
c_and_i	915	15.09753	8.896995	.6532953	50.07718
consumer	915	5.297073	6.135287	.0474004	32.97627

Table 2: Correlation matrix

This table shows the correlation among variables used in our analysis. * indicates the correlation is significantly different from 0 at 5% level.

	allowa~e	charge~f	provis~n	Levera~o	total_~1	tier_1	Size
allowance	1.0000						
charge_off	0.6055*****	1.0000					
provision	0.7829*	0.8991	1.0000				
leverage_r~o	0.1010*****	0.0579	0.0617	1.0000			
total_capi~1	0.0191	0.0103	-0.0390	0.7573*****	1.0000		
tier_1	-0.0605	-0.0742*	-0.1151*	0.8051*****	0.9581*****	1.0000	
Size	0.1874*****	0.1750*****	0.2134*	-0.2869*****	-0.1826*****	-0.2725*****	1.0000
Real_estate	0.0280	0.0258	0.0527	0.0019	-0.0403	-0.0033	-0.2834*****
c_and_i	0.0261	-0.200	-0.0047	-0.0249	-0.1194	-0.1378*	0.1187*
consumer	0.0063	0.0195	-0.0324	0.0114	0.1366*	0.1171*	0.2126*

	real_e~e	c_and_i	consumer
Real_estate	1.000		
c_and_i	-0.6675*	1.0000	
consumer	-0.4957*	-0.0264	1.0000

Table 3: Regression result using Allowance to measure risk

This table reports regression results when Allowance ratio is used to measure risk. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)
leverage_ratio	0.072***		
	(0.020)		
total_capital		0.021*	
		(0.012)	
tier_1			0.003
			(0.011)
Size	0.180***	0.155***	0.145***
	(0.029)	(0.029)	(0.030)
real_estate	0.015***	0.014***	0.013***
	(0.004)	(0.004)	(0.004)
c_and_i	0.016***	0.017***	0.015***
	(0.005)	(0.005)	(0.005)
consumer	0.011*	0.010*	0.011*
	(0.006)	(0.006)	(0.006)
Constant	-2.849***	-2.105***	-1.637***
	(0.584)	(0.580)	(0.573)
Observations	915	915	915
R-squared	0.083	0.059	0.052

Table 4: Regression result using Charge-offs ratio to measure risk

This table reports regression results when Charge-offs ratio is used to measure risk. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)
leverage_ratio	0.065**		
	(0.026)		
total_capital		0.018	
		(0.018)	
tier_1			-0.007
			(0.016)
size	0.202***	0.179***	0.162***
	(0.031)	(0.031)	(0.031)
real_estate	0.011**	0.011**	0.011**
	(0.004)	(0.004)	(0.004)
c_and_i	0.007	0.008	0.005
	(0.007)	(0.007)	(0.007)
consumer	0.008	0.008	0.008
	(0.007)	(0.007)	(0.007)
Constant	-3.532***	-2.846***	-2.155***
	(0.680)	(0.706)	(0.685)
Observations	915	915	915
R-squared	0.053	0.041	0.039

Table 5: Regression result when risk is measured using Provision ratio

This table reports regression results when Provision ratio is used to measure risk. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)
leverage_ratio	0.098***		
	(0.032)		
total_capital		0.011	
		(0.020)	
tier_1			-0.015
			(0.018)
size	0.326***	0.281***	0.261***
	(0.040)	(0.039)	(0.039)
real_estate	0.020***	0.019***	0.017***
	(0.005)	(0.006)	(0.006)
c_and_i	0.016*	0.015*	0.013
	(0.008)	(0.009)	(0.009)
consumer	0.002	0.002	0.003
	(0.009)	(0.009)	(0.009)
Constant	-5.947***	-4.466***	-3.712***
	(0.879)	(0.872)	(0.860)
Observations	915	915	915
R-squared	0.084	0.064	0.065