The Impact of Liquidity Risk and Credit Risk on the Capital Adequacy Ratios of USA Banks before and after the 2008 Financial Crises

Toh Chia Kenneth

Submitted to the
Institute of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science
in
Banking and Finance

Eastern Mediterranean University
December, 2016
Gazimağusa, North Cyprus

Approval of the Institute of Graduate Studies and Research

Prof. Dr. Mustafa Tümer
Director

I certify that this thesis satisfies the requirements as a thesis for the degree of Master of Science in Banking and Finance.

Assoc. Prof. Dr. Nesrin Özataç
Chair, Department of Banking and Finance

We certify that we have read this thesis and that in our opinion it is fully adequate in scope and quality as a thesis for the degree of Masters of Science in Banking and Finance.

Prof. Dr. Hatice Jenkins
Supervisor

Examining Committee

1. Prof. Dr. Hatice Jenkins

2. Assoc. Prof. Dr. Bilge Öney

3. Assoc. Prof. Dr. Nesrin Özataç

ABSTRACT

The importance of capital adequacy of banks in USA became prominent following the 2008 financial crises. The main objective of this study is to identify the determinants of Capital Adequacy Ratios (CAR) of banks in USA and the role played by both liquidity and credit risk during the crises. This study used the financial information of 30 selected banks over the period of 2004-2011. The panel data analysis and fixed effect model were carried out. The results of the study suggested that both credit risk and liquidity risk ratios have positive and statistically significant impact on CAR of banks in USA.

Keywords: Capital adequacy ratio, U.S.A. banks, financial crises, Credit risk, Liquidity risk, panel data.

ÖZ

ABD'de bankaların sermaye yeterliliğinin önemi 2008 finans krizinden sonar daha çok belirgin oldu. Bu çalışmanın temel amacı, ABD'de bankaların sermaye yeterliliğinin (CAR) belirleyicilerini ve krizler sırasında likit ve kredi riskinin oynadığı rolü belirlemektir. Bu çalışma, ABD'de bulunan 30 büyük bankanın 2004-2011 döneminde ki finansal verilerini kullanmıştır. Panel very analizi ve sabit etki modelleri gerçekleştirildi. Çalışmanın sonuçları, hem kredi riski hem de likidite riskinin sermaye yeterliliği rasyosunu pozitif ve istatistiksel olarak anlamlı etkilediğini ortaya koymaktadır.

Anahtar Kelimeler: Sermaye yeterliliği rasyosu, ABD Bankalar, Finansal krizler, Kredi riski, Likidite riski, Panel verileri..

DEDICATION

This thesis is dedicated to the soul of my precious mother whom I lost during my studies in the master's program at the Eastern Mediterranean University.

ACKNOWLEDGMENT

I want to thank my supervisor, Prof. Dr. Hatice Jenkins for her valuable advices and support in completing this work. Despite her busy schedule, she was still able to give me as much attention as I wished as well as helpful suggestions.

I am grateful to Dlawar Madi for his comments and suggestions in this research.

I am equally thankful to my beautiful fiancée (Awah Stephanie) for her care, moral and academic support during this period.

Finally, I am deeply thankful to Mr. Bezhan Rostamov for his friendly support during this period. He was always willing to help me in all ways possible. I always leave his office with a smile on my face.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AC	Autocorrelation
BCBS	Basel Committee on Banking Supervision
CAR	Capital Adequacy Ratio
CRR	Credit Risk Ratio
DW	Durbin Watson
FDIC	Federal Deposit Insurance Cooperation
FED	Federal Reserve.
FIs	Financial institutions
LIQR	Liquidity Ratio
LLC	Levin, Lin, and Chu Test
NASDAQ	National Association of Securities Dealers Automated Quotations
NIM	Net interest margin
NPL	Non-performing loans
NYSE	New York Stock Exchange
OLS	Ordinary List Squares
U.S.A	United States of America

Chapter 1

INTRODUCTION

1.1 Background of the Study

Capital adequacy ratio of banks has attracted much attention at a global scale mainly due to the global financial crises of 2008-2010. The crises started in the United States of America and later spread to the rest of the world (Helleiner, 2011). According to Ahmad, Ariff and Michael (2008), Capital adequacy of banks is critical in maintaining banks' efficiency and stability during crises where banks' losses are high. Banks tend to increase their capital base in response to the level of risks they carry in their day-to-day operations. Principally, banks face the risk of loan default (credit risk), risk of asset and liability duration mismatch in their balance sheets (interest rate risk), risk of trading in foreign currencies (exchange rate risk) and market related risks. The above cited risks are potential sources of bank distress if poorly managed. According to Al-Sabbagh (2000), a financial institution's capital adequacy can be used to measure its risk exposure. The more banks get involved into risky operations, the more they should be compelled by regulatory and supervisory organs to provide a cushion for unexpected capital losses. All these are obligations to render the banks capable of protecting depositors' money.

The financial crisis of 2008 initially resulted from credits given to individuals with low credit rating history. The crises spread to the world at large and the Basel Committee for Bank Supervision and Regulation was accused for its weakness to

prevent banks' failure. The Basel Accord was created in 1974 by the governors of the central banks of member countries. The main aim of the Accord was to define minimal capital adequacy requirements for members' banks. The first regulatory standard introduced is known as Basel I with the purpose of minimizing risk resulting from loans issued to the public. Here, CAR is defined as "a ratio of bank's capital to its risk weighted assets". A CAR of 8% is considered acceptable to guard against credit risk. The major weakness of Basel I is that it considers only credit risk, ignoring interest rate risk, operational risk and market risk. The Basel committee decided to upgrade Basel I to a more comprehensive set of requirements to better mitigate potential sources of risks.

The Basel II Accord was introduced in 2004 to replace Basel I. Its focus was on working with international financial institutions to motivate the application of Basel rules and introduced tighter internal controls. In addition to credit risk Basel II considers market and operational risks. As evidenced from the global financial crises of 2008, Basel II was not an ultimate solution as banks ran into crises a few years after its introduction. The committee introduced an enhanced mechanism known as Basel III in 2010. This was a response to the 2008-2010 credit crises. The key issues addressed by Basel III were (Cohen, 2013);

- The capital base of institution should be well specific in order to enhance transparency.

- The capital base should also be organized in such a way so as to cover the totality of risks of the firm.

- The amount of capital set aside (buffer) should be in proportion to the amount of risk activities the bank undertake. In this regard, attention should be paid to off balance sheet activities which are the sources of significant risk to the banks involved.

- The quality of capital should be dominated by common equity and retained earnings as the main source of capital.

The main concern of Basel III to banks is its robustness and the amount of resources required for its applications. The issue here is whether the Basel III alone is sufficient to prevent future crisis.

According to Innocent, Mary and Mathew (2013), stakeholders such as investors, depositors and other third parties mainly focus on banks profitability as a proxy for measuring the performance and rating managers of banks. They argue that profitability ratios of firms are used by the public to measure the efficiency and performance of financial institution because of their direct impact on share value of the company. While considering such measures, the capital requirements of such banks should also be monitored in order to avoid possible losses. Leila, Hamidreza and Farshid (2014) presents capital adequacy ratio as an optimal means to judge bank's efficiency and stability against unforeseen shocks such as massive loan losses. The amount and quality of capital set aside by financial institution should be such that it guards the bank against most risks especially credit risk which is one of the risks in banking business with high frequency. This will go a long way to render banks a sound financial position and market competitiveness.

According to Al-Tamimi and Obeidat (2013), the variables that affect the amount of capital that banks hold with respect to their assets is listed as follows; interest rate risk, liquidity risk. Credit risk, capital risk, net interest margin, ROA and return on equity related variables. Various researchers have studied the capital adequacy of various companies from in countries and across different time zones. These studies show some of the explanatory variables are significant and some not.

This study examines the capital adequacy of banks in the United States. The variables that this study uses to explain capital adequacy ratio are credit risk (CRR) measured by the natural logarithm of non-performing loans and liquidity risk ratio (LIQR) measured by the ratio of cash and short term assets to total liabilities. These variables are chosen based on the fact that they were the main factors behind the 2008 financial crises.

1.2 Motivation and Objective of the Study

The United States is the leader in banking and financial services and it is therefore very important to understand the behavior of its banks. Due to the 2008-2010 crises, the capital adequacy of banks has been widely questioned. A lot of research has been done worldwide about the capital adequacy of banks. Few have paid particular attention to pre and post analysis of the crises, to examine whether pre crises weaknesses of banks that caused the crises have been improved upon in recent years.

1.3 Research Questions

Based on the subject of this study the following questions have been addressed;

1) What are the factors influencing capital adequacy ratio of banks?

2) How has capital adequacy ratio changed before and after the crises?

1.4 Research Hypotheses

Based on the research questions the following three null hypotheses have been developed.

Ho 1: The capital adequacy ratio of US banks remained unchanged after the crises.

Ho 2: The credit risk is not significantly associated with the capital adequacy ratio of the USA banks.

Ho 3: The liquidity risk is not significantly associated with the capital adequacy ratio of the USA banks.

1.5 Scope of the Study and Limitation

This study seeks to investigate the capital adequacy ratios of USA banks before and after the financial distress of 2008-2010. Since many banks became insolvent during this period, we expect to see that banks increased their capital after the crises to avoid insolvency. A sample of 30 USA banks will be used in this analysis. The research will be based on a cross sectional and panel data of 30 banks and a time period considered from 2004 to 2011 that includes before and after the crisis. Due to the availability of data this study will focus on USA banks listed in the both NASDAQ and NYSE within the time period considered.

1.6 Data and Methodology

A cross-sectional data collected from 30 USA banks from 2004 to 2011 will be used to find out the impact of determinants of capital adequacy of banks before and after the crisis. Data has been obtained from Thomson Reuters Data stream. The main dependent variable in this study is the capital adequacy ratio (CAR). The explanatory variables are liquidity risk (LIQR) measured by the ratio of cash and short term financial assets to total liabilities and credit risk (CRR) measured by the natural logarithm of non-performing loans. Equally, descriptive statistics will be employed

to show the average capital adequacy and the explanatory variables before the crisis and after the crises. In order to measure the relationship between the explanatory variables, the correlation matrix has been used alongside the OLS regression analysis. In addition to the above techniques, the panel root test has been used to test the stationary of the regression model. Autocorrelation and multicollinearity will also be detected and corrected. The technical analysis of the data on this work will be done using Excel and Eviews.

The plan of this thesis is summarized as below. In chapter two, the literature of capital adequacy is reviewed. Concepts as well as various literatures will be reviewed. Also, a further attention is paid to the explanatory variables of capital adequacy ratios. In chapter three, data and methodology are reviewed. A descriptive analysis of the sample will be carried out. The stated hypothesis and the various preliminary tests to assure that the OLS regression assumptions are not violated will be stated.

In chapter four, empirical results and findings are summarized. The econometrics analysis such as multicollinearity, autocorrelation and unit root test and all the regression results will be presented and interpreted here. Finally, in chapter five; conclusion and recommendation of the findings are presented and discussed.

Chapter 2

REVIEW OF LITERATURE

2.1 The Basel Committee on Bank Supervision (BCBS)

The Basel Committee for bank supervision was formed by central banks' governors of the member countries in 1974 in Japan, with head office in Geneva, Switzerland (http://www.bis.org/Basel). Their main objective was the formulation and the supervision of capital adequacy rules in the member countries.

The motivation for the formation of this Accord was the increased failure of banks all over the world largely attributed to low capital buffers compared to the riskiness of their financial transactions.

According to Saunders and Cornett (2003, pp 613-614), the capital of a financial institution also known as net worth is defined as the value of assets minus liabilities. Capital can also be seen as what will be distributed to the owners in an event of bank liquidation.

Banks all over the world play a crucial role in the development of the economy in which they are located. Banks act as relay mechanism between the real sector and the financial sector. According to Rime (2001), one of the main functions of financial institutions is the collections of funds from those in excess (depositors) and issuing of loans to those in need (borrowers). The interest income banks make from

selling of loans constitute the principal source of banks' earnings. The impact of banks activities on the real economy can be evidenced from the credit crises of 2008-2010 both in USA and the rest of the world. This impact can be explained by a table of economic indicators in US from 2005-2010 .The stability of banks does not come by chance. It usually comes as a continuous effort both from internal and the external forces such as FED and BIS bodies.

Capital adequacy of a depository institution according to Rime (2001) is the amount of funds its owners must set aside to manage crises such as unexpected and massive loan defaults which might lead to bank failure. It is measured by a bank's capital to its risk weighted assets it keeps in its balance sheets.

The credit crises of 2008-2010 that started in the USA and due to financial integration spread to the rest of the world shows how vulnerable and how inefficient the capital adequacy measures introduced by supervisory bodies such as Bank for International Settlement, FDIC and the Fed were in monitoring the banking sector.

According to the BIS (www.bis.org), Basel II was introduced in July 2006 to take over Basel I as a capital adequacy measure. Two years later while many countries have not yet started using it, the financial crises started. The Basel Committee on Bank Supervision in response to the crisis introduced Basel III with more reliable capital adequacy ratios measures than those in Basel II. The next sections would focus on the Basel framework.

2.2 The 1988 Basel I Accord

In 1988, a team of central banks' governors of the 10 most industrialized countries met in Basel, Switzerland and formulated Basel I rules. The main objective of the

Basel I accord was to reduce the vulnerability of banks to credit risk at an international level. This is due to the fact that banking activities in the world are chained up and the failure of one bank might trigger the whole system to fail due to globalization of financial services.

The key points under the 1988 Accord are (www.bis.org/basel I):

1) The amount of capital a thrift institution should keep should be Relative to its risk taking activities. The higher the risk the higher the amount of capital reserves a bank should keep to protect the bank from defaulting on its obligations.

2) The capital of any financial institution should be split into two Tiers: Core capital (the value of shares that have been paid in, accumulated retained earnings and all disclosed reserves) and supplementary capital (long-lived assets revaluation reserves, provision for loan losses account, undisclosed revaluation reserves and subordinated debts instruments).

3) The Basel I Accord also grouped countries according to their debt repayment ability: The low risk group consisted of European Union countries alongside Japan and the United States. Switzerland and Saudi Arabia were also included in this group. The high risk economies were any country not belonging to the above class. This classification was in order to easily determine the riskiness of a given economy."

According to the Basel Committee, there are two classes of capital: the Tier 1 capital also known as the core capital and the Tier 2 capital also known as the supplementary capital. The former is made of paid in capital, retained earnings and

disclosed revaluation reserves while the latter is made of supplementary capital sources such as undisclosed reserves, general provisions and subordinated debts.

2.3 The Basel II Accord

In April 1998, the Basel Committee on Bank supervision released the second consultative document (International Convergence of Capital Measurement and Capital Standards, April 1998) on the new Accord. The key points under this new proposal were summarized under three broad pillars:

1-Minimum capital requirements

2-Supervisory review process and

3- Market discipline.

It can be seen that this new Accord is more elaborate than the first one in that in addition to minimum capital requirements it has introduced supervision and market discipline as a means to render the second approach risk sensitive. All these amendments were necessary in that a few years after Basel I Accord was introduced, the financial services industry entered into a technology dominated era. This technological advancement also introduced technological and operational risks into the capital adequacy model and hence the Basel I was no more valuable.

2.3.1 Pillar I: Minimum Capital Requirement

Here, there is no modification of the definition of capital as provided by the Basel I Accord. The ratio of capital to risk weighted assets including operational and market related risk is still kept at a minimum of 8% of total assets of which the Tier capital contribution must be a minimum of 4%.

The main changes that can be noticed here is the inclusion of operational risk into the model and also new measures of credit risk appraisal. These measures are the

Standardized Approach of measuring credit risk and the Internal Rating Based approach (IRB).

According to the Standardized Approach of credit risk management, risk weights attribution was based on external ratings provided by approved rating agencies such as S & P 500 and the Moody's Analytics. Countries and corporations were given rating grades based on objective findings by the rating agencies (table 5.2).

By the Internal Rating Based approach (IRB), banks were allowed to evaluate the credit risk of the loans they were creating by focusing on the chances of default by borrowers. The probability of default was the key parameter used in the internal rating based approach. Ratings were assigned to various borrowers on this basis. In addition to the probability of default, banks also had to ascertain how much they would lose in the event of default. This will give a deeper analysis of the credit history of the borrower and hence will help the bank in the determination of a credit rating.

It is worth noting that though this approach sounds so simple, banks might face the problem of accurately estimating the right probability of default of a given customer.

2.3.2 Pillar II: Supervisory Review

The supervisory committee gave banks the liberty to choose among the various approaches to measure credit risk, operational and market related risk. Care was to be taken because each method chosen was to be a function of the availability of data to the bank in question. For example, the IRB approach for risk weighs was dependent upon the inputs availability to the bank in question. According to the

Basel Accord, the review process needs to be done following the following principles:

1-Banks should asses their capital relative to the amount of risk they carry in their balance sheets and equally be ready to adjust their capital as their risk profile is increasing.

2-Supervisors should assess the extent of compliance of banks to stipulated capital adequacy ratios as well as reviewing their capital assessment strategies.

3-Supervisors should have a means of encouraging banks to hold capital above the required minimum. This would help to create enough capital buffers to counter any unforeseen losses a bank might find itself in.

4-Supervisors should try as much as possible to keep watch of banks whose capital fall below the required level and in that situation, respond with immediate effect to avoid the situation getting worse.

2.3.3 Pillar III: Market Discipline

Under this third pillar, the Basel committee seeks to introduce order, fairness and the elimination of any misconduct that will have as a consequence deception of market participants. Enough accurate disclosure has to be made by banks about their capital structure, their risk profile and the various risk mitigation strategies employed. With all these disclosures, market stakeholders would be in full possession of necessary and accurate information on which to form the bases of their financial decisions.

2.4 The Effects of Basel II on the United States Banking Sector

Although the Basel II came to add to the provisions of Basel 1 such as the introduction of operational risk, market risk and off balance sheet related risks, it didn’t have the same effect on all the banks.

According to a study by Lang, Mester, and Vermilyea (2007), on USA bank credit card lending, many banks did not turn to the Basel II because of the costs needed to be incurred on compliance.

Majority of small capital based banks remained on the provisions of Basel I. Most of the banks that switched to Basel II were the few giant banks in the USA.

While many banks were still struggling to implement Basel II Accord, the Accord in itself was later proven to be inadequate due to the break out of the 2008 crisis. The Basel II provisions were formulated at a moment when banks were not into too much of off balance sheet activities, securitization and a lack of corporate governance measures to reduce malpractices in the financial market place. This saw the need for the introduction of new and stricter capital measures to handle these crises.

2.5 Basel III Accord

The crisis that began in the second semester of 2007 pointed to the fact that the Basel II Accord did not provide a good model for the handling of liquidity risk which was one of the courses of the 2008 crisis. The Basel committee responded to this lapse in liquidity management by banks by issuing a new set of rules that provided new guidelines. In December 2010, the Basel committee had responded fully by providing the following guidelines for capital adequacy that might mitigate risk to a greater extend:

1-Increasing the quantity and quality of capital: the total capital buffer of 8% under Basel II had to be raised to 10.5% of which Tier 1 is 6% minimum under the new regulation in order to reduce future liquidity risk.

2-Reduce leverage: the ratio of the total of both on and off balance sheet assets to the bank's capital should be highly regulated so that if banks wish to create more assets they should also be required to widen their capital base to secure the assets in the event of losses.

3-Increase short term liquidity coverage: banks are required to hold enough short term liquid assets (cash, reserves at the central bank and T-bills) in order to offset any negative net drain in liquidity that might arise within the next 30 days. This is an attempt to avoid bank runs.

4-Increase long term balance sheet funding: under Basel III, it is required that banks should be able to fund long term assets with very stable sources of funds. Enough capital should be set aside to guarantee such long term assets if not the bank might find itself in liquidity crisis.

Even though still in its foundation phase, the Basel III is a major challenge to banks as well as the committee supervisors. It is expected to be fully implemented by 2019. The main concern now is the extent to which its effect will be felt across various banking sectors. It is believed that the effect will not be equally felt on both investment banks and commercial banks. The investment banks will have to comply with the Basel III by implementing the required leverage ratios, long term funding of the balance sheet because of the nature of their activities. Investment banks as compared to retail banks are highly involved in risky activities such as derivatives trading, cash trading and securitization.

2.6 Empirical Research on Capital Adequacy Ratio

Capital adequacy ratio of banks seeks to measure banks' capital in relation to its risk weighted assets. This ratio has the ultimate purpose of determining the banks soundness in terms of its probability of going insolvent in case of an unexpected loss in assets. In addition to Basel rules, several studies have worked on capital adequacy. Many of them have suggested some findings on CAR capital adequacy. A brief overview of studies from different backgrounds is presented below.

Zong-yi, Jun, and Qiong-fang (2008) investigates the impact of capital adequacy regulation on the risk-taking behavior of commercial Banks in China. They find that an increase in capital to asset ratio reduces the risk taking behavior of banks. Their research suggests that changes in capital are negatively related to changes in risk in a significant way. They conclude by saying that banks should consider increasing their capital in order to reduce portfolio risk. Another finding still in the Chinese banking sector is done by Yuanjuan and Shishun (2012). They use CAR as the dependent variable. The independent variables used here are: ROE, ROA, EPS deposit to loan ratio and non-performing loans. From regression analysis, a positive relationship is found between ROA and CAR. ROA, NPL, and LDR show a positive relation with CAR.

Keynes and Achmad (2015) carry out a research on the determinants of capital adequacy ratio of Indonesian banks. They investigate the impacts of bank size, credits, none performing loan, liquidity coverage ratio, ROA, ROE and net interest margin on capital adequacy ratio. The results suggest that assets, non-performing loans and ROA have a positive effect on CAR while ROE, NIM, credits and deposits

have a negative effect on the dependent variable CAR. On the other hand LCR does not have any significant effect on capital adequacy ratio.

A similar research is done by Shingjergji and Hyseni (2015) on the determinants of capital adequacy in the Albanian banks from 2007 to 2014. The explanatory variables used here are: ROE, ROA, poor-performing loans ratio, the size of banks and the ratio loans to deposits ratio. Their study concludes that performance ratios such as return on equity and assets do not explain CAR. Independent variables such as non-performing loans, loan to asset ratio and equity multiplier show a negative influence on CAR while bank size shows a positive effect on CAR. Banks with large amount of assets on the balance sheet should consider having a higher CAR.

Büyükşalvarcı and Abdioğlu (2011) carried out a research on the determinants of CAR in Turkish Banks from 2006 to 2011. For the dependent variables they used: size of the bank, quantity of deposits, total loans issued, profitability, NIM and percentage of borrowed funds. From their findings, ROA, ROE, leverage, loan loss reserves and loans have an effect on CAR while size, deposits, liquidity and NIM do not have an effect on CAR of Turkish banks.

To sum up, no consensus has been arrived at as to the determinants of capital adequacy ratio due to contrasting results arrived at on previous findings. This research contributes to the above mentioned literature.

Chapter 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Research Data and Design

As it was mentioned earlier, this research aims investigate whether USA banks increase their capital after the 2008 financial crisis in order to avoid solvency problems in the future. Furthermore, we try to examine the sensitivity of bank toward two major risks, namely credit and liquidity risks through a regression analysis. As the dependent variable, we use the ratio of bank's capital to its risk weighted assets (capital adequacy ratio) and the independent variables are credit and liquidity risks.

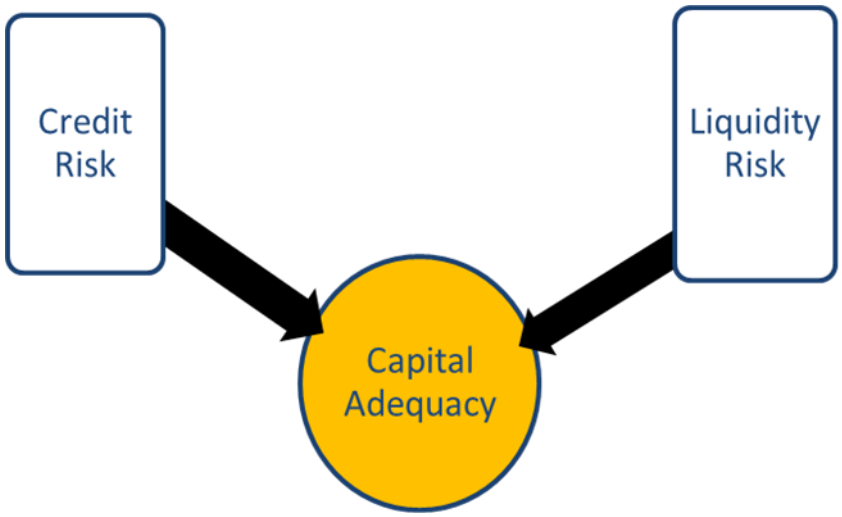

Figure 1. The Research Variables

3.2 Data

In this research, we use the secondary data that are obtained from Thomson Reuter's DataStream database. The variables used in this study include the items of the statement of financial position and statement of income that are obtained from the sampled banks' statements.

3.3 Research Sample

Table 1. The sampled banks (2015)

No.	Bank Name	Total Assets (billion)
1	JPMorgan Chase	$2,417
2	Bank of America	$2,154
3	Citigroup	$1,808
4	Wells Fargo & Company	$1,751
5	Bank of New York Mellon	$377
6	PNC Financial Services	$362
7	Capital One Financial	$314
8	State Street	$247
9	BB&T	$209
10	SunTrust Banks	$187
11	Fifth Third Bancorp	$142
12	Regions Financial	$125
13	Northern Trust	$120
14	M&T Bank Corporation	$100
15	Keycorp	$95
16	Sterling Bancorp	$12
17	First Midwest Banc	$10
18	Bank of the Ozarks	$9
19	Provident Financial Service	$9
20	WesBanco	$8
21	Union Bankshares	$8
22	Simmons First National	$8
23	Renasant	$8
24	NBT Bancorp	$8
25	First Financial Bancorp	$8
26	CVB Financial	$8
27	Community Bank System	$8
28	Berkshire Hills Bancorp	$8

29	BBCN Bancorp	$8
30	Park National	$7

Source: http://www.forbes.com/

As it can be seen in Table 1, the presented study has chosen a developed economy that is the US for two reasons. First reason is that the US is the biggest economy in the world and the second reason is the global financial crisis of 2008 started in the USA. Annual reports of thirty various banks from the US are collected from 2004 to 2011. The sample banks of this research are containing of fifteen big and fifteen small banks from the population of the banks in the US. The total asset size of the selected banks represents about 80% of the total assets of USA banks at the time of study. The study uses the panel data with period of study from 2004 to 2011 and a sample of 30 different banks in the US. The sample banks were chosen from the listed firms in NYSE and NASDAQ.

3.4 Research Questions, Hypotheses, and Model

3.4.1 Research Questions

This thesis is designed to provide possible answers to the following questions:

1) How has capital adequacy ratio changed after the crises?

2) What are the factors influencing capital adequacy ratio of banks?

3) Is there a difference in response to risk failure between large and small banks?

3.4.2 Hypotheses

In order to provide answers to the above questions, the following hypotheses will be used:

Ho 1: The capital adequacy of the US banks remains the same after the crisis.

Ho 2: The credit risk is not significantly associated with the capital adequacy of the USA banks.

Ho 3: The liquidity risk is not significantly associated with the capital adequacy of the USA banks.

3.4.3 Model Specification

In respect of research questions of the banks before the crisis will be compared with their capital adequacy after the crises. The banks average capital adequacy ratio also will be compared between large size banks and small size banks. In order to answer the second research question, this study uses a linear regression model with two independent variables. In this model, the CAR is the dependent variable while the credit and liquidity risk ratios are the independent variables.

Based on our panel data the equation takes the below form:

$Y_{it} = a + \beta X_{it} + u_{it}$

Where:

Y_{it}	Stands for explained variable in the model
a	Represents the intercept of the equation
β	Represents the coefficient
X_{it}	Stands for explanatory factor (i) at (t) time
u	Is the error term of the model
i	Presents the cross-sectional dimension
t	Presents the time series dimension

The empirical model to be used in this study for the capital adequacy ratio as explained variables in the pre and post crisis are presented as follow:

$CAR_{it} = \beta 0 + \beta 1 CRR_{it} + \beta 2 LIQR_{it} + u_{it}$

Where:

CAR_{it} =The Ratio of Total Shareholders' Equity to Risk Weighted Total Assets of firm i at time t

$\beta 1CRR_{it}$ =Natural Log of Non-Performing Loans of firm i at time t

$\beta 2LIQR_{it}$=The Ratio of Cash to Total Liability of firm i at time t

3.5 Variables of the Study

As presented in the table below, capital adequacy ratio is the explained variable and the independent variables are liquidity risk ratio and credit risk ratio.

Table 2. The variables of the study

Variables	Variables	Measurements	Literature
Capital Adequacy Ratio	Explained	$\frac{Shareholders' Equity}{Risk Weighted total assets}$	Keynes & Achmad (2014 Ali & Marsida (2015) Rime, B. (2001)
Credit Risk Ratio	Explanatory	$\frac{non performing loans}{total assets}$	Li & Xiao (2012) Keynes & Achmad (2014)
Liquidity Risk Ratio	Explanatory	$\frac{Cash\ (or\ Equivalent)}{Total\ Liabilities}$	Al-sabbagh (2000) Li & Xiao (2012)

3.5.1 Variables Description

3.5.1.1 CAR (Capital Adequacy Ratio)

The explained variable is obtained by dividing Tier 1capital plus Tier 2 capital over risk weighted assets, however in our equation shareholders' equity is representing (Tier 1capital plus Tier 2 capital) and risk weighted assets stands for sum of amount subject to credit risk, market risk and operational risk. The CAR of most banks is usually under the control of regulatory authorities such as the Basel Committee. According to the BCBS, banks should try to maintain a capital ratio of 8% or more

as a means of ensuring an efficient and stable financial system. The higher the amount of capital set aside by banks, the less risky the bank will be and hence the more confident depositors will have in the bank. A lot of research has been done on CAR especially after the 2008 financial crisis. For instance, Keynes and Achmad (2015) carried out a research on the determinants of CAR on Indonesian banks. They concluded that among other factors, NPL has a positive effect on CAR.

b) CRR (Credit Risk Ratio).

CRR is measured by the non-performing loans of the bank. NPL are loans whose principal portion and interest have not been paid by the debtor for up to six months consecutively. Writing off loans require additional capital because an increase in NPL decreases the CAR of banks and hence additional resources will be required to maintain the capital requirements of 8% and above. According to a research by Heydari and Abdoli (2015), a direct relationship exists between CRR and CAR. The higher the amount of NPL, the higher the amount of capital set aside to absorb the losses.

3.5.1.2 LIQR (Liquidity Risk Ratio)

It is measured by the ratio of cash and cash equivalents (money market instruments) to the total liabilities of the bank. It measures the ability of the bank to settle its financial liabilities as they fall due. A higher LIQR indicates a higher ability of the bank to settle its short term financial needs as the fall due. The weakness of higher LIQR is that the bank losses the investment income the cash would have been making if it was invested. According to a study by Harley (2011) on CAR in Nigeria, LIQR is positively related to CAR.

3.5.2 Descriptive Statistics

In descriptive analysis, the mean, median, maximum and minimum and variance of the variables under consideration are being analyzed. Also, since we are investigating the determinants of capital adequacy ratio before and after crises, we are going to also do a further analysis of the descriptive study before and after crises focusing on the percentage changes as an indication of the effect of crises on such variables.

Table 3. Descriptive statistics from 2004-2011

Variables	Observations	Mean	Median	Maximum	Minimum	Std. Dev.
CAR	240	0.13	0.13	0.33	0.00	0.01
CRR	240	0.08	0.04	0.12	0	0.09
LIQR	240	0.03	0.03	0.32	0.01	0.03

As seen from Table 3 above, the mean of capital adequacy ratio is 0.130773 which means that about 13% of risk weighted assets value is usually set aside as capital to guard against losses in the banks. This is in line with the above 8% capital adequacy requirement stipulated by Basel. Equally, the mean of liquidity risk ratio (LIQR) is 0.029. This implies that banks keep on average 13% of the value of its total liabilities in cash. This cash has the role of settling liabilities as they fall due. The mean value of credit risk ratio from 2004 to 2011 is 8.5%. This is very high compared to the BCBS requirements of acceptable 2% to 3% credit risk ratio in any financial institution.

The main conclusion from this descriptive statistics is that the banks claim to have maintained a capital adequacy ratio of 13% on average, much higher than what the Basel required. Credit risk was seen to increase beyond the recommended standards. Table 4 gives a presentation of mean values before and after financial crises. It also presents percentage changes in the variables before and after the crises.

Table 4. Descriptive statistics before and after the crises

Variables	**Observations**	**Mean (2004-2007)**	**Mean (2008-2011)**	**Percentage change**
CAR	120	0.13	0.15	15%
CRR	120	0.08	0.09	13%
LIQR	120	0.032	0.026	-19

As seen from the table above, the capital adequacy ratio (CAR) of US banks rose from 0.13 before the crises to 0.15 after the crises, seeing a 15% rise in CAR. This increase in CAR can be explained by the fact that banks in the US after the financial crises were compelled to hold enough capital in order to avoid another crisis. The credit risk ratio increased from 8% to 9%. This increase can be explained by the fact that the ratio of bad loans to total assets was highest just after the crises because banks were still struggling with bad loans recovery. The liquidity of banks (LIQR) measured by the amount of cash to total liabilities also dropped significantly by 19%. This appears to be contrary to the expected situation because after the crises banks were less willing to lend money and the government also injected a lot of liquidity into the economy.

3.6 Methodology

Our econometric model will be analyzed by carrying out a regression analysis on the data collected on Eviews package. Below is a set of preliminary tests that will be carried out to validate the data and choice of the model before the final regression analyses is carried out.

3.6.1 Unit Root Test

The unit root test aims to check whether the variables are stationary or not. According to Gujarati (2008), a variable is said to be stationary when the mean, median and covariance do not change with time. The Levin, Lin and Chu (LLC) test for stationarity will use the following hypotheses;

In the null hypothesis, (Ho) we would assume the panel data has a unit root problem (absence of stationarity) and in the Alternate hypothesis (H1) we would assume the panel data has no unit root problem (existence of stationarity)

In order to reject Ho at 5% significance level, the probability value for the test for each variable should not be more than 5%. If Ho is not rejected then there is the existence of unit root and should be solved taking the first difference of all the variables and repeating the test until Ho is rejected and the model fit for OLS regression.

3.6.2 Correlation Analysis

Correlation seeks to expose the degree of association among the independent variables of the model. This is also known as the multicollinearity problem. The existence of multicollinearity problem makes it impossible for the individual impact of each independent variable on the dependent variable to be estimated. The

regression coefficients in this case will be misleading. According to Gujarati (2008), a degree of association of more than 80% among the explanatory variables requires modification to render the data fit to explain the dependent variables. The dependent variable data will have to be lagged by one or two in order to increase the number of observation and eliminate this problem

3.6.3 Hausman Test

The Hausman test is used to make a choice between the fixed effect model and the random effect model depending on which one is more appropriate (Baltagi, 2005). The fixed effect model assumes that the constant term and the error term of banks are not correlated with each other. The Hausman test is based on the following hypothesis: the null hypothesis, Ho, assumes that the random effect model is better while the alternate hypothesis, HI, assumes that the fixed effect model is better. If this is the case, it will imply that the constant term and the error terms of the model are not related with each other. The null hypothesis would be rejected if the probability value is less than 5%

3.6.4 Durbin Watson (DW) Test for Autocorrelation

DW test as suggested by Gujarati (2008) is one of the prerequisite tests to be performed on data before the regression analysis is carried out. It is used to detect any serial correlation among the residual terms of the model. For a given set of observations, the residual terms are expected to be randomly distributed. DW test is one of the tests used to detect serial correlation. DW takes values between 0 and 4. The critical value of DW test is 2. If DW is less than 2 then there is the existence of positive autocorrelation. If DW is above 2 then we would expect a negative autocorrelation among the independent variables. If DW is close to 2 from above or

below then would conclude the absence of autocorrelation and the model is fit for regression analysis.

If there is the existence of autocorrelation either positive or negative, it will be fixed by using lagged dependent variables (Keele and Kelly, 2006). Having ensured that the model is stationary, that there is no multicollinearity among the independent variables and that the model best fits the data available and fixing any autocorrelation problem, the model is now ready for OLS panel regression analysis.

Chapter 4

EMPIRICAL ANALYSIS AND RESULTS

The main objective of this chapter is the regression analysis of our model. Before regression analysis, preliminary tests will be performed on the model to ascertain its validity by making sure the OLS regression assumptions are not violated. The following tests will be carried out before the regression analysis: Unit root test for stationarity of the model, correlation analysis among the explanatory variables, the Hausman test for the choice of the model and finally DW test for correlation among the residual terms in the model.

4.1 Unit Root Test

According to the test methodology presented in the previous chapter, the results of Levin, Lin, and Chu (LLC) at level stationary test suggest that all the variables of our model have no unit root hence stationary at 5% significance level. We cannot reject the null hypothesis at this stage. The implication of this is that our mean variance and covariance will change with time. This unit root problem has been solved by running the test again after taking the first difference of the variables. The result of LLC at first difference shows that we can reject the null hypothesis at 5% confidence level. The results of this test are shown in the appendices section.

4.2 Correlation Results

The aim of this analysis is to detect the existence of multicollinearity among the independent variables of the model. The correlation matrix of this model is shown in Table 5 below:

Table 5. Correlation matrix

	CAR	CRR	LIQR
CAR	1.00		
CRR	0.09	1.00	
LIQR	0.28	-0.17	1.00

From the correlation matrix above, reading from the correlation coefficients of the explanatory variables, we can see that both CRR and LIQR have almost no correlation among themselves. This makes the explanatory power of the model very strong. As suggested by Gujarati (2008), correlation among explanatory variables is always possible and neglected when it is less than 80%. It can thus be concluded that there is the absence of multicollinearity among the independent variables.

4.3 Hausman Test

Following the steps mentioned in the previous chapter and at 5% significance level, the Hausman test is carried out. According to the results as shown in the appendices section, the fixed effect model is more appropriate given that its p-value is significantly less than 5% (0.000<.05). The null hypothesis cannot be rejected. This means that the constant terms and the error terms of the model are not different. All the banks under study will have a common mean value for the constant term.

4.4 Autocorrelation Test

For the regression model to be useful there should be no autocorrelation between the residual terms in the model. The results of the DW test are 1.18. As suggested by Gujarati (2008) DW takes values from 0 to 4. If the results fall between 0 and 2, we would conclude the existence of positive autocorrelation. If the results fall 2 and 4, then there would be the existence of negative autocorrelation. When the results get

close to 2 from above or from below, we can conclude the absence of autocorrelation. Following the DW results of this analysis one can conclude that there is a positive autocorrelation problem.

This autocorrelation problem has been solved by introducing a lagged dependent variable into the model. The second results give a DW value of 2.2. Since this value is very close to 2, we can conclude that the autocorrelation problem has been solved.

4.5 Regression Analysis

After having carried out preliminary tests such as stationarity, multicollinearity and autocorrelation, our model is now fit for OLS regression analysis. The OLS panel regression analysis has generated the following results. The result of the regression analysis gives an R-squared of 78%. This implies that only 78% of variations in CAR, the dependent variable are explained by the independent variables (liquidity risk ratio and credit risk ratio). The remaining 22% is explained by variables not considered in our model. However, a superior measurement of the explanatory power of a model is the adjusted R-squared which adjusts for independent variables with no influence in the model. The value of the adjusted R-squared is 74%, less than R-squared. The explanatory power of this model would be would be based on adjusted R-squared of 74%. The explanatory power of this model is absolutely high.

In order to evaluate the overall significance of the model, the F-test is applied. It compares the model with an intercept -only model. The null hypothesis of the F-test suggests that the two models are equal while the alternate hypothesis suggests that the model at hand is better than the intercept –only model. At a significance level of 5%, the results of the analysis gives a probability value for F-test of 0.0000<.05, suggesting that our model at hand is better than the intercept-only model.

The OLS panel regression results as shown below reveal that at 5% significance level, both credit risk ratio (CRR) and liquidity risk ratio (LIQR) are statistically significant.

Table 6. Regression results for the determinants of CAR

Variables	Coefficients	Probability values
Capital Adequacy		
CRR	1.72	0.0000
LIQR	0.48	0.0000
R-square	0.58	
Adjusted R-square	0.52	
F-Statistic	9.32	0.0000

As shown on the table above, the independent variable LIQR has a significant positively related to CAR (capital adequacy ratio) with a value of 0.483725. This means that a one unit rise in the ratio of liquid assets to total liabilities will increase the ratio of capital to risk weighted assets by 0.484 units. The more the amount of liquid assets the bank has the better is its capital adequacy. More cash is available for unforeseen operational risk losses generated by the bank. This regression analysis is in line with previous studies such as Mekonnen (2015) and Williams (2011).

Also, the results reveal that the second explanatory variable of the Model, CRR (credit risk ratio) has a significant positive relationship with CAR with a coefficient of 1.7150. This means that as the quantity of doubtful loans is increasing, banks should be compelled to increase the amount of capital buffers to absorb the losses. This result is in line with previous studies such as Shingjergji and Hyseni (2015) and

Al-Tamimi and Obeidat (2013) who attempted to identify the determinants of CAR in their respective researches using NPL as a proxy for credit risk.

In sum, the regression model with an adjusted R-squared of 51.9% is shown to be good in explaining the changes in CAR as a result of changes in credit risk and liquidity risk of the banking system. Based on the 2008 financial crises, capital losses can be limited by constantly checking on the credit risk bank take on daily bases and the liquidity they hold to settle their obligations as they fall due.

In order to see if the CAR ratio of US banks changed after the 2008 financial crises, a t-test assuming unequal and unknown variances has been carried out. The test divides the CAR data into pre crises period, from 2004 to 2007 and post crises period from 2008 to 2011 and the t-test is carried out. The null hypothesis of the test is that the mean value of CAR remained the same before and after the crises while the alternative hypothesis states that the mean value of CAR changed after the crises. At a significance level of 5 percent the following results have been found.

Table 7. T-test for two samples with unequal means

	CAR pre crises	**CAR post crises**
Mean	0.13	0.16
Variance	0.002	0.002
Observations	111	115
Hypothesized mean differences	0	
Df	223	
t-stat	-4.70	
P(T<=t) one-tail	$2.27427*10^{-6}$	
T critical one-tail	1.65	
P(T<=t) two-tail	$4.5*10^{-6}$	
t critical two-tail	1.970658961	

As can be seen from the above table, for one- tail and two-tailed test performed at 5% significance level, the probability values are much less than the 5%. This means that the mean values of capital adequacy ratio of US banks changed significantly after the crises. This is in line with the Basel requirements after the financial crises. As asserted by Cohen (2013) in BIS quarterly journals, banks were compelled by stronger regulatory requirements to increase their capital base. The main source of the capital was retained earnings that were used to add to the existing capital of the banks. After the economic crises banks were obliged to increase their capital base either by increasing their capital base, reducing balance sheet risk by selling most of the loans they were keeping. The graph below shows the picture of banks' assets from 2004 up to 2011. The movement in total loans of the banks can be read off from the graph below.

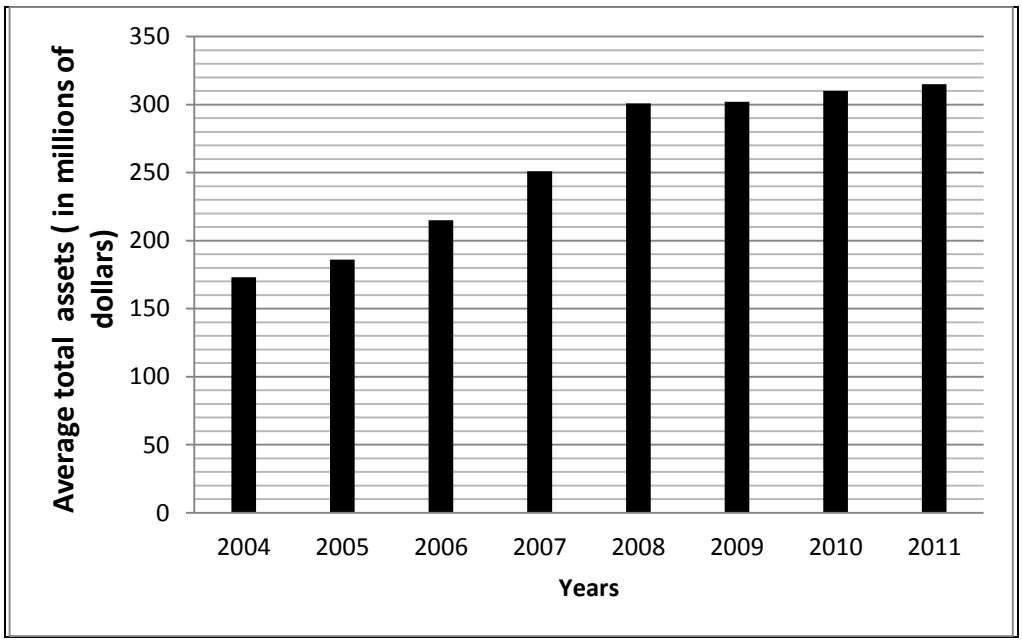

Figure 2. Average Values of Total Assets of Banks from 2004 to 2011

The graph above shows the mean values of total assets of the banks under study. It should be noted that 90% of banks assets is made up of loans. From 2004 up to 2008

a sharp increase in banks' assets is noticed. During this pre crises period banks were engaged into a lot of subprime mortgage lending. This risky lending by banks was the source of the credit crises of 2008 (Cohen, 2013). Banks issued a lot of loans to customers which later turned into bad loans given that they defaulted on principal and interest payments.

Immediately after the crises the rate of growth of bank loans in US noticed a dramatic drop given the default rate that was seen among customers. A lot of care was taken in issuing loans to the public. In quantitative terms, loans grew by 8%from 2004 to 2005, 15% from 2005 to 2006, 16% from 2006 to 2007 and 19% from 2007 to 2008. This increase in loans in the banking sector in the United States seems to be at the origin of the crises given that a lot of non-performing loans were given out without caring about customers' credit records and their ability to promptly fulfill their loan obligations. After the crises total assets saw a sharp decline from a growth rate of 19% in 2008 to 2009, to an annual growth rate of less than 3% from 2009 to 2011 as shown in the graph below.

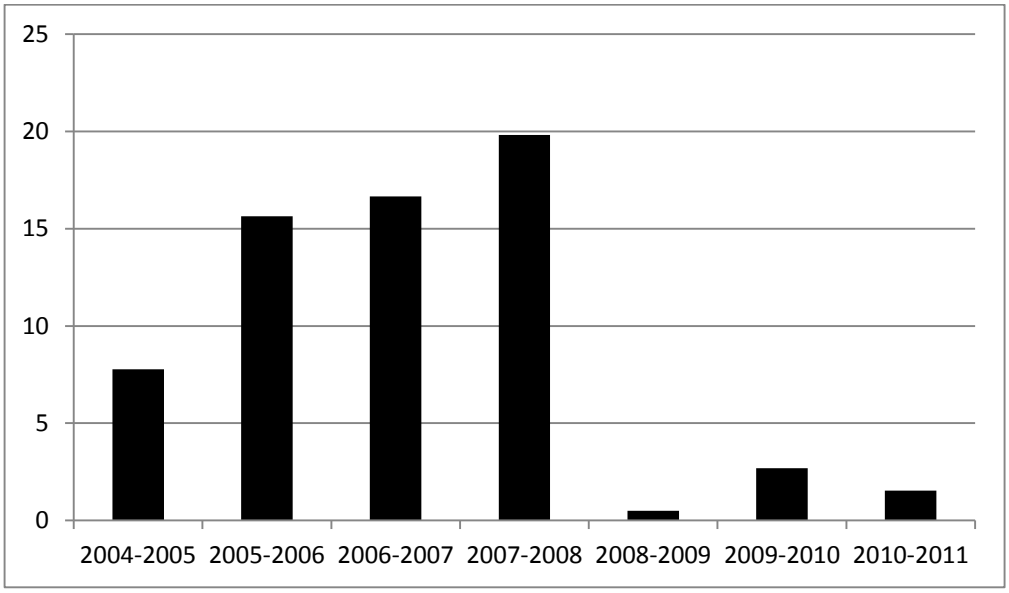

Figure 3. Annual Growth Rates of Assets from the Interval 2004-2005 to 2010-2011

As banks became conscious of the dangers of careless lending, the amounts of loans issued on annual bases after the crises was much smaller than that issued before the crises. The riskiness of banks is seen to drop with a decrease in the amount of loans being issued as indicated by the results of our econometric model.

Chapter 5

CONCLUSION AND SUGGESTION

This study focuses on the determinants of CAR before and after the 2008 financial crises on the U.S banking sector. The expectations of this study was to find out whether the high insolvency in the banking sector, made banks more cautious by keeping higher amounts of capital buffers. A sample of 30 largest U.S banks was examined between the years 2004 and 2011. This study used the panel data methodology and considered fixed effect model for the OLS regression analysis.

Findings show that the CAR of US banks rose from 13% before the crises to 15% after the crises, seeing a 2% rise in CAR. This implies that US banks became more conscious of their capital requirements and were also compelled to keep adequate capital corresponding to their level of risk. The credit risk ratio between 2008 and 2011 rose from 7% to 9% due to the increase in the non-performing loans during that period. The results also showed that the liquidity of banks dropped significantly by 18% despite the fact that the Federal government injected billions of dollars to the banking sector.

The econometric analysis of this research also indicated that the credit risk and liquidity risk affected the CAR of banks positively at 5% significance level.

For further research more independent variables can be added to the econometric model used in this study. Since this study concentrates on the pre and post crises periods, further study could focus on CAR at the peak of the financial crises. This study also concentrates on the CAR of banks only. Further analysis could consider the CAR of nonbank financial institutions. Further studies can also try to investigate the CAR of other countries before and after the crises.

REFERENCES

Ahmad, R., Ariff, M., & Skully, M. J., (2009). The determinants of bank capital ratios in a developing economy. *Asia-Pacific Finance Markets*, *3*(4), 255-272.

Ali, S. & Marsida, H. (2015). The determinants of capital adequacy ratio in the Albanian banking system during 2007-2014. *International Journal of Economics, Commerce and Management, 3*(1), 2348-0386.

Al-Sabbagh, N. (2000). Determinants of capital adequacy ratios in Jordanian banks. Master thesis, Yarmouk University, Irbid, Jordan.

Baltagi, B. H. (2005). *Econometric Analysis Of Panel Data* (2nd ed.), New York.

Basel Committee (2008). Principles for Sound Liquidity Management and Supervision. BIS, Basel.

Bateni, L., Vakilifard, H., & Asghari, F. (2014). The influential factors on capital adequacy ratio in Iranian banks. *International Journal of Economics and Finance*, 6(11), 108-116.

BCBS (2011). Basel III. A global regulatory framework for more resilient banks and banking systems. Bank for International Settlements.

Büyüksalvarci, A., & Abdioglu, H. (2011). Determinants of capital adequacy ratio in Turkish Banks: A panel data analysis. *African Journal of Business Management*, 5(27), 11199-11209.

Cohen, B. H. (2013, September). How have banks adjusted to higher capital requirements? *BIS Quarterly Review,* 25-41.

Gujarati, D. (2008). *Basic Econometrics* 4thEdition. McGraw-Hill/Irvin.

Innocent, E. C., Mary, O. I., & Matthew, O. M. (2013). Financial ratio analysis as a determinant of profitability in Nigerian pharmaceutical industry. *International Journal of Business and Management 8*(8), 107-117

Keele, L. & Kelly, N. J. (2006). Dynamic models for dynamic theories: The ins and outs of lagged dependent variables. *Political Analysis*, 14*(2)*, 186-205.

Keynes, I. & Achmad, A., (2015). A study of capital adequacy ratio and its determinants in Indonesian Banks: Panel Data analysis. *31st The IIER International Conference*, Bangkok, Thailand.

Lang, W. W., Mester, L. J., & Vermilyea, T. A. (2008). Competitive effects of Basel II on US bank credit card lending. *Journal of Financial Intermediation*, *17*(4), 478-508.

Leila, B., Hamidreza, V., & Farshid A. (2014). The influential factors on capital adequacy ratios in Iranian banks. *International Journal of Economics and Finance*6(11), 108-116.

Mekonnen, Y. (2015). Determinants of capital adequacy ratios of Ethiopia commercial banks. *European Scientific Journal*,11*(25).* Retrieved from http://search.proquest.com/docview/1749736312?accountid=15792

Rime, B. (2001). Capital requirements and bank behavior: Empirical evidence for Switzerland. *Journal of Banking & Finance*, 25*(4)*, 789-805.

Saunders, A., Cornett, M. M., & McGraw, P.A. (2006). *Financial Institutions Management; A Risk Management Approach* (Vol. 8). McGraw-Hill/Irvin.

Shingjergji, A., & Hyseni, M. (2015). The determinants of the capital adequacy ratio in the Albanian banking system during 2007-2014. *International Journal of Economics, Commerce and Management,* 3*(1),* 1-10.

Williams, H. T. (2011). Determinants of capital adequacy in the Banking Sub-Sector of the Nigeria Economy: Efficacy of Camels. (A Model Specification with Co-Integration Analysis). *International Journal of Academic Research in Business and Social Sciences,* 1*(3),* 233-248.

Yuanjuan, L., & Shishun, X. (2012). Effectiveness of China's Commercial Banks' Capital Adequacy Ratio Regulation: A Case Study of the Listed Banks.

Interdisciplinary Journal of Contemporary Research in Business, 4*(1)*, 58-68.

APPENDICES

Appendix A: The Results of Stationarity Test

Panel unit root test: Summary
Series: D(CRR)
Date: 07/28/16 Time: 11:29
Sample: 2004 2011
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-9.67962	0.0000	28	160
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.14007	0.0008	26	154
ADF - Fisher Chi-square	90.9765	0.0022	28	160
PP - Fisher Chi-square	115.951	0.0000	28	160

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality

Panel unit root test: Summary
Series: D(CAR)
Date: 07/28/16 Time: 11:31
Sample: 2004 2011
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-12.7014	0.0000	29	166
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.93112	0.0000	27	160
ADF - Fisher Chi-square	111.304	0.0000	29	166
PP - Fisher Chi-square	158.785	0.0000	29	166

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptoticnormality

Panel unit root test: Summary
Series: D(LIQR)
Date: 07/28/16 Time: 11:27
Sample: 2004 2011
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-Sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-14.5125	0.0000	30	180
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.96032	0.0000	30	180
ADF - Fisher Chi-square	139.988	0.0000	30	180
PP - Fisher Chi-square	193.373	0.0000	30	180

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality

Appendix B: Hausman Test and Regression Results

Correlated Random Effects - Hausman Test

Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	4.198949	2	0.1225

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
CRR	1.715024	1.569858	0.005208	0.0443
LIQR	0.483725	0.505998	0.000910	0.4603

Cross-section random effects test equation:
Dependent Variable: CAR
Method: Panel Least Squares
Date: 10/23/16 Time: 06:09
Sample: 2004 2011
Periods included: 8
Cross-sections included: 30
Total panel (balanced) observations: 240

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.113213	0.005099	22.20383	0.0000
CRR	1.715024	0.333355	5.144732	0.0000
LIQR	0.483725	0.110120	4.392690	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.581503	Mean dependent var	0.141949
Adjusted R-squared	0.519131	S.D. dependent var	0.055128
S.E. of regression	0.038229	Akaike info criterion	-3.566901
Sum squared resid	0.303976	Schwarz criterion	-3.102816
Log likelihood	460.0282	Hannan-Quinn criter.	-3.379909
F-statistic	9.323134	Durbin-Watson stat	1.187814
Prob(F-statistic)	0.000000		

Appendix C: Adjusted DW Test for Autocorrelation Result

Dependent Variable: CAR
Method: Panel Least Squares
Date: 10/23/16 Time: 06:43
Sample (adjusted): 2005 2011
Periods included: 7
Cross-sections included: 30
Total panel (balanced) observations: 210

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.036259	0.006680	5.427880	0.0000
CAR(-1)	0.722687	0.043830	16.48856	0.0000
CRR	0.442868	0.255934	1.730398	0.0851
LIQR	0.158078	0.079261	1.994394	0.0474

R-squared	0.611724	Mean dependent var	0.144153
Adjusted R-squared	0.606069	S.D. dependent var	0.053054
S.E. of regression	0.033299	Akaike info criterion	-3.947737
Sum squared resid	0.228413	Schwarz criterion	-3.883983
Log likelihood	418.5124	Hannan-Quinn criter.	-3.921964
F-statistic	108.1834	Durbin-Watson stat	2.247916
Prob(F-statistic)	0.000000		