AN EMPIRICAL STUDY OF STRESS TESTING FOR

CREDIT RISK IN BANKING SECTOR OF PAKISTAN

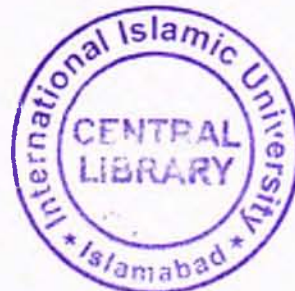Researcher

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MUE

1- Credit; Management

2- Collection of accounts

AN EMPIRICAL STUDY OF STRESS TESTING FOR

CREDIT RISK IN BANKING SECTOR OF PAKISTAN

Muhammad Nisar

Reg No. 37-FMS/MSFIN/S08

A thesis submitted in partial fulfillment of the requirements for the Degree of Master of Philosophy/Science in Management with specialization in Finance at the Faculty of Management Sciences

International Islamic University Islamabad.

Supervisor
Dr. Syed Zulfiqar Ali Shah
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Islamabad

(Dec, 2012)

FORWARDING SHEET

The thesis entitled "An Empirical Study of Stress Testing for Credit Risk in Banking Sector of Pakistan" submitted by <u>Mr. Muhammad Nisar</u> in partial fulfillment of M.Phil degree in Management with specialization in Finance has been completed under my guidance and supervision. I am satisfied with the quality of student's research work and allow him to submit this thesis for further process as per IIU rules & regulations.

Date:_____   Supervisor Signature:_____

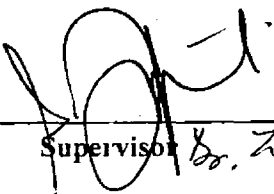Name : _____

(Acceptance by the Viva Voice Committee)

Title of Thesis: An Empirical Study of Stress Testing for Credit Risk in Banking Sector of Pakistan

Name of Student: Muhammad Nisar

Registration No: 37-FMS/MSFIN/S08

Accepted by the Faculty of Management Sciences International Islamic University Islamabad, in partial fulfillment of the requirements for the MS/ Master of Philosophy Degree in Management with specialization in Finance.

Viva Voce Committee

Supervisor *Dr. Zulfiqar Ali Shah*

External Examiner *Dr. Eatzaz Ahmed*

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Dean *Dr. M. Bashir Khan*

Member

Date: 21- 12 · 2012

IV

DEDICATION

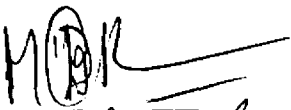**My Mother:**   Thank you for your unconditional support with my studies. I am honored to have you as my mother. Thank you for giving me a chance to prove and improve myself through all my walks of life. Please don't ever change. I love you.

My Father: Hoping that with this research I have proven to you that there is no mountain higher as long as Allah is on our side. This thesis will fulfill your dreams.

My Family: Thank you Muhammad Altaf, Muhammad Ikram, Muhammad Imran, Younas Elahi, Naveed Ur Rehman and Abid Ur Rehman for believing in me and allowing for further studies. You have been a great source of inspiration and motivation for me.

Abstract

The primary objective of the current research is to assess Financial Stability of the banking sector of Pakistan by creating scenarios and applying shocks to different variables like, Increase in Non-Performing Loans, Shift in Non-Performing Loans Categories and Decrease in the Forced Sale Value of Mortgage Collateral, called Stress Testing for credit risk. For this purpose data was collected from State Bank of Pakistan website and its officials, Bank's annual reports and Banks balance sheets from 2009 to 2011. After analyses, all banks ranked in order from strong to weak. Samba bank is the strongest bank among the Public Private Commercial Banks due to highest CAR. Its CAR 32.2%, which is above the minimum requirement of State Bank guidelines even after applying stress test. Standard Chartered Bank with a CAR 6.4%, Allied Bank limited CAR 5.6%, Summit Bank 3.1% and Habib Metropolitan Bank with a CAR 2.1% fall in average category after the Stress Test. All of the remaining banks in the analyses perform badly during the stress test and considered weak banks. Objective of the analysis is to help credit risk managers appreciate the importance of credit risk's stress test. A bank's credit risk management efforts are incomplete if they do not have a comprehensive stress testing program.

Keywords: Financial Stability, Stress Testing, Credit Risk, Capital Adequacy Ratio, State Bank of Pakistan, Non-Performing Loans and Risk Management.

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VII

DECLARATION

I here by declare that this thesis, neither as a whole nor as a part thereof has been copied out from any source. It is further declared that I have prepared this thesis entirely on the basis of my personal efforts made under the sincere guidenance of my supervisor.

No portion of the work presented in this thesis has submitted in support of any application for any degree or qualification of this or any other university or institute of learning.

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Chapter 1

1. Introduction

Turning towards a more forward looking approach, early warning systems plays a vital role in measuring the significance of various variables in financial stability, and in predicting financial instabilities, which is within the financial institutions and also different classes of financial institutions and within different markets. Stress tests performed as the first step in early warning systems, since stress test shows the overall picture of flexibility of the economy under severe financial distress (Quagliariello, 2009).

Analysis of financial stability focuses on informing concerned authorities with full understanding of the nature and functions of financial systems, which is evaluated with an analytical tool resulting in predicting upcoming uncertainties, vulnerability and weakness and measures the unfavorable condition of financial system (Kunt et al., 2005). Vigorous financial systems are necessary to keep monetary policy strengthen to keep the economy rigid and fulfill its objectives.

It is necessary for policy makers to develop strong models to tackle the effects of a potential shock. Therefore, for the development of early warning systems adequate policies are necessary to assess financial stability on timely basis. The framework should identify the recoils on the financial soundness and better responses. Such type of assessment is based on a combination of quantitative methods, statistical data and human judgment takes into account the functions of financial system plays and its key components (Quagliariello, 2009). The final goal

1

is to establish or develop appropriate preventive measures or rapid policy responses to crises arise. Important component in the toolbox is to enhance the financial stability of various countries. Indeed, Globalization and financial integration systems often require systematic evaluation of responses and several national authorities. As pointed by Akhtar (2008) that State Bank of Pakistan conducts analyses of financial stability for the last 5 years, however, the financial stability of the economy starting in 2004, SBP conducted a financial sector assessment program with annual, quarterly and annual reports of the bank. Integration of these reports, and in 2007, launched its first global financial stability report (SBP FSR), which offer a wealth of evaluating risks and vulnerabilities in the financial sector and macroeconomic challenges. Structures and arrangements that enable information exchange networks are strengthened and well-functioning national supervisory authorities and central banks in normal times and improve dialogue which contributed to the development of financial system stability assessment (Kunt et al., 2005). In this sense, the implementation of stress tests in order to compare the different approaches and share a common understanding of the imperfections in the reproduction of the financial system can be considered.

Reserve Bank encourages banks to develop an integrated approach to risk management, as well as the crisis simulation exercises, both in the context of liquidity and credit risk (Reserve Bank of India 2007-08). In different markets and intermediaries increases the likelihood that shocks can be transmitted to the financial system, thereby aggravating the crisis. Because this propagation mechanism, which idiosyncratic shock, for example, one or a few banks can lead to a systemic crisis, where many institutions or markets are in turn influenced by their relationships with banks. Banks in India use statistical models to measure and manage risks. The stress tests are appropriate for banks (Khan, 2010). Although the use of statistical models and stress tests are

2

an integral part of the framework, and risk management for banks (Hallikas et al., 2004). A well designed system will be completed and the stress testing of risk management systems in banks and helps to make the system more robust. Stress testing framework to help banks better equipped to stressful situations, and when they occur, and to overcome them so that they can not be a serious threat to the banking system in which they operate. In the study of Jones et al., (2004) stress testing is a large-scale exercise. There is no scientific formula that predicts the stability of the financial system; it is an art, which is accompanied by quantitative and qualitative methods in a single set of human judgment and prudential rules and Assumptions. In the same way (Wong and Lam, 2008) conformed that There is no standard methodology to perform stress tests of banks credit portfolio stress testing and standards to assess self-reported results of some banks and the banks are trying to build models of the macro stress tests in econometrics. These models can not be consistent, because insufficient data available to draw conclusions, unsustainable patterns of association, non-linear behavior of credit losses in stressful conditions and relevance of historical data for calibrating the model parameters. As pointed out by Cihak (2005) in the stress tests, lack of data constitutes obstacles to the construction of models. This is also the case with the Austrian banking data. However, the changes have already begun the process of data collection and monitoring of Basel-II, and, in the future there will be a large amount of data available to assess the stability of the financial system.

Following the recent crisis, unresolved, extreme stress testing of credit risk and the credit was on top of the agenda for subprime collateral. The Walker Report (2009) suggests that "the risk committee of the board should be aware of the potential added value from seeking external input to its work."

1.1 Problem Statement

Despite the importance of credit risk for Banks and Financial Institutions, sufficient research is available which can help banks managers to assess their credit risk. Although some efforts are made to manage credit risk while making lending decisions. But still there is a need of comprehensive credit risk stress testing program to identify the ability of a firm / individual to pay back their loans. This study will help both the financial risk managers and investors to follow a roadmap with which they may design and implement a credit risk stress testing program.

1.2 Objectives of the Study

The main objectives of this study are:

1: To help credit risk managers appreciate the importance of credit stress-tests.

2: To provide credit risk managers a roadmap with which they may design and implement a credit stress testing program.

3: To show that banks' credit risk management efforts are incomplete if they do not include a comprehensive stress-testing program.

4: To help institutions and investors in assessing credit risk of weak and strong financial institutions.

5: To know the level of financial stability of the banking sector of a country.

6: To measure the resilience of a banking system towards the shock events.

1.3 Significance and Implications

After 2008, the use of stress tests to gauge the risk appetite has been gaining importance. These encouraging trends also extend to credit risk stress testing in particular. My research on Stress testing for credit risk is innovative because the study is first attempt to investigate specifically the impact of credit risk on financial stability of the banking sector, instead of scenario analysis for macroeconomic variables. I believe this research will be a value addition to understand the core issue of credit risk, which is a burning issue in the current situation of financial crises. The study will be helpful to financial regulators, government agencies and State Bank of Pakistan to identify the ability of banks to tackle with unaffordable financial circumstances.

Chapter 2

2. Literature Review

Many approaches have been applied previously to test stress testing in banks to measure credit risk. Hoggarth et al., (2005) concluded that the Financial Sector Assessment Program's (FSAP) are most common approaches used by International Monetary Fund which are single factor sensitivity tests. The above said approaches measure change in one variable, for example Credit risk, exchange rate risk, liquidity risk and Interest rate risk. Different banks and supervisory agencies developed a number of macro stress testing frameworks.

Generally, stress testing refers to the investigation of the performance of an entity under abnormal operating conditions (Misina et al., 2006). The main purpose of such study is to determine potential vulnerabilities. It includes testing beyond normal operational capacity, usually to a breaking point, in order to scrutinize the results. Stress testing may be use in a different meaning in certain industries like banking. For any institution financial stability is important and it uses a lot of efforts to gain financial stability, For this financial stability stress testing plays an important role because it find the maximum loss incurred, as it measures the performance under abnormal conditions.

2.1 Stress Testing

To check response of portfolio of assets and liabilities under different financial conditions stress testing is used. Stress tests are used to check the impact of different stressors on a firm or industry. Usually the technique is used through simulation in which hypothetical scenarios are

entered as an input to the computer. *"Stress testing" is a broad term relating a variety of techniques applied by financial institutions to measure their potential vulnerability to extraordinary but probable events* (Bank for International Settlements, 2000). As explained by Kalfaoglou (2007), *"Stress testing is a general name used to illustrate a range of techniques and procedures used by financial institutions to calculate their potential vulnerability to extraordinary but probable event."*

In different studies Hilbers et al., 2005) & (Kida ,2008) stress testing is termed as a tool to measure potential vulnerabilities in a system .Cihak (2007) supplement that Stress testing is a beneficial and prominent phenomenon, Although it is sometimes misunderstood but it is a way of investigating the flexibility of financial systems to unfavorable events. For measuring stress testing no standard method is used, nether there is any standard scenario. Rather it is totally based on the personal experience and judgment of risk manager (Linsmeier & Pearson, 2000).

According to Misina et al., (2006) Stress testing in a broader meaning is the examination of the performance of an entity under anomalous circumstances. According to Federal Reserve Bank of San Francisco (2005) a practice named as "stress testing" is developed by risk managers which play an important role in the monitoring of financial institutions. This practice is not limited to USA as it is also adopted by Indian Banks in the monitoring and managing of risks. Stress testing is considered essential for designing of risk managing framework (Reserve Bank of India, 2007). That is the reason that numerous institutions have started to use stress testing techniques to measure the capital adequacy of isolated firms as well as integrated financial systems.

Moretti (2008) established that stress testing is in use of IMF for almost a decade to spot vulnerabilities across institutions that could influence the stability of a country's financial system. Generally the vulnerability is calculated with reference to the bank's profitability or capital adequacy. As Barone & Bragho (1996) articulated that "two major goals of stress testing are to evaluate the ability of the bank's capital to absorb potential losses and identify important measures that the bank can take to reduce risk and preserve capital".

As per requirement of State Bank of Pakistan (SBP) the paid-up capital of locally incorporated banks must be elevate to Rs. 10 billion by 31 December 2013 in a phased manner (Bank Al Habib AR, 2010). Pakistani Banks also perform stress testing of portfolios on hand, which consist of all assets including advances and investments. Usually semi-annual period is used to conduct this exercise. In this process shocks are assigned to all assets and the results are then observed on minimum capital adequacy requirement of SBP.

According to monthly report of Bank for International Settlements (2005) Stress testing mechanism work as a complement, not as an addition to already existing risk management tools, for example value-at-risk. That is the reason that it is gaining more popularity in the risk management framework of banks and other financial institutions. According to Oracle Financial Services (2009) stress testing take into account different risk measures across groups and is better than traditional risk models. It defines the risk which an organization can observe as well as accurately measures the risk. Stress testing is also helpful to senior management as it provides information regarding capital allocation. Stress testing can be used in different types of risk including market risk, credit risk, operational and liquidity risk.

Bunn et al., (2005) scrutinized that stress testing is not only used by indivisual banks but also by financial policy makers that are anxious mainly with systemic risk. Drehmann (2005) originated that systematic factors have a non linear relationship with credit risk and these effects are very important in those scenarios which are highly abnormal, which is of key interest for a risk manager.

Stress testing include to estimate the "ability to perform" of the portfolio of a financial institution under extreme market moves. Stress testing is a two step process. In the first step scenarios are developed and in the second step the portfolios are evaluated under these scenarios.

2.2 Macroeconomic Stress Tests:

The use of stress testing as a risk management tool is extensive all over the world for example in the use of stress testing is taking a rapid pace in Nepalese Banking system. Generally macro-level stress tests are carried out to gauge the vulnerability present in the financial system and to compute the flexibility of a banking system towards the outside shock. (Nepal Rastra Bank January, 2012).

2.2.1 Simple Sensitivity Test and Scenario Analysis

The techniques most frequently involved in determining the impact on the holding company or a unit of a move to a market-specific risk factors (sensitivity testing simple) or a simultaneous movement on a number of risk factors, made reflecting risk managers now believe that can happen in the foreseeable future (scenario analysis). To estimate the expected value of a portfolio after a period of time, on the assumption that specific changes in the values of the key factors in the portfolio, which will affect the value of securities, such as changes in rate types of

interest rates, exchange rates, inflation and economic conditions, etc., scenarios are developed on the basis of a significant market event experienced in the past (historical scenario) or think about the consequences event of a market that does not happen plausible (scenarios). Scenarios can be designed to include both the movements of a group of risk factors and changes in the underlying relationships between these variables (e.g. correlations and volatilities). According to State bank of Pakistan, stress testing can be based on the hypothetical scenario, a forward-looking approach or the historical scenarios, a backward looking approach. Research study of Cihak (2004b) states that the advantage of scenario analysis is that it can capture the impact of consistent sets of shocks. The sensitivity analysis has its advantages, as it can help to assess the robustness of the system in relation to individual impacts and how the impact of changes if assumptions change impact. Financial Sector Assessment Programs (FSAPs) have addressed a number of risks in various stress tests in the categories of credit risk, market risk (interest rate, volatility of exchange rates, equities, real estate and other asset price risk), liquidity risk and the risk of contagion.

2.2.2 Top Down and Bottom up Approach

Macroeconomic stress tests comprise of two types of analyses i.e.; Sensitivity analysis and Scenario analysis (Cihak 2004). The impact on portfolio of a firm or business unit is significant due to particular market risk factor like market risk, credit risk (interest rate, equity, exchange rate, volatility, real estate and other asset price risks), liquidity risk, and contagion risk. While scenario analyses are simultaneous moves in a number of risk factors, reflecting an event believed to occur in the foreseeable future the firm's risk managers. The question is which approach either top down or bottom up approach should be used? Bottom up is used on

institutional based or what we can say by each individual bank while top down is used by the supervisory institution like central bank of the country.

Approaches to macroeconomic stress tests
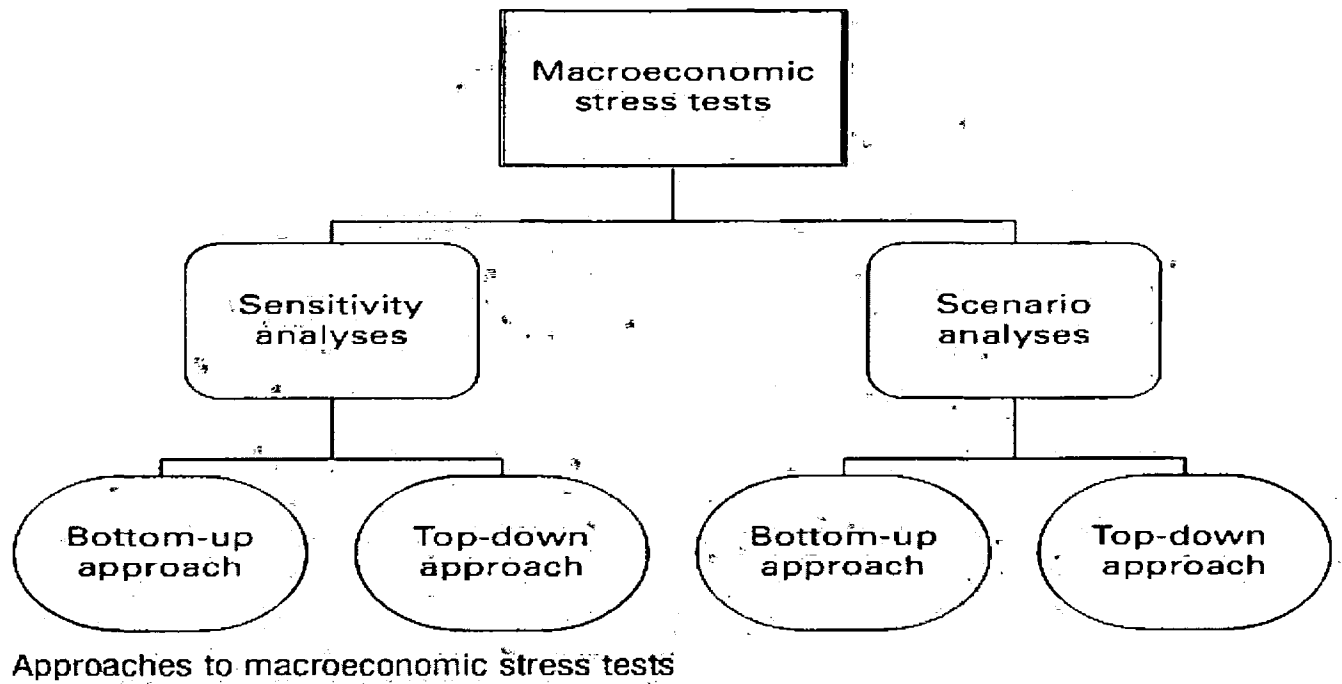
Figure: 2.2.2   Approaches to Macroeconomic Stress Tests

2.2.3 Piecewise Approach and Integrated Approach:

The study of Sorge (2004) distinguished two general approaches to stress test of the "piecewise approach" and "integrated approach". The piecewise approach typically involves estimating the impact of a macroeconomic shock in a measure of financial strength (as a loan loss), while the integrated approach attempts to model the impact of a macroeconomic shock on multiple risks (e.g. credit and market risk) and then determine the portfolio level, the impact on the probability distribution of losses. The main objective is to independently verify the accuracy of the financial conditions of individual bank. Particular attention will be paid to proper

11

classification of loans (as per segment of business and as performing, substandard and non-performing), identification of restructured and refinanced loans and the adequate level of provisioning for the Spanish banks' credit portfolios, according to Spanish regulations (Bank of Spain AR, 2012).

2.2.4 Extreme Value/ Maximum Shock Scenario

According to State Bank of Pakistan extreme maximum value / setting of impact measures the change in the risk factor in the worst case i.e. the unloading level that completely eliminates the capital outside. The probability of an extreme movement in the value of a portfolio is essential for risk management and regulatory purposes (Maghyereh & Haitham, 2006).

2.2.5 Aggregate Stress Tests

"Aggregate" and "macro" stress tests are key elements of these quantitative tools. Aggregate stress tests are synonymous with an analysis of the entire system. A set of test stress can be defined as a measure of exposure the risk of a group of financial institutions in a stress scenario specified (Virolainen, 2004). Stress test is a measure of the overall risk exposure of a group of companies to inform a specific stress scenario. Every company reports to provide information about their own exposure in the stress scenario.

2.3 Credit Risk

This study mainly focuses on banking sector's credit risk to analyze that how the default of customers negatively affects the efficiency of bank. A study conducted by Cihak (2005) stated that Credit risk is correlated with unexpected changes in credit quality and bearing a loss. Credit risk is usually the utmost significant source of risk, although significant innovations take place in

the banking sector. This is mainly occurred in the credits, but also in corporate bonds or even counter transactions, which involve counterparty default risk.

Cihak (2005) further investigated that Stress tests are useful because they provide a quantitative measure of technical vulnerability of risk factors to the financial system noted by the Federal Reserve Bank of San Francisco (2005). With respect to credit risk, stress testing is of two main types: stress testing of credit spreads, such as corporate bond spreads, in trading portfolios and the less frequent stress testing of loan portfolios. Stress testing credit spreads in trading portfolios is reasonably straightforward and more directly related to market risk analysis. For stress testing of loan portfolios, variables such as borrowers' credit ratings and collateral values are stressed, often using scenarios based on shocks to the macro-economy. Although based on a common source of risk, efforts to integrate stress testing of credit risk on trade and lending are hampered by several factors, such as lack of differences in the accounting treatment of transactions and credit facilities, some. Even more basic level, most of these companies do not have sufficient historical data analysis and system infrastructure for integrated credit risk profile. Credit risk arises from the failure of counterparties (borrowers, brokers, Underwriters, reinsurers and guarantors) that fulfill their obligations.

There are three main approaches to modeling credit risk through stress tests. First, there are mechanical approaches (mainly used when data are missing or are not sufficient, if the shocks are different from those of the past). Secondly, there are approaches which are based on the credit activity (for example, the probability of default, loss given default, non-performing loans and provisions) and Regressions (for example, a structural equation regression and automatic vector). Third, there are approaches which are based on the sector data (e.g., leverage

and interest coverage), and it is possible that the household sector data, despite the fact that such data are very difficult to collect data on business sector (Cihak, 2004).

Credit risk analysis for the financial sector, as a whole, can be considered as an important means of preventing financial instability. This can be realized by means of a regular robustness test on a country's banking sector against credit risk. Jakubik and Schmieder (2008) in their study confirm the findings of previous studies, which are of the view that stress events have more material effect in less developed economies. Credit Risk can be defined as the likelihood of loss because of unexpected defaults or a worsening of credit worthiness of a business (Allied Bank Limited Annual Report, 2010). The Bank has adopted a Standardized approach of Basel II for calculation of capital charge against credit risk in line with State Bank requirements.

The study Jakubik and Schmieder (2008) found that the number of variables explains the credit risk of companies in different countries, despite significant differences in the pattern of default rates. This does not apply to home loan portfolio and further studies seem to be in this area. But Cihak (2005) found that more data on the performance of loans is that they are available to leaders. Data is also available in all areas, including the household sector, for which it is difficult to obtain reliable results in the income statement or the main drawback of this approach is that the bad debts are lagging indicators of asset quality.

2.4 Credit Risk and Financial Stability

Four types of risks in the financial system are exposed to financial intermediaries: liquidity risk, market risk, credit risk and operational risk (Andreeva, 2004). One of the central questions about the stability of the financial statements is; how to measure and manage those risks, trends and risk review to assess how vulnerabilities in the financial system for them.

14

Political risk control is especially important to the majority of banks, financial intermediaries, such as banks failed to induce significant costs on the economy, society and government. It is widely recognized that the credit risk is one of the main factors leading to the failure of banks and financial vulnerability. The main functions of commercial banks loan more common and characteristic feature is that almost all the savings loans rose. In addition, other types of risks, strengthen credit risk to a certain extent, for example, due to fluctuations in interest rates and changes in the operational environment with the banking counterparties may be at risk of bias.

Banks may be worth the risk, because the risk factors for intentional and high tolerance for risk in a competitive environment, situations of moral hazard and adverse selection. Even banks that are applicable to a risk measurement techniques can underestimate the potential risks of low frequency and high intensives, that can produce a huge amount of damage, but hardly unexpected. As it is emphasized by Herring (1998), Banks often affects some form of financial vulnerability, disaster myopia when they underestimate the probability of default, if the failure does not occur for a long time. And even if the Bank uses models that indicate a higher risk, credit risk, Premium pricing, it may lose its competition with other banks, which do not take into account the risk and therefore choose to herd behavior. Increased competition in the credit markets force banks to small differences and at the same time relaxed lending standards will increase the pool of borrowers. Strong competition with disaster myopia and herding may therefore increase financial vulnerability of banks.

2.5 Macro-Prudential Analysis

Monitoring and evaluation of the strengths and weaknesses of the financial system is called macro-prudential analysis. Macro-prudential analysis clearly requires the use of a wide

15

variety of information capture early signals of systemic fragility in the financial system as a whole Evans et al., (2000) and the use of integrated macro and micro-economic development of stress testing and analysis of structural and institutional framework is becoming a useful tool for identifying the determinants of financial instability. Macro-prudential analysis is the tool that governments use to assess the financial stability. According to the IMF (2001), macro-prudential analysis "methodological tool to quantify and qualify the strength and vulnerability of financial systems." Therefore, based on the analysis of the ongoing process of information gathering, analysis and continuous monitoring of the technical developments that may threaten the health of the financial system, governments can use the quick collection information necessary to assess the resilience of the financial system to adverse shocks, and they are trying to do better, the idea that they have to treat early stage sources of vulnerability.

There are two approaches to macro-prudential stress tests for credit risk (Cihak, 2005). Firstly, the approaches based on loan performance data (i.e. on the classification of loans into different categories of performing and non-performing loans). Secondly, the approaches based on borrowers' data, which are normally balance sheet or income statement data about financial institutions barrowers'.

2.6 Approaches Based on Loan Performance Data

The first group of these approaches are based on asset reclassification i.e. those that model the transition of loans (and other assets), one or more of the classification categories down. The effects of the reclassification of assets, capital adequacy ratio are calculated after deducting the provision of capital and assets.

The second groups of approaches in this group are based on econometric model including NPLs and a number of macroeconomic factors, such as real interest rates, GDP growth and terms of trade changes. The advantage is that credit availability to supervisors. In addition, they are available in all areas, including the household sector, for which it is difficult to obtain reliable information on the balance sheet or income statement. The main disadvantage of this approach is that, NPLs are lagging indicators of asset quality.

2.7 Approaches Based on Data on Borrowers

There are a wide range of approaches to modeling credit risk using data on borrowers. Relatively complex approach to estimate a model to predict the probability of failure of individual companies based on the company's age, size, industry characteristics and business soundness indicators (leverage, earnings, liquidity and financial stability) and the borrower. The advantage is that they can provide more data material to the borrower's credit risk stress testing model allowing a clear relationship between the health of the banking sector and the real economy: Another advantage is that it can help the data show that the borrower has a loan portfolio. The disadvantage is that a classification of loans that borrowers of data (especially in households and small businesses) are often difficult to obtain and are usually available only to long delays.

2.8 Value at Risk

Value at risk (VaR) refers to the maximum amount of money that may be lost over at certain period at a specific confidence level. Some assumptions of VaR analysis are not easily supportable, which lend further backing to stress testing (Kalirai & Scheicher, 2002). First, Var analysis is performed at time when the market breaks the horizon. These terms are often

17

characterized by increased market breaks tenderness financial and stress tests can be used to evaluate the potential loss of these breaks. Second, the analysis usually assumed that var change in financial time series (risk factors), which are normally distributed in the case when, in fact characterized by fat-tail. This assumption can lead to a fatal error, because the probability of extreme events is reduced when using a loss function, usually applied as opposed to fat tail distribution (Bank for International Settlements, 2000).

Stress tests measure the risk of abnormal market conditions, but they do not mean any probabilities to the likelihood of such losses. They are used to quantify the risks associated with the tails of the distribution losses contempt Var analysis

Chapter 3

3. Methodology

Stress tests can be classified by methodology in three main categories (Cihak, 2005), (i) Sensitivity analysis, which analyzes the impact of changes in relevant economic variables, such as credit risk, interest rates and exchange rates. (ii) Scenario analysis, which assesses the impact of exceptional but plausible scenarios, and (iii) Contagion analysis, which aims to take into account the transmission of disruptions of personal exposures in the whole system.

3.1 Sample

This study contains population of overall Banking Industry of Pakistan, listed on Karachi Stock Exchange for the period of 2009, 2010 and 2011. The main aim is to find the relationship between non-performing loans (NPL), Forced sale value of Mortgage collateral (FSV MC) and capital adequacy ratio (CAR). As a sample only those banks were selected for this study that fulfills the following criteria:

1. Scheduled Private Banks of the banking sector.

2. Availability of data.

On the Basis of above mentioned criteria, 17 banks were chosen because these banks satisfied both criteria. By setting the limitations, Probability sampling was applied for data collection. Large enough panel data was selected because a sample selected through probability sampling is the best representative of whole population.

3.2 Data

As the IMF stress tests; the absence of data poses significant constraints on model building. It is also the case with the Austrian banking data (Boss et al., 2004). However, the changes have already begun the process of data collection and monitoring of Basel II, and in the future there will be a large amount of data available to assess the stability of the financial system.

Data were collected from "State Bank of Pakistan and Annual Reports of each bank" selected for analysis prepared by the State bank of Pakistan, that consists of past financial data and the annual reports of banks; that are listed on KSE (Karachi Stock Exchange). Data were collected for the period of 2009, 2010 and 2011.

3.3 Variables and Measurements

The main objective of this study is to find credit risk of banks in a stress scenario. For this purpose the relationship between Non-performing loans and Capital adequacy ratio has been analyzed. For finding this relationship, Non-performing loans and Forced sale value of Mortgage collateral are taken as the independent variables while Capital adequacy is taken as the explanatory variable.

In this research, a baseline scenario and three other scenarios are worked out. The baseline shows the actual position of every bank at the end of each year. In baseline scenario the regulatory capital of the bank has been taken for its operations and capital requirements, and also the risk weighted assets of banks; the minimum amount of capital that is required within banks and other institutions based on a percentage of the assets, weighted by risk calculated by every bank at the end of each period.

State Bank of Pakistan (SBP) necessitates that the paid-up capital of locally incorporated banks should be higher to Rs. 10 billion by 31 December 2013 in a phased way (Bank Al Habib AR, 2010).

According to the Ministry of regulatory capital and risk-weighted capital adequacy ratio of the bank has been received, which means that the capital of the bank. It is expressed as a percentage of a bank disclosures made to weighted credit.

CAR = Total Regulatory Capital / Risk Weighted Assets

Also known as "Capital to Risk Weighted Assets Ratio (CRWAR), this index is used to protect depositors and promote the stability and efficiency of financial systems around the world. The standardized requirements for banks and other institutions within the depositary, who shall determine the amount of liquidity to be maintained at a certain level of assets; regulatory bodies, such as the Federal Deposit Insurance Corporation or the Bank for International settlements with the Federal Reserve. These requirements are in place to ensure that these institutions do not participate in or hold investments that increase the risk of default and sufficient operating capital to withstand losses,

A number of international banking regulations put forth by the Basel Committee on Banking Supervision, the minimum capital requirements for financial institutions to minimize credit risk. Banks that operate internationally are required to maintain a minimum amount (8%) of capital based on a percentage of risk-weighted assets, a bank must maintain capital (tier 1) and (2-tier) of at least 8% of risk-weighted assets, for example, if a bank has risk-weighted assets of $100 million, it is required to maintain capital of at least $8 million. Basel II is the second of the

Basel Committee on Bank Supervision's recommendations, and unlike the first accord, Basel I, which focus mainly on credit risk. Basel II-The objective is to establish standards and regulations regarding the amount of capital financial institutions should be set aside. The banks have to set aside capital to reduce risks related to investments and lending practices. Basel III is part of ongoing efforts to improve the regulatory framework by Basel Committee on Banking Supervision. It is based on the Basel I and Basel II documents and aims to improve the capacity of the banking sector with the financial and economic difficulties, improve risk management and increase the transparency of the project aims to promote greater flexibility Disposal III each bank to reduce the system-wide shocks.

3.3.1 Baseline Scenario: In baseline scenario, the regulatory capital is divided by the risk weighted assets to get the capital adequacy ratio of the bank. The stress test for credit risk assesses the impact of increase in the level of non-performing loans of the bank. This involves three types of shocks for three scenarios:

3.3.1.1 Increase in Non-Performing Loans (NPLs): The first one deals with increase in the NPLs and the respective provisioning. All three shocks explain the impact of 5%, 10% and 20% increase in the total NPLs directly downgraded to loss category having 100% provisioning requirement. The tax adjusted impact was calibrated in the CAR of the bank for each of the shock, respectively. The total non performing loans are calculated by adding all four loan categories i.e.: Other assets especially mentioned (OAEM), Substandard, Doubtful and Loss categories. Then given the first credit shock of 5 %, 10 % and 20 % to total NPLs to find increase in non-performing loans same amounts of provisions are provided as the amount of increase in non-performing loans. A tax rate of 35 % is applied on net income for the increased

amount in non-performing loans. The tax adjusted loss is calculated by multiplying non-performing loans with tax rate and then deduct it from regulatory capital & risk weighted assets, which gives the revised capital & revised risk weighted assets of the bank. Revised Capital Adequacy Ratio is calculated from the division of revised capital by revised risk weighted assets.

3.3.1.2 Negative Shift in The Non-Performing Loans (Npls) Categories: The second sscenario with a negative shifts in the NPLs categories and therefore increases in respective provisions. The three scenarios are to explain the effect of 50%, 80% and 100% downward shift in the NPLs categories. For example, 50% of the OAEM categorized under substandard, 50% of the substandard categorized under doubtful and 50% of the doubtful added to the loss category.The tax impact of the car adjusted upward supplied calibrated bank / DFI each shock.

The total non performing loans are calculated by adding all four loan categories i.e.: Other assets especially mentioned (OAEM), Substandard, Doubtful and Loss categories. To find out weighted NPLs, weights of 0%, 20 %, 50 % and 100 % are assigned to each category, like other assets especially mentioned (OAEM), Substandard, Doubtful and Loss categories respectively. Weighted NPLs is the sum of weighted NPLs in each category of classified loans where weights being the rate of provision required against each category.

The 2nd credit shock of 50 %, 80 % and 100 % is given downward shift in NPL categories i.e. from substandard to doubtful and from doubtful to loss. The impact of credit shock 2 is more severe than the first one. This shock badly affects the capital adequacy of the bank.

3.3.1.3 Fall in the Forced Sale Value (Fsv) Of Mortgaged Collateral: The third scenario deals with the fall in the forced sale value (FSV) of mortgaged collateral. The forced sale values of the collateral were given shocks of 10%, 20% and 40% which decline in the forced sale value of mortgaged collateral for all the three shocks respectively. Weighted FSV is the sum

of weighted FSVs in each category loans, where weights being the rates of provision required against each category. The Forced sale value of mortgage collateral was calculated for all banks and the tax adjusted impacts of the additional required provision were calibrated in the CAR for each shock.

Chapter 4

4. Results & Discussions

After developing the above said scenarios, the cumulative impact of all shocks, i.e., increase in non performing loans, shift in NPLs, categories and decrease in forced sale value of mortgage collateral were analyzed and its impact was shown on the overall financial position of the bank. The capital adequacy ratio (CAR) has been recalculated to show the impact of overall shocks on the bank's capital.

Separate tables are made to show the year-wise results of every bank from 2009 to 2011. The results of stress testing for credit risk in the year 2009 are shown below in table 4.1.

4.1 Stress Testing Results for the Year 2009

In the year 2009, two banks performed below the prudential regulations of state bank of Pakistan. SBP requires that banks in Pakistan should maintain regulatory capital for credit, market, and operational risks, the amount of which should at least be equal to 10% of their risk weighted assets. Total regulatory capital should be at least 10 % of risk-weighted assets of the Bank's capital (Bank Al Habib AR 2011).

Table: 4.1   Stress Testing Results for the Year 2009

Year 2009	Baseline	Scenario 1: 5 % increase in NPL's, 50 % downward shift in NPL categories i.e. from substandard to doubtful and from doubtful to loss and 10 % decrease in FSV of mortgage collateral.	Scenario 2: 10 % increase in NPL's, 80 % downward shift in NPL categories i.e from substandard to doubtful and from doubtful to loss and 20 % decrease in FSV of mortgage collateral	Scenario 3: 20 % increase in NPL's. 100 % downward shift in NPL categories i.e from substandard to doubtful and from doubtful to loss and 40 % decrease in FSV of mortgage collateral.	
Banks	*< 0 0-10% <10% **0 2 15	< 0 0-10% >10% 2 9 6	< 0 0-10% >10% 11 5 1	< 0 0-10% >10% 15 1 1	MEAN < 0 0-10% >10% 13 3 1
Allied Bank limited	13.469	10.267	6.590	(0.866)	5.330
Habib Bank Limited	13.245	3.470	(9.090)	(45.616)	(17.079)
MCB Bank Limited	19.073	10.555	(0.198)	(30.594)	(6.745)
United Bank Limited	13.184	5.676	(3.541)	(27.173)	(8.346)
Askari Bank Limited	11.753	2.429	(9.393)	(42.786)	(16.583)
Bank Al-Habib Limited	14.985	2.693	(13.840)	(71.717)	(27.621)
Bank Al-Falah Limited.	12.424	6.809	0.117	(15.251)	(2.775)
Faysal Bank Limited	14.985	8.504	0.650	(18.473)	(3.106)
KASB Bank Limited	3.525	(4.430)	(14.692)	(38.662)	(19.262)
Samba Bank Limited	57.039	53.415	49.081	37.727	46.741
NIB Bank Limited	19.578	10.461	(1.795)	(35.104)	(8.813)
SILKBANK Limited	0.562	(8.547)	(19.976)	(49.544)	(26.022)
Soneri Bank Limited	12.746	3.214	(8.974)	(43.899)	(16.553)
Summit Bank Limited	12.031	11.073	9.944	8.091	9.703
Habib Metropolitan Bank	12.031	7.612	2.701	(8.776)	0.512
JS Bank Limited	23.990	13.093	(1.744)	(52.372)	(13.674)
Standard Chartered Bank	11.556	6.224	(0.073)	(14.267)	(2.706)

* CAR Less than Zero % (< 0%), In between Zero to 10% (0-10%) and Greater than 10% (<10%)
** Number of Banks

In the year 2009, two banks performed below the prudential regulations of state bank of Pakistan. SBP requires that banks in Pakistan should maintain regulatory capital for credit, market, and operational risks, the amount of which should at least be equal to 10% of their risk weighted assets. Total regulatory capital should be at least 10 % of risk-weighted assets of the Bank's capital (Bank Al Habib AR 2011).

The minimum capital requirement for each bank is 10 %, but the KASB and Silk Bank do not meet the criteria. After the first shock only 6 banks met the criteria and 9 banks were performing on average, but after 2nd shock only 1 bank met the criteria and 5 banks were performing on average, but after the third shock only 1 bank met the criteria and only 1 bank performed at average. All the remaining banks were wiped out. The overall result for 2009 was 1 strong bank i.e.; Samba Bank which survived even after all the three credit shocks, other 3 banks performed on average.

4.2 Stress Testing Results for the Year 2010

In the year 2010, the same procedure was adopted and the following results, as shown in the table 4.2 were obtained. In the base line scenario, KASB Bank's CAR was negative which shows that the bank is under performing, Silk Bank did not meet the State Bank criteria. After the first shock only 5 banks met the criteria and 10 banks were performing on average, but after 2nd shock only 2 banks met the criteria and 5 banks were performing on average, but after the third shock no bank met the criteria and only 4 banks performed on average. The remaining all other bank's capital is wiped out. The overall result for the year 2010 was that 2 strong banks i.e.; Samba Bank and Standard Chartered Bank survived even after all the three credit shocks, and 3 banks performed on average.

Table: 4.2   Stress Testing Results for the Year 2010

Year 2010	Baseline	Scenario 1: 5 % increase in NPL's, 50% downward shift in NPL categories i.e. from substandard to doubtful and from doubtful to loss and 10 % decrease in FSV of mortgage collateral.	Scenario 2: 10 % increase in NPL's, 80 % downward shift in NPL categories i.e. from substandard to doubtful and from doubtful to loss and 20 % decrease in PSV of mortgage collateral	Scenario 3: 20 % increase in NPL's, 100 % downward shift in NPL categories i.e. from substandard to doubtful and from doubtful to loss and 40 % decrease in FSV of mortgage collateral.	
Banks	*< 0 0-10<10% **1 1 15	< 0 0-10% >10% 2 10 5	< 0 0-10% >10% 10 5 2	< 0 0-10% >10% 13 4 0	MEAN < 0 0-10 >10% 12 3 2
Allied Bank limited	13.843	10.572	6.820	(0.870)	5.507
Habib Bank Limited	14.614	6.530	(3.533)	(30.402)	(9.135)
MCB Bank Limited	22.069	12.804	0.910	(35.458)	(7.248)
United Bank Limited	14.512	6.239	(4.147)	(31.850)	(9.920)
Askari Bank Limited	10.296	1.372	(9.776)	(40.486)	(16.297)
Bank Al-Habib Limited	12.821	0.391	(16.265)	(73.880)	(29.918)
Bank Al-Falah Limited	10.278	5.095	(0.856)	(14.765)	(3.509)
Faysal Bank Limited	12.821	10.590	8.083	3.233	7.302
KASB Bank Limited	(3.565)	(11.922)	(22.385)	(47.567)	(27.291)
Samba Bank Limited	52.613	46.199	37.756	9.481	31.145
NIB Bank Limited	14.726	4.666	(9.660)	(46.394)	(17.130)
SILKBANK Limited	6.757	(1.088)	(10.726)	(35.083)	(15.632)
Soneri Bank Limited	12.608	3.072	(8.921)	(43.842)	(16.564)
Summit Bank Limited	10.772	9.051	7.088	3.473	6.537
Habib Metropolitan Bank	10.772	6.548	1.888	(8.920)	(0.161)
JS Bank Limited	17.637	8.513	(3.059)	(37.017)	(10.521)
Standard Chartered Bank	12.219	11.558	10.702	9.560	10.607

* CAR Less than Zero % (< 0%), In between Zero to 10% (0-10%) and Greater than 10% (<10%)
** Number of Banks

4.3 Stress Testing Results for the Year 2011

In the year 2011, the results of stress test for credit risk are shown in table 4.3 below; which depict the results of baseline and all three scenarios. In the baseline three banks were performing on average i.e.; KASB Bank, Silk Bank and Summit Bank. These banks didn't meet the SBP criteria, while the rest of the banks were performing under prudential regulations of SBP. After the first shock results were same as in year 2010; only 5 banks met the criteria and 10 banks were performing on average, but after 2nd shock only 2 banks met the criteria (CAR) and only 6 banks were performing on average, but after the third shock only one bank i.e.; Standard Chartered Bank meet the required capital (CAR) and the banks shifted to negative capital (CAR Negative) and financial stability became destabilize and unstable. The overall result for the year 2011 was that, 2 strong banks i.e.; Samba Bank and Standard Chartered Bank survived even after all the three credit shocks, and 2 banks performed on average.

Table: 4.3 Stress Testing Results for the Year 2011

Year 2011	Baseline	Scenario 1: 5 % increase in NPL's, 50 % downward shift in NPL categories i.e. from substandard to doubtful and from doubtful to loss and 10 % decrease in FSV of mortgage collateral.	Scenario 2: 10 % increase in NPL's, 80 % downward shift in NPL categories i.e. from substandard to doubtful and from doubtful to loss and 20 % decrease in FSV of mortgage collateral	Scenario 3: 20 % increase in NPL's, 100 % downward shift in NPL categories i.e. from substandard to doubtful and from doubtful to loss and 40 % decrease in FSV of mortgage collateral.	
Banks	*<0 0-10<10% **0 3 14	<0 0-10% >10% 2 10 5	<0 0-10% >10% 10 6 2	<0 0-10% >10% 16 0 1	MEAN <0 0-10 >10% 13 2 2
Allied Bank limited	13.577	10.516	7.093	(0.074)	5.845
Habib Bank Limited	15.041	8.686	1.191	(17.563)	(2.562)
MCB Bank Limited	21.884	12.577	0.713	(35.972)	(7.561)
United Bank Limited	14.276	6.640	(2.667)	(27.322)	(7.783)
Askari Bank Limited	11.350	1.948	(9.879)	(43.719)	(17.216)
Bank Al-Habib Limited	16.858	0.279	(24.576)	(148.166)	(57.488)
Bank Al-Falah Limited	11.604	6.380	0.408	(13.713)	(2.308)
Faysal Bank Limited	10.646	2.563	(7.405)	(33.534)	(12.792)
KASB Bank Limited	0.080	(9.285)	(21.487)	(51.708)	(27.493)
Samba Bank Limited	43.410	35.954	26.227	(5.885)	18.765
NIB Bank Limited	14.109	5.237	(6.196)	(36.836)	(12.598)
SILKBANK Limited	6.646	(0.726)	(9.660)	(31.887)	(14.091)
Soneri Bank Limited	12.644	2.226	(11.438)	(52.199)	(20.470)
Summit Bank Limited	7.769	2.206	(4.217)	(19.364)	(7.125)
Habib Metropolitan	14.073	10.880	7.395	(0.297)	5.993
JS Bank Limited	16.131	9.848	1.500	(15.921)	(1.524)
Standard Chartered Bank	13.241	12.460	11.454	10.078	11.331

* CAR Less than Zero % (< 0%), In between Zero to 10% (0-10%) and Greater than 10% (<10%)
** Number of Banks

4.4 Stress Testing Results for the Year 2009 To 2011 & Ranking

In order to combine and conclude the stress test results for all three years are summarized in a cumulative table 4.4. The table shows the year wise results of each bank since 2009 to 2011.

Table: 4.4   Stress Testing Results for the Year 2009 To 2011 & Ranking

BANKS	2009	2010	2011	Mean	Ranking
Samba Bank Limited	46.741	31.145	18.765	32.217	1
Standard Chartered Bank	(2.706)	10.607	11.331	6.411	2
Allied Bank limited	5.330	5.507	5.845	5.561	3
Summit Bank Limited	9.703	6.537	(7.125)	3.038	4
Habib Metropolitan Bank	0.512	(0.161)	5.993	2.114	5
Bank Al-Falah Limited	(2.775)	(3.509)	(2.308)	(2.864)	6
Faysal Bank Limited	(3.106)	7.302	(12.792)	(2.865)	7
MCB Bank Limited	(6.745)	(7.248)	(7.561)	(7.185)	8
JS Bank Limited	(13.674)	(10.521)	(1.524)	(8.573)	9
United Bank Limited	(8.346)	(9.920)	(7.783)	(8.683)	10
Habib Bank Limited	(17.079)	(9.135)	(2.562)	(9.592)	11
NIB Bank Limited	(8.813)	(17.130)	(12.598)	(12.847)	12
Askari Bank Limited	(16.583)	(16.297)	(17.216)	(16.699)	13
Soneri Bank Limited	(16.553)	(16.564)	(20.470)	(17.862)	14
SILKBANK Limited	(26.022)	(15.632)	(14.091)	(18.582)	15
KASB Bank Limited	(19.262)	(27.291)	(27.493)	(24.682)	16
Bank Al-Habib Limited	(27.621)	(29.918)	(57.488)	(38.342)	17

Table 4.4 depicts the ranking of banks in order from strong to weak. Samba Bank is the strongest bank among the public private commercial banks due to highest CAR. Its CAR is 32.2% which is still above the minimum requirement of State Bank guidelines even after stress test. Standard Chartered Bank with a CAR 6.4%, Allied Bank limited CAR 5.6%, Summit Bank 3.1% and Habib Metropolitan bank with CAR 2.1% come in average category after the stress test. All the remaining banks performed badly during the stress test and considered weak banks.

The criteria for being weak is that it does not fulfill the requirements of State Bank of Pakistan and the capital adequacy of these banks fell below to negative values after stress test.

The stress testing results by the profitability ratios, like return on assets (ROA) and return on equity (ROE) prove that the three stress testing categories of strong banks, average banks and weak banks significantly differ in terms of ROA and ROE. For this purpose Chi-square test is applied to calculate ROA and ROE.

4.5 Return on Assets and Return on Equity:

Return on assets and return on equity has been calculated by the formula:

$$ROA \ (A) = \frac{Net \ Profit \ After \ Taxes}{Assets.}$$

And Return on equity was calculated by the formula;

$$ROE \ (E) = \frac{Net \ Profit \ After \ Taxes}{Equity \ Capital.}$$

Table 4.5.1   Year Wise Return on Equity of All Banks from 2009 Till 2011

Banks	2009	2010	2011	
	ROE	ROE	ROE	Mean
Allied Bank limited	0.28%	0.27%	0.27%	0.27%
Habib Bank Limited	0.18%	0.20%	0.22%	0.20%
MCB Bank Limited	0.25%	0.24%	0.24%	0.24%
United Bank Limited	0.17%	0.17%	0.20%	0.18%
Askari Bank Limited	0.08%	0.06%	0.10%	0.08%
Bank Al-Habib Limited	0.23%	0.25%	0.25%	0.24%
Bank Al-Falah Limited	-0.01%	0.07%	0.19%	0.08%
Faysal Bank Limited	0.11%	0.07%	0.07%	0.08%
KASB Bank Limited	-0.99%	-1.41%	-0.27%	-0.89%
Samba Bank Limited	-0.12%	-0.02%	0.03%	-0.04%
NIB Bank Limited	0.02%	-1.23%	-0.03%	-0.41%
SILKBANK Limited	-14.74%	-0.08%	0.04%	-4.93%
Soneri Bank Limited	0.02%	0.01%	0.07%	0.03%
Summit Bank Limited	-0.51%	-0.87%	-0.28%	-0.55%
Habib Metropolitan Bank	0.15%	0.13%	0.12%	0.13%
JS Bank Limited	-0.11%	-0.06%	0.04%	-0.04%
Standard Chartered Bank	0.02%	0.08%	0.11%	0.07%

Return on assets and Return on equity were calculated by the above formulae for all banks for three years from 2009 to 2011.Table 4.5.1 shows year wise Return on Equity of all banks. In the above table average for all years were calculated in the mean column. The table 4.5.2 shows return on assets for all banks.

Table 4.5.2   Year Wise Return on Assets of All Banks from 2009 to 2011

Banks	2009	2010	2011	
	ROA	ROA	ROA	Mean
Allied Bank limited	1.71%	1.84%	1.99%	1.85%
Habib Bank Limited	1.55%	1.84%	1.96%	1.78%
MCB Bank Limited	3.06%	2.96%	2.94%	2.99%
United Bank Limited	1.48%	1.52%	1.84%	1.61%
Askari Bank Limited	0.42%	0.29%	0.50%	0.40%
Bank Al-Habib Limited	1.14%	1.22%	1.18%	1.18%
Bank Al-Falah Limited	-0.03%	0.28%	0.92%	0.39%
Faysal Bank Limited	0.67%	0.45%	0.44%	0.52%
KASB Bank Limited	-7.08%	-4.64%	-3.45%	-5.06%
Samba Bank Limited	-2.50%	-0.39%	0.75%	-0.71%
NIB Bank Limited	0.33%	-5.90%	-1.34%	-2.30%
SILKBANK Limited	-4.23%	-1.56%	0.77%	-1.67%
Soneri Bank Limited	0.15%	0.12%	0.60%	0.29%
Summit Bank Limited	-5.41%	-4.20%	-1.26%	-3.62%
Habib Metropolitan Bank	1.16%	1.11%	0.98%	1.08%
JS Bank Limited	-1.81%	-1.03%	0.66%	-0.73%
Standard Chartered Bank	0.27%	L14%	1.52%	0.98%

In the above table the average of all years is calculated in the mean column for all banks. By comparing the stress testing results and ROA and ROE, each category was different than one another. Strong banks were almost one or two in each year, the Chi-square should not be calculated if the expected value in any category is less than 5, which is the basic assumption of chi-square test.

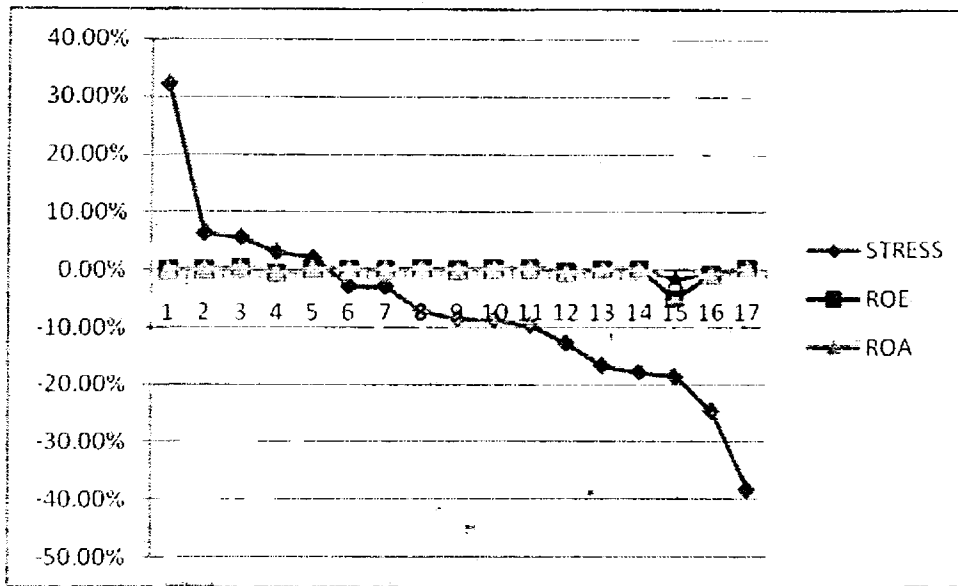## 4.6 Means Comparison of Stress Testing, ROE and ROA of All Banks

Below is the table 4.6 showing means of stress testing, return on equity and return on assets for all banks. The ranking is based on the mean of stress testing from strong to weak.

Table 4.6 Means Comparison of Stress Testing, ROE and ROA of All Banks

	BANKS	STRESS MEAN	ROE MEAN	ROA MEAN	Ranking
STRONG	Samba Bank Limited	32.22%	-0.04%	-0.01%	1
AVERAGE	Standard Chartered Bank	6.41%	0.07%	0.09%	2
	Allied Bank limited	5.56%	0.27%	0.27%	3
	Summit Bank Limited	3.04%	-0.55%	-0.57%	4
	Habib Metropolitan Bank	2.11%	0.13%	0.13%	5
WEAK	Bank Al-Falah Limited	-2.86%	0.08%	0.11%	6
	Faysal Bank Limited	-2.87%	0.08%	0.07%	7
	MCB Bank Limited	-7.18%	0.24%	0.24%	8
	JS Bank Limited	-8.57%	-0.04%	-0.02%	9
	United Bank Limited	-8.68%	0.18%	0.18%	10
	Habib Bank Limited	-9.59%	0.20%	0.21%	11
	NIB Bank Limited	-12.85%	-0.41%	-0.56%	12
	Askari Bank Limited	-16.70%	0.08%	0.08%	13
	Soneri Bank Limited	-17.86%	0.03%	0.04%	14
	SILKBANK Limited	-18.58%	-4.93%	-1.66%	15
	KASB Bank Limited	-24.68%	-0.89%	-0.86%	16
	Bank Al-Habib Limited	-38.34%	0.24%	0.25%	17

The graphical representation of the above table is also shown below in the chart. The chart shows the relationship of stress testing results, return on assets and return on equity.

Chart 4.7 Comparison of Stress Testing, ROE and ROA of All Banks

4.7 Comparison of Stress Testing, ROE and ROA of All Banks

From the chart it can be concluded that stress testing results are independent of return on assets and return on equity, because capital adequacy ratio is independent of net profit, while the ROA and ROE are totally based on net profit. CAR is actually based on the liquidity position of the bank. The more a bank is liquid the less will be the profit, because the bank will keep cash reserve and would not lend in the market.

Chapter 5

5. Conclusion

From the above results and discussions, it can be concluded that overall Pakistan's banking sector is resilient to adverse conditions up to some extent. The main reason for its resilience is that the banks extend fewer loans to people, that's why the risk weighted assets of the banks are less. Though some banks haves risk weighted assets more than required, which affect their capital adequacy ratio. After analyses we rank all banks in order from strong to weak. Samba Bank is the strongest bank among the public private commercial banks due to highest CAR. Its CAR is 32.2%, which is above the minimum requirement of State Bank guidelines even after stress test. Standard Chartered Bank with a CAR 6.4%, Allied bank limited CAR 5.6%, Summit Bank 3.1% and Habib Metropolitan Bank with CAR 2.1% come in average category after the stress test. All the remaining banks performed badly during the stress test and considered weak banks. According to Funder et al., (2001) banks rely on stress tests to assess exposures in those asset markets where illiquid conditions and poor historical data make the use of other risk measures difficult. In addition, risk managers see stress tests as an effective means of communicating risks to bank senior management.

5.1 Limitations and Future Directions

Almost every work has some barriers and limitations; just like that the main limitation for this research work was the limitations of data. Every researcher denotes limitation of data in his work and also the sophistication of the methodology of undertaking the stress tests. According to (Bank for International Settlements, 2000) Stress testing can appear to be a straightforward

36

technique. In practice, however, stress tests are often neither transparent nor straightforward. They are based on a large number of practitioner's choices as to what risk factors to stress, how to combine factors stressed, what range of values to consider, and what time frame to analyze. As pointed out by Cihak (2005) in the field of stress testing, data limitations pose significant constraints on the construction of models. Banks data is very secret and important from banks point of view. Banks were reluctant to provide data for mortgage collateral, because if they provide this data, the people would know about its credit exposure and might be unwilling to do large businesses with the bank.

According to Reserve Bank of India (2006-07) global banks heavily relying on statistical models to measure and manage the financial risks they are exposed. These models are gaining credibility, because it provides a framework to identify, analyze, measure, communicate and manage these risks. Since these models cannot incorporate all possible risk outcomes and are generally not capable of capturing sudden and dramatic changes, the banks supplement these models with 'stress tests'. Stress testing has become an integral part of the banking systems of risk management and is used to assess potential vulnerabilities, as well as a series of events or unlikely but possible movements of financial variables.

The process of stress testing should be an integral part of an institution's risk management program, as well as clear reporting and communication lines, and the clear format. Institutions should regularly that stress tests are not adequate. Institutions must use accurate, complete and fulfilling as the proper representative of the stress tests and IT resources should be proportionate to the complexity and coverage of stress tests on the equipment and facilities to know how to increase availability and data model will be further developed over time.

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