

A Framework for Macroeconomic Stress Testing on Credit Risk Management in Sri Lankan Banking Sector

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Abstract— In Sri Lanka the financial System composes the leading financial institutions which are associated with increased growth of an economy and contributes to the nation's growth as well. Hence Financial system stability has become an integral part which safeguards financial system which is able to hold off external and internal shocks. This Process implements a healthy environment for investors and encourages financial markets and institutes for the efficient and effective functioning. The maintenance of financial system stability leads to analyze and emphasize potential vulnerabilities and risks to the financial system. Among the potential vulnerabilities and risks, Credit risk can be introduced as the dominant and leading macroeconomic risk factor in many banking sectors which has been introduced as the problem towards the financial system stability. Therefore Credit risks must be managed from financial crisis to enhance the performance, sustainable growth and consistent profitability for the betterment of financial system stability. The purpose of this research project is to propose a framework to investigate the relationship between credit risk management and its impact on performance of the Sri Lankan Banking Sector.

Keywords— credit risk, macroeconomic factors, stress testing, financial stability,

I.INTRODUCTION

Financial system stability is defined as the ability of the financial system to perform its key functions of resource mobilization and allocation, risk management and the settlement of payments, effectively at all times and even under stressful circumstances. Financial system stability is founded on the confidence of the public in the financial system. This in turn is based on the soundness, efficiency, robustness and security of financial institutions, financial markets, financial infrastructure and financial regulation. The stability of the financial system depends largely on the soundness and resilience of the principal components, i.e., financial institutions, financial markets and financial infrastructure to collectively withstand adverse disturbances and shocks. The financial system in Sri Lanka consists of the following main components:

1. Financial institutions: Banks, finance companies, other credit providing institutions (including microfinance institutions), leasing companies, insurance companies, primary dealers, stock brokers/dealers, investment managers, margin providers, stock underwriters, unit trusts, provident and pension funds.
2. Financial markets: Money market, bond market, foreign exchange market and the equity market and the derivatives market.
3. Financial infrastructure: Payment and securities settlement systems, clearing systems and trading platforms. There are also infrastructure service providers, such as credit rating agencies, credit information registries and financial information providers.

Financial stability in financial institutions is mainly based on the economic and financial influences. Hence that the financial crisis explicitly affecting to the financial institutions existence and the profitability. Following are the interrelated factors which support financial system stability, which is stable macro economy, reliable payment system, efficient financial market etc. [1]. It is necessary to measure the performance of the financial institutions and predict them for the future enhancements and to minimize the potential vulnerabilities that can be affecting to the survival of the financial institutions. Credit risk plays an integral role on banks "profitability since a large chunk of banks" revenue accrues from loans from which interest is derived [20]. Also, this credit risk may be a most serious threat to the performance of financial institutions. Hence that several researchers have investigated the impact of credit risk on financial institutions in varying dimensions. The major studies related to this related issue of credit risk and financial institution performance have reviewed in following section.

This paper is organized as follows: Section I discuss about the introduction to the area of research. Section II illustrates work related to this research area. Methodology is comprehensively elaborate in section III. Finally, the conclusion and the future works are stated in the final part stated as section IV.

II. LITERATURE SURVEY

During the past decade many literature have handled with theoretical frameworks of macro-economic stress testing and its practical application. Central bank and World Bank have emphasized the importance of stress testing to the financial stability modeling in order to safeguard the financial system from potential vulnerabilities. Today stress testing is conducted on both macroeconomic and micro economic level. Central banks have implemented their own stress testing models. Stress testing is also adopted by individual banks for the purpose of risk management.

In the study by C. Borio, C. Furfine and P.Lowe on "Procyclicality of the financial system and financial stability: issues and policy options"[3], explicitly reveal that stress testing has been adopted as a mechanism for the awareness of the relationship between risk and business cycles.

Most recent study by M. Drehmann and K. Tsatsaronis the paper on "The credit-to-GDP gap and countercyclical capital buffers: questions and answers", shows that stress testing could be adopted in effective and convenient way as a crisis management and resolution mechanism and it could raise the discipline of thinking about financial stability [4].

Basically there can be several potential vulnerabilities and the risks directly affecting to the financial systems in the banks. Risk is something that cannot be predicted exactly due to uncertainty of an event. The extensive risk that is confronted by financial institutions is credit risk, market risk and liquidity risk [1].

2.1 Financial Risk Types

A. Credit Risk

Credit risk is the risk that a counterparty may not pay amounts owed when they fall due. Credit quality often becomes the dependent variable because the stability of financial sectors mainly comes from the credit risk. This can be measured by looking at Non- Performing Loan (NPL) ratio and NPLs are defined as loans on which the borrower does not make any payments in respect of interest or principal for a period exceeding three months [2]. Following equation (Eq.1) shows the Non-Performing Loan manipulation.

Non- Performing Loan (NPL) ratio=Total Non-Performing Loan (NPL)/Total Loan (1)

Hence that Non- Performing Loan (NPL) ratio can be used as an indicator of credit risk to conduct macroeconomic stress testing for financial institutions [1], [10].

B. Market Risk

Market risk is the risk of loss due to changes in market prices such as interest rate risk and foreign exchange risk [1], [10].

C. Liquidity Risk

Liquidity risk is the risk that amounts due for payment cannot be paid due to a lack of available funds [1], [10].

Among above mentioned potential risks, credit risk has the highest severity which involves in the banking risks category. Hence that it is an essential to manage this risk to safeguard the financial bankrupts. To manage the risk first the institution must identify the risk, for that a unique process called stress testing is used to examine the potential effects on a firm's financial crisis.

2.2 Stress Testing

A stress test is an estimate of how the value of portfolio changes when making considerable changes to some of its risk factors. The main objectives are to identify and determine structural vulnerabilities in the financial system and to assess its resilience to shock. Commonly stress testing used to estimate the impacts of macroeconomic conditions. Due to that specifically called it as Macroeconomic Stress testing which is a technique used to assess the flexibility of the financial system to extreme but credible macroeconomic shocks. Macroeconomic stress testing is a forward looking mechanism that could be used to identify systemic risk to the financial sector at an early stage, due to changes in macroeconomic variables [2].

Stress testing could be conducted on many different risks. The paper of H. Hesse and M. Čihák, on "Cooperative Banks and Financial Stability", discusses about various stress tests for the individual risk factors such as credit risk, interest rate risk, foreign exchange risk and liquidity risk. In the most of the studies that were conducted on stress testing focal point is on credit risk as the primary risk in banking sector. Before calculating the liability to credit risk in case of stress scenario it is essential to create a link between macroeconomic conditions such as GDP growth, interest rate, exchange rate, inflation rate and credit risk indicator.

In the paper of M. Bofondi and T. Ropele on "Macroeconomic Determinants of Bad Loans" illustrates and analyzed Italian financial sector and captured from the study that the quality of lending depends on a small number of macroeconomic conditions that illustrate situation of economy in a broad manner. The loans quality and credit risk are impacted by changes in those macroeconomic conditions with delay [6]. Also another conformation of robust link between credit risk and macroeconomic conditions happens from the study of Virolainen on "Stress Testing with a Credit Risk Model: an Application to the French Manufacturing Sector", in this research paper collective default rates were estimated on key macroeconomic condition including interest rates and GDP growth. The test results show significant relationship between the mentioned conditions [7]. As stress testing is conducted commonly for the conditions of the

macroeconomic, there is a necessity of familiar with the macroeconomic variables that are impacted on credit risk's Non Performing Loans. Following section illustrates the variables that are going to consider in this research.

2.3 Macroeconomic variables

A. GDP Growth

Gross Domestic Product (GDP) is combine demand of an economy. A growing economy is associated with rising incomes and makes financial distress decreased. Hence that real GDP growth has negative impact towards the Non-Performing Loan [1].

B. Exchange Rate

Exchange rate is the price of domestic currency which has expressed in terms of a foreign currency. The correlation between exchange rate and Non-Performing Loan is uncertain, because it depends on international trade and country's capital account [1].

C. Inflation Rate

The inflation rate is the percentage rate of change of a price index over time [1]. The impact on inflation on Non-Performing Loan can be positive and negative [1].

D. Interest Rate

Interest rate is the amount charged which can be expressed as a percentage of principal by a lender to a borrower for the use of assets. Interest rates are typically noted on an annual basis, known as the annual percentage rate (APR) [8].

Since this research area is primarily focuses to the stream of economic and financial literature, there are two pin points were specifically used to benchmark the banking performance. It is the profitability of assets namely Return on Assets (ROA) and Return on Equities (ROE). Following literature illustrate the two performance benchmarks separately.

2.4 Financial Stability Profitability Performance Indicators

A. Return on Asset

This is the indicator of how a firm is relative to its total assets and how efficiently manages its firm's assets to generate earnings. Basically this Return on Assets (ROA) measured as a percentage and following is the equation (Eq.2) for the Return on Assets (ROA) [9], [10].

$$\text{Return on Assets (ROA)} = \text{Annual Earnings/Total Assets (2)}$$

B. Return on Equities

This is another variable used to measure profitability performance. It is the ratio of net income and total equity. It shows the rate of return generated by the owner's equity. Basically this Return on Equity (ROE) measured as a percentage and following is the equation (Eq.3) for the Return on Equity (ROE) [10].

$$\text{Return on Equity (ROE)} = \text{Net Income/Shareholder's Equity (3)}$$

There have been arguments and deliberations regarding the impact of credit risk management and financial institution's financial profitability performance. In the paper of Liyuqi on "Determinants of Banks profitability and its implication on Risk management practices: Panel Evidence from the UK", has executed extensive study and generated some results and others came up with another result that indicates credit risk management has positive impact or the effect on bank financial performance [11]. In the paper of Muhammed et al on "Credit risk and the performance of Nigerian banks", has found negative correlation and others suggest that other factors apart from credit risk management impacts on financial profitability performance [12].

Specifically in H.S. Kargi's paper on "Credit risk and the Performance of Nigeria banks", discuss the case study of Nigeria banks from 2004 to 2008 that there is a compelling relation between financial institutions profitability performance and credit risk management. In the paper, which confess that loans and advances and Non-Performing Loans (NPL) are major micro variables that determine asset quality of financial institutions [13].

T.F kolapo, R. K. Ayeni and O. Oke are discussed the research on "Credit Risk Management and Banks Performance" using panel data regression for the period 2000 to 2010, originates the impact of credit risk on financial institution's profitability performance measured by the Return on Asset (ROA) of banks is cross sectionally constant. Paper concluded that the nature and managerial pattern of individual firms do not determine the effect [14].

In A. Hosna, B. Manzura, and S. Juanjuan paper on "Credit risk management and profitability in commercial banks in Sweden" underline the effect of credit risk management on profitability level of banks, it concluded that higher capital requirement contributes positively to bank's profitability [15].

S. H. Boahene et al stated that, "Credit risk and profitability of selected banks in Ghana"[16], discussed with regression analysis to decide whether there is a compelling link between credit risk and profitability of Ghanain financial institutions and this research has followed the idea of A. Hosna, B. Manzura, and S. Juanjuan paper on "Credit risk management and profitability in commercial banks in

Sweden”[15], by using Return of Equity as a measurement of financial institution's profitability performance and a ratio of non-performing loans to total asset for credit risk management [15], [16]. The research comes up with a broad conclusion that there is an effect of credit risk management on profitability level of Ghanaian banks. And also further study emphasizes that higher capital requirement committed positively to bank’s profitability [16].

Charles, O. Kenneth's paper on "Impact of Credit Risk Management and Capital Adequacy on the Financial Performance of Commercial Banks in Nigeria", inspects the impact of credit risk management on capital adequacy and financial institution's financial profitability performance in Nigeria. In this research, six banks were chosen as the sample and the technique used to select the sample is positive sampling mechanism. The panel data gathered from financial statements from 2004 to 2009. Panel data modeling has been used to evaluate the relationship that exists among Loan Loss Provisions (LLP), Loans and Advances (LA), Non-performing Loans (NPL), Capital Adequacy (CA), and Return on Assets (ROA) [17]. The test results indicates that the credit risk management and capital adequacy related positively on financial institutions financial profitability performance, Loans and advances have a negative impact on banks’ profitability in the period which has conducted the survey.

In the paper of M. Girma on "Credit risk management and Its Impact on Performance on Ethiopian commercial Banks", illustrates the credit risk management and its impact performance on Ethiopian Commercial Banks. This research includes 10 years panel data from the licensed commercial banks in Sri Lanka for the case study, to investigate the link between ROA and loan provision, non-performing loans and total assets. The predictions explicitly say that there is a compelling link between bank performance and credit risk management [18].

The significance of this proposed research work affected since the other researchers straight away consider the correlation between performance and the Non- Performing Loans, this paper suggests to consider macroeconomic factors to evaluate the performance of the banking sectors in Sri Lanaka.

III. RESEARCH METHODOLOGY

The paper propose a method to be applied in this study is a quantitative evaluation. Besides, both the historical and ex-post facto research design shall be adopted. While the former shall be used to study and appraise the chronological level of financial facilities available to commercial banks in Sri Lanka and the level of development of the country. Following information shows the determinants to be included for the quantitative evaluation framework.

After detailed analysis of the literature regarding the performance enhancement and the credit risk management, following set of variables are considered to build a quantitative framework to evaluate the performance of the banking sector.

1. ROA/ROE (Y)
2. Macroeconomic factors (X_1, X_2, X_3, X_4)
 - GDP Growth (X_1)
 - Exchange Rate (X_2)
 - Inflation Rate (X_3)
 - Interest Rate (X_4)
3. Non-Performing Loan Ratio (NPL) (X_5)
4. Error Term (e)

According to the selected variables which has listed as above, ROA/ROE (Y) indicates the dependent variable whereas, GDP Growth (X_1), Exchange Rate (X_2), Inflation Rate (X_3), Interest Rate (X_4) and Non-Performing Loan Ratio (NPL) (X_5) as independent variables. In order to generate the framework following (Fig. 1) processes can be identified as the main phases to be followed.

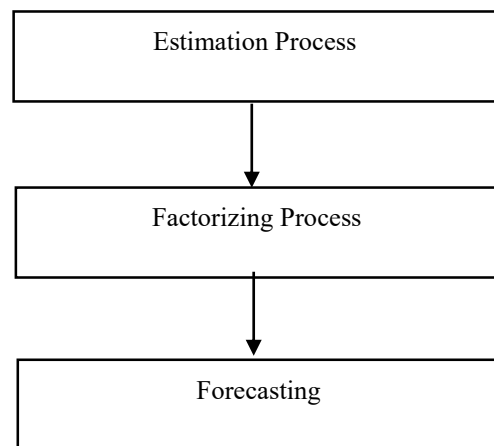


Fig 1: Main Steps of the Framework Generation

According to Fig. 1 estimation process emphasis the selection of the best predictor variables for the forecasting and it acts as an extraction method. That is done by using called Principle Component Analysis (PCA) method. As the second step factorizing process (Factor Analysis) can be done using a software to conduct the analysis on selected predictor variables in the first step. After the factorization, forecasting process can be applied to predict the performance of the banking sector to mitigate the credit risk. Forecasting can be done by using linear regression analysis. Consequently the following linear framework can be proposed to measure the performance of the banking sector.

$$\text{Non-Performing Loan Ratio (NPL)} (X_5) = a + b_1.\text{GDP Growth} (X_1) + b_2.\text{Exchange Rate} (X_2) + b_3.\text{Inflation Rate} (X_3) + b_4.\text{Interest Rate} (X_4) + e_1 \quad (4)$$

$$\text{ROA/ROE} (Y) = c + d_1.\text{Non-Performing Loan Ratio (NPL)} (X_5) + e_2 \quad (5)$$

IV. CONCLUSION & FUTURE WORK

This proposed research study is adopting descriptive and causal comparative research design. Further, this proposed model uses pooled data regression model for the analyzation. The technique of pooled data estimation takes care of the macroeconomic factors with respect to the Non-Performing Loans (NPLs) and then Non-Performing Loans (NPLs) to the ROA and ROE performance factors according to the Sri Lankan context. In future the proposed framework supposed to test using panel data of the Sri Lankan banking sector to predict the performance to eliminate the credit risk while determining the impact of the credit risk to the banking sector as it is the major risk affecting to the sector.

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