# Credit Risk Management and Its Impact On the Performance of Commercial Banks in Pakistan: An Application of Penal Var Approach

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## Abstract

*Credit risk is nothing else but the default by the borrower. Credit risk management practices are adopted by the banks to mitigate this risk. It is crucial for every bank or financial institution to follow the effective risk management system to avoid or mitigate the credit risk. This paper is an attempt to investigate the effect of default or credit risk management on the financial performance of banks and how factors of CRM affect each other. VAR approach has been used to analyze the penal data. Sixteen private commercial banks have been taken into the consideration. Data has been collected from the year 2012 to 2021. Granger causality and impulse response have also been identified and analyzed. E view has been used for the purpose of analysis. Results of Granger causality reveal that almost all the variables are affecting or explaining each other. There is a bidirectional association ship between LTDR and ROE. In variance decomposition analysis, all the variables are mostly being affected by themselves or by their own shocks and shocked of other variables. Finally, short term relationship has been found or identified through VECM. This study is helpful for all the stakeholders of commercial banks. This study is also helpful for the students using penal var approach for understanding and analysis purpose. This study is also helpful for the decision makers to frame policy of credit risk management and see how effective risk management affects the financial health of commercial banks.*

Keywords*: NPL, Loan loss provision, CAR, LTDR, VAR*

# Introduction

## Background of the Study

Economic development of every country depends on the smooth and efficient working of its financial sector. Commercial banks paly vital role in the economic development of the country. Most of the businesses need finances or funds to meet their requirements and always look towards the banking sector of the country. Credit extended by the financial institutions works like a life blood for every organization. Economic development cannot be achieved without the sound, healthy and stable banking sector of the economy. Financial soundness of banks depends on its earnings and banks earn money by charging interest on advances. On the one side advances play crucial role in the development of businesses in the country and on the other side generate income for the banks and contribute towards the financial soundness of banks. Bank can't achieve its objective of earning maximum revenues without having effective credit risk management (Shaikh et al., 2017). Majority of the banks faces troubles or collapse because of significantly high default risk (Accornero et al. 2018)

Soundness of banking sector depends on the effective risk management practices adopted by these banks and financial institutions (Oke et al 2012). Defaults of banks adversely affect the performance of overall economy, and this alarming situation occurs due to the lack of effective risk management practices. (Abhiman and Saibal, 2007).

The most important factor that is neglected by most of the banks is poor monitoring of vulnerable advances. Non-performing loans arise due to poor risk analysis and monitoring of loans. It is imperative for the banks to sort out the mentioned problem by taking effective risk management steps to avoid the risk of default(State Bank of Pakistan, 2020).

In today's world risks and businesses go together or side by side. Risk is a reality and can't be avoided rather it is mitigated or managed. Financial institutions are more exposed towards the different types of risk like market risk, operational risk, default risk and liquidity risk. Therefore, it is essential for every bank or financial institution to have sound risk management system in place to tackle the threats of different types of risks. The main function of every commercial bank is lending and risk associated with the lending is credit or default risk. Lending and risk of default by the borrowers go side by side or together. Income of every commercial bank depends

on the size of lending, if rate of lending is high profits would also be high (Dasah, et al., 2012). Financial performance every commercial bank is heavily influenced by the risk management measures and procedures adopted by that bank and risk management procedures must be adopted in the different and risk-based environment(Sleimi, 2020). Risk management has become the area of great of interest for every bank. Every bank wants to follow the effective risk management practices to encounter the challenge of risk of default or credit risk.

Credit risk is nothing else but the default on the part of the party who has borrowed the money. If someone borrows money form the bank and fails to pay off his or her borrowed amount on time, this is credit risk(Nawaz *et al.*, 2013). No financial institution or a bank can progress or even survive without the effective risk management. Risk management is the process in which risk is identified, analyzed, interpreted and mitigated. All banks due to the nature of their businesses are more exposed towards this phenomenon of risk.

Performance of banks and financial institutions is badly affected due to the failure or absence of effective risk management system. Failure of risk management system or flaw in the risk management system causes disasters situation for every bank. Effective CRM enables the banks to avoid or reduce the chances of defaults by the borrowers and ultimately positively affect the profitability or performance of banks. Financial performance every commercial bank is heavily influenced by the risk management measures and procedures adopted by that bank and risk management procedures must be adopted in the different and risk based environment ( Sleimi, 2020).

**Problem Statement**

Lending is the primary source of earning for every bank. Lending and default risk go side by side. Every bank wants to avoid the defaults against their lending or financing provided to borrowers. NPLs are mostly arise because of lack of effective credit risk management practices. These risk management practices are necessary for banks to grow and remain competitive in the banking industry (State Bank of Pakistan, 2020). Absence or ignorance of CRM badly affect the financial performance of banks. (Abhiman and Saibal, 2007). In order to avoid or mitigate the problem of default risk, banks are bound to follow the effective risk management practices. Sustainable growth of the banks depends on the effective management of risk and improved financial performance of banks. (Oke et al 2012). This study will be focusing on the practices

followed by financial institutions and commercial banks to tackle the problem of default risk and how these CRM practices affect the financial health of commercial banks.

**Questions of the study**

1. How factors of CRM affect the financial health of commercial banks?
2. Is there any granger causality among these variables?
3. Is there any impulse response among variables?
4. Is there any short term relationship among the variables?

**Objectives of Study**

1. To find out the impact of CRM on profitability of commercial banks
2. To find out the granger causality among all variables.
3. To find out impulse response and variance decomposition among all variables.
4. To identify the short term relationship through ECM among the variables.

**Significance of Study**

- This study is very useful for all the commercial banks which are involved in lending and interested to know the mechanism of effective credit risk management.
- Shareholders will also be benefited from this study because they will be able to know how CRM practices are being followed by different banks.
- Academia (students and teachers) will also be benefited from this study to enhance their knowledge and skills about credit risk and CRM.

## Literature Review

Every study has to be supported by any theory and theories related to this study are credit risk theory and agency theory (**S**iddique *et al.* 2020). The phenomenon of credit default or non-performing loans is related to credit risk theory and agency theory. According to this theory risk of default does not arises only form borrower side. It also arises from the side of banks. Sometimes, it happens that banks become insolvent and unable to pay the number of borrowers. This theory further states that measures should be taken by the banks to avoid the risk of default. Insurance cover is useful to tackle the threat of default risk. Transfer of risk to the third party is usual practices of banks (Owojori et al., (2011). Siddique *et al.* (2020) added that, the

phenomenon of credit default or non-performing loans is related to credit risk theory and agency theory. According to this theory owners and managers have different objectives. Banks act as an agents and depositor is just like a principal. There should be a mechanism which must protect or ensure the rights of principals and agents. Meckling (1976) and Fama (1980) are the main contributors for this theory.

**Credit Risk and Credit Risk Management**

When borrowers of the banks don't fulfil their commitment and don't pay off their dues or borrowed amount, it is known as credit or default risk. **(Accornero *et al.,* 2018).**Credit risk arises when borrowers don't pay their borrowed amounts on time or as specified by the banks. It is simply a default by the borrower. Nawaz *et al.* (2013) discovered from his study that default from the part of borrower, who borrows desired amount from the bank and does not pay on time. According to Gostineau (1992), there is a possibility that outstanding portion of loan given by the bank becomes uncollectible due to the default by the borrower. There is another possibility that sometimes banks get collapsed and unable to meet their obligations and commitments. Most important risk faced by the commercial bank arises due to default by the borrowers. CRM is the process of identifying, analysis and mitigation of risk. Risks and returns are associated with each other. Effective risk management is nothing else but tradeoff between risk and return that ultimately guide the bank or financial institution towards success and growth. (Fatemi and Fooladi, 2006). Risk of default is associated with the financing provided by the bank. Risk of default cannot be managed without the identification and proper assessment of risk. (Nawaz *et al,* 2013). Systematic method to encounter the threat of default risk with the help of different strategies by using administrative resources and by analyzing and monitoring the risk at different levels. Risk of credit can be gauged and mitigated by NPLR, CAR, LLPR and LTDR. Therefore, variable wise literature review is as follows:

**Proxies of Credit Risk Management**

CRM is measured by CAR, NPL, LTDR and LLPR and empirical literature review is being discussed in this part of the literature review. Chukwu ulu et al. (2019) found that there is a negative association ship between NPL and profitability of banks. Effect of default risk and profitability was analyzed in Turkey and it was found that there is a negative relationship between default risk and profitability. Proxies which were taken to measure default risk and

profitability were NPL, ROE and ROA(Ekinci and Poyra, 2019). Previous researches (Nawaz et al., 2012; Musyoki & Kadubo, 2012) suggest that level of default risk can be measured by NPL ratio and LA ratio. NPL ratio is used to know and analyze the strength and quality of assets and it is also used to analyze the credit facility extended by the banks. There was a study which was conducted in Qatar and data was collected from year 2001 to 2005. This study was conducted to check how commercial banks manage or mitigate their credit risk. It was found that NPL ratio had negative relationship with the profitability of banks. Achou and Tenguh (2008). Commercial banks are more exposed towards the default risk. As the volume of NPLs increases it hampers the progress of the bank. NPLs badly affect the profitability of banks. Returns of the banks decline as the volume of non-performing loans( Kolapo *et al.,* 2012). As the rate of default increases, banks have to keep provisions against those defaults and consequently it negative affects the financial performance and market price of the banks. Badar and Javid (2013). Ahmad and Bashir (2013) conducted a study on penal data and data was collected from 30 banks from year 2006 to 2010. Results of the study indicated that non-performing loans had significant relationship with the ROE of banks.

Credit risk is measured by capital adequacy ratio and this ratio has negative and relationship with the return on assets(Ekinc, 2019). Return of asset which is the proxy of performance has positive association with the capital adequacy ratio and asset quality(Ali and Dhiman, 2019). Poudel (2012) found in his study that CAR had negative effect on the performance of banks. 31 banks were taken into the consideration and data was collected from 2001 to 2011. In this study cause variables were default rate and CAR and both the ratios had negative impact on the performance of banks. Another study was conducted in Ghana and results of the study indicated that CAR and NPLs had significant effect on the financial performance of the banks. Tefera (2011) conducted study on CRM practices and CAR was used to measure the credit risk. Result of the study indicated that CAT had positive significant relationship with return on asset. There is negative as well as significant impact of LTDR on the financial health of banks, financial performance of banks was checked with ROA and ROE. Findings of the study suggest that banks must take effective measure to overcome the problem of default. Balance approach can be adopted bay managing the credit and liquidity risks to have positive impact on the financial performance of banks (Sathyamoorthi, 2020). Dhanuskodi Rengasamy (2014) found in his study which was

about creidt risk management and profitability of banks. Restults of study indicated that LTDR had negatice associationship with the ROE of banks.. Bourke (1989) conducted a study and took loan to deposit ratio as one of the cause variables. The prime objective of using this variable as an independent variable was that all the loans involve risk of defaults. Therefore, it necessary that we must know how much loans and advances have been provided by the banks as compare to their deposits. Most of the studies have checked the impact of credit risk management on the performance of bank but no one has attempted to apply VAR on the variables of credit risk management to know how variables of credit risk management affect each other and ultimately affect the performance of banks. This paper is an attempt to fill this particular gap.

## Research Methodology

In this study penal var model approach is being used to check the granger causality, impulse response and variance decomposition among the variables of credit risk and financial performance. Impulse response indicates that how one dependent variable or independent variable behaves to shock given to itself or to other variable over a period to time. In Variance decomposition shocks are given to each cause variable involved in the equation and response of each shock is observed on dependent variable. All the mentioned tests are used in penal var approach. This study is quantitative in nature. In quantitative studies hypotheses are developed and tested and results are generalized. This study is also based on research philosophy which is known as post positivism. In post positivism, hypotheses are accepted or rejected. Secondary data is being utilized. In secondary data, penal data is being used. Data has been collected from the financial statement of banks issued by the state of banks of Pakistan. Period of study is from year 2012 to 2021. Data of 10 years from 16 banks have been collected. Unit root tests have been applied to check that whether data is stationary or not. VAR approach has been used to analyze the data with the help of Granger causality, Impulse responses and variance decomposition. VECM is used to check the short term relationship among the variables. Econometric Model. The econometric model is as follows:

$ROE_{it} = \beta_0 + \beta_1 LTDR_{it} + \beta 2 LLPRRit + \beta_3 NPLR_{it} + \beta_4 CAR_{it} + \varepsilon_i$

## Discussion on Results

This paper examines the impact of CRM practices and its impact on the profitability of banks. Effect variable of this study is ROE and cause variables of this study are LTDR, LLPR, CAR and NPLR.VAR is used to see the effect of each variable on itself and others.

Table 1

| Cause Variables | Statistic | Probability Value | Stationary |
|---|---|---|---|
| LTDR | -4.388 | .0000 | At Level |
| NPLR | -4.681 | .0000 | At Level |
| LLPR | -8.037 | .0000 | At Level |
| CAR | -5.578 | .0000 | At Level |
| Effect Variable | | | |
| ROE | -2.765 | .0028 | At Level |

Unit Root Test: Test of data stationary: Levin, Lin & Chu *

Note: Whereas LTDR is the loan to deposit ratio NPLR is non-performing loan ratio, LLPR is loan loss provision ratio, CAR is capital adequacy ratio, ROE is return on equity.

Table 1 indicates that all the independent and dependent variables are stationary at level. P value is less than .05, it means that all variables are stationary at level.

### Vector Auto regression

Vector Auto regression Estimates

Date: 01/10/22 Time: 16:34

Sample (adjusted): 2014 2021

Included observations: 128 after adjustments

Standard errors in () & t-statistics in [ ]

Table 2

| | LTDR | NPLR | LLPR | CAR | ROE |
|---|---|---|---|---|---|
| LTDR (-1) | 0.767210 | 0.016596 | 0.057382 | -0.043977 | -0.459019 |
| | (0.07239) | (0.04122) | (0.01903) | (0.02689) | (0.21829) |
| | [ 10.5988] | [ 0.40265] | [ 3.01528] | [-1.63529] | [-2.10279] |
| LTDR (-2) | 0.096999 | 0.019898 | -0.024034 | 0.040541 | 0.207798 |

| | | | | | |
|---|---|---|---|---|---|
| | (0.07643) | (0.04352) | (0.02009) | (0.02839) | (0.23047) |
| | [ 1.26920] | [ 0.45725] | [-1.19615] | [ 1.42782] | [ 0.90162] |
| NPLR (-1) | -0.624041 | 0.747228 | 0.010999 | -0.162135 | -0.631006 |
| | (0.19653) | (0.11190) | (0.05167) | (0.07301) | (0.59266) |
| | [-3.17529] | [ 6.67754] | [ 0.21289] | [-2.22059] | [-1.06469] |
| NPLR (-2) | 0.706918 | -0.424764 | -0.167038 | 0.140245 | 0.893616 |
| | (0.21640) | (0.12321) | (0.05689) | (0.08039) | (0.65257) |
| | [ 3.26678] | [-3.44739] | [-2.93611] | [ 1.74445] | [ 1.36937] |
| LLPR (-1) | 0.656981 | 0.373077 | 1.133109 | 0.124020 | -0.895322 |
| | (0.40857) | (0.23263) | (0.10741) | (0.15179) | (1.23210) |
| | [ 1.60800] | [ 1.60370] | [ 10.5490] | [ 0.81704] | [-0.72666] |
| LLPR (-2) | -0.525203 | 0.037191 | -0.075606 | -0.059554 | 0.545482 |
| | (0.42513) | (0.24206) | (0.11177) | (0.15794) | (1.28203) |
| | [-1.23540] | [ 0.15364] | [-0.67646] | [-0.37707] | [ 0.42548] |
| CAR (-1) | 0.339479 | -0.070647 | -0.151697 | 0.991614 | 0.558716 |
| | (0.14691) | (0.08365) | (0.03862) | (0.05458) | (0.44302) |
| | [ 2.31081] | [-0.84458] | [-3.92768] | [ 18.1684] | [ 1.26114] |
| CAR (-2) | -0.356930 | 0.033622 | 0.094540 | -0.147526 | -0.689008 |
| | (0.12184) | (0.06937) | (0.03203) | (0.04527) | (0.36742) |
| | [-2.92953] | [ 0.48465] | [ 2.95145] | [-3.25915] | [-1.87525] |
| ROE (-1) | -0.104345 | -0.022820 | 0.002140 | -0.009145 | 0.224129 |
| | (0.03475) | (0.01978) | (0.00914) | (0.01291) | (0.10479) |
| | [-3.00297] | [-1.15344] | [ 0.23424] | [-0.70841] | [ 2.13894] |
| ROE (-2) | 0.008204 | -0.042973 | 0.001286 | 0.025221 | 0.283111 |
| | (0.03307) | (0.01883) | (0.00870) | (0.01229) | (0.09974) |
| | [ 0.24805] | [-2.28193] | [ 0.14790] | [ 2.05252] | [ 2.83851] |
| C | 0.045017 | 0.027345 | 0.001416 | 0.020815 | 0.235058 |
| | (0.03250) | (0.01850) | (0.00854) | (0.01207) | (0.09800) |
| | [ 1.38528] | [ 1.47785] | [ 0.16577] | [ 1.72407] | [ 2.39860] |
| R-squared | 0.891346 | 0.791000 | 0.908286 | 0.930175 | 0.450447 |

| | | | | | |
|---|---|---|---|---|---|
| Adj. R-squared | 0.882059 | 0.773137 | 0.900447 | 0.924207 | 0.403477 |
| Sum sq. resids | 0.445838 | 0.144541 | 0.030815 | 0.061537 | 4.054487 |
| S.E. equation | 0.061730 | 0.035148 | 0.016229 | 0.022934 | 0.186155 |
| F-statistic | 95.98115 | 44.28082 | 115.8705 | 155.8611 | 9.590049 |
| Log likelihood | 180.6049 | 252.6940 | 351.6096 | 307.3456 | 39.31706 |
| Akaike AIC | -2.650077 | -3.776469 | -5.322026 | -4.630400 | -0.442454 |
| Schwarz SC | -2.404980 | -3.531372 | -5.076929 | -4.385304 | -0.197358 |
| Mean dependent | 0.644218 | 0.122992 | 0.096848 | 0.156371 | 0.073716 |
| S.D. dependent | 0.179748 | 0.073794 | 0.051435 | 0.083303 | 0.241025 |

**Selection of Lag order**

VAR Lag Order Selection Criteria

Endogenous variables: LTDR NPLR LLPR CAR

ROE

Exogenous variables: C

Date: 01/10/22 Time: 16:36

Sample: 2012 2021

Included observations: 80

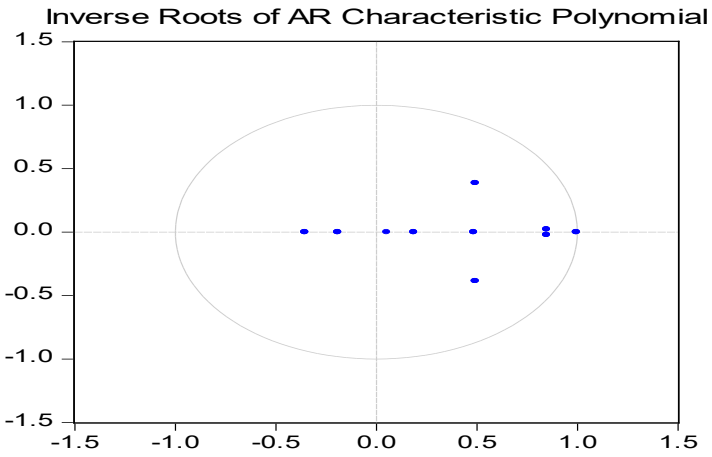
Table 3

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | 453.6428 | NA | 9.26e-12 | -11.21607 | -11.06719 | -11.15638 |
| 1 | 805.6103 | 651.1399 | 2.61e-15 | -19.39026 | -18.49700* | -19.03212* |
| 2 | 834.1342 | 49.20358 | 2.41e-15 | -19.47835 | -17.84071 | -18.82178 |
| 3 | 872.6165 | 61.57174 | 1.75e-15 | -19.81541 | -17.43339 | -18.86039 |
| 4 | 901.5262 | 42.64184 | 1.65e-15 | -19.91316 | -16.78675 | -18.65969 |
| 5 | 951.2565 | 67.13585* | 9.42e-16* | -20.53141* | -16.66062 | -18.97950 |

Hann Quinn information is used for lag order selection. According to the above table, and HQ criterion maximum 2 lag length are suitable and appropriate.

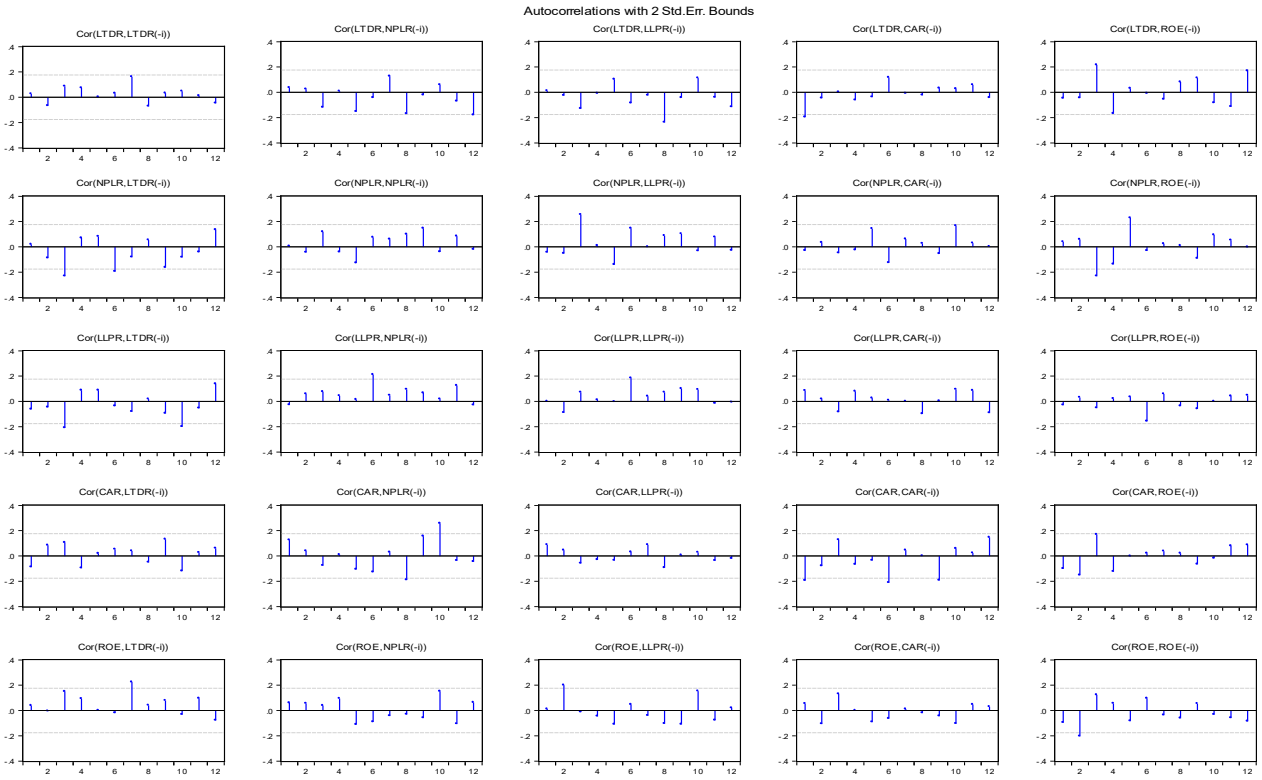
**Stability of VAR is checked through AR Roots**

Fig 1




It can easily be observed from the above diagram that all the points fall in the circle, it indicates that VAR can easily be used.

**Residual Testing through Correlogram**

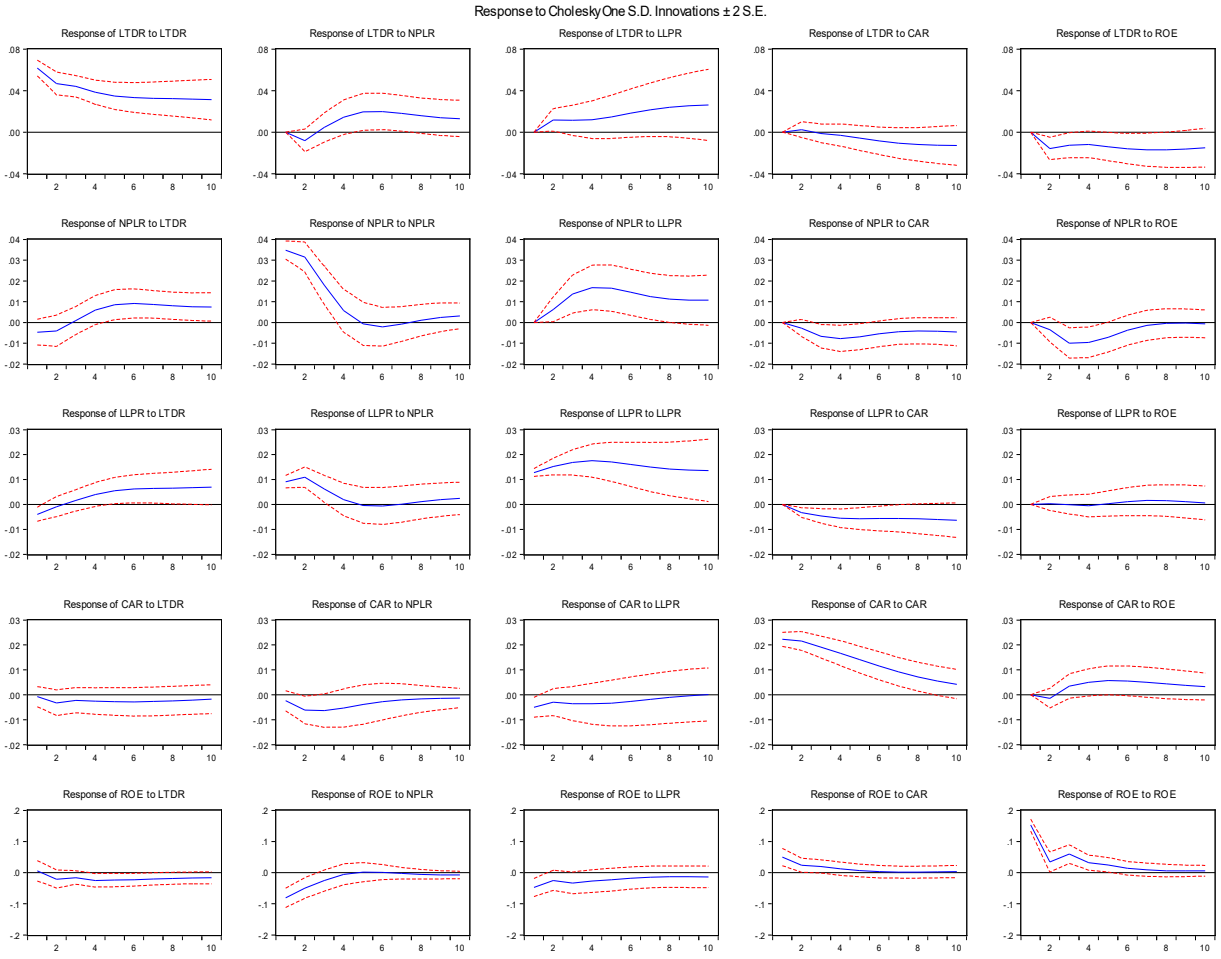


Problem of autocorrelation can be observed from the above pictures. If values are out of band, it means that there is a problem of autocorrelation. Form the above pictures, it can be observed that all the value are within the bands, that shows that problem of autocorrelation does not exist.

**Impulse Response (IR):**

IR is a very important function that indicates that how one dependent variable or independent variable behaves to shock given to itself or to other variable over a period to time. Function of IR observes the response of effect variable in the dynamic system of VAR after giving sock to each variable in every equation.It is also significant to note that error term is also given shock and effect of every unit shock is examined and monitored. There are five variables in this study that is why five impulse responses have been gathered and generated. It is also worthwhile to mention the innovations or shocks must be uncorrelated(Enders, 1995).

Figure 2



**Choleskey Degree of Freedom**

Table 4

| Response of LTDR: Period | LTDR | NPLR | LLPR | CAR | ROE |
|---|---|---|---|---|---|
| 1 | 0.061730 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| | (0.00386) | (0.00000) | (0.00000) | (0.00000) | (0.00000) |
| 2 | 0.046816 | -0.008100 | 0.011677 | 0.002354 | -0.015930 |
| | (0.00554) | (0.00551) | (0.00538) | (0.00383) | (0.00540) |
| 3 | 0.044014 | 0.004443 | 0.011325 | -0.001308 | -0.012625 |
| | (0.00518) | (0.00703) | (0.00731) | (0.00447) | (0.00605) |
| 4 | 0.038310 | 0.014315 | 0.011895 | -0.002958 | -0.011936 |
| | (0.00581) | (0.00838) | (0.00907) | (0.00537) | (0.00640) |
| 5 | 0.034745 | 0.019396 | 0.014687 | -0.005754 | -0.014075 |
| | (0.00656) | (0.00891) | (0.01044) | (0.00599) | (0.00680) |
| 6 | 0.033146 | 0.019860 | 0.018300 | -0.008476 | -0.015993 |
| | (0.00720) | (0.00877) | (0.01161) | (0.00664) | (0.00733) |
| 7 | 0.032543 | 0.018021 | 0.021589 | -0.010584 | -0.017146 |
| | (0.00778) | (0.00854) | (0.01288) | (0.00735) | (0.00798) |
| 8 | 0.032245 | 0.015733 | 0.023918 | -0.011881 | -0.017079 |
| | (0.00840) | (0.00852) | (0.01427) | (0.00811) | (0.00851) |
| 9 | 0.031830 | 0.013970 | 0.025338 | -0.012558 | -0.016244 |
| | (0.00906) | (0.00864) | (0.01570) | (0.00887) | (0.00895) |
| 10 | 0.031229 | 0.012934 | 0.026145 | -0.012899 | -0.015077 |
| | (0.00973) | (0.00875) | (0.01713) | (0.00961) | (0.00932) |
| Response of NPLR: Period | LTDR | NPLR | LLPR | CAR | ROE |
| 1 | -0.004706 | 0.034832 | 0.000000 | 0.000000 | 0.000000 |
| | (0.00309) | (0.00218) | (0.00000) | (0.00000) | (0.00000) |
| 2 | -0.004053 | 0.031450 | 0.006226 | -0.002706 | -0.003484 |
| | (0.00378) | (0.00362) | (0.00297) | (0.00206) | (0.00303) |
| 3 | 0.000929 | 0.017950 | 0.013647 | -0.006655 | -0.009989 |
| | (0.00338) | (0.00459) | (0.00458) | (0.00282) | (0.00365) |
| 4 | 0.005965 | 0.005661 | 0.016804 | -0.007741 | -0.009652 |
| | (0.00348) | (0.00518) | (0.00538) | (0.00314) | (0.00367) |
| 5 | 0.008485 | -0.000733 | 0.016543 | -0.006936 | -0.007117 |
| | (0.00361) | (0.00516) | (0.00558) | (0.00312) | (0.00356) |
| 6 | 0.009096 | -0.002105 | 0.014529 | -0.005506 | -0.003749 |
| | (0.00350) | (0.00465) | (0.00555) | (0.00308) | (0.00359) |
| 7 | 0.008635 | -0.000831 | 0.012507 | -0.004446 | -0.001459 |
| | (0.00333) | (0.00417) | (0.00556) | (0.00309) | (0.00363) |
| 8 | 0.007989 | 0.001032 | 0.011208 | -0.004050 | -0.000417 |
| | (0.00327) | (0.00381) | (0.00563) | (0.00314) | (0.00352) |
| 9 | 0.007559 | 0.002428 | 0.010692 | -0.004187 | -0.000344 |
| | (0.00330) | (0.00345) | (0.00578) | (0.00324) | (0.00340) |
| 10 | 0.007431 | 0.003118 | 0.010675 | -0.004583 | -0.000724 |
| | (0.00342) | (0.00309) | (0.00604) | (0.00340) | (0.00334) |

Response of LLPR:

| Period | LTDR | NPLR | LLPR | CAR | ROE |
|---|---|---|---|---|---|
| 1 | -0.003973 | 0.009122 | 0.012821 | 0.000000 | 0.000000 |
| | (0.00141) | (0.00127) | (0.00080) | (0.00000) | (0.00000) |
| 2 | -0.000883 | 0.010910 | 0.015191 | -0.003266 | 0.000327 |
| | (0.00203) | (0.00205) | (0.00168) | (0.00096) | (0.00139) |
| 3 | 0.001629 | 0.006232 | 0.016843 | -0.004654 | -0.000101 |
| | (0.00215) | (0.00271) | (0.00257) | (0.00145) | (0.00191) |
| 4 | 0.003967 | 0.001899 | 0.017574 | -0.005563 | -0.000494 |
| | (0.00239) | (0.00328) | (0.00332) | (0.00187) | (0.00228) |
| 5 | 0.005533 | -0.000380 | 0.017066 | -0.005730 | 0.000347 |
| | (0.00264) | (0.00361) | (0.00394) | (0.00220) | (0.00255) |
| 6 | 0.006229 | -0.000671 | 0.016022 | -0.005643 | 0.001136 |
| | (0.00283) | (0.00368) | (0.00446) | (0.00248) | (0.00281) |
| 7 | 0.006478 | 9.69E-05 | 0.014980 | -0.005614 | 0.001591 |
| | (0.00299) | (0.00361) | (0.00492) | (0.00274) | (0.00303) |
| 8 | 0.006583 | 0.001107 | 0.014248 | -0.005767 | 0.001528 |
| | (0.00317) | (0.00349) | (0.00537) | (0.00299) | (0.00319) |
| 9 | 0.006731 | 0.001913 | 0.013837 | -0.006057 | 0.001119 |
| | (0.00337) | (0.00335) | (0.00581) | (0.00323) | (0.00331) |
| 10 | 0.006959 | 0.002406 | 0.013639 | -0.006386 | 0.000558 |
| | (0.00359) | (0.00325) | (0.00628) | (0.00348) | (0.00342) |

Response of CAR:

| Period | LTDR | NPLR | LLPR | CAR | ROE |
|---|---|---|---|---|---|
| 1 | -0.000768 | -0.002399 | -0.005047 | 0.022229 | 0.000000 |
| | (0.00203) | (0.00202) | (0.00199) | (0.00139) | (0.00000) |
| 2 | -0.003259 | -0.006154 | -0.002979 | 0.021588 | -0.001396 |
| | (0.00257) | (0.00276) | (0.00271) | (0.00189) | (0.00197) |
| 3 | -0.002212 | -0.006386 | -0.003585 | 0.019097 | 0.003459 |
| | (0.00253) | (0.00334) | (0.00344) | (0.00219) | (0.00245) |
| 4 | -0.002596 | -0.005343 | -0.003621 | 0.016637 | 0.004965 |
| | (0.00266) | (0.00383) | (0.00411) | (0.00251) | (0.00275) |
| 5 | -0.002764 | -0.003936 | -0.003349 | 0.014051 | 0.005740 |
| | (0.00279) | (0.00396) | (0.00461) | (0.00270) | (0.00289) |
| 6 | -0.002835 | -0.002792 | -0.002678 | 0.011514 | 0.005544 |
| | (0.00286) | (0.00370) | (0.00490) | (0.00281) | (0.00298) |
| 7 | -0.002692 | -0.002072 | -0.001856 | 0.009193 | 0.005012 |
| | (0.00288) | (0.00322) | (0.00509) | (0.00287) | (0.00302) |
| 8 | -0.002426 | -0.001690 | -0.001051 | 0.007190 | 0.004361 |
| | (0.00288) | (0.00270) | (0.00520) | (0.00291) | (0.00298) |
| 9 | -0.002107 | -0.001490 | -0.000378 | 0.005540 | 0.003765 |
| | (0.00288) | (0.00226) | (0.00528) | (0.00294) | (0.00288) |
| 10 | -0.001794 | -0.001353 | 0.000133 | 0.004217 | 0.003260 |
| | (0.00288) | (0.00193) | (0.00532) | (0.00295) | (0.00273) |

Response of ROE:

| Period | LTDR | NPLR | LLPR | CAR | ROE |
|---|---|---|---|---|---|
| 1 | 0.005841 | -0.081052 | -0.047605 | 0.049761 | 0.152669 |
| | (0.01645) | (0.01565) | (0.01450) | (0.01385) | (0.00954) |
| 2 | -0.020928 | -0.049653 | -0.024968 | 0.023573 | 0.034218 |
| | (0.01442) | (0.01655) | (0.01599) | (0.01126) | (0.01614) |

| | | | | | |
|---|---|---|---|---|---|
| 3 | -0.016016 | -0.025653 | -0.033157 | 0.019667 | 0.059330 |
| | (0.01098) | (0.01705) | (0.01723) | (0.01074) | (0.01490) |
| 4 | -0.025129 | -0.005709 | -0.027063 | 0.012134 | 0.031822 |
| | (0.01076) | (0.01680) | (0.01819) | (0.01076) | (0.01207) |
| 5 | -0.024128 | 0.001393 | -0.023069 | 0.006890 | 0.024727 |
| | (0.01079) | (0.01524) | (0.01839) | (0.01020) | (0.01175) |
| 6 | -0.023079 | 0.001147 | -0.017594 | 0.002949 | 0.013604 |
| | (0.01027) | (0.01198) | (0.01791) | (0.00990) | (0.01087) |
| 7 | -0.020394 | -0.002216 | -0.014431 | 0.001261 | 0.008786 |
| | (0.00980) | (0.00919) | (0.01751) | (0.00966) | (0.01068) |
| 8 | -0.018428 | -0.005360 | -0.013096 | 0.001250 | 0.006114 |
| | (0.00951) | (0.00741) | (0.01730) | (0.00960) | (0.00992) |
| 9 | -0.017129 | -0.007154 | -0.013302 | 0.002259 | 0.005578 |
| | (0.00944) | (0.00648) | (0.01729) | (0.00966) | (0.00922) |
| 10 | -0.016538 | -0.007651 | -0.014184 | 0.003597 | 0.005663 |
| | (0.00955) | (0.00593) | (0.01752) | (0.00985) | (0.00857) |

Cholesky Ordering:
LTDR,NPLR,LLPR,CAR,ROE
Standard Errors: Analytic

## Granger Causality

Table 5

VAR Granger Causality/Block Exogeneity Wald Tests

Date: 01/10/22 Time: 16:47

Sample: 2012 2021

Included observations: 128

DV: LTDR

| Excluded | Chi-sq | Df | Prob. |
|---|---|---|---|
| NPLR | 15.53534 | 2 | 0.0004 |
| LLPR | 2.589475 | 2 | 0.2740 |
| CAR | 8.648539 | 2 | 0.0132 |
| ROE | 9.388186 | 2 | 0.0091 |
| All | 55.50850 | 8 | 0.0000 |

Above mentioned results are indicating the granger causality among all variables. According to the above table NPLR, CAR and ROE have significant impact on the LTDR. LLPR is not affecting the LTDR. Overall results is significant because p value is .0000 which is less than .05.

Table 6

DV:NPLR

| Excluded | Chi-sq | Df | Prob. |
|---|---|---|---|
| LTDR | 2.583482 | 2 | 0.2748 |
| LLPR | 6.600864 | 2 | 0.0369 |
| CAR | 0.878164 | 2 | 0.6446 |
| ROE | 8.663629 | 2 | 0.0131 |
| All | 22.57328 | 8 | 0.0040 |

Above mentioned results are indicating the granger causality among all variables. According to the above table LTDR, ROE has significant impact on the NOLR. CAR and LTDR are not affecting the NPLR. Overall results is significant because p value is .0040 which is less than .05.

Table 7
DV:LLPR

| Excluded | Chi-sq | Df | Prob. |
|---|---|---|---|
| LTDR | 16.33425 | 2 | 0.0003 |
| NPLR | 9.296637 | 2 | 0.0096 |
| CAR | 15.80308 | 2 | 0.0004 |
| ROE | 0.103953 | 2 | 0.9494 |
| All | 41.30598 | 8 | 0.0000 |

Above mentioned results are indicating the granger causality among all variables. According to the above table LTDR, NPLR, CAR has significant impact on the LLPR. ROE is not affecting the LLPR. Overall results is significant because p value is .0000 which is less than .05.

Table 8
DV: CAR

| Excluded | Chi-sq | Df | Prob. |
|---|---|---|---|
| LTDR | 2.676835 | 2 | 0.2623 |
| NPLR | 6.053631 | 2 | 0.0485 |
| LLPR | 0.785085 | 2 | 0.6753 |
| ROE | 4.233854 | 2 | 0.1204 |
| All | 19.79928 | 8 | 0.0111 |

Above mentioned results are indicating the granger causality among all variables. According to the above table NPLR has significant impact on the CAR. All other independent variables are not affecting the ROE. Overall results is significant because p value is .0111 which is less than .05.

Table 9

DV: ROE

| Excluded | Chi-sq | Df | Prob. |
|---|---|---|---|
| LTDR | 7.470031 | 2 | 0.0239 |
| NPLR | 2.286895 | 2 | 0.3187 |
| LLPR | 0.557051 | 2 | 0.7569 |
| CAR | 3.833972 | 2 | 0.1470 |
| All | 17.11343 | 8 | 0.0289 |

Above mentioned results showing the granger causality among all variables. According to the above table LTDR has significant impact on the ROE. All other independent variables are not affecting the ROE. Overall results is significant because p value is .0289 which is less than .05.

**Variance Decomposition (VD):**

VD is used to analyze dynamic nature of system and system is analyzed and examined by using VD in a different and unique way. In VD, shocks are given to each cause variable involved in the equation and response of each shock is observed on dependent variable. It is also imperative to not that shock is also given to error term and effect of each shock is observed and noted.

Table 10

| VD of LTDR: Period | S.E. | LTDR | NPLR | LLPR | CAR | ROE |
|---|---|---|---|---|---|---|
| 1 | 0.061730 | 100.0000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 0.080397 | 92.86337 | 1.015140 | 2.109561 | 0.085734 | 3.926191 |
| 3 | 0.093327 | 91.15522 | 0.979935 | 3.038002 | 0.083262 | 4.743577 |
| 4 | 0.103321 | 88.12191 | 2.719208 | 3.804085 | 0.149912 | 5.204881 |
| 5 | 0.112719 | 83.54163 | 5.245528 | 4.893953 | 0.386546 | 5.932343 |
| 6 | 0.121906 | 78.81675 | 7.138822 | 6.437519 | 0.813897 | 6.793014 |
| 7 | 0.130832 | 74.61637 | 8.095316 | 8.311956 | 1.361050 | 7.615312 |
| 8 | 0.139317 | 71.16121 | 8.414591 | 10.27776 | 1.927607 | 8.218834 |
| 9 | 0.147245 | 68.37736 | 8.433063 | 12.16196 | 2.453027 | 8.574586 |
| 10 | 0.154600 | 66.10721 | 8.349752 | 13.89246 | 2.921297 | 8.729277 |

Table 11
VD of NPLR:

| Period | S.E. | LTDR | NPLR | LLPR | CAR | ROE |
|---|---|---|---|---|---|---|
| 1 | 0.035148 | 1.792600 | 98.20740 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 0.047949 | 1.677807 | 95.78973 | 1.686039 | 0.318484 | 0.527939 |
| 3 | 0.054337 | 1.335769 | 85.50508 | 7.620553 | 1.748184 | 3.790409 |
| 4 | 0.058784 | 2.170831 | 73.98416 | 14.68278 | 3.227896 | 5.934326 |
| 5 | 0.062455 | 3.768907 | 65.55780 | 20.02428 | 4.093183 | 6.555838 |
| 6 | 0.065140 | 5.414304 | 60.36864 | 23.38227 | 4.477123 | 6.357665 |
| 7 | 0.067058 | 6.766961 | 56.97991 | 25.54243 | 4.664218 | 6.046486 |
| 8 | 0.068585 | 7.825784 | 54.49416 | 27.08849 | 4.807562 | 5.784008 |
| 9 | 0.069992 | 8.680637 | 52.44519 | 28.34388 | 4.974115 | 5.556179 |
| 10 | 0.071409 | 9.422343 | 50.57449 | 29.46463 | 5.190444 | 5.348092 |

| Period | S.E. | LTDR | NPLR | LLPR | CAR | ROE |
|---|---|---|---|---|---|---|
| 1 | 0.016229 | 5.993819 | 31.59629 | 62.40990 | 0.000000 | 0.000000 |
| 2 | 0.024995 | 2.651605 | 32.37405 | 63.25025 | 1.707019 | 0.017083 |
| 3 | 0.031170 | 1.978196 | 24.81440 | 69.86855 | 3.326825 | 0.012033 |
| 4 | 0.036482 | 2.626243 | 18.38479 | 74.20825 | 4.753568 | 0.027141 |
| 5 | 0.041060 | 3.888995 | 14.52256 | 75.85946 | 5.700433 | 0.028554 |
| 6 | 0.044889 | 5.179561 | 12.17300 | 76.20976 | 6.349771 | 0.087909 |
| 7 | 0.048119 | 6.319944 | 10.59390 | 76.01319 | 6.887084 | 0.185885 |
| 8 | 0.050977 | 7.298932 | 9.486701 | 75.54237 | 7.416514 | 0.255487 |
| 9 | 0.053637 | 8.167530 | 8.696002 | 74.88810 | 7.974083 | 0.274284 |
| 10 | 0.056199 | 8.973531 | 8.104670 | 74.10711 | 8.554990 | 0.259698 |

| VD of CAR: Period | S.E. | LTDR | NPLR | LLPR | CAR | ROE |
|---|---|---|---|---|---|---|
| 1 | 0.022934 | 0.112124 | 1.094291 | 4.843176 | 93.95041 | 0.000000 |
| 2 | 0.032424 | 1.066614 | 4.149582 | 3.267325 | 91.33106 | 0.185415 |
| 3 | 0.038555 | 1.083506 | 5.678565 | 3.175196 | 89.12672 | 0.936016 |
| 4 | 0.042852 | 1.244136 | 6.151426 | 3.284516 | 87.21997 | 2.099957 |
| 5 | 0.045837 | 1.451095 | 6.113863 | 3.404543 | 85.62705 | 3.403451 |
| 6 | 0.047826 | 1.684389 | 5.956619 | 3.440699 | 84.44855 | 4.469744 |
| 7 | 0.049112 | 1.897840 | 5.826925 | 3.405798 | 83.58907 | 5.280365 |
| 8 | 0.049925 | 2.072641 | 5.753133 | 3.340073 | 82.96136 | 5.872794 |
| 9 | 0.050440 | 2.205021 | 5.723616 | 3.277863 | 82.48288 | 6.310619 |
| 10 | 0.050771 | 2.301298 | 5.720244 | 3.235976 | 82.10154 | 6.640939 |

| VD of ROE Period | S.E. | LTDR | NPLR | LLPR | CAR | ROE |
|---|---|---|---|---|---|---|
| 1 | 0.186155 | 0.098454 | 18.95713 | 6.539769 | 7.145376 | 67.25927 |
| 2 | 0.199768 | 1.183037 | 22.63950 | 7.241060 | 7.597172 | 61.33924 |
| 3 | 0.214074 | 1.589907 | 21.15055 | 8.704498 | 7.459672 | 61.09537 |
| 4 | 0.219964 | 2.810971 | 20.10044 | 9.758302 | 7.369832 | 59.96045 |
| 5 | 0.223963 | 3.872078 | 19.39295 | 10.47391 | 7.203663 | 59.05739 |
| 6 | 0.226267 | 4.834045 | 19.00261 | 10.86630 | 7.074699 | 58.22234 |
| 7 | 0.227825 | 5.569424 | 18.75291 | 11.11934 | 6.981278 | 57.57704 |
| 8 | 0.229092 | 6.155067 | 18.60086 | 11.32349 | 6.907270 | 57.01332 |
| 9 | 0.230306 | 6.643480 | 18.50176 | 11.53804 | 6.844255 | 56.47246 |
| 10 | 0.231558 | 7.081939 | 18.41142 | 11.78882 | 6.794577 | 55.92324 |

Chelsey Ordering:
**Ltdr,Nplr,Llpr,Roe**

Results shown in the above table depicts that LTDR is being influences or affected by LTDR and LTDR in the later part is being influenced by LLPR.

Results shown in the above table depicts the NPLR is 100 percent affected by NPLR and NPLR in the later part is being influenced by LLPR.

Results shown in the above table depicts the LLPR is 100 percent affected by LLPR and LLPR in the later part is being mostly influenced by NPLR.

CAR is also being influenced by CAR itself.

**Short Term Impact by using VECM:**

In penal data, it is very **difficult to find out long term relationship** among different variables, only short term relationship can be found and results of short term relationship are as follows:

Dependent Variable: ROE

Method: Panel Least Squares

Date: 01/10/22 Time: 15:56

Sample: 2012 2021

Periods included: 10

Cross-sections included: 16
Total panel (balanced) observations: 160
Table 12

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.421925 | 0.064052 | 6.587246 | 0.0000 |
| LTDR | -0.232497 | 0.091565 | -2.539139 | 0.0121 |
| NPLR | -2.096312 | 0.370730 | -5.654548 | 0.0000 |
| LLPR | 0.303383 | 0.502411 | 0.603855 | 0.5468 |
| CAR | 0.119211 | 0.174458 | 0.683322 | 0.4954 |

| | | | |
|---|---|---|---|
| R-squared | 0.448204 | Mean dependent var | 0.070599 |
| Adjusted R-squared | 0.433964 | S.D. dependent var | 0.247523 |
| S.E. of regression | 0.186225 | Akaike info criterion | -0.492973 |
| Sum squared resid | 5.375353 | Schwarz criterion | -0.396873 |
| Log likelihood | 44.43781 | Hannan-Quinn criter. | -0.453950 |
| F-statistic | 31.47523 | Durbin-Watson stat | 1.371565 |
| Prob(F-statistic) | 0.000000 | | |

To check the short term relationship through VECM first the normal equation was run and residual was residual. In this study we saved the residual with the name of ET and the following equation was applied.

$$\Delta ROE_{it} = \alpha + \beta_1 \Delta LTDR_{it} + \beta_2 \Delta NPL_{it} + \beta_3 \Delta LLPR_{it} + \beta_4 \Delta CAR_{it} + \theta \varepsilon_{t-1} + \xi_t$$

Above model has been developed by the differences of each variable because it is the requirement of short term relationship can be judged and observed.

Results of above equation are as follows:

Dependent Variable: DROE

Method: Panel Least Squares

Date: 01/10/22 Time: 16:05

Sample (adjusted): 2013 2021

Periods included: 9

Cross-sections included: 16

Total panel (balanced) observations: 144

Table 13

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.009833 | 0.013502 | 0.728217 | 0.4677 |
| DLTDR | -0.253350 | 0.176135 | -1.438388 | 0.1526 |
| DNPLR | -1.733689 | 0.423564 | -4.093098 | 0.0001 |
| DLLPR | -2.375718 | 0.836236 | -2.840968 | 0.0052 |
| DCAR | 0.649781 | 0.284104 | 2.287122 | 0.0237 |
| ET(-1) | -0.752246 | 0.076893 | -9.782977 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.502333 | Mean dependent var | 0.004148 |
| Adjusted R-squared | 0.484302 | S.D. dependent var | 0.220381 |
| S.E. of regression | 0.158261 | Akaike info criterion | -0.808373 |
| Sum squared resid | 3.456407 | Schwarz criterion | -0.684631 |
| Log likelihood | 64.20288 | Hannan-Quinn criter. | -0.758091 |
| F-statistic | 27.85879 | Durbin-Watson stat | 2.211759 |
| Prob(F-statistic) | 0.000000 | | |

Et is significant and its coefficient is negative it indicates that there is a short run association ship which exist among cause and effect variables and speed of adjustment is a bit high as the

coefficient of error term is – 0.75 which means that short term relationship is converging quickly.

## Conclusion and Future Directions

This study is based on CRM and prime objective of this research is to know how these CRM factors affect profitability of banks and each other. Uniqueness of this study is that in this paper VAR approach has been used to know the effect of cause variables on the effect variable and effect of each variable on each other. Effect variable of this study is ROE and cause or independent variables of this research are LTDR, LLPR, NPLR and CAR. As discussed in the earlier chapters, objective of this research are to know how CRM factors affect each other. VAR model has been used to know the impact of different variables on each other. Stability of VAR has been checked through residual testing. In this study, variance decomposition and impulse response have been analyzed and checked. In VAR, shocks are given to each cause variable involved in the equation and response of each shock is observed on dependent variable. It is also imperative to not that shock is also given to error term and effect of each shock is observed and noted. Granger causality among all the variables have also been checked. There is bidirectional relationship between LTDR and ROE. Results of granger causality reveal that almost all the variables are affecting or explaining each other.

In the function of variance decomposition, dependent variable is given movements, these movements are the results of shocks. Shocks are sometime due to cause variables and sometime due to effect variable. In VAR, Shocks affect all variables involved in the model. Original variable is also affected by shock and other variables are also affected by the shocks. In variance decomposition analysis, all the variables are mostly being affected by themselves or by their own shocks and shocked of other variables. Finally, short term relationship was identified among all the variable through VECM and shot term relationship was found as indicated in the results section.

## Future Directions

- This study is based on private commercial banks only. Public banks are not included in this study. All those banks which come under the public sector may also be included in future for further studies.

- In future, sharia compliance banks can also be taken into consideration.
- Macro-economic factors such as interest rate and inflation can also be added in future studies. These factors also affect the profitability of banks.
- Operating, liquidity and market risks can also be included in future studies.
- Mixed method, qualitative and quantitative techniques can also be used or adopted at a same time to triangulate the results in future.

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