The Impact of Non-Performing Assets on the Performance of Scheduled Commercial Banks of India: A Time-Series Analysis

Paromita Dutta* and Chanchal Chatterjee**

The Indian financial system consists of various financial institutions, of which commercial banks play an active role in the development of the country's economy as a whole. The present paper attempts to study the impact of Non-Performing Assets (NPA), capital adequacy to risk-weighted assets and liquidity on the operational performance [termed as Return on Assets (ROA)] of scheduled commercial banks in India. ROA is taken as the dependent variable. The time-series data has been collected for scheduled commercial banks (consisting of 27 public sector, 25 private sector and 45 foreign banks) in India for the period 1997-1998 to 2016-2017. The study uses Augmented Dickey-Fuller Test to check the stationarity of data. To measure the cointegrating relationship between dependent and independent variables, Johansen cointegration model has been used. The study finds that there is a long-run causality between dependent and independent variables with negative coefficients for NPA and liquidity.

Introduction

Indian financial system is greatly dominated by banks, but the constant deterioration of bank's asset quality has not only shrunk its overall profitability, but has also restricted financial intermediation. During 2016-17, almost 35% credit was provided by commercial banks to commercial sector.

The stock-in-trade in banking business is money, which they deal in terms of deposits from various economic agents in the form of loans and advances. Adequate assets are required for survival, sustenance and development in the overall bank money creation process and it also helps to shape the fortune of the firm in both short and long run.

Asset quality is an aspect of banking operation, as it entails evaluation of a bank's asset in order to facilitate the measurement of the level and size of credit risk associated with its operations.

The quality of assets in banking sector is a popular issue in bankruptcy. A sizeable amount of non-performing loans must exist before declaring a bank as bankrupt, since bank asset

* Assistant Professor, Accounting and Finance, Xavier Business School, St. Xavier's University, Action Area-IIB, New Town, Kolkata 700160, West Bengal, India; and is the corresponding author. E-mail: paromita22oct@gmail.com

** Associate Professor, Finance International Management Institute, 2/4C, Judges Court Road, Alipore, Kolkata 700027, West Bengal, India. E-mail: cchatterjee.finance@gmail.com

quality is an indicator for the liquidation of banks (Demirguc-Kunt, 1991; and Whalen, 1991). The main reason behind the deterioration of bank's asset quality is size and types of loans and advances provided to various priority and non-priority sectors. Based on the world financial report of International Monetary Fund (Annual Report of IMF, 2009), Non-Performing Assets (NPAs) are considered as the main cause of economic stagnation. By identifying and mitigating the distressed assets and ensuring recapitalization of weak institutions, the conditions of collapsed institutions are resolved and reinstated.

Hence, this banking challenge raised a research enquiry on the nature of the relationship between bank asset quality and its overall performance, due to the indispensable nature of banking operation in the financial intermediation process and development. The study examines the influence the asset quality has on the performance of scheduled commercial banks in India.

Literature Review

Many studies have been conducted on bank's profitability in the context of bad loans and factors affecting those bad loans. Quality of assets is primarily affected by credit administration program and quality of portfolio of loans (Nazir and Tabassum, 2010). The basis of management evaluation is bank's ranking which is significantly affected by quality of assets.

Sangmi and Nair (2010) elaborated CAMEL approach by forming hypothesis on two banks, namely, Punjab National Bank and Jammu and Kashmir Bank. Both the banks have adopted prudent policies of financial management and have shown significant performance as far as asset quality is concerned. It can be seen that the presence of a large number of NPAs would negatively affect the performance of banks. This view is supported by Dash and Kabra (2010) and Jing-Xin and Wei (2010) who studied that NPAs in banks and financial institutions have resulted in causation of financial crisis in both developed and developing countries. Chatterjee *et al.* (2012) found that NPAs have a negative influence on mobilization of funds and its deployment policy, credibility and productivity of banking system, the level of capital adequacy and the economy as well.

Other researchers opined that there is a negative relationship between NPA and overall efficiency (Kwan and Eisenbeis, 1996). Haslem (1968) examined that there are two sets of factors that have a bearing on the performance of banks, namely, internal and external factors. Internal factors emerge from balance sheet and profit and loss account of the bank that are often termed as 'bank-specific determinants of profitability', whereas external determinants are economic forces which condition the operations and performance of financial institutions. The economic forces can be inflation, interest rates, cyclical output and variables that represent market characteristics such as market concentration, industry size and ownership status.

The performance of bank (mainly its profitability) is determined by the cost control methods adopted by a particular bank. It can be seen that the high profit earning banks have low operating cost. Sufian and Noor (2012) examined the internal and external factors influencing the performance of commercial banks operating in India during the period 2000-2008. The study found that credit risk, network embedded, operating expenses, liquidity and size had a significant impact on the profitability and overall performance of banks. However, the impact on the performance was not uniform across banks in countries of Asian origin. Khalid (2011) explained that banks list amount of loans for collection purpose and for that banks incur extra operating costs to supervise the collection process such as frequent tracking of debtors' financial status, paying for negotiation of contract, vigilant about collateral value, costs incurred to monitor the quality of loans and high future costs generated, when the loan quality issues comes into the purview of the senior management. Abata and Adeolu (2014) explored the financial stability of Nigeria financial service industry due to loan problems and unexpected losses with different loan severity. The study used various ratios to measure the bank performance and asset quality. The study found a statistical relationship between asset quality and bank performance and concludes with the recommendation of various policies that would encourage revenue diversification, minimize credit risk and liquidity holdings.

Singh (2006) examined the broad structure of banking system in India and analyzed the overall efficiency of the system on two broad parameters: technical efficiency and allocation efficiency. The study uses DEA approach to study the technical efficiency of commercial banks in India over the period 2006-10. The study concludes that deregulation in the banking sector increases the efficiency of commercial banks in India. But still some banks like SBI, PNB and HDFC can be a matter of concern as their efficiency scores are below satisfactory level. The main reason for such poor performance is huge amount of deposits and operating expenses. Vallabh *et al.* (2007) explored the application of empirical analysis of NPAs. Various macroeconomic and bank-specific parameters were established to study the behavior of NPAs for three categories of banks, i.e., public, private and foreign. Siraj and Pillai (2011) investigated the performance of Indian commercial banks before and after the global financial crisis from 2007 to 2009. It was observed that the financial crisis led to higher NPAs and forced banks to invest in less risky investment portfolios. A reduction in cash-deposit ratio has been observed after 2007 across all banks.

Singh (2013) observed that the NPAs of public sector banks are increasing year by year. On the contrary, the NPAs of private sector banks decrease year by year. The main reason for decreasing NPAs is credit appraisal process of private sector banks, which they have strengthened over the years. Shingjergji (2013) examined the impact of macroeconomic variables such as GDP, inflation rate, exchange rate and base interest rate on non-performing loans. The study highlighted that the fast increase in non-performing loans not only increased vulnerability of banks to further shocks, but also limited their lending operations with broader repercussions for economic activity. The paper identifies the main determinants behind the non-performing loans. The examination of the feedback effect between banking system and economic activity broadly confirms the strong macro-financial linkages. The study concluded that there is a positive relationship between base interest rate and non-performing loans.

Mittal and Suneja (2017) described that the size of NPA is the most important factor that measures the health of the banking industry. The study compares the performance of both public and private sector banks and shows that the magnitude of NPAs is more in public sector banks and the banks should take some control measures to increase their profitability and efficiency.

Raghavan (2008) elaborated on the importance of Basel II norms for Indian banks. Basel II norms should be viewed as the overall risk management capabilities of banks rather than basic regulatory guidelines. The progressive implementation of Basel III capital requirements has provided an impetus for the banking system as a whole to scaleup Capital to Risk Weighted Assets Ratio (CRAR).

Objective

The main objective of this paper is to study the impact of NPAs, capital adequacy to risk-weighted assets and liquidity on the profitability (ROA) of the scheduled commercial banks in India.

Data and Methodology

To investigate the linkages between total NPAs, capital adequacy, liquidity and profitability (return) of banks, data was collected for 27 public sector, 25 private sector and 45 foreign banks in India for the period 1997-1998 to 2016-2017, resulting in a balanced pool of time-series data of 1940 observations.

The time period was selected on the basis of data availability, which is based on a number of conditions. First, banks should have balance sheets for all the years across the study period in the Prowess, a highly reliable corporate database maintained by Centre for Monitoring Indian Economy (CMIE); and secondly, banks should be classified as Scheduled Commercial Banks. The reason behind considering only scheduled commercial banks is to avoid comparisons between different types of banks like regional rural banks, investment banks, cooperative banks and so on.

Augmented Dickey-Fuller (ADF) test has been conducted to find out whether the dependent variable ROA has a unit root, i.e., whether the variable is stationary or not. The number of cointegrating relationships between dependent and independent variables is also checked using Johansen cointegration model. To estimate the long-run or short-run causality between the variables, VECM test is conducted. The problem of serial correlation and heteroskedasticity is also taken care of through Breusch-Godfrey Serial Correlation LM test and Breusch-Pagan-Godfrey test of heteroskedasticity.

A few possibilities may crop up depending on the constraints based on constant and time trend which are summarized in Table 1. On the basis of Table 1, if the data follows an increasing time trend, then it is better to choose the fourth situation. Hence, the choice of situation depends on economic theory and trending behavior of the data.

Table 1: Different Situations in ADF Unit Root Test Based on Constant and Time Trend			
Situations	Possibilities Under *Null Hypothesis* (H_0)	Equation	Explanation
1	Pure Random Walk	$Y_t = Y_{t-1} + \varepsilon_t$	It predicts that the value at time '*t*' is equal to the last period value plus a stochastic component, i.e., ε_t, which is independent and identically distributed with mean '0' and variance 'σ^2'.
2	Random Walk with Drift	$Y_t = \alpha + Y_{t-1} + \varepsilon_t$	It predicts that the value at time '*t*' is equal to the last period value plus a constant or drift (α) and a white noise term, i.e., ε_t.
3	Deterministic Trend	$Y_t = \alpha + \beta_t + \varepsilon_t$	The value at time '*t*' is regressed on a time trend 'β_t'.
4	Random Walk with Drift and Deterministic Trend.	$Y_t = \alpha + Y_{t-1} + \beta_t + \varepsilon_t$	It specifies the value at time '*t*' by the last period's value, a drfit, a trend and a stochastic component.

Results and Discussion

Asset Quality of Public Sector, Private Sector and Foreign Banks

NPA is a double-edged weapon that effects profitability of banks. NPAs can dry up the credit flow to various priority and non-priority sectors. Tables 2, 3 and 4 show the growth in gross GNPAs of public sector, private sector and foreign banks, respectively.

From Table 2, it can be observed that the change in the growth of GNPA increased in 2008, but remained more or less stable till 2011, from there it rose to 55.16% in 2012, declined in 2015 and again increased drastically in 2016 (382.31%). Similarly, the percentage of GNPA to gross advances also decreased from 2006 to 2009, i.e., from 3.58% to 2.26%, and afterwards started increasing, and in 2016 and 2017 (9.29 and 11.70%), it was at its peak level.

Table 3 shows that the private sector banks experienced a sharp decline in the growth of NPAs, especially during the period 2007 to 2012. In 2007, the changes in growth of NPA were 67.52%, which declined to 1.80% in 2012, increased thereafter, and rose to 152.85% in 2016. The percentage of GNPA on gross advances increased slightly in 2016 from 2015 and was highest in 2017 (4.09%).

Table 4 shows that the foreign banks registered a boom in the growth of NPAs in 2009 and 2012, whereas GNPA to gross advances increased from 2006 onwards, and was highest in 2014. There was a substantial change in the growth of GNPA; it rose to 92.03% in 2016 from 3.64% in 2015, but GNPA as a percentage of gross advances declined in 2016 from 2015.

Table 2: Growth in Gross NPAs of Public Sector Banks				
Year	Gross Advances (₹)	Gross NPAs (₹)	Gross NPAs as a % of Gross Advances	Change in Growth in Gross NPAs (%)
2006	507,015.77	18,168.30	3.58	
2007	660,267.12	16,874.20	2.56	7.13
2008	822,985.45	19,393.50	2.36	14.93
2009	1,037,447.91	23,427.10	2.26	20.80
2010	1,041,713.36	28,507.83	2.74	21.68
2011	1,239,786.13	35,282.85	2.85	23.77
2012	1,430,418.90	54,745.50	3.83	55.16
2013	2,044,661.90	79,526.30	3.89	45.27
2014	2,388,665.20	103,561.00	4.34	30.22
2015	2,568,175.50	111,963.10	4.36	8.11
2016	5,812,809.47	540,010.10	9.29	382.31
2017	5,852,136.75	684,700.50	11.70	26.79

Source: Report on Trend and Progress of Indian Banks, RBI

Table 3: Growth in Gross NPAs of Private Sector Banks				
Year	Gross Advances (₹)	Gross NPAs (₹)	Gross NPA as a % of Gross Advances	Change in Growth in Gross NPAs (%)
2006	205,498.78	3,093.37	1.51	
2007	282,602.00	5,182.00	1.83	67.52
2008	353,823.00	8,970.00	2.54	73.10
2009	405,980.56	12,523.71	3.08	39.62
2010	360,389.29	12,370.01	3.43	1.23
2011	450,006.83	13,063.27	2.90	5.60
2012	529,207.60	12,827.70	2.42	1.80
2013	738,623.20	14,027.30	1.90	9.35

Table 3 (Cont.)

Year	Gross Advances (₹)	Gross NPAs (₹)	Gross NPA as a % of Gross Advances	Change in Growth in Gross NPAs (%)
2014	884,673.50	16,282.60	1.84	16.08
2015	1,050,858.50	22,227.40	2.12	36.51
2016	2,007,225.50	56,202.30	2.79	152.85
2017	2,273,173.10	93,200.10	4.09	65.83
Source: Report on Trend and Progress of Indian Banks, RBI				

Table 4: Growth in Gross NPAs of Foreign Banks

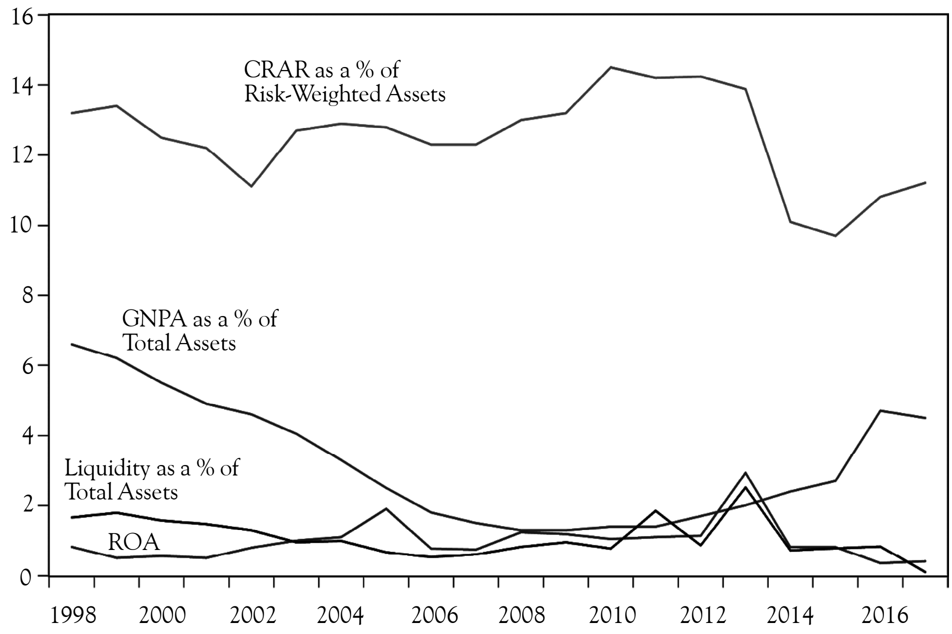
Year	Gross Advances (₹)	Gross NPAs (₹)	Gross NPA as a % of Gross Advances	Change in Growth in Gross NPAs (%)
2006	66,182.34	1,529.54	2.31	
2007	87,128.00	1,889.00	2.17	23.50
2008	103,111.00	2,431.00	2.36	28.69
2009	107,753.32	4,684.50	4.35	92.70
2010	103,854.82	4,054.33	3.90	13.45
2011	119,307.65	2,981.99	2.50	26.45
2012	141,933.80	4,778.70	3.37	60.25
2013	153,691.00	5,879.60	3.83	23.04
2014	171,993.00	7,939.20	4.62	35.03
2015	183,431.40	8,228.50	4.49	3.64
2016	376,190.47	15,800.10	4.20	92.03
2017	340,024.78	13,602.67	4.00	13.91
Source: Report on Trend and Progress of Indian Banks, RBI				

In 2008-09, banks and other financial institutions were largely affected due to indirect spillovers of the crisis. The failure of Lehman Brothers in mid-September 2008, immediately following the crisis, made the banks cautious about lending.

Asset quality witnessed a declining trend from 2010 onwards. Moreover, there was little positive growth in credit post 2010. Private sector and foreign banks stayed away from high risk lending. Hence, the divergence in NPA during the period pointed to a general economic downfall due to various domestic as well as global factors.

Figure 1 shows the trend of four variables used in the study from 1998 to 2017. In the figure, the line trend showing ROA and liquidity remains almost same throughout the study period, with a slight increase in 2013 and a decrease in 2015, 2016 and 2017. There was an increase in ROA in 2005 and a decline in 2006, and it remained almost same till 2012 and again increased in 2013. The GNPA decreased from 1998 to 2008, and from 2009 onwards it started increasing, whereas CRAR decreased in 2002, and from there it started increasing and fell drastically in 2013, 2014 and 2015, and slightly increased in 2016 and 2017.

Figure 1: Trends of Four Variables from 1998 to 2017



Unit Root Test Results

The ADF or unit root test has been conducted for intercept, and trend and intercept at level to check the stationarity of the dependent variable. Table 5 shows the p-value and t-statistic of ADF test.

Intercept (At Level)

H_{01}: *ROA has unit root.*

H_{11}: *ROA does not have unit root.*

Trend and Intercept (At Level)

H_{02}: *ROA has unit root.*

H_{12}: *ROA does not have unit root.*

The null hypothesis shows that the dependent variable, i.e., *ROA*, is not stationary which means it has unit root. From Tables 5 to 8, it can be viewed that on the basis of the *p*-value of ADF test, we cannot reject null hypothesis. The values of test statistic are also lower than

Table 5: The *p*-Value of Intercept at Level

	t-Statistic	Sig. Value (*p*-Value)
ADF Test Statistic	–2.367221	0.116
Test Critical Values		
1%	–3.371120	
5%	–2.861110	
10%	–2.454211	

Table 6: ADF Test Equation

Variable	Coefficient	Standard Error	*t*-Statistic	Sig. Value (Prob.)
RETURN(–1)	–0.211732	0.141159	–1.499952	0.1510
C	0.317651	0.185323	1.714040	0.1107

Table 7: The *p*-Value of Trend and Intercept at Level

	t-Statistic	Sig. Value (*p*-Value)
ADF Test Statistic	–3.264453	0.1022
Test Critical Values		
1%	–4.532598	
5%	–3.673616	
10%	–3.277364	

Table 8: ADF Test Equation

Variable	Coefficient	Standard Error	*t*-Statistic	Sig. Value (Prob.)
RETURN(–1)	–0.853240	0.261373	–3.264453	0.1049
C	0.741919	0.353833	2.096808	0.1523
@*TREND*(1998)	0.010269	0.026941	0.381154	0.7081

critical values at 1%, 5% and 10% levels of significance. Hence, our dependent variable, i.e., *ROA*, has unit root. It depicts that it is not stationary both at intercept (constant) and trend and intercept (time trend) at level. Therefore, to convert the data into stationary or to eliminate the unit root, first differencing of the dependent variable needs to be done both for intercept (constant), and trend and intercept (time trend).

Further, the model fit was assessed with coefficient of determinants (R^2) and adjusted coefficient of determinants (adjusted R^2). The results (higher values) of adjusted R^2 indices show a bad fit of model (Table 9). To determine how well the model fits the data, associated prob (F-statistic) can also be checked. Akaike Info criterion, Schwarz criterion and Hannan-Quinn criterion are also considered to check the model fit summary. Based on the observed R^2, adjusted R^2 and Prob. (F-statistic) value, the null hypothesis is accepted and the conclusion drawn is that ROA (dependent variable) has unit root, which means data is not stationary in nature.

Table 9: Model Fit Summary at Level

Particulars	Summary for Intercept	Summary for Trend and Intercept
R^2	0.110307	0.405501
Adjusted R^2	0.110307	0.331188
Log-Likelihood	–20.07383	–16.24384
F-Statistic	3.69124	3.176699
Prob. (F-Statistic)	0.12147	0.115603
Akaike Info Criterion	2.025668	2.341728
Schwarz Criterion	2.174790	2.235610
Hannan-Quinn Criterion	2.050905	2.032182

Intercept (At First Difference)

To convert the variable into stationary, we do the first difference for both intercept, and trend and intercept.

H_{03}: D(ROA) has unit root.

H_{13}: D(ROA) does not have unit root.

Trend and Intercept (At First Difference)

H_{04}: D(ROA) has unit root.

H_{14}: D(ROA) does not have unit root.

The p-value of ADF test statistic is statistically significant at 1% level as depicted by Tables 10 to 13 at both intercept, and trend and intercept, which means that the dependent

Table 10: Intercept (Constant) at First Difference		
	t-Statistic	Sig. Value (*p*-Value)
ADF Test Statistic	–4.367221	0.001
Test Critical Values		
1%	–3.831511	
5%	–3.029970	
10%	–2.655194	

Table 11: ADF Test Equation (at First Difference)				
Variable	Coefficient	Standard Error	*t*-Statistic	Sig. Value (Prob.)
D(*RETURN*(–1))	–1.471224	0.216655	–6.790630	0.0000
C	0.289185	0.386704	0.747820	0.5578

Table 12: Trend and Intercept (At First Difference)		
	t-Statistic	Sig. Value (*p*-Value)
ADF Test Statistic	–6.446887	0.000
Test Critical Values		
1%	–4.571559	
5%	–3.690814	
10%	-–3.286909	

Table 13: ADF Test Equation				
Variable	Coefficient	Standard Error	*t*-Statistic	Sig. Value (Prob.)
D(*RETURN*(–1))	–1.461224	0.226656	–6.446887	0.0000
C	0.288085	0.386704	0.744976	0.4678
@*TREND*(1998)	–0.029113	0.033110	–0.879264	0.3931

variable, i.e., *ROA* is stationary. Moreover, the test statistic is more than the critical values at 1%, 5% and 10% levels of significance, which shows a rejection of null hypothesis and acceptance of alternative hypothesis. Therefore, we can conclude that by first differencing the unit root problem has been eliminated for the dependent variable, i.e., *ROA*.

The model fit summary for intercept, and trend and intercept at first difference is shown in Table 14. The model fit summary shows that the R^2 and adjusted R^2 of intercept (constant), and trend and intercept (time trend) are more than 60% which is quite satisfactory. Moreover, the probability value of *F*-statistic is also significant at 1% level. Hence, we can reject the null hypothesis by considering the fact that the dependent variable, i.e., *ROA*, is stationary in nature, meaning its mean and variance will remain constant over time at first difference.

Table 14: Model Fit Summary at First Difference

	Summary for Intercept	Summary for Trend and Intercept
R^2	0.775691	0.734891
Adjusted R^2	0.679643	0.699543
Log-Likelihood	–18.12102	–18.08452
F-Statistic	20.65124	20.79024
Prob. (*F*-Statistic)	0.000	0.000047
Akaike Info Criterion	2.541724	2.342724
Schwarz Criterion	2.392119	2.491119
Hannan-Quinn Criterion	2.261286	2.363186

Johansen Cointegration Test Results

In the determination of cointegration or long-run relationship in our multivariate model, we still need to determine the number of lags or lag intervals to be included in the hypothesis and how much the dependent and independent variables are explained by the lag interval of (1 3). Once the lag intervals are determined, our next task is to test for cointegration among variables.

H_{05}: *There exist cointegrating relationships between dependent and independent variables.*

H_{15}: *There exist no cointegrating relationships between dependent and independent variables.*

From Table 15, it can be observed that the trace statistics at $r = 1$ and 3 are 38.64299 and 5.020387, respectively, which is more than the critical values of 29.79707 and 3.841466, and also significant at 5% level and hence the null hypothesis of cointegrating equations can be rejected. But, the trace statistics at $r = 2$ of 13.13528 is less than the critical value of 15.49471, which shows that there are at most two cointegrating equations between dependent and

Table 15: Unrestricted Cointegration Rank Test (Trace)			
Hypothesized No. of CE(s)	**Trace Statistic**	**Critical Value**	**Sig. Value (Prob.)**
At Most 1*	38.64299	29.79707	0.0037
At Most 2	13.13528	15.49471	0.1099
At Most 3*	5.020387	3.841466	0.0250

independent variables of scheduled commercial banking and hence the null hypothesis is accepted.

Another alternative to determine the cointegrating relationships between dependent and independent variables is the maximum eigenvalue test statistics. From Table 16, it can be concluded that the max-eigen statistic at $r = 1$ and 3 are 25.50771 and 5.020387, which is more than the critical values of 21.13162 and 3.841466, respectively. The probability values are also statistically significant at 5% level, which means the acceptance of alternative hypothesis that there are no cointegrating relationships between dependent and independent variables at $r = 1$ and $r = 3$. The max-eigen statistic at $r = 2$ is 8.114892, which is less than the critical value of 14.26460 and is not statistically significant at 5% level, which shows acceptance of null hypothesis, that means there is a cointegrating relationship between dependent and independent variables at rank 2. Hence, it can be concluded that there is indeed a long- run relationship between ROA, capital adequacy to risk-weighted assets, NPA to total assets and liquidity to total assets at most 2 level.

VECM was employed to examine the relationship between ROA, NPA, capital adequacy to risk-weighted assets and liquidity. In Table 17, NPA to total assets demonstrates unilateral causality to ROA at first order lag at 5% level of significance. However, liquidity to total assets demonstrates unilateral causality to ROA at both the lags order at 5% and 10% levels of significance. The *F*-value given in Table 17 is used to check the overall significance of the model and represents a long run and short run causality between ROA, NPA, capital adequacy to risk-weighted assets and liquidity.

Table 16: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**Critical Value**	**Sig. Value (Prob.)**
At Most 1 *	0.757583	25.50771	21.13162	0.0113
At Most 2	0.362899	8.114892	14.26460	0.3672
At Most 3 *	0.243392	5.020387	3.841466	0.0250

Table 17: Results of Vector Error Correction Estimates	
Independent Variables	**Return on Assets (DLOGROA)**
Error Correction	
Standard Errors () and *t*-statistic []	
Cointegration Equation (1)	
D(DLOG*CRAR*(–1))	0.079070 (0.06383) [1.2387]
Cointegration Equation (2)	
D(DLOG*NPA*(–1))	–0.313734 ** (0.07940) [–3.9513]
D(DLOG*NPA*(–2))	0.250665 (0.03430) [7.3080]
Cointegration Equation (3)	
D(DLOG*LIQ*(–1))	0.475366 (0.29799) [1.5952]
D(DLOG*LIQ*(–2))	–0.138674 ** (0.15943) [–0.869811]
D(DLOG*LIQ*(–3))	1.084042 *** (0.38750) [2.7975]
R^2	0.62291
Adj. R^2	0.37612
***F*-Statistic**	**18.22013**

Note: * testifies that values are significant at 1% level (critical value: 2.58); ** testifies that values are significant at 5% level (critical value: 1.96); and *** testifies that values are significant at 10% level (critical value: 1.65).

Tables 17 and 18 show that NPA has a negative and significant impact on ROA at lag 1, but has a positive and insignificant impact at lag 2. Liquidity has a positive but insignificant impact at lag 1, while liquidity has a negative and significant impact at lags 2 and 3. Therefore,

Table 18: Summary of Cointegrating Equations			
Cointegrating Equations	Cointegrating Equation (1)	Cointegrating Equation (2)	Cointegrating Equation (3)
Return	1.0000	0.000000	1.000000
CRAR	0.079070	1.000000	0.000000
NPA	–0.313734	0.546945	1.000000
Liquidity	0.475366	–1.957197	–4.877885
C1	–39.09148	–26.33762	–22.28017

the next step is to collect the VECM estimates, which is a time series modeling that can directly estimate the level to which the variable can be brought back to equilibrium, after a shock on other variables.

When the data are non-stationary as at ordered and there exists a cointegrating relationship as large as *r*, then the VECM is to be used. In the study, we have four variables (one dependent and three independent variables) and found that there are at most two cointegrating relationships among the variables. The first step is to determine the optimum lag by comparing every lag to the criteria used.

The minimum values for each of the criteria are given in star (*) sign. Table 19 indicates that the lag optimal is at lag 2, hence the model used is VECM (2). The next step is to estimate the parameters in the model (Table 20).

C1 values represent the long-run associationship among the cointegrating vectors and C2 reflects the long-run impact of CRAR, NPAs and liquidity on ROA for various series. However, the R^2 of the close logarithmic returns is really good (0.712522), indicating a possible overspecification in as far as explaining the ROA is concerned.

Table 19: VAR Lag Order Selection Criteria					
Lag	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	NA	3.276	9.817	9.996	9.877
1	575.77	0.00062	1.0134	1.4320	1.1865
2	24.60*	0.00053*	0.87653*	1.57887	1.14562*
3	8.9540	0.000056	0.97553	1.96854	1.37456
4	5.226	0.00065	1.15674	2.43256	1.66329

Table 20: VECM Estimates for Return on Assets (Dependent Variable) and Capital Adequacy to Risk-Weighted Assets, Non-Performing Assets to Total Assets and Liquidity to Total Assets (Independent Variables) of Scheduled Commercial Banks

Log Likelihood: –39.09148			AIC = 7.454608 SBIC = 8.839631	
Error Correction	D(*RETURN*)	D(*CRAR*)	D(*NPA*)	D(*LIQUIDITY*)
CointEq1	–1.214043	–0.128670	–0.990076	–0.854554
	(0.35452)	(0.47215)	(0.81211)	(0.25061)
	[–3.42451]	[–0.27252]	[–1.21914]	[–3.40989]
D(*RETURN*(–1))	0.491654	0.099338	0.152786	0.613255
	(0.33705)	(0.77209)	(0.44889)	(0.23826)
	[1.45871]	[0.12866]	[0.34037]	[2.57389]
D(*CRAR*(–1))	0.192213	0.162529	0.491303	0.081310
	(0.20814)	(0.47680)	(0.27721)	(0.14714)
	[0.92347]	[0.34087]	[1.77232]	[0.55261]
D(*NPA*(–1))	–0.229370	–0.078617	–0.248229	–0.073496
	(0.19428)	(0.44505)	(0.25875)	(0.13734)
	[–1.18061]	[–0.17665]	[–0.95934]	[–0.53514]
D(*LIQUIDITY*(–1))	–0.363764	–0.243829	0.186541	–0.814107
	(0.24822)	(0.56862)	(0.33059)	(0.17547)
	[–1.46547]	[–0.42881]	[0.56427]	[–4.63954]
C2	–0.019785	–0.124198	–0.063091	–0.116632
	(0.11912)	(0.27288)	(0.15865)	(0.08421)
	[–0.16609]	[–0.45514]	[–0.39768]	[–1.38506]
R^2	0.712522	0.726488	0.792061	0.833503
Adj. R^2	0.592740	0.645858	0.662913	0.764129

Long-run causality of dependent variable return is presented in the following equation:

$$D(RETURN) = C(1)*(RETURN(-1) + 0.079070*CRAR(-1) - 0.313734*NPA(-1) + 0.475366*LIQUIDITY(-1) + 2.14856917512 + C(2)*D(RETURN(-1)) + C(3)*D(CRAR(-1)) + C(4)*D(NPA(-1)) + C(5)* D(LIQUIDITY(-1)) + C(6)$$

C(1) is the coefficient of the cointegrated model, which predicts the speed of adjustments towards long-run equilibrium, but it must be significant and the sign must be negative. In the study, the coefficient value is negative; therefore, there is a long-run causality between independent variables such as capital adequacy to risk-weighted assets, NPA to total assets and liquidity to total assets, which means that all the independent variables have influence on the dependent variable, i.e., ROA. Moreover, R^2 is also quite high which is 0.713, that means, the model is explaining 71% of the variability of the response data around its mean; *F*-statistic is 5.95 and it is also significant at 5% level (0.005) (Table 21).

Table 21: Model Fit summary of Return on Assets

Coefficient of C(1)	–1.214043
Std. Error	0.354516
R^2	0.712522
Adjusted R^2	0.592740
F-Statistic	5.948474
Prob. (*F*-Statistic)	0.005419
Akaike Info Criterion	1.694942
Schwarz Criterion	1.991732
Hannan-Quinn Criter.	1.735865

Test for Serial Correlation and Heteroskedasticity

After checking for long-run causality, a test has been conducted to check the problem of serial correlation and heteroskedasticity. Serial correlation was checked through Breusch-Godfrey Serial Correlation LM Test, and the hypotheses are framed as follows:

As per this test, the hypotheses are:

H_{06}: *There is no serial correlation among the variables.*

H_{16}: *There is serial correlation among the variables.*

Table 22 shows the probability of *F*-statistic and chi-square, which signifies the acceptance of null hypothesis at 5% level of significance and confirms the absence of serial correlation among variables.

To check for heteroskedasticity which is a major problem in regression analysis, we employ Breusch-Pagan-Godfrey test. As per this test, the hypotheses are:

H_{07}: *Residuals are not heteroskedastic.*

H_{17}: *Residuals are heteroskedastic.*

Table 22: Serial Correlation			
F-Statistic	0.3078	Prob. (*F*-Statistic)	0.7418
Observed R^2	1.044	Prob. (Chi-Square)	0.5934

From Table 23, it can be observed that the probability values of chi-square of all the banks (all scheduled commercial banks) are more than 5%, which indicates acceptance of null hypothesis, meaning that residuals are not heteroskedastic.

Table 23: Heteroskedasticity Among Residuals			
F-Statistic	1.6324	Prob. (*F*-Statistic)	0.2401
Observed R^2	10.6561	Prob. (Chi-Square)	0.2220

Conclusion

The paper uses time-series analysis to examine the balanced pool of time-series data of scheduled commercial banks (public sector, private sector and foreign banks) consisting of 1,940 observations. EBT on Total Assets is taken as the dependent variable, termed as ROA. The impact of rising stressed assets, defined as NPA, on the overall profitability has been studied. The rising percentage of NPA is a great concern mainly for public sector banks.

The study finds long-run causality between dependent and independent variables, of which, the level of NPA and liquidity adversely affect the profitability of banks, which according to our pre-estimations strongly support the theory behind it and the method of regression used. ⅄

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