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Non-Performing Assets and Financial Health of Commercial Banks in India: A Study

Abstract

The assets not contributing any income to the bank is known as Non-Performing Assets (NPAs). NPAs are the key factors to decide the financial health of commercial banks in India. They affect the operational efficiency which in turn influences the liquidity, efficiency, solvency and profitability position of the banks. The study investigates the relationships between the non-performing assets and six ratios presenting liquidity, efficiency, solvency and profitability over the period 2004-05 to 2014-15. Johansen's co-integration test and Vector Error Correction Model (VECM) have been applied to explore the long-run equilibrium relationship between the NPAs and six variables under the study. The analysis reveals that the non-performing assets of the Indian commercial banks are negatively co-integrated with the liquidity, efficiency, solvency, and profitability position of the banks and hence, a long-run equilibrium relationship exists between them. The results VECM reveals that the relationship between NPA and profit-per employee, return on equity and return on assets is positive, while the relationship between the NPA and cash-deposit ratio, credit-deposit ratio and net interest margin is negative. The findings from Granger Causality based on the VECM indicate bidirectional causality between non-performing assets and all the variables tested. It is observed that the financial health of the Indian commercial banks is significantly affected by the non-performing assets.

Keywords: NPAs, Indian Commercial Banks, Financial Health, Co-Integration Test, VECM.

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Introduction

The key factor to decide the financial health of a commercial bank is operational efficiency. Among other factors, non-performing assets (NPAs) in the loan portfolio affect the operational efficiency which in turn influences the liquidity, efficiency, solvency and profitability position of commercial banks. Commercial banks have to maintain and increase viability by generation of more products in order to meet the capital adequacy norms and make provision against NPA. A commercial bank comes into liquidity crisis when the funds deployed by it get locked as NPA, which reduces the profitability and solvency position of the bank also.

NPAs also affect the economy of the country. A very high level of NPAs, eliminating fully or partially the banks' capital could cause significant banking crisis. Banking crisis exists in the country if the level of NPAs touches 10 percent of GDP (Khan & Bisnoi, 2001).

The non-performing asset of the banking system is an offshoot and has hampered the growth of the Indian banking system. Ever since the introduction of financial sector reforms in India.The cost of the intermediation by the banks has raised brows for controlling the interest rates and identification of benchmarks for the identification and resolution of NPAs. Recently with implementation of Basel II and Basel III, better risk management system and implementation of new accounting standards, enhancement of technology and customer services, innovations of various products, US sub-prime crisis and volatile market has made it essential to maintain the NPA with lower level and effective monitoring before they become bad debts. Non-Performing Assets are a serious strain on the profitability, as banks cannot book income on such accounts, while their funding cost and provision requirements are charged on their profits. In order to have a proper understanding of the NPA menace, it is necessary to have an idea of the growth and structural changes that have taken place in the banking sector. The financial strength and operational efficiency of the Indian banks and financial institutions which were working in a highly protected and regulated environment were not measuring up to international standards (RBI, 1999).

For each banking industry, Non-performing assets are an unavoidable burden. The methods of managing NPAs and keeping them within tolerance level will decide the success of banks. So, to change the curve of NPAs, there is only one technique that an effective monitoring and control policy should be planned and executed which is aided by proper legal reforms. The focus of this paper is to give comprehensive view of NPAs in commercial banks in India and its impact on liquidity, efficiency, solvency and profitability of commercial banks operating in India.

Review of Literature

The problem of NPAs has been studied over the years to bring insight into the problem of NPAs, its cause and solution. Several studies have examined the impact of NPAs in developed and emerging economies. According to Iyer (1999) Banking business is exposed to various risks such as credit risk, liquidity risk, interest risk, market risk, operational risk and management risk. But, credit risk stands out as the most detrimental of them all.

Bhattacharya et. al., (1997) used DEA to measure the productive efficiency of Indian commercial banks in the late 1980's to early 1990's and to study the impact of policy of liberalising measures taken in 1980's on the performance of various categories of banks. They found that the Indian public sector banks were the best performing banks, as the banking sector was overwhelmingly dominated by the Indian public sector banks, while the new private sector banks were yet to emerge fully in the Indian banking scenario. Kumbhakar and Sarkar (2003) found evidence on Indian banks that while private sector banks have improved their performance mainly due to the freedom to expand output. Public sector banks have not responded well to the deregulation measures. Ram Mohan and Ray (2004) compared the revenue maximising efficiency of public, private and foreign banks in India. Using physical quantities of input and outputs in the 1990's, using deposits and operating costs as inputs and loans, investments and other income as outputs. They found that public sector banks were significantly better than private sector banks on revenue maximisation efficiency. But between public sector banks and foreign banks the difference in efficiency was not significant. Shanmugam and Das (2004) studied banking efficiency using stochastic frontier production function model during the reform period 1992-1999. They found that deposits are dominant in producing all outputs and the technical efficiency of raising interest margin is varied across the banks. In particular, they found that the reform measures that had been introduced since 1992 have not helped the banks in raising their interest margin. Also in general, they found that private or foreign banks performed better than public banks. Sanjeev (2006) studied efficiency of private, public and foreign banks operating in India during the period 1997-2001 using data envelopment analysis. He also studied if any relationship can be established between the efficiency and non-performing assets in the banks. He found that the there is an increase in the efficiency in the post-reform period and that non-performing assets and efficiency are negatively related. Karunakar (2008) in his article explained that the lasting solution to the problem of NPAs can be achieved only with proper credit assessment and risk management mechanism. It is better to avoid NPAs at the market stage of credit consolidation by putting in place of rigorous and appropriate credit appraisal mechanisms. Uppal (2009) evaluated the performance of public, private and foreign banks in India and analysed the target achievement by them during 2006-07. He found that priority sector advances of public and private sector banks were higher than foreign banks. He observed that public sector banks were unable to achieve the target of priority sector, while the private sector banks achieved the target. Private sector banks could not achieve the target for the weaker sections. He further observed that NPA of the public sector banks were the highest followed by private sector and foreign banks. Ahmed (2010) evaluated empirically the various loans of priority sector advances by commercial banks during the period being 1995-96 to 2005-06. The entire study is subjected to statistical techniques like correlation analysis, regression analysis and growth rate. The study covers the following areas like sector-wise break-up of bank credit, interrelationship between NPA and priority sector advances, factor influencing priority sector lending etc. Kaur (2011) examined the performance of commercial banks in India in the post reform era. Objective of the study was to measure the contribution of public and private sector banks in financing priority sector. The study period was 1990-91 to 2007-08. The researcher concluded that during the post reform period, priority sector advances of private sector banks grew faster than that of public sector banks. The showed that the public sector bank concentrated more on agriculture than the other sectors of the economy. Kaur (2012) in his paper measured the priority sector advances by different bank groups. The study period was 1997-98 to 2007-08 with the conclusion that public and private sector banks have achieved the overall target of 40 percent. He also showed that non-achievement of the targets by banks is due to poor capital formation and low credit absorption rate. Raman (2013) in his paper traced out the evaluation and development of priority sector lending using the data for the period 2001-2012. This study employed analytical type of methodology. He concluded that the activity wise performance of commercial banks in Tamil Nadu. Over 10 years, agriculture advances grew over 18 percent, education and housing loans continued to grow over 30 percent and 8 percent respectively. Selvi (2014) observed the trend of lending by the scheduled commercial banks in India. His study period was 2000-2013. He applied tools like percentages, correlation and trend analysis. He concluded that the composition of the priority sector lending in the non-food credit of commercial banks showed that non-food advances account for 97 percent of the gross bank credit while food advances was account for just 3 percent. Manjeet Singh (2018) revealed in his study that profitability analysis is one of the important and dangerous concepts that have created a ruckus in banking system. The study shows that the Profitability of the Private Sector Banks is higher than Public Sector Banks in most of the years under study due to NPA. HDFC has the highest ratio of ROA among all the selected banks. Similarly, the highest ratio of ROE is of Axis Bank. On the basis of ROI, the highest ratio is of Canara Bank, among all the banks. Karamjeet Singh and Amit Bhatia (2018) observed that SBI is performing its good performance but the NPA of subsidiary companies was higher. For the recovery of these NPA the SBI needs to develop some effective recovery policies and launch some new loan sanctioned plans for less NPA in future.

Based on the above discussion, the present study tried to investigate the long term equilibrium relationship between the NPAs and six variables of liquidity, efficiency, solvency and profitability by considering the following models:

X_t = (NPA_t, CDR_t, $CRDR_t$, NIM_t, PER_t, ROA_t, ROE_t)where NPA is the non-performing assets, CDR is cash-deposit ratio, CRDR is credit deposit ratio, NIM is net interest margin, PER is profit per employee, ROA is return on assets, ROE is return on equity and X is a 7×1 vector of variables.

Objectives, Data Source and Methodology

The aim of this paper is to investigate the relationship between the NPAs and liquidity, efficiency, solvency and profitability of Indian commercial banks comprising of three categories of banks viz. public sector, private sector and foreign banks. To accomplish the research objective yearly data ranging from 2004-05 to 2014-15 are obtained which comprises 528 data points for the analysis. The choice of study period is based on the availability of data series. Descriptions of variables and data sources are presented in Table 1.

Table 1 Showing Variables Included in the Analysis

Name of Variables	Measurements
Ratio of Net NPA to Net Advances (NPA)	Solvency Position
Cash-Deposit Ratio (CDR)	Liquidity
Credit-Deposit Ratio (CRDR)	Liquidity
Ratio of Net Interest Income to Total Assets (NIM)	Profitability
Profit Per Employee (in rupees million) (PER)	Profitability
Return on Assets (ROA)	Efficiency
Return on Equity (ROE)	Efficiency

[***Source:*** RBI database]

The present study employs the time series data analysis technique to stud the relationship between the NPA and CDR, CRDR, NIM, PER, ROA and ROE. In a time series analysis the result might provide a spurious if the data series are non-stationary. Thus the data series must obey the time series properties i.e. the time series data should be stationary, meaning that the mean and variance should be constant over time and the value of covariance between two time periods depends only on the distance between the two time periods and not the actual time at which the covariance is computed. The most popular and widely used test for stationary is the unit root test. The presence of unit root indicates that the data series is non-stationary. The standard procedures of unit root test namely the Augmented Dickey Fuller (ADF) (1979) (1981) is performed to check the stationary nature of the series. Assuming that the series follows an AR (p) process the ADF test makes a parametric correction and controls for the higher order correlation by adding the lagged difference terms of the dependent variable to the right hand side of the regression equation. In the ADF test null hypothesis is that data set being tested has unit root. This provides a robustness check for stationary. The unit root tests also provide the order of integration of the time series variables. In a multivariate context if the variables under consideration are found to be I(1) (i.e. they are non-stationary at level but stationary at first difference). But the linear combination of the integrated variables is I (0). Then the variables are said to be co-integrated (Enders, 2004). The Augmented Dickey Fuller (ADF) (1979) (1981) is performed to check the stationary nature of the series. The complete model with deterministic terms such as intercepts and trends is shown in equation (1).

$$\Delta y_t = \alpha + \beta_t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \ldots\ldots\ldots\ldots\ldots.. + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t \qquad (1)$$

Where α is a constant, β is the coefficient on a time trend and p is the lag order of the auto regressive process. Lag length for VAR system is selected based on minimum sequential modified LR test statistics. The vector auto regression (VAR) is commonly used for forecasting systems of interrelated time series and for analysing the dynamic impact of random disturbances on the system of variables. The VAR approach sidesteps the need for structural modelling by treating every endogenous variable in the system as a function of lagged values of all of the endogenous variables in the system. The mathematical representation of a VAR is:

$$y_t = A_1 y_{t-1} + \ldots\ldots\ldots + A_p y_{t-p} + Bx_t + \epsilon_t \qquad (2)$$

Where y_t is a k vector of endogenous variables. x_t is a variable d vector of exogenous variables.A_1…….A_P and B are matrices of coefficients to be estimated. ϵ_t is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand side variables.

Lag length criteria computes various criteria to select the lag order of an unrestricted VAR (Lutkepohl, 1991). The sequential modified likelihood ratio (LR) test is carried out as follows starting from the maximum lag test the hypothesis that the coefficients on l lag are jointly zero using theχ^2statistics:

$$LR = (T - m)\{log|\Omega_{l-1}| - log|\Omega_l|\} \sim \chi^2(k^2) \qquad (3)$$

Where m is the number of parameters per equation under the alternative, note that we employ Sims' (1980) small sample modification which uses $(T-m)$ rather than T. We compare the modified LR statistics to the 5% critical values starting from the maximum lag and decreasing the lag one at a time until we first get a rejection.

With the non-stationary series, co-integration analysis has been used to examine whether there is any long run relationship exists. However, a necessary condition for the use of co-integration technique is that the variable under consideration must be integrated in the same order and the linear combinations of the integrated variables are free from unit root. According to Engel and Granger (1987) if the variables are found to be co-integrated they would not drift apart over time and the long run combination amongst the non-stationary variables can be established. To conduct the co-integration test, the Engel and Granger (1987) or the Johansen and Juselius (1990) or the Johansen (1991) approach can be used. The Engel-Granger two step approaches can only deal with one linear combination of variables that is stationary. In a multivariate practice, however, more than one stable linear combination may exist. The Johansen's co-integration method is regarded as full information maximum likelihood method that allows for testing co-integration in a whole system of equations.

The Johansen methods of co-integration can be written as the following vector autoregressive framework of order p.

$$X_t = A_0 + \sum_{j=1}^{p} B_j\, X_{t-j} + e_t \qquad (4)$$

Where X_t is an n×1 vector of I (1) variables, A_0 is an n×1 vector of constants. $p$is the maximum lag length. B_j is an n×n matrix of coefficient and e_t is a n×1 vector of white noise terms. The number of characteristic roots can be tested by considering the following trace and the maximum eigen value test.

$$\lambda_{trace}\,(r) = -T \sum_{i=j+1}^{p} In\left(1-\hat{\lambda}_j\right) \qquad (5)$$

$$\lambda_{max}\,(r, r+1) = -T\,\ln(1-\hat{\lambda}_{r+1}) \qquad (6)$$

Where, r is the number of co-integrating vectors under the null hypothesis, T is the number of usable observations and $\hat{\lambda}_j$ is the estimated value for the j^{th}ordered characteristic roots or the eigen value from the II matrix.

A significant non-zero eigen value indicates a significant co-integrating vector. The trace statistics is a joint test where the null hypothesis is that the number of co-integration vectors is less than or equal to r against an unspecified general alternative that there are more than r. Whereas, the maximum eigen value statistics test the null hypothesis that the number of co-integrating vectors is less than or equal to r against the alternative of r+1 (Enders, 2004) (Brooks, 2002).

A vector error correction (VEC) model is a restricted VAR designed for use with non-stationary series that are known to be co-integrated. The VEC model has co-integration relations built into the specification so that it restricts the behaviour of the endogenous variables to coverage to their co-integrating relationship while allowing for short-run adjustment dynamics. The co-integration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments.

The corresponding VEC Model is:

$$\Delta y_{1,\ t=\alpha_1}\left(y_{2,\ t-1} - \beta_{y1,\ t-1}\right) + \epsilon_{1,\ t} \qquad (7)$$

$$\Delta y_{2,\ t=\alpha_2}\left(y_{2,\ t-1} - \beta_{y1,\ t-1}\right) + \epsilon_{2,\ t} \qquad (8)$$

In this model the only right hand side variable is the error correction term. In long run equilibrium, this term is zero. However, if y_1 andy_2 deviate from the long run equilibrium the error correction term is non zero and each variable adjusts to partially restore the equilibrium relation. The coefficient $\alpha_i$measures the speed of adjustment of the i^{th} endogenous variable towards the equilibrium.

Further to examine dynamic relationship between variables and bivariate Granger Causality Test (Engel &Granger, 1987) is applied. The bivariate regressions of Granger Causality Test are:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \ldots\ldots\ldots.. + \alpha_l\, y_{t-l} + \beta_1\, x_{t-1} + \ldots\ldots\ldots\ldots.. + \beta_l x_{-l} + \epsilon_t \qquad (9)$$

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \ldots\ldots\ldots.. + \alpha_l\, x_{t-l} + \beta_1\, y_{t-1} + \ldots\ldots\ldots\ldots.. + \beta_l y_{-l} + \mu_t \qquad (10)$$

For all possible pairs of $(x,\ y)$series in the group, the reported F-statistics are the Wald statistics for the joint hypothesis:

$\beta_1 = \beta_2 = \ldots\ldots\ldots\ldots. = \beta_l = 0$

For each equation the null hypothesis is that x does not Granger cause y in the first regression and y does not Granger cause $x$in the second equation.

Analysis and Findings

The descriptive statistics for all the variables under the study, namely, NPA, CDR, CRDR, NIM, PER, ROA and ROE are presented in Table 2. The value of skewness and kurtosis indicate the lack of symmetric in the distribution. Generally, if the value of skewness and kurtosis are 0 and 3 respectively, the observed distribution is said to be normally distributed. Furthermore, if the skewness coefficient is in excess of unity it is considered fairly extreme and the low (high) kurtosis value indicates extreme platykurtic (extreme leptokurtic). From the table it is observed that the frequency distributions of underlying variables are not normal. The significant coefficient of Jarque-Bera statistics also indicates that the frequency distributions of considered series are not normal. The value of standard deviation indicates that the CDR, CRDR, PER and ROE are relatively more volatile as compare to rest of other variables.

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Table 2 showing Descriptive Statistics of Variables

	NPA	CDR	CRDR	NIM	PER	ROA	ROE
Mean	1.3873	6.8856	73.7407	2.8781	0.7990	0.9649	13.5161
Median	1.0900	6.4276	72.0131	2.7975	0.4950	0.9600	14.4845
Maximum	8.1100	19.5468	300.6996	5.6181	83.2000	3.1300	31.6210
Minimum	-0.0500	2.8387	42.1089	0.2309	-1.1000	-3.3800	-63.7871
Std. Dev.	1.1177	2.1204	16.2580	0.7820	3.6691	0.6509	8.8518
Skewness	1.8060	1.2670	6.5544	0.4243	21.5369	-0.8608	-2.9193
Kurtosis	8.1396	5.8616	81.9485	3.8379	483.6709	9.2227	20.7923
Jarque-Bera	868.1776	321.4021	140903.5000	31.2903	5123797.0000	917.0789	7714.3570
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sum	732.4900	3635.5780	38935.1000	1519.6270	421.8660	509.4800	7136.4930
Sum Sq. Dev.	658.3460	2369.5310	139298.1000	322.2407	7094.4530	223.2882	41292.7000
Observations	528	528	528	528	528	528	528

[***Source:*** Computed by Author]

To check the stationarity of the underlying data series, we follow the standard procedure of unit root testing b employing the Augmented Dickey Fuller (ADF) test. The results are presented in Table 3. On the basis of the ADF test all the series are found to be non-stationary at level with intercept. However, after taking the first difference these series are found to be stationary at 1, 5 and 10 percent significant level. Thus the stationary test indicates that all series are individually integrated of the order I (1).

Table 3 Showing Augmented Dickey-Fuller Unit Root Test

Variables			Trend		Trend & Intercept		None	
			t-Statistic	**Prob.***	**t-Statistic**	**Prob.***	**t-Statistic**	**Prob.***
D(NPA)	Augmented Dickey-Fuller test statistic		-11.7379	0.0000	-11.7414	0.0000	-11.7493	0.0000
	Test critical values:	1% level	-3.44275		-3.97587		-2.56943	
		5% level	-2.8669		-3.41852		-1.94144	
		10% level	-2.56969		-3.13177		-1.61629	
D(CDR)	Augmented Dickey-Fuller test statistic		-18.6817	0.0000	-18.6627	0.0000	-18.6997	0.0000
	Test critical values:	1% level	-3.44263		-3.9757		-2.56939	
		5% level	-2.86685		-3.41844		-1.94143	
		10% level	-2.56966		-3.13172		-1.61629	
D(CRDR)	Augmented Dickey-Fuller test statistic		-12.3846	0.0000	-12.3718	0.0000	-12.3995	0.0000
	Test critical values:	1% level	-3.44295		-3.97615		-2.5695	
		5% level	-2.86699		-3.41866		-1.94145	
		10% level	-2.56973		-3.13185		-1.61628	
D(NIM)	Augmented Dickey-Fuller test statistic		-15.8877	0.0000	-15.8758	0.0000	-15.8997	0.0000
	Test critical values:	1% level	-3.44267		-3.97577		-2.56941	
		5% level	-2.86687		-3.41847		-1.94143	
		10% level	-2.56967		-3.13174		-1.61629	
D(PER)	Augmented Dickey-Fuller test statistic		-13.0916	0.0000	-13.0788	0.0000	-13.1045	0.0000
	Test critical values:	1% level	-3.44277		-3.97591		-2.56944	
		5% level	-2.86691		-3.41854		-1.94144	
		10% level	-2.56969		-3.13178		-1.61629	
D(ROE)	Augmented Dickey-Fuller test statistic		-12.5845	0.0000	-12.5767	0.0000	-12.5972	0.0000
	Test critical values:	1% level	-3.44277		-3.97591		-2.56944	
		5% level	-2.86691		-3.41854		-1.94144	
		10% level	-2.56969		-3.13178		-1.61629	
D(ROA)	Augmented Dickey-Fuller test statistic		-12.3287	0.0000	-12.3141	0.0000	-12.3368	0.0000
	Test critical values:	1% level	-3.44275		-3.97587		-2.56943	
		5% level	-2.8669		-3.41852		-1.94144	
		10% level	-2.56969		-3.13177		-1.61629	

[***Source:*** Computed by Author]; *MacKinnon (1996) one-sided p-values.

Table 4 shows Karl Pearson's Correlation Matrix. The correlation matrix highlighted that there is negative correlation between NPA and CDR, CRDR, NIM, PER, ROA and ROE.

Table 4 showing Result of Karl Pearson's Correlation Coefficient Matrix

Variables	NPA	CDR	CRDR	NIM	PER	ROA	ROE
NPA	**1.0000**	-0.2137	-0.1345	-0.2185	-0.0468	-0.6314	-0.6318
CDR	-0.2137	**1.0000**	0.1454	0.0476	0.0081	0.1121	0.0972
CRDR	-0.1345	0.1454	**1.0000**	-0.0335	0.1292	0.1602	0.0189
NIM	-0.2185	0.0476	-0.0335	**1.0000**	0.0852	0.5338	0.2536
PER	-0.0468	0.0081	0.1292	0.0852	**1.0000**	0.1852	0.0640
ROA	-0.6314	0.1121	0.1602	0.5338	0.1852	**1.0000**	0.7866
ROE	-0.6318	0.0972	0.0189	0.2536	0.0640	0.7866	**1.0000**

[***Source:*** Computed by Author]

The presence and the number of co-integrating relationship among the underlying variables are tested through the Johansen procedure i.e. Johansen and Juselius (1990) and Johansen (1991). Specifically, trace statistic and the maximum eigenvalue are used to test for the number of co-integrating vectors. The results of VAR lag order selection criteria are presented in the Table 5. Lag order selection for the study is based on FPE and AIC criterion. The results of both trace statistics and the maximum eigenvalue test statistics are presented in Table 6. The trace statistics indicates seven co-integrating equations and the maximum eigenvalue statistics identify seven co-integrating equations. The result shows that long-run equilibrium relationship exists between the NPA and CDR, CRDR, NIM, PER, ROA and ROE.

Table 5 showing VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-7948.016	NA	45755.85	30.59621	30.65348	30.61865
1	-7758.865	372.4807	26690.21	30.05717	30.51528*	30.23663
2	-7652.008	207.5491	21367.37	29.83465	30.69359	30.17113
3	-7526.897	239.637	15948.58	29.54191	30.8017	30.03542*
4	-7439.276	165.4688	13753.38	29.39337	31.054	30.0439
5	-7381.012	108.46	13281.83	29.35774	31.41921	30.1653
6	-7302.924	143.2622	11889.02	29.24586	31.70817	30.21044
7	-7205.285	176.4999	9875.603	29.05879	31.92194	30.1804
8	-7155.098	**89.37296***	**9850.459***	**29.05422***	32.31822	30.33285

[*Source:* Computed by Author]

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 6 Showing Result of Johansen's Co-Integration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.17894	370.7347	125.6154	**0.0000**	0.17894	102.3257	46.23142	**0.0000**
At most 1 *	0.159313	268.409	95.75366	**0.0000**	0.159313	90.06485	40.07757	**0.0000**
At most 2 *	0.121806	178.3442	69.81889	**0.0000**	0.121806	67.41151	33.87687	**0.0000**
At most 3 *	0.091656	110.9327	47.85613	**0.0000**	0.091656	49.89237	27.58434	**0.0000**
At most 4 *	0.053338	61.04029	29.79707	**0.0000**	0.053338	28.44783	21.13162	**0.0039**
At most 5 *	0.04333	32.59245	15.49471	**0.0001**	0.04333	22.9898	14.2646	**0.0017**
At most 6 *	0.018332	9.602648	3.841466	**0.0019**	0.018332	9.602648	3.841466	**0.0019**

[***Source:*** Computed by Author]

Trace test indicates 7 cointegrating eqn(s) at the 0.05 level
Max-eigenvalue test indicates 7 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Assuming one co-integrating vector, the short run and long run interaction of the underlying variables the VECM has been estimated based on the Johansen co-integration methodology. The results are presented in Table 7. The results show that there is no long-run equilibrium relationship exists between the Non-Performing Assets (NPA) and CDR, CRDR, NIM, PER, ROA and ROE. The estimated co-integrating coefficients for the NPA is based on the first normalised eigenvector are as follows. These values present long term elasticity measures. Thus the co-integration relationship can be re-expressed as:

NPA = -5.535567+ 0.18226*CDR + 0.09225*CRDR + 1.45703*NIM + (-) 0.055346*PER + (-) 5.432738*ROA + (-) 0.002084*ROE

Table 7 Showing Result of Vector Error Correction Model

Panel A: Normalised Co-integration Coefficients							
NPA(-1)	CDR(-1)	CRDR(-1)	NIM(-1)	PER(-1)	ROA(-1)	ROE(-1)	Constant
1.0000	0.18226	0.09225	1.45703	-0.055346	-5.432738	-0.002084	-5.535567
	-0.05597	-0.01715	-0.27386	-0.05911	-0.65925	-0.03472	
	[-3.25651]	[-5.37798]	[-5.32027]	[0.93631]	[8.24084]	[0.06001]	
Panel B: Coefficient or Error Correction Term							
Error Correction:	D(NPA)	D(CDR)	D(CRDR)	D(NIM)	D(PER)	D(ROA)	D(ROE)
CointEq1	0.22765	0.360558	2.456672	-0.07134	-0.23082	-0.28116	-3.34855
	0.06028	0.11212	1.02733	0.04434	0.2524	0.03741	0.51815
	[3.77654]	[3.21593]	[2.39133]	[-1.60909]	[-0.91451]	[-7.51547]	[-6.46247]
F-statistic	9.741438	10.61731	12.12782	9.229909	9.037695	13.58034	12.27347

[***Source:*** Computed by Author]; ***Note:*** Standard errors in ( ) & t-statistics in [ ]

The t-statistics are given in [ ] brackets while the error term are given in ( ) brackets. The coefficients of cash-deposit ratio, credit-deposit ratio and net interest margin are positive and statistically insignificant, while the coefficient of profit per employee, return on assets and return on equity are negative and statistically significant. The intercept term is negative. The results reveals that the relationship between NPA and cash-deposit ratio, credit-deposit ratio and net interest marginis negative, while the relationship between the NPA and PER, ROA and ROE is positive. The sign of the error correction coefficient in determination of NPA is positive (0.22765) and the t-value is (3.77654). This indicates that NPA does not respond significantly to re-establish the equilibrium relationship once deviation occurs in the long run.

The co-integration results indicate that causality exists between most of the co-integrated variables and shows us the direction of the causal relationship in some cases. The pair-wise Granger Causality Test (1987) is performed between all possible pairs of variables to determine the direction of causality. Partially accepted hypothesis are reported in Table 8. The results show that the NPAs granger causes three variables i.e. cash-deposit ratio, credit-deposit ratio and return on assets. While there is bi-directional causality exists between all the three variables tested (i.e. CDR, CRDR and ROA) and NPA. While there exists a unidirectional causality between PER and NPA. NPA granger causes net interest margin and return on equity but not the other ways around.

Table 8 Showing the Result of Granger Causality Test

Null Hypothesis	Obs	F-Statistic	Prob.	Decision
CDR does not Granger Cause NPA	520	2.57325	0.0093	Reject
NPA does not Granger Cause CDR		2.2452	0.0232	Reject
CRDR does not Granger Cause NPA	520	6.73388	2.00E-08	Reject
NPA does not Granger Cause CRDR		4.37812	4.00E-05	Reject
NIM does not Granger Cause NPA	520	1.10182	0.3603	Accept
NPA does not Granger Cause NIM		2.5605	0.0096	Reject
PER does not Granger Cause NPA	520	1.06366	0.3873	Accept
NPA does not Granger Cause PER		1.68313	0.0998	Accept
ROA does not Granger Cause NPA	520	2.05096	0.039	Reject
NPA does not Granger Cause ROA		5.13394	4.00E-06	Reject
ROE does not Granger Cause NPA	520	1.76509	0.0815	Accept
NPA does not Granger Cause ROE		6.40981	6.00E-08	Reject

[***Source:*** Computed by Author]

Conclusion and Suggestion

This study examined the inter-linkage between the NPAs and liquidity, efficiency, solvency and profitability of Indian commercial banks comprising of three categories of banks viz. public sector, private sector and foreign banks using Johansen's co-integration test. The Analysis used yearly data over the period 2004-05 to 2014-15 which is obtained from RBI website. The ratio of cash deposit ratio, credit deposit ratio, net interest margin profit per employee, return on assets and ratio of return on equity are used to present the liquidity, efficiency, solvency and profitability of the Indian commercial banks. It is believed that the selected ratios, among others, represent the state of Indian commercial banks.

To conclude, the Augmented Dickey Fuller test suggests that all the series are found to be non-stationary at level with intercept. However, after taking the first difference these series are found to be stationary at 1, 5 and 10 percent level of significance. The result of Karl Pearson's correlation matrix suggest that there is a negative relationship between the NPA and liquidity, efficiency, solvency and profitability of Indian commercial banks represented in the study as CDR, CRDR, NIM, PER, ROA and ROE. The analysis revealed that the non-performing assets in study formed there is no significant long-run relationship with all the six variables tested. But the Johansen's co-integration test suggests that the non-performing assets of Indian commercial banks have co-integrated with the six variables under the study. It is observed that only in the short-run, the non-performing assets of the Indian commercial banks are negatively co-integrated with the liquidity, efficiency, solvency and profitability position of the banks.

The results show that the NPAs granger causes three variables i.e. cash-deposit ratio, credit-deposit ratio and return on assets. While there is bi-directional causality exists between all the variables tested (i.e. CDR, CRDR and ROA) and NPA. While there exists a unidirectional causality between PER and NPA. NPA granger causes net interest margin and return on equity but not the other ways around.

The findings from Granger Causality based on the VECM indicate a bi-directional causality exists between all the three variables tested (i.e. CDR, CRDR and ROA) and NPA. While there exists a unidirectional causality between PER and NPA. It is observed from the findings that non-performing assets granger causes net interest margin and return on equity but not the other ways around in long run and short run.

The present study confirms the beliefs that non-performing assets (NPA) continue to affect the financial health of the Indian commercial banks. However, the limitations of the study should not be overlooked. The present study is limited to only six selected variables. Inclusion of more variables with a longer time period may improve the results. A logical extension of the study can be done by including more variables and analysing the financial health sector wise.

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