

Empirically Testing the Causal Relationship among NPA's and Financial Ratios of Indian Commercial Banks

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Abstract

Non-performing assets are the important variables to be considered while evaluating the financial health and performance of Indian banks. They influence the operational and functional productivity, which had a deep impact on the liquidity, proficiency, dissolvability and financial profitability of the banks. The paper is an attempt to examine the connections, impact, causal relationship between the non-performing assets and nine ratios addressing liquidity, productivity, dissolvability and financial profits over the period 2005 to 2021. Johansen's Test of co-integration and Vector Error Correction Model (VECM) is applied to investigate the long- term causality in relationship among NPA's and nine ratios considered under the review. The examination uncovers that the non-performing assets of the Indian banks are adversely related with the liquidity, productivity, operating profitability, solvency and financial health of the banks and thus, a long-run harmony relationship exists among them. Regression analysis shows profit per employee and return on equity has least independent impact and collectively the variables affect NPA of banks. The results of Granger causality test using VECM confirms that Cash deposit ratio, return on assets and Return on equities are unidirectional and Credit deposit ratio, Net interest margin ratio, Operating profit to total Assets ratio, Profit per employee and Return on investments are bidirectional relation with non-performing assets. It can be confirmed that there is a unidirectional relation of NPA with Cash Deposit Ratio, Return on Assets and Return on Equity ratio and bidirectional relation among Credit Deposit Ratio, Net Interest Margin Ratio, Operating Profit to total Assets Ratio, Profit per Employee and Return on Investment.

Keywords: Non- Performing Assets, Indian Banks, Financial Health, Granger Causality Test, VECM.

Introduction

Non- Performing Asset (NPA) is termed as that investment turned dead over a period of time occurring out of non- payment of interest and principle having negative effect on the operating efficacy of the commercial banks in India. This operational competency is benched

marked with liquidity, solvency, efficacy and profitability performance of the banks. These are the important determinants that gets affected if there is change in the position of NPA. The banks in order to meet the minimum standard of capital adequacy and creating provision against NPA had to invest into financial innovations and development of new financial vehicles.

Banks run into losses when they wrongly assess the financial competencies of borrower or for more than six months borrower is unable to pay interest or principal amount. This in process negatively affect the financial performance of banks and adversely affect the solvency and cost-effectiveness of banks. NPAs not only affects the financial position of banks but also affect the economy at large. An intense increase in NPA results into increasing crisis and risk of bank's that further shrink's the capital structure. The NPA level if exceeds 10 percent of total GDP results into an outburst of banking crisis (Khan & Bisnoi, 2001).

Rising NPA's is an area of concern for the growing banking system. In this context the study explores to estimate the relation between solvency, profitability, liquidity and performance of Indian banks. "Increasing levels of NPA have been increasing the stress on banks' and reducing the earning competencies. As a result, banks provisioning capacity has come under pressure leading to a spike in the net NPA levels. Higher net NPAs indicate lower provisioning coverage" (Viswanathan, 2016). Financial sector reforms in India are designed and developed to help the growth of banking sector but increasing NPA had slowdown the pace of growth and keeps on increasing over prolonged period. Banks have raised the cost of borrowings and intermediation to exercise control over the varying impact of NPA. Banks have designed their own mechanism to ensure timely repayment of principle and interest so as to fire fight NPA. Revision in Basel Accord is an attempt to uplift the banking performance it has reduced the risk, revised accounting standards, enhanced technology, customer services and new product development. The global subprime crisis have shown its ill effect on the economic and banking performance where bad and doubtful debts are impossible to be recovered by banks.

Eventually, Corona pandemic had also adversely hit the financial sector leading to loss of lives and bank loans have turned dead to a larger extent. NPA are adversely impacting the profitability as banks are unable to show the profitability statement and their capital is shrinking. This is resulting into increased funding cost and minimizing provisions that need to be maintained by banks.

Understanding the effect of NPA is mandatory and it is necessary to have a clarity in terms of change in structure financially or operationally that, should be taken care to strengthen the banking system. Indian banks are operating in a highly protective and regulated environment as prescribed by RBI. They are in then cocoon and precautionary measures have been taken now and again to enhance operational and financial efficiency of banks in India (Reserve Bank of India, 1999). The financial burden in form of NPA is unavoidable for any bank it is a challenge that needs to be dealt with and should be kept within a manageable range. The banks success and failure largely depends upon the manner in which it has managed its recovery system and ways to bring down NPA over a period of time. The process by which NPA can be kept in the controlled level is through effective monitoring of loan, timely recovery of both interest and principle. Apart from this proper planning should be done while framing, revising and controlling the policy matter related to loans and legal reforms should be strengthened. This paper is an attempt to provide the varying impact of NPA over liquidity, efficiency, profitability and solvency of Indian banks. The study will also provide knowledge regarding causal relationship among NPA and various variables.

Literature Review

(Vithessonthi, 2016) studied the relationship among the growth in credit of bank against growing NPA in the economy keeping in view the deflationary trends. The study was carried using data from 82 Japanese commercial banks for the period 1993 to 2003 and found time-varying relationship among growth in bank credit and NPAs. It was found that, an increased bank loan distribution results into an increased level of NPA and further reduces banks profitability. (Annapurna & Manchala, 2017) studied Indian banks and used the authors used balanced scorecard

(BSC) method for which they selected top three PSB's namely, SBI, PNB and BOB, using their performance statistics over a period ranging from 2006 to 2015. The researchers applied Correlation and Multiple Regressions to find impact and relationship between profitability and variables using BSC framework. The variables exhibit statistically significant relationship among, Capital Adequacy Ratio (CAR), number of ATMs, Net NPA Ratio and number of trained personnel with Return on Assets (ROA). The Regression Analysis confirms that the Net NPA Ratio had direct and significant linear relationships with CAR and ROA while inverse relationship is observed among Net NPA Ratio and ROE.

(Arindam, 2018) measured the efficiency of Indian banks during pre- (2001- 02 to 2006- 07) and post-global recession (2007-08 to 2012-13) he used an operation research technique named Data Envelopment Analysis and input-oriented variable return to scale approach. Different commercial banks efficiency and super efficiency scores were mapped using Linear programming and Spearman correlation analysis was used to determine pre and post-recession relationship. Although the study coined that, during the post- recession period PVSBS were capable enough to perform better than PSBs, it is discovered that the recession had little effect on performance. The Karnataka State Financial Corporation (KSFC) is a state-level development financial agency that was founded by the Karnataka government in 1959 to support the state's industrial entities. Over the course of these six decades, the organisation has given loans and advances totalling '152.75 billion to more than 1.70 lakh units, with more than 75% of this support going to MSMEs. (Inchara, 2018) assessed the corporation's overall performance using performance information from 1997–1998 through 2016–2017. The study's findings showed that its performance had improved in terms of net interest spread (by preventing a major increase in its interest expenses), excess (i.e., an excessive net total income over non-interest expenditures), and provision for NPAs (by not permitting it to escalate substantively owing to its effort to improve asset quality). This is deemed to be insufficient and hence recommended that the banks can enhance their performance by carrying out the credit evaluation as objectively as necessary, by

enhancing the performance of its recovery, by enhancing its standard assets, and by lowering the sub-standard assets and dubious assets.

According to (Muniappan, 2018), "The internal factors include reallocating resources for growth and launching new ventures, assisting/advancing partner concerns, time/cost intrusions during the project usage stage, business (item, showcasing, and so forth) disappointment, wasteful administration, stressed work relationships, unscrupulous innovation/specialized issues, item oldness, and so forth, while the external factors include downturn, non-installation in other countries, inputs/power lack, value heighten." According to (Pillai, 2018), the Indian banking industry has prospered admirably despite the collapse of the global monetary system. This is due to the strong and efficient regulatory framework that guarantees ongoing oversight of Indian institutions. However, the protection of banking companies from potential credit risk has not been guaranteed by this regulatory structure. As is well known, the number of bad loans has been steadily rising and is depleting otherwise profitable assets. And the NPA issue hasn't been fixed. In this context, an examination of the recent chronological trend in NPAs in the Indian banking system is made. It is observed that considering the NPA problem involves greater attention of both the higher authorities and government and requires the involvement of bank level efforts dedicatedly.

With the aid of 31 financial/accounting ratios, (Jaslene et al., 2019) analysed 46 Indian banks panel data of eight years ranging from 2007 to 2014. They employed the GMM model, which addresses the endogeneity problems in the studied data. Additionally, 31 ratios were employed to assess the performance of various performance factors that collectively have an impact on NPAs, including operating competency, liquidity, profitability, solvency, capital sufficiency, and business development competency. The intermediation cost ratio, ROA, and NPAs were found to have a negative, statistically significant association.

According to (Kalyanasundaram, 2020), an increased amount of NPAs written off, rather than an improvement in recovery performance, is the main cause of the drop in the gross NPAs of Indian SCBs. For instance, the SCBs

recovered \$1,797 billion in NPAs (including customary loans) during 2018–19 as opposed to \$2,369 billion in NPAs that were written off. This should be highlighted that these write-offs are reflected in the Statements of P&L account and have a negative impact on the financial performance of banking organisations. (Inchara, 2019) looked analysed the recovery performance of Karnataka State Financial Corporation based on performance stats over a period of ten years, 2007-08 to 2016-17. The analysis's findings revealed that the performance of its recuperation has significantly improved. However, there is room for more advancement, which the firm demonstrated in one or more of the study period's years while permitting a decrease in others. It is therefore recommended that the company now strive for consistent improvement in its recovery performance. According to (Debarsh & Goyal, 2020), "on the board of non-performing resources in the point of view of the public area banks in India under severe resource characterization standards, utilisation of most recent innovative stage dependent on centre financial arrangement, recuperation methodology, and other bank specific markers with regards to tough administrative system of the RBI" are important points to note. Using a loan strategy, structures, and culture was the focus of the initial inquiry.

(Reddy, 2019) brought up a number of fundamental concerns regarding the credit conveyance instrument used in the Indian financial sector. Initially assessed "several concerns regarding the terms of credit offered by Indian banks. It was discovered in this particular instance that the

"intensity component makes no difference to the criminal behaviour." A default decision isn't completely absurd. Or perhaps a defaulter thinks about probability analysis of various costs and benefits of his option ". The NPA issues and challenges are linked to a few internal and external factors that the debtors must deal with. According to (Siraj & Pillai, 2021), "NPA is an illness that affects the banking industry. According to the investigation, NPA genuinely continues to pose a serious threat, and the consistent increase in NPA presents an excellent conversation starter regarding the productivity of credit risk for the executives of Indian banks ".

Research Objective

The objective of the paper is to study the varying impact of profitability, liquidity, solvency and performance over NPA and to understand causal relationship among NPA, profitability, liquidity, solvency and performance over a prolonged period of time.

Research Methodology

In the process of discovering the causal relations among NPA with various determinants of banks performance namely profitability, liquidity, solvency and performance we took the study period ranges from 2005 to 2021 and to accomplish the study 620 observations were obtained during analysis. The study and data is based upon availability of data from the official website of Reserve Bank of India. Variables description and the data sources is shown in Table 1 below.

Table 1: “Variables Description”

Acronyms	Construction of Variable	Data Source
DNPA	Net NPA To Net Advances Ratio	
DCDR	Cash Deposit Ratio	
DCRDR	Credit Deposit Ratio	
DNIM	Net Interest Margin Ratio	
OPTAR	Operating Profit to Total Assets Ratio	
DPER	Profit per employee Ratio	
DROA	Return on Assets	
DROE	Return on Equity	
DROI	Return on Investment	

The present study entails the time series data analysis to explore the relationship among DNPA, DCDR, DCRDR, DNIM, DPER, DOPTAR, DROA, DROE and DROI. The non-stationary data series can provide a false result if the variables are heteroscedastic and hence the dataset should fulfil the properties of time series and should be homoscedastic. The stationarity is observed when the variance and mean remain constant over a prolonged period. The most significant test of stationarity is unit root and the benchmarking is done using Augmented Dickey Fuller (ADF). The unit root test is performed at various levels namely Trend, Trend & Intercept and None. The unit root equation represents constant as α and coefficient as β while considering time at trend and lag (1) as order of autoregressive process. The study undertakes Vector Auto regression model (VAR) while performing minimum sequential LR test indicates interrelated time series for analysing dynamic impact. The VAR model includes structural modelling by treating endogenous variables as lag function of all lagged values. VAR model also entails modified likelihood ratio (LR) that starts from maximum lag length and 5% critical value is observed to accept or reject the hypothesis.

The Granger Causality test proves that if the co-integration is observed among the variables over the period of time they won't drift apart, and among non-stationary variables long run combination is expected. In a Johansen model and Granger Causality Test they possess multivariate approach and expected to have more than one sublinear combinations.

Results & Findings

The table- 2 is revealing the outcome of descriptive statistics applied on the variables DNPA, DCDR, DCRDR, DNIM, DPER, DOPTAR, DROA, DROE and DROI. It is evident from the results that there is an unsymmetrical distribution as the assessment of skewness and kurtosis are not in range of 0 to 3. Hence the observed from the results that variables does not follow normal distribution as the skewness coefficient value is greater than unity. The Jarque- Bera statistics displays that the value of frequency distribution is very high and hence it is not normally distributed. The standard deviation signifies the volatility of variables and it is observed in variables DCDR, DCRDR, DNPA, DPPE and DROE as the calculative values are very high.

Table-2

	DCDR	DCRDR	DNIMR	DNPAR	DOPTAR	DPPE	DROA	DROE	DROI
Mean	-0.001118	-0.005439	0.000217	0.003738	0.000247	-0.013010	-0.000631	-0.010282	0.000982
Median	-0.090834	-0.121286	-0.028833	-0.005000	-0.041343	0.080000	-0.010000	0.117605	-0.029481
Maximum	21.28725	246.5826	2.909881	13.18000	3.776968	99.90000	6.070000	104.9743	6.748859
Minimum	-17.37692	-247.8960	-2.788460	-12.88000	-3.488666	-92.00000	-5.070000	-86.31473	-6.768055
Std. Dev.	2.617917	21.76350	0.829806	2.320645	0.910066	10.35349	1.085732	16.69608	1.002252
Skewness	0.462720	-0.023784	0.127971	0.055987	0.180402	0.560380	0.294730	0.219843	0.202774
Kurtosis	16.02380	63.65074	4.840564	10.20750	5.191125	29.30380	9.765460	9.703871	11.92231
Jarque- Bera	4389.753	94721.75	88.91942	1337.984	126.9786	17848.51	1187.562	1162.232	2054.133
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	-0.690880	-3.361472	0.133929	2.310000	0.152507	-8.040000	-0.390000	-6.354484	0.607118
Sum Sq. Dev.	4228.604	292242.0	424.8523	3322.787	511.0121	66139.21	727.3281	171994.3	619.7827
Observations	618	618	618	618	618	618	618	618	618

Source: "Authors Approximation of Descriptive Statistics"

Unit root test is applied understand the stationarity of studied variables the values of Augmented Dickey Fuller (ADF) test is considered to be an authentic measure. The results can be observed in the table-3 below, and all the

variables used in study are suggested to be non-stationary in nature at trend, trend & intercept and none. However after testing at the 1st difference the series were proved to showcase stationarity at 1%, 5% and 10% significance level.

Table-3

Variables			Trend		Trend & Intercept		None	
			t- Statistics	Prob.*	t- Statistics	Prob.*	t- Statistics	Prob.*
DCDR	ADF Test Statistic		-14.28825		-14.27616		-14.30021	
	Test Critical Value	1% Level	-3.440858	0	-3.973195	0	-2.568765	0
		5% Level	-2.866068		-3.417215		-1.941344	
		10% Level	-2.56924		-3.130996		-1.61635	
ADF Test Statistic		-14.41297			-14.40955			
DCRDDR	Test Critical Value	1% Level	-3.440858	0	-3.973195	0	-2.568765	0
		5% Level	-2.866068		-3.417215		-1.941344	
		10% Level	-2.56924		-3.130996		-1.61635	
	ADF Test Statistic		-14.30939				-14.29754	
DNIMR	Test Critical Value	1% Level	-3.440858	0	-3.973195	0	-2.568765	0
		5% Level	-2.866068		-3.417215		-1.941344	
		10% Level	-2.56924		-3.130996		-1.61635	
	ADF Test Statistic		-14.42439				-14.41232	
DOPTAR	Test Critical Value	1% Level	-3.440858	0	-3.973195	0	-2.568765	0
		5% Level	-2.866068		-3.417215		-1.941344	
		10% Level	-2.56924		-3.130996		-1.61635	
	ADF Test Statistic		-21.30782				-21.29028	
DPPE	Test Critical Value	1% Level	-3.440771	0	-3.973071	0	-2.568734	0
		5% Level	-2.866029		-3.417154		-1.94134	
		10% Level	-2.569219		-3.13096		-1.616353	
	ADF Test Statistic		-16.65615				-16.64255	
DROA	Test Critical Value	1% Level	-3.440806	0	-3.97312	0	-2.568746	0
		5% Level	-2.866044		-3.417178		-1.941341	
		10% Level	-2.569227		-3.130974		-1.616351	
	ADF Test Statistic		-23.10953				-23.09059	
DROE	Test Critical Value	1% Level	-3.440771	0	-3.973071	0	-2.568734	0
		5% Level	-2.866029		-3.417154		-1.94134	
		10% Level	-2.569219		-3.13096		-1.616353	
	ADF Test Statistic		-17.7794				-17.76464	
DROI	Test Critical Value	1% Level	-3.440806	0	-3.97312	0	-2.568746	0
		5% Level	-2.866044		-3.417178		-1.941341	
		10% Level	-2.569227		-3.130974		-1.616351	

Source: "Authors Approximation of Unit Root Test, (ADF)"

Further, the study is carried using Karl Pearson's Correlation analysis in the following below mentioned table- 4 that is the representative of relation among the studied variables. The correlation matrix shows the presence of positive and negative correlation among the variables. It is clearly observed from the table that the

variables namely DCDR (0.0509) has low positive correlation and remaining all variables DCRDR, DNIMR, DOPTAR, DPPE, DROA, DROE and DROI are negatively correlated. It is conclusive that any change in these variables will negatively or positively affect DNPA performance.

Table-4

	DCDR	DCRDDR	DNIMR	DNPAR	DOPTAR	DPPE	DROA	DROE	DROI
DCDR	1.000000	0.200497	-0.039721	0.050930	-0.032027	-0.016178	0.015436	-0.010200	0.005910
DCRDDR	0.200497	1.000000	-0.091173	-0.273967	0.134356	0.237142	0.279416	0.216260	-0.470498
DNIMR	-0.039721	-0.091173	1.000000	-0.327057	0.733300	0.256513	0.498275	0.417708	0.311108
DNPAR	0.050930	-0.273967	-0.327057	1.000000	-0.365684	-0.546977	-0.640433	-0.618051	-0.078629
DOPTAR	-0.032027	0.134356	0.733300	-0.365684	1.000000	0.432020	0.692452	0.601509	0.144977
DPPE	-0.016178	0.237142	0.256513	-0.546977	0.432020	1.000000	0.803925	0.760958	-0.067063
DROA	0.015436	0.279416	0.498275	-0.640433	0.692452	0.803925	1.000000	0.929791	0.033357
DROE	-0.010200	0.216260	0.417708	-0.618051	0.601509	0.760958	0.929791	1.000000	0.062949
DROI	0.005910	-0.470498	0.311108	-0.078629	0.144977	-0.067063	0.033357	0.062949	1.000000

Source: "Authors Approximation of Karl Pearson's Correlation"

Analysing the impact of independent variables on dependent variables we applied Linear Regression Analysis and the result is seen in the table-5 below revealing that, independently DPPE and DROE has less or no impact on DNPA as the p value greater than 0.05. There

exist a collective impact of all independent variables as the p value is 0.05. The hypothesis stating no impact is rejected and over a period of time DCDR, DCRDR, DNIM, DOPTAR, DPPE, ROA, ROE and ROI effect DNPA respectively.

Table-5

Variables	Probabilities
C	0.9658
DCDR	0.0005
DCRDDR	0
DNIMR	0.0001
DOPTAR	0
DPPE	0.0914
DROA	0
DROE	0.0573
DROI	0
r²	0.47722
Adjusted r²	0.470353
F-stat	69.49084
Probability (F-stat)	0
AIC	3.900479
SC	3.964942
HQC	3.92554
DW Stat	2.948184

Source: "Author's Approximation of Linear Regression"

The study explored the existence of numerous co-integrating and causal relationship among the underlying studied variables. The relations can be observed using Johansen Co- integration Model. In the process of understanding the co- integrating vectors maximum eigenvalues and trace statistics are used and highest values

ach as bench mark and VAR leg length selection is shown in the table- 6 below. As indicated in the table eight co-integrating equations were considered and the maximum eigenvalue is observed at seventh co-integration equation. The results proves the occurrence of long term relationship among DNPA, DCDR, DCRDR, DNIM, OPTAR, ROA, ROE and ROI.

Table-6

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-1323.29	2648.567	18.29583	28.361339	24.504951	26.46455
1	-2584.69	159088.7	26.20349	28.256782	28.600394	25.89596
2	-602.415	254.9997	20.86993	28.020828	27.164439	25.7686
3	-1236.47	1997.991	20.75866	27.079463	24.223074*	25.5527
4	-646.837	294.5617	23.04443	26.165054	24.308666	25.4094
5	-2168.9	41243.13	18.88750	26.106805	27.250417	24.44728
6	-793.757	474.6150	16.68838	25.642069	24.785681	24.42412
7	-2480.19	113316.4	56.22481*	24.117504*	24.261116	24.23847*
8	-700.685	350.8370	24.03119	24.339887	25.483499	25.75413

* indicated lag order designated by the criterion'

'LR: sequential modified LR test stat (each test at 5% level)

'FPE: Final prediction error'

'AIC: Akaike information criterion'

'SC: Schwarz information criterion'

'HQ: Hannan-Quinn information criterion'

Table- 6; Source: "Author's Approximation of VAR Lag Selection Criteria"

Vector Error Correction model estimates are based on Johansen Co- integrating model as it facilitates to unearth co- integrating vectors having short term and long term

interactions. The result can be observed in the table- 7 below that shows that DNPA had a long term equilibrium relationship with DCDR, DCRDR, DNIM, OPTAR, DPPE, ROA, ROE and ROI. The co- integrating coefficients can be projected in contrast to DNPA depending upon first normalized eigenvector. The study also proves that the variables have long term elasticity measures and based on the same co-integrating relation can be formalized as:

$$NPA = .21319 + (.97017)*DCDR + .78403* DCRDR + 9.3736* DNIMR + (-12.4.106)* DOPTAR + (-.83138) * DPPE + (- 15.3962)* DROA + 1.3979 * DROE + (-7.5972) * DROI$$

Table-7

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value 0.05	Prob.**	Max- Eigen Statistic	Critical Value 0.05	Prob.**
None *	0.244032	704.2844	197.3709	0.0001	171.7699	58.43354	0.0000
At most 1 *	0.213035	532.5144	159.5297	0.0000	147.0969	52.36261	0.0000
At most 2 *	0.150548	385.4175	125.6154	0.0000	100.1827	46.23142	0.0000
At most 3 *	0.120128	285.2349	95.75366	0.0000	78.57928	40.07757	0.0000
At most 4 *	0.112633	206.6556	69.81889	0.0000	73.37093	33.87687	0.0000
At most 5 *	0.095761	133.2846	47.85613	0.0000	61.80614	27.58434	0.0000
At most 6 *	0.055643	71.47851	29.79707	0.0000	35.15203	21.13162	0.0003
At most 7 *	0.043813	36.32647	15.49471	0.0000	27.50817	14.26460	0.0002
At most 8 *	0.014259	8.818306	3.841466	0.0030	8.818306	3.841466	0.0030

'Trace test indicates 9 cointegrating eqn(s) at the 0.05 level'

'Max-eigenvalue test indicates 9 cointegrating eqn(s) at the 0.05 level'

'* denotes rejection of the hypothesis at the 0.05 level'

'**MacKinnon-Haug-Michelis (1999) p-values'

Table- 7; Source: "Author's Approximation of Johansen Model"

Table- 8

Panel A: Normalized Co -integration Coefficients									
DNPA (-1)	DCDR(-1)	DCRDR (-1)	DNIMR(-1)	DOPTAR(-1)	DPPER(-1)	DROA(-1)	DROE(-1)	DROI(-1)	Constant
	-0.970177	0.784037	9.373617	-12.41061	-0.831384	-15.3962	1.397955	-7.59727	
	(0.37206)	(0.06518)	(1.80302)	(2.13475)	(0.18343)	(3.51023)	(0.16654)	(1.02057)	
1	[-2.60760]	[12.0295]	[5.19885]	[-5.81362]	[-4.53249]	[-4.38610]	[8.39400]	[-7.44416]	0.213194
Panel B: Coefficient of Error Correction term									
Error Correction:	DNPA	DCDR	DCRDR	DNIMR	DOPTAR	DPPER	DROA	DROE	DROI
	- 0.001756	0.010816	-0.684587	0.006046	0.014476	0.069928	0.008227	0.021942	0.035058
	(-0.00862)	(0.00992)	(0.07689)	(0.00308)	(0.00331)	(0.03915)	(0.00420)	(0.06489)	(0.00361)
	[- 0.20380]	[1.09016]	[-8.90327]	[1.96404]	[4.37515]	[1.78614]	[1.95881]	[0.33813]	[9.70890]
F-statistic	20.75866	18.29583	26.20349	20.86993	23.04443	18.88750	16.68838	16.22481	24.03119

Source: "Author's Approximation of VECM" 'Standard errors in () & t- statistics in []'

The table- 8 of Vector Error Correction Model above indicates bracket [] as t- statistics and () represents error term. The coefficient of DCRDR is negative and rest DCDR, DNIM, OPTAR, DPPE, ROA, ROE and ROI are positive indicating insignificance statistically. As the interpreting term is negative and it proves that there exist

relationship among non- performing asset and credit deposit ratio. The error correction coefficient and t- statistics table shows that NPA values are negative proving that DNPA respond significantly in process of establishing equilibrium in terms of relationship if any deviation is observed among the variables.

Table- 9

Null Hypothesis	Observations	F- Stat	Probability	Accepted/ Rejected	Direction
DNPAR doesn't Granger Cause DCDR	617	8.76686	0.0002	Rejected	Unidirectional Relation with Cash Deposit Ratio
DCDR doesn't Granger Cause DNPAR		0.70758	0.4932	Accepted	
DNPAR doesn't Granger Cause DCRDDR	617	2.78957	0.0622	Accepted	Bidirectional Relation with Credit Deposit Ratio
DCRDR does not Granger Cause DNPAR		2.78812	0.0623	Accepted	
DNPAR doesn't Granger Cause DNIMR	617	11.2227	2.00E-05	Rejected	Bidirectional Relation with Net Interest Margin Ratio
DNIMR doesn't Granger Cause DNPAR		7.97402	0.0004	Rejected	
DOPTAR doesn't Granger Cause DNPAR	617	10.7030	3.00E-05	Rejected	Bidirectional Relation with Operating Profit to total Asset Ratio
DNPAR doesn't Granger Cause DOPTAR		10.4861	3.00E-05	Rejected	

Null Hypothesis	Observations	F- Stat	Probability	Accepted/ Rejected	Direction
DPPE doesn't Granger Cause DNPAR	617	6.59025	0.0015	Rejected	Bidirectional Relation with Profit Per Employee
DNPAR doesn't Granger Cause DPPE		15.8669	2.00E-07	Rejected	
DROA doesn't Granger Cause DNPAR	617	2.60206	0.0749	Accepted	Unidirectional Relation with Return on Assets
DNPAR doesn't Granger Cause DROA		30.0506	4.00E-13	Rejected	
DROE doesn't Granger Cause DNPAR	617	0.45726	0.6332	Accepted	Unidirectional Relation with Return on Equity
DNPAR doesn't Granger Cause DROE		20.1867	3.00E-09	Rejected	
DROI doesn't Granger Cause DNPAR	617	2.82383	0.0602	Accepted	Bidirectional Relation with Return on Investment
DNPAR doesn't Granger Cause DROI		0.38167	0.6829	Accepted	

Source: "Author's Approximation of Granger Causality Test"

The VECM test marks the evidence of causality among the studied co- integrated variables but unable to predict the direction of causality in terms of relations. The above test of Granger causality in table- 9 helps to determine and reveals all possible directions in terms of causal relations. The granger causality table reliably estimates that NPA has cause and effect relation bi- directionally with Credit Deposit Ratio, Net Interest margin Ratio, Operating profit to Total Asset Ratio, Profit Per Employee Ratio and Return on Investments. It is also evident that unidirectional relation is observed with Cash Deposit Ratio, Return on Assets and Return on Investment. Finally it is observed that NPA affect all the variables.

Conclusion

The study evidently proves the linkage between DNPA, DCDR, DCRDR, DNIM, OPTAR, DPPE, ROA, ROE and ROI of Indian banks using Johansen's co- integration test. The analysis was carried on the yearly data for the period ranging from 2005 to 2021 from official website of RBI. Primarily, unit root test was performed using ADF and it was concluded that the data used under the study is was non- stationary at trend, level and intercept. This proves that data is good for further investigations and we can apply Correlation, Regression, Johanssen, VECM and Granger tests to prove the existence of causal relation. The series

were found to be stationary on applying unit root test at the first difference indicating the values of 1%, 5% and 10% level of significance.

The correlation analysis proved that DCDR is positively correlated with DNPA and the remaining DCRDR, DNIMR, DOPTAR, DPPE, DROA, DROE and DROI variables are negatively correlated. The regression analysis proves that only 2 variables DPPE and DROE have least or no impact on NPA and remaining all the variables independently affect NPA. Collectively the p- value is 0 hence they have a combined impact on NPA.

The test of co- integration is represented by Johansen model and it is evident that all seven variables are negatively co- integrated with non- performing assets. The Granger Causality test in line with VECM concludes NPA has cause and effect relation bi- directionally with DCRDR, DNIMR, DOPTAR, DPPE, and DROI whereas, unidirectional relations with others. This causality is long term in nature and tend to change by time and profitability. The present study is carried for limited variables and we can use many more to land on more precise decision and clearer picture of financial health.

Implication

It is determined from correlation analysis that negative correlation pushes prices in other direction i.e. if DCRDR,

DNIMR, DOPTAR, DPPE, DROA, DROE and DROI increases NPA decreases and vice- a- versa. It is conclusive of the fact that variables have long term relationship with one another and help discovering values. There is a lasting impact of DCDR, DCRDR, DNIM, DOPTAR, DPPE, ROA, ROE and ROI on DNPA. This can be assumed from the study that, in the long run non- performing assets of Indian banks will be co- integrated negatively in contrast with efficiency, solvency, profitability and liquidity respectively. There is a strong causal relation among the variables and NPA tend to create challenges in banking system.

Suggestion

Banks are hallmark of economic performance and hence they need to stand tall and strong financially. NPA is a subject matter of concern and bother for banks they need to keep it down to a certain level. It is suggest that banks should work more on profitability, liquidity, solvency and performance these verticals to keep the NPA in the balanced range and improvise the financial structure for a prolonged period of time.

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