Determinants of nonperforming assets-bank-specific and macroeconomic factors: A panel data analysis of different group of commercial banks operating in India

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Abstract. *This paper examines the relationship between the Net Nonperforming Assets (NNPAs) and the factors influencing them (bank specific and macroeconomic) for different group of Indian commercial banks (State Bank of India and its associates, nationalised banks, private Banks, foreign banks) in a panel data framework. From the macroeconomic variables, two principal component series have been created; one is from the group of variables having positive correlation with the NNPAs and the other from the group of variables having negative correlation, for different type of banks. The linear and the dynamic panel regressions and further Impulse Response analysis have been carried out to check the linkages between the NNPAs with its determinants. The result shows that the impact of determinants on NNPAs varies for different group of banks as the banking practices and regulations vary among themselves. Indian banks got influenced more in comparison to the foreign banks with the change in macroeconomic conditions.*

Keywords: scheduled commercial banks, determinants, nonperforming assets, NPAs, bank specific, macroeconomic parameters, principal components, panel data models, India.

JEL Classification: C33, E44, G21.

1. Introduction

The financial strength of any bank depends upon the performance of its own assets. The degradation in the assets quality results in accretion of nonperforming assets. The continual rise in nonperforming assets[1] (NPAs) leads to worsening of the banking industry functions. NPAs result from the nonpayment of loans by borrowers to lenders/banks. It not only reduces the earnings of the banks but also affects the capital base of the banks leading to banking crisis, and then economic downturn. Presently, the news of increase in the NPAs among banks is one of the alarming findings in the Indian financial system which has worried each concerned controlling bodies; starting from each bank's board of directors to Reserve Bank of India (RBI). It posed a concern for the banks in India, as one of the nationalised banks, namely United Bank of India has been forced by the regulator to put cap on amount of lending to a single borrower due to frequent rise in its NPAs. Particularly, the public sector banks in India have started to show decline in profits and even losses in their financial results because of piling up of bad assets. The growth of NPAs has two side effects on the profits of the banks. On the one side, it stops interest earnings from those stressed assets, and on the other, it leads to the making of more compulsory provisions for those NPAs out of earned profits. Furthermore, the capital base of the bank depends upon the accumulated profits and banks need to maintain the minimum required capital as a percentage to their risk weighted assets. Thus, when profit does not rise or starts to fall, banks become standstill and cannot lend further as they become unable to meet the eligible capital requirement. In that case, these banks are forced to stop their business or finally government supports them by infusing capital.

The performance of any bank's loans depends upon the progress of the operating economy, its own management practices and earning capacity of the financing firms. In other words, apart from macroeconomic fundamentals, banks internal management's decisions, such as targeting return on assets (ROA), maintenance of capital adequacy ratio (CAR), and amount of provisioning also strongly influence in the progress of banks' business. There have been several studies that analysed the relationship between the nonperforming loans with the bank specific and the macroeconomic variables by the researchers and academicians (Castro, 2012; Erding and Abazi, 2014; Louzis et al., 2012; Pestova and Mamonov, 2012; Tanaskovic and Jandric, 2014). The rise of NPAs is considered to be the representation of rise in credit risk. The credit risk is considered to be the major risk for banks as most of the assets remains in the form of loans. The increase in nonperforming loans leads to credit default and worsening of the credit risk ratios for the banks (Samad, 2012). Many research had also been done in explaining the NPAs of Indian banks, but further, the analysis for different group of banks will be novel in this direction for the present time (Arora, 2013; Das and Ghosh, 2007; Dhar and Bakshi, 2015; Dwivedi, 2012; Ghosh et al., 2014).

With this background, the paper tries to build up the empirical relation of nonperforming loans with the bank-specific and macroeconomic parameters for different categories of commercial banks operating in India. For this study, 58 commercial banks[2] are considered in different groups with an intention to examine how the impacts of the

determinants vary across the groups as each has their own banking practice and regulation. The major share of State Bank of India (SBI) and its associates and nationalised banks are owned by the government, whereas shares of private banks are owned by their private owners, and the foreign banks have their ownership outside India. The government owned banks are controlled by the government representatives and are modeled to work for the benefit of all sections of people by lending to priority sectors like agriculture, weaker sections, education, farmers etc. However, the private banks work for profit with high priority. The foreign banks do limited business like credit card facilities, credit guarantee loans and act as a representative bank between banks in India and their parent bank. From the trend of lending by the commercial banks, it is observed that, public sector banks burn their hand by lending to risky agricultural sector as compared to private and foreign banks. The last 10 years' average share of lending to agricultural sector by SBI and its associates, nationalised banks works out to be 12 percentages to 13 percentages, whereas for the private banks it is 7 percentages, and for the foreign banks it is even less than 2 percentage of their total lending. This is considered to be one of the reasons for accumulation of more bad assets for the public sector banks. The other reasons may be the style of banking practices and the dependence on macro fundamentals of the country. Further, the bank's behavior plays important role for controlling the non performing loans (NPLs), the state run banks are generally bailed out by Government while they got burdened with bad assets and need of capital. The attitude that state will protect us leads to further deterioration of assets base of publicly owned banks. Zhang et al. (2016) examined the impact of bank behavior on bad assets in China and observed that Chinese banks exhibit moral hazard manner in taking the lending decisions as they add more risky loans to reduce their NPLs ratios and end up with more stressed assets.

The bank specific parameters are taken into consideration for each bank separately for different groups of banks, whereas the macroeconomic parameters are common for all the banks. The common macroeconomic parameters are grouped into two types for each category of banks depending whether they have positive or negative correlation with the NNPAs of the groups of banks. For nationalised and private banks, the macroeconomic parameters like unemployment rate, fiscal deficit, and weighted average lending rate (WALR) are kept under the first group having the positive correlation with NNPAs, and the rest of the parameters like gross domestic product (GDP), wholesale price index (WPI), index of industrial production (IIP), exchange rate and scheduled commercial banks' (SCBs) credit growth rate belonged to the second group of parameters having negative correlation. The group consisting of SBI and its associates has positive correlation with unemployment rate, fiscal deficit, WALR and exchange rate with their NNPAs and has negative correlation with rest of the macroeconomic parameters. Similarly, for the foreign banks operating in India, the macro parameters like unemployment rate, fiscal deficit, WALR and SCBs credit growth rate are kept under first group while the rest are put under the second group.

Following this, the Principal Component Analysis (PCA) technique is used for common macroeconomic parameters to generate one single component vector for each correlated group, that is, group having positive correlation and negative correlation with the NNPAs. Further, it leads to the creation of two variables for each category of banks. They

are named as positively correlated macro principal component (PCMPC) and negatively correlated macro principal component (NCMPC), derived from positively and negatively correlated macro variable group with the NNPAs respectively. Then, different type of panel regressions such as fixed effect, random effect, and dynamic panel models are estimated for each category of banks by using NNPAs as the dependent variable and bank specific parameters such as return on assets (ROA), capital adequacy ratio (CAR), provisions and two principal component macro variables groups (PCMPC and NCMPC) as the independent variables. The Hausman specification and Breusch-Pagan LM tests are also been conducted to check suitability of random effects model over the fixed effect model. Moreover, the impulse response analysis has also been carried out to check the linkages between the NPAs and its determinants in a Panel Vector Autoregressive (PVAR) model which helps to find out the response of NNPAs due to standard shocks in their determinants.

The rest of the article goes as follows. Section 2 discusses the existing literature on the nonperforming loans and its determinants. In Section 3, the data and methodology used for this paper is discussed. The estimated empirical results are analysed in Section 4, and Section 5 concludes the paper.

2. Literature review

Several studies exist that explore the determinants of credit risk - both theoretical and empirical in nature to explain the factors influencing the nonperforming loans. The performance of bank's loan depends upon repayment capacity of the borrowers, which again depends upon running of their business and economic condition of the operating country. It is generally a trend that in the booming phase of economy NPAs decline as the repayment capacity of the people increases and then the trend changes when the recession steps in. The present study may be linked to the famous financial accelerator theory of macroeconomics, which explains that, the adverse shocks to the economy are amplified by worsening financial market conditions. Specifically, adverse conditions in the real economy and in financial markets propagate the financial and macroeconomic downturn. Bernanke et al. (1996) studied the US economy where the lenders got affected due to macroeconomic shocks in the economy. With the fall in macro fundamentals, the firms in the economy loose loan repayment capacity due to rising cost in the market and declining demand for their products at the same time. It leads to non-payment of loans and then leading to rise in NNPAs ratio. It can also be linked with that of Merton Framework of Macro financial risks where the problems in the macro financial setup lead to credit failure in the economy. Gray et al. (2007) analysed the inter linkages between the external shocks and asset liability mismatch (ALM) of the enterprises.

The importance of studies on credit risk can be seen worldwide. People across the globe have studied the determinants of the nonperforming loans. Tanaskovic and Jandric (2014) studied the determinants of nonperforming loans (NPLs) in Central and Eastern and South-Eastern Europe (CESEE) countries and observed that the increase in NPLs are positively related with the GDP growth, level of foreign currency loans and foreign

exchange rates. Erding and Abazi (2014) had also analysed the NPLs of the emerging European countries and their empirical study shows that among the macroeconomic factors, the growth of NPLs are prone to real GDP growth, inflation and credit growth rate, and among the bank specific factors, profitability and interest rate charged by banks stand important. Furthermore, Beck et al. (2015) studied NPAs of 75 counties and found that growth rate of real GDP, movement of share prices, exchange rate, and lending interest rates play an important role in influencing the NPL ratio. Similarly, Castro (2012) had studied the credit risk in the countries like Greece, Ireland, Portugal, Spain and Italy (GIPSI) by using the dynamic panel models and found that GDP growth and share price movement are inversely related to the NPLs rise, whereas unemployment and interest rate are positively related. Moreover, Ahmad and Ariff (2007) compared the credit risk determinants of both developed and emerging economies and observed that the two to four macroeconomic factors influence the credit risk of both these type of countries to a significant extent. They also opined that the emerging economies have more credit risk as compared to developed ones because of bank specific factors. Furthermore, Ahmad et. al. (2008) mentioned about the determinants of bank capital ratios in case of developing economies. According to them, there is a strong relationship between regulatory capital and bank's internal risk taking decision. They also declined the opinion that earnings and capital within a bank are positively linked.

Apart from cross country analysis, empirical researches on credit risk have also been carried out for different countries separately. The nonperforming loans of Greek banks are mainly explained by the macroeconomic variables and management quality (Louzis et al., 2012). Pestova and Mamonov (2013) had studied the Russian banks credit risk through macroeconomic and bank specific parameters by the use of single equation panel data models and noted that the macroeconomic factors, basically the rise in interest rates accelerate the growth of bad assets. Furthermore, Ghosh (2015) studied the banking industry specific and regional economic parameters as the determinants of US banks stressed assets and observed that greater capitalization, liquidity risks, poor credit quality, greater cost inefficiency and banking industry size positively impact NPLs, while profits of the bank and economic parameters like real GDP, real personal income and housing price index lowers the bad assets of these banks. Samad (2012a) had also studied the credit risk variables of the US bank failure and noted that credit loss provision and loan loss allowance to non-current loans are the responsible factors for the banking failure in the US. Similarly, Festic et al. (2010) had studied the systematic macroeconomic sources of credit risk in the European States and found that the slowdown in economy leads to growth of NPLs.

The credit risk determinants are also being studied in the developing countries. Garr (2013) studied the credit risk of Ghana banking industry and found out that the credit risk is influenced by the management efficiency, per capita domestic product, government borrowing and the financial sector development. Furthermore, Washington (2014) had analysed the impact of macroeconomic parameters on the nonperforming loans in Kenyan banking sector and found that the macroeconomic parameters strongly influences the nonperforming loans and also found that the lending to private sector is negatively related to the rise of bad loans. Additionally, some models are being analysed to verify how

effectively credit risk can be measured. Manab et al. (2015) had studied the earnings management and credit default forecast of Malaysia and established the result that the liquidity ratios, productivity ratio, and profitability ratio are significant factors in determining credit risk.

Similarly, Podpiera and Otker (2010) indentified that the business models, earnings potential and economic uncertainty are the determinants of credit default in European Large Complex Financial Institutions (LCFIs). The cost of the commercial banks depends upon the nonperforming assets and probability of failure in assets helps to predict the cost structure (Maggi and Guida, 2011). Nishikawa (2002) tried to predict the credit risk for business units and emphasized that credit rating models helps to identify the bank's risk and enables the bankers to determine the fair interest rate based on business unit ratings.

 The credit risk profile varies across the countries depending upon the policy setup and regulatory control. Ali and Daly (2010) studied the credit default rates across the countries, and they observed that the defaults are influenced by the macroeconomic parameters and concluded that the responsiveness of factors affecting the defaults varies across the countries; as the US is more prone to macro shocks than the Australia. In India, case studies for credit risk determinants are also been done by academicians and policy makers. Dhar and Bakshi (2015) had studied the NPAs of 27 public sector banks during the period of 2001-2005 and opined that bank specific parameters such as net interest margin and return on assets play major roles in influencing the piling up of bad assets. Ghosh et al. (2014) studied the NPAs of public sector banks and opined that GDP and market conditions have a direct relationship with the NPAs of public sector banks. In the similar line, Das and Ghosh (2007) studied the credit risk of Indian banks and observed that the rapid growth in credit and decline in the capital adequacy ratio (CAR) of banks is the early indicator of the financial downturns of the banks. Furthermore, Bittu and Dwivedi (2012) had studied the Indian banking industry and found that the variations in the fresh slippages of loans are affected by the change in the business growth and maintenance of CAR. They also studied the causal relation between the stressed assets and the macro parameters and noted that there is causal relation from GDP to slippages, however no reverse causation, from slippages to GDP.

In India, the risk profile varies from bank to bank depending upon the management goal and compliance requirement of banks. Arora (2013) had studied the credit risk management practices of public and private sector banks and observed that credit worthiness analysis and collateral requirements are major risk control tools and also pointed out that the risk management practices differ among public and private sector banks.

3. Data and methodology

The year wise data on bank specific parameters such as capital adequacy ratio (CAR), return on assets (ROA) and provisions have been captured from a set of 58 banks. It has been compiled from Centre for Monitoring Indian Economy (CMIE) data base and annual reports of the individual commercial banks separately for the period of 1999-2015. As per the RBI's classification based on shareholding strength, the covered 58 banks operating in

India have been broadly categorized into four different groups, namely SBI and its associates, nationalised banks, private banks and foreign banks. Furthermore, the factors outside the banking system (macroeconomic parameters) such as GDP, IIP, WPI, SCBs credit growth, exchange rate, unemployment rate, fiscal deficit and WALR data are taken year wise from CMIE and RBI data base for the same time period. Bank specific parameters are unique for each bank, whereas the macro parameters are common for all the banks. The macro parameters are classified into two groups, one having positive correlation with the NNPAs and the other having negative correlation, for different type of banks separately.

The details of the parameters used in this study and their descriptions are presented in Table 1.

Table 1. *Variables included in the analysis*

No.	Variable Name	Description
1	Net nonperforming assets(NNPAs)	Ratio of total net nonperforming assets to net advances
2	Capital Adequacy Ratio (CAR)	Ratio of total risk weighted assets to total capital funds
3	Return on Assets (ROA)	Ratio of average earnings to total average assets
4	Provisions	Provision amount kept by the bank for risk weighted assets as per the statutory audit
5	Gross Domestic Product(GDP)	Measures the growth percentage of national income and output.
6	Index of Industrial Production (IIP)	Measures the growth rate of total industrial output.
7	Wholesale Price Index (WPI)	Measures the growth rate of wholesale price level.
8	Weighted Average Lending Rate (WALR)	Weighted average lending rate (WALR) of banks in India. The weights are given according the total outstanding of the bank.
9	Exchange Rate	Exchange rate of the US Dollar and the Indian Rupee
10	Fiscal Deficit	Fiscal Deficit (difference between the government's expenditures and its revenues) as a percentage of its gross domestic product (GDP).
11	Unemployment Rate in India	No of people actively looking for job as a percentage of total labour force
12	Scheduled Commercial Banks(SCBs) credit growth rate	Credit growth of all the Scheduled Commercial Banks.

Group wise common principal components have been constructed through the PCA technique for macroeconomic parameters. The PCA helps to address the problem of correlation among the macro economic variables and generates the principal component which is used as a single factor for estimating the panel regressions. The panel regressions are done by using the bank specific parameters and the two principal components of the macro variables groups with NNPAs. Besides, the impulse response analysis has also been carried out to check the linkages between the NPAs and its determinants in Panel Vector Autoregressive (PVAR) model. A brief summary of the tests and estimated methods used for this paper are discussed as follows.

3.1. Principal component analysis

The principal component analysis (PCA) is a statistical technique used for data analysis, wherein large complex group of variables which are correlated with each other are converted into small and simple group of variables (components) which are not related among them. It keeps the maximum amount of data variation and makes the data easy to operate. PCA can also be defined as the linear combination of its basis factors which is expressed as

$$P = XY \tag{1}$$

where, X and Y are m X n matrices related to each other with a transformation P, X is the original data set taken for analysis and Y is the resultant component data set. From the set of components, the first component is generally selected as the representative principal component as it explains the maximum proportion of the total variance. Once the group wise principal components are formed, they are used for following panel regressions.

3.2. Panel data models

For this study we have used the famous fixed and random effect panel data models and they are being tested through Hausman specification and Breusch-Pagan Lagrangian multiplier (LM) test to check which model is appropriate – fixed or random effect model. Additionally, the Blundell-Bond (1998) linear dynamic panel model is also used for panel regressions.

3.2.1. The fixed effects model

The fixed effect model explains the relationship between explanatory variable and dependent variable where each individual entity has significant role in predicting the outcome in the system. The fixed effect model can be written as

$$Y_{it} = \beta_1 X_{it} + \alpha_i + U_{it} \qquad\qquad (2)$$

where, α_i is the unknown intercept and $i = 1, \dots, N$, Y_{it} is the dependent variable, t is the time variable and i is the entity level variable. X_{it} is the independent variables and β_1 is the coefficient for this independent variables and U_{it} is the error term.

3.2.2. The random effects model

The random effect model differs from the fixed effects model as the variation across entities is assumed to be random and uncorrelated with the independent variables included in the model. The random effect model can be written as

$$Y_{it} = \beta_1 X_{it} + \alpha + U_{it} + \varepsilon_{it} \qquad\qquad (3)$$

where, the α, as intercept remains fixed and ε_{it} is the error term, within entity.

3.2.3. Hausman Specification and Breusch-Pagan LM test

The Hausman specification and Breusch-Pagan LM tests are being conducted to check which one is better, fixed or random effect model, depending upon the significance of the test results. The random effect model is chosen over fixed effect model if the Hausman specification test is found to be statistically insignificant. But this is reverse in case of Breusch-Pagan LM test, which indicates that the random effect model is better if the test result is found to be statistically significant.

3.2.4. Blundell–Bond linear dynamic panel model

The linear dynamic panel model takes into account the lags of the dependent variable as explanatory variable and also includes the unobserved panel-level effects, fixed or random. Arellano and Bond (1991) derived a consistent generalized method of moments (GMM), dynamic panel regression model which is useful for the datasets with many

panels and few periods. Further, Blundell–Bond in 1998 had developed extended dynamic panel model which is superior to existing non-linear dynamic panel models.

The Blundell–Bond linear dynamic panel-data model can be written as

$$y_{it} = \Sigma_{j=1}^{p} \alpha_j y_{i,t-j} + x_{it}\beta_1 + w_{it}\beta_2 + v_i + \varepsilon_{it}, i = 1, \ldots, N,; t = 1, \ldots, T. \qquad (4)$$

Where, α_j are the p parameters to be estimated,

x_{it} are the independent variables and β_1 are the coefficient for the same, w_{it} are the predetermined variables and β_2 are their coefficients., v_i are the panel level effects and ε_{it} is the identically independently distributed (i.i.d.) for the whole sample with variance σ^2_ϵ.

3.2.5. Panel Vector Auto regression (PVAR) Analysis

In Vector Auto regression (VAR) model all the variables are treated as endogenous and interdependent among each other. The Panel VAR model is calculated in a panel data set and allows individual heterogeneity and it can be written as

$$y_{it} = \alpha_0 + A_1 y_{it} + \mu_{it} + \varepsilon_{it}, i = 1, \ldots, N, \qquad (5)$$

where y_{it}, is the vector of endogenous variables and μ_{it} is the parameter that explains the unobserved bank specific parameters and ε_{it} represents the idiosyncratic error terms.

In the panel VAR model, impulse response is a technique used to analyse the response of the variables due to shocks in their endogenous variables. The impulse response basically shows the reaction of any external shock to the system and how the variables got affected due to change in the other variables.

4. Empirical results

The empirical results found in this paper are as follows. The trend and descriptive statistics of NNPAs of different group of banks operating in India are shown as per Tables 2 and 3 respectively.

Table 2. *Trend of NNPAs in Indian Banks*

Year	Public Sector Banks	Private Banks	Foreign Banks
1996-97	17.84	8.48	4.29
1997-98	16.02	8.67	6.38
1998-99	15.89	10.81	7.59
1999-00	14.02	8.47	6.99
2000-01	12.39	8.54	6.85
2001-02	11.09	9.65	5.49
2002-03	9.36	8.08	5.34
2003-04	7.79	5.83	4.81
2004-05	5.37	3.9	2.99
2005-06	3.65	2.46	2.12
2006-07	2.66	2.19	1.88
2007-08	2.23	2.47	1.9
2008-09	1.97	2.91	4.3
2009-10	2.19	2.73	4.24
2010-11	2.23	2.24	2.56
2011-12	2.98	1.89	2.68
2012-13	3.61	1.79	2.98
2013-14	4.36	1.78	3.86
2014-15	4.96	2.09	3.20

The above trend shows that the percentage of NPAs has been continuously rising in past three years for all the type of banks; however, the government owned banks have observed higher rate of growth in accumulation of bad assets since the financial year 2009-10. This may due to ill health of the domestic economy and compulsory regulation for lending to the priority sectors of the economy for the public sector banks.

Table 3. *Descriptive Statistics of NNPAs of different group of banks*

	Public Sector Banks	Private Banks	Foreign Banks
Mean	7.40	5.00	4.23
Standard Error	1.26	0.75	0.41
Median	4.96	2.91	4.24
Standard Deviation	5.49	3.28	1.80
Sample Variance	30.09	10.76	3.25
Kurtosis	-1.02	-1.59	-0.95
Skewness	0.73	0.50	0.44
Range	15.87	9.03	5.71
Minimum	1.97	1.78	1.88
Maximum	17.84	10.81	7.59

The descriptive statistics shows that the average bad assets percentage is highest for the public sector banks and it is lowest for the foreign banks operating in India. The positive skewness is observed to be highest in case of public sector banks and lowest for the foreign banks indicating that the NPAs are the major problem for the public sector banks. The standard deviation result shows that the private banks have highest volatility in their percentage of NPAs to total loans.

4.1. Correlation analysis

The correlation matrix[3] is formed to determine the group having positive and negative correlation with the NNPAs of different type of banks. From the set of macroeconomic variables - GDP, WALR, WPI, fiscal deficit, IIP, exchange rate, unemployment, SCBs credit growth - two groups have been formed on the basis of correlation matrix, one having positive correlation and the other having negative correlation with the NNPAs of that particular type of banks. It is observed that, both nationalised and private banks' NNPAs are correlated with the same set of macro parameters both positively and negatively.

For SBI and its associates - NNPAs; WALR, unemployment rate, exchange rate and fiscal deficit are grouped under the first group having positive correlation and others under the second group, whereas for foreign banks, NNPAs; WALR, unemployment rate, fiscal deficit and SCBs credit growth are grouped under the first group and the rest of the variables are grouped under the second group.

The groupings of macro parameters based on the sign of correlation as presented in the correlation matrix for different type of banks is detailed in the Table 4.

Table 4. *Grouping of variables based on the Correlation with NNPAs*

Type of Bank	Positively correlated macro variables group	Negatively correlated macro variables
Nationalised Banks	WALR, unemployment rate, fiscal deficit	GDP, WPI, IIP, exchange rate , SCBs credit growth
Private Banks	WALR, unemployment rate, fiscal deficit	GDP, WPI, IIP, exchange rate , SCBs credit growth
SBI and its Associates	WALR, unemployment rate, exchange rate, fiscal deficit	GDP, WPI, IIP, SCBs credit growth
Foreign Banks	WALR, unemployment rate, fiscal deficit, SCBs credit growth	GDP, WPI, IIP, exchange rate

Based on the above categorisation, two principal components have been formed for each correlated groups and for each category of banks. It is observed that fall in exchange rates leads to rise of NNPAs of SBI and its associates, however the relationship is reverse in case of other group of banks. The SCBs credit growth is positively correlated with the NNPAs of foreign banks indicating that NPAs of foreign banks rises when there is growth in SCBs credit and for other banks the NPAs percentage falls with the rise in credit in the system.

4.2. Panel regressions

Once the principal components have been formed, the panel data models have been estimated for different type of banks separately. The different type of linear panel regressions such as fixed effect; random effect and Blundell–Bond dynamic panel model have been estimated to see the impact of both bank specific and macroeconomic determinants on NNPAs. The panel regressions have been constructed as per the following equation:

$$NNPA_t = \alpha_1 + \beta_1 CAR + \beta_2 ROA + \beta_3 Provisions + \beta_4 PCMPC + \beta_5 NCMPC + u_{it} \quad (6)$$

The Hausman specification and Breusch-Pagan LM tests have also been carried out to check suitability of random effects model over the fixed effect model.

4.2.1. Panel regressions for nationalised banks

The nineteen nationalised banks data have been taken for this panel estimation. Bank specific parameters like CAR, ROA, and provisions are taken as explanatory variables, besides, the two constructed principal components (PCMPC and NCMPC) which are also included as independent variables and NNPAs is taken as the dependent variable for regression analysis.

Table 5. *Results of fixed effect, random effect and Blundell–Bond dynamic panel estimations for different group of banks*

Regressors	Fixed-effects Coefficients	Random-effects Coefficients	Blundell–Bond dynamic panel estimation Coefficients
(1) Nationalised Banks			
NNPA(1)			0.67 (0.00)
CAR	-0.53 (0.00)	-0.53 (0.00)	-0.15 (0.00)
ROA	-1.91 (0.00)	-2.04 (0.00)	-1.06 (0.00)
PROVISIONS	0.000042 (0.07)	0.000023 (0.25)	0.000045 (0.97)
PCMPC	1.49 (0.00)	1.41 (0.00)	0.18 (0.02)
NCMPC	-0.09 (0.27)	-0.12 (0.14)	-0.19 (0.00)
Constant	10.38 (0.00)	11.03 (0.00)	3.55 (0.00)
Wald chi square		570.95	1956.14
Hausman specification test, P value- 0.655			
Breusch Pagan LM Test, P value- 0.0001			
(2) Private Banks			
NNPA(1)			0.64 (0.00)

Regressors	Fixed-effects Coefficients	Random-effects Coefficients	Blundell–Bond dynamic panel estimation Coefficients
CAR	-0.03 (0.39)	-0.02 (0.38)	0.01 (0.70)
ROA	-0.25 (0.27)	-0.61 (0.00)	-0.35 (0.02)
PROVISIONS	0.00010 (0.00)	0.000031 (0.19)	0.000073 (0.78)
PCMPC	1.52 (0.00)	1.44 (0.00)	0.41 (0.00)
NCMPC	-0.08 (0.23)	-0.13 (0.06)	-0.20 (0.00)
Constant	3.09 (0.00)	3.61 (0.00)	1.01 (0.01)
Wald chi square		252.00	636.98
Hausman specification test, P value- 0.00			
Breusch Pagan LM Test, P value- 0.00			
(3) SBI and its associates			
NNPA(1)			0.34 (0.00)
CAR	-0.00026 (0.00)	-0.00017 (0.05)	-0.00048 (0.01)
ROA	-0.79 (0.11)	-1.02 (0.05)	-2.36 (0.02)
PROVISIONS	0.0000735 (0.71)	0.00000367 (0.81)	0.00000251 (0.83)
PCMPC	0.98 (0.00)	0.98 (0.00)	0.83 (0.00)
NCMPC	-0.77 (0.00)	-0.76 (0.06)	-0.52 (0.00)
Constant	3.83 (0.00)	3.96 (0.00)	4.51 (0.01)
Wald chi square		39.64	266.08
Hausman specification test, P value- 0.00			
Breusch Pagan LM Test, P value- 1.00			
(4) Foreign Banks			
NNPA(1)			0.25 (0.00)
CAR	-0.02 (0.69)	0.06 (0.06)	0.07 (0.09)
ROA	-0.63 (0.04)	-0.75 (0.01)	-0.67 (0.02)
PROVISIONS	0.000019 (0.88)	0.0000023 (0.99)	-0.0000015 (0.99)
PCMPC	0.50 (0.09)	0.52 (0.08)	1.01 (0.02)
NCMPC	-0.34 (0.16)	-0.30 (0.22)	-0.36 (0.18)
Constant	3.30 (0.00)	2.76 (0.02)	1.83 (0.07)
Wald chi square		15.74	42.66
Hausman specification test, P value- 0.1469			
Breusch Pagan LM Test, P value- 0.0001			

P Value in the parentheses

The suitability of fixed and random effect model has also been tested through Hausman specification and Breusch Pagan LM tests. The null hypothesis of the Hausman specification test says that the random effect models are appropriate which is accepted as

per the above p-value in the model and confirms that the random effect model is better in this case. In case of the Breusch Pagan LM test, the null hypothesis tells that the pooled effect models are appropriate over the random effect model and the p-value rejects the null hypothesis and confirms the same as concluded by Hausman specification test (see Table 5 (1)).

The regression results show that all the bank specific and macro parameters are significant in affecting the NNPAs except the provisions in case of nationalised banks indicating that the amount of provisions kept by these banks have no significant impact on the rise of NNPAs as the provisioning varies from year to year and amount of provisioning being altered by restructuring the asset classification. On the other hand, return on assets play a major role in reducing the NNPAs. The positively correlated macro principal component (PCMPC) which is the constituent of the WALR, unemployment rate, and fiscal deficit also determines the NNPAs growth to a larger extent showing that both monetary and fiscal parameters impact in the performance of assets. The results of the dynamic panel model also reveal the same thing. Besides, it shows that the past trend of NNPAs is significant determinant of the movement of NNPAs.

4.2.2. Panel regressions for private banks

The selected nineteen private banks data have been captured for the panel estimation where the NNPAs as the dependent variable depends upon both the bank specific and macro specific factors.

For the private banks, the results of Hausman specification and Breusch-Pagan LM tests give opposite results. The first test indicates that random effect model is not appropriate, whereas the second test confirms the superiority of the random effects model. However, both the fixed and random effect model show that return on assets and PCMPC play major roles in determining the movement of NNPAs for private banks. The dynamic panel shows that all the parameters significantly influence the NNPAs except the provisions and capital adequacy ratio (CAR). These banks are known to be maintaining higher capital adequacy ratio, as they add more profit every year to their balance sheets and hence, the CAR does not have significant influence in determining the movement of NPAs. Apart from the bank specific parameters, the private banks get influenced by the monetary and fiscal forces too (see Table 5 (2)).

4.2.3. Panel regressions for SBI and its associates

The SBI and its associates cover the largest share of the Indian banking business. The captured seven banks' NNPAs determinants have been estimated by both the micro and macro specific parameters. The PCMPC have been constructed from WALR, unemployment rate, exchange rate and fiscal deficit and NCMPC has been created from other macroeconomic variables.

The results of Hausman specification and Breusch-Pagan LM tests imply that the fixed effect regression is better in case of SBI and its associate group as each entity has significant role in explaining the group behavior. The regression output resulting from the

fixed effect model shows that the CAR, PCMPC, and NCMPC are statistically significant factors which play a lead role in influencing the NNPAs of SBI and its associates. The dynamic panel estimation shows that all the factors are significant in affecting the NNPAs except the provisions, among which ROA and PCMPC play foremost role. The amount of provisioning is being done for the bad loan accounts and the banks always try to provide less provision amount by restructuring the loan account from NPAs to standard assets. The macroeconomic parameters influences the NPAs of SBI and its associates significantly as the performance of these banks depends much on the stability of the economic situation of the country (see Table 5 (3)).

4.2.4. Panel regressions for foreign banks

The foreign banks have their parent operation in their domestic country and in India they do selected business activities and mainly act as an agent banker. They generally deal with businesses like providing credit cards, export finances and non-fund based credit facilities which generates more fees based income and are profitable in nature. The thirteen foreign banks have been captured to calculate the determinants of NNPAs.

The results of Hausman specification and Breusch-Pagan LM test imply that the random effect regression is better in case of foreign banks operating in India. Regression result shows that in case of fixed and random effect models the growth of NNPAs is not significantly influenced by any of the factors in the model except return on assets (ROA). Similarly, the dynamic panel model also shows that the all the estimators have insignificant coefficients except ROA and PCMPC (see Table 5 (4)).

In a nutshell, it is observed that for all the type of banks the provisions have insignificant impact, however the ROA and PCMPC, that is, factors like WALR, unemployment rate, and fiscal deficit play major roles in influencing the level of NNPAs. In addition to these macro variables, in case of SBI and associates, the exchange rate and for foreign banks the credit growths in the industry play significant roles in determining the level of NNPAs.

4.3. Impulse response analysis in Panel Vector Auto regression (PVAR) framework

The impulse response function tries to analyse the dynamic effects of the system when the model receives any external shock in the system. In the present PVAR model the impulse response analysis has been carried out for different type of banks separately. The impulse responses here measures that how much the NNPAs get responded to what magnitude due to the one standard deviation (S.D.) shock in the explanatory variables of the panel data set for different type of banks. The result clearly shows that macroeconomic shocks affect the NNPAs differently for different type of banks.

For different type of banks, group wise impulse response has been carried out as follows.

4.3.1. Impulse response analysis for nationalised banks

The result of the impulse response shows that, in case of the nationalised banks, one positive S.D. shock in CAR and ROA impacts the NNPAs positively as the NNPAs show downward trend.

Figure 1. *Impulse Response for nationalised banks*

It means when the CAR and ROA rises it leads to fall in the NPAs for these banks. The shocks in PCMPC and NCMPC have strong impact on the NNPAs as it shows there is straight rise and fall in the NNPAs due to positive shocks in PCMPC and NCMPC respectively. The shocks in the provisioning amount have no impact initially however it leads to rise in NNPAs as time passes (see Figure 1).

4.3.2. Impulse response analysis for private banks

Private banks behave differently as compared to the nationalised banks in India. One positive S.D. shock in CAR and ROA leads to rise in the NNPAs for the banks. The shock in the amount of provisioning has direct impact on the NNPAs. Shocks in positively correlated macroeconomic group have direct relationship with the NNPAs indicating the percentage of NPAs increases due to any positive shocks in PCMPC. The shocks in NCMPC have negative impact on NNPAs although the impact is less as

compared to other bank groups indicates that, private banks NNPAs do not decline much when there is positive shock in NCMPC (see Figure 2).

Figure 2. *Impulse response for private banks*

Response of CAR to Cholesky
One S.D. NNPA Innovation

Response of ROA to Cholesky
One S.D. NNPA Innovation

Response of PROVISIONS to Cholesky
One S.D. NNPA Innovation

Response of PCMPC to Cholesky
One S.D. NNPA Innovation

Response of NCMPC to Cholesky
One S.D. NNPA Innovation

4.3.3. Impulse response analysis for SBI and its associates

The NNPAs of SBI and its associates got influenced in the same way as that of nationalised banks due to shocks in the positively correlated macroeconomic determinants. The positive shocks in PCMPC and NCMPC lead to rise and fall in the NNPAs respectively. However, to the shocks in bank specific parameters the NNPAs behave as per the private banks. It shows that SBI and its associates are able to catch up the management practices of the private banks where as the nationalised banks lack behind (see Figure 3).

Figure 3. *Impulse Response for SBI and its associates*

Response of CAR to Cholesky
One S.D. NNPA Innovation

Response of ROA to Cholesky
One S.D. NNPA Innovation

Response of PROVISIONS to Cholesky
One S.D. NNPA Innovation

Response of PCMPC to Cholesky
One S.D. NNPA Innovation

Response of NCMPC to Cholesky
One S.D. NNPA Innovation

4.3.4. Impulse response analysis for foreign banks

Foreign banks NNPAs moves in the opposite direction in comparison to all other type of banks with the shocks in macroeconomic determinants indicating that, when there will be macroeconomic trouble in India, the foreign banks assets will not be impacted negatively, however at the same time Indian banks will face problem of accretion of bad assets. The NNPAs got affected significantly due to positive shocks in the returns on their assets showing that the rise in returns leads to fall in NNPAs (see Figure 4).

Figure 4. *Impulse response for foreign banks*

By and large, it is perceived that the shocks in bank-specific and macro specific parameters have different type of impacts for different type of banks. The trend of the impulse response shows that the nationalised banks and SBI and its associates are prone to behave equally to the macroeconomic shocks, whereas for the private banks any shock leads to upward movement for NNPAs. It shows that NNPAs for the private banks increases due to any external shocks in the bank specific and macro parameters. The trouble in macro fundamentals is not a problem for foreign banks earning assets.

5. Conclusion

The panel data approach to study the credit risk of different type of banks in India gives us an idea to determine how nonperforming loans are being affected by change in its determinants. In general, it is implied that both macro and bank specific factors play significant roles in influencing the occurrence of NNPAs. The NNPAs of different type of banks behave differently towards the change in the macroeconomic determinants as they

follow multiple banking practices and regulations. SBI and its associates and nationalised banks are controlled by the government bodies and specifically designed for providing banking facility to all sections of people, whereas the private banks are owned by the private owners and their main aim is profit maximisation. There is target for lending toward priority sectors like agriculture, weaker sections, education, farmers etc. for government owned banks, however these rules are not strict for the private sector and foreign banks. The public sector banks got influenced more by the changes in monetary and fiscal norms of the country. Overall, the bank specific parameters also influence the NNPAs. From the set of bank specific parameters; CAR, ROA play key function, whereas the amount of provisioning has less important in influencing the NNPAs. The impulse response analysis through panel VAR technique also shows that the shocks of the macro and bank specific parameters have diverse type of effect for different type of banks. The nationalised and SBI and its associates are influenced in the similar way due to changes in the macro parameters. The private banks are more sensitive to shocks in both macro and bank specific parameters. The foreign banks behave completely opposite with the other banks in the presence of shocks in macro determinants. So, the present problem of NNPAs in Indian banking industry is more of a problem posing for Indian banks rather than for the foreign banks operating in India. It may be suggested that banks management should cautiously follow the macro fundamentals, the regulators policy announcements, and their own management decisions to control the NNPAs.

Notes

[1] Nonperforming assets (NPAs) is one of the classification criteria used by banks and financial institutions for categorisation of the loans where the borrower does not pay neither the principal nor the interest for a period of 90 days. As per the Reserve Bank of India (RBI) guidelines, an asset is called NPA when it stops generating income for the banks; both interest and/or installment remain overdue for 90 days.

[2] Banks in India are broadly classified into Scheduled commercial banks and Scheduled cooperative banks as per the Reserve Bank of India Act-1934. Furthermore, Scheduled commercial banks are categorised into five types such as SBI and its associates, nationalised banks, private sector banks, foreign banks and Regional Rural Banks (RRBs). The 58 important banks are captured from the first four groups. RRBs have been excluded from the present study due to improper data base and small size of its business. The detailed names of different group of banks covered are presented in Appendix I.

[3] The correlation matrix tells us how strongly the different macro parameters are correlated to the NNPAs of different group of commercial banks. Depending upon the sign of correlation coefficients (positive and negative) the macro variables are grouped under two categories. Please refer Appendix II for the correlation matrix.

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Appendix I. Names of banks considered for this study

Nationalised banks	Private Banks	SBI and its Associates	Foreign Banks
Allahabad Bank	Axis Bank Ltd.	State Bank Of Bikaner and Jaipur	Abu Dhabi Commercial Bank
Andhra Bank	Catholic Syrian Bank Ltd.	State Bank Of Hyderabad	Antwerp Diamond Bank N V
Bank Of Baroda	City Union Bank Ltd.	State Bank Of India	Bank Of Bahrain and Kuwait Bsc
Bank Of India	D C B Bank Ltd.	State Bank Of Mauritius Ltd.	Bank Of Ceylon
Bank Of Maharashtra	Dhanlaxmi Bank Ltd.	State Bank Of Mysore	Bank Of Nova Scotia
Canara Bank	Federal Bank Ltd.	State Bank Of Patiala	Barclays Bank Plc
Central Bank Of India	H D F C Bank Ltd.	State Bank Of Travancore	Citibank N A
Corporation Bank	I C I C I Bank Ltd.		D B S Bank Ltd.
Dena Bank	I D B I Bank Ltd.		Deutsche Bank A G
Indian Bank	I N G Vysya Bank Ltd.		Hongkongand Shanghai Banking Corpn. Ltd.
Indian Overseas Bank	Indusind Bank Ltd.		Mizuho Bank Ltd.
Oriental Bank Of Commerce	Jammu and Kashmir Bank Ltd.		Royal Bank Of Scotland N V
Punjab and Sind Bank	Karnataka Bank Ltd.		Standard Chartered Bank - India Branches
Punjab National Bank	KarurVysya Bank Ltd.		
Syndicate Bank	Lakshmi Vilas Bank Ltd.		
Uco Bank	Ratnakar Bank Ltd.		
Union Bank Of India	South Indian Bank Ltd.		
United Bank Of India	Tamilnad Mercantile Bank Ltd.		
Vijaya Bank	Yes Bank Ltd.		

Appendix II. Correlation matrix

Parameters	GDP	WALR	WPI	Fiscal Deficit	IIP	ER	Unemployment	SCBS credit Growth	NNPA
Correlation for Nationalised banks									
NNPA	-0.38	0.69	-0.29	0.44	-0.22	-0.08	0.34	-0.27	1.00
Correlation for Private Banks									
NNPA	-0.31	0.62	-0.33	0.45	-0.14	-0.21	0.39	-0.15	1.00
Correlation for SBI and its Associates:									
NNPA	-0.46	0.42	-0.23	0.34	-0.25	0.09	0.25	-0.23	1.00
Correlation for Foreign Banks:									
NNPA	-0.15	0.19	-0.23	0.23	-0.06	-0.06	0.20	0.01	1.00