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Bank-specific determinants of nonperforming assets of Indian banks

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Abstract The paper examines the role of bank-specific variables in explaining the dynamics of non-performing assets (NPAs) of Indian banks in a panel data framework over the post liberalisation period, 1995–2011. The results have been derived after controlling for macroeconomic factors like real GDP, inflation, exchange rate etc. Applying several variants of Generalized Method of Moments (GMM) technique in dynamic models, we find that that there is significant time persistence of NPAs in Indian banking system. We also find that larger banks are more prone to default than smaller banks. We find support for the 'bad management hypothesis' as we observe that an increase in profit level of the banks reduces NPAs in the next period. Lagged capital adequacy ratio as an important prudential indicator also significantly reduces current NPAs of banks. The paper also draws some important policy implications about NPA management.

1 Introduction

In a bank-based financial system, the quality of asset of banks is a matter of serious concern to the regulatory authorities both from the point of view of stability in the financial system as well as from the point of view of efficiency of bank management. Deterioration in quality of assets of banks and the subsequent increase of Non-performing Assets (NPAs) severely affects the process of financial intermediation (Berger and Hefeker 2008; Welfens 2008). The consequent financial fragility adversely affects economic growth (Demirguç-Kunt and Detragiache 1998; Gonzalez-Hermosillo 1999; Reinhart and Rogoff 2010). Wilful default and growth of NPAs are also major problems of Indian banking system (Bardhan and Marjit 2005; Bardhan and Mukherjee

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2013). High level of non-performing assets (NPAs) reflected in the balance sheet of Indian banks particularly the public sector banks, during the initial years of the reform period posed a significant threat to the stability of the Indian financial system.[1]

In recent years, the issues related to the possible macroeconomic and bank-specific determinants behind growing incidence of NPAs in banking systems across the countries have drawn great deal of attention. In the first place, economists debate over possible procyclicality of banks' activity. Banks are said to behave in a procyclical manner when the lending activities, profitability etc. move in correlation with the economy's short-term business cycles. At the beginning of an expansionary phase in the economy, firms' profits tend to increase, asset prices increase, loan recovery rate increases and overall NPA decreases. However, during the boom, banks may also underestimate their risk exposures, relax credit standards and reduce provisions for future losses. Once the cyclical upturn is over and the business cycle turns down, borrowers' creditworthiness deteriorates because of the fall in profits. This may lead to an increase in NPA and greater provisioning. So, banks will typically respond by cutting back loans that may even lead to a credit crunch, further aggravating the situation. In extreme situations, it may even precipitate systematic banking crises. But the question remains why different banks in the same economy performs differently in managing their NPAs?

It appears that bank-specific factors play relatively more significant role in the evolution of NPAs over time as these factors directly affect the health of a bank. In fact, loan decision making process, management of loan default, loan recovery processes, risk exposure, and more importantly, performance of banks are different for different banks. All these factors affect NPAs of banks differently. In the existing literature, Berger and DeYoung (1997) examine if the bank-level efficiency, particularly cost efficiency, might affect NPAs of banks by testing a set of hypotheses concerning the causality relationship among NPAs, cost efficiency and bank capital. First, the '*bad management hypothesis*' postulates that low measured cost efficiency is a signal for poor bank management: inefficient bank managers do not control and sufficiently monitor their operating expenses, which are reflected in low measured cost efficiency. As poor managers, they may also choose investment projects with very little creditworthiness or they may not properly judge the true value of collateral pledged against the loans. Consequently, a significant number of loan accounts may eventually turn out to be non-performing. Second, the '*skimping hypothesis*' postulates that a bank may rationally choose to have lower costs in the short-run by economizing on the resources allocated for monitoring and underwriting of loans, but ultimately bears the consequences of higher NPAs and the possible costs of dealing with these problem loans in the future. Third, the '*moral hazard hypothesis*' postulates that thinly capitalized banks

[1] An NPA has been defined as a loan advance in respect of which payment of interest or repayment of instalment of principal or both remains unpaid for a certain period of time. At present, in Indian banking system an NPA is defined as an advance where payment of interest or repayment of instalment of principal (in case of term loans) remains unpaid for a period of one-quarter or more. In fact, Narasimham Committee (1998) as a part of the second phase of reforms of the banking sector, recommended the tightening of the asset classification and provisioning norms with an objective of moving towards international standard. Accordingly, the RBI has moved over to the one-quarter norm (90 days) since 2004. Net NPAs are obtained from gross NPAs after adjusting (i) balance in interest suspense account, (ii) claims received from credit guarantors and kept in suspense account, (iii) part payment received and kept in suspense account and total provisions (RBI 1997).

raise the riskiness of their loan portfolio through moral hazard incentives on the part of bank managers. In case of US banks, Berger and DeYoung find evidence of negative causation from cost efficiency to NPAs thereby supporting both the bad management hypothesis as well as the moral hazard hypothesis. Similar evidences have been found in the context of banking in other countries as well (Salas and Saurina 2002; Williams 2004; Podpiera and Weill 2008; Breuer 2006). Bank size also plays an important role in affecting NPAs. As larger banks may opt for more diversification opportunities, it is assumed to be a proxy of diversification. Salas and Saurina (2002), Rajan and Dhal (2003) and Hu et al. (2004) find negative relation between bank size and NPAs in case of Spanish banks, Indian public sector banks and Taiwanese banks respectively. However, in case of Greek banks Louzis et al. (2012) find counter evidence to this. They argue that larger banks rather than going for diversification indulge in relatively risky activities leading to higher burden of NPAs. Bank's performance on account of profit may also play a significant role in affecting its NPAs. It is argued that poor performance in the past acts as a negative signal for management quality and aggravates the problem of NPAs similar to the '*bad management hypothesis*' discussed above. However, following the '*skimping hypothesis*' good performance of a bank in the past may also lead to higher NPAs (Rajan 1994).

As far as Indian banks are concerned, most of the existing studies look exclusively into public sector banks for bank-specific determinants of NPAs covering a small period of time. However, none of them looks into the dynamics of the problem. Rajaraman and Vasishtha (2002) provide evidence of significant bivariate relationship between operating inefficiency and the problem loans of public sector banks. According to Mukherjee (2003) although an earlier study by RBI (1999a) revealed that the priority sector lending generates a higher proportion of NPAs compared to the non-priority sectors, relative contribution of non-priority sector in NPAs has an increasing trend. Reddy (2004) examines various issues pertaining to terms of credit of Indian banks and argues that banks' lending policy crucially influence NPAs of banks. Bardhan and Marjit (2005) raise doubts over the efficacy of official definition of NPAs in Indian banking system which is entirely based on loan repayment status. They propose a concept of tolerable limit of NPAs based on actual conditions of a bank's health and measure the severity of the problem as the difference between actual level of NPAs and tolerable level of NPAs.

Against this background, this paper looks into various bank-specific factors behind performance of Indian banks on account of NPAs over time in a dynamic setting during the post liberalisation period (1995–2011) after controlling for the macroeconomic factors.[2] Its claim to contributions to the literature is twofold. First, unlike the earlier studies it explores a novel panel data set comprising of data from Indian commercial banks under all ownership groups. Second, contrary to earlier studies it uses dynamic panel data models and employs available instrumental-variable techniques to estimate these models. Therefore, it is able to capture factors like time persistence in accumulation of NPAs in Indian banks. The rest of the paper is organized as follows. Section 2

[2] This period has been considered because in this period, a proper objective and transparent yardstick for the measurement of problem loans was introduced in Indian banking replacing the earlier 'Health Code System' (RBI 1999a).

presents the econometric methodology and the database. Section 3 presents the results. Section 4 concludes the paper.

2 Methodology and database

2.1 Econometric methodology

In order to test the time persistence in loan default structure and to find out major determinants of NPAs in Indian banking system, we use a dynamic panel data model that incorporates time-varying bank-specific determinants and uses macroeconomic variables as control variables. Using a panel data framework, we control for biases arising out of potential heterogeneity and omitted variables. The basic model is as follows:

$$Y_{i,t} = \alpha Y_{i,t-1} + \beta' X_{i,t} + \eta_i + \varepsilon_{i,t}, \quad |\alpha| < 1 \tag{1}$$

where $Y_{i,t}$ is the dependent variable of the model which stands for a measure of loan default. $X_{i,\ t}$ is the $k \times 1$ vector of explanatory variables (bank-specific and macroeconomic) other than $Y_{i,\ t-1}$. η_i is the unobserved bank-specific effect, $\varepsilon_{i,t}$ is the observation-specific error term, (α, β') is the vector of the parameters to be estimated in the model. i and t stand for cross-section and time dimension of the panel structure. We estimate Eq. (1) by using alternative Generalised Methods of Moments (GMM) techniques proposed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). Arellano and Bond (1991), in their difference estimator, propose to take first-difference of Eq. (1) as follows:

$$Y_{i,t} - Y_{i,t-1} = \alpha\left(Y_{i,t-1} - Y_{i,t-2}\right) + \beta'\left(X_{i,t} - X_{i,t-1}\right) + \left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right). \tag{2}$$

While differencing (1) eliminates bank-specific effects, introduces a new bias. The new error term, $(\varepsilon_{i,t} - \varepsilon_{i,t-1})$ in (2) now gets correlated with lagged dependent variable $(Y_{i,t-1} - Y_{i,t-2})$. However given that $\varepsilon_{i,\ t}$ are serially uncorrelated, $Y_{i,\ t-2}$ which is correlated with $(Y_{i,\ t-1} - Y_{i,\ t-2})$ but uncorrelated with $(\varepsilon_{i,\ t} - \varepsilon_{i,\ t-1})$ for t = 3….T, can be used as an instrument in the estimation of (2). This results in the following moment condition:

$$E\left[Y_{i,t-s}\left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right)\right] = 0 \text{ for } s \geq 2,\ t = 3.\ldots\ldots T. \tag{3}$$

However, another source of bias arises out of the possible endogeneity of the explanatory variables (X) and their correlation with the error term. Depending on the spirit of the model to be estimated, Xs can either be *strictly exogenous* or *weakly exogenous* (*predetermined*). If Xs are *strictly exogenous*, all the past and future values of Xs are uncorrelated with the error term and the resulting moment conditions are as follows:

$$E\left[X_{i,t-s}\left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right)\right] = 0 \text{ for all } s,\ t = 3.\ldots\ldots T. \tag{4}$$

If, however, Xs are *weakly exogenous*, only current and lagged values of Xs are valid instruments and those predetermined regressors are instrumented exactly in the same way as Y_{t-1} is instrumented using subsequent lags of Y_{t-1}. This suggests that lags of order two and more satisfy the following moment conditions:

$$E\left[X_{i,t-s}\left(\varepsilon_{i,t}-\varepsilon_{i,t-1}\right)\right] = 0 \text{ for all } s\geq 2,\ t = 3\ldots\ldots T. \tag{5}$$

Equations (3), (4) and (5) impose restrictions on the use of instruments and provide the basis of the one-step GMM estimator. These, under the assumptions of homoscedastic and independent residuals, produce consistent estimates of the parameters of (1). Arellano and Bond (1991) proposed another variant of the GMM estimator, namely two-step estimator, which utilizes estimated residuals in order to construct a consistent variance-covariance matrix of the moment conditions. But it has been argued in the literature that two-step estimator may suffer from potential biases.[3] In the original Arellano and Bond estimator also, lagged levels of the explanatory variables can very often be poor instruments for first difference. Arellano and Bover (1995) show that if original equations in levels are considered along with the difference equation, additional moment conditions would be generated and these would increase efficiency in the resulting estimators. In these equations, predetermined variables in levels are instrumented with suitable lags of their first differences. So, in order to take care of potential biases and inefficiency in estimates associated with the difference estimator, we also use system GMM approach that combines in a system the regression in differences with the regression in levels (Arellano and Bover 1995; Blundell and Bond 1998). The same set of instruments is used for the difference equation. However, equation in level is instrumented by the lagged differences of the corresponding variables.[4] Thus, additional moment conditions for the second part of the system (the level equation) are:

$$E\left[\Delta Y_{i,t-1}\ \left(\eta_i + \varepsilon_{i,t}\right)\right] = 0 \tag{6}$$

$$E\left[\Delta X_{i,t-1}\ \left(\eta_i + \varepsilon_{i,t}\right)\right] = 0 \tag{7}$$

So in system GMM, we employ additional moment conditions as implied by (6) and (7) along with those presented in Eqs. (3), (4) and (5) in order to generate consistent and relatively more efficient estimates compared to those obtained in the difference GMM method.

[3] Although the two-step estimator is asymptotically more efficient than the one-step estimator and relaxes the assumption of homoscedasticity, the efficiency gain is not that important even in the case of heteroscedastic errors (Judson and Owen 1999). Moreover, the two-step estimator imposes a bias in standard errors due to its dependence on estimated residuals from the one-step estimator which may lead to unreliable asymptotic statistical inference particularly in data samples with small cross section dimension (Bond and Windmeijer 2002; Windmeijer 2005).

[4] These are appropriate instruments under the following additional assumption: although there may be correlation between the levels of the right-hand side variables and the bank-specific effect in Eq. (1), there is no correlation between the differences of these variables and the bank-specific effect. Given that lagged levels are used as instruments in the regression in differences, only the most recent difference is used as an instrument in the regression in levels.

The consistency of all the GMM estimators depends on the validity of the instruments and on the validity of the assumption that error terms do not exhibit serial correlation. The 'Sargan test' of over-identifying restrictions tests the overall validity of instruments by analysing the moment conditions. Absence of serial correlation in the error term ε_{it} is confirmed by testing whether the differenced error term is second order serially correlated. By construction, the differenced error term is first order serially correlated even if the original error term is not. If the test fails to reject the null hypothesis of absence of second-order serial correlation, we conclude that the original error term is serially uncorrelated.

2.2 Database

The study covers the commercial banks operating in India under different ownership groups. Our sample consists of an unbalanced panel of 28 public sector banks, 34 private banks and 25 foreign banks. These banks in spite of belonging to different ownership groups, are fairly homogenous in their functioning and are subject to same regulatory bindings. The period of analysis consists of 17 years from 1995–96 to 2011–12. After dropping banks with missing data, we have an unbalanced panel of 87 banks with 1479 observations.

Bank-wise data of NPA and other relevant balance-sheet variables are collected from various issues of *Statistical Tables Relating to Banks in India* (RBI 1995-2011) published by the RBI. For few years, NPA data in our sample are collected from *Database on Indian Banking* (special issue) published by Indian Bank's Association (IBA 2006) and *Money and Banking* (CMIE 2006). We use two alternative indicators of NPA: net NPA as a proportion of net advances and gross NPA as a proportion of gross advances.[5] We consider three important macroeconomic variables such as GDP growth rate, inflation rate, and nominal effective exchange rate (NEER) as control variables. Statistical data on macroeconomic variables are collected from Planning Commission and RBI. All the macroeconomic variables are considered with at least one-lag in order to take care of possible delay with which shocks affect the likelihood of default and also to avoid *reverse causality*.[6] Description of all the variables used in the paper is summarised in Table 5 in the appendix.

3 Results

3.1 Stylised facts: macroeconomic and bank-specific variables

With the onset of reforms introduced in Indian financial system, Indian banking system has been subject to tight monitoring of loan quality which has its reflection in the declining trend of different measures of NPAs across different bank groups over the

[5] Gross NPA reflects the quality of the loans made by banks. In contrast, net NPA reflects the actual burden of the bank. In Indian banking system, there is a time lag involved in the process of recovery and detailed safeguards are placed before the write-off of NPAs. As a result, banks even after making provisions for the advances considered irrecoverable continue to hold such advances, which are termed as gross NPA (RBI 1999a).

[6] We also check the contemporaneous effect of all the macroeconomic variables.

years during post liberalisation period (Table 1). Moreover, Indian economy has proven to be resilient in the face of global financial crisis that triggered in 2007. Indian banks remained flexible throughout even in the face of the sub-prime catastrophe and the subsequent financial turmoil. Private banks as well as foreign banks record relatively much lower level of NPAs compared to that in public sector banks at least in the initial years of the reform period. For example, net NPAs as a percent of net advances is recorded as 5.9 % in case of private banks in 1995–96 as compared to 9.4 % for public sector banks. Between 1995–96 and 2011–12, NPAs in terms of either gross or net NPAs substantially fell in all the bank groups. Despite the fact that Indian industries have gone through relatively low growth phase since mid 1990s, the reform period coincides with considerable improvements in the asset quality of banks following noticeable improvement in credit appraisal process whereby incremental NPAs have been low. This perhaps reflect the success of several initiatives taken by RBI related to accounting standard, disclosure standard and transparency in the operations of banks including the promulgation of SARFAESI Act.[7] In fact, decline in NPAs in all the different bank groups in subsequent years of the study period may be attributed to the reduction in doubtful and loss assets.

Ghate et al. (2013)[8] show that during the post-liberalisation period, the key macro-economic variables such as GDP, inflation, exchange rate had been less volatile compared to those in the pre-reform period which resembles the experiences in developed economies and other emerging market economies in Asia that have also undergone economic liberalisation. Volatility in aggregate GDP declines from 2.13 in the pre-reform period to 1.78 in the post-reform period. Volatility in inflation as measured by consumer price index declines from 5.69 in the pre-reform period to 3.49 in the post-reform period and volatility in nominal exchange rate declines from 6.74 to 5.35 during these two reform periods. However, Table 2 reveals that GDP, rate of growth of credit in the economy, inflation, and the exchange rate remained considerably volatile in the study period. While most of the macro-variables are found to be pro-cyclical over the business cycles, NPAs are found to be counter-cyclical.[9]

In addition to macroeconomic and macro-financial factors, we also present summary statistics of few relevant bank-specific factors on the basis of our selected sample (Table 3). While net NPAs appear to be 4.5 % of net advances, gross NPAs are recorded to be 8.6 % of gross advances. As a proportion of total assets of banks in our sample, net NPAs and gross NPAs are recorded to be 1.9 and 4.2 % respectively. Average capital adequacy ratio (CAR) of banks in our sample is estimated to be 17 % which is not only higher than the internationally acceptable level of 8 %, but also higher than India's own regulatory requirement of 9%. Most of the banks in India

[7] Securitisation and Reconstruction of Financial Assets and Enforcement of Security Interest (SARFAESI) act provides for constitution of Asset Reconstruction Company (ARC) in order to remove NPAs from the balance sheets of the banks through the process of securitisation of assets. It is thought to be a unique mechanism for the settlement of dues and can be pursued without the intervention of courts. The ARC specialises in recovery and liquidation of assets. In India, both the Committee on Banking Sector Reforms (GOI 1998) and the Committee on Restructuring Weak Public Sector Banks (RBI 1999b) recommended the transfer of sticky assets of banks to the ARC.

[8] Ghate et al. (2013) consider the period 1950–1991 as the pre-reform period and the period 1992–2010 as the post-reform period.

[9] This is confirmed from the observed correlation of the variables.

Table 1 Movement of NPAs by Bank groups: 1995–2011

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
PSBs																	
GNPAs/ GA	18.12	18.53	16.02	15.89	13.98	12.39	11.09	9.36	7.79	5.53	3.7	2.7	2.2	2.0	2.27	2.31	3.17
NNPAs/ NA	9.44	9.90	8.15	8.13	7.42	6.74	5.82	4.53	2.99	2.06	1.3	1.1	0.8	0.7	1.1	1.09	1.53
GNPAs/ TA	8.12	7.99	7.03	6.71	5.95	5.32	4.89	4.21	3.5	2.73	2.09	1.6	1.3	1.2	1.4	–	–
NNPAs/ TA	3.73	3.84	3.27	3.14	2.94	2.72	2.42	1.93	1.28	0.95	0.72	0.6	0.6	0.6	0.7	–	–
Private Banks																	
GNPAs/ GA	9.74	9.42	8.67	10.81	8.17	8.48	9.64	8.07	5.84	3.77	2.45	2.2	2.5	2.9	2.97	2.45	2.08
NNPAs/ NA	5.91	5.57	5.26	7.41	5.41	5.44	5.73	4.95	2.84	1.85	1.85	1.0	1.5	1.9	0.9	0.56	0.46
GNPAs/ TA	4.93	4.10	3.93	4.48	3.61	3.7	4.36	3.97	2.82	2.05	1.36	1.2	1.4	1.7	1.4	–	–
NNPAs/ TA	2.49	2.24	2.29	2.83	2.3	2.26	2.49	2.32	1.32	0.98	0.55	0.5	0.6	0.7	0.5	–	–
Foreign Banks																	
GNPAs/ GA	3.64	8.60	6.38	7.59	6.99	6.76	5.38	5.25	4.62	2.85	1.9	1.8	1.8	4.0	4.26	2.54	2.68
NNPAs/ NA	1.53	5.53	6.74	7.79	6.59	9.76	1.89	1.76	1.48	0.86	0.8	1.0	0.9	1.7	1.8	0.58	0.52
GNPAs/ TA	3.67	5.84	3.05	3.1	3.16	3.02	2.41	2.44	2.13	1.43	0.96	0.8	0.8	1.5	1.7		
NNPAs/ TA	1.04	3.19	1.02	1.1	1.03	0.79	0.81	0.79	0.66	0.42	0.4	0.3	0.3	0.7	0.7	–	–

[a] GNPA, NNPA, TA, GA, NA, OE denote *gross nonperforming assets*, *net non-performing assets*, *total assets*, *gross advances*, *net advances* and *operating expenses respectively*. Source of data of all these variables is mainly *Trend and Progress in Banking* (various issues) published by Reserve bank of India

[b] Years indicated in the table denote financial years. For example, the year 1995 denotes the financial year 1995–96

[c] Figures reported in this table are in percentage terms and ('–') denotes that data are not available

Table 2 Movement of few select Macroeconomic variables: 1995–2011

	GDP	ROGC	Inflation	NEER
1995–96	7.29	20.1	10.22489	104.84
1996–97	7.97	9.6	8.977149	102.24
1997–98	4.3	16.4	7.164254	105.42
1998–99	6.68	13.8	13.23084	101.99
1999–00	7.59	18.2	4.669821	104.25
2000–01	4.3	17.3	4.009434	105.51
2001–02	5.52	15.3	3.684807	104.89
2002–03	3.99	23.7	4.3922	102.07
2003–04	8.06	15.3	3.805866	99.81
2004–05	6.97	30.9	3.767238	100.00
2005–06	9.48	30.8	4.246353	102.24
2006–07	9.57	28.1	6.145522	97.63
2007–08	9.32	22.3	6.369997	104.75
2008–09	6.72	17.5	8.351816	93.34
2009–10	8.59	16.9	10.87739	90.93
2010–11	9.32	21.5	11.9923	93.66
2011–12	6.21	17.0	8.857845	87.61
Mean	**7.2**	**19.7**	**7.1**	**100.07**
SD	**1.85**	**5.91**	**3.16**	**5.54**
Max	**9.57**	**30.90**	**13.23**	**105.51**
Min	**3.99**	**9.60**	**3.68**	**87.61**

GDP denotes *rate of growth of gross domestic product* at 1994–95 prices at factor cost (Source: Planning commission, Govt. of India). ROGC denotes *rate of growth of gross bank credit* in the banking system as a whole ((source: Handbook of Statistics of the Indian economy, Reserve Bank of India). Inflation denotes *Consumer Price index* (Source: Planning commission, Govt. of India). NEER denotes *Nominal Effective Exchange Rate* based on 36 currency export based weights (Source: Reserve Bank of India) with the base 1994–95=100

Table 3 Summary Statistics of Select Bank-specific Variables: 1995–2011

Variables	Mean	SD	Min	Max
NNPANA	0.045	0.095	−0.001	2.615
GNPAGA	0.086	0.122	0.000	1.799
NNPATA	0.019	0.032	−0.001	0.582
GNPATA	0.042	0.085	0.000	2.082
Operating Expenses/TA	0.031	0.150	0.004	3.320
CAR	0.170	0.159	0.000	1.755
MSHARE	0.013	0.026	0.000	0.241
Net profit/Total Assets	0.013	0.094	−0.254	2.917
No of Banks	87	87	87	87

For definition of the variables in Table 3, see appendix

comply with minimum capital adequacy requirements and it helps in reducing the magnitude of NPAs.

3.2 Estimation results

Table 4 presents estimation results of Eq. (1) using alternative GMM estimation methods discussed above. In order to check the robustness of our results, we also estimate (1) by using the system GMM method which makes use of wider set of instruments compared to difference GMM estimators considering additional moment conditions. All bank-specific variables in our model are treated as predetermined (weakly exogenous) and all macroeconomic variables are modelled as strictly exogenous.[10] Weak exogeneity of bank-specific variables follows since banks are not supposed to consider future random shocks to NPAs while taking managerial decisions because of unpredictable nature of the shocks. Therefore future values of bank-specific variables are not valid instruments in this case. However, all past and future values of macroeconomic variables are uncorrelated with error term. In order to check the time persistence in NPA structure of Indian banks and also to capture the effects of possible omitted variables, we include two lags of the dependent variables in all the dynamic models estimated.

Results indicate that second lag of net NPA ratio gives significant positive coefficient in most of the models estimated. Net NPA, as the measure of actual debt burden of a bank signify that even after adjusting all provisions and other receivables, past values of net NPA still contributes to current net NPA. However, taking GNPA ratio, we find that coefficient of first lag only gives positive coefficient in the system GMM model. Positive and significant coefficients of different measures of lagged NPA indicate that problem loans are not immediately written off and they remain in the balance sheet for a long time.[11] These results indicate that there is significant time persistence in NPA structure of Indian banks (Table 4). What explains the time-persistence? Since gross NPA, unlike net NPA which accounts for actual burden of default of a bank net of provisions, takes into account quality of assets by considering different types of bad debts along with respective provisions made, there always remains certain amount of bad debt in bank's balance sheet that positively affects current period's NPA level. Besides economic slowdown experienced by the Indian economy in the study period, it seems that shortcomings in credit appraisal, disbursal and recovery mechanism of the banks, to a large extent, are responsible for persistence of NPAs in Indian banking system. Another reason of time persistence of NPA is that the pace of migration of Indian banks to the standardised approaches (including

[10] Macroeconomic variables which are treated as strictly exogenous (with lag) are instrumented with their levels lagged by two or more periods. Lagged dependent variable is also instrumented similarly. However, bank-specific variables which are treated as predetermined (weakly exogenous), are instrumented using their levels lagged by one or more periods. The procedure requires no second-order correlation in the differenced equation. While the presence of first-order autocorrelation in the error terms does not imply inconsistency of the estimates, the presence of second-order autocorrelation makes estimates inconsistent (Arellano and Bond 1991).

[11] In Indian banking system, there is a time lag involved in the process of recovery and detailed safeguards put in place before the write-off. As a result, banks even after making provisions for the advances considered irrecoverable, continue to hold such advances.

Table 4 Dynamic panel data estimation results (Models with lagged Bank-specific variables)

Variables and Test	Dep var: net NPA/net advances				Dep var: gross NPA/gross advances			
	AB-1 Coeff	AB-2 Coeff	(System1) Coeff	(System-2) Coeff	AB-1 Coeff	AB-2 Coeff	(System-1) Coeff	(System-2) Coeff
Intercept	−0.260* (−2.05)	−0.259* (−1.96)	−0.151 (−2.38)	−0.150 (−2.32)	−0.289 (−0.151)	−0.286(−1.22)	0.086 (0.68)	0.185 (0.66)
NPA(t-1)	0.108 (0.92)	0.108 (0.84)	0.082 (1.03)	0.081 (1.25)	0.292 (1.21)	0.293 (1.06)	0.299 (1.27)	0.298* (2.43)
NPA(t-2)	0.102*** (1.65)	0.102(1.39)	0.073* (3.10)	0.073* (4.68)	0.022 (0.33)	0.022 (0.22)	0.024 (0.80)	0.024(0.50)
CAR	−0.027(−0.93)	−0.027 (−0.72)	−0.005(−0.18)	0.006 (−0.08)	−0.101 (−0.88)	−0.101 (−0.77)	0.052*(−0.66)	−0.051(−0.36)
CAR(t-1)	−0.069* (−1.79)	−0.069 (−1.47)	−0.065*(−2.47)	−0.065(−1.58)	−0.121***(−1.70)	−0.121 (−1.54)	−0.073***(−1.73)	−0.072(−0.76)
Profit	−0.083 (−1.12)	−0.081 (−0.96)	−0.139 (−1.29)	−0.142(−1.24)	−0.439 (−1.17)	−0.439 ***(−1.77)	−0.567 (−1.24)	−0.570 (−1.12)
Profit(t-1)	−0.025*** (−1.72)	−0.013(−1.87)***	−0.024*(−2.58)	−0.024*(−2.55)	−0.022*(−2.35)	−0.022*(−2.22)	−0.028*(−3.26)	−0.028*(−4.21)
Size	−0.005((−0.35)	−0.005(−0.50)	−0.020*(−3.59)	−0.020(−4.02)	−0.018(−0.74)	−0.018(−0.81)	−0.043*(−2.42)	−0.043(−1.51)
Size (t-1)	0.008(1.01)	0.008(0.98)	0.012*(2.83)	0.012**(1.88)	0.031*(1.76)	0.031***(1.71)	0.030*(1.91)	0.030(1.06)
GDP(t-1)	−0.663* (−2.42)	−0.660* (−2.41)	−0.615* (−2.09)	−0.615* (−7.33)	−1.006* (−2.76)	−0.978* (−2.60)	−0.921* (−2.07)	−0.915* (−3.03)
INFL(t-1)	0.285* (7.56)	0.282* (6.88)	0.356* (7.63)	0.356* (8.03)	0.270* (2.82)	0.266* (3.02)	0.254* (2.84)	0.250*(2.88)
NEER(t-1)	0.003* (4.08)	0.003*(4.02)	0.003* (5.94)	0.003* (6.35)	0.003* (3.48)	0.003*(3.05)	0.002 (1.29)	0.002 (1.37)
No of Obs	1050	1050	1140	1140	1009	1009	1104	1104
No of groups	86	86	87	87	85	85	86	86
Sargan test	103.32 (0.50)	85.30 (0.91)	180.169 (0.18)	86.469 (1.00)	398.30 (0.000)	83.53 (0.93)	621.670 (0.000)	84.031(1.00)
m1 test	−1.33(0.183)	−1.109(0.267)	−1.315 (0.189)	−1.137 (0.255)	−1.761 (0.078)	−1.467 (0.142)	−1.848 (0.065)	−1.503(0.133)
m2 test	−0.825(0.409)	−0.518(0.604)	0.018 (0.986)	0.010 (0.992)	0.833 (0.405)	0.535 (0.592)	0.477 (0.633)	0.313 (0.754)

Table 4 reports GMM estimation results of econometric models with bank-specific variables. Here, we present results of 4 variants of dynamic panel data models. All models are estimated with constant and robust standard errors. Robust t-statistics are reported in parentheses. AR (1) and AR (2) are the Arellano-Bond tests for first and second order autocorrelation of the residuals. (One should reject the null hypothesis of zero first order serial correlation and accept the null hypothesis of zero second order serial correlation of the residuals). P-values in case of m1 and m2 tests are reported in brackets. The Sargan test of overidentifying restrictions for the GMM estimators is the null hypothesis that instruments used are not correlated with the residuals, and hence, overidentifying restrictions are valid. ***, **, and * indicate significance levels at 10, 5, and 1 % respectively. All the models are estimated with restrictions imposed on the maximum number of lags so as to keep the number of instruments used in the estimation process at reasonable level. All estimations are performed in STATA 13 econometric software

management of NPAs) under the Basel II framework has been slow despite indicative time schedule has been put by RBI for its implementation.

Lagged capital adequacy ratio as a prudential indicator has desired negative and significant coefficient while explaining current NPA levels of banks (Table 4). However, contemporaneous level of CAR gives insignificant coefficient in most cases. Lagged Profit of banks as measured by net profit as a proportion of total assets gives negative and significant coefficient in all the models. Lower profit of banks reflects that repayment of outstanding loans is overdue resulting in accumulation NPAs over time. So, result supports the existence of '*bad management hypothesis*' in case of Indian banks. However contemporaneous profit gives insignificant results in most of the models estimated.

We also explore the role of bank size as measured by past loans as a bank specific variable in explaining NPAs of Indian banks. The lagged size effect is found to be significantly positive in all the models estimated. This shows the smaller banks may have greater managerial efficiency than larger banks in terms of screening and monitoring of loans, leading to lower defaults. Larger banks may also engage themselves in inherently more risky activities rather than diversifying the banking activities. Lending decisions of Indian banks, in general, are so guided that banks put much emphasis on the size of past loan granted to a borrower as an indicator in setting the credit limit. However, it is observed that borrowers who have greater need of credit are often found to be more susceptible to default (Banerjee and Duflo 2002). It is observed that big defaulters in banks are eventually the large firms in the industry.

As far as macroeconomic variables are concerned, lagged GDP growth leads to a decline in NPAs of banks. Coefficients of GDP across all the models turn out to be significant and robust.[12] We also find that the nominal effective exchange rate (NEER) has a significant positive impact on NPAs. Positive coefficient of NEER suggests that depreciation (appreciation) of the domestic currency leads to a decline (increase) in NPAs. Depreciation of rupee reflects the fact that goods and services produced at home are relatively less expensive. It subsequently strengthens the competitiveness of export-oriented firms and improves their repayment capacity.[13] Consequently, NPAs of banks fall. The results also reveal that lagged inflation, measured by percentage change in consumer price index number, positively and significantly increases NPAs in the current period. Note, theoretically, effect of inflation on NPAs is ambiguous. On the one hand, a long period of high inflation reduces real value of the loans. This, in turn, eases the repayment capacity of the borrowers. On the other hand, it can also weaken repayment capacity of the borrowers because real income decreases as inflation goes up. In India, where loan rates are variable, higher inflation can also lead to higher interest rates resulting from the changes in monetary policy to combat inflation. This, in turn, raises NPAs of banks.

As far as the validity of the estimated models are concerned, although the null hypothesis of no first order autocorrelation in residuals is rejected in few cases, null

[12] Typically, a decline in economic activity tends to affect non-performing loans with a time lag.

[13] Indian economy is thought to be less open than other developing economies even though India has opened up its market since the beginning of the last decade (especially from July 1991) by lowering various tariff and non-tariff barriers, and liberalising investment policy. So, apart from the liberalisation policies towards more exports, depreciation of Indian rupee is thought to play a major role in boosting up exports and contributing to the reduction of loan default in banking system.

hypothesis of no second order autocorrelation is accepted in all the models. Therefore, we conclude that the original error term in Eq. (1) is serially uncorrelated which gives support to our model. The fact that Sargan's test of overidentifying restrictions has been accepted in most of the cases justifies the validity of instruments used in all these models.

4 Conclusions

The paper uses a novel panel data set to examine the dynamics of NPAs in Indian banks across all ownership groups during the post liberalization period. Most of the estimation results obtained are robust with respect to the alternative GMM methods. All the specification tests in order to judge the validity of the models are mostly satisfied in all the estimated models. The results reveal that past NPAs significantly affect current NPAs which reinforce the fact that despite several regulatory measures adopted, there is significant time persistence in NPA structure of Indian banks. The result supports the '*bad management hypothesis*' which predicts that past performance is negatively related to future NPAs where past performance is regarded as a proxy of managerial efficiency. As it happens in a typical developing economy banking system, poor managerial efficiency and inability to control moral hazard incentives, very often, induce many banks in India to choose bad projects with little credit worthiness. Consequently, a significant number of loan accounts turn out to be non-performing as time elapses and there always exists certain amount of bad debts. The results also reveal that larger banks are more prone to default compared to smaller banks. This might have happened as the larger banks engaged themselves in more risky activities. Negative coefficients of profit in all the models imply that following repayment of loans as profit increases, NPAs in next period falls. This reinforces the 'bad management hypothesis'. Prudential regulations such as CAR requirements also helped in reducing NPAs of the banks.

We find some macroeconomic variables significantly affect NPAs in Indian banks. It is evident from the results that NPAs of banks have a countercyclical relation with business cycle. The nominal effective exchange rate has a positive and significant impact on NPAs. Although the theoretical prediction about the role of inflation on accumulation of NPAs is ambiguous, we find a positive and significant effect of inflation on NPAs.

There are some important policy prescriptions that follow from results we have obtained in this paper. For controlling NPAs in Indian banks, we emphasize that both management of banks at the micro level and management of indicators at the macro level are equally important. Specifically, the banking regulations have an important role to play. It should concentrate at the bank specific factors like banks' size, their profitability and adherence to the CAR norms. Since there is significant time persistence in the structure of NPAs, adequate attention to these factors would automatically solve the problem of NPAs to a significant extent in the long run. Although macroeconomic factors like business cycles and inflation would have their impacts on the NPAs, efficient management of bank specific factors would significantly reduce the accumulation of NPAs.

Although performance of banks on their NPA account may have an impact on their lending behaviour, we have not studied this aspect in the present paper. Following the

'Credit Crunch' hypothesis it is argued that an increase in NPAs may lead to decline in a commercial bank's lending as banks with high level of NPAs may become increasingly reluctant to take more risks. However, there is a conjecture that this negative effect on lending is non-linear i.e. there is a critical threshold level of NPAs of banks. It would be of considerable interest to examine the existence of such a threshold for Indian banks and study the banks' lending behaviour below and above the threshold. This remains as our future research agenda.

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Appendix

Table 5 Description of the variables

Variables	Description	Source
Indicators of loan default		
NNPANA	net nonperforming assets (NNPA) as a proportion of net advances,	Statistical Tables Relating to Banks in India (RBI), Database on Indian Banking(IBA), Money and Finance (CMIE)
GNPANA	gross nonperforming assets (GNPA) as a proportion of gross advances (GA)	
NNPATA	net nonperforming assets (NNPA) as a proportion of total assets	
GNPATA	gross nonperforming assets (GNPA) as a proportion of total assets	
Macroeconomic variables		
GDPGR	Rate of growth of gross domestic product (GDP) at 1994–95 prices (factor cost)	Planning Commission, (GOI)
INFL	Inflation rate, annual percentage of consumer price index	
NEER	Nominal effective exchange rate (based on 36 currency export based weights). It is the weighted average of bilateral nominal exchange rates of the home currency in terms of foreign currencies.	Reserve Bank of India
Bank-specific variables		
CAR	Capital adequacy ratio	Reserve Bank of India
SIZE	Log of total advances of a bank (inflation adjusted)	
PROFIT	Net profit as a proportion of total assets of a bank	

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