Are Increased Profits Always a Sign of Better Management? Evidence from Indian Banks using Dynamic Panel Data Approach

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ABSTRACT

This paper analyses the role of bank-specific variables in describing the nuances of non-performing assets (NPAs) of Indian banks in an unbalanced panel dataset of 71 banks for the period 2005–2017. Empirical analysis is controlled for macroeconomic variables; Gross Domestic Product growth rate, Wholesale Price Index (Inflation rate), and currency exchange rate. Generalized Method of Moments (GMM) technique in dynamic models is applied to identify statistically significant time persistence of NPAs in Indian banks. Empirical evidence establishes that lagged NPAs have a significant and positive affect on current NPAs thus concluding that significant time persistence exists in NPA structure of Indian banks. Presence of moral hazard in bank lending is also established; empirical evidence suggests that larger banks are more likely to default in comparison to their smaller counterparts and a rise in profits in the previous period leads to increased NPAs in the next period. The study has found empirical evidence for existence of adverse selection and moral hazard incentives in sample banks and thus has conclusive associations of rising problem loans with elapsing time period. Significant and positive effect of macroeconomic variables on NPAs in Indian banks is also established. Results conclude pro-cyclical relation of bank NPAs with business cycle.

- **INTRODUCTION**

Literature on financial intermediation suggests that deterioration in bank asset quality negatively impacts the financial intermediation process. (Berger and

Hefeker 2008; Welfens 2008). Poor bank asset quality is subsequently linked to negative impact on economic growth (Demirguç-Kunt and Detragiache 1998; Gonzalez-Hermosillo 1999; Reinhart and Rogoff 2010). Indian banking system is confounded by deteriorating asset quality and a momentous rise in non-performing assets (NPAs) which is a cause of major concern for the sector, the regulators and other stakeholders. Stressed assets in Indian banking sector has been on the rise since 2011, however the its growth has been intense particularly after 2015, primarily because the Reserve Bank of India directed an Asset Quality Review (AQR) of the banks' advances portfolio in that financial year (July, 2015), which led to recognition of various loan accounts as nonperforming accounts which were marked as standard accounts previously (Vishwanathan, 2018).

The association of bank-specific factors and macroeconomic factors with banks' problem loans has found widespread discussion in the scholarly literature. Berger and DeYoung (1997) in their seminal paper on US banks, examined whether bank-level cost efficiency impact NPAs of banks. They test a set of four hypotheses, building causality with NPAs, bank cost efficiency and capital. Their First hypothesis 'the bad luck hypothesis' assumed that external events precipitate an increase in problem loans for the bank. These problem loans cause an increase in the costs associated with loan workout and default thus marking decreases in measured cost efficiency. Importantly, faced with an exogenous increase in nonperforming loans, even the most cost efficient banks have to purchase the additional inputs necessary to administer these problem credits. Their second hypothesis the 'bad management hypothesis' assumes that low cost efficiency is a sign of poorly managed bank, subsequently inferring that inefficient bankers neither control nor adequately keep a watch over banks' operating expenses, thus resulting in low measured cost efficiency. Bad bankers might miscalculate projects' investment worthiness and subsequently poor credit-worthy projects with miscalculated collateral requirements may be approved. As a result, substantial loans may become non-performing. The third hypothesis, 'skimping hypothesis' assumes that a bank may elect by itself to reduce on monitoring and underwriting expenses on loans in the short term to cut costs, however the side-effect of this assuming simple way of cost reduction, is increased NPAs in the longer term due to decreased monitoring and other resource-cut. The fourth hypothesis, 'moral hazard problem' assumes that bank managers demonstrate raised risky behavior in their lending decisions if their banks are not adequately capitalized, thus demonstrating moral hazard incentives problems in projects.

Berger and DeYoung (1997) conclude negative causality from cost efficiency to NPAs, finding supporting for the 'bad management hypothesis' and 'the moral hazard hypothesis'. Simulating the works of Berger and DeYoung (1997), in context of various other economies, various authors have found empirical evidence for the bad management hypothesis and the moral hazard hypothesis. For example, Salas and Saurina (2002) in context of Spanish banks, Williams (2004) in context of European banks, Podpiera and Weill (2008) in context of Czech banks and Breuer (2006) in context of various countries.

The impact of bank size on NPAs is tested by Salas and Saurina (2002) for Spanish banks, Rajan and Dhal (2003) Indian banks and Hu et al. (2004) Taiwanese banks, and establish a negative relation between bank size and NPAs. Conversely, in context of Greek banks, Louzis et al. (2012) have found positive relation between bank size and NPAs.

In context of Indian banks, Rajaraman and Vasishtha (2002) conclude positive relationship between operating inefficiency and the problem loans of public sector banks. Reddy has (2004) argued and suggested that Indian banks' lending policy particularly of the public sector banks affect NPAs of banks. Louzis et al. (2012) and Makri et al (2014) argue that positive and rising profitability ratios such as return on assets and return on equity have a negative relation with NPA ratios.

Widespread empirical literature is available on the relationship between macroeconomic variables and its effect on bank non-performing loans. For example, GDP growth rate affects NPAs negatively (Makri et al, 2014), Inflation has a positive effect on NPAs (Rinaldi and Sanchis-Arellano, 2006) and Currency exchange rate likewise has a positive effect on NPAs (Bardhan & Mukherjee, 2016).

This paper attempts to study the various bank-specific factors influencing the NPAs of Indian banks for the period 2005–2017. Unlike earlier studies this paper is set in a unique time backdrop, which includes the time period post the Global Financial Crises of 2008 and the Reserve Bank of India initiated Asset Quality Review (AQR - resulted in a marked increase in the NPA ratios of Indian commercial banks; John et al, 2016) of Indian Banks in July 2015. The selection of time period of this study is crucial and unique as it covers the entire duration of tumultuous contemporary timer period of the Indian Banking sector. The panel data used in this study comprise 71 commercial banks from 31st March 2005 to 31st March 2017. The study uses an unbalanced panel data including the State Bank of India and its Associates, The Public Sector Banks, the Private Sector Banks and the Foreign Banks operating in India. The Regional Rural Banks and the Cooperative Banks are excluded due to data deficiencies. The data set employed is a novel panel data set comprising data from Indian commercial banks under four major bank ownership groups. The study employs dynamic panel data models and instrumental-variable techniques for estimation of these models as has been employed by Louzis et al (2012), Makri et al (2014) and Bardhan & Mukherjee (2016). Thus, capturing factors such as time persistence in accumulation of NPAs. A persistent series is one where the value of the variable at a certain date is closely related to the previous value, which are measured mainly by autocovariance and the autocorrelation coefficient. The rest of the paper is organized as follows. Section 2 presents the econometric methodology and the database. Section 3 presents the results. Section 4 concludes the paper.

- **REVIEW OF EMPIRICAL LITERATURE**

2.1 SURVEY OF LITERATURE ON BANK SPECIFIC FACTORS

Apart from the systemic factors which are exogenous to the banking sector, each bank's distinctive behaviour and policies are important endogenous factors which affect their non-performing loans. Empirical literature is available on the dynamics and relationship of endogenous bank-specific variables on the evolution of NPAs.

A strand in the literature examines the relationship between bank-specific factors and NPLs. A seminal work in this strand has been of Berger and DeYoung (1997) who investigated the causality between loan quality, cost efficiency and bank capital. The causality between these three variables were tested using the following four hypotheses:

(1) 'Bad luck 'hypothesis: Exogenous macroeconomic events, for example economic slack negatively impacts non-performing loans and thus causes banks to incur extra costs to deal with the problem loans, consequently affecting their cost efficiency.

(2) ‘Bad management’ hypothesis: Poor management represented through inefficiency is positively associated with increases in future problem loans. Inefficiency is linked with poor credit screening, appraisal and monitoring.

(3) ‘Skimping’ hypothesis: Banks may cut costs on loan monitoring by allocating fewer resources on loan underwriting and monitoring and thus may register higher cost efficiency. However, in the long run there will be a burgeoning number of problem loans.

(4) ‘Moral hazard’ hypothesis: This assumes that when banks are thinly capitalized the bank managers have incentives to engage in risky lending behavior.

Berger and DeYoung (1997) found empirical evidence for the bad management hypothesis and the ‘moral hazard’ hypothesis. The bad management hypothesis is also evidenced by Podpiera and Weill (2008). Salas and Saurina (2002) however have found an insignificant effect of lagged efficiency on problem loans and a significant negative effect of the lagged solvency ratio on problem loans, thus demonstrating the evidence of moral hazard hypothesis.

Bank size in empirical literature has been employed as a proxy for bank diversification. Salas and Saurina (2002), Rajan & Dhal (2003) and Hu et al. (2004) empirically establish negative relation between bank size and problem loans arguing that bigger size implies more diversification for banks.

The moral hazard of ‘too-big-to-fail’ banks represents another channel relating bank-specific features with problem loans (Lousiz et al, 2014). Stern and Feldman, 2004 suggest that ‘too-big-to-fail’ banks may resort to raised risk taking as bank depositors and creditors do not strictly impose market discipline, and rely on government intervention in case of a bank run. A consequent result is excessive risk taking, too much leverage and poor selection of subprime borrowers. Empirical evidence however is inconclusive regarding performance and risk behavior of too big to fail banks. Boyd and Gertler (1994) in context of US banks have concluded that in the decade of 1980s, large US banks’ behavior towards riskier lending was emboldened by US government policy towards ‘too big to fail’ banks. Contrary to this, Ennis and Malek (2005) in study of US banks performance with respect to bank size for the period 1983–2003 do not find conclusive evidence of the ‘too big to fail’ distortions.

Lousiz et al (2014) tested a hypothesis similar to the 'bad management' hypothesis which they named 'bad management II' hypothesis, concluding that performance is negatively associated with increases in future problem loans. Similar to the 'bad management' hypothesis, the 'bad management II' hypothesis uses past performance as a proxy for the quality of management. Rajan (1994) however notably suggests that a reverse direction of the association between lagged performance measures and problem loans is also possible. Rajan (1994) conclude that banks' current earnings may be deliberately manipulated following a liberal credit policy and therefore banks may falsely convince the market of its inflated or manipulated earnings at the cost of future loan defaults, thus suggesting that past earnings may be positively linked to future problem loans. Lousiz et al (2014) name this phenomenon as the 'pro-cyclical credit policy' hypothesis, inconclusively testing the assumption that performance is positively related with future increases in nonperforming loans, as it reflects liberal credit policy on the part of the bank.

2.2 SURVEY OF LITERATURE ON MACROECONOMIC FACTORS

Carey (1998) argues that a bank's loan portfolio quality is largely dependent on the state of the economy. Literature on relationship of macroeconomic factors with bank nonperforming loans have hypothesized that during the expansionary phase of economy, banks' problem loans are comparatively low as customers are capable of debt service due to sufficient inflow of revenues and income. Subsequently, credit is extended to subprime borrowers and when economic cycle alters, problem loans increase (Louzis et al 2014).

For a sample of Italian banks for the period 1985-2002, Quagliarello (2007) concluded that business cycle affects non-performing loans. Similarly, for a sample of Turkish banks for a period 2001-2007, Cifter et al. (2009) concluded lagged impact of industrial production on non-performing loans. Salas and Saurina (2002) have concluded a negative contemporaneous effect of GDP growth on non-performing loans. Rinaldi and Sanchis-Arellano (2006) conclude in their study of sectoral non-performing loans in the Eurozone that the probability of loan default has association with current national income and unemployment rate. De'Bock and Demyanets (2012) in their study on bank asset quality in emerging countries for the period 1996-2010 conclude that GDP growth rate and exchange rates are significant determinants of non-performing loans in the surveyed countries. Nkusu (2011) studied the association between non-performing loans and macroeconomic performance of advanced economies for the period 1998 to 2009 and employ variables like GDP growth, unemployment rate, inflation, nominal effective exchange rate, policy rate of interest and credit to the private sector for empirical investigation and concluded that poor macroeconomic performance is associated with increasing non-performing loans in advanced economies.

- **METHODOLOGY AND DATABASE**
- **ECONOMETRIC METHODOLOGY**

The purpose of this paper is to investigate the existence of time persistence in nonperforming loans of Indian banks and subsequently to determine determinants of NPAs in the Indian banking system. We employ a dynamic panel data model (Makri et al, 2014; Bardhan & Mukherjee, 2016) which includes time-varying bank-specific variables as determinants and includes macroeconomic factors as control variables. A balanced panel dataset is used to control for random biases due to possible heterogeneity and variables which not considered. The basic model is as follows:

$$Y_{i,t} = \alpha Y_{i,t-1} + \beta X_{i,t} + \eta_i + \varepsilon_{i,t}, \; |\alpha| < 1 \qquad (1)$$

where $Y_{i,t}$ is the dependent variable (Non-Performing Assets) in the model, representing the measure of loan default;

$X_{i,t}$ is the k × 1 vector of the explanatory variables (bank-specific endogenous determinants and other macroeconomic factors);

η_i is the unobserved bank-specific effect;

$\varepsilon_{i,t}$ is the observation-specific error term;

(α, β) are the vector of the parameters to be estimated in the model;

i and t stand for cross-section and time dimension of the panel dataset.

The above model as represented by Eq. (1) is estimated by alternative Generalized Methods of Moments (GMM) techniques of Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). The Arellano and Bond (1991) model, in their difference estimator proposes to measure first-difference of above Model (1) as under:

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

The above equation is a differencing equation derived from the Equation (1), where the dependent variables and the explanatory variables are differenced with their own time lagged terms. The purpose of differencing is to eliminate bank-specific effects; however, this introduces a new bias in the model. The differenced new error term as given in Equation (2) will have correlation with differenced lagged dependent variable $(Y_{i,t-1} - Y_{i,t-2})$ .Yet, given that error terms, $\varepsilon_{i,t}$ are serially uncorrelated; lagged dependent variable $Y_{i,\ t-2}$ which has correlation with $(Y_{i,\ t-1} - Y_{i,\ t-2})$ will be uncorrelated with differenced error term $(\varepsilon_{i,t} - \varepsilon_{i,\ t-1})$ where t = 3….T. Thus $\varepsilon_{i,t}$ now can be employed as an instrument in the estimation of Equation (2). The above conditions and assumptions may be represented as under through the moment equation:

$$E\ \{Y_{i,t-s}\ (\varepsilon_{i;t} - \varepsilon_{i;t-1})\ \} = 0 \text{ for } s \geq 2;\ t = 3......T. \qquad (3)$$

Yet another source of biasness is generated due to possible endogeneity related to explanatory variables X and their correlation with the error terms. Whether explanatory variables (X) are exogenous or pre-determinedly weakly exogenous depends on the model and subjective assumptions related to the model estimation. If X are exogenous, then all the future values and past values of X will be uncorrelated with the error term, thus resulting in a moment condition as described as under:

$$E\ \{X_{i,t-s}\ (\varepsilon_{i;t} - \varepsilon_{i;t-1})\ \} = 0 \text{ for all } s,\ t = 3......T. \qquad (4)$$

Conversely, in case of X being weakly exogenous, only current and lagged values of X 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:

$$E\ \{X_{i,t-s}\ (\varepsilon_{i;t} - \varepsilon_{i;t-1})\ \} = 0 \text{ for } s \geq 2;\ t = 3......T. \qquad (5)$$

The above equations (3), (4) and (5) impose restrictions on the use of instruments and thus generates the basis of the one-step GMM estimator model, and under the pre-assumed conditions of homoscedasticity and independent residuals, generate consistent estimates of the parameters for the model as represented in Equation (1).

Arellano and Bond (1991) have also proposed a two-step estimator, a variant of the GMM estimator model. The two-step estimator uses estimated residuals to create a consistent variance-covariance matrix of the moment conditions. Empirical literature however suggests that two-step estimator may suffer from potential biases (Judson and Owen 1999; Bond and Windmeijer 2002; Windmeijer 2005). In the original Arellano and Bond (1991) estimator model too, the lagged levels of the explanatory variables can repeatedly be poor instruments for first difference. Arellano and Bover (1995) however suggest that if original equations in levels are considered along with the difference equations, 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. Therefore, to steer clear off the potential biases and inefficiency in estimates associated with the difference estimator, we deploy system GMM approach that is a combination of regression in differences with the regression in levels as suggested and proposed by Arellano and Bover 1995 and Blundell and Bond 1998. This model uses same set of instruments for the difference equation and equation in level is instrumented by the lagged differences of the corresponding variables (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.) Consequently, the additional moment conditions generated for the second part of the system - level equation are represented by:

$$E\{\Delta Y_{i,t-1}(\eta_i + \varepsilon_i)\} = 0 \qquad (6)$$

$$E\{\Delta X_{i,t-1}(\eta_i + \varepsilon_i)\} = 0 \qquad (7)$$

As represented by equations (6) and (7) the system GMM approach employs additional moment conditions together with those represented in Equations (3), (4) and (5) in order to generate consistent and relatively more efficient estimates compared to those obtained in the difference GMM method.

The stability of GMM estimators depends on validity of the instruments and most significant assumption that errors terms are free from serial correlation. Sargan's Test is therefore employed for testing the overall validity of instruments by analyzing 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, it may be concluded that the original error term is serially uncorrelated.

- **DATABASE**

The study covers four groups of commercial banks operating in India represented by their ownership structure. The dataset consists of 71 banks, which includes State-owned State Bank of India and its associate banks, state-owned Public Sector Banks, Private sector banks and Foreign banks operating in India. After dropping banks with missing data, we have an unbalanced panel of 71 banks with 605 observations over the period 2005-2017. The Regional Rural Banks and Cooperative Banks are not considered for the study due to data uniformity concerns.

The bank wise data for Non-Performing Assets Ratio, Capital Adequacy Ratio, Bank Size and Profit Ratio is collected from Statistical Tables Relating to Banks in India for the period 2005-2017 published by the Reserve Bank of India. This paper used dual ratios for the NPA viz, the Gross Non-Performing Assets Ratio – Gross NPA to Gross Advances, and net Non-Performing Assets Ratio – Net NPA to Net Advances and gross NPA as a proportion of gross advances. The control variables except Gross Domestic Product (GDP) growth rate, other two macroeconomic control variables, viz , the WPI Inflation rate (Wholesale Price Index -WPI), and nominal effective exchange rate (EXR) are collected from RBI times series data on Indian Economy. The GDP growth rate data is collected from World Bank database. The three macroeconomic control variables are included in the econometric GMM model with at one-period lag. This is done to factor-in the possibility of delayed effects of these variables pertaining to bank loan defaults. *Table 04* describes the variables used in this study.

4. RESULTS

Table 1:Macroeconomic variables:2005 -2017

Year	GDP	EXR	WPI
2005	9.284	100.00	100.0
2006	9.263	102.24	104.5
2007	9.801	97.63	111.4
2008	3.890	104.75	116.6
2009	8.479	93.34	126.0
2010	10.259	90.94	130.8
2011	6.638	93.54	143.3
2012	5.4563	87.38	156.1
2013	6.386	78.32	167.6
2014	7.410	72.32	177.6
2015	8.154	74.08	181.2
2016	7.112	74.76	176.7
2017	6.681	74.65	183.0
Mean	7.639	87.80	144.48
SD	1.748	11.511	30.49
Min	3.890	72.32	100.00
Max	10.25	104.75	183.04

GDP-Gross Domestic Product Growth Rate (GDP at market prices based on constant local currency),WPI-Whole Sale Price Index calculated at base 2004-05, EXR- Nominal Effective Exchange Rate.

Table 2: Summary Statistics of Select Bank-specific Variables: 2005-2017

Variables	Mean	SD	Min	Max
Gross NPA Ratio	5.271	8.441	.1103	99.202
CAR	17.399	17.216	.99	277.45
Operating Profit/Total Assets	2.201	1.324	-3.623	10.205
No of Banks	71	71	71	71

Table 3: Macroeconomic and bank-specific variables used in this study and their expected relations with the non-performing loans

Variable	Expected Sign	Research Support
Capital adequacy ratio (CAR)	Negative	Berger and DeYoung (1997)
Assets size (Size)	Positive	Louzis et al. (2012)
Profit (Operating Profit to Total Assets)	Negative	Louzis et al. (2012), Makri et al (2014)
GDP growth rate (GDP)	Negative	Makri et al (2014)
Inflation (WPI)	Positive	Rinaldi and Sanchis-Arellano (2006)
Exchange Rate (EXR)	Positive	Bardhan & Mukherjee (2016)

4.1 ESTIMATION RESULTS

Table 4 represents 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. We consider bank-specific variables models1-4 as predetermined (weakly exogenous) and the three macroeconomic variables exogenous (Bardhan and Mukherjee, 2016). To test the presence of time persistence in NPA structure of Indian banks and include the possible effects of variables not considered, we have considered two lags of the dependent variable-Gross NPA Ratio in models1-4.

Results indicate that first lag of Gross NPA ratio gives significant positive coefficient in all four models 1 to 4. However, coefficient of second lag gives positive coefficient in the three models 2 to 4. Significant and positive coefficients of lagged Gross NPA measures specify that nonperforming loans continue to remain in the bank balance sheet for a longer duration of time and are not immediately written-off. Thus significant time persistence in NPA structure of Indian banks is established through these results. (Models 2 and 4 establish these results robustly).

Lagged Profit of banks as measured by operating profit as a proportion of total assets gives positive and significant coefficient in all the four models (robust results in models 2 and 4). On the contrary, contemporaneous measures of Profits generate negative and significant coefficients. Results find evidence that lagged profits impact the Gross NPA ratio in positive direction (Rajan,1994). The results are consistent with 'Pro-cyclical credit policy' hypothesis, where credit policy is lax on part of the banks. Implicit in this result is the establishment of adverse selection problem in Indian banks, i.e to generate or increase profits banks tend to lend irrationally and consequently in shorter duration this may positively impact profits but eventually leads to higher problem loans in longer duration. The negative and significant contemporaneous coefficients of Profit indicate that in shorter duration banks may tend to increase profits by expanded lending. The negative and significant contemporaneous coefficients of Profits also indicate that a deterioration in profits leads to a rise in non-performing loans, correspondingly confirming the risk-taking behaviour of banks and therefore conforming to the premise that bad management leads to riskier activities and weaker profits (Makri et al, 2014).

The role of bank size as measured by log of gross advances as a bank specific variable is also explored to in explaining NPAs in Indian banks. The coefficients of lagged size effect are found to be significant and positive in models 1 to 4. Results establish that smaller banks have lower defaults, implicitly indicating that smaller banks are better in loan selection and post disbursement monitoring. The results also indicate that the larger banks have larger nonperforming loans, leading to the empirical establishment of moral hazard hypothesis of 'too big to fail banks' (Lousiz et al 2014) suggesting that larger banks raise lending and engage in raised risker behaviour.

Capital adequacy ratio as a prudential indicator has given inconsistent results in Arellano-Bond dynamic panel data estimations and System dynamic panel-data estimations. While the models1-2 give negative coefficients of CAR in contemporaneous and lagged measures, the models 3-4 give significant positive coefficients of CAR in contemporaneous and lagged measures.

Lagged GDP growth is found to have positive and significant effect on banks non-performing loans, suggesting that an expansion in the economy leads to higher NPAs in longer duration. Results support pro-cyclical association of problem loans with business cycle. Coefficients of GDP across models 2 and 4 turn out to be significant and robust.

The results also reveal that lagged inflation, measured by the whole sale price index, positively and significantly increases NPAs in the current period. In a variable interest rate loan scenario, higher inflation can also lead to higher interest rates contingent upon monetary policy measures to combat inflation. A higher interest rate regime may lead to increased problem loans for banks.

Nominal effective exchange rate (EXR) has a significant positive impact on NPAs. Positive coefficient of EXR indicate that depreciation of the domestic currency leads to a decline in NPAs; and similarly appreciation of the domestic currency leads to increase in NPAs. A depreciated domestic currency indicates that export oriented units are relatively better-off in terms of their repayment capacity.

Robustness of the models are checked through Sargan's test of over-identifying restrictions for the GMM estimators and the Arellano-Bond test for zero autocorrelation in first-differenced errors for first and second order (represented as AR1 and AR2 respectively). Null hypothesis related to first order autocorrelation in residuals is rejected in models 2 and 4, and, null hypothesis related to second order autocorrelation is accepted in models 2 and 4. Therefore, we conclude that the original error term in Eq. (1) is serially uncorrelated which gives support to the econometric model. The fact that Sargan's test of over-identifying restrictions has been accepted at alpha= 1% in models 2 and 4 justifies the validity of instruments used in these models.

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

Dependent Variable-Gross NPA Ratio	Model-1 AB-1 Step Estimator Coeff	Model-2 AB-2 Step Estimator Coeff	Model-3 (System-1 Step) Coeff	Model-4 (System-2 Step) Coeff
Intercept	−32.87 (−2.45 **)	−29.20 (−6.10*)	−39.055 (−5.64*)	−39.26 (−37.60*)
NPA(t-1)	0.857 (10.88*)	0.848 (25.84*)	0.746 (22.51*)	0.748 (233.18*)
NPA(t-2)	0.096 (1.09)	0.079 (2.70**)	0.079 (1.95*)	0.077 (17.56*)
CAR	−0.085 (−3.53*)	−0.0792 (−4.02*)	0.053 (3.76*)	0.052 (26.19*)
CAR(t-1)	−.023 (−1.79**)	−0.021 (−16.37*)	0.002 (0.33)	0.0019 (4.08*)
Profit	−0.644 (−2.30**)	−.639 (−4.55*)	−.198 (-1.14)	−2.03 (−8.57*)
Profit(t-1)	.877 (.018**)	.92 (6.00*)	0.507 (3.05**)	.512 (27.20*)
Size	−26.87 (−5.67*)	−28.90 (−15.37*)	−28.68 (−12.14*)	−28.52 (−89.80*)
Size (t-1)	29.15 (6.84*)	29.85 (23.58*)	29.69 (13.00*)	29.49 (91.22*)
GDP(t-1)	0.206 (1.91***)	.250 (7.01*)	0.357 (4.86*)	0.363 (38.52*)
WPI(t-1)	0.058 (1.40)	.071 (5.38*)	0.096 (5.73*)	0.096 (46.60*)
EXR(t-1)	0.159 (2.49**)	.174 (8.24*)	0.208 (5.11*)	0.211 (31.76*)
No of Observations	530	530	605	605
No of groups	67	67	71	71
Sargan test	109.1 (0.000*)	47.41 (0.0389**)	449.03 (0.000*)	64.70 (0.81)
AR(2)	--	-0.0549 (0.956)	--	−.899(0.366)

Table 4 reports GMM estimation results of econometric models with bank-specific variables for the dependent variable Gross NPA Ratio. Four variants of the dynamic panel data models for the dependent variable Gross NPA Ratio is presented. z-statistics are reported in parentheses. The Sargan test of over-identifying restrictions for the GMM estimators is the null hypothesis that instruments used are not correlated with the residuals, and hence, over-identifying restrictions are valid. *, **, and ***represent significance levels at 1%, 5%, and 10 % respectively. Models are estimated with restrictions on the maximum number of lags. AB-1: The Arellano-Bond dynamic panel-data estimation with one-step estimator. AB-2: The Arellano-Bond dynamic panel-data estimation with two-step estimator. System-1: System dynamic panel-data estimation with one-step estimator. System-2: System dynamic panel-data estimation with two-step estimator. NPA-Gross NPA Ratio, CAR-Capital to Risk Weighted Assets Ratio, Profit- Operating Profit to Total Assets Ratio, Size- Log of Gross Advances, GDP-Gross Domestic Product Growth Rate (GDP at market prices based on constant local currency),WPI-Whole Sale Price Index calculated at base 2004-05, EXR- Nominal Effective Exchange Rate. AR (2) are the Arellano-Bond tests for second order autocorrelation of the residuals.

- **CONCLUSIONS**

This paper uses an unbalanced panel dataset to examine the dynamics of nonperforming assets in Indian Banks for the period 2005 to 2017. The dataset consists of commercial banks operating in India under the classification of four groups based on their ownership structure. The dataset consists of State Bank of India and its Associate banks, the Public Sector Banks, the Private Sector Banks and the Foreign Banks operating in India. The two-step GMM estimation applied on the panel data set obtain robust results. The robustness tests conducted to establish the validity of the models are satisfied in the two-step GMM estimated models. Results have empirically established that lagged NPAs have a significant and positive affect on current NPAs. This concludes that significant time persistence exists in NPA structure of Indian banks (results are consistent with Makri et al 2014; Ghosh 2015; Dimitrios et al. 2016; Bardhan & Mukherjee 2016).

Results also conclude that larger banks are more likely to record loan defaults in comparison to their smaller counterparts clearly suggesting that larger banks take excessive risks (results are consistent with Louzis et al. 2012; Bardhan & Mukherjee 2016). These results indicate that the “too big to fail” banks exhibit presence of moral hazard in their lending, suggesting that larger banks engage in higher lending and consequently exhibiting raised riskier lending behavior.

The positive and significant coefficients of lagged profit in empirical analysis (contrary to Lousiz et al 2014; Bardhan & Mukherjee, 2016) infer that increased profits in the previous period denote that NPAs in the next period will increase. This result supports the ‘pro-cyclical credit policy’ hypothesis, suggesting that raised profits in shorter duration may increase NPAs in longer duration due to raised risker lending and therefore higher possibility of adverse selection.

Capital Adequacy ratio give inconsistent results in empirical analysis and therefore have not been used to explain the current NPA levels (contrary to Makri et al 2014; Bardhan & Mukherjee, 2016).

The three macroeconomic variables employed in the current study, significantly affect NPAs in Indian banks (consistent with Bardhan & Mukherjee, 2016). A lagged positive GDP growth rate has a positive and significant effect on bank NPAs (contrary to Louzis et al , 2012 ; Makri et al 2014). Results conclude pro-cyclical relation of bank NPAs with business cycle. Similarly, the lagged nominal effective exchange rate has a positive and significant impact on NPAs. The lagged inflation rate is also found to have positive and significant effect on NPAs.

APPENDIX

Table 5: Description of Variables

Variable	Description	Data Source
NPA	Gross Nonperforming assets As a proportion of Gross Advances	Reserve Bank of India
CAR	Capital to Risk Weighted Assets Ratio	Reserve Bank of India
Profit	Operating Profit to Total Assets Ratio	Reserve Bank of India
Size	Log of Gross Advances	Reserve Bank of India
GDP	Gross Domestic Product Growth Rate (GDP at market prices based on constant local currency)	World Bank
WPI	WPI-Whole Sale Price Index calculated at base 2004-05	Reserve Bank of India
EXR	Nominal Effective Exchange Rate.	Reserve Bank of India

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