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INVESTIGATING THE DETERMINANTS OF NON-PERFORMING ASSETS: THE CASE OF THE INDIAN BANKING SECTOR

Sonia Chawla*, Seema Rani**

Abstract *The purpose of this paper is to investigate significant macroeconomic and bank-specific determinants of non-performing assets (NPAs) in the Indian banking sector, based on data for a period of more than two decades (1997 to 2017). For the objective in hand, step-up confluence analysis is applied to panel data, with both fixed effects and random effects modelling; the latter has an advantage over the former, based on Hausman's test. Findings of the study reveal that the significant macroeconomic variables explaining the NPAs include GDP growth rate, external debt, and FDI inflows. Furthermore, bank level determinants, viz. revenue efficiency, return on assets, and return on equity, indicate that better the quality of management, lower the NPAs. The findings of the study have far-reaching implications for banking regulation and policy, as efficiency and performance measures can be the paramount indicators for future management of NPAs. Moreover, the statistically significant macroeconomic variables can manage the effect of economic turbulences on the health of the Indian banking system.*

Keywords: *Non-Performing Assets, Indian Banking Sector, Bank-Specific and Macroeconomic Variables, Panel Data Estimation, Frisch Confluence Analysis*

INTRODUCTION

Probing the issue of non-performing assets is of substantial importance for the regulators, as accumulation of the same is always assumed to be the harbinger of a banking crisis, causing the banks to fail, worldwide (Barr & Siems, 1994; Reinhart & Rogoff, 2010). NPAs affect the operative capability of the banks and successively affect the profitability, liquidity, and solvency of those banks (Michael et al., 2006). No doubt, to some extent, deterioration of assets is inevitable, but it is always appreciable if these distressed assets remain at a minimum, with the vital contribution of the credit risk management system. Hence, for a stable financial system, it is necessary to identify the factors that affect assets quality and to make efforts to reduce NPLs (Stijepović, 2014).

Contemporary literature has distinguished two sources of factors responsible for mounting NPAs: bank level and macro level. Berger and DeYoung (1997) used Granger-causality approach while focussing on efficiency indicators and the non-performing loans (NPLs), and found that extra cost has to be borne to administer to the problem loans. However, Rajaraman and Vasishtha (2002) used panel regression on NPAs of 27 public sector banks (PSBs) and found that there is a significant relation between operational efficiency and NPAs. Keeton and Morris (1987) found that local economic conditions and abject performance of particular industries could increase the problem of NPLs if a bank's risk-taking behaviour is active. Podpiera and Weill (2008) considered Czech banks from 1994 to 2005, and estimated a causal relationship between NPLs and cost efficiency, signalling bad management symptoms. Espinoza and Prasad (2010) presented macroeconomic variables and used a dynamic panel estimated over 1995-2008 on around 80 banks in the Gulf Cooperative Council (GCC) region; they found that the NPL ratio worsens as economic growth becomes lower and interest rates and risk aversion increase. The model implies that the cumulative effect of macroeconomic shocks over a three-year horizon is indeed large, as NPLs decrease due to non-oil GDP growth. Jimenez and Saurina (2005) found that rapid credit growth during economic boom increases the loan losses and showed that during upturns, riskier borrowers get bank loans, while collateralised loans decrease. Arpa et al. (2001) evidenced that risk provisions increase with decrease in real GDP growth, and rise with real estate prices, consumer prices, and operating income. Babouček and Jančar (2005) found that inflation and unemployment levels worsen the non-performing loans. However, Pain (2003) concluded that lending to sensitive sectors and real interest rates, along with

* Associate Professor, Department of Humanities and Management, Dr B R Ambedker National Institute of Technology, Jalandhar, Punjab, India. Email: chawlas@nitj.ac.in
** Research Scholar, IKG Punjab Technical University, Kapurthala, Punjab, India. Email: sethi.seema13@gmail.com

real GDP growth, are some of the factors that determined the NPLs in major banks in the UK. Klein (2013) examined the bank-specific factors as well as macroeconomic factors, showing the variations in NPLs in 16 Central, Eastern, and South Eastern Europe (CESEE) regions during 1998-2011, and concluded that unemployment, inflation, exchange rate depreciation, GDP, ROA, and equity to assets ratio are some of the prominent factors explaining the variations in NPLs in CESEE.

However, deteriorating asset quality has become a menace to the Indian banking industry as well (Batra, 2003 and Heid & Kruger, 2011). In India, since the operationalisation of the reforms process, the regulators considered the resolution to the NPA problem as a 'national priority'. With that in mind, the gross NPA ratio (gross NPA to gross advances ratio) declined gradually from 15.7% in 1996-1997 to 2.5% in 2010-2011. However, NPAs have again registered an increasing trend since 2011-2012. The situation is relatively more adverse in the case of public sector banks (PSBs). The statistics are alarming as the total pile of bad loans in the PSBs has increased from 3090 billion to 5800 billion during the span of one year (2015-2016) (Tiwari, 2016). However, a similar trend is observed in the four quarters of the financial year 2016-2017. Such proliferating NPAs lay a burden on a bank's balance sheets, hindering their intermediation role in economic growth. Therefore, unveiling the underlying determinants of NPAs is of prime interest for policy formulations.

In this context, we undertook an empirical analysis to examine the determinants of NPAs over the last two decades (1996-1997 to 2016-2017) in the Indian banking sector. The review of literature divulged a gap in the literature and there are no significant studies on determinants of NPAs in the Indian banking sector, especially in the post-reform period. The next part of the paper proceeds as follows: section II reveals the pertinent determinants of NPAs and their theoretical support; section III presents estimation models; section IV discusses the results; and finally, section V concludes the paper.

THEORETICAL FRAMEWORK AND VARIABLE SELECTION

Dependent Variable: The study will capture asset quality using gross NPAs ratio, as gross NPAs indicate the total default amount that ceases to generate income for the bank or an advance that is irrecoverable. It is the sum total of sub-standard, doubtful, and lost assets of a bank. Rajaraman and Vasishtha (2002) asserted that gross NPA is preferable over net NPA, as the former is not influenced by the discretion employed by banks regarding provisioning, according to their capacities.

Based on the aforementioned literature and our understanding of the Indian banks, we have pondered the following bank-specific and macro level factors as the NPA's explanatory variables (Table 1).

Table 1: Description of Variables

	Symbol	Description	Expected Sign
Dependent Variable			
Non-Performing Assets	NPAS	Gross NPA to Total Advances Ratio	
Bank-Specific Variables			
Operating Efficiency	CSTE	Operating Expenses to Total Income	(+)
	RVNE	(IEA / Advances)	(−)
Profitability	ROAS	Net Income / Total assets	(−)
	ROEQ	Net Profit / (Capital + Reserves and Surplus)	(−)
	NITA	Net Interest to Total Assets	(−)
Size	TAST	Total Assets	(−)
	RVNU	Total Income − Interest Expenses	(−)
Diversification	NITI	Non-Interest Income to Total Income	(−)
Loan Growth	CDRT	Credit-Deposit Ratio	(+)
Directed Credit	PATA	Priority Sector Advances to Total Advances	(+/−)
Loan Maturity	TLTA	Term Loans to Total Advances	(−)
Collateralised Loans	SATA	Secured Advances to Total Advances	(−)
Bank Capitalisation	EQAS	CAR (Equity to Assets Ratio)	(+/−)

	Symbol	Description	Expected Sign
Higher Risk Taking	FBAS	Foreign Borrowings to Assets Ratio	(+)
	CSTB	Interest Paid on Interbank Borrowings & Others/Average Borrowings	(+)
	TDTE	Borrowings to Equity Ratio	(+)
	TDTA	Borrowings to Total Assets Ratio	(+)
Macroeconomic Variables			
Economic Performance	ROGR	Average Annual Rate of Growth (in %)	(−)
Asset Prices	MTCB	Market Cap of BSE	(−)
Interest Rate	CLRT	Call Rate	(+)
Debt	EDGP	External Debt to GDP Ratio	(+)
Exchange Rate Depreciation	M2FE	M2 to Foreign Exchange Reserves	(−)
Unemployment	RUNE	Rate of Unemployment	(+)
Credit Growth	DCGP	Domestic Credit to GDP Ratio	(+)
Price Stability	CPIN	Consumer Price Index (Base = 2010)	(+)
Foreign Direct Investment	FDGP	FDI as a %age of GDP	(−)

Bank-Specific Factors

- *Operating Efficiency:* Berger and De Young (1997) argued that low-cost efficiency is positively related to burgeoning future NPLs, termed as 'bad management' hypothesis, as bank managers lack the skill in credit scoring and monitoring borrowers. In this study, an attempt has been made to measure operational efficiency firstly through cost efficiency (as the ratio of operating expenses to total income) in a way similar to Podpiera and Weill (2008); Louzis et al. (2012); Espinoza and Prasad (2010); Williams (2004); and Salas and Saurina (2002), expecting a positive relation with NPAs, and also through revenue efficiency (through the measure of return on advances), similar to Ghosh (2014); an efficient management is also emulated through revenue efficiency. A higher value negatively impacts the NPAs.
- *Bank Profitability:* 'Bad management' hypothesis of Berger and DeYoung (1997) found that profitability is supposed to negatively affect the NPLs as banks with higher profits do not involve themselves in risky activities. In the present study, we have used ROA, ROE, and NIM as a proxy for bank profitability, like Demirgüç-Kunt and Huizinga (1999); Louzis et al. (2012); Klien (2013); Ghosh (2015); and Dimitrios et al. (2016).
- *Bank Capitalisation:* Low capitalisation of banks tends to higher levels of NPLs, as justified in the moral hazard incentives on the part of bank managers, which enhance the risk in their loan portfolio when the banks have inadequate capital (Keeton & Morris, 1987; Berger & DeYoung 1997; Salas & Saurina, 2002; Klein, 2013; Zhang et al., 2016). Whereas, as per Ghosh (2015), this relation is ambiguous. The reason is that, as per Rajan (1994), banks with a high capital base may be boosted to get involved in risky lending, bringing a positive relation between both due to 'too big to fail' hypothesis. In the present analysis, we have also used CAR (equity to assets ratio), much like Louzis et al. (2012), Klien (2013), and Makri et al. (2014).
- *High Risk Taking:* Fofack (2005) asserted that interbank borrowings are a major factor responsible for NPLs in banks in Sub-Saharan Africa, which leads to increasing cost of borrowings, including foreign borrowings. Therefore, high risk taking, which is in line with 'moral hazard' hypothesis, may be captured through 'borrowings to total assets ratio', similar to Fofack (2005), and higher 'borrowings to equity ratio' and foreign borrowings to total assets ratio, like Ghosh (2014), as well as cost of borrowings, to check whether increase in these ratios leads to higher NPAs.
- *Size:* Louzis et al. (2012) found that in 'too big to fail' hypothesis, large banks take more risk by enhancing their leverage, and hence have to face high NPLs. However, the researcher would capture size through total assets much like Laeven and Levine, 2009; Matejašák et al., 2009; Teixeira et al., 2014; and Vallascas and Hagendorff, 2013, as well as revenue (total income − interest expenses), similar to Schildbach (2017).
- *Loan Growth:* Keeton and Morris (1987), Salas and Saurina (2002), and Jimenez and Saurina (2005)

asserted that banks that extend excessive loans ultimately face higher NPLs, because when banks enhance extension of loans, they lower their interest rates and also reduce their credit standards, which eventually increases the chances of higher NPLs. Klein (2013) found that unrestrained lending steers higher NPLs; in addition, they had the moral hazard argument of higher risks taken by banks. Accordingly, we have used credit-deposit ratio, similar to Dimitrios et al. (2016) and Keeton and Morris (1987), to check the level of risk taking in the credit culture of a bank as a high credit-deposit ratio will depict higher NPLs.

- *Collateralised Loans:* Extant literature and credit market surveys elucidate the use of collateral as a result of an erroneous selection (Chan & Kanatas, 1985 and Bester, 1985) and of moral hazard (Boot et al., 1991), emerging out of information asymmetry between the banker and the borrower. Therefore, similar to them, we have tried to examine if collateralised lending (secured advances to total advances) affects NPLs.
- *Directed Lending:* Ghosh (2014) and Bhowmick and Banerjee (2008) empirically found that directed lending did not deteriorate loan portfolios of banks and supported that such lending has no impact on problem loans. In this exercise, an attempt has been made to check whether priority sector lending to total advances would be a significant explanatory variable.
- *Loan Maturity:* Ranjan and Dhal (2003) established that if the borrower is highly bank dependent, a borrower may not consider defaulting on a short-term loan, even though such loans involve a high present value of debt burden. On the contrary, Jackson and Perraudin (1999) asserted that longer the maturity, the greater the risk of the borrower's encountering problems. We would be using the ratio of term loans to total advances, similar to Ranjan and Dhal (2003) and Jimenez and Saurina (2005), who asserted that the maturity terms of credit have a significant negative impact, indicating that higher term loans induce lower NPAs.

Macro-Level Factors

- *Economic Performance:* Growth of an economy can be captured through GDP growth. Salas and Saurina (2002); Espinoza and Prasad (2010); Bofondi and Ropele (2011); Nkusu (2011); and Buncic and Melecky (2013) estimated that GDP growth lowers the NPL ratio. Beck et al. (2015) found that the major driver of NPLs is GDP growth. In the study, we have attempted to check whether non-performing assets induce a negative or positive relation with GDP growth.
- *Asset Prices:* The extant literature showed the role of asset prices, specifically the stock prices, in driving the asset quality of banks (Chen, 2001; Lokare 2014; Gambacorta, 2005; and Demirgüç-Kunt & Detragiache, 1998). A booming stock market shields borrowers from sudden jerks, by providing access to credit and also helping to repay their existing debts. In this we have used market capitalisation of S&P BSE index as the proxy for asset prices, much like Ghosh (2014).
- *Interest Rates:* Many empirical papers, viz. Gerlach et al., 2005 and Bofondi and Ropele, 2011, asserted that non-performing loans proliferate due to real and nominal interest rates. In addition, Brewer III et al. (2014) found that a higher interest rate uncertainty influences the bank's source of funds, and consequently affects loan growth, and therefore, NPLs. We have used money market rate as a proxy for lending rate, similar to Lokare (2014) and Ghosh (2014), expecting a positive relation with NPAs.
- *Debt:* Banking crises are generally faced by nations having external vulnerabilities or greater current account deficits (Leaven & Valencia, 2008). Louzis et al. (2012) also hypothesised that increasing sovereign debt initiates higher NPLs. Therefore, an attempt has been made to check whether the variable, 'external debt to GDP' ratio, positively affects the NPAs, same as established by Louzis et al. (2012).
- *Exchange Rate Depreciation:* Klein (2013) established that exchange rate depreciation caused an increase in NPLs in banks of the CESEE countries. However, Fofack (2005) and Beck et al. (2015) observed that real effective exchange rate has a positive impact on bad loans. Therefore, to check whether banking problems are connected to unanticipated capital outflows in economies with an exchange rate peg, the researchers introduced the ratio of 'M2/foreign exchange reserves' as regressor, as this ratio could very well predict a country's external vulnerability (Demirgüç-Kunt & Detragiache, 1998 and Calvo, 1996).
- *Unemployment:* Lawrence (1995) and Rinalidi and Sanchis Arellano (2006) framed models that showed that lower income causes higher NPLs, as unemployment leads to reduced cash flows for the borrowers. So, the researchers have used rate of unemployment as a primary determinant, which indicates that macroeconomic activity expects a positive relation with NPAs.
- *Credit Growth:* Konstantakis et al. (2016) observed that a shock in the domestic credit extended by the banking sector is related to poor credit standards,

further leading to higher NPLs. Therefore, to check the effect of credit growth in the Indian banking sector on NPAs, the researchers have used the proxy of 'domestic credit to GDP ratio', similar to Konstantakis et al. (2016).

- *Price Stability:* Gerlach et al. (2005), Bofondi and Ropele (2011), and Klein (2013) found that bad loans declined due to a decrease in consumer price index (CPI), as increase in inflation rate can decrease the real value of a debt, hence making it easy for the borrowers to service their debt. So, we would be using CPI as a proxy for inflation, similar to Klein (2013) and Gerlach et al. (2005), and expect a positive relation with the NPAs.
- *FDI:* Blomstrom (1994), De Mello (1997), Dees (1998), and Nair Reichert and Weinhold (2001) asserted that FDI, along with direct capital financing, contribute to technology and know-how, which ultimately boosts the business of the economy and increases the debt servicing capacity of the borrowers. Therefore, in the present investigation, we have used the ratio of FDI as a percentage of GDP, expecting a negative relation with NPAs.

DATA AND METHODOLOGY

In the present investigation, we have employed both descriptive as well as analytical research design for realising the framed objectives. As per the nature of the investigation, we have made use of secondary data. The requisite data is compiled from RBI sources, such as 'Statistical Tables Relating to Banks in India' and 'Report on Trends and Progress of Banking in India' for a period of 21 years, from 1996-1997 to 2016-2017. As is well established, the RBI website provides the most comprehensive database for research in banking. It may be mentioned that the prime objective in the present study is to identify the main determinants of NPAs of India's scheduled commercial banks. In the Indian banking system, scheduled commercial banks (SCBs) consist of mainly three bank groups, namely public sector banks (PSBs), private sector banks (PVTs), and foreign sector banks. So, we have used bank group-wise data (comprising all the banks in these groups) for the panel analysis. The data set has the following year-wise and bank type-wise composition of the number of banks:

Number of Banks																					
Bank Group Type	**1996-1997**	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-2017**
PSBs	27	27	27	27	27	27	27	27	28	28	28	28	27	27	26	26	26	27	27	27	27
PVTs	35	34	34	32	31	31	29	30	29	28	25	23	22	21	20	19	19	20	20	22	21
Foreign	39	42	44	42	42	40	36	33	31	29	29	28	31	30	32	37	41	43	44	46	43
Total	101	103	105	101	100	98	92	90	88	85	82	79	80	78	78	82	86	90	91	95	91

Source: RBI

Panel Unit Root Testing

In panel data analysis, the panel unit root test is necessary to identify the stationary properties of the variables. However, for this very purpose, all the variables, except return on equity and return on assets, were considered on normal as well as on logarithmic scales. The two exceptional variables (i.e. return on equity and return on assets) had to be considered on the normal scale alone, because of their negative values for certain years. We may mention that there are a variety of tests available for unit root testing. However, we have resorted to Levin et al. (2002) panel unit root test (which presumes a common unit root process) and Maddala and Wu (1999) test (which assumes an individual unit root process), similar to Espinoza and Prasad (2010) and Ghosh (2015). Maddala and Wu (1999) assert that the individual panel unit root tests perform the best, compared to the tests that assume the common unit root test, because the former does not necessitate a balanced panel data set. Furthermore, with the objective of robustness checking, we have executed both individual as well as common panel unit root test on the selected variables. We have first differenced on the logarithmic scale, and almost all the variables, except RUNE and CPIN, have been detected to have attained stationarity (Table 2).

Table 2: Panel Unit Root Test Result First Differenced

Name of Variable	Levin. Lin and Chu - z	Prob	Maddala & Wu – Chi-Square	Prob	Nature
Log of Gross NPAS to Total Advances (NPAs)	−2.209	0.014	10.823	0.212	Stationary
Log of Cost Efficiency (CSTE)	−4.026	0.000	34.724	0.000	Stationary
Return on Equity (ROEQ)	−1.194	0.116	43.973	0.000	Stationary
Log of Revenue Efficiency (RVNE)	−4.015	0.000	46.687	0.000	Stationary
Return on Assets (ROAS)	6.13	1.000	26.845	0.001	Stationary
Log of Equity to Asset Ratio (EQAS)	−3.95	0.000	87.588	0.000	Stationary
Log of Foreign Borrowings to Asset Ratio (FBAS)	−6.376	0.000	222.407	0.000	Stationary
Log of Cost of Borrowings (CSTB)	−2.211	0.014	54.96	0.000	Stationary
Log of Total Assets Ratio (TAST)	−2.076	0.019	25.604	0.001	Stationary
Log of Revenue (RVNU)	−2.105	0.018	25.276	0.001	Stationary
Log of Non-Interest Income to Total Income (NITI)	−2.528	0.006	90.36	0.000	Stationary
Log of Credit Deposit Ratio (CDRT)	−4.962	0.000	42.205	0.000	Stationary
Log of Priority Sector Advances to Total Advances (PATA)	−3.639	0.000	28.73	0.000	Stationary
Log of Total Loans to Total Advances (TLTA)	−3.847	0.000	47.872	0.000	Stationary
Log of Secured Advances to Total Advances (SATA)	−2.855	0.002	52.721	0.000	Stationary
Log of Total Debt to Total Equity (TDTE)	−4.765	0.000	50.733	0.000	Stationary
Log of Total Debt to Total Assets (TDTA)	−3.504	0.000	133.588	0.000	Stationary
Log of Net Interest Income to Total Assets (NITA)	−2.745	0.003	58.442	0.000	Stationary
Log of Average Annual Rate of Growth (ROGR)	3.548	1.000	67.081	0.000	Stationary
Log of Market Capitalisation of BSE (MTCB)	−9.649	0.000	109.984	0.000	Stationary
Log of Interest Rate/Call Rate (CLRT)	15.691	1.000	91.859	0.000	Stationary
Log of External Debt to GDP (EDGP)	−2.486	0.006	28.249	0.000	Stationary
Log of M2 to Foreign Exchange Reserves (M2FE)	−5.383	0.000	49.094	0.000	Stationary
Log of Rate of Unemployment (RUNE)	−1.428	0.077	5.439	0.710	Non-Stnr
Log of Domestic Credit to GDP (DCGP)	−8.155	0.000	93.202	0.000	Stationary
Log of Consumer Price Index (CPIN)	7.675	1.000	3.828	0.872	Non-Stnr
Log of FDI as %age of GDP (FDGP)	−0.3	0.382	23.728	0.003	Stationary

Source: Author's own calculations.

Estimation Methodology for the Determinants of NPAs

For identifying the concomitants of NPAs in the Indian banking sector, panel data regression analysis with both fixed effects modelling as well as random effects modelling has been applied, similar to Miaou (1990), Prasanna et al. (2014), and Patra and Padhi (2016).

The specification of the model for balanced panel data estimation (Baltagi, 2001; Croissant & Millo, 2008) is as follows:

$$y_{it} = \alpha_{it} + \beta^{T}_{it}\, x_{it} + \mu_{it}$$

where, i = 1, 2, ……., k refers to bank group index and t = 1, 2, ……, n refers to time index, μit is a random disturbance term of mean zero, y_{it} is the dependent variable (gross NPAs ratio), and x_{it} is the k dimensional row vector of predictor variables, which does not include the constant. The aforementioned model is not calculable with N = k × n data points, as a huge number of unknowns are difficult to estimate from a lower number of observations. For this, a genuine set of assumptions is required for the parameters, the

errors, and the exogeneity of the regressors, which gives rise to a set of suitable models for panel data. The most common is parameter homogeneity, which is the most customary; this means that $\alpha_{it} = \alpha$ i, t ∀ and it β = β i, t ∀. The resultant model then would be as follows:

$$y_{it} = \alpha + \beta^T x_{it} + \mu_{it}$$

This is simply a standard linear model, which is the result of pooling the whole data across i and t. For the purpose of introducing heterogeneity (through state-specific modelling), it may be assumed that the error term (μi t) is made up of two additive components: μi (which is specific to a particular bank group and does not change over time), and εi t (the idiosyncratic error, which is supposed to be independent from both the regressors, xi t, and individual error component, μi, as well as being presumed to be well behaved). Consequently, we are steered to the unobserved effects model:

$$y_{it} = \alpha + \beta^T x_{it} + \mu_i + \varepsilon_{it}$$

The suitable assessment method for this model relies on the properties of two error components. The individual element can be independent from the regressors or correlated. If in a situation, it is correlated, there would be inconsistency of OLS estimators for β. Hence, it is common to treat i μ as a further set of n parameters to be estimated, as if in the general model αit i = α for all t. This is known as fixed effects model, which is generally estimated by the OLS technique on transformed data, and which also provides consistent estimators for β. However, in case the bank group-specific component i μ is not correlated with the regressors, we are steered to the random effects model. The overall error terms would be random, and hence, the OLS estimator is known to be consistent for a random effects model. Within the same model, estimations are executed in three alternative ways:

- Walhus – Wallace and Hussain (1969)
- Amemiya – Amemiya (1971)
- Nerlove – Nerlove (1971)

Next, Hausman test (1978) was applied to test the significance of difference between the vectors of estimates derived through fixed and random effects modelling.

$$H = (\beta_{RE} - \beta_{FE}) [Var (\beta_{FE}) - Var (\beta_{RE})] ^{-1} (\beta_{RE} - \beta_{FE})$$

where, β_{RE} and β_{FE} are the vector of random effects and fixed effects estimates.

The whole analysis is executed through appropriately adapted computer programs in R language.

DISCUSSIONS

Identification of the Major Determinants of NPAs in the Indian Banking Sector - Panel Data Approach

At the outset, we have considered the exhaustive list of 24 variables for this part of the analysis. Further, in order to capture the effect of the really meaningful variables among this exhaustive list, we have performed step-up panel data-based multiple linear regression analysis. It may be reiterated that the estimation was carried out through both fixed effects and random effects modelling, using three alternative versions, viz., *walhus* (Wallace & Hussain, 1969), *amemiya* (Amemiya, 1971), and *nerlove* (Nerlove, 1971). With the purpose of identifying suitable indicators from the 24 determinants, the estimation approach has a close resemblance to Frisch confluence analysis, wherein, the variable that is capable of explaining the variation in the dependent variable to the maximum extent is entered in the linear regression model in an iterative manner. This approach is continued up till the accompanying value of $\bar{R}^2$ has reached the maximum, indicating that the added variable indeed was worthwhile, provided that the majority of the partial regression coefficients are statistically significant.

With the purpose of having a clearer picture, we have executed the iterative procedure till all the 24 predictor variables were used. At each of the iterative step, the χ 2-statistic related to the Hausman test turned out to be statistically non-significant, thus indicating relative superiority of random effects modelling. Moreover, the Nerlove's version was associated with the highest value of R^2, as were the lowest values of each of the AIC and BIC criteria, and was accepted to be the appropriate versions for the present analysis. An examination of Table 3, citing the results of step-up regression analysis, depicted that at the very first iteration, the most paramount variable (as also estimated on the criteria of the numerical value of the corresponding t-ratio) happened to be the revenue efficiency (RVNE). In the next iteration, another variable, return on equity (ROEQ), was added (along with RVNE) from the data set, and the analysis was again carried out. While doing so, it was noticed that statistical significance of the existing predictor variable remained unchanged. However, the values of both R^2 and $\bar{R}^2$ improved relatively; R^2 increased from 0.664 to 0.789, whereas $\bar{R}^2$ happened increased from 0.660 to 0.783. Therefore, adding the new variable seemed to be desirable. Likewise, when the analysis was performed for the third time, after adding FDI

Table 3: Results of Step-Up Panel-Data Based on Random Effect Model (Nerlove's Version)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Intercept	13.983***	15.656***	11.404***	10.205***	8.382***	2.313	1.921	2.311	1.759	2.696	2.993 .	4.606*	11.989***	16.310***	19.474***	25.702***	25.032***	83.229	111.083	117.746	113.738	115.820	115.333	116.159
	(14.446)	(19.205)	(9.903)	(9.656)	(6.805)	(1.232)	(1.080)	(1.335)	(1.021)	(1.562)	(1.734)	(2.481)	(3.891)	(3.381)	(4.913)	(5.238)	(5.197)	(1.281)	(1.601)	(1.665)	(1.569)	(1.582)	(1.561)	(1.554)
RVNE	-2.95***	-3.218***	-2.161***	-2.111***	-1.976***	-1.869***	-1.490***	-1.789***	-1.619***	-1.961***	-2.001***	-2.336***	-1.909***	-1.908***	-1.766***	-1.907***	-2.065***	-2.017***	-1.762***	-.1745***	-1.806***	-1.846***	-1.885**	-1.886**
	(12.735)	(17.017)	(7.774)	(8.517)	(8.130)	(8.381)	(6.189)	(6.829)	(6.058)	(6.496)	(6.625)	(6.671)	(4.677)	(4.725)	(4.360)	(4.750)	(5.217)	(5.041)	(3.784)	(3.725)	(3.577)	(3.553)	(3.366)	(3.340)
ROEQ		-0.039***	-0.041***	-0.051***	-0.057***	-0.048***	-0.049***	-0.046***	-0.025*	-0.012	-0.007	-0.006	-0.008	-0.008	-0.009	0.005	0.006	0.005	0.005	0.003	0.004	0.003	0.003	0.003
		(7.178)	(8.431)	(10.542)	(11.042)	(9.287)	(10.066)	(9.277)	(2.311)	(0.971)	(0.534)	(0.499)	(0.697)	(0.644)	(0.810)	(0.348)	(0.440)	(0.373)	(0.373)	(0.267)	(0.325)	(0.237)	(0.247)	(0.251)
FDGP			-0.492***	-0.501***	-0.528***	-0.395***	-0.514***	-0.505***	-0.510***	-0.458***	-0.444***	-0.433***	-0.442***	-0.442***	-0.401***	-0.416***	-0.332***	-0.338***	-0.363***	-0.354***	-0.349***	-0.357***	-0.359***	-0.358***
			(4.753)	(5.435)	(5.928)	(4.475)	(5.637)	(5.743)	(5.891)	(5.244)	(5.072)	(4.962)	(5.437)	(5.545)	(5.009)	(5.286)	(3.900)	(3.951)	(4.090)	(3.891)	(3.796)	(3.765)	(3.738)	(3.691)
CDRT				0.498***	0.0582***	0.385***	0.384***	0.392***	0.401***	0.275*	0.296**	0.266*	0.163	0.152	0.138	0.085	0.013	0.024	0.012	0.010	-0.002	0.018	0.014	0.011
				(4.734)	(5.433)	(3.524)	(3.727)	(3.944)	(4.102)	(2.493)	(2.667)	(2.375)	(1.486)	(1.397)	(1.289)	(0.795)	(0.118)	(0.218)	(0.109)	(0.091)	(0.021)	(0.144)	(0.108)	(0.079)
EQAS					0.437*	0.974***	1.033***	1.028***	0.999***	1.020***	1.091***	1.036***	0.863***	0.708***	0.503*	0.247	0.154	0.137	0.082	0.034	0.049	0.033	0.019	0.016
					(2.589)	(4.812)	(5.375)	(5.537)	(5.487)	(5.743)	(5.897)	(5.653)	(4.542)	(3.514)	(2.322)	(1.008)	(0.636)	(0.566)	(0.333)	(0.131)	(0.182)	(0.121)	(0.068)	(0.053)
EDGP						1.477***	1.230**	1.259***	1.238***	1.525***	1.545***	1.458***	1.041**	0.831*	0.465	0.068	-0.244	-0.316	-0.239	-0.192	-0.183	-0.189	-0.150	-0.134
						(3.978)	(3.416)	(3.629)	(3.631)	(4.279)	(4.346)	(4.088)	(2.897)	(2.263)	(1.178)	(0.157)	(0.555)	(0.707)	(0.523)	(0.410)	(0.387)	(0.395)	(0.288)	(0.250)
ROGR							-0.289**	-0.292**	-0.288**	-0.312***	-0.296***	-0.298***	-0.389***	-0.401***	-0.396***	-0.395***	-0.374***	-0.388***	-0.444***	-0.461***	-0.465***	-0.466***	-0.469***	-0.469***
							(3.165)	(3.325)	(3.334)	(3.676)	(3.472)	(3.503)	(4.726)	(4.961)	(5.004)	(5.116)	(4.953)	(5.030)	(4.799)	(4.720)	(4.715)	(4.681)	(4.608)	(4.570)
TDTE								0.155*	0.167**	0.130*	0.091	0.095	0.167*	0.116	0.090	-0.593 .	-0.760*	-13.303	-19.521	-20.840	-19.903	-20.161	-20.080	-20.303
								(2.518)	(2.742)	(2.122)	(1.376)	(1.447)	(2.600)	(1.662)	(1.296)	(1.690)	(2.181)	(0.952)	(1.299)	(1.363)	(1.269)	(1.274)	(1.259)	(1.255)
ROAS									-0.368*	-0.559**	-0.628**	-0.618**	-0.528**	-0.469*	-0.454*	-0.629**	-0.608**	-0.605**	-0.566**	-0.546**	-0.551**	-0.545**	-0.548**	-0.547**
									(2.161)	(3.021)	(3.351)	(3.364)	(2.924)	(2.570)	(2.552)	(3.233)	(3.217)	(3.194)	(2.945)	(2.765)	(2.768)	(2.712)	(2.697)	(2.665)
FBAS										0.077*	0.055	0.045	0.020	0.011	-0.010	-0.562	-0.062	0.073 .	-0.076 .	-0.077 .	-0.074 .	-0.082 .	-0.082	-0.085
										(2.253)	(1.465)	(1.212)	(0.545)	(0.298)	(0.288)	(1.338)	(1.524)	(1.711)	(1.789)	(1.812)	(1.679)	(1.672)	(1.664)	(1.575)
CSTB											-0.128	-0.127	-0.134	-0.130	-0.157 .	-0.165*	-0.142 .	-0.169 .	-0.233*	-0.225*	-0.218*	-0.225*	-0.231*	-0.229 .
											(1.405)	(1.394)	(1.562)	(1.545)	(1.890)	(2.037)	(1.785)	(1.988)	(2.270)	(2.149)	(2.032)	(2.050)	(2.013)	(1.947)
RVNU												0.075 .	0.319**	0.450***	0.649***	0.761***	0.831***	0.840***	0.900***	0.921***	0.755	0.750	0.768	0.778
												(1.856)	(3.422)	(3.995)	(4.556)	(5.102)	(5.596)	(5.636)	(5.776)	(5.743)	(1.442)	(1.420)	(1.422)	(1.416)
DCGP													-1.953***	-2.668***	-3.108***	-3.474***	-3.683***	-3.745***	-3.999***	-4.103***	-4.191***	-4.234***	-4.225***	-4.206***
													(3.436)	(4.038)	(4.574)	(5.058)	(5.461)	(5.521)	(5.670)	(5.620)	(5.515)	(5.455)	(5.395)	(5.261)
NITA														-0.481 .	-0.667*	-1.039**	-1.032**	-1.015**	-1.237**	-1.245**	-1.156*	-1.114*	-1.135*	-1.149*
														(1.791)	(2.427)	(3.212)	(3.279)	(3.213)	(3.358)	(3.357)	(2.470)	(2.304)	(2.273)	(2.237)
MTCB															-0.150 .	-0.224**	-0.263**	-0.270**	-0.316***	-0.323***	-0.339**	-0.326**	-0.320**	-0.318**
															(1.942)	(2.682)	(3.178)	(3.246)	(3.456)	(3.490)	(3.356)	(3.057)	(2.865)	(2.818)
TDTA																0.722 .	0.912*	13.456	19.649	20.970	20.030	20.286	20.206	20.431
																(1.978)	(2.505)	(0.963)	(1.308)	(1.373)	(1.277)	(1.282)	(1.267)	(1.264)
SATA																	0.845*	0.826*	0.779*	0.760 .	0.748 .	0.774 .	0.758 .	0.770 .
																	(2.199)	(2.144)	(2.018)	(1.950)	(1.902)	(1.925)	(1.840)	(1.816)
NITI																		-12.533	-18.885	-20.232	-19.261	-19.499	-19.420	-19.631
																		(0.898)	(1.253)	(1.320)	(1.223)	(1.228)	(1.212)	(1.210)
PATA																			0.475	0.478	0.466	0.404	0.424	0.419
																			(1.078)	(1.078)	(1.036)	(0.842)	(0.856)	(0.838)
CLRT																				-0.073	-0.087	-0.088	-0.087	-0.087
																				(0.528)	(0.604)	(0.605)	(0.596)	(0.592)
TAST																					0.198	0.187	0.159	0.146
																					(0.345)	(0.323)	(0.265)	(0.238)
M2FE																						-0.095	-0.086	-0.094
																						(0.377)	(0.333)	(0.352)
TLTA																							0.053	0.055
																							(0.197)	(0.203)
CSTE																								0.030
																								(0.138)
									STOP															
R^2	0.664	0.789	0.837	0.872	0.883	0.905	0.916	0.924	0.927	0.931	0.933	0.934	0.945	0.948	0.951	0.954	0.958	0.958	0.959	0.960	0.960	0.960	0.960	0.960
$\bar{R}^2$	0.660	0.783	0.831	0.866	0.876	0.897	0.909	0.916	0.918	0.922	0.923	0.923	0.935	0.937	0.941	0.944	0.947	0.947	0.947	0.947	0.946	0945	0.944	0.943

Source: Author's own calculations

as a percentage of GDP (FDGP), the value of $\bar{R}^2$ rose from 0.783 to 0.831. Again, this improvement in the value of $\bar{R}^2$ duly justified the addition of the new variable. This way, the process was performed iteratively (Table 3). However, after the 9th iteration, although the value of R^2 and $\bar{R}^2$ continued to improve, the statistical significance of the existing variables started to change. However, the same results were obtained in the next iterations. Therefore, in line with the 'principle of parsimony of parameterisation' (Pindyck & Rubinfeld, 1985), we decided to terminate the process after the 9th iteration.

Thus, we were left with a list of nine bank-specific and macro-level determinants, which affected the gross NPA ratio among the Indian banking sector. Furthermore, the non-significance (p = 0.9919) of the Hausman test (χ^2 = 1.9716 at 9 d.f.), the highest value of $\bar{R}^2$ (0.918), and the least value of AIC (−1.900) and BIC (−2.699) were observed to be associated with Nerlove's version of random effects modelling (Table 4), thereby leading us to accept this version to be the most appropriate representation.

Table 4: Hausman Test

	Fixed Effect Model	Random Effect Model		
		Wallace-Hussain's Transformation	Amemiya's Transformation	Nerlove's transformation
R^2	0.929	0.911	0.926	0.927
$R\square^2$	0.917	0.899	0.917	0.918
AIC	−1.793	−1.669	−1.888	−1.900
BIC	−2.531	−2.468	−2.687	−2.699

Source: Author's own calculations.

The estimated model apparently reveals that the most important determinant, which directly affected the gross NPA (GNPAs) ratio among the Indian banking sector, was credit-deposit ratio (CDRT), as did the equity to assets ratio (EQAS), external debt to GDP ratio (EDGP), and total debt to total equity ratio (TDTE). However, the determinants that inversely affected the GNPAs ratio were revenue efficiency (RVNE), return on equity (ROEQ), FDI to GDP ratio (FDGP), average annual rate of growth (ROGR), and return on assets (ROAS). The remaining determinants failed to incite a perceptible effect on the GNPAs ratio.

As hypothesised, an increasing credit to deposit ratio depicts a risk preference of the banks, and is expected to steer higher NPAs; the results revealed the same. Therefore, the 'moral hazard' hypothesis finds full support, depicting that risk taking attitude of the banks is a major boosting factor for increasing NPAs in the Indian banking sector. Further, the equity-to-assets ratio reveals a positive and significant coefficient, which is in line with the 'too big to fail' hypothesis, stating that banks having more capital opt for lenient credit checking and easy lending policies, which ultimately turns into higher NPAs. The results of external debt to GDP (EDGP) ratio are in line with that of the 'sovereign debt' hypothesis, which implies that rising sovereign debt leads to an increase in NPLs, and vice versa. It concludes that reduction in government's public debt will definitely help in lowering the NPAs of the banks. As can be seen from Table 3, borrowings to assets ratio (TDTE) could explain high NPAs in the Indian banking sector, depicting that when the bankers opt for high risk borrowings, they endanger the solvency of the bank, risking its deposits.

While surveying the extant literature and developing the theoretical framework section, it was observed that good quality management is a pre-requisite for monitoring credit, with the purpose of lowering NPAs. For capturing quality of management, we have resorted to cost efficiency as well as revenue efficiency (RVNE). However, the results established that there is no effect of cost efficiency on NPAs in the Indian banking sector. In addition, revenue efficiency outcome of analysis is as envisaged, which reflects that the results are in consonance with that of 'bad management' hypothesis, instead of bad luck or 'skimping' hypothesis. Further, the results established that return on assets (ROAS) negatively affects the NPAs. Higher return on advances reflects that the performance of the banking sector is good, leading it to profitability. Hence, banks should avoid reckless extending of loans for boosting profits, otherwise it would impact the future asset quality of the banks in India by increasing NPAs. Moreover, the negative coefficient of return on equity (ROEQ), which is also a proxy of profitability, depicts that higher profitability (ROEQ) contributes to lower NPAs and proposes that better managed banks have, on average, better quality of assets, validating the 'bad management' hypothesis. As hypothesised, GDP growth ratio signified a negative coefficient, which established that the results are in consonance with that of the literature. Hence, a growth during the study period improved the debt servicing capacity of the borrowers in the Indian banking sector. However, the FDI inflows to GDP ratio signified a negatively significant relation with NPAs, as hypothesised. It concludes that direct capital financing, along with its extra contributions during the study period, proved a boon for the NPAs of the banks in India.

CONCLUSIONS AND IMPLICATIONS

A comprehensive analysis of asset quality in the Indian banking industry is an important part of macro-prudential observation. An exhaustive apprehension of its drivers enables to discern the key vulnerabilities of this industry.

In the study, we found that macroeconomic determinants, particularly GDP growth rate, external debt, and FDI inflows, have a substantial effect on the level of NPAs in the Indian banking industry. Therefore, ameliorating the health of the economy is imperative to reduce NPAs of banks. Furthermore, bank level determinants, viz. revenue efficiency, return on assets, and return on equity, specifically relating to efficiency and performance, hold an added prediction power and support the 'bad management' hypothesis, which indicates that better the quality of management, lower the NPA. Moreover, the positive results of the credit-deposit ratio related to risk preference of the banks depicts that when the credit growth is high, the credit standards probably become low, boosting the NPAs. On the contrary, when this growth is slow, the bank officials have the due time to scrutinise the loan applications, which ultimately results in lower NPAs. So, the positive coefficient of credit-deposit ratio is suggestive of not extending reckless loans to avoid future NPAs.

There are various implications of our findings concerning regulation and policy, particularly, where it is evident that efficiency and performance measures can be the paramount indicators for future NPAs. It is suggested that bank regulators should focus on improving the performance level of the credit department, and on improving the risk management systems to avoid future instability of the bank. These findings also carry macro-prudential policy implications, as the statistically significant macroeconomic variables can be considered while calibrating the effect of economic shocks on the health of the banking system.

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