



An analysis of NPAs of Indian banks: Using a comprehensive framework of 31 financial ratios

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Received 2 February 2016; revised form 23 September 2016; accepted 30 August 2018; Available online 5 September 2018

KEYWORDS

Accounting ratios;
Non-performing asset;
Loan intermediation;
Asset quality;
Cost efficiency;
Capital adequacy;
GMM;
Generalised method of moments

Abstract The study examines panel data for 46 Indian banks with 31 bank specific financial ratios over eight years (2007 to 2014). Together, these ratios reflect operating capability, liquidity, solvency, profitability, capital adequacy and business development capacity aspects across Indian banks that affect non-performing assets (NPAs). The data was analysed using a GMM model that dealt with endogeneity issues present in the data. This model captured NPA with an r-square of 85%. We find a negative significant relationship between intermediation cost ratio, Return on Assets and NPAs. Asset growth, lagged NPAs, and total liabilities by total assets are positively related to NPAs.

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Introduction

Non-performing assets (NPA) are assets that cease to generate income through interest earned on the principal loan amount and the repayment of the principal loan amount. Non-Performing assets are an outcome when the borrower intentionally defaults on the loan payment or is unable to repay the loan due to poor economic conditions affecting his business. In either case, for a bank it means that the loan asset may not be fully recovered or may be only partly recovered. Non-performing assets are a reflection of the bank's overall efficiency while performing its business of converting deposits into loans and recovering these loans. Non-recovery or partial recovery of loans has an impact on the bank's balance sheet and income statement items in the form of reduction in interest earned on loan assets, increase in provision on NPAs, increase in capital

requirement and lower profits. Hence, rising NPAs are a concern for a bank and determinants of NPAs should be identified prior to loans turning into NPAs.

Most academicians have examined NPA determinants, and these determinants are a topic of substantial importance for academia concerned with understanding a bank's management. Previously, academicians such as Berger and DeYoung (1997), Podpiera and Weill (2008), Li et al. (2007) and Breuer (2006) who have investigated determinants of NPAs have focussed on a bank's efficiency (representing operational capability of a bank). The bank's efficiency is studied using a number of bank operational ratios such as operational costs in relation to interest income, net interest income to total assets, and others. These ratios indicated how well the bank used the available resources to generate income, and studies found empirical evidence that lower efficiency and NPAs have a positive relation. Subsequently, academicians such as Salas and Saurina (2002), Sinkey and Greenawalt (1991), Clair (1992), Hess et al. (2009), Borio et al. (2001) and Keeton (1999) have examined loan growth (representing business development

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<https://doi.org/10.1016/j.iimb.2018.08.004>

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capacity of a bank) and its effect on non-performing assets, and found empirical evidence that higher loan growth leads to higher NPAs, i.e., when a bank undertakes aggressive loan growth it may overlook the credit risk undertaken, and these loans may turn into NPAs in the future. A few other authors (such as [Bhatia, Mahajan and Chander, 2012](#)) suggested that bank profitability affected NPAs, and found that NPAs and bank profitability had a negative relationship. However, operational capability, business development capacity and bank profits are not the only three aspects that affect bank NPAs. A bank's capital, solvency and liquidity also affect NPAs. Consequently, these determinants were considered as well by researchers. Academicians such as [Gonzalez-Hermosillo et al. \(1997\)](#) and [Louiz et al. \(2012\)](#) suggested that a well-capitalised bank tends to have lower NPAs as the bank tends to keep credit risk levels at a low while lending to borrowers. Similarly, a bank's level of solvency would mean that a bank would not be able to repay its depositors in case NPAs were high. However, extant research has not considered all these determinants together and analysed their effect on NPAs. We extend the literature on NPAs by considering 31 financial ratios that represent determinants under operational capability, business development capacity, liquidity, capital adequacy, profitability, and solvency of banks; and aim to study the effect of these ratios on NPAs. In this paper, first we attempt to identify the determinants of NPAs across Indian banks prior to their turning into bad loans. Second, we focus on the Indian banking system because it has witnessed an increase in the Gross NPA level from 3% in 2014 to 4% in 2015. Public sector banks that are government owned are largely responsible for the NPA problem with the State Bank of India (SBI) group's gross non-performing assets (GNPA) at 5.17% and other public sector banks' GNPA at 4.13% in 2014. World GNPA to gross loans is at 4.3% in 2015. Although Indian GNPA is lower than the world figure, NPA in Indian banks is on the rise and is higher than emerging nations such as China, Mexico and Brazil that have a GNPA of 1.5%, 2.5% and 3.3% respectively in 2015¹. Their GNPA is lower when compared to Indian banks. The rise in NPAs in Indian banks is owing to the new Reserve Bank of India (RBI) guidelines² that tried to curb the banks' malpractice to defer bad loan recognition. The RBI guidelines treated restructured assets on par with non-performing assets, and the restructured assets attracted a provision similar to NPAs by 2016. These new guidelines would impact the non-performing assets figure and bank earnings. Finally, we attempt to build a model that comprehensively captures non-performing assets using these ratios. The paper uses a panel data set comprising 46 Indian banks (26 public sector and 20 private sector banks) during the period 2007 to 2014. For example, we have analysed the 31 ratios that represent the operational capability, business development capacity, liquidity, capital adequacy and solvency of Indian banks, and find that by using this comprehensive ratio framework, banks are able to identify the ratios that require corrective action and deter NPAs.

¹ World Bank Data, Global Gross NPA ratio annual data, available on the world bank database on the internet at, <http://data.worldbank.org/indicator/FB.AST.NPER.ZS>, accessed on 20 August 2016

² Review of Prudential Guidelines on Restructuring of Advances by Banks and Financial Institutions, RBI circular issued on 30 May 2013 circular number RBI/2012-13/514 DBOD.BP.BC.No.99/21.04.132/2012-13, available on the RBI website at, <https://www.rbi.org.in/scripts/NotificationUser.aspx?id=8008&Mode=0>, accessed on 10 January 2016.

The argument of this paper is presented as follows: Previous studies in the second section, followed by data sources and data preparation in the third section. Methodology is described in the fourth section and empirical results are presented in the fifth section. Discussion and analysis in the sixth section, are followed by a summary and conclusion in the concluding, seventh section.

Previous studies

Previous studies have focussed on studying determinants such as bank efficiency, business development capacity, bank profitability, bank solvency, bank capital and their effect on NPAs. Most researchers such as [Berger and DeYoung, 1997](#); [Drake and Hall, 2003](#); [Podpiera and Weill, 2008](#); [Li et al., 2007](#) and [Breuer, 2006](#) suggested that bank efficiency represented the ability of the bank management to align bank processes to ensure smooth credit generation using manpower and technology resources according to the bank's vision coupled with the ability to deliver the credit generation process effectively and efficiently. Efficiency in the bank process was indicated through various ratios such as cost income, loan to deposit ratio and loan to expense ratios. Research studies found empirical evidence that a negative relationship existed between efficiency (that indicated operational capability) and NPAs (see [Barr and Siems, 1997](#); [Martin, 1977](#); [Hanweck, 1977](#); [Pantalone and Platt, 1987](#); [Karim, Chan and Hassan, 2010](#); [Kwan, 2006](#)).

Subsequently, researchers started to explore how loan growth affected NPAs. They found that banks with a high loan growth rate had higher NPAs. Loan growth represented a bank's business development capacity. These studies suggested that banks that followed an aggressive loan growth often overlooked the credit risk undertaken while lending. Hence high loan growth resulted in higher NPAs (see [Salas and Saurina, 2002](#); [Sinkey and Greenawalt, 1991](#); [Clair, 1992](#); [Hess et al., 2009](#); [Borie et al., 2001](#); [Keeton, 1999](#)).

Thereafter, academicians found that a high level of NPAs was not only affected by bank efficiency and loan growth but also by the bank capital. Banks with higher bank capital were less inclined to undertake more credit risk. This meant that a bank with a huge amount of capital had a high loss absorption capacity. Academicians found that a higher capital ratio of a bank meant lower NPAs (see [Das and Ghosh, 2006](#); [Mester, 1996](#); [Rajaraman, Bhaumik and Bhatia, 1999](#); [Khemraj and Pasha, 2009](#); and [Greenidge and Grosvenor, 2010](#)).

Another strand of research threw up a mixed response while establishing the relation between bank solvency and NPAs. Researchers suggested that a financially healthy bank would have assets worth more than liabilities. But when the liabilities surpass the assets the bank resorts to its capital for loss absorption. But if depositors start withdrawing their deposits the bank's solvency is affected (see [Stern and Feldman, 2004](#); [Boyd and Gertler, 1994](#); and [Ennis and Malek, 2005](#)). Increased bank capital leverage would mean that the bank would have to bear more expenses in the form of interest on debt. A high NPA already means higher NPA provisions. On one hand, this would increase the expenses borne by a bank in the form of interest on debt and higher provision on NPAs, and on the other interest earned is reduced owing to NPAs. High NPAs would reduce the bank profits (see [Rajaraman, Bhaumik and Bhatia, 1999](#); [Louiz et al., 2012](#); and [Mester, 1996](#)).

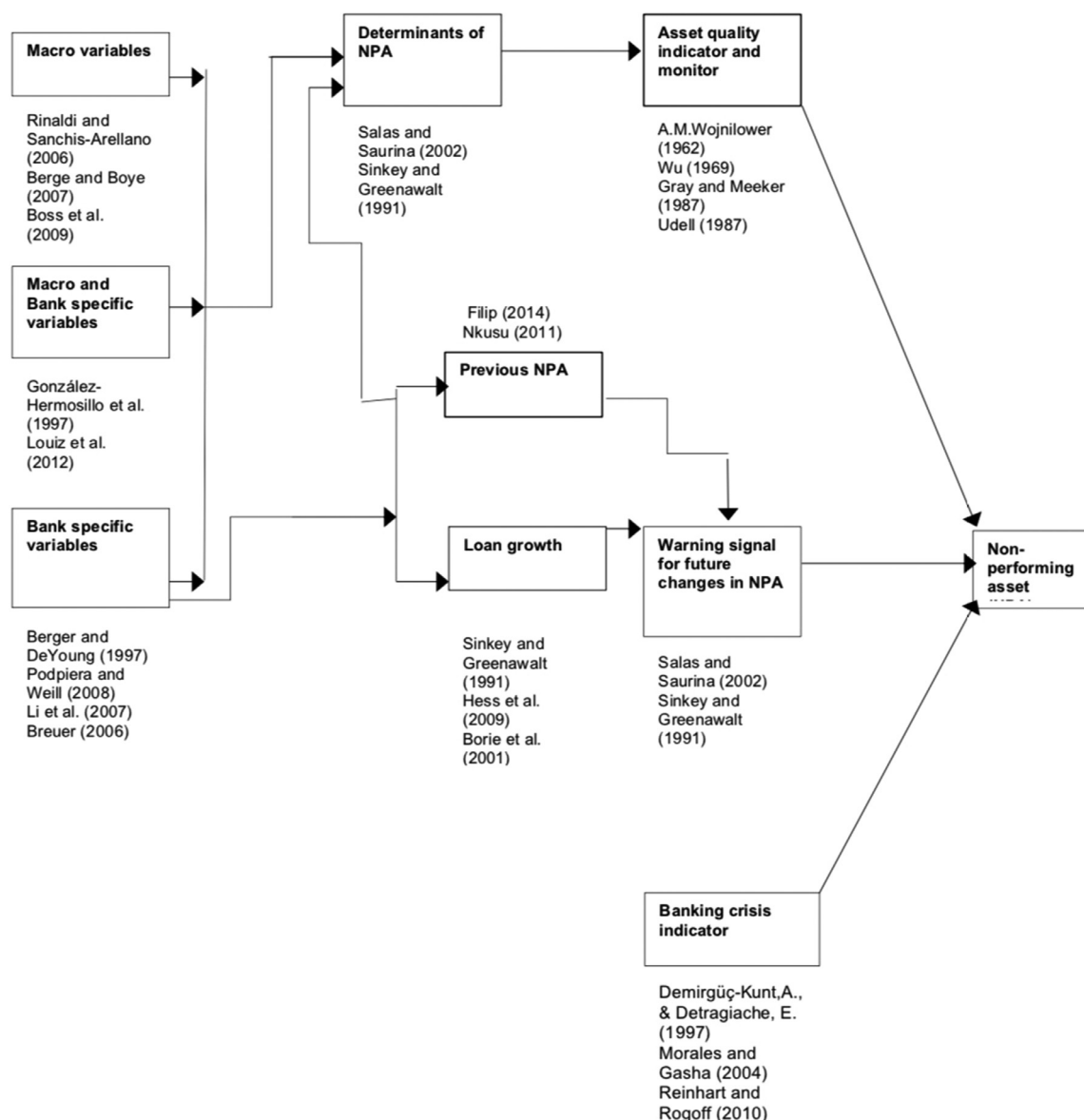


Figure 1 Schematic diagram of NPA literature review. This figure presents a schematic diagram of the theoretical linkages between the variables that affect NPAs. Macro and bank specific variables lead to NPAs.

Research in the area of NPA has considered the individual impact of operational capability, solvency and profitability on NPAs. However, the possibility of exploring the impact of these together on NPAs has not been considered as of now. We extend the literature in the area of NPAs by creating a comprehensive framework where we explore the impact of operational capability, liquidity, business development capacity, solvency, capital adequacy and profitability on NPAs using a sample of 46 Indian banks. Figure 1 provides a schematic diagram of the NPA literature review.

Data sources and preparation

The Indian banking system comprises 26 public sector banks, 20 private sector banks, 43 foreign banks and 51

urban cooperative banks. In this study we have used a sample of 46 public and private sector Indian banks, where “i” represents the bank $i=\{1,\dots,46\}$. These 46 banks constitute more than 85% of lending and deposit business across India, whereas the 43 foreign banks³ and 51 urban co-operative banks contribute to less than 15% of lending and deposit business. Leading urban co-operative banks

³ The 43 Foreign banks operate through presence of branches in India and operate as a representative unit in India for the parent banks. These banks are locally incorporated and there is a complete delineation between assets and liabilities of the parent bank and the domestic bank. Local incorporation and delineation of assets and liabilities of the representative unit help protect depositors’ money and support greater regulatory control. Citibank and Standard Chartered lead the foreign bank group according to asset size.

such as Saraswat Co-operative Bank, Cosmos Co-operative Bank and Shamrao Vithal Co-operative Bank form less than 1% of the total lending business⁴.

Public sector banks are characterised by a majority equity stake (more than 50%) owned by the Government of India, and State Bank of India is the largest public sector bank according to asset size. Public sector banks include State Bank of India (SBI and its five subsidiaries) Bank of Baroda, Bank of India, Punjab National Bank and others. Among 20 private sector banks, Industrial Credit Investment Corporation of India (ICICI) Bank and Housing Development Finance Corporation (HDFC) Bank lead this group according to asset size. Other private sector banks included in the study were Axis Bank and Kotak Mahindra Bank among others.

Annual data in the form of standardised ratios for 46 public and private sector banks was obtained from the statistical tables relating to Banks in India⁵ (2007 to 2014) - Reserve bank of India (Central bank, regulatory and monitoring authority for banks operating across India) database for the study period "t", where $t = \{2007, \dots, 2014\}$. Data prior to the year 2007 was not considered because Indian banks were undergoing reforms, and a part of the reform was to achieve the NPA target level of less than 5% of total assets. This might have resulted in misleading results. Similarly, during the year 2008, the Government of India had announced and implemented a farm waiver scheme within 30 days that resulted into write-off loans worth INR 660 billion benefiting 36.6 million farmers⁶. Bank of India, a bank in our sample study, had written off INR 10.04 billion in relation to farm debt write-off. However, the loan waiver did not impact the bank's ratios as it was waived off in stages, and the total impact was not sudden on the bank's balance sheet. A total of 31 ratios was considered for the study with the first 24 ratios extracted from statistical tables titled Selected Ratios of Commercial Banks⁷, and the other seven ratios calculated using bank balance sheets and income statement figures featuring in the above mentioned database. We denote the bank ratio as, "X" represents the bank ratio, where $X = \{1, \dots, 31\}$. A major reason for using the ratio form was to regulate for size effect on explanatory variables under study. Another reason for using ratios was to hold constant additional factors such as sectoral characteristics that might affect a bank's performance by noting variation in

earnings based financial ratios such as return on assets (ROA) (See: Lev and Sunder, 1979; Berg et.al, 1991; Berg et. al., 1993; Ferrier and Lovell, 1990 and Fucuyama, 1993). The 31 ratios selected and mentioned in Table 1 represent either operational capability or liquidity or solvency or capital adequacy or profitability or business development capacity of a bank (See Geng et al., 2015).

Each of these 31 ratios mentioned in Table 1 is selected based on a theoretical framework presented in Figure 2, and an explanation of the relation of each ratio with NPAs follows.

In Figure 2, we find that liquidity, operational capability, solvency, capital adequacy, business development capacity and profitability parameters of a bank affect NPAs.

We begin with describing how the first parameter, liquidity, affects NPAs and subsequently explain how the other ratios under operational capability, solvency, capital adequacy, business development capacity and profitability affect NPAs.

Figure 2 presents the theoretical linkage between the various determinants that lead to NPAs.

1. **Liquidity:** Liquidity is represented through cash to deposit ratio. When the NPA level increases, the cash level is likely to decrease as the borrower is unable to repay loan interest and principal. This will likely create a temporary shortage of cash and the bank will have to approach alternate sources to improve liquidity. This ratio will have a negative relationship with NPA. As NPAs reduce, liquidity improves.
2. **Operational capability:** The second parameter that affects NPAs is operational capability (OC). Operational capability refers to the ability of the bank to efficiently manage its resources. The OC is represented through 22 bank ratios.

Each ratio that represents operational capability has a negative or a positive relation with NPAs. We briefly explain below how these ratios affect NPAs.

- First we explain how the credit deposit ratio affects NPAs. Credit is extended out of bank deposits. When an asset stops generating income in the form of principal payments, the principal that is extended from deposits is not recovered. This reduces the deposit base by the amount unrecovered. So the ratio of credit to deposits will reduce. This ratio represents the bank's ability to make optimal use of available resources and convert deposit into loans. Hence, high NPAs reduce the deposit base and affect the credit generation capacity. (See: S. Fries and A. Taci, 2005)
- Second, expense to revenue ratio is used as an indicator of how the bank spends to earn interest on loan assets. The generation of Interest on loan assets ceases when NPAs are registered. However, the expenses increase in terms of interest paid on deposits and provision on loan losses. Hence, this ratio decreases when NPAs increase. Expenses and NPAs tend to have a negative relation (See Halkos and Salamouris, 2004). The intermediation cost to total assets ratio (also referred to as an intermediation cost ratio) represents the loan monitoring capability of the bank agents (See: Diamond, 1984). According to

⁴ The Hindu Business Line, Urban Co-operative banks in India, available on the internet at, <http://www.thehindubusinessline.com/money-and-banking/top-urban-coop-banks-set-to-expand-area-of-operations/article2085298.ece>, accessed on 25 August 2016

⁵ Statistical Tables Relating to Banks are available on the Reserve Bank of India website, <https://dbie.rbi.org.in/DBIE/dbie.rbi?site=publications>, accessed on 16 February 2018

⁶ Of the INR66,000 crore, 50% of the loan write-offs were conducted across Regional Rural Banks and Cooperative banks http://wap.business-standard.com/article/finance/co-op-banks-seek-rate-cut-to-boost-farm-lending-108101501075_1.html, <http://www.thehindu.com/todays-paper/tp-national/tp-tamilnadu/banking-sector-quite-safe-chidambaram/article1342566.ece>, http://articles.economictimes.indiatimes.com/2012-03-01/news/31113521_1_debt-waiver-loan-waiver-agricultural-loans, accessed on 10th May 2015

⁷ Ratio definitions are available at Reserve Bank of India (RBI) website, <https://rbi.org.in/scripts/PublicationsView.aspx?id=15466>, accessed on 10th May 2015

Table 1 Explanatory variables and dependent variables. Table 1 presents the ratios examined under the study. Column 1 reports the variable number, column 2 the variable head and column 3 the ratio under study. This table presents the 31 independent ratios and one dependent ratio.

| Variable | Classification | Ratio definition |
|-----------|-------------------------------|--|
| Dependent | NNPA | Net NPA to Net advances |
| LIQ1 | Liquidity | Cash-Deposit ratio |
| OC1 | Operational capability | Credit-Deposit ratio |
| OC2 | Operational capability | Investment-Deposit ratio |
| OC3 | Operational capability | Ratio of deposits to total liabilities |
| OC4 | Operational capability | Ratio of demand & savings bank deposits to total deposits |
| OC7 | Operational capability | Ratio of secured advances to total advances |
| OC8 | Operational capability | Ratio of investments in non-approved securities to total investments |
| OC9 | Operational capability | Ratio of interest income to total assets |
| OC10 | Operational capability | Ratio of net interest income to total assets (Net Interest Margin) |
| OC11 | Operational capability | Ratio of non-interest income to total assets |
| OC12 | Operational capability | Ratio of intermediation cost to total assets |
| OC13 | Operational capability | Ratio of wage bills to intermediation cost |
| OC14 | Operational capability | Ratio of wage bills to total expense |
| OC15 | Operational capability | Ratio of wage bills to total income |
| OC16 | Operational capability | Ratio of burden to total assets |
| OC17 | Operational capability | Ratio of burden to interest income |
| OC18 | Operational capability | Ratio of operating profits to total assets |
| OC19 | Operational capability | Business per employee |
| OC20 | Operational capability | Profit per employee |
| OC21 | Operational capability | Operating expenses/Operating income |
| OC22 | Operational capability | Lag of NNPA |
| CA1 | Capital adequacy | Tier 1 Basel II |
| CA2 | Capital adequacy | Tier 2 Basel II |
| CA3 | Capital adequacy | Owned cap/Total assets |
| P1 | Profitability | ROA (return on assets) |
| P2 | Profitability | Lag of ROA |
| S1 | Solvency | Total liabilities/Total assets*size |
| S2 | Solvency | Total liabilities/Total share capital |
| BDC1 | Business development capacity | Business income this year/Last year business income |
| BDC2 | Business development capacity | Total assets this year/Total assets in the last year |

Source: Compiled by authors; CA1 - We have considered Basel II capital adequacy ratios since the Basel III capital norms are under the process of implementation across Indian scheduled commercial banks.

RBI, Intermediation cost is the total operating expenses for a bank as it represents the total cost involved for lending. This ratio is calculated using the total operating expenses to total assets¹.

- Third, when a bank has a higher proportion of secured assets, the bank has a safety net to fall back on in case an asset becomes an NPA. If a loan asset becomes an NPA, the bank has the option to recover the amount through liquidation of the security pledged. This reduces the possibility of a bank losing the entire amount in case of a secured asset (Berger and Udell 1990, 1995; Jimenez et al., 2006). This implies that when a higher portion of the loan assets are secured, banks have a lesser risk of losing the entire amount in case of loan default. Hence, NPA and secured assets should be negatively related.
- Fourth, a bank's operational capability using the non-interest income ratio was to serve as indicator of the bank's diversification. If a bank was well-diversified, the bank protected itself from the downside of loan assets going bad. There is a negative relation between

non-interest income and NPAs. (See Salas and Saurina, 2002; Hu et al., 2004 and Rajan and Dahl, 2003)

- Fifth, net interest income to total assets. Net Interest income is the interest income earned on loan assets minus the interest expense paid on deposits. This represents the income a bank earns from its core bank lending business. When a loan asset becomes an NPA, the interest earned reduces, while the bank has to still pay interest on deposits. The net interest income earned in case of NPA reduces. Hence, NPA and net interest income have a negative relation. Similarly, interest income and total assets also have a similar negative relation with NPAs. (See Sensarma and Ghosh, 2004)
 - Sixth, under operational capability, Filip (2014), Espinoza and Prasad (2010) and Nkusu (2011) explored the relation between NPA and NPA lags. These authors suggested that past NPAs are indicative of future NPAs, hence they serve as an important indicator of NPAs.
3. **Capital adequacy:** Capital adequacy is a tool to control excessive risk taking by banks to prevent them from

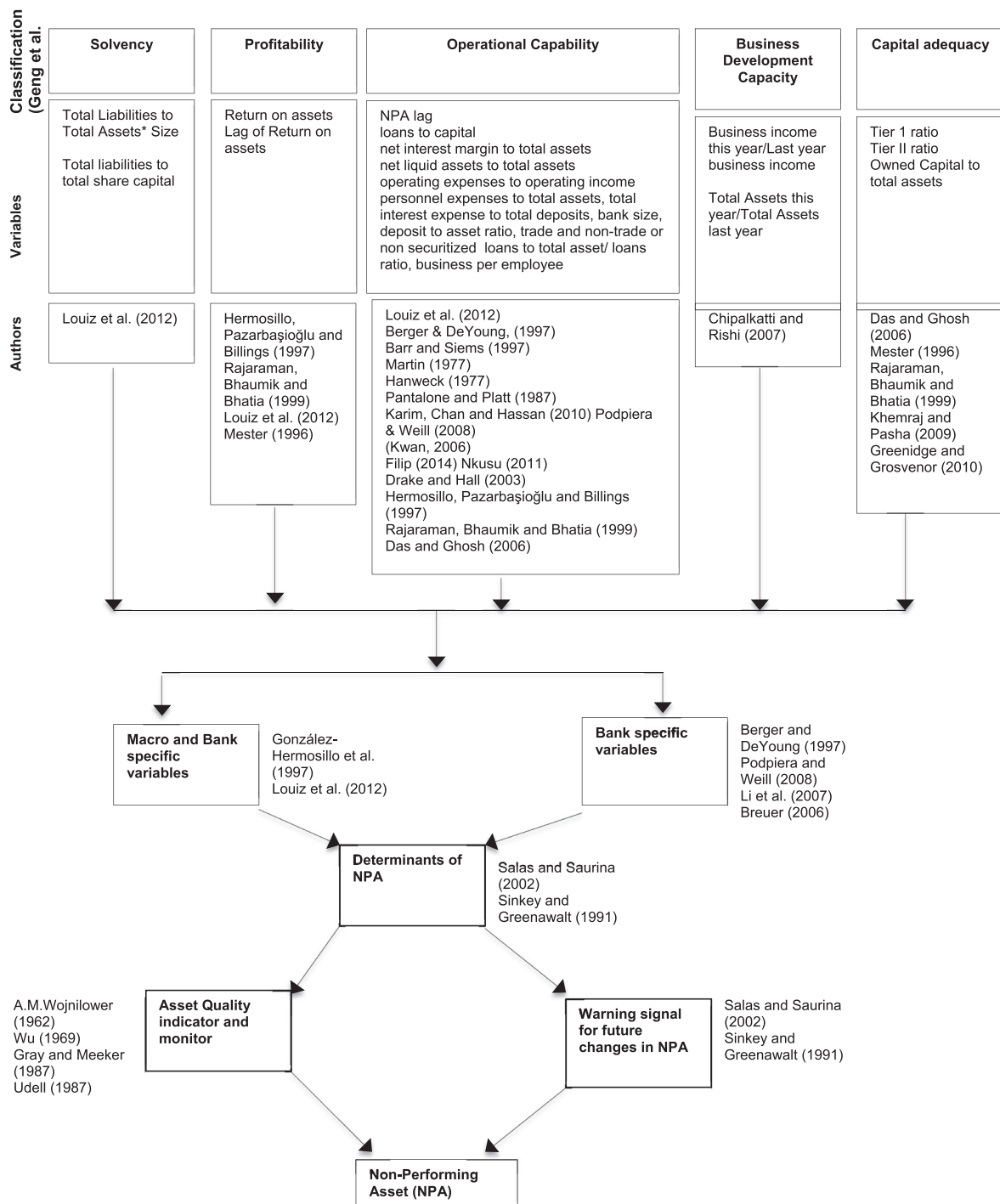


Figure 2 Theoretical framework for selection of variables.

becoming insolvent through capitalisation. When there is a large portion of owned capital in the total bank capital structure, the managers of the bank have more incentive to follow the owner(s) objectives. This curbs the risk undertaking behaviour of the managers to a certain extent. Hence, when owned capital is high the NPA level will be lower. There exists a negative relation between them (See Altunbas, Evans, & Molyneux, 2001).

When NPAs are high, there is a higher loan loss provision to be maintained, hence the portion of Tier 2 capital is

increased. The bank's capital requirements increase when the NPAs are high. So, there exists a positive relation between the two. (See Mester, 1996; Hermosillo, Pazarbaşıoğlu and Billings, 1997; Rajaraman, Bhaumik and Bhatia, 1999; Rajaraman and Vasishtha, 2002; Ghosh, 2005; Das and Ghosh, 2006; and Khemraj and Pasha, 2009)

4. **Solvency:** When the loan assets stop generating income, the bank assets start witnessing a decrease in their value. Gradually, if the loan assets discontinue to generate income, the value of liabilities surpasses the value of

assets. First, the bank resorts to bank capital for this loan loss absorption; thereafter to fulfil the capital requirements, banks have to approach the market to raise capital. Banks raise debt or equity to meet the capital requirements. Hence, their solvency ratios are adversely affected when NPAs are high.

5. **Profitability:** Returns on assets ratio is the net income (profits) generated by the bank on its total assets (including fixed assets). Fixed assets of Indian banks form less than 1% of the total bank assets worth INR 123,148 billion (According to RBI Statistical Database as on 31 March 2014 that include Public and Private Sector Banks). The higher the portion of income generating assets among total bank assets, the higher would be the likelihood of the bank earning interest income. Income generating assets of a bank form more than 90% of the bank's total assets. Income generating assets for a bank are usually Loan assets, investments, foreign currency assets and cash balances with other banks. When NPAs increase, interest earned reduces, and hence ROA declines. Hence, NPAs and ROA have a negative relation.

Dependent variable

Gross and net non-performing assets are both measures of a bank's bad loans. Gross non-performing asset is the amount that is outstanding in the books irrespective of interest recorded and debited. Net non-performing asset is gross non-performing asset minus interest debited to borrowal account, and not recorded or recovered as income. The technical definition of Net NPA according to the Reserve Bank of India is Gross NPA less (Balance in interest suspense account + DICGC/ECGC claims received and held pending adjustment + part payment received and kept in suspense account + total provisions held) (<https://www.rbi.org.in/scripts/glossary.aspx>). The dependent variable considered in this study is NNPA defined as Net NPA to Net advances. The reason behind selecting NNPA is that it does not include the provisions for loan losses. Indian banks have been under-reporting the loan loss provisions using the restructured asset window. The NNPA is the actual default on loans after all the adjustments (See Berger and DeYoung, 1997; Rajaraman, Bhaumik and Bhatia, 1999; and Rajaraman and Vasishtha, 2002). Hence, in the Indian context NNPA would be an apt measure for the dependent variable.

Methodology

Using the variables explained above, we establish a base regression model that indicates the relationship between NNPA and its determinants.

Net NPA has a:

- Negative relation with operational capability
- Negative relation with capital adequacy
- Negative relation with profitability
- Negative relation with solvency
- Negative relation with liquidity

The data consists of 46 scheduled commercial banks in India covering a span of eight years from 2007 to 2014 with

31 variables as given in Table 1. We use the panel data technique that allows for control of individual heterogeneity that we cannot observe or measure like bank management decisions or bank practices followed by an individual bank or bank regulations that change over time. Individual heterogeneity would result in biased results if a simple regression technique were used to model the data. We analysed the data using a fixed effect and a random effect model. However, to check the suitability of the model, a Hausman test was used to confirm which model was more apt for the given dataset, under which the chi-square statistic was 30.78 with degrees of freedom = 12 and a p-value of 0.0021. This test statistic helped us reject the null hypothesis that random-effects model was appropriate. The Hausman tests rejects the null hypothesis (Ho: Random effect model is suitable due to higher efficiency and consistent estimators) and therefore, the fixed effect model was set up. However, the independent variables included a lagged dependent variable such as lag of NNPA and a lag of ROA. This presented an endogeneity issue while building the model. Since we have included the lagged dependent variable and a lagged variable as an explanatory variable, owing to this, strict exogeneity of the regressors no longer holds. The fixed effect model could not address the endogeneity issue in the data. To resolve this we consider another model that covers the dynamic feature of the panel data regression model. This prevents us from implementing the standard least square estimators that would prove to have a bias and would be inconsistent. Inconsistency would be a result of a correlation that would exist between the unobserved effect (η_i) and the lagged dependent variable. Hence, we opt for a two-stage least square generalised method of moments (GMM) that deals with the endogeneity issue. The subsequent three subsections give the details of the methodology used in this study.

Fixed-effect model

The fixed-effect model is used to study how an individual bank's heterogeneity differs across banks. However, this model assumes that the individual bank's heterogeneity would be held constant (also referred to as fixed-effect) across an eight-year period for each individual bank. This means that changes in NNPA may occur due to influences other than these fixed-effects, and may also depend on financial ratios of each individual bank. Under the fixed-effect model, all the regression coefficients are restricted to be the same across the individual banks over the time periods.

We run a fixed-effect panel regression of the form in equation 1 using 31 variables: (Woolridge, 2010)

$$Y_{i,t} = C + X_{i,t}\beta + \eta_i + \varepsilon_{i,t} \quad (1)$$

Where,

$Y_{i,t}$ is the Net NPL to Net Advances ratio $NNPA_{i,t}$, for i -th bank where $i=1, \dots, 46$ and t -th year where $t=1, \dots, 8$

C is the common intercept,

$X_{i,t}$ is the bank financial ratios for i -th bank where $i=1, \dots, 46$ and t -th year where $t=1, \dots, 8$

η_i is the fixed-effect for the i -th bank; $i=1, \dots, 46$, also referred to as the unobserved effect

$\varepsilon_{i,t}$ is the error term for i -th bank and t -th year, and also referred to as the idiosyncratic error
 β is a vector of model parameters.

Where, C is the common intercept, β s are parameters, i and t denote cross-section and time indicators, respectively. Under the fixed-effect model we control for the heterogeneity of i -th bank and assume that i -th bank's heterogeneity remains constant over time and is arbitrarily correlated with i -th bank's independent variables.

Random-effect model

Under the random-effect model, the co-efficient represents average change within units. The general structure for estimation of the random-effect model is specified in [equation 2: \(Woolridge, 2010\)](#)

$$Y_{i,t} = C + X_{i,t}\beta + (\eta_i + \varepsilon_{i,t}) \quad (2)$$

Where,

$Y_{i,t}$ is the Net NPA to Net Advances ratio $NNPA_{i,t}$, for i -th bank where $i=1, \dots, 46$ and t -th year where $t=1, \dots, 8$
 C is the common intercept,
 $X_{i,t}$ is the financial ratios, for i -th bank where $i=1, \dots, 46$ and t -th year where $t=1, \dots, 8$
 η_i is the random-effect, for the i -th bank $i=1 \dots 46$
 $\varepsilon_{i,t}$ is within entity error term, for the i -th bank where $i=1, \dots, 46$ and t -th year where $t=1, \dots, 8$
 β is a vector of model parameters.

The term η_i is the bank specific random-effect. It measures the difference between the average financial ratios of i -th bank and the average financial ratios of the whole bank dataset. The term $\varepsilon_{i,t}$ is the deviation between the financial ratio of the i -th bank at time t and the average of the same financial ratio of the i -th bank. Again this is regarded as random because there is a random selection of banks within the bank dataset. This model does not assume that i -th bank's heterogeneity remains constant. A shortfall of this method is that it assumes no correlation between i -th bank effect and the explanatory variables. This may lead to inconsistent estimation.

However, random-effect uses the de-meaning mechanism (subtracting the sample mean from each observation so that they are mean zero) under which the sum of squares difference within banks (within groups) and the sum of squares difference between banks (between groups) is considered. This method helps one make inferences about the population from which the sample is selected, and looks at what effect the difference across entities has on the dependent variable.

Generalised method of moments (GMM)

In order to deal with the exogeneity problem introduced by the lagged dependent variable and the lagged return on assets, we have used the [Arellano-Bond \(1991\)](#) two-step generalised method of moments approach to resolve errors and biases. With numerous panels and limited periods and with the assumption that no correlation exists in

idiosyncratic errors $\varepsilon_{i,t}$, this GMM estimator eliminates the panel specific heterogeneity by conducting the first difference of the regression equation. We calculate robust standard errors with reference to serial correlation ([Arellano, 1987; White, 1980](#)). We select the "White period" as the Co-efficient covariance method with no degrees of freedom. Thereafter, it uses lags of the endogenous variables and the first differences of the exogenous variables as instruments.

The model specification under the GMM approach is specified in [equation 3:](#)

$$Y_{it} = \gamma Y_{i,t-1} + \beta' X_{it} + \rho' Z_i + \alpha_i + \varepsilon_{i,t} \quad (3)$$

Where, $i = 1, \dots, 46$ and $t = 1, \dots, 8$

$Y_{i,t}$ is the Net NPA to Net Advances ratio $NNPA_{i,t}$, for i -th bank where $i = 1, \dots, 46$ and t -th year where $t = 1, \dots, 8$

α_i = the unobserved individual bank effect for the i -th bank $i = 1, \dots, 46$

X_{it} financial ratios of banks for the i -th bank $i = 1, \dots, 46$ and across t , $t = 1, \dots, 8$

Z_i a vector of K_2 time-invariant explanatory variables

ε_{it} error term with $E(\varepsilon_{it}) = 0$ and $E(\varepsilon_{it}\varepsilon_{js}) = \sigma_\varepsilon^2$ if $j = s$ and $t = s$ and $E(\varepsilon_{it}\varepsilon_{js}) = 0$ otherwise.

We assume that $E(\alpha_i) = 0$ $E(\alpha_i X_{it}) = 0$

Under the GMM estimation, we consider two-stage least square model with cross section weights. GMM estimation begins with the assumption that there are set of L moment conditions that the K dimensional parameters of interest, β should satisfy. These moment conditions are usually quite general. However, a particular model may have more specified moment conditions than parameters to be estimated. Thus the vector of $L \geq K$ moment conditions may be written as: $E(m(y_t, \beta)) = 0$. We confine our attention to the moment conditions that is written as an orthogonality condition between the residuals of the equation $u_t \beta = u(y_t, X_t, \beta)$ and a set of K instruments Z_t . $E(Z_t u_t(\beta)) = 0$. (β), which in the linear case are the regressors. $u_t(\beta)$ = the residuals from a linear specification so that, $u_t(\beta) = y_t - X_t' \beta$.

β is the GMM estimate that minimizes the sample moment $m_t(\beta)$ is as close to zero where the moment conditions are greater than the parameters. The equation for the estimate is defined using a quadratic form: $J(\beta, W_T) = T m_t(\beta)' W_T^{-1} m_t(\beta) = \frac{1}{T} u(\beta)' Z W_T^{-1} Z' u(\beta)$ as a measure of distance. W_T = weighting matrix since it acts to weight the various moment conditions in constructing the distance measure. The GMM estimate is β that minimizes the measure of distance.

Under GMM, $u_t(\beta)$ are residuals from a linear specification on $u_t(\beta) = y_t - X_t' \beta$. The objective function of the GMM is given by $J(\beta, W_T) = \frac{1}{T} (y - X\beta)' Z W_T^{-1} Z' (y - X\beta)$. The GMM estimator provides a unique solution $\theta = (X' Z W_T^{-1} Z' X)^{-1} X' Z W_T^{-1} Z' y$. The two-stage least squares objective is simply the GMM objective function multiplied by $\hat{\sigma}^2$ using weighting matrix $W_T = (\hat{\sigma}^2 \frac{ZZ'}{T})$. Ordinary least squares is equivalent to two-stage least squares objective with the instruments set equal to the derivatives of u_t . The details about GMM estimates and objective function are available on the internet and the Eviews website.

Under cross-section weights, feasible generalised least squares (FGLS) are specified assuming the presence of cross-section heteroscedasticity. Please refer to Eviews website for more details.

The GMM dealt with the endogeneity issue in the data. We present the results for the model using the GMM estimates obtained under two-stage least squares (2SLS) in the subsequent section.

Empirical results and comparative assessment

The data is represented in a balanced panel format for 31 ratios over the period 2007 to 2014 for 46 scheduled commercial banks (26 public sector banks and 20 private sector banks), and as there is no structural break in the data for the selected period using the F statistics, we ran the Chow structural break test (See: [Chow, 1960](#)) for 46 banks for each of the 31 ratios across the period 2007 to 2014. We accept the null hypothesis under the test that no break exists at specified break points.

Initially a regression was run with all 31 variables with 46 scheduled commercial banks (SCB) that covered data from 2007 to 2014. Insignificant variables based on p-value of 5% were eliminated. If an insignificant variable was retained in the model, the significant variables could suffer from loss in the variance in the estimator (See [Woolridge, 2015](#)). Hence, an insignificant variable with the highest p-value was eliminated first. Thereafter, elimination of the subsequent insignificant variables was undertaken to arrive at a parsimonious model. The significance level was set at 5%. After 21 runs, 10 variables under the GMM (Two Stage Least Square - 2SLS) model appeared significant. [Table 2](#) provides the list of significant variables and result using the GMM (2SLS).

The purpose of the paper was to identify and analyse the determinants of NPAs and build a model that captures non-performing assets using the [Geng et al. \(2015\)](#) comprehensive framework. The GMM approach allows some regressors to be correlated with the unobserved effect and the

disturbance terms, but instruments are strictly exogeneous with respect to the disturbances and the unobserved effect. The GMM model under the two-stage least square with cross-section weighting matrix provides the best results and shows an improvement in the explanatory power, reduction in the sum of residual squares and standard errors.

Under the GMM (2SLS) cross-section weight model, the explanatory power was at 85.9%. The dynamic model resolves the issue of endogeneity faced due to the presence of lagged dependent variable considered under the model. The co-efficient for non-interest income to total assets and intermediation cost to total assets were significant under the GMM model. The non-interest income, business per employee, total assets_t to total assets_{t-1} and return on assets were significant. Non-interest income signified diversification of the bank business. The coefficient that this variable had was positive. This signified that a bank which focussed more on diversified banking services overlooked their basic banking services. Hence, a focus on bank diversification would lead to higher NPAs. This was contrary to the literature. Intermediation cost carried the required negative sign on the co-efficient as this represented the bank's operating capability. A bank that would spend more on loan monitoring would incur lower NPAs. Business per employee represented the business each employee contributed to a bank. The higher the business per employee, the lower the NPAs as it reflected the banks operational capability in terms of generating income in the form of interest received. Return on assets reflected the profitability of a bank and carried the negative sign that was in line with theory. When an NPA is about to be recognised the loan asset stops generating income in the form of interest income and an increase in the expenses is incurred. Hence, the profit generated by a bank tends to reduce. Growth of total assets is representative of the business development capacity of a bank. This carries a negative sign in line with the theory that aggressive asset

Table 2 Panel data regression results for 46 banks, dependent variable NNPA. Table 2 presents the results estimated using the GMM econometric technique. The first column reports the variables that appeared significant under the techniques. The second column presents the ratio definition. The third column reports the coefficients under the GMM technique used to model NNPA.

| Variable | Ratio definition | GMM (2SLS) |
|-------------------------------|--|------------|
| C | Common Intercept | 2.6274 |
| OC10 | Ratio of net interest income to total assets (Net Interest Margin) | - |
| OC11 | Ratio of non-interest income to total assets | 9.4283 |
| OC12 | Ratio of intermediation cost to total assets | -9.7668 |
| OC16 | Ratio of burden to total assets | 10.6645 |
| OC17 | Ratio of burden to interest income | -0.0940 |
| OC19 | Business per employee | -0.0002 |
| OC20 | Profit per employee | -1.1967 |
| P1 | Return On Assets | -0.4334 |
| S1 | Total Liabilities/Total Assets*Size | 0.4375 |
| BDC2 | Total Assets this year/Total Assets last year | 0.3742 |
| OC22 | Lag of NNPA | 2.6274 |
| P2 | Lag of Return On Assets | - |
| R-squared | | 0.8598 |
| Adjusted R-squared | | 0.8356 |
| Standard errors of regression | | 0.4584 |
| Sum of squared residuals | | 65.7824 |

Source: Compiled by authors

growth leads to higher NPAs. The Indian banks had an average total asset ratio of current year to past year total assets of more than 100%. This reflected the aggressive asset growth followed by Indian banks. Higher past NPAs were an indication to higher future NPAs. This served as an indication that if a bank's past NPA level was high, the future NPAs would also tend to remain high. Burden to total income had the required negative sign as burden represented the non-interest expenses. A higher burden would lead to lower NPAs. This also represented the operational capability aspect of a bank. Past profits had a positive relation with NPAs. When previous profits are high, the bank management tends to ensure that these high levels of profits are maintained. As a consequence, a bank tends to extend riskier loans that earn high profits.

Capital adequacy did not appear to be significant as Indian banks are well-capitalised and have a ratio well above the prescribed 9%. Well-capitalised banks tend to undertake risk-averse lending. Keeton & Morris, 1987; Klein, 2013 and Salas & Saurina, 2002 suggest that well-capitalised banks tend to take lower risks and hence have lower NPAs. Similarly, solvency that was represented through total liabilities to total assets was significant; this ratio had a positive relation with NPA in line with literature. The ratio represented the leverage undertaken by a bank - the higher the leverage of a bank the higher the NPAs. Liquidity did not form a significant determinant under the Indian banking system as the RBI closely monitors the banks' lending and cash base maintained by an Indian bank. The RBI has laid down the exposure that a bank can undertake while lending to a borrower. The RBI also makes Indian banks maintain a 4% cash reserve ratio (CRR) and 21% statutory liquidity ratio (SLR) with it⁸. Hence, the strict and regular monitoring protects banks from the downside of a liquidity crisis.

Discussion and analysis

The first unique point in our study is that unlike previous studies, we have used a bank's operating, liquidity, solvency, profitability, capital adequacy and business development capacity together to identify the determinants affecting NPAs in the Indian banking system.

Secondly, unlike previous studies we looked at the financial intermediation literature and the information production role of intermediaries to explain the relationship between intermediation cost ratio and non-performing assets. Traditionally, a financial intermediary plays the vital role of information creation and information provision in the process of conversion of deposit to loans and vice-versa. The depositors do not have the time, expertise and bandwidth to monitor the loans given to various bank borrowers. Owing to this limitation, financial intermediaries serve as "delegated monitors" and act on behalf of the depositor. Financial intermediaries have access to borrowers' information and possess the expertise and skill to differentiate a bad loan from a good loan. They represent and protect the interest of depositors. Banks, in this process, decrease information

⁸ Cash Reserve Ratio and Interest Rates, available on the Reserve Bank of India (RBI) website at, <https://www.rbi.org.in/scripts/WSSView.aspx?id=20832>; accessed on 28 August 2016

acquiring and processing costs about the borrowers (Diamond, 1984). Our study found that banks' intermediation cost ratio was negatively related to NPAs. This was indicative that a significant intermediation cost ratio helps bank agents to spend more time and effort to monitor bank asset quality and lower default probability faced by the banks.

Thirdly, we looked at capital adequacy and liquidity of Indian banks, but both these ratios did not emerge as significant in our study. Indian banks had a capital ratio well above the 9% prescribed by norms. Hence, the Indian banks were well-capitalised. With the bad debts on the rise due to a change in the recognition of restructured assets guidelines since 2013 and the Basel III norms for a higher capital base approaching, RBI eased norms with respect to raising capital for Indian banks and allowed them to raise capital through bonds such as Masala bonds. These bonds allowed residents and non-residents to undertake large open positions in the currency market in India⁹.

The RBI closely monitors the liquidity across Indian banks on a weekly basis and this protects the bank from the downside of liquidity crisis. In case a bank faces shortage, the RBI acts as a lender of last resort (LLR). Under the LLR facility, RBI extends credit to the aggrieved bank that is solvent but faces temporary liquidity issues. This facility is extended to these aggrieved banks to protect bank depositor interest, and prevent possible bank failure that may have a contagion effect in the financial system.

Continuing in line with financial intermediation literature, our paper found that business per employee (indicating staffing efficiency) was significant. This was in line with our intuition, that every staff member is associated with the loan generation and monitoring, and NPAs were a function of the bank agents' bad assessment of lending. Our finding was contrary to the Rajaraman, et al. (1999) study.

Managerial implications

The study is helpful to bankers, bank depositors, investors and bank management to assess how bank financial ratios can be used as indicators to evaluate NPAs. Operational capability and intermediation costs are important factors to ascertain NPAs and should be monitored carefully; these factors have not been analysed in earlier studies. Non-performing assets are important indicators of banks' profitability and efficiency and hence, it is important for bankers and regulators to use significant indicators and variables to analyse the NPA, which this study has focussed on.

Summary and conclusion

This study evaluated the effect of financial ratios on bank NPAs using a comprehensive framework of 31 variables under

⁹ Forbes, Masala Bonds Open Opportunity For Indian Banks To Raise Necessary Capital, available on the Internet at, <http://www.forbes.com/sites/timworstall/2016/08/26/masala-bonds-open-opportunity-for-indian-banks-to-raise-necessary-capital/#53b0d9af5971>, accessed on 27 August 2016. Deccan Herald, Overexposure to Masala Bonds kills its forex boons, available on the internet at, <http://www.deccanherald.com/content/564322/overexposure-masala-bonds-kills-its.html>, accessed on 27 August 2016.

the intermediation approach. The paper examines the determinants of non-performing assets (NPA) of Indian scheduled commercial banks during the period 2007 to 2014, and adds to the non-performing assets literature in three ways. Firstly, unlike previous studies, our study used a comprehensive list of as many as 31 financial indicators. These indicators present a holistic view of the bank's operational capability, profitability, solvency, business development capacity, capital adequacy and liquidity. Earlier studies focussed on one aspect of the bank. However, we have tried to capture the business performance not only at the functional level but also at the corporate level. The functional level of a bank was captured through the operational, liquidity and solvency indicators, while the banks' business growth strategy (in terms of asset growth) at the corporate level was captured using business development capacity as a proxy. If banks followed an aggressive growth strategy they would witness higher NPAs. We used the GMM (2SLS) method using the cross-section weights that had an r-square of 86%. This method dealt with the endogeneity issue displayed due to the dynamic nature of the bank data under study.

Secondly, we explored the financial intermediation literature and used the intermediation cost ratio as a proxy to capture the role of bank agents to monitor bank loans and protect depositor interest. We found that a significant intermediation cost ratio helps bank agents spend more time and effort to monitor bank asset quality and lower default probability faced by the banks.

A further enhancement of the present study could be to explore the determinants of addition and reduction of non-performing assets across bank loans using a combination of restructured assets and non-performing assets. The latest regulation of the Reserve Bank of India has stipulated that henceforth (from 2015) the banks should place the restructured assets as non-performing assets. Restructured assets recognition allowed banks to defer recognising a loan as a bad loan for at least five years. A further extension could be the assessment of whether restructured non-performing assets given to firms become good loans after the restructuring procedure is complete or do they slip into NPA category.

Acknowledgements

The authors wish to sincerely thank the reviewers for their detailed comments which has significantly improved the final version of the paper.

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