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**Working Paper**

## Modelling bank asset quality and profitability: An empirical assessment

Economics Discussion Papers, No. 2015-27

**Provided in Cooperation with:**

Kiel Institute for the World Economy – Leibniz Center for Research on Global Economic Challenges

*Suggested Citation:* Swamy, Vighneswara (2015) : Modelling bank asset quality and profitability: An empirical assessment, Economics Discussion Papers, No. 2015-27, Kiel Institute for the World Economy (IfW), Kiel

This Version is available at:

<https://hdl.handle.net/10419/109515>

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**Discussion Paper**

No. 2015-27 | April 20, 2015 | <http://www.economics-ejournal.org/economics/discussionpapers/2015-27>

## **Modelling Bank Asset Quality and Profitability: An Empirical Assessment**

*Vighneswara Swamy*

**Abstract**

The determinants of default risk of banks in emerging economies have so far received inadequate attention in the literature. This paper seeks to study the determinants of bank asset quality and profitability using panel data techniques and robust data sets for the period between 1997 and 2009. The study findings reveal some interesting results that run contrary to established perceptions. Priority sector credit has been found to be not significant in affecting NPAs; this is contrary to the general perception. Similarly, with regard to rural bank branches, the results reveal that aversion to rural credit is a falsely founded perception. Bad debts are dependent more on the performance of industry than on other sectors of the economy. Public sector banks have shown significant performance in containing bad debts. Private banks have continued to be stable in containing bad debts, as they have better risk management procedures and technology, which definitely allows them to finish with lower levels of NPAs. Further, this study investigates the effect of determinants on profitability, and establishes that while capital adequacy and investment activity significantly affect the profitability of commercial banks, apart from other accepted determinants of profitability, asset size has no significant impact on profitability.

**JEL** G21 G28 G32 E44 E58

**Keywords** Banks; risk management; ownership structure; financial markets; non-performing assets; lending policy; macro-economy; central banks; banking regulation; financial system stability

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**Citation** Vighneswara Swamy (2015). Modelling Bank Asset Quality and Profitability: An Empirical Assessment. Economics Discussion Papers, No 2015-27, Kiel Institute for the World Economy. <http://www.economics-ejournal.org/economics/discussionpapers/2015-27>

## **I. Introduction**

Financial stability in an economy is largely dependent on the stability and the resilience of the banking system. To achieve banking stability, banks are required to maintain quality assets that aid in achieving profitability. The failure to ensure banking stability can cause financial fragility and may lead to crisis in the event of market illiquidity and/or bank contagion. The significance of banking stability can be better understood in the backdrop of the global financial crisis of 2008 that resulted in the collapse of financial markets and institutions. Moreover, output per capita is projected to slide down in countries representing three-quarters of the global economy. The consequent deterioration in the economic environment has led to a rise in the overall level of stress in the banking sector. Commercial bank loan charge-offs in the US and Europe may exceed the levels reached during the 1991–1992 recession, even though they should remain below the levels experienced in the US during the Great Depression.

Financial stability has once again emerged as an important area of concern in financial systems worldwide. Financial stability is widely accepted as a situation in which the financial system is capable of satisfactorily performing its three key functions simultaneously:

- (1) efficient and smooth facilitation of the inter-temporal allocation of resources from the surplus economic units to the deficit economic units;
- (2) managing the forward looking financial risks with appropriate pricing; and
- (3) to be prepared all the time to absorb the financial and real economic surprises and shocks.

Counterparty risk is an important risk in the financial system, more particularly in the banking system; therefore, it poses a bigger challenge to the achievement of financial stability. Counterparty risk is an outcome directly related to the non-performing assets<sup>1</sup> (NPA) of a financial institution. Non-performing assets are permanent phenomena in the balance sheets of financial institutions, but they need to be contained properly. Otherwise, they eventually lead to crisis, which can pose big threats of contagion that can engulf the health of the financial system.

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<sup>1</sup> Loans that the bank foresees it will have difficulty in collecting. They include nonaccrual loans, non-performing leases, reduced rate loans, renegotiated loans, and loans past due 90 days or more. They exclude assets acquired in foreclosures and personal property. NPAs mainly arise due to the default of the borrower, which involves his inability or unwillingness in meeting the commitments to the loan. Non-performing assets (NPAs) or bad loans, as they are commonly called, have been a menace for the banking sector across the world.

The immediate consequence of bubbling up of NPAs in the banking system is bank failure. In view of this established fact, the issue of NPAs has gained growing attention in the past few decades. Many researchers like [Demirguc-Kunt \(1989\)](#) and [Barr and Siems \(1994\)](#) have showed that asset quality is a statistically significant predictor of insolvency for the cause of bank failures. Failing banking institutions always have a high level of non-performing loans prior to failure. The problem of NPAs has become synonymous to functional efficiency of financial intermediaries, and is believed to be the major cause of economic stagnation problems. According to the Global Financial Stability Report, identifying and dealing with distressed assets and recapitalizing weak but viable institutions and resolving failed institutions are two of the three important priorities that directly relate to NPAs ([IMF, 2009](#)). It is obvious that better asset quality fosters higher profitability. As such, it is imperative on banks to efficiently manage their asset quality as well as other determinants of profitability. The growing incidence of poor bank asset quality calls for a renewed look at the factors that impact the performance of banks.

Only a few studies of citable significance have dealt on the problems of NPAs, particularly in the context of developing economies. This is due perhaps to the lack of sufficient published, disaggregated information on the micro-management of NPAs and the nature and type of default. Though the Indian banking system has not experienced notable banking crises, unlike other banking systems in the world, the issues concerning NPAs have come up particularly in view of the comparatively high levels of NPAs of Indian commercial banks vis-à-vis that of the other countries. This kind of economy, which has not suffered banking crises but continues to face the problem of mounting NPAs, is indeed a motivation for undertaking an empirical examination conjoining the profitability analysis as well.

This study attempts to find answers for specific questions:

- (i) What are the significant determinants that influence the NPAs of commercial banks and to what extent?
- (ii) What factors affect bank profitability in a banking system that is quite different from that of the crisis-ridden advanced banking systems?
- (iii) What lessons (particularly in the domain of macro-economic management and prudential regulation) can be drawn from the banking system dynamics in the context of bank asset quality and profitability?

In view of this, it is essential to identify and understand the determinants (both macro-economic and industry specific) of NPAs. Further, this study aims at a comprehensive empirical analysis of the determinants of bank asset quality and profitability in the context of Indian banking. It contributes to the growing literature on bank asset quality management and profitability and suggests measures for better asset quality.

The rest of the paper is organised as follows. Section II provides a discussion on the related literature on macro-economic and endogenous determinants of asset quality and bank profitability, and identifies the scope for this study. We present in Section III a brief discussion on the asset quality in Indian commercial banks with some stylised facts. Empirical specification and estimation strategy is described in Section IV. The discussion on the results is provided in Section V followed with the summary and conclusion of the study in Section VI.

## **II. Related Literature**

### *II A. Macro-Economic Determinants of Asset Quality*

A good strand of financial economics literature suggests that the NPAs of banks are closely linked to economic activity. In other words, macroeconomic factors such as downturns / slowdowns in the economy, recessions, low rate of savings, weak markets, depressions in industrial production, reduction in per capita income levels and, most importantly, the inflation levels in the economy impact on bank asset quality. A fair amount of the academic literature has dealt with the determinants of a banking crisis, which is one of the most severe of the consequences of bad loans in a banking system. [Dermiguc-Kunt and Detragiache \(2000\)](#) employ a multivariate logit framework to develop an early warning system for banking crisis and a ratings system for bank fragility. [Beck, Demirguc-Kunt, and Levine \(2005\)](#) examine the inter-linkage between bank concentration and banking system fragility and show that higher bank concentration is associated with lower profitability. [Lis et al. \(2000\)](#) observe that gross domestic product (GDP) growth, bank size and capital had a negative effect on NPAs, while loan growth, collateral, net interest margin, debt-equity ratio, market power and regulation regime had a positive impact on NPAs.

[Fernandez et al. \(2000\)](#) explain bank loan losses in Spain employing a simultaneous equation model. They use a host of indicators such as GDP growth rate, debt-equity ratios of firms, regulation regime, loan growth, bank branch growth rates, bank size (assets over total size), collateral loans, net interest margin, capital asset ratio (CAR) and market power of default companies. They find that GDP growth (contemporaneous, as well as one period lag term), bank size and CAR had a negative effect, while loan growth, collateral, net interest margin, debt equity, market power, regulation regime and lagged dependent variable had positive effect on problem loans. Studying NPAs in Italy, [Sergio \(1996\)](#) shows that an increase in the riskiness of loan assets is rooted in a bank's lending policy adducing to relatively unselective and inadequate assessment of sectoral prospects. Interestingly, this study refuted the theory that a business cycle could be a primary reason for banks' NPAs. However, according to [Bloem and Gorter \(2001\)](#), NPAs may be caused by wrong economic decision or by plain bad luck. Studying corporate recovery rates, [Resti and Sironi \(2001\)](#) observe that bond default rate, amount of bonds, default bonds and economic recession had a negative effect, while the GDP growth rate and stock return had a positive effect on corporate recovery rate. In their study of Argentinean banks, [Bercoff, Giovanniz and Grimardx \(2002\)](#) measure NPAs by using bank related parameters as well as macroeconomic parameters. Bank specific parameters in their study included the ratio of net worth to net assets, banks' exposure to peso loans and type of banks such as foreign, private or public. Macroeconomic factors included credit growth, reserves adequacy, foreign interest rate and monetary expansion. They show that variables such as operating cost, exposure to peso loans, credit growth and foreign interest rate have a negative effect on NPAs. Macroeconomic variables such as money multiplier and reserve adequacy have a positive impact on NPAs.

Ownership pattern and management efficiency are observed to affect bank asset quality significantly. [Berger and De Young \(1995\)](#) observe that a management team with poor operating capability is unable to correctly appraise the value of collateral. Its poor credit rating technology results in management being unable to control and supervise the operating expenses efficiently, thus leading to a significant increase in NPAs. Therefore, we have considered the various bank groups in Indian banking based on their ownership structures for the analysis. [Chen et al. \(1998\)](#) study the relationship between risks and ownership structure, and find an apparent negative correlation between managers' shareholdings and risks faced by financial institutions. In times of

downturn, the government would often turn to banks for financial resources through policy loans for state owned enterprises (SOEs). Projects financed by these policy loans give rise to growing default rates (Huang, 1999). The biased lending behaviour of banks to SOEs is supported by other research findings as well (Lu *et al.* 2001). In case of Taiwanese banks, the rate of non-performing loans is found to decrease as the government shareholding in banks goes higher (Hu *et al.* 2002). Few studies suggest a relationship between bank size and the level of bad loans. Bank size is often found negatively related to the rate of non-performing loans (Hu *et al.* 2002). Banks are facing a number of challenges, such as frequent changes in banking technology, stringent prudential norms, increasing competition, worrying level of NPAs, rising customer expectations, increasing pressure on profitability, asset liability management, liquidity and credit risk management, rising operating expenditure, shrinking size of spread and so on. However, Singh (2005) argues that globalization of operations and development of new technologies are taking place at a rapid pace, and this has led to the increase in resource productivity, increasing level of deposits, credits and profitability and decrease in NPAs.

### *II B. Endogenous Determinants of Asset Quality*

The literature on these issues identifies determinants of banks' risk taking that can be translated into a tractable empirical specification by measuring the effect of observable variables like capital adequacy, credit growth, operational efficiency, branch spread and others. Rajaraman, Bhaumik and Bhatia (1999) have explained the variations in NPAs across Indian banks through differences in operating efficiency, solvency and regional concentration. Again, Rajaraman and Vasishtha (2002) in their empirical study have shown that a significant bivariate relationship exists between NPAs of public sector banks and inefficiency problems. Das (1999) has contrasted the different efficiency measures of public sector banks by applying a data envelopment analysis model and concluded that the level of NPAs has significant negative relationship with efficiency parameters. Kwan and Eisenbis (1997) examine the relationship between problem loans and bank efficiency by employing the Granger causality technique and find that a high level of problem loans causes banks to increase spending on monitoring.

Ranjan and Dhal (2003) conduct an empirical analysis of the NPAs of public sector banks in India. They probe the response of NPAs to terms of credit, bank size and macroeconomic

condition and find that terms of credit have significant effect on the banks' NPAs in the presence of bank size and macroeconomic shocks. They also observe that alternative measures of bank size could give rise to differential impact on NPAs. In the ensuing section, we present the discussion on asset quality in Indian banking to provide a setting for the empirical analysis of this study.

### *III C. Bank Profitability*

The importance of bank profitability can be assessed at the micro and macro levels of the economy. At the micro level, profit is the essential prerequisite of a competitive banking institution and the cheapest source of funds. It is not merely a result but also a necessity for successful banking in a period of growing competition on financial markets. Therefore, the basic object of a bank's management, the essential requirement for conducting any business, is to achieve a profit. At the macro level, a sound and profitable banking sector is better able to withstand negative shocks and contribute to the stability of the financial system. The importance of bank profitability at both the micro and macro levels has led researchers, academics, bank managements and bank regulatory authorities to develop considerable interest in the factors that determine bank profitability ([Athanasoglou et al., 2005: 5](#)). [Bourke \(1989\)](#) examined the internal and external determinants of profitability for the banks of twelve countries from Europe, North America and Australia, and observed that banks with a high degree of market power tend to exhibit risk avoidance behaviour. Several studies demonstrate the existence of a significant relation between business cycle and bank profitability. [Demirgüç-Kunt and Huizinga \(1999\)](#) were among the first to relate bank profits to macro-economic indicators such as real GDP per capita. Based on aggregate data of the banking sector in a number of OECD countries, [Bikker and Hu \(2002\)](#) estimate the relation between bank profitability and real GDP growth. More recently, [Albertazzi and Gambacorta \(2009\)](#) report a significant relation between real GDP growth and bank profitability. [Athanasoglou et al. \(2008\)](#) find a positive relation between the output gap and the profitability of a panel of Greek banks.

Bank capital is observed to have a positive impact on profitability. There is a positive relationship between higher capital and higher earnings ([Berger 1995](#)). Increased exposure to credit risk has a negative impact on profitability whereas labour productivity growth has a



positive effect on bank profits ([Athanasoglou, Brissimis and Delis 2005](#)). Business cycles have a positive but asymmetric effect on profits. Larger bank size, activity diversification and private ownership are observed to be associated with higher profitability ([Flamini, McDonald and Schumacher 2009](#)). In terms of macroeconomic variables, low inflation and stable output growth improve profitability indicators. Monitoring contributes positively to the financial performance of small banks because risk-adjusted loan yields and spreads are greater for small banks. One explanation for the positive relation between monitoring and performance is the ability of small banks to find economically valuable information about a firm's financial condition by monitoring the firm's demand deposit account ([Carter, McNulty and Verbrugge 2004](#); [Carter and McNulty 2005](#)).

Empirical literature on the relationship between bank profit efficiency and market value is scarce. One study ([Aggarwal, Akhigbe and McNulty 2006](#)) that deals only with banks involved in mergers finds that these two measures are positively related. NPAs assume significance in determining the level of profitability, as we are well aware of the relationship between loan losses and loss of income.

The stability of the banking sector is closely related to the profitability and capital structure of the sector. The 2008 global financial crisis has shown that a banking sector ridden with problems of profitability and capital structure may have a devastating effect on the economy. As such, a banking sector will not be able to generate credit for the economy. Although the determinants of profitability in commercial banks have been the subject of research in a number of papers, there is a need for research regarding the profitability of banking systems distinct from those that have experienced crisis quite often.

### **III. Some Stylised Facts**

A synoptic review of the literature brings to the fore insights into the determinants of NPAs across countries. Quite a lot of economies have experienced such distressed debt cycles. NPA levels and capital to risk (weighted) assets ratio (CRAR) ([Table-1](#)) and provisions to NPAs and return on assets (ROA) of developing and advanced countries ([Table-2](#)) explain the

differences in levels as well as the approaches towards NPA management in different countries. Bank regulatory CRAR of select countries is depicted in [Figure-1](#).

Table 1: NPA levels, CRAR of Developing and Advanced Countries

Country	CRAR				NPA/TL			
	2002	2006	2007	2008	2002	2006	2007	2008
Developing Economies								
China	-	-	8.4	8.2	26	7.5	6.7	2.5
India	12	12.4	12.3	13	10.4	3.5	2.5	2.3
Indonesia	20.1	21.3	19.3	16.8	24	13.1	4.1	3.5
Korea	11.2	12.8	12.3	10.9	2.4	0.8	0.7	1.1
South Africa	12.6	12.3	12.8	12.5	2.8	1.2	1.4	2.6
Advanced Economies								
Australia	9.6	10.4	10.2	10.9	0.4	0.2	0.2	0.5
Canada	12.4	12.5	12.1	12.7	1.6	0.4	0.7	1.1
France	11.5	-	10.1	-	4.2	3.2	2.7	-
Germany	12.7	-	12.9	-	5	4	2.7	-
Italy	11.2	10.7	10.4	-	6.5	5.3	4.6	-
Japan	9.4	13.1	12.9	12.3	7.4	2.5	1.5	1.5
United Kingdom	13.1	12.9	12.6	-	2.6	0.9	0.9	-
United States	13	13	12.8	12.5	1.4	0.8	1.4	2.3

Source: Global Financial Stability Report, April 2009, IMF.

In USA, the resolution on non-performing and sub-performing loans was embedded into the savings and loans crisis from 1989 to 1994. In Japan, the NPA cycle began in 1997 and China and the rest of Asia deal with NPAs subprime loans (SPLs) since 1999. The origin of the Chinese NPA crisis can be traced to political issues. In this centrally planned economy, state-owned banks granted loans to state-owned companies from 1949 onwards, without proper credit or due diligence, at pre-determined standardised conditions by the government. Especially in the overheated economy of the 1990s, domestic credit extended enormously and grew by 30 percent year on year between 1992 and 1995 ([Chen, 2004](#)).

Table 2: Provisions to NPAs and ROA of Developing & Advanced Countries

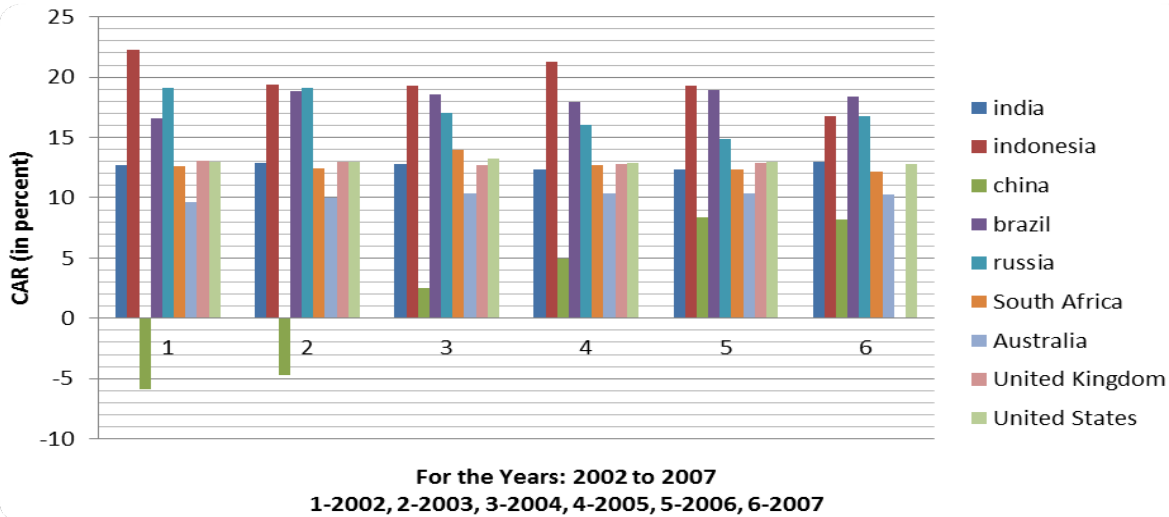
Country	PROVISIONS TO NPAs				ROA			
	2002	2006	2007	2008	2002	2006	2007	2008
Developing Economies								
China	-	-	39.2	115.3	-	0.9	1	-
India	-	58.9	56.1	52.6	0.8	0.9	0.9	1
Indonesia	130	99.7	87.7	98.5	1.4	2.6	2.8	2.6
Korea	89.6	175.2	199.1	155.4	0.6	1.1	1.1	-
South Africa	46	-	-	-	0.4	1.4	1.4	1.8
Advanced Economies								
Australia	106.2	204.5	183.7	87.2	1.4	-	1	0.9
Canada	41.1	55.3	42.1	34.7	0.4	1	0.9	1.3
France	58.4	58.7	61.4	-	0.5	-	0.4	-
Germany	-	-	77.3	-	0.1	0.5	0.2	-
Italy	-	46	49.5	-	0.5	0.8	0.8	-
Japan	-	30.3	26.4	24.9	-0.7	0.4	0.2	0.3
United Kingdom	75	-	-	-	0.4	0.5	0.4	-
United States	123.7	137.2	93.1	84.7	1.3	1.3	0.8	0.3

Source: Global Financial Stability Report, April 2009, IMF.

A typically high leverage in the country shown by a debt/gross domestic product (GDP) ratio of 146 percent may be an indicator for the problem of NPAs (see [Ernst & Young, 2001](#)). High leverage was experienced in the real estate sector, particularly during the Japanese real estate bubble in the 1980s. With the burst of the bubble in 1991 and the dramatic economic slowdown, real estate values waned tremendously in Japan, borrowers defaulted on the debt service and lenders had to sign big losses. The Japanese government did not provide regulations<sup>2</sup> or tax incentives, and the equity reserve of banks was not enough to write off distressed debt. This situation forced the banks to deal with the problem by a wait-and-see approach. [Barseghyan \(2004\)](#) identifies a link between the Japanese government's reluctance to solve the bad loan problem and the economic slowdown. He opines that the government's behaviour deteriorated the economic situation of Japan and affirms this hypothesis by a normative study.

<sup>2</sup> The inconsistent regulatory policies and short-sighted macro-economic policies were a prelude to the banking crises in most of the Latin American countries. Further, the rapid and uncontrolled expansion of bank lending was found to be the key cause for the Scandinavian banking crisis.

Figure 1: Bank Regulatory Capital to Risk-Weighted Assets



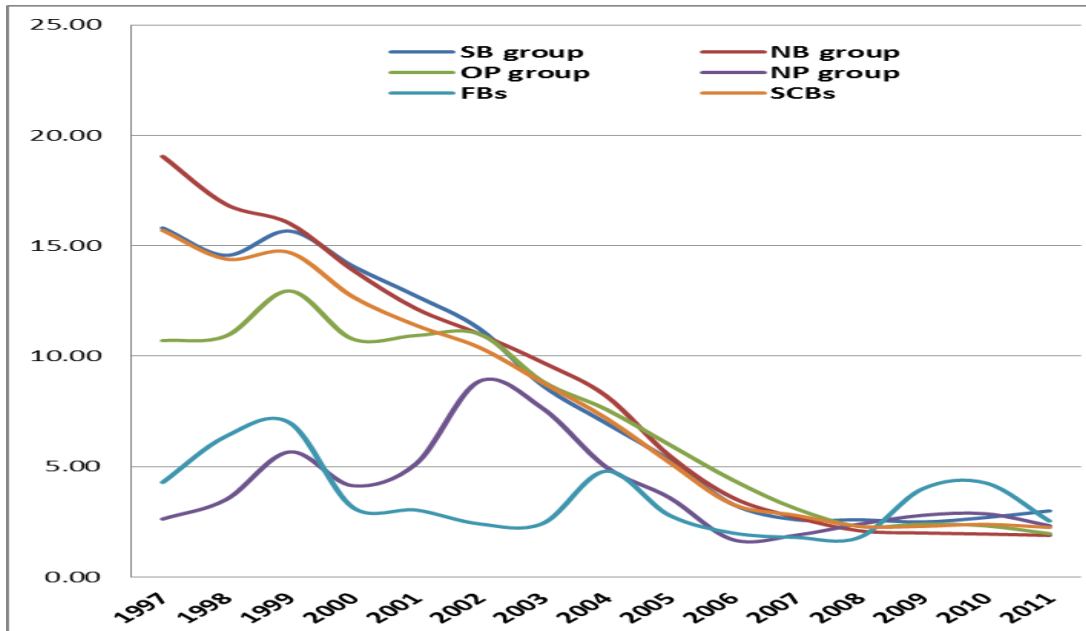
### Asset Quality in Indian Banking

In India, as in most other countries, NPAs<sup>3</sup> are only an indicator of loan performance. The degree to which it measures actual performance of banks depends on the quality of accounting, auditing, regulation and supervision and the amount of ‘ever greening’ of weak loans, through restructuring. This is an incessant problem<sup>4</sup> in India, to judge from the numerous circulars that the Reserve Bank of India (RBI) has issued against the practice over the past decade. Although NPAs have been substantially reduced since regulation was tightened in 1993, especially in public sector banks (PSBs), momentum has recently slowed down, and the levels of NPAs remain high compared to international standards (Figure-2). It is argued that the problems of NPAs have a sizeable overhang component, arising from infirmities in the existing practices of debt recovery, inadequate legal provisions for foreclosure and bankruptcy and difficulties in the execution of court decrees. The problem is exacerbated by the regulatory provisions for loan classification vis-à-vis international best practices.

<sup>3</sup> Non-Performing Asset (NPA) has been defined as a loan or an advance in respect of which payment of interest or principal or both has remained unpaid as per agreed terms of the loan contract for more than 90 days. The official definition of NPA in the Indian context is largely based on the loan repayment status. The distinguishing features of reporting of NPAs are in the terminology of Gross NPA (GNPA) and Net NPA (NNPA). Banks hold the bad loans even after making provisions in their books and continue to report as gross NPA. NNPA is the net value of the bad loan after deducting the available/marketable security and the appropriate provision from the gross NPA.

<sup>4</sup> It is widely claimed in news reports that the figures of NPAs reported by different banks might be underestimated and might not reflect the true picture mostly due to the weak accounting practices, laxity and bias leading to improper classification with a motive to recognise higher revenue though not received, and disclosure measures, etc.

Figure 2: Trends in Non-Performing Assets

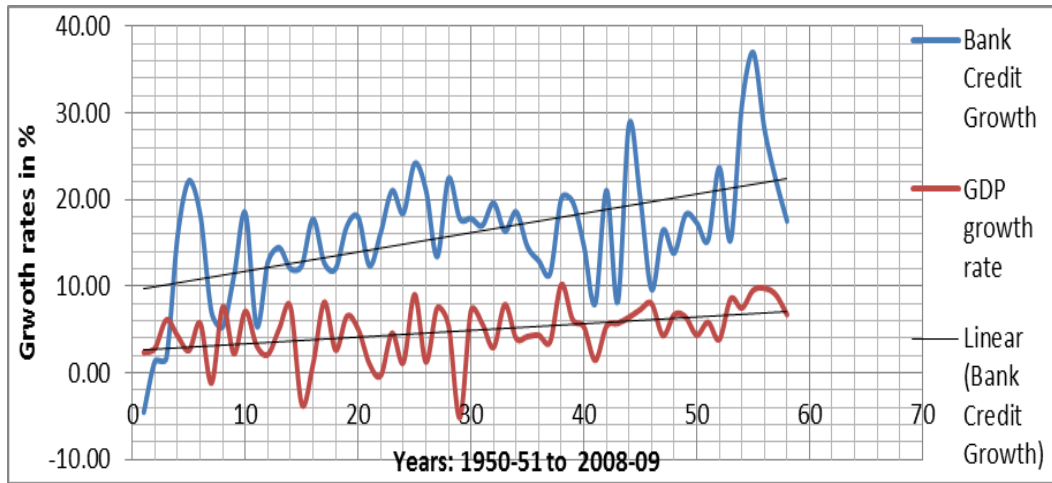


Source: Compiled by Author based on data from RBI publications

Although PSBs recorded improvements in profitability, efficiency (in terms of intermediation costs) and asset quality in the 1990s, they continue to have higher interest rate spreads but at the same time earn lower rates of return, reflecting higher operating costs. [Bhattacharya \(2001\)](#) rightly points to the fact that in an increasing rate regime, quality borrowers would switch over to other avenues such as capital markets, internal accruals for their requirement of funds. Under such circumstances, banks would have no option but to dilute the quality of borrowers, which might lead to increasing probability of generation of NPAs.

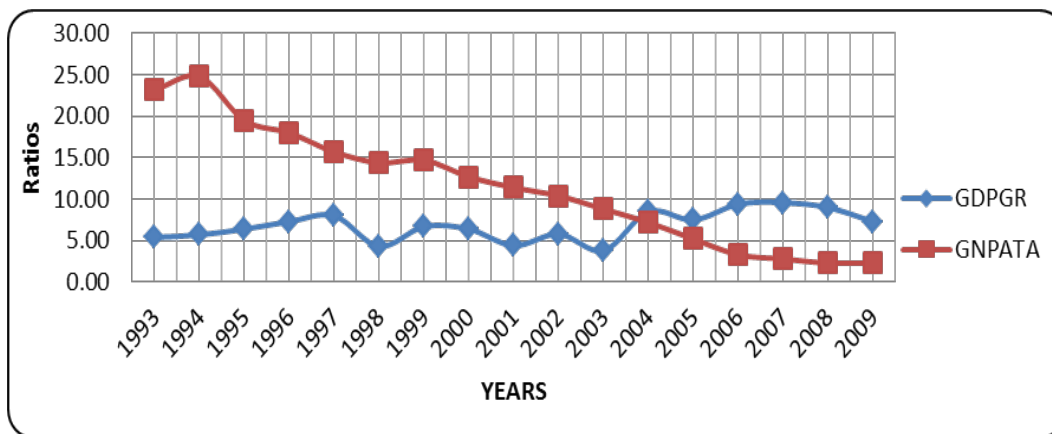
There are many internal and external factors affecting NPAs in India. While the internal factors might be taking up new projects, promoting associate concerns, cost overruns during the project implementation stage, business failure, inefficient management, strained labour relations, inappropriate technology/technical problems, product obsolescence etc., the external factors include GDP growth, default in other countries, high inflation, accidents and natural calamities. We notice a positive correlation between GDP growth and bank credit ([Figure-3](#)). Procyclicality is observed in the case of comparison of GDP growth to NPA levels ([Figure-4](#)).

Figure 3: Comparison of GDP growth to bank credit in India



Source: Compiled by Author based on data from RBI publications

Figure 4: Procyclicality of NPAs: Comparison of GDP growth to Gross NPA level in India



Source: Compiled by author based on data from RBI publications

#### IV. Empirical Specification and Estimation

In this section, we introduce the methodology and data source adopted for the empirical analysis. There is a need to estimate the relationship using the panel data consisting of different groups of banks in the Indian banking industry<sup>5</sup> (such as State Bank Group, nationalised banks, old private banks, new private banks and foreign banks) data across a period from March 1997 to

<sup>5</sup> State Bank group (SB) includes the prominent State Bank of India and its subsidiary banks, Nationalised Banks group includes all other public sector banks excluding SB group. SB group and NB group adding together constitute the public sector banks in Indian banking. Private sector banks are grouped as Old Private banks (OP) which have been in existence for a long time well before the financial sector reforms and New Private banks (NP) are the new generation banks that have emerged after the reforms and are technology savvy coupled with professional modern managements. The last group constitutes the Foreign Banks (FB) that has a very feeble presence in the entire economies and is found only in metros scheming the creamy business of the economy.

March 2009. The choice of the period is dictated by several considerations. First, this study considers published data on the variables. Second, the year 1996-97 marks the rigorous regime of prudential norms because of the 'first generation' reforms programme initiated in 1991, and hence it is desirable to study the impact of various determinants and the behaviour of different banking sectors in terms of NPAs through the initiation of the reform process. Further, the said period covers the significant period of post-liberalization in Indian banking. The period chosen is up to March 2009 and not beyond, to avoid the sudden devastating effect of the global financial crisis, and is not before March 1997, as the effects of liberalization and various financial sector reforms were well established by this year.

The data for the empirical analysis has been sourced from the robust database of the RBI and from various RBI publications (more particularly, the annual reports on trend and progress of banking in India and statistical tables relating to banks in India). We also source the data from published annual audited accounts of individual banks. Several appropriate and relevant variables were identified in the backdrop of the theoretical considerations deliberated in the earlier section of this paper. The description of the variables and the related explanation is presented in [Appendix 1](#). The descriptive statistics of the variables employed in the econometric analysis are presented in [Appendix 2](#). The movement of determinant variables in panels of analyses are presented in [Appendix 3a to 3d](#).

### *Econometric Approach*

Two models of analysis were designed (Model 1 and 2) to capture the effect of variables in different dimensions. Our baseline specification involves GDPGR as the control variable for macro-economic activity, whereas IIPGR, INFLA, MCAP and LR replace the GDPGR in the alternate specification. We study our specifications employing the panel least squares method with a first difference estimator for the data with robust standard errors ([Wooldridge](#) example 10.6, p. 282; 2002). Following [Baltagi and Chang \(1994\)](#) (also described in [Baltagi, 2005](#)), a fixed effects GLS specification has been estimated assuming the presence of cross-section heteroskedasticity in models 1a and 1b. The coefficient covariance method has been chosen from among the robust methods to compute coefficient standard errors. The covariance calculations are chosen to be robust under the assumption perhaps that of cross-section heteroskedasticity and

the calculations are performed without the leading degree of freedom correction term. The observed R-squared and  $F$ -statistics are based on the difference between the residuals sums of squares from the estimated model, and the sums of squares from a *single* constant-only specification, not from a fixed-effect-only specification.

Further, the observed Durbin-Watson stat is formed simply by computing the first-order residual correlation on the stacked set of residuals. Variance Inflation Factors (VIF) for the explanatory variables are found to be on the non-performing expected lines. The  $F$ -test of the joint significance of variables that are presently omitted from a panel or pool equation has been performed with the null hypothesis that the variables are jointly irrelevant. Further, a redundant variables test has been performed to ascertain the joint significance of the variables included in the panel equation; irrelevant variables are removed from the model. Balanced panel data is employed for estimation by employing the EViews tools for detailed analysis.

### *Model Specification*

The primer model that can be estimated using panel techniques and can be written as

$$Y_{it} = f(X_{it}, \beta) + \delta_i + \gamma_t + \epsilon_{it} \text{ ----- (Eqn 1)}$$

Assuming a linear conditional mean specification, we can write the specification as;

$$Y_{it} = \alpha + X_{it} \beta + \delta_i + \gamma_t + \epsilon_{it} \text{ ----- (Eqn 2)}$$

Where  $Y_{it}$  is the dependent variable, and  $X_{it}$  is a  $k$ -vector of regressors, and  $\epsilon_{it}$  are the error terms for  $i = 1, 2, \dots, M$  cross-sectional units observed for dated periods  $t = 1, 2, \dots, T$ . The  $\alpha$  parameter represents the overall constant in the model, while the  $\delta_i$  and  $\gamma_t$  represent cross-section or period specific effects (random or fixed).

### *Determinants of Bank Asset Quality*

The objective here is to identify and analyse the determinants of NPAs. The following specification is designed for a panel regression method.



Then, the equation would be

$$\begin{aligned} \text{GNPA}_{it} = & \alpha + \beta_1 \text{GDPGR}_t + \beta_2 \text{ER}_t + \beta_3 \text{MCAP}_t + \beta_4 \text{LR}_t + \beta_5 \text{IIPGR}_t + \\ & + \beta_6 \text{INFLA}_t + \beta_7 \text{SVGR}_t + \beta_8 \text{ASSET}_{it} + \beta_9 \text{CAR}_{it} + \beta_{10} \text{CDR}_{it} + \beta_{11} \text{COF}_{it} + \\ & + \beta_{12} \text{ROA}_{it} + \beta_{13} \text{RUSUBRA}_{it} + \beta_{14} \text{CREDGR}_{it} + \beta_{15} \text{PSC}_{it} + \beta_{16} \text{OER}_{it} + \\ & + \beta_{17} \text{ROI}_{it} + \delta_i + \gamma_t + \epsilon_{it} \text{ ----- (Eqn 3)} \end{aligned}$$

The vector of regressors includes both macroeconomic and endogenous (industry-specific) variables that are assumed to determine the level of NPAs. The explanatory variables are represented by macro-economic variables such as gross domestic product growth rate (GDPGR), exchange rates (ER), market capitalisation growth rate (MCAP), bank lending rates (LR), index of industrial production (IIPGR), inflation rate (INFLA) and savings growth rate (SVGR). The endogenous variables among the explanatory variables are represented by bank assets (natural log) (ASSET), capital adequacy ratio (CAR), credit to deposit ratio (CDR), cost of funds (COF), return on assets (ROA), ratio of rural and semi urban branches to total bank branches (RUSUBRA), bank credit growth (CREDGR), ratio of priority sector credit to total loans (PSC), operating expenses to total assets (OER) and return on investments (ROI) that are supposed to determine the NPAs in the Indian context. While ‘i’ represents the bank, ‘t’ represents the year and  $\epsilon_{it}$  represents the unexplained residual. This equation is estimated using panel regression analysis considering gross NPA (GNPA), which is calculated as the ratio of gross assets to total advances and as regressand.

GDPGR is involved as a determinant in view of its all-pervading effect in the economy that may have a say in causing the NPAs. It controls for macroeconomic conditions that owing to business cycles in the economy have a significant role to play in causing defaults in loan repayments. It is also because of the reasoning that as the GDP increases the amount of NPAs decreases. INFLA is considered a macroeconomic determinant as it is an aspect related to the Indian economy that affects banks’ overall performance, especially the level of NPAs in the banking system. This is because when the RBI takes some steps related to interest rates to control inflation, the defaulters’ list also grows for banks with rising interest rates. Further, the savings level in an economy explains the savings propensity as well as the economic surpluses available, which has a relation to the repayment capacity of the borrowers of the banking sector

in general. In view of this, SVGR is considered a determinant. Also, in a growing economy like India, capital markets attract many investors and stimulate capital formation in the country, which has a bearing on the performance of the organized industrial sector. In view of this logic, the Bombay Stock Exchange market capitalisation growth rate (MCAP) is considered a determinant.

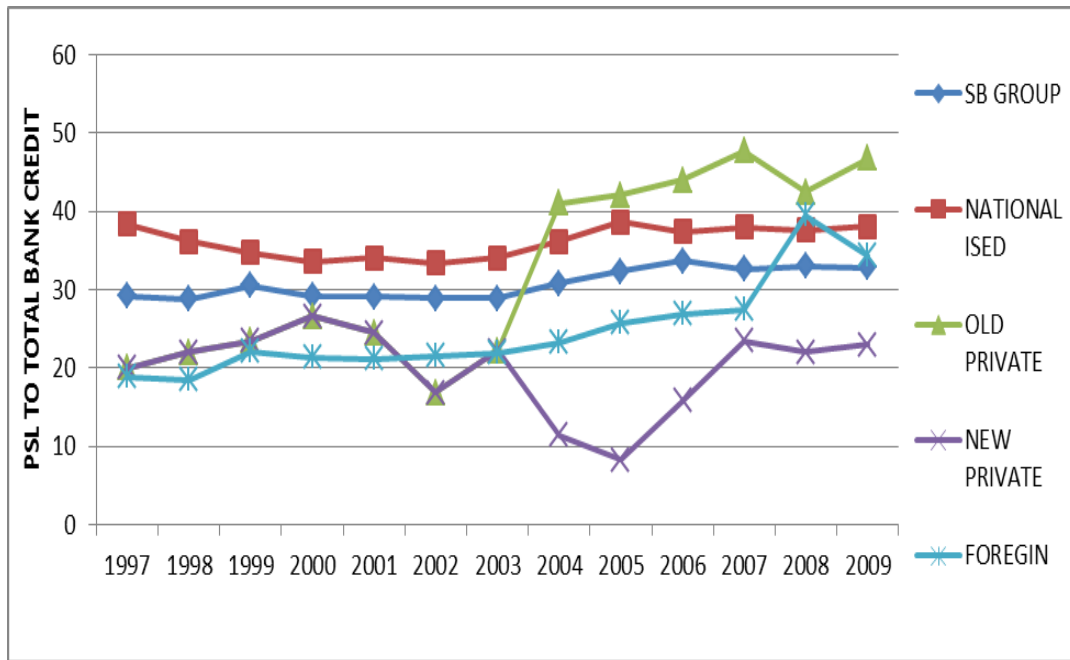
It is argued that the non-priority sector is the prime contributor to NPAs. To include this viewpoint in the study, bank assets (ASSET) is taken as a control for whether the bigger banks are more vulnerable to the problem of NPAs than their smaller counterparts are. CAR was also considered a determinant, as higher the capital of banks, lower the level of NPAs. It is also because a bank's capital base increases its confidence, which is reflected in their performance thus leading to effective recovery of bank loans and bringing down the level of NPAs. ROA is considered an endogenous determinant because bank profitability would have a close relation with its NPAs. It is obvious that, in general, the more profitable banks would have fewer NPAs. To capture the aggressiveness in lending activity of banks that can lead to NPAs, CDR is considered an endogenous variable.

Cost of funds (COF) for banks cause significant strategic decisions in the area of bank lending. Accordingly, COF is also considered a determinant. Growth in bank credit is also a factor that can determine the emergence of NPAs. In view of this, CREDGR is considered a determinant. In the area of bank lending, lending rates play a significant part. Cheaper the rates, more the recovery rate; higher the rates, higher the defaults. To account for this argument, LR is considered. Much of the operating expenses in the bank are believed to be towards employing the work force and related resources for credit deployment and recovery. Accordingly, OER is also considered a variable.

The proportion of rural and semi-urban bank branches (RUSUBRA) has been considered a determinant to examine whether the location of banks (i.e. rural and semi-urban areas) matter in causing NPAs in banking. The more aggressive banks are in their lending, the more they may end up pushing riskier loans and thereby end up with a higher level of NPAs. However, there is a contention that as banks concentrate on credit management, they may have developed expertise

in managing credit risk and, hence, may sometimes exhibit a lower level of NPAs. Therefore, the role of lending aggressiveness in causing an increase in NPAs is still hazy. The ratio of priority sector credit to total bank lending (PSC) was included as a determinant to account for the argument that priority sector loans are responsible for the most number of defaults (Figure 5).

Figure 5: Priority Sector Loans to Total Bank Credit in India



Source: Compiled by Author based on data from RBI publications

Panel regression estimation for analysing the determinants of asset quality is made with GNPA as dependent variable (proxy for asset quality). Models 1a and 1b are analysed with panel least squares and models 2a and 2b are analysed by employing panel least squares with cross-section weights (PCSE) standard errors and covariance. Residuals of the specification are presented in Appendix 4.

#### Determinants of Bank Profitability

The objective here is to identify and analyse the determinants of bank profitability of foregoing analysis of NPAs. The following specification is designed for a panel regression method. Then, the specification for analysis would be

$$\begin{aligned}
ROA_{it} = & \alpha + \beta_1 GDPGR_t + \beta_2 ASSET_{it} + \beta_3 CAR_{it} + \beta_4 CDR_{it} + \beta_5 COF_{it} + \beta_6 GNPA_{it} \\
& + \beta_7 RUSUBRA_{it} + \beta_8 ROADV_{it} + \beta_9 PSC_{it} + \beta_{10} OER_{it} + \\
& + \beta_{11} ROI_{it} + \beta_{12} IDR_{it} + \epsilon_{it} \text{ ----- (Eqn 4)}
\end{aligned}$$

Where, vector of regressors include both the macroeconomic and the endogenous (industry specific) variables that are assumed to determine the level of profitability. Similar specification is employed as furnished here below for determining explanatory factors for ROE as the dependent variable for profitability analysis.

$$\begin{aligned}
ROE_{it} = & \alpha + \beta_1 GDPGR_t + \beta_2 ASSET_{it} + \beta_3 CAR_{it} + \beta_4 CDR_{it} + \beta_5 COF_{it} + \beta_6 GNPA_{it} \\
& + \beta_7 RUSUBRA_{it} + \beta_8 ROADV_{it} + \beta_9 PSC_{it} + \beta_{10} OER_{it} + \\
& + \beta_{11} ROI_{it} + \beta_{12} IDR_{it} + \epsilon_{it} \text{ ----- (Eqn 5)}
\end{aligned}$$

The explanatory variables include GDPGR, ASSET, CAR, CDR, COF, GNPA, RUSUBRA, ROADV, PSC, OER, ROI and IDR that are supposed to determine the profitability in a broader perspective in the Indian context. While ‘i’ represents the bank, ‘t’ represents the year and  $\epsilon_{it}$  represents the unexplained residual. This equation is estimated using panel regression analysis considering ROA and ROE as regressand.

GDPGR is involved as a determinant in view of its all-pervading effect in the economy that may have a say in affecting profitability. It controls for the macroeconomic conditions that, owing to business cycles in the economy, have a significant role to play in causing defaults in loan repayments and revenues. It is also because of the reasoning that as GDP increases, profitability also increases. As the size of the banking firm matters in profitability, bank asset (ASSET) is considered as control for whether the bigger banks have advantages in terms profitability than their smaller counterparts. CAR is considered as a determinant, as higher the bank capital, higher the profitability. It is also because as capital base of the banks increases, their confidence also increases; this is reflected in their performance, which leads to effective recovery of bank loans and reduction in NPA level. To capture the aggressiveness in lending activity of the banks that can lead to boosting of interest income, CDR is considered an endogenous variable. For banks, COF causes significant strategic decisions in the area of lending and affects profitability.

As NPAs rise, there would be a dampening effect on profitability, and to understand the impact of NPAs, GNPA is included as a predictor variable. Much of the operating expenses in the bank are believed to be towards employing the work force and related resources for credit deployment and recovery. Accordingly, OER is also considered as a variable. The proportion of rural and semi-urban bank branches (RUSUBRA) has been considered a determinant to examine whether the location of banks (i.e. in rural and semi-urban areas) matter in causing NPAs. The more aggressive the banks in lending, the more they may end up pushing riskier loans and thereby end up in higher level of NPAs. However, there is a contention that as banks concentrate on credit management, they may have developed expertise in managing the credit risk and hence may sometimes exhibit lower level of NPAs. Therefore, the role of lending aggressiveness in causing increase in NPAs is still hazy.

The ratio of priority sector credit to total bank lending (PSC) was included as a determinant to account for the argument that priority sector loans are responsible for the most number of defaults. As the return on investments (excluding the loans and advances) increases, the profitability gets positively affected and as such, ROI is considered as a variable. Lastly, investment to deposit ratio (IDR) is also considered to control for the impact of deposit vis-à-vis investment activity on bank profitability. Panel regression estimation for analysing the determinants of profitability is made with ROA and ROE as dependent variables as proxy for profitability. Model 1 is analysed with panel least squares and model 2 is analysed by employing panel least squares with cross-section weights (PCSE) standard errors & covariance. Residuals of the analysis are presented in [Appendix 5](#).

## **V. Results and Discussion**

The results of the analysis for determinants of asset quality are presented in [Table 5A](#) and [5B](#). [Table 5A](#) presents the results of the baseline specification. Under both models, GDPGR is found to be negatively associated with GNPA. COF is found to have a significant negative relationship at 1% significance level. The coefficient of CREDGR has turned out to be negative indicating that banks with higher credit growth may have better risk management procedures and technology, which definitely allows them to end up with lower levels of NPAs. CDR is

significant and negatively associated with bad loans, signifying that higher the CDR the lower tends to be the level of NPAs. OER has a direct and significant association with GNPA.

[Table 5B](#) presents the results of the alternate specification for analysing the determinants of bank asset quality. In this specification, we introduce the macro-economic variables – IIPGR, INFLA, LR and MCAP by replacing GDPGR. This specification helps in capturing the transition from a bank-based financial system to a market-based financial system. IIPGR has significant relationship with GNPA suggesting that rise in IIPGR has positive effect on the bank asset quality. The negative sign of the coefficient of MCAP suggests that transition to market orientation has a positive impact on banks asset quality, as the companies tend to present a healthy picture of their borrowings in the markets. The significant positive relationship of LR with GNPA supports our argument that higher lending rates contribute to bad debts. Under both specifications, COF is found to have a significant negative relationship at 1% significance level. As expected, RUSUBRA affects the GNPA significantly in both specifications. Under both models, COF is found to have a significant negative relationship at 1% significance level. This supports our argument that as the cost of funds increase the banks tend to be very cautious and choosy in their lending thus leading to decrease in NPAs. The rest of the explanatory variables exhibit theoretically expected relationships and are self-explanatory.

Another corollary objective of this study is to know whether the NPAs are in any way affected by the ownership styles of the banks. We investigate by introducing the ownership dummies (SBdummy for State bank group of banks, NBdummy for Nationalised Banks, OPdummy for old private banks, NPdummy for new private banks and FBdummy for foreign banks. The results summarized in [Table 5A and 5B](#) indicate that Private Banks (both old and new) and foreign banks appear to manage their NPAs efficiently. State bank group and nationalised banks appear to lag behind their private counter parts in NPA management.

Table 5A: Macroeconomic Determinants of NPAs - Baseline specification results

We report the results of the Panel regression estimation for analysing the determinants of asset quality with gross non-performing assets (GNPA) as dependent variable (proxy for asset quality). Model 1a to 1f are estimated with panel least squares with cross-section weights (PCSE) standard errors & covariance. Model 2a to 2f are estimated with Panel Generalized Method Moments with cross-section weights (PCSE) standard errors & covariance and 2SLS instrument weighting matrix. We report the coefficient values marked with significance levels in the first row followed by the standard errors (in the parenthesis) in the second row. Asterisks \*\*\*, \*\* indicate levels of significance at 1%, and 5% respectively.

	Model 1a	Model 1b	Model 1c	Model 1d	Model 1e	Model 1f	Model 2a	Model 2b	Model 2c	Model 2d	Model 2e	Model 2f
CDR	-0.11** (0.055)	-0.13*** (0.040)	-0.1*** (0.040)	-0.17*** (0.040)	-0.10*** (0.045)	-0.11*** (0.038)	-0.13*** (0.037)	-0.13*** (0.037)	-0.12*** (0.037)	-0.17*** (0.042)	-0.10** (0.043)	-0.11*** (0.035)
COF	-1.27*** (0.365)	-0.85** (0.352)	-1.09*** (0.371)	-1.02*** (0.333)	-1.02*** (0.362)	-1.12*** (0.339)	-0.87*** (0.309)	-0.85*** (0.307)	-1.09*** (0.321)	-1.02*** (0.325)	-1.02*** (0.321)	-1.12*** (0.300)
CREDGR	-0.047 (0.034)	-0.008 (0.033)	-0.025 (0.031)	-0.035 (0.030)	-0.011 (0.030)	-0.054 (0.032)	-0.011 (0.028)	-0.008 (0.029)	-0.025 (0.028)	-0.035 (0.030)	-0.011 (0.027)	-0.054 (0.029)
GDPGR	-0.072 (0.163)	-0.114 (0.173)	-0.070 (0.169)	-0.059 (0.162)	-0.116 (0.169)	-0.072 (0.161)	-0.108 (0.155)	-0.114 (0.156)	-0.070 (0.153)	-0.059 (0.160)	-0.116 (0.153)	-0.072 (0.145)
OER	152.2*** (54.58)	108.3** (49.22)	84.95* (45.18)	106.3** (42.07)	124.2** (46.9)	135.0*** (43.50)	102.4** (40.83)	108.3** (44.84)	84.9** (41.86)	106.3** (41.98)	124.2*** (44.68)	135.03*** (39.420)
PSC	-0.032 (0.045)	-0.055 (0.040)	-0.066* (0.037)	-0.017 (0.039)	-0.063* (0.037)	-0.053 (0.035)	-0.059* (0.031)	-0.055 (0.033)	-0.066** (0.030)	-0.017 (0.036)	-0.063** (0.031)	-0.053* (0.030)
ROI	1.44*** (0.318)	1.12*** (0.304)	1.33*** (0.321)	1.21*** (0.285)	1.28*** (0.316)	1.31*** (0.290)	1.13*** (0.262)	1.12*** (0.260)	1.33*** (0.275)	1.21*** (0.276)	1.28*** (0.275)	1.31*** (0.254)
RUSUBRA	5.3* (2.664)	6.4*** (1.674)	8.1*** (1.969)	5.7*** (1.591)	7.1*** (1.741)	3.4* (1.888)	6.4*** (1.640)	6.4*** (1.643)	8.1*** (1.901)	5.7*** (1.718)	7.1*** (1.701)	3.498* (1.859)
SVGR	-0.056 (0.039)	-0.053 (0.042)	-0.055 (0.041)	-0.060 (0.039)	-0.050 (0.041)	-0.058 (0.039)	-0.054 (0.038)	-0.053 (0.038)	-0.055 (0.037)	-0.060 (0.040)	-0.050 (0.038)	-0.058 (0.036)
NBdummy		-0.231 (0.814)						-0.231 (0.731)				
SBdummy			-1.251 (0.798)						-1.251 (0.764)			
NPdummy				2.264*** (0.844)						2.264** (0.849)		
OPdummy					1.078 (0.801)						1.078 (0.649)	
FBdummy								-3.05*** (1.102)				-3.05*** (1.029)
Intercept	5.963 (5.067)	8.848* (4.752)	7.751 (4.696)	10.16** (4.470)	5.720 (5.248)	9.048** (4.431)	8.97** (4.265)	8.84** (4.312)	7.751* (4.213)	10.16** (4.539)	5.720 (4.916)	9.04** (4.064)
R-squared	0.878	0.852	0.858	0.869	0.857	0.870	0.852	0.852	0.858	0.869	0.857	0.870

**Table 5B: Macroeconomic Determinants of NPAs - Alternate specification results**

As an alternate specification we have introduced the Index of Industrial Production (IIPGR) and Inflation (INFLA) instead of GDP growth rate (GDPGR). Model 3a to 3f are estimated with panel least squares with cross-section weights (PCSE) standard errors & covariance. Model 4a to 4f are estimated with Panel Generalized Method Moments with cross-section weights (PCSE) standard errors & covariance and 2SLS instrument weighting matrix. We report the coefficient values marked with significance levels in the first row followed by the standard errors (in the parenthesis) in the second row. Asterisks \*\*\*, \*\* indicate levels of significance at 1%, and 5% respectively.

	Model 3a	Model 3b	Model 3c	Model 3d	Model 3e	Model 3f	Model 4a	Model 4b	Model 4c	Model 4d	Model 4e	Model 4f
COF	-1.60*** (0.45)	-1.79*** (0.47)	-1.81*** (0.46)	-1.62*** (0.45)	-1.74*** (0.44)	-2.07*** (0.42)	-1.60*** (0.38)	-1.79*** (0.39)	-1.81*** (0.38)	-1.62*** (0.38)	-1.74*** (0.37)	-2.07*** (0.37)
CREDGR	-0.02 (0.03)	-0.03 (0.03)	-0.04 (0.03)	-0.03 (0.03)	-0.02 (0.03)	-0.08** (0.03)	-0.02 (0.03)	-0.03 (0.03)	-0.04 (0.03)	-0.03 (0.03)	-0.02 (0.03)	-0.08*** (0.03)
IIPGR	-0.84*** (0.25)	-0.84*** (0.25)	-0.83*** (0.25)	-0.83*** (0.25)	-0.87*** (0.25)	-0.88*** (0.23)	-0.84*** (0.21)	-0.84*** (0.21)	-0.83*** (0.21)	-0.83*** (0.21)	-0.87*** (0.21)	-0.88*** (0.20)
INFLA	0.18 (0.41)	0.15 (0.41)	0.36 (0.42)	0.20 (0.41)	0.54 (0.43)	0.47 (0.38)	0.18 (0.37)	0.15 (0.37)	0.36 (0.39)	0.20 (0.37)	0.54 (0.39)	0.47 (0.34)
LR	0.56** (0.24)	0.70** (0.26)	0.42* (0.25)	0.52** (0.25)	0.26 (0.28)	0.51** (0.22)	0.56** (0.22)	0.70*** (0.24)	0.42* (0.25)	0.52** (0.23)	0.26 (0.25)	0.51** (0.20)
MCAP	-0.92 (1.18)	-0.80 (1.18)	-0.63 (1.18)	-0.87 (1.19)	-0.67 (1.15)	-0.54 (1.07)	-0.92 (1.07)	-0.80 (1.06)	-0.63 (1.06)	-0.87 (1.06)	-0.67 (1.03)	-0.54 (0.96)
OER	134.9*** (44.9)	104.5** (51.4)	106.0** (47.9)	138.9*** (45.4)	143.1*** (43.8)	155.3*** (40.8)	134.9*** (42.8)	104.5** (48.4)	106.0** (45.4)	138.9*** (43.2)	143.1*** (40.8)	155.3*** (36.8)
PSC	0.01 (0.04)	-0.01 (0.04)	-0.01 (0.04)	0.02 (0.04)	-0.02 (0.04)	0.01 (0.03)	0.01 (0.03)	-0.01 (0.03)	-0.01 (0.03)	0.02 (0.03)	-0.02 (0.03)	0.01 (0.03)
ROI	1.61*** (0.32)	1.74*** (0.34)	1.72*** (0.32)	1.62*** (0.32)	1.60*** (0.31)	1.80*** (0.29)	1.61*** (0.28)	1.74*** (0.29)	1.72*** (0.27)	1.62*** (0.28)	1.60*** (0.27)	1.80*** (0.26)
RUSUBRA	12.24*** (1.31)	12.47*** (1.32)	13.12*** (1.41)	12.23*** (1.32)	11.11*** (1.39)	7.77*** (1.71)	12.24*** (1.20)	12.47*** (1.17)	13.12*** (1.24)	12.23*** (1.18)	11.11*** (1.33)	7.77*** (1.52)
SVGR	0.12 (0.09)	0.11 (0.09)	0.11 (0.09)	0.11 (0.09)	0.12 (0.08)	0.11 (0.08)	0.12 (0.08)	0.11 (0.08)	0.11 (0.08)	0.11 (0.08)	0.12 (0.07)	0.11 (0.07)
NBdummy		1.08 (0.88)						1.08 (0.89)				
SBdummy			-1.29 (0.82)						-1.29 (0.82)			
NPdummy				0.67 (0.85)						0.67 (0.63)		
OPdummy					1.67** (0.81)						1.67** (0.64)	
FBdummy						-3.80*** (1.04)						-3.80*** (0.90)
C	-11.11** (4.42)	-11.70** (4.42)	-8.54* (4.65)	-11.03** (4.43)	-7.14 (4.70)	-7.46* (4.10)	-11.11*** (4.05)	-11.70*** (4.06)	-8.54** (4.29)	-11.03*** (4.06)	-7.14* (4.13)	-7.46* (3.72)
Adj. R-squared	0.83	0.84	0.84	0.83	0.84	0.87	0.83	0.84	0.84	0.83	0.84	0.87



We present in [Table 6](#) the results of the analysis for macroeconomic determinants of bank profitability. Subscribing to the theory of economies of scale, our results suggest that Asset size is significant and positively affecting bank profitability. Cost of funds (COF) is significant and negatively affecting profitability supporting our viewpoint that as the cost of funds increase the profits experience the pressures. OER is negative and significantly impacting on profitability. This evidences the theory that enhanced efficiency results in higher profitability. As well established in theory, our results suggest that as the ROI increases, the profitability of the banks too increases as well. Priority sector credit is found to be significant and negatively associated with profitability suggesting that the higher the priority sector credit, the lower would be bank profitability. In accordance with the theory, our results evidence that NPAs are negatively associated with profitability. Finally, one of the corollary objectives of this study was to know whether the profitability is affected by the ownership styles of the banks. This issue was investigated by introducing the ownership dummies as explained earlier. The results indicate that excluding old private banks, other ownership styles appear to perform better in profitability management.

#### *Robustness Checks*

To ascertain whether the empirical results presented above are robust, four routes were explored. First, the robustness of the results with respect to the presence of outliers was investigated; the main results were not found to be driven by outliers. Second, the robustness of the above results to various specifications was investigated by various iterations of regression analysis. Variables included in the above specifications were excluded one by one and combinations of them and the final results presented are found robust to those modifications after duly considering the potential biases resulting from the omitted variables. Third, to ensure the non-stationary of the data, (as the recent literature suggests, panel-based unit root tests have higher power than unit root tests based on individual time series) we estimate panel-based unit roots. Fourth, we perform Three-stage least-squares regressions for the Simultaneous equations involving dependent variables GNPA – ROA and GNPA – ROE. In addition, we run robust regressions for GNPA, ROA and ROE to verify our results. We find that the results pass the tests of robustness checks (refer [Table 7](#)).

**Table 6: Macroeconomic Determinants of Bank Profitability**

We report the results of the Panel Generalized Method Moments with cross-section weights (PCSE) standard errors & covariance and 2SLS instrument weighting matrix for analysing the determinants of bank profitability with return on assets (ROA) and return on equity (ROE) as the dependent variables. We report the coefficient values marked with significance levels in the first row followed by the standard errors (in the parenthesis) in the second row. Asterisks \*\*\*, \*\* indicate levels of significance at 1%, and 5% respectively.

	Dependent variable - ROA						Dependent variable – ROE					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
ASSET	1.09** (0.53)	1.1*** (0.35)	0.46* (0.23)	0.61*** (0.21)	0.86* (0.45)	0.59*** (0.21)	0.10 (0.73)	0.84* (0.48)	0.83** (0.39)	0.91** (0.38)	0.30 (0.63)	0.90** (0.38)
CAR	0.17 (0.17)	0.25 (0.18)	0.29 (0.18)	0.27 (0.16)	0.38** (0.17)	0.22 (0.16)	1.18*** (0.23)	1.25*** (0.23)	1.17*** (0.23)	1.20*** (0.23)	1.21*** (0.22)	1.21*** (0.23)
CDR	0.00 (0.04)	0.00 (0.03)	0.01 (0.03)	0.07** (0.03)	0.04 (0.04)	0.01 (0.02)	-0.10 (0.07)	-0.10* (0.05)	-0.11** (0.05)	-0.09 (0.06)	-0.14** (0.06)	-0.11** (0.05)
COF	-0.20 (0.23)	-0.22 (0.26)	-0.23 (0.26)	-0.25 (0.23)	-0.25 (0.26)	-0.21 (0.22)	-1.66*** (0.41)	-1.66*** (0.43)	-1.65*** (0.42)	-1.66*** (0.42)	-1.64*** (0.42)	-1.65*** (0.43)
GDPGR	-0.02 (0.10)	-0.02 (0.11)	-0.01 (0.11)	0.01 (0.11)	0.04 (0.12)	0.00 (0.10)	0.24 (0.18)	0.27 (0.18)	0.23 (0.18)	0.26 (0.18)	0.25 (0.18)	0.26 (0.18)
GNPA	-0.15* (0.08)	-0.05 (0.08)	-0.05 (0.08)	-0.12 (0.08)	-0.03 (0.09)	-0.15* (0.08)	-0.37** (0.15)	-0.41*** (0.14)	-0.39*** (0.14)	-0.38** (0.15)	-0.40*** (0.14)	-0.39** (0.15)
IDR	-0.03 (0.05)	0.00 (0.04)	0.01 (0.04)	0.02 (0.04)	0.04 (0.05)	-0.02 (0.04)	0.03 (0.06)	0.04 (0.06)	0.02 (0.06)	0.03 (0.06)	0.01 (0.06)	0.03 (0.06)
OER	-52.04 (33.93)	21.35 (27.92)	21.79 (28.64)	-15.76 (26.43)	27.93 (31.76)	-61.6** (29.88)	-324.0*** (68.52)	-308.0*** (50.98)	-308.0*** (50.91)	-320.4*** (55.13)	-319.5*** (51.04)	-322.1*** (61.29)
PSC	-0.06** (0.03)	-0.08*** (0.03)	-0.06** (0.02)	-0.02 (0.02)	-0.05* (0.02)	0.04* (0.02)	-0.08* (0.04)	-0.06 (0.04)	-0.05 (0.04)	-0.07* (0.04)	-0.05 (0.04)	-0.06 (0.04)
ROADV	0.25* (0.13)	0.32** (0.13)	0.35** (0.14)	0.36*** (0.13)	0.30** (0.13)	0.26** (0.12)	0.56** (0.25)	0.46** (0.22)	0.51** (0.22)	0.49** (0.23)	0.45** (0.23)	0.46** (0.23)
ROI	0.08 (0.26)	0.12 (0.19)	0.08 (0.23)	0.01 (0.18)	0.20 (0.28)	0.04 (0.17)	1.33*** (0.38)	1.77*** (0.31)	1.66*** (0.33)	1.75** (0.31)	1.53*** (0.36)	1.76*** (0.31)
RUSBUBRA	-1.14 (1.01)	-3.29** (1.48)	-2.85* (1.59)	-1.40 (1.26)	-1.62 (1.33)	-0.16 (1.08)	5.31 (3.47)	5.72* (2.91)	4.60 (2.95)	5.62** (2.75)	5.66** (2.77)	5.81** (2.87)
NBdummy		1.92*** (0.65)						0.17 (1.16)				
SBdummy			1.07** (0.50)						0.80 (0.97)			
NPdummy				1.94*** (0.25)						0.64 (0.92)		
OPdummy					0.83 (0.96)						1.53 (1.31)	
FBdummy						3.08*** (0.79)						0.52 (1.17)
INTERCEPT	-16.51 (12.28)	-20.4*** (6.42)	-12.8* (6.75)	-17.6*** (5.71)	-24.6** (12.14)	-11.3* (5.90)	7.34 (15.39)	-9.59 (9.60)	-6.55 (10.18)	-9.98 (9.45)	3.70 (14.55)	-8.88 (9.57)
Adj. R-squared	0.38	0.28	0.24	0.32	0.21	0.39	0.61	0.61	0.62	0.62	0.62	0.61

**Table 7: Results of Robustness Tests:**

We present the results of the robustness check tests to verify the soundness of the results of our specifications for analysing the determinants of banks asset quality and profitability. In the first part, we run Three-stage least-squares regressions for the Simultaneous equations involving GNPA and ROA in model 1, and GNPA and ROE in model 2. In the second part, we also run robust regressions for GNPA, ROA and ROE. We report the coefficient values marked with significance levels in the first row followed by the standard errors (in the parenthesis) in the second row. Asterisks \*\*\*, \*\* indicate levels of significance at 1% and 5% respectively.

	Simultaneous Equations				Robust Regressions		
	Three-stage least-squares regressions				GNPA	ROA	ROE
	(1)		(2)				
	GNPA	ROA	GNPA	ROE			
Constant	-5.94** (2.610)	-14.500 (10.436)	-5.579** (2.6077)	-4.7763 (19.393)	-7.25** (2.76)	2.40* (1.36)	-1.91 (22.08)
COF	-1.46*** (0.3245)	-0.2729 (0.4219)	-1.38*** (0.3236)	-2.4*** (0.9137)	-1.08*** (0.35)	-0.067** (0.032)	-1.85*** (0.527)
CREDGR	-0.072** (0.0289)		-0.0396 (0.0279)		-0.15*** (0.035)		
GDPGR	-0.1277 (0.1476)	-0.041 (0.107)	-0.1647 (0.1472)	0.0433 (0.2312)	-0.001 (0.15)	0.012 (0.032)	0.239 (0.217)
ASSET		1.103** (0.4538)		0.1240 (0.8352)		-0.08 (0.06)	0.148 (0.98)
CAR		0.1749 (0.1564)		1.14*** (0.3027)		0.07*** (0.018)	1.09*** (0.30)
CDR		-0.0032 (0.0495)		-0.0841 (0.0982)		-0.002 (0.005)	-0.032 (0.089)
GNPA		-0.0755 (0.3214)		-1.1528 (0.7072)		-0.007 (0.01)	-0.203 (0.177)
IDR		-0.0284 (0.0397)		0.0384 (0.0735)		-0.002 (0.005)	0.056 (0.082)
OER	199.5*** (45.57)	-35.432 (69.69)	211.6*** (45.43)	-130.29 (152.62)	239.7*** (48.95)	-13.4*** (4.93)	-375.7*** (79.90)
PSC	-0.0612 (0.0395)	0.0568* (0.0303)	-0.0565 (0.0395)	-0.1216* (0.0661)	-0.05 (0.041)	-0.005 (0.003)	-0.08 (0.05)
ROADV		0.2533 (0.1611)		0.5988* (0.3088)		0.011 (0.018)	0.664** (0.298)
ROI	1.710*** (0.267)	0.1870 (0.4493)	1.6*** (0.2657)	2.49*** (0.9702)	1.45*** (2.90)	0.038 (0.031)	1.44*** (0.51)
RUSUBRA	5.303** (2.4547)	-0.7028 (2.6107)	5.67** (2.4521)	10.17* (5.7434)	-2.41 (2.66)	-0.274 (0.232)	-5.414 (3.761)
SVGR	-0.0425 (0.0355)		-0.079* (0.0336)		0.004 (0.039)		
SBdummy	4.352** (1.8996)	-3.0614* (1.7955)	4.05** (1.897)	4.8627 (3.7748)	6.39*** (2.05)	0.63*** (0.213)	2.409 (3.46)
NBdummy	4.3021 (1.6077)	-4.206** (1.6849)	3.87** (1.602)	4.6398 (3.4823)	6.0*** (1.73)	0.438** (0.202)	2.443 (3.27)
OPdummy	6.10*** (1.6197)	-2.4232 (1.9845)	5.87*** (1.6181)	4.0756 (4.1086)	7.45*** (1.72)	1.418*** (0.218)	0.115 (1.622)
NPdummy	3.63*** (1.0715)	-2.506** (1.1752)	3.19*** (1.0632)	1.5894 (2.5508)	4.66*** (1.14)	1.41*** (0.100)	-0.738 (1.622)
R Square	0.8683	0.5292	0.8624	0.5423			
RMSE	1.6961	1.0922	1.7338	2.3472			
chi2	428.5***	69.74***	427.76	88.16	F=33.55	F=27.35	F=6.97

## **VI. Summary and Conclusion**

This study has comprehensively analysed the macroeconomic determinants of bank asset quality and profitability. Several policy implications can be garnered from this analysis. In favourable macroeconomic conditions, NPA management leads to better asset quality. First, as banks grow in size, they tend to control the NPA owing to efficiency in their management. There is a case for consolidation of banks in the public sector to reap this potential of efficiency in scale of operations. Larger banks have exhibited better credit risk management with lower NPA levels. Second, in contrast to the perception of some urban bankers that PSL causes NPAs, this study finds that PSL does not contribute significantly to NPAs. This supports the contention that branch expansion in rural and semi-urban areas for extending priority sector credit is a viable proposition, and there need not be aversion to this by policy makers or industry heads. Third, ownership of banks is an interesting issue that has been debated quite often. This study establishes that private and foreign banks have advantages in terms of efficiencies in better credit management in containing NPAs, which indicates that bank privatization can lead to better management of default risk. These findings infer that better credit risk management practices need to be taken up for bank lending. Adequate attention should be paid to those banks with low operating efficiency and low capitalization, as also to macroeconomic cycles that appear to be playing some role in NPA management. The NPA management practices of state-owned banks need sharpening. It is summarized that foreign and private banks (both old and new) appear to manage their NPAs efficiently. The State Bank group and nationalized banks appear to lag behind their private counterparts in NPA management.

Investigating the industry-specific and macroeconomic determinants of profitability for commercial banks in India, we notice that capital adequacy influences profitability positively. It can be inferred that although capital infusion comes with a cost, it improves the profitability. These results contribute to the existing literature, particularly in the context of emerging economies, by providing new understanding about the determinants of quality of assets and profitability of banks.

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## Appendix 1: Description of Variables

Variable	Empirical Definition and explanation
ASSET	Size of the bank is represented by the total asset of the bank (natural log) and is expected to have a positive effect on profitability.
CAR	Capital Adequacy Ratio (also called CRAR) is the ratio of the capital of the bank against its risk weighted assets. It is expected to have a positive effect on profitability.
CDR	Credit Deposit Ratio represents the ratio of the loans outstanding vis-à-vis deposits outstanding in a bank. Very high CDR indicates the aggressive lending activity of the bank and is predicted to have a positive effect on the NPA levels and negative effect on the profitability as increasing NPA levels lead to non-realisation of income by the bank.
COF	Cost of Funds in percentage is the cost incurred by the bank in raising its funds for banking business in which cost of deposits constitutes a major chunk. It is expected to negatively affect the NPAs as the rising cost of funds compels the bank to selectively go for quality credit deployment and hectic recovery measures. Further, it would negatively on the profitability, as the increase in cost of funds would drain away the margin for the bank.
CREDGR	Bank Credit Growth Rate (Growth in real advances) is measured in percentage and is expected to negatively affect the NPAs and positively influence the income of the bank.
ER	Exchange rate levels are expressed by the trend in the exchange of domestic currency vis-à-vis US Dollar widely considered as the global anchor currency. It is expected that as the exchange rate for Dollar increases, the domestic currency depreciates leading the unhealthy scenario on many fronts in the economy and hence it is predicted to impact on the banking industry too.
GDPGR	Growth Rate of real Gross Domestic Product (measured in percentage growth) is the variable that controls for the impact of macroeconomic activity on the banking industry. It is expected to have a negative effect of the NPAs and on the other hand positively affect the profitability of the bank.
GNPA	Gross NPA to Total Advances is a broad measure of non-performing bank assets. The higher the ratio the higher is the loss of profitability for the bank and speaks low about the bank's efficiency in credit management. It is expected to have a significant negative impact on the profitability.
IDR	Investment to Deposit Ratio explains the level of Investments as against the Deposit levels of the bank and is expected to have a positive impact on profitability and negative impact on the NPA levels.
IIPGR	Index of Industrial Production (IIP), measured in percentage annual growth of industrial production in the economy is expected to have a significant effect on the NPAs.
INFLA	Inflation levels measured in annual growth of whole sale price index in the economy is expected to have a positive and significant impact on the NPAs
LR	Bank Lending Rates measured in percentage are expected to positively affect the NPA levels as the rising loan rates would lead to defaults thereby causing NPAs.
MCAP	Market capitalisation of Bombay Stock Exchange (BSE) is considered as a proxy for the market activity and its sentiments in the Indian industry. For the purpose of this analysis, the annual growth in the market capitalisation is considered and is expected to positively affect the profitability and negatively impact on the NPA levels.
OER	Operating Expenses to Total Assets is expressed in ratio and is predicted to negatively impact the profitability of the banks as the reduction in operating costs would lead to rise in net profit.
PSC	Priority Sector Credit to Total Loans is measured in ratio and is expected to positively impact on the NPA levels as per popular perception of the banking industry and negatively impact on the profitability.
ROA	Return On Assets of banks is measured in ratio and is considered an accounting measure of the profitability of a firm. It is expected to have negative relationship with NPA levels.
ROADV	Return On Advances is an accounting ratio measured with the amount of income generated by the lending activity of the bank (income by loans). Obviously it is expected to have a positive effect on profitability
ROE	Return On Equity of banks is measured in ratio and is considered an accounting measure of profitability of a firm. Similar to ROA it is also expected to have negative relationship with profitability of the bank.

ROI	Return on Investment is measured as the percentage of income earned by the bank out of its investment (mostly in market and off-market investment portfolios) other than loans and advances. Higher the ROI, the higher is the positive impact on profitability.
RUSUBRA	Ratio of number of Rural and Semi-Urban branches to total bank branches is expressed in ratio. It is generally believed that increase in this ratio would positively affect the NPA levels and negatively affect the profitability.
SVGR	Savings Growth Rate is expressed in ratio and represents the level of savings activity in the economy. The role of this variable in this analysis is to control for the effects of savings activity in the economy on the banking industry.

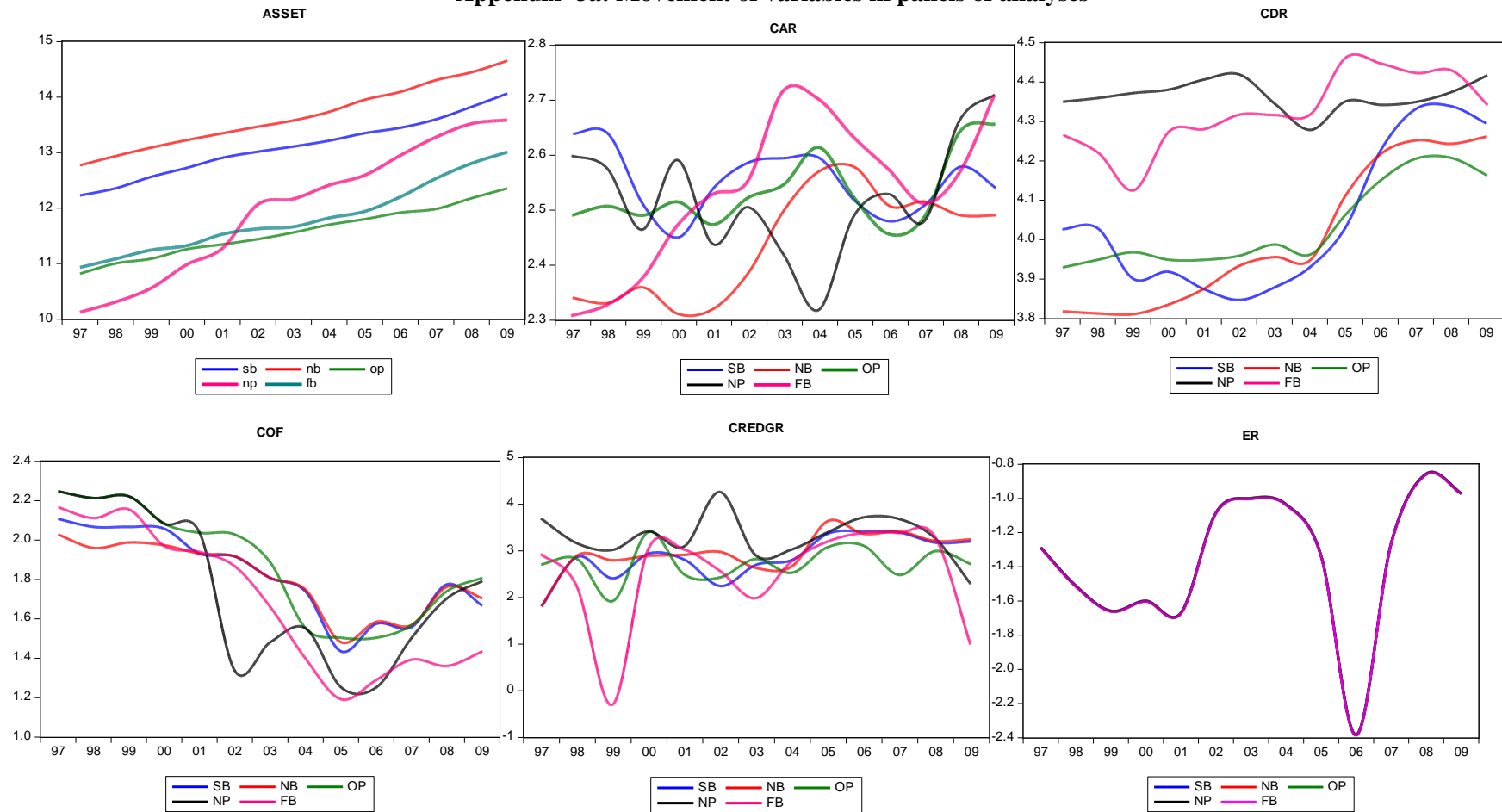
## Appendix 2: Descriptive Statistics of Variables

	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
ASSET	25000.00	2314102.00	429639.83	466356.88	2.01	4.55
CAR	10.10	15.20	12.49	1.27	0.04	-0.17
CDR	45.24	87.18	65.28	13.00	-0.07	-1.47
COF	0.01	0.05	0.02	0.01	1.35	1.88
CREDGR	0.74	71.04	20.78	10.96	1.57	5.79
ER	0.09	0.43	0.28	0.09	-0.20	-0.76
GDPGR	3.80	9.60	6.98	1.90	-0.29	-1.15
GNPA	1.70	19.05	6.80	4.71	0.82	-0.46
IDR	33.29	60.42	45.06	7.25	0.42	-0.51
IIPGR	2.80	11.50	6.81	2.16	0.19	0.16
INFLA	3.70	9.30	5.76	1.50	0.56	0.26
LR	10.75	18.00	14.23	1.81	-0.08	-0.64
MCAP	-0.37	1.10	0.29	0.40	0.37	-0.48
OER	0.01	0.05	0.02	0.01	1.35	1.88
PSC	8.31	47.69	28.80	8.52	0.09	-0.41
ROA	0.10	8.20	1.11	0.99	5.98	42.49
ROADV	3.65	17.12	10.62	2.72	0.26	0.26
ROE	6.25	23.20	14.80	3.50	-0.26	0.49
ROI	5.70	12.66	9.40	2.23	-0.02	-1.55
RUSUBRA	0.00	0.74	0.39	0.27	-0.27	-1.53
SAVGR	0.03	0.27	0.16	0.07	-0.39	-1.13

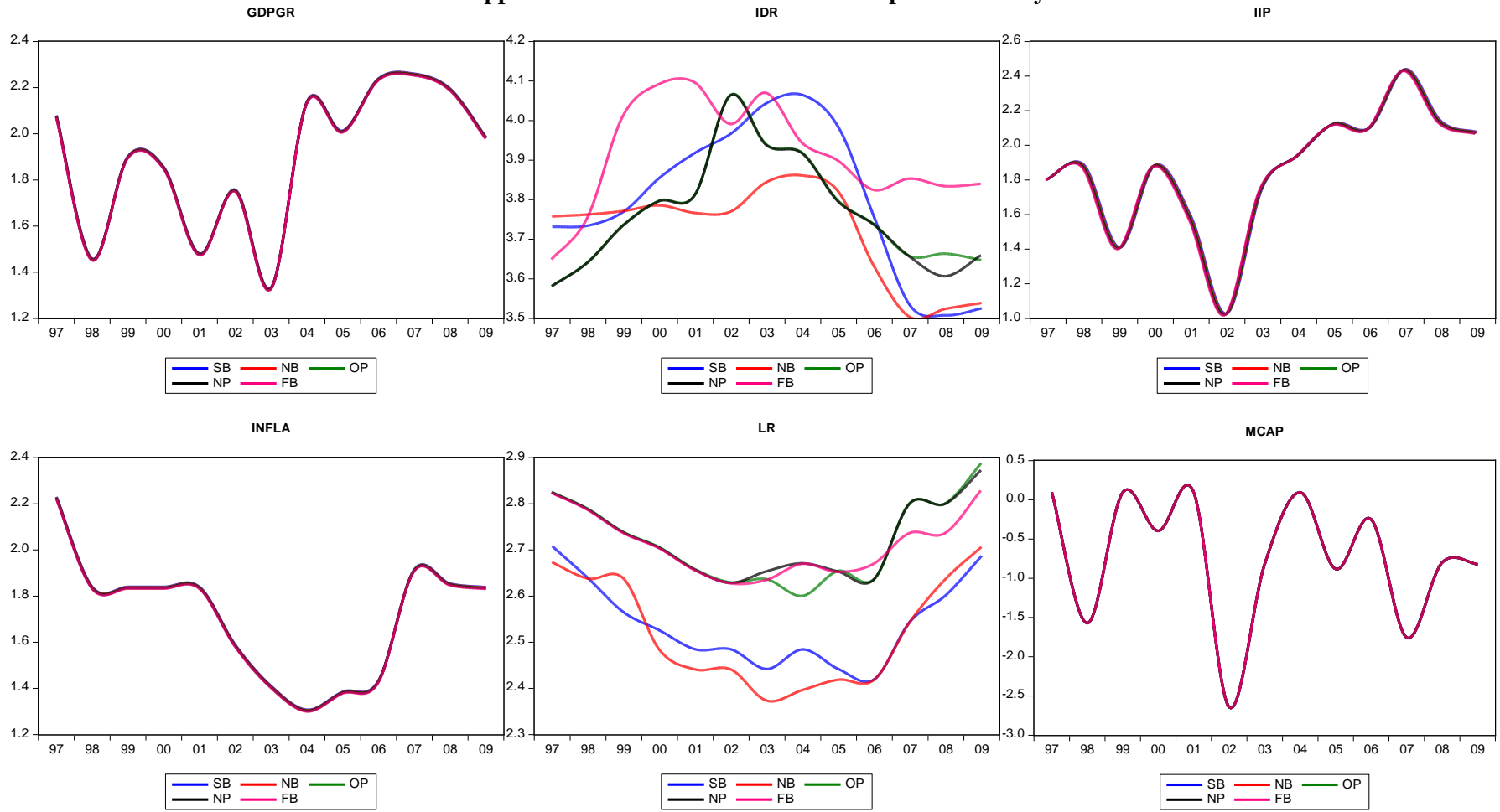
Note: ASSET that describes the bank assets is denominated in INR crores. All other variables are presented in ratios



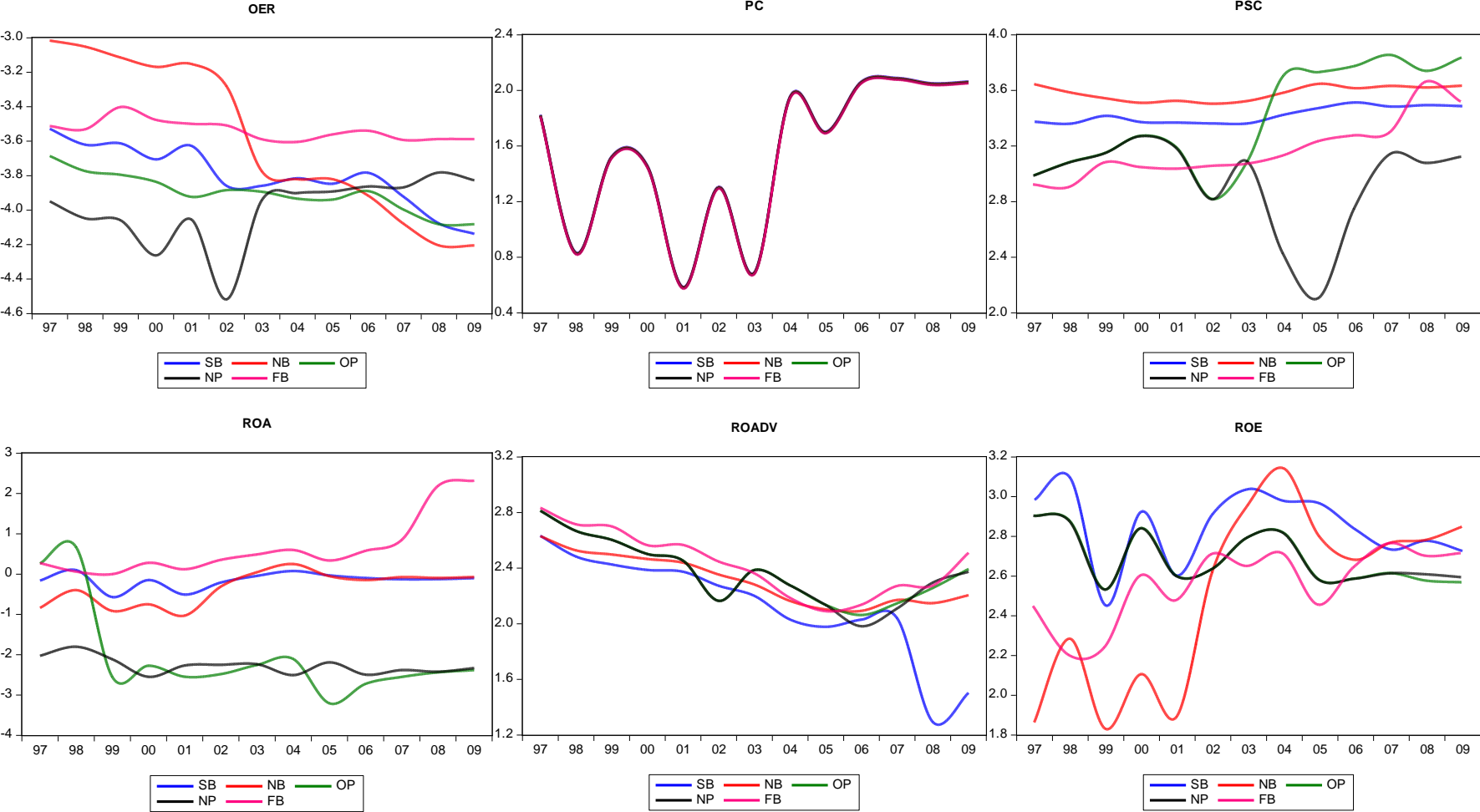
### Appendix -3a: Movement of variables in panels of analyses



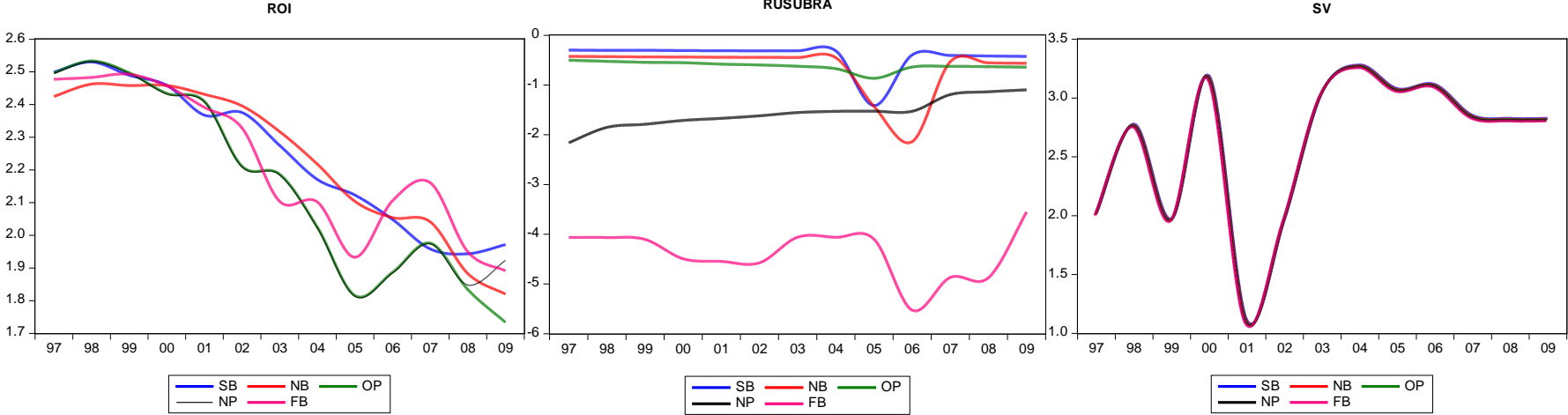
### Appendix 3b: Movement of variables in panels of analyses



**Appendix 3c: Movement of variables in panels of analyses**

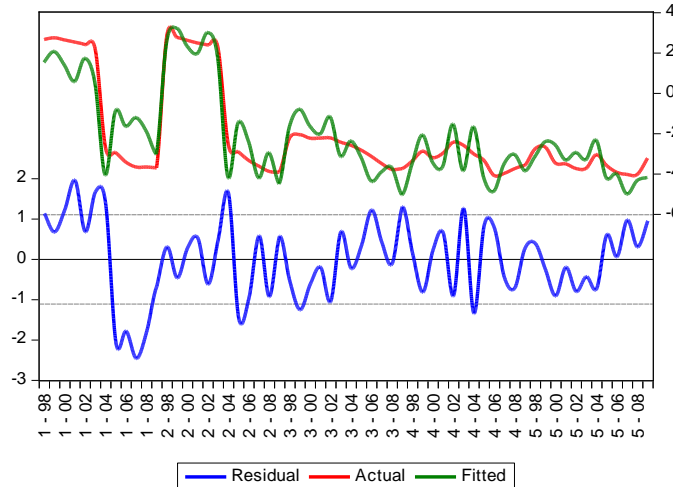


**Appendix 3d: Movement of variables in panels of analyses**

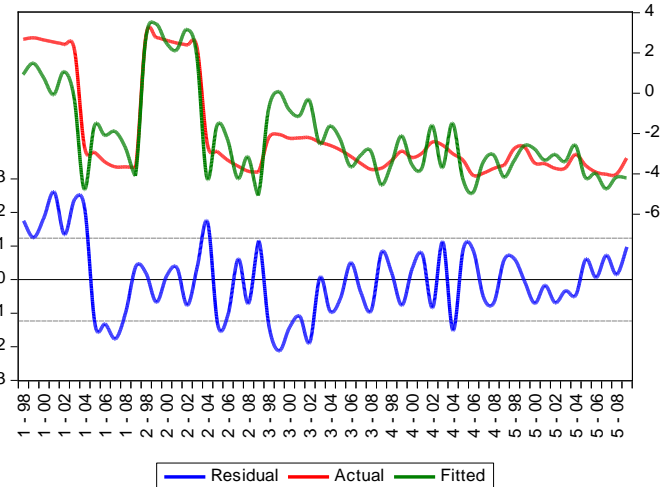


### Appendix 4: Chart of residuals - Analyses for determinants of bank asset quality

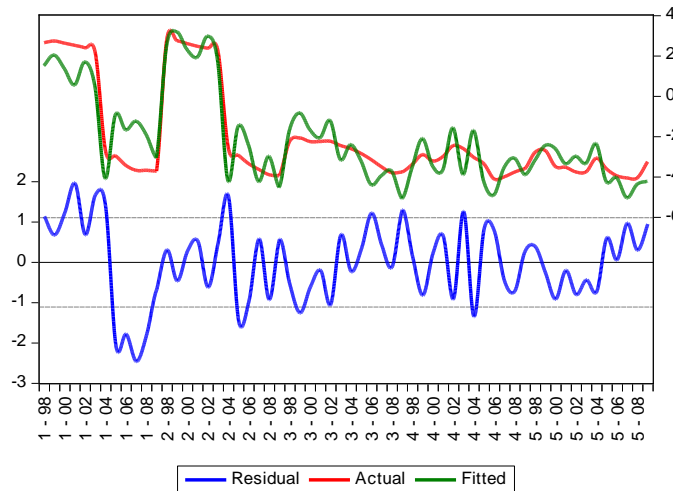
MODEL 1a



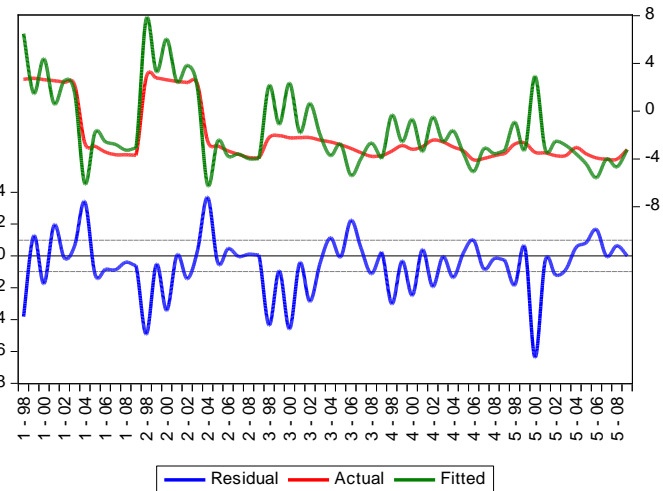
MODEL 1b



MODEL 2a



MODEL 2b

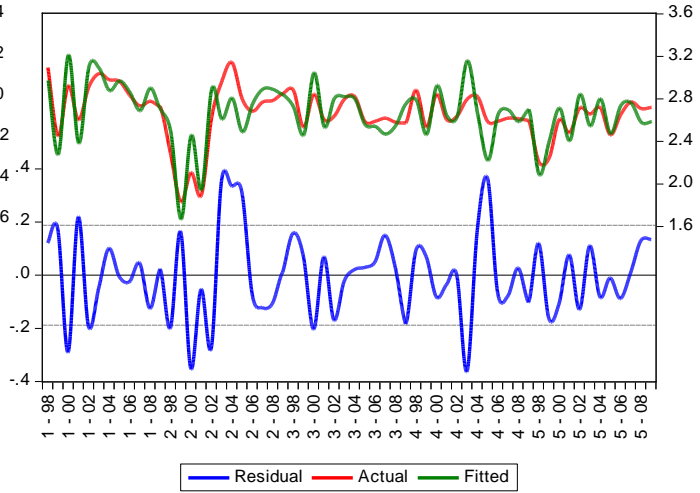


## Appendix 5: Chart of residuals - Analyses for determinants of Profitability

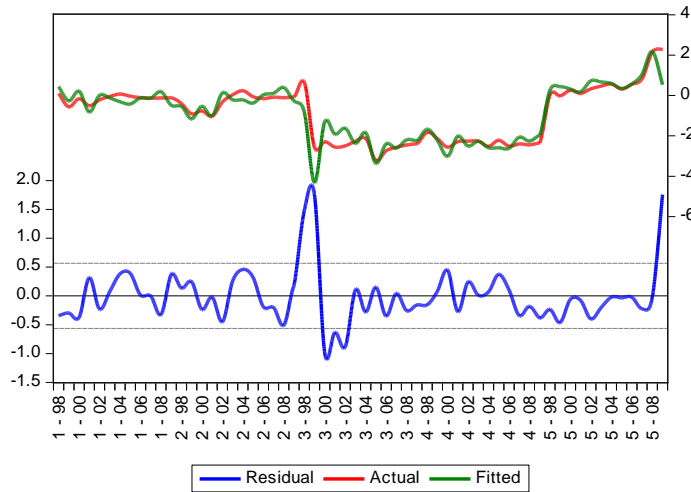
**Model-3a**



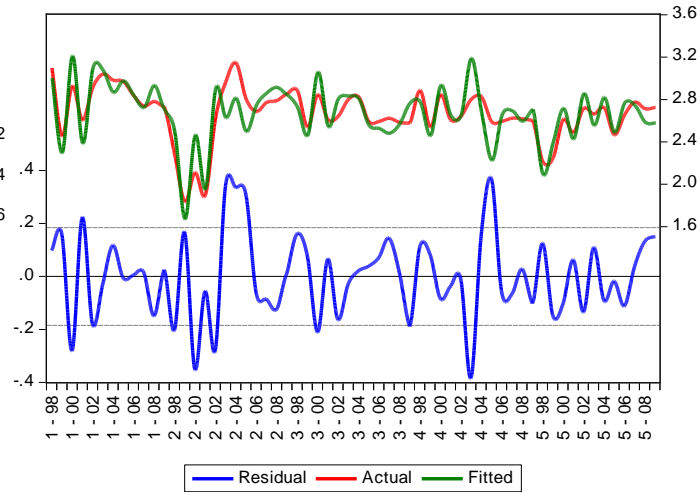
**Model-4a**



**Model-3b**



**Model-4b**



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The Editor