Modeling the NPA of a Midsized Indian Nationalized Bank as a Function of Advances

Rajveer Rawlin*

Senior Lecturer in Finance, Department of Management Studies,

Dayananda Sagar College of Engineering, Kumaraswamy layout,

Bangalore 560078, Karnataka, India

Email: samuelrr@yahoo.com

Tel: (+) 91-80-26662226 Mb: (+) 91-9480217380 Fax: (+) 91-80-26660789

Shwetha M Sharan

2nd Year MBA Student, Department of Management Studies,

Dayananda Sagar College of Engineering, Kumaraswamy Layout

Bangalore-560078, Karnataka, India

Pradeep B Lakshmipathy

2nd Year MBA Student, Department of Management Studies,

Dayananda Sagar College of Engineering, Kumaraswamy Layout

Bangalore-560078, Karnataka, India

Abstract

Non-performing assets (NPA) occur in loans given by a bank or a financial institution where in the borrower defaults or delays interest and or principal payment. The management of NPAs therefore, is a very important part of credit management of banks and financial institutions in the Country. Currently NPA estimates in India are predominantly obtained from the figures published by the Reserve Bank of India (RBI). However it would be helpful for banks and financial institutions to have an estimate of the NPA as soon as loan amounts are disbursed. This study attempted to develop a predictive model for the NPA% at both the gross and net level from the advances made at a midsized Indian national bank. A strong correlation was observed between gross and net NPA% and the advances made suggesting that estimates of gross and net NPA can be made from advances. Linear and non linear models were fit to predict the NPA% from the amounts advanced. A non linear model linking both Gross and net NPA to advances provided the best curve fit and the least deviation from actual values. Thus by simply looking at advances an overall picture of the banks NPA level can be ascertained.

Keywords:, Advances, Gross NPA, Indian nationalized Bank, Linear Model, Net NPA, Non Linear Models, NPA Management.

1. Introduction

Industries and businesses are major drivers of the Indian national economy. Bank finance is an effective mechanism for strengthening industrial activity in the country, particularly when it involves industry

segments that cover the small and medium scale enterprises (SME's) not listed on the countries major stock exchanges (Mallick et al., 2010). However, when industries or businesses experience difficulties related to a weakening economic environment or business slowdown, and viability of the business is called into question industries may   fail to meet their obligations towards interest and principal payments of the loans availed by them. Banks may then classify such accounts as distressed assets and eventually as non performing assets (NPAs). The management of NPAs therefore is a very important part of credit management of banks and financial institutions in the country. By looking at NPAs one can monitor the asset quality of the bank as a whole (Meeker and Laura, 1987).

The primary aim of any business is to make profits. Therefore any asset created in the course of conduct of the business should generate income for the business. This applies equally to the business of the banks. Banks, typically offset deposits by gaining higher margins through amounts advanced as loans. Interest payments if not made 180 days after they are due can be classified as NPAs (www.rbi.gov.in). Studies have shown that the terms of credit given to borrowers significantly impacts the amount of NPAs at the bank (Ranjan et al., 2003). If for any reasons such assets created do not generate any income or become difficult to recover, then the very position of the banks on repaying the deposits on the due date would be at stake and in jeopardy. Banks with such asset portfolio would become weak and naturally such weak banks will lose the faith and confidence of the investors.   Ultimately unrecoverable amounts are written off as NPA's, which are a direct function of amounts advanced as loans (Mallick et al., 2010).

The asset quality of the banks can be assessed by monitoring NPAs. When NPAs arise, banks have to make provisions for the same as per the regulatory prescriptions. Therefore it would be prudent for the banks to manage their assets in such a manner that they always remain healthy, generate sufficient income, and capable of meeting obligations on due dates. Currently banks and financial institutions and their investors rely on the Reserve Bank of India (RBI) to publish NPA data. This could potentially take a long time. It would be hence useful to arrive at an estimate of NPA right as soon as advances are made. This study attempts to assess the NPA level of one of the nationalized banks in India as a direct function of the loans advanced. While gross NPAs are directly based on advances, net NPA's factor in provisioning allowed for loan losses (www.rbi.gov.in). The purpose of the study was to find out the nature and extent of the relationship between the NPA's and the advances made by a midsized public bank in India. A relationship between the two can help us measure Gross and Net NPAs directly from advances. Given the time lag involved in establishing a problem loan as an NPA it would be useful if an NPA estimate can be made as and when loans are advanced.

2. Literature Review

The accumulation of non-performing assets in banks has assumed great importance as it tends to reflect asset quality as a whole (Meeker and Laura, 1987). There are several factors that contribute to NPA's at banks and other financial institutions. Keeton and Morris, 1987 were one of the earliest researchers to examine the causes of loan losses. On examining the losses in 2,470 insured commercial banks in the United States (US) from 1979-85 using non performing loans (NPLs) net of charge offs as the primary measure of loan losses, it was observed that local economic conditions along with the weak performance of

certain sectors contributed to the variation in loan losses recorded by these banks. The study also showed that commercial banks taking greater risk tend to record higher losses. Sinkey and Greenwalt, 1991 employed a simple log-linear regression model to study loan losses in large commercial banks in the United States from 1984 to 1987. They found that both internal and external factors contribute to the loan-loss rate of these banks. These authors find a significant positive relationship between the loan-loss rate and internal factors such as high interest rates, excessive lending, and volatile funds and also external factors such as depressed regional economic conditions. Using a vector auto regression model Keeton, 1999 analyzed the impact of credit growth and loan delinquencies in the US. The study found a strong relationship between credit growth and impaired assets.   Rapid credit growth, which was associated with lower credit standards, contributed to higher loan losses in certain states in the US.

Studies that examined other financial systems also corroborate the findings made in the US.   Bercoff et al., 2002 examined the fragility of the Argentinean banking system from 1993-1996. It was found that NPLs are affected by both bank specific factors and macroeconomic factors. Using a dynamic model and a panel dataset covering the period 1985-1997 to investigate the determinants of problem loans of Spanish commercial and saving banks, Salas and Saurina, 2002 find that real growth in GDP, rapid credit expansion, bank size, capital ratio and market power determine variation in NPLs. Jimenez and Saurina, 2005 find more support for this while examining the Spanish banking Sector from 1984 to 2003. They find in addition to GDP growth, NPLs are also determined by high real interest rates and lenient credit terms used by bank managers while lending excessively in periods of economic boom. Ranjan and Dhal, 2003 used panel regression analysis and found that favorable macroeconomic conditions (measured by GDP growth) and financial factors such as maturity, cost and terms of credit, banks size, and credit orientation significantly influenced the NPLs of commercial banks in India. Using a pseudo panel-based model for several Sub-Saharan African countries, Fofack, 2005 finds evidence that economic growth, real exchange rate appreciation, the real interest rate, net interest margins, and inter-bank loans are significantly impact NPLs in these countries. The strong association between the macroeconomic factors and non-performing loans was attributed to the undiversified nature of some African economies. Hu et al., 2006 analyzed the relationship between NPLs and ownership structure of commercial banks in Taiwan with a panel dataset covering the period 1996-1999. The study shows that banks with higher government ownership recorded lower non-performing loans. The study found that bank size is negatively related to NPLs. Larger the size of the bank lesser the NPLs.

Quagliariello, 2007 has shown that business cycles significantly impact NPA management and control. Sanjeev, 2007 finds that external factors such as economic down turns influence NPA's more than internal factors. Shehzad et al., 2008 find that ownership concentration affects loan quality and capitalization of companies significantly. Waweru, 2009 investigated the causes of nonperforming loans in Kenya and found that the national economic downturn, the failure of customers to disclose vital information during the loan application process and the lack of an aggressive debt collection policy were the key contributors to the NPA problem. Liang et al., 2008 found that private banks in Taiwan were less efficient in NPA management than their public counterparts even though they were more productive than their public peers. Thus the current literature is focused on establishing the determinants and causes of the NPA problem in banks.

However models to forecast the NPA at banks are yet to be developed.

3. Need of the Study

As NPA's are a direct reflection of asset quality, estimating them can prove useful in overall credit management. Given large time lags involved in establishing problem loans as NPAs (substandard, doubtful and loss), the current work has been undertaken to help managers at banks arrive at a quick estimate of NPA as soon as advances are made without waiting for calculated NPAs from the RBI which can prove laborious and time consuming.

4. Research Objective

To obtain a reasonable estimate of NPA both in terms of gross and net from the advances made by a mid-sized Indian public bank.

5. Methodology

This study used historical data to study the impact of the independent variable advances, on the dependent variables which were the gross & net NPA% of a midsized Indian bank. The study was conducted with secondary data over the past ten year period i.e. from the financial year 2000-01 to 2009-10. Historical data on the gross & net NPA percentages were obtained from figures published by the Reserve Bank of India (www.rbidocs.rbi.org.in/rdocs/Publications). Data for the advances were obtained from company balance sheets documented in the Capitaline financial database (www.capitaline.com). The relationship between the NPA% and advances was studied with the Statistics SPSS 18.0 package, curve estimation function.

Correlation coefficients were determined to study the relationship between the NPA% and the independent variable advances. Linear and non linear models were developed to predict the NPA% as a function of advances. Linear models were simple linear relationships obtained from SPSS between the dependent and independent variable. Non-linear models were those where the dependent variable was expressed as non linear combinations of the independent variables obtained from the curve estimation function in SPSS after several combinations of the independent variables were studied. The Curve Estimation routine in SPSS is a curve-fitting program to fit linear, logarithmic, inverse, quadratic, cubic, power, compound, S-curve, logistic, growth, and exponential models to data based on their relative goodness of fit. Significant F values from ANOVA analysis and regression coefficients such as R^2 were computed and used to determine the statistical significance of the above models. Gross and net NPA figures were then computed from the model with the most appropriate fit. Predicted values were compared to actual published NPA% values obtained from the RBI website. Differences between actual and predicted values were tabulated.

6. Discussion and Analysis

A strong banking sector is important for a flourishing economy. The failure of the banking sector may have an adverse impact on other sectors too. The Indian banking system, which was operating in a closed economy, now faces the challenges of an open economy. On one hand, a protected environment ensured that banks never needed to develop sophisticated treasury operations and asset liability management skills. On the other hand a combination of directed lending and social banking pushed profitability and competitiveness to the background. The net result was unsustainable NPAs and consequently a higher effective cost of banking services. Some of the reasons for an account becoming NPA includes, lack of

proper enquiry by the bank before sanctioning loans/advances to the customer (Ranjan et al., 2003), non performance of the business for the purpose of which the customer has taken the loans/advances, willful defaulters (Sanjeev (2007), loans sanctioned for agricultural purposes that were not paid back by farmers etc leads to NPA's. The main cause of NPAs in the banking sector is the non repayment of the interest and/installments for the loans/advances borrowed. Such amounts remaining unfulfilled 180 days after the obligation is due can be classified as NPAs (www.rbi.gov.in).

Banks are required to classify NPAs into the following three categories, based on the period for which the asset has remained nonperforming:
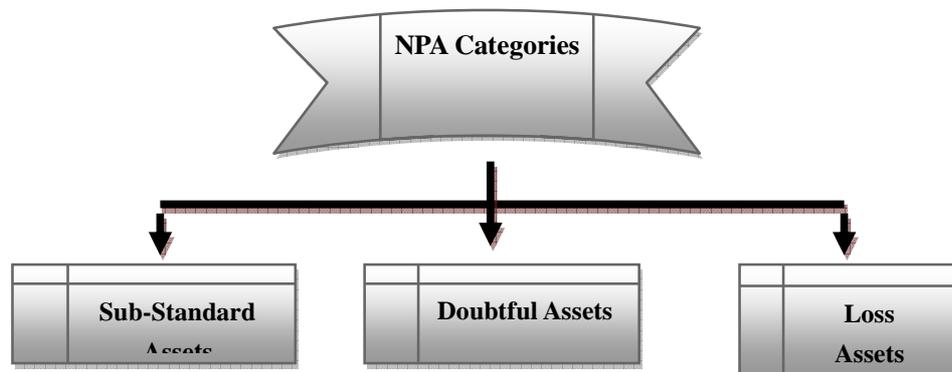
Figure 1: Categories of NPA

- ❖ **Substandard Assets**: A sub-standard asset would be the one, which has remained as an NPA for a period of at least 12 months.

- ❖ **Doubtful Assets**: A doubtful asset would be the one, which has remained in the sub-standard category for a period greater than a year.

- ❖ **Loss Assets**: Loss assets are those where a loss has been identified by the Bank or by internal or external auditors or the by the RBI on inspection but the amount has not been written off wholly. It is an asset for which no security is available or there is considerable erosion in the realizable value of the asset (www.rbi.gov.in, Fig 1).

Gross NPAs are the sum total of all the loan assets that are classified as NPA's as per the RBI guidelines. Gross NPA reflects the quality of the loans made by the Banks. It consists of all the non standard assets like sub-standard, doubtful and loss assets while net NPA's deduct provisions made for loan losses from the gross NPA figures. Net NPAs show the actual burden of the Banks. Since in India, Bank balance sheets contain a huge amount of NPA's and the process of recovery and write off of loans is very time consuming, net NPAs could prove to be a better indicator of asset quality than gross NPAs (www.rbi.gov.in). Thus it is clear that determining NPAs is not straight forward and significant time lags persist before a problem loan can be classified as an NPA. Given this scenario it could prove useful if one can forecast a bank's NPA as soon as advances are made. Thus, it would be useful to develop a predictive model for arriving at estimates

of gross and net NPA% from advanced amounts.

6.1 NPA Percentage Forecasting Using Advances:

To conclude the study, we attempted to forecast both the gross and net NPA%, from the advances. Linear and non linear models were obtained from SPSS analysis. The forecasted values were compared to the actual values. Statistically significant linear and non-linear relationships were obtained between the gross NPA% and the single independent variable advances, (Table I). Similar relationships were obtained between the Net NPA% and the single independent variable advances, (Table 2). The R and R^2 values were very low (Table 1 and 2) for the linear Model, though statistically significant. Thus the relationship between the variables was not linear. Statistically significant non linear models were thus estimated during the study i.e. Cubic, Inverse, Quadratic, Logarithmic and S Curve Models. Among these models Inverse, Quadratic and S Curve and Cubic models were found to be better fits, since R and R^2 found to be close to 1. The S Curve model showed the highest R and R^2 values and was the best fit for gross NPA and Cubic model showed the highest R and R^2 values and was the best fit for net NPA estimations.

The cubic relationship between the Net NPA% and the independent variable advances (Eqn. 2) and the S-Curve relationship between the Gross NPA% and the independent variable advances (Eqn.1) were then used to estimate gross and net NPA amounts which were compared with the respective RBI Published figures. The difference between predicted and actual values is shown in Tables 3 and 4 and Figures 2 and 3. Thus a reasonable estimate of both gross and net NPA can be made from these models from advances made by the bank. Model accuracy can be improved by combining different non-linear models to arrive at a better fit.

7. Conclusion

As NPA's are a direct reflection of asset quality, estimating them can prove useful in overall credit management. We attempt to model the non performing assets at one of India's midsized banks as a function of the loans advanced by the bank. We obtained statistically significant linear and non linear models to accomplish the above. A cubic model provided the best fit for net NPA percentage and an S Curve model provided the best fit for the Gross NPA percentages as a function of advances, thereby helping us arrive at NPA estimates. Given large time lags involved in establishing problem loans as NPAs, this can help managers at banks arrive at an estimate of NPA as soon as advances are made, as opposed to relying solely on the RBI for published NPA figures. Thus bank managers can monitor and improve their asset quality continuously over time by monitoring amounts advanced and corresponding NPAs over a periodic basis.

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Table 1: Linear and Non Linear Models, Gross NPA% = F (Advances)

Dependent Variable	Independent Variable	Model Fit	Correlation Coefficient R	Regression Coefficient R^2	Adjusted R^2	Sig. F Value
Gross NPA%	Advances	Linear	0.828	0.685	0.646	0.003
Gross NPA%	Advances	Quadratic	0.959	0.920	0.898	0.000
Gross NPA%	Advances	Inverse	0.985	0.971	0.967	0.000
Gross NPA%	Advances	Logarithmic	0.929	0.864	0.847	0.000
Gross NPA%	Advances	S Curve	0.987	0.593	0.970	0.00
Gross NPA%	Advances	Cubic	0.986	0.973	0.959	0.00

Table 1 shows a list of the estimated models. Among these models, Inverse, Quadratic, S Curve, Cubic and Logarithmic Models provided the best fit, with R and R^2 values close to 1. The model with the best fit was the S Curve Model which was taken for further analysis in computing the Gross NPA% from Advances. The model is given below:

$$Y = e^{[0.123 + (11526.501 / Adv)]} \qquad \text{(Eqn. 1)}$$

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Table 2: Linear and Non Linear Models, Net NPA% = F (Advances)

Dependent Variable	Independent Variable	Model Fit	Correlation Coefficient R	Regression Coefficient R^2	Adjusted R^2	Sig. F Value
Net NPA%	Advances	Linear	0.710	0.504	0.441	0.022
Net NPA%	Advances	Quadratic	0.906	0.820	0.769	0.002
Net NPA%	Advances	Inverse	0.932	0.869	0.853	0.00
Net NPA%	Advances	Logarithmic	0.839	0.704	0.668	0.002
Net NPA%	Advances	S Curve	0.946	0.895	0.882	0.00
Net NPA%	Advances	Cubic	0.962	0.925	0.888	0.001

Table 2 shows a list of the estimated models. Among these models, Inverse, Quadratic, S Curve, Cubic and Logarithmic Models provided the best fit, with R and R^2 values close to 1. The model with the best fit was the Cubic Model which was taken for further analysis in computing the Net NPA% from Advances. The model is given below:

$$Y = [-2.490 * 10^{-12} * (Adv)^3] + [1.526 * 10^{-7} * (Adv)^2] - [0.003 * (Adv)] + 16.995 \qquad \text{(Eqn. 2)}$$

Table 3:   Gross NPA% predicted Vs Gross NPA% actual, non linear relationship
S Curve Model, Gross NPA%=F (Advances)

Year	Advances (10 Million)	Actual Gross NPA %	Predicted Gross NPA %
2000-01	4286.71	13.55	16.64
2001-02	4914.5	12.7	11.80
2002-03	5260.67	10.68	10.11
2003-04	6306.72	7.76	7.03
2004-05	8781.26	4.56	4.20
2005-06	11754.16	3.3	3.01
2006-07	16465.54	2.29	2.28
2007-08	21027.14	1.68	1.95
2008-09	25616.05	1.42	1.77
2009-10	29535.86	1.00	1.67

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**Table 4: Net NPA% predicted Vs Net NPA% actual, non linear relationship Cubic Model,
Net NPA% = F (Advances)**

Year	Advances (10 Million)	Actual Net NPA %	Predicted Net NPA %
2000-01	4286.71	7.65	7.22
2001-02	4914.5	7.36	6.19
2002-03	5260.67	5.19	5.66
2003-04	6306.72	2.96	4.22
2004-05	8781.26	0.92	1.71
2005-06	11754.16	0.74	0.08
2006-07	16465.54	0.45	0.00
2007-08	21027.14	0.43	0.57
2008-09	25616.05	0.5	1.26
2009-10	29535.86	1.02	0.62
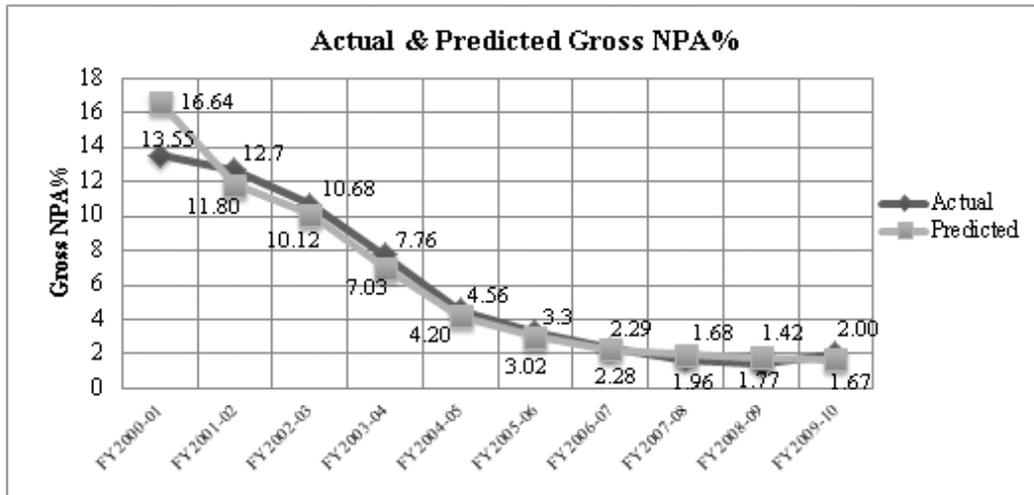
Figure 2: Actual & Predicted Gross NPA% for the Financial Years 2001-2010
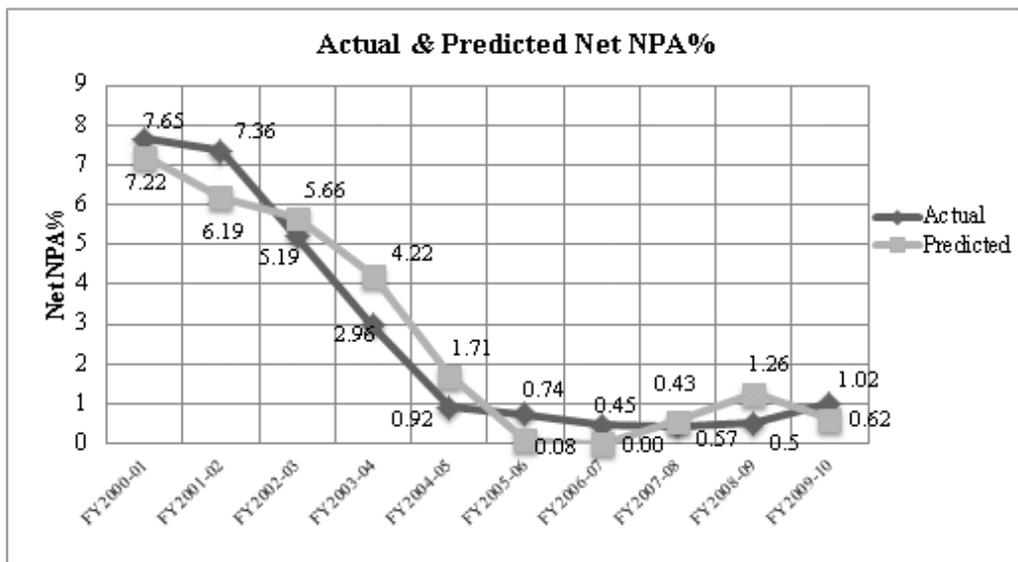
Figure 3: Actual & Predicted Net NPA% for the Financial Years 2001-2010