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Das, Abhiman and Ghosh, Saibal

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An Empirical Investigation

Abhiman Das[1]*
Saibal Ghosh**

Abstract

The determinants of credit risk of banks in emerging economies have received limited attention in the literature. Using advanced panel data techniques, the paper seeks to examine the factors affecting problem loans of Indian state-owned banks for the period 1994-2005, taking into account both macroeconomic factors as well as microeconomic variables. The findings reveal that at the macro level, GDP growth and at the bank level, real loan growth, operating expenses and bank size play an important role in influencing problem loans. The study performs certain robustness tests of the results and discusses several policy implications of the analysis.

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[1]*(corresponding author) MIT Department of Economics, E52 - 251D, 50 Memorial Drive, Cambridge MA 02142-1347, USA. and Department of Statistical Analysis and Computer Services, Reserve Bank of India, Bandra Kurla Complex, Mumbai 400051, INDIA, Email: ADas@ rbi.org.in.
**Department of Economic Analysis and Policy, Reserve Bank of India, Fort, Mumbai 400001, INDIA, Email: saibalghosh@rbi.org.in.

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Introduction

The health of the financial sector is a matter of policy concern, especially in developing countries where failure in financial intermediation can disrupt the development process. Empirical research has uncovered robust evidence supporting the view that financial development contributes to economic growth. At the cross-country level, for instance, measures of financial development such as financial intermediary sector's assets and domestic credit to private sector have been found to be positively correlated with economic growth (King and Levine, 1993; Levine and Zervos, 1998; Aghion *et al*., 2005). Similarly, at the firm level, researchers have found that firms in countries with more financial development are able to obtain more external funds and thereby grow faster (Demirgúc-Kunt and Maksimovic, 1998).

Notwithstanding these advancements, there is limited work of operational relevance for improving the functioning of the financial sector. It is argued that the major economic upheavals have their origins in a banking crisis. Illustratively, the events during the second half of the 1990s in Asia and elsewhere provided graphic testimony that the combination of a weak financial system and inadequate macroeconomic policies - with weakness in one area reinforcing problems in the other – were instrumental in exacerbating the crises. What is also widely documented is the fact that the problems faced by Asia's banking systems were the legacy of years of bad lending practices fuelled by inadequate supervision and regulation that led to rapid lending growth and excessive risk taking (Lindgren *et al*., 1997; Caprio and Klingebiel, 2003).

The aforesaid examples clearly illustrate the role of credit risk affecting the functioning of the overall economy. There is limited work in the empirical literature examining the determinants of credit risk for improving the functioning of the financial sector. This is our point of entry into the paper. More specifically, the analysis examines the proximate causes of credit risk in state-owned banks (SOBs) in India during 1994-2005. This represents the highest periodicity with which data on the concerned variables is available on a consistent basis. In particular, the study examines *ex-post* loan losses at the bank-level and investigates the determinants of such losses, taking into account both macroeconomic factors and microeconomic variables that approximate the credit policies of financial intermediaries. The exercise is confined to the state-owned banks, so as to examine the determinants of problem loans within a class that

is homogeneous on the ownership dimension and comprises the majority of the banking sector assets over the sample period. Therefore, the paper contributes to the credit risk literature by providing empirical evidence that enables to assess expected credit losses combining macro- and microeconomic data. Towards this end, the study performs advanced panel data techniques, thereby ensuring avoidance of estimation bias and specification problems.

The rest of the paper proceeds as follows. Section 2 provides an overview of the received literature. The following section describes the institutional structure of the Indian banking sector and provides evidence of the evolution of problem loans during the period under study. Section 4 provides an overview of the factors affecting problem loans of banks. The empirical model and the sample data are presented in Section 5. The model estimation and a discussion of the results are contained in Section 6. The final section concludes.

2. Review of Literature

Several theoretical explanations have appeared in the literature to explain fluctuations in credit policies of banks. The most common reflection of this phenomenon arises from the fact that management compensation structures can generate perverse incentives, which in turn, is an aspect of the *principal-agent* problem. Once managers obtain a reasonable return on equity for their shareholders, they may engage in activities that depart from the firm's value maximization. To the extent that managers have limited liability, a manifestation of this possibility could be to favour high risk-return strategies (i.e., over extension of credit) in order to increase the social presence of the bank managers or the power of managers in an enlarging organization (Williamson, 1963).

Second, strong competition among banks or between banks and other financial intermediaries erodes margins and puts pressure on banks' bottomlines. To compensate for declining profitability, bank managers might sacrifice objectivity in credit evaluation standards and increase loan growth indiscriminately at the expense of the (future) quality of their loan portfolios. To the extent that such loans turn out to be non-performing only with a lag, it might encourage further loan growth.

Herd behavior (Rajan 1994) might also help to explain why bank managers finance negative NPV projects during expansions. The fact that others are lending may be considered as invaluable information concerning the creditworthiness of a potential borrower. And importantly, managerial performance is generally judged relative to some market benchmark. The disincentives for being wrong in company are generally much less than for being wrong in isolation. Managers, as a result, have a strong incentive to behave as their peers, which, at an

aggregate level, enhances lending booms and recessions. Short-term objectives are prevalent and might explain why banks finance projects during expansions that, later on, will become non-performing loans.

Fourth, the extended passage of time since the last loan bust could lead to an accumulation of problem loans in the books of banks. This could be the result of two complementary forces. First, the proportion of loan officers that experienced the last bust declines as the bank hires new, younger employees and the former ones retire, leading to an overall loss of learning experience. Second, some of the experienced officers might not be able to adequately recollect the previous bust; the more far away is the earlier recession, the less likely is their recollection of the previous bust. The culmination of these forces is an overall decline in the institutional memory, a cadre less skilful of adequately judging credit risk, resulting in a build up of problem loans (Berger and Udell, 2004).

Finally, collateral might also play a role in influencing bad loans. In an upturn, rapid increases in asset prices increase the availability of pledgable funds, propelling banks to increase lending, since it has an (increasingly worthier) asset to back the loan. The net effect of these developments could be an overall decline in credit standards, including the need to pledge collateral. As the upturn recedes and recessionary tendencies gather momentum, the decline in asset values leads to an overall lowering in collateral values as well, leading to an overall decline in credit standards, aggravating bad loans and fueling credit cycles (Gabriel *et al*., 2006).

Notwithstanding these theoretical advancements, available evidence of the factors influencing credit risk is admittedly limited. The extant research has concentrated mostly on evaluation of *ex-ante* risks of borrowers and/or of individual loan operations, and on studying the response of lenders to such evaluations (Santomero, 1997; Altman and Saunders, 1998; Holmstrom and Tirole, 2000). Credit spreads, collateral, loan term structures and commitments between borrowers and lenders over time (relational lending) have been some of the widely investigated topics. Other relevant variables, such as *ex-post* credit losses, have been largely ignored, especially at the micro-level of financial institutions, possibly owing to the lack of reliable data on loan losses.

The majority of the studies in this area have primarily dealt with the US banking industry (Berger and Young, 1997; Kwan and Eisenbis, 1997) and to a lesser extent, the Mexican (Gonzalez-Hermosillo *et al.*, 1997) banking sector. Using data on US banks for 1985-94, Berger and DeYoung (1997) found that decreases in cost efficiency are related to increases in non-performing loans, suggesting that high levels of problem loans cause banks to increase spending on monitoring. For the period 1986:2 to 1995:4, Kwan and Eisenbis (1997) demonstrate that

inefficient banks are more prone to risk-taking. In case of the Mexican banking sector, Gonzalez-Hermosillo *et al.* (1997) found that the higher the proportion of non-performing loans to total loans, the greater is the probability of banking failure. Salas and Saurina (2002) find that, for the Spanish banking sector, credit risk was significantly influenced by individual bank-level variables, after controlling for macroeconomic conditions.

In the Indian context, Rajaraman *et al.* (1999) examined the regional dimension of the non-performing loan problem. The study was, however, confined to only a single year, *viz.*, 1996-97, and employed only macro variables to explain problem loans, which, in a way, limited the empirical appeal of the model. However, it is widely believed that problem loans are the result by both macroeconomic as well as microeconomic factors. Illustratively, in a downturn, the condition of the borrower generally deteriorates, resulting in a setback in the repayment schedule, thereby possibly engendering greater problem loans. At the same time, bank-specific factors, such as low operating efficiency and unbridled branch expansion, might also lead to accumulation of problem loans. This would mean that not only macroeconomic conditions, but also microeconomic variables are important in explaining problem loans in banks.

We choose India as a case study for two reasons. First, India is presently one of the most important developing countries in the present world with a rich history of banking sector controls (Demetriades and Luintel, 1996). Since the initiation of economic reforms in the 1990s, these controls have gradually been deregulated, allowing greater role of market forces in the resource allocation process. Second, the time period of the study spans a decade coinciding with the inception of financial sector reforms and enables to clearly isolate the factors influencing banks' problem loans. The findings so obtained may be representative of the factors affecting problem loans in banks in other emerging markets.

3. Indian Banking System and Evolution of Problem Loans

The Indian banking system is characterized by a large number of banks with mixed ownership[2]. The commercial banking segment comprises 27 SOBs in which Government has majority ownership of over 51% percent, 40 private sector banks and 33 foreign banks. Total bank assets constituted a little over 80 percent of GDP in 2004-05. Public sector banks had a 75% share in the assets of the banking system in 2004-05, while private and foreign banks constituted

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[2] The banking system in India consists of commercial and co-operative banks, of which the former accounts for around 98 per cent of banking system assets. The entire segment is referred to as Scheduled Commercial Banks, since they are included in the Second Schedule of the RBI Act, 1934. The financial year for commercial banks runs from the first day of April of a particular year to the last day of March in the subsequent year.

25 percent. In 1991, public sector banks share in the total assets of the banking system was a little over 90%.

Prior to the initiation of financial sector reforms in 1992, the financial system essentially catered to the needs of planned development where the Government sector had a predominant role in every sphere of economic activity. The pre-emption of a large proportion of bank deposits in the form of reserves and an administered interest rate regime resulted in high cost and low quality financial intermediation. The existence of a complex structure of interest rates arising from economic and social concerns of providing concessional credit to certain sectors resulted in 'cross subsidization' which implied that higher rates were charged from non-concessional borrowers. Even the free portion of banks' resources was subject to 'credit norms', which set inflexible limits to loans according to sector, purpose and security. On the expenditure front, inflexibility in licensing of branches and management structures constrained the operational independence and functional autonomy of banks and raised overhead costs. The net effect of these developments was distortion of interest rates and the inefficient allocation of scarce resources.

With so much emphasis on allocating assets according to Government guidelines, income recognition rules and asset classification norms were of secondary importance. The first effort for standardization of credit assets for a better understanding of the inherent risk component was made in 1985 when RBI introduced categorization of bank advances termed as 'health code' system. Accordingly, loans were classified into eight health codes depending on the repayment history of the borrower.[3] While the health code system provided for the categorization of bank-credit based on risk exposure, it did not provide for risk coverage on account of credit assets turning non-productive. The classification was left to the discretion of each bank, which meant that these norms were highly subjective, so that large amounts of income accrued on non-performing loans, and reduced incentives for maintaining a high quality portfolio.

The underlying philosophy of financial sector reforms initiated in 1992 was to make the banking system more responsive to changes in the market environment. Accordingly, statutory pre-emptions were lowered, interest rates deregulated and banks allowed to raise capital not

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[3] The eight health code categories were: satisfactory, irregular, sick (viable under nursing), sick (non-viable/sticky), advances recalled, suit-filed accounts, decreed debt and debts classified by the bank as bad/doubtful. Of these, four categories, *viz.*, advances recalled, suit-filed accounts, decreed debt and debts classified by the bank as bad/doubtful were deemed as non-performing.

exceeding 49% of their equity. Objective criteria were instituted for loan classification and provisioning, in line with international best practices.[4]

Evidence of competitive pressures on the Indian banking industry is well supported from the decline in the five bank asset concentration ratio from 0.46 in 1993-94 and thereafter to 0.38 in 2004-05 and by the increasing number of private and foreign banks. The performance of SOBs has become attuned to profitability considerations, with return on asset at 1% from negative levels in 1993-94. Reflecting the growing efficiency of the intermediation process, the net interest income to total assets from declined from over 3% to around 2.8% over this period (Table 1).

Table 1: Summary of the Banking Industry: 1993-94 to 2004-05

Year /Bank group	1993-94			1998-99			2004-05		
	SOBs	Pvt.	Forgn.	SOBs	Pvt.	Forgn.	SOBs	Pvt.	Forgn.
No. of Banks	27	24	23	27	35	44	28	29	31
Total asset (Rs. bn.)							22018	4279	1536
Deposits (Rs. bn.)	3034	201	259	6369	868	475	14207	3146	865
Credit (Rs. bn.)	1469	98	116	297	428	295	8093	2211	753
Credit/deposit (%)	48	49	45	47	49	62	57	70	87
Share of (in %):									
Total Deposits	86	6	8	83	11	6	78	17.3	4.7
Total Credit	87	6	7	80	12	8	73	20	7
Total Income (Rs. bn.)	373	24	41	789	115	97	1476	326	130
Total Expenses (Rs. bn.)	417	23	35	756	108	90	1318	291	110
Net Profit (Rs. bn.)	-44	1	6	33	7	7	158	35.3	20
Net interest margin	2.36	2.97	4.21	2.81	2.09	3.47	2.91	2.34	3.52

SOBs. State-owned Banks; Pvt. Private Sector Banks; Forgn: Foreign Banks

In spite of the substantial progress made in terms of improving the efficiency and competitiveness of the financial system, a concern of policymakers remains in terms of the high quantum of non-performing loans. Notwithstanding the gradual tightening of prudential norms over the reform period (Table 2), the non-performing loans of state-owned banks stood at over Rs.480 billion at end-March 2005, comprising over 5% of their total advances and around 80% of the non-performing loans of the commercial banking sector (Table 3).[5]

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[4] As at end-March 2005, the cash reserve ratio was 5% (statutory minimum of 3 %) and the statutory liquidity ratio was 25 % (the statutory minimum). The corresponding figures as at end-March 1994 were 14.0 % and 34.25 %, respectively.

Table 2: Evolution of IRAC norms – Cross Country Comparisons

	Sub-standard	Doubtful	*Memo*: NPL/Total loans (%)
Non-performing loans in India (period overdue in months- M)			
1993-94	10 M	25 M	24.8
1995-96	7 M	25 M	18.0
1999-2000	7 M	25 M	14.0
2002-03	6 M	18 M	9.4
2003-04	3 M	18 M	7.8
2004-05	3 M	12 M	5.5
Memo: International practices			
China	Overdue		15.6 (2004)
Indonesia	3 M	6 M	13.4 (2004)
Korea	3 M (July 1998)	'expected to be loss'	1.7 (2004)
Malaysia	6 M	9 M	11.6 (2005)
Thailand	3 M	6 M	11.9 (2004)
Argentina	3 M	6 M	17.1 (2005)
Brazil	2 M	6 M	3.9 (2004)
Chile	1 M (mortgage) 2 M (consumer)	7 M (mortgage) 4 M (consumer)	1.2 (2005)
Mexico	6 M (mortgage) 3 M (other)		2.4 (2005)
Czech Rep.	3 M	6 M	4.8 (2005)
Poland	1 M or 'borrower in poor state'		15.5 (2004)

Figures for India refers to state-owned banks
Figures in brackets for other countries refer to the latest year for which data are reported
Source: RBI (2005b), Hawkins and Turner (1999) and IMF (2005)

Table 3: Non-performing Loans of Different Bank Groups: 1994-2005

| Year (end-March)	SOBs	Old Private Banks	New Private Banks	Foreign Banks
1994	410 (24.8)	N.C.	N.C.	N.C.
1995	384 (19.5)	N.C.	N.C.	N.C.
1996	416 (18.0)	N.C.	N.C.	N.C.
1997	436 (17.8)	23 (10.7)	2 (2.6)	12 (4.3)
1998	456 (16.0)	28 (10.9)	4 (3.5)	20 (6.4)
1999	517 (15.9)	38 (13.1)	9 (6.2)	24 (7.6)
2000	530 (14.0)	38 (10.8)	10 (4.1)	26 (7.0)
2001	547 (12.4)	43 (10.9)	16 (5.1)	31 (6.8)
2002	564 (11.1)	48 (11.0)	68 (8.9)	27 (5.4)
2003	540 (9.4)	46 (8.9)	62 (7.6)	28 (5.3)
2004	515 (7.8)	44 (7.6)	59 (5.0)	29 (4.6)
2005	485 (5.5)	42 (6.0)	46 (3.6)	22 (2.8)

N.C. Not Compiled
Amount in Rs. billion.
Figures in brackets are as percent to total advances.

In the study, we measure problem loans in relative terms as the ratio between problem loans to total loans. The annual bank-wise figure is published by the RBI in its banking report

titled *Report on Trend and Progress of Banking in India*. Chart 1 plots the development of the problem loans ratio of state-owned banks and the evolution of GDP (inverse growth rate) for the Indian economy over the period 1994-2005. The cyclical behavior of problem loans is confirmed by observing the overlap between the ratio of problem loans (on average for all state-owned banks) and the GDP growth variable.

Chart 1: Non-performing Loans of State-owned Banks and GDP Growth
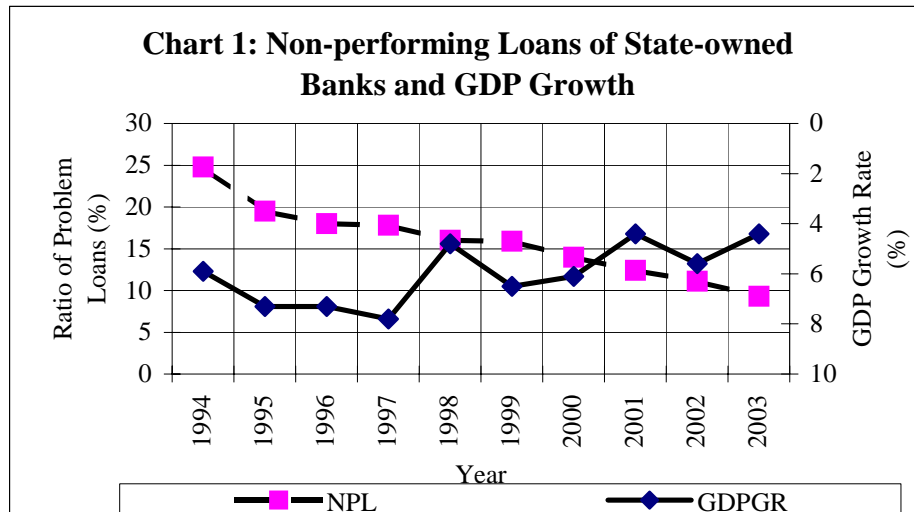
In order to contain their problem loans, banks have been provided with a menu of strategies. These steps have been preventive, remedial and legal in nature. For instance, corporate debt restructuring mechanism has been introduced aimed at restructuring the debt of viable corporate entities. Another major step has been the introduction of One Time Settlement (OTS) schemes. Compromise settlements have been operational at several time points over the sample period to provide an opportunity to borrowers for settlement of their outstanding dues. More recently, an Act has been passed which seeks to strengthen creditor rights. Given the concentrated focus devoted to tackling the problem of non-performing loans, the issue, therefore, arises whether it is possible to identify factors influencing problem loans.

4. Determinants of Banks' Problem Loans

Disaster myopia, herding behaviour, perverse incentives and principal-agent problems are the main factors that explain mistakes in bank credit policy in an expansionary phase. Banks could be forced into an excessive credit expansion as a fall-out of an informational externality that makes bank credit policies interdependent. Short-term concerns, coupled with the fact that the market is more forgiving if judgemental errors are made by several participants at the same time, often lead bank managers to pursue an expansionary credit policy that raise borrowers' debt levels, with an adverse effect on the loan portfolio.

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4.1 Macroeconomic Conditions

The empirical evidence tends to suggest that banks problem loans are closely related to economic activity: in other words, behind every financial crisis, there are macroeconomic factors, such as downturns in aggregate economic activity. When growth slows or even turns negative, firms and households reduce their cash inflows (sales, wages), which, in turn, render it difficult for them to repay the loans. Banks anticipate that if a recession occurs, firms and households will encounter liquidity shortages, which, in turn, would raise the likelihood of delays in the fulfillment of their financial obligations (Jimenez and Saurina, 2006). Under such circumstances, they are more inclined to pursue a stringent credit policy (credit crunch), exacerbating the liquidity difficulties of firms and households. Economic activity is further slowed down compounding the problem loan difficulty.

In the present setup, aggregate economic activity is measured by real GDP growth rate (GDPGR), since GDP is highly informative of other relevant macro variables. We are also interested in the lag structure of the effects of economic activity on problem loans.

Proponents of financial liberalisation argue that a financially repressed regime constraints savings and investment through negative real rates of interest (see, for instance, Ghatak, 1981; Fry, 1988). In the banking sector, it seems likely that high real interest rates could raise the cost of capital for borrowers and make it difficult for them to repay their loans on time. This would suggest that higher real rates of interest would engender higher non-performing loans, and as a result, the coefficient on this variable is expected to be positive.

4.2 Microeconomic Factors

The literature identifies moral hazard, ownership structure and regulatory actions as the primary factors influencing bank risk-taking behaviour (Kwan and Eisenbis, 1997). The theoretical determinants of bank risk-taking are translated into a tractable empirical specification by measuring the effect of observable variables, such as credit growth, operating efficiency and solvency.

A rapid credit expansion is considered one of the most important causes of problem loans (Caprio *et al.*, 1994).[5] During economic expansion, banks are often engaged in fierce competition for market share in loans, resulting in rapid credit growth. An easy way to garner market share

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[5] As one referee pointed out, a rapid expansion of credit, by itself, is not always a problem. It depends upon the stability of the money demand function and the growth of output.

could be to lend to borrowers of inferior credit quality. The market share strategy is even more dangerous if the bank is a new entrant in a product or regional market. Initially, banks selling new products will probably have more problem loans in their new business simply because they lack the necessary credit risk management expertise. Banks entering a distinct regional market will be subject to adverse selection. It is likely that incumbents will allow the riskiest customers to leave the bank, but attempt to retain the creditworthy ones. The risk profile of a client becomes known only with passage of time. The informational disadvantage of new entrants together with their appetite for market share is often a recipe for loan portfolio problems at a later stage. Alternately, managers that are poorly monitored by shareholders might be willing to increase risk in order to bolster short-term profitability. Therefore, managers could have incentives towards overextension of credit in order to maximise utility.

Several additional factors could also affect the level of bank problem loans. First, inefficient banks performing poor screening and monitoring of borrowers will tend to have inferior portfolio quality. Kwan and Eisenbis (1997) demonstrate that higher levels of bank inefficiency can lead to an increase in problem loan ratios of banks. Net interest margins could also impinge on problem loans. A decrease in margins can prompt banks to adopt 'gamble for resurrection' strategies, resulting in the creation of a loan portfolio with higher probability of default in the future (Dewartipont and Tirole, 1994). Not only margins, but also if the bank has solvency problems, the incentives to shift to riskier portfolios becomes difficult to resist. It is also possible that if the increase in loans is made in a traditional geographical market, the impact of problem loans can be kept under control. However, if the bank enters into a new geographical market, e.g., opening branches in new areas, the adverse selection problem could be important. The higher *ex-post* credit risk may be anticipated by the bank by charging an *ex-ante* risk premium in the interest on the loan. Finally, since bigger banks have greater opportunities for portfolio diversification *vis-à-vis* smaller ones, microeconomic determinants of problem loans need to control for bank size.

5. Econometric Model and Data (ABHIMAN, may like to redraft)

Based on the foregoing discussion, one can postulate the following equation for the ratio of problem loans of bank i in year t ($NPL_{i,t}$):

$$NPL_{i,t} = \gamma_o \, NPL_{i,t-k} + \sum_{h=0}^{1} \gamma_h \Delta GDP_{t-h} + \gamma_1 \, REG + \sum_{p=2}^{4} \gamma_2 \Delta LNGR_{i,t-p} + \sum_{p=2}^{3} \gamma_3 \Delta BRANCH_{i,t-p} +$$

$$\gamma_4 INEFF + \gamma_5 \, SIZE + \sum_{s=2}^{3} \gamma_6 SPRD_{i,t-s} + \sum_{u=2}^{3} \gamma_7 CRAR_{i,t-u} + \gamma_8 \, PRM_{i,t-3} + \gamma_9 NPRIOL_{i,t} + \eta_i + \varepsilon_{i,t}$$

Since the ratio of problem loans to total loans is a truncated variable (bounded between zero and one), in order to make it amenable for the analysis, we make a logarithmic transformation of $NPL_{i,t}$, so that it can assume values in the range $(-\infty, +\infty)$. The new dependent variable is $\ln [NPL_{i,t}/(1-NPL_{i,t})]$.

It has been observed that in the Indian banking system, the problems of non-performing loans has a sizeable legacy component arising from infirmities in the existing processes of debt recovery, inadequate legal provisions on foreclosure and bankruptcy and difficulties in the execution of court decrees (Jalan, 2001). This would suggest that the ratio of problem loans of one period is closely related to that of the previous period, since the problem loans are not immediately written down, but are, in fact, carried forward in the balance sheet. This would suggest a positive coefficient of γ_o.

The impact of aggregate economic activity is measured by using the real GDP growth rate (ΔGDP_{t-h}). We include the current rate as well as one lag to assess the timing. Intuitively, one would expect negative coefficients, since improved economic activity would imply better repayment by borrowers and therefore, a lowering of problem loans (Salas and Saurina, 2002). REG is a dummy variable that assumes a value of one from 2001 onwards, else zero. This is because the definition of problem loans was tightened in 2000-01. This would imply a positive sign of γ_1.[6]

As regards microeconomic determinants, $\Delta LNGR_{i,t-k}$ is the real loan growth rate for each bank lagged one through four years. A target of rapid increase in market share can force the bank to compromise on the quality of borrowers, which, in turn, might provoke higher problem loans. We expect positive coefficients on these variables. If the bank advances loans in a traditional geographical market where bank managers are well-versed with their clients, problem loans can be kept under control. However, if the bank enters into a new geographical market (i.e., opening of branches in new areas), the adverse selection problem could be important. To control for the impact of branch network growth, we include $\Delta BRANCH_{i,t-q}$ (lagged bank branch growth). We expect positive signs on the coefficients reflecting managers' lack of familiarity of the new area.

In order to capture bank-level inefficiency (INEFF), we use the ratio of operating expenses to total assets. Operating expenses capture wage expenditure as well as non-wage expenses (such as rent, taxes, directors' fees, lighting, advertisement and publicity expenses, etc.).

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[6] Prior to 2000-01, a loan was treated as non-performing if interest and/or installment of principal remained overdue for more than 180 days *plus* a grace period of 30 days. This grace period (termed 'past due') was removed effective April 2001.

A high value of the variable indicates that the costs of intermediation are high, so that bank managers are unable to internalise the positive externalities of a bigger branch network and employees to increase profitability. We expect the coefficient to be of positive sign. Bigger banks might be better able to control problem loans by diversifying their loan portfolio *vis-à-vis* smaller ones. To control for this, we include the natural logarithm of total assets (SIZE), a monotonic transformation of assets, and expect negative coefficient on the variable.

The incentives of managers are introduced using the variable $SPRD_{i,t-s}$, the net interest margin lagged two and three years. A reduction in the margin can bring about a change in the credit policy of the bank, making it riskier, since there is less to lose if the outcome turns adverse. The increase in risk will create a loan portfolio with higher default probability in the future, which is the reason for the lags on the variable. The coefficients of the variable are expected to be negative. If the bank has solvency problems, then it might have an incentive to shift to riskier portfolios in order to shore up the capital base. To capture this possibility, we include $CRAR_{i,t-u}$, the ratio of capital to risk-weighted assets lagged two and three years. The impact of solvency difficulties is not straightforward. Problem loans are likely to appear at a later date consequent upon a change in the credit policy of the bank. On the one hand, the higher the solvency ratio, the lower the incentives to take more risks. Alternately, higher solvency ratios could also provide incentives to banks to pursue higher profits by following high risk-return strategies. The sign of the coefficient on this variable is, therefore, not clear *a priori*.

The higher *ex-post* credit risk may be anticipated by the bank charging higher *ex-ante* risk premium on the interest of the loan. To account for this possibility, we include $PRM_{i,t-3}$ (the difference between the income stemming from loans over total loans *less* average end-period call money rate) as a proxy for the risk premium. The lag structure is designed to catch the *ex-ante* component of risk premium. If riskier loans are properly priced, we should find a positive coefficient for the parameter of the variable. However, it might be possible not to find a positive impact if strong competition introduces cross-subsidisation of products inside banks.

Finally, to control for the composition of loan portfolio, we include the ratio of non-priority sector loans to total loans ($NPRIOL_{i,t}$). This variable reflects credit to the industrial sector (with or without collateral backing). Higher loans to non-priority sector might lead to lower problem loans if the bank has sound credit risk management practices or alternately, if might be the reverse. The sign on this variable is, therefore, not clear *a priori*, and is left to be determined econometrically. η_i captures unobservable effects due to intrinsic characteristics of each bank (the risk aversion of managers, their preferences for maximising profits or growth, etc). $\varepsilon_{i,t}$ is random disturbance.

Bank-wise data on the concerned variables starting 1994 are published by the RBI in its two banking publications, *viz.*, *Report on Trend and Progress of Banking in India* (RTP), a yearly statutory report which provides bank-wise information on financial and prudential ratios and *Statistical Tables Relating to Banks in India* (STB), a yearly publication which provides bank-wise data on assets and liabilities and profit and loss figures. The data on the macro-variables are published in the *Handbook of Statistics on Indian Economy*, a yearly report which provides time series information on macroeconomic variables.

Table 4 presents the descriptive statistics of the variables. Three features of the table are of interest. First, over the sample period, operating expenses has been high on average, with a low variability. Second, the average CRAR for state-owned banks was 9.90%, although with high variability. Finally, the premium (PRM), on average, is negative for the state-owned banks, reflecting the fact that, during many years, there was cross-subsidisation from liability to asset operations in the state-owned banking system.

Table 4: Summary Statistics of the Variables

Notation	Empirical definition	Source	Mean	Std.Dev.
NPL/(1-NPL)	Non-performing loans	Report on Trend and Progress of Banking	0.143	0.052
GDPGR	Growth rate of real GDP	Handbook of Statistics on Indian Economy	0.063	0.013
ADVGR	Growth in real advances	Statistical tables relating to banks in India	0.146	0.497
BKOFF	Growth in number of bank offices	Statistical tables relating to banks in India	0.035	0.175
INEFF	Operating expenses/total asset	Report on Trend and Progress of Banking	0.026	0.006
NPRIOL	Loans to non-priority sector/total loans	Report on Trend and Progress of Banking	0.654	0.061
SIZE	Log(bank asset)	Statistical tables relating to banks in India	9.851	0.995
SPRD	Interest income *less* interest expense/total asset	Report on Trend and Progress of Banking	0.029	0.008
CRAR	Capital (tier-I *plus* tier-II)/risk weighted assets	Report on Trend and Progress of Banking	0.106	0.095
PRM	Income from loans/total loans *less* call money rate	Report on Trend and Progress of Banking and Handbook of Statistics on Indian Economy	-0.081	0.033

6. Results and Discussion

The ordinary least squares (OLS) estimation of equation (1) may yield unsatisfactory results, because dynamic models are likely to suffer from both endogeneity and heterogeneity problems. The presence of lagged endogenous variables will also bias the coefficient estimates for the OLS estimation. Moreover, substantial differences in non-performing loans across banks may result in heterogeneity problems.

The generalised method of moments (GMM) estimation is widely used for dynamic panel data models. If there are no unobserved firm effects, we can apply the GMM technique to (1) in levels by using lagged right hand side variables as instruments.

The consistency of the GMM estimator depends on whether the lagged values of the micro variables are valid instruments in the regression procedure. A necessary condition for the validity of such instruments is that the error term be serially uncorrelated. To address these issues, we present two specification tests suggested by Arellano and Bond (1991). The first is the Sargan test of over-identifying restrictions, which tests for the overall validity of the instruments by analyzing the sample analog of the moment conditions used in the estimation process. The second test examines the hypothesis that the error term differenced regression is not second-order serially correlated, which implies that the error term in the level regression is not serially correlated. The failure to reject the null hypotheses in both cases provides support to the model.

The main concern is to test some hypotheses on the determinants of problem loans. Therefore, the focus is not on predicting the factors influencing problem loans in a particular bank. The hypothesis that tests the study requires using an estimation procedure that avoids estimation biases as much as possible. This necessitates the use of the GMM procedure. Such estimation technique also requires transforming the dependent variable, in order to make it suitable to employ the GMM technique.

The result of the analysis is presented in the second column of Table 5 (Model 1). The hypothesis of a significant first-order and no second-order serial correlation (keeping in mind that equation 1 has been transformed to first differences) and the hypothesis of validity of the instruments used (Sargan's test) are not rejected. Therefore, the former tests guarantee the consistency of the estimators and the validity of the instruments employed

Regarding the explanatory variables, there is evidence of high level of persistence in the NPL variable. The macroeconomic controls when significant, have the expected sign. Thus, an acceleration of GDP leads to a decline in problem loans. More specifically, GDP growth has a contemporaneous impact, suggesting that downturn in economic activity get reflected in problem loans fairly quickly, but does not exhibit persistence. Real interest rates, on the other hand, do not seem to exert any significant influence on problem loans.

At the micro level, there is a strongly significant and positive impact of credit growth on problem loans, with a lag of 1 year. Therefore, an increase in credit today will have a negative impact on problem loans one year hence. Loan growth loses significance when lagged multiple periods, suggesting that over-extension of credit are transmitted fairly quickly into problem loans. The composition of the loan portfolio (NPRIOL) negatively impacts problem loans, corroborating stricter credit evaluation standards for loans to corporates. The negative coefficient on risk premium proxy (PRM) indicates that competitive pressures have been engendering cross-subsidisation of products inside banks. Finally, larger banks appear to have higher problem loans

than smaller ones. Although bigger banks allow for greater diversification opportunities, it could be outweighed by higher problem loans on overall quantum of credit extended, leading to a positive sign on this variable.

Table 5: Determinants of Credit Risk: GMM Results

Variables	Model 1	Model 2	Model 3
Lagged Dependent variable	0.854 (0.032)***	0.854 (0.032)***	0.854 (0.033)***
Microeconomic			
Loan growth with 1 lag	0.314 (0.154)**	0.329 (0.154)**	0.317 (0.187)**
Loan growth with 2 lags	0.185 (0.210)	0.175 (0.208)	0.184 (0.212)
Loan growth with 3 lags	-0.049 (0.161)	-0.026 (0.150)	-0.046 (0.182)
Loan growth with 4 lags	0.136 (0.148)	0.111 (0.129)	0.135 (0.154)
Bank branch growth with 2 lags	0.044 (0.059)	0.047 (0.058)	0.045 (0.060)
Bank branch growth with 3 lags	0.056 (0.065)	0.047 (0.062)	0.056 (0.065)
NPRIOL	-0.048 (0.026)*	-0.050 (0.025)**	-0.048 (0.026)**
INEFF	0.144 (0.342)	0.108 (0.341)	0.143 (0.345)
SIZE	0.004 (0.001)***	0.004 (0.001)***	0.004 (0.001)***
Spread with 1 lag	-0.278 (0.233)	-0.297 (0.239)	-0.279 (0.237)
Spread with 2 lags	-0.205 (0.159)	-0.185 (0.155)	-0.204 (0.159)
CRAR with 2 lags	0.0002 (0.0009)	0.0002 (0.0009)	0.0002 (0.0009)
CRAR with 3 lags	0.0004 (0.0005)	0.0004 (0.0005)	0.0004 (0.0005)
PRM with 3 lags	-0.001 (0.0007)*	-0.001 (0.0009)	-0.001 (0.0007)*
REG	-0.002 (0.005)	-0.002 (0.004)	-0.001 (0.005)
Macroeconomic			
GDP growth	-0.006 (0.001)***		-0.005 (0.002)*
GDP growth with 1 lag	-0.0007 (0.0009)		-0.0006 (0.002)
Real interest rate with 1 lag	0.001 (0.003)	0.001 (0.004)	0.001 (0.003)
IIP		-0.001 (0.008)	
IIP with 1 lag		0.0005 (0.001)	
MKTCAP			-0.0003 (0.008)
No. of observations, time period	324; 1994-2005	324; 1994-2005	324; 1994-2005
Log likelihood	-561.327	-561.697	-561.328

Robust standard errors in parentheses
***, ** and * denote statistical significance at 1, 5 and 10%, respectively.

Most of the other variables are not significant at conventional levels. In other words, branch expansion strategies, operating expenses or interest margins do not exert any substantial impact on the problem loans of banks.

As an alternative macroeconomic indicator, we employ the index of industrial production (IIP) instead of GDP. The results (Model 2) indicate that the coefficient on this variable is not statistically significant, suggesting that the predictive power of this variable is admittedly lower vis-à-vi GDP; most of the other explanatory variables are qualitatively unaltered in sign.

As a variant of the aforesaid specification, we introduce the market capitalisation ratio (MKTCAP), defined as the ratio of stock market capitalisation to GDP. This variable attempts to

capture the transition from bank-based to market-based financial system. Intuitively, since a market-based system would imply less reliance on bank finance, this would possibly give rise to lower problem loans and consequently, we expect the coefficient to be negative. The results (Model 3) demonstrate that although MKTCAP is negative, it is not statistically significant, supporting the conjecture that a transition to a market-oriented financial system does not impinge on problem loans in any significant manner.

6.1 Robustness Tests

This section discusses certain robustness tests of the basic model discussed in the earlier section. Accordingly, we introduce several additional features in the framework to ascertain the robustness of the basic model. Table 6 summarises the results.

Table 6: Determinants of Credit Risk: Robustness Tests – GMM Results

Variables	Model 4	Model 5	Model 6
Lagged Dependent variable	0.851 (0.032)***	0.866 (0.032)***	0.854 (0.032)***
Macroeconomic			
GDP growth	-0.005 (0.001)***	-0.008 (0.001)***	-0.004 (0.001)***
GDP growth with 1 lag	-0.0006 (0.0009)	-0.0006 (0.0009)	-0.0007 (0.0009)
Real interest rate with 1 lag	0.001 (0.003)	0.001 (0.003)	0.001 (0.003)
REG	-0.002 (0.005)	-0.001 (0.005)	-0.001 (0.005)
Microeconomic			
Loan growth with 1 lag	0.307 (0.155)**	0.314 (0.155)**	0.314 (0.154)**
Loan growth with 2 lags	0.193 (0.206)	0.153 (0.209)	0.185 (0.210)
Loan growth with 3 lags	-0.055 (0.162)	-0.041 (0.162)	-0.049 (0.161)
Loan growth with 4 lags	0.147 (0.152)	0.120 (0.152)	0.136 (0.148)
Bank branch growth with 2 lags	0.039 (0.061)	0.041 (0.061)	0.044 (0.059)
Bank branch growth with 3 lags	0.051 (0.067)	0.058 (0.065)	0.056 (0.065)
NPRIOL	-0.049 (0.025)**	-0.053 (0.026)**	-0.048 (0.026)*
INEFF	0.132 (0.345)	0.197 (0.349)	0.144 (0.342)
SIZE		0.004 (0.001)**	0.004 (0.002)*
Spread with 1 lag	-0.285 (0.227)	-0.263 (0.218)	-0.278 (0.233)
Spread with 2 lags	-0.210 (0.155)	-0.187 (0.147)	-0.205 (0.159)
CRAR with 2 lags	0.0002 (0.0009)	0.0002 (0.0008)	0.002 (0.0009)
CRAR with 3 lags	0.0004 (0.0005)	0.0003 (0.0005)	0.0004 (0.0005)
PRM with 2 lags	-0.001 (0.0007)*	-0.001 (0.0007)*	-0.001 (0.0007)*
BIG	0.001 (0.004)		
DIVEST		0.005 (0.003)	
|GDPGR|			-0.0006 (0.001)
No. of observations, time period	324; 1994-2005	324; 1994-2005	324; 1994-2005
Log likelihood	-561.411	-561.659	-561.327

Robust standard errors in parentheses
***, ** and * denote statistical significance at 1, 5 and 10%, respectively.

First, we investigated whether non-performing loans differ among big *versus* small banks. Towards this end, we constructed a dummy variable (BIG), which assumed a value of 1 if the bank had total asset of at least Rs.2 billion (belonging to the 90th percentile of asset distribution) at the beginning of the sample period. As observed from the second column of Table 5 (Model 4), the sign on the coefficient was negative and statistically significant, suggesting that bigger banks tend to have lower problem loans, perhaps owing to their better portfolio diversification or possibly even superior credit risk management techniques.

Second, we tested whether the problem loans are symmetric, i.e., whether they decrease in the same way during upturns as they increase in downturns. In particular, we added a new independent variable: the absolute value of the difference between GDP growth in a particular year and the average GDP growth in the sample period. The estimates (Model 5) indicate that the variable is negative, but not statistically significant.

A final issue of interest was whether problem loans are, in any way, affected by the ownership structure of institutions. In particular, several state-owned banks have made an initial public offering over the sample period and thus have lowered the Government holding in them. Evidence from the US banking industry seems to suggest that different ownership structures and distinct corporate governance arrangements might have different effects on the risk profile of institutions (Himmelberg *et al.*, 1999). We, therefore, constructed a variable (DIVEST), which was 1 in a particular year (and all subsequent years), if a bank had made an equity offering in that year and zero, otherwise. The revised estimation result (Model 6), reveals that the sign of the variable is negative, but not statistically significant. The remaining properties of the model are not affected in any meaningful manner.

7. Policy Implications

While there have been several contributions to the literature on determinants of bankruptcy of non-financial firms, empirical studies focusing exclusively on the determinants of problem loans of banks have been limited. The present paper attempts to address this shortcoming. Using data on state-owned banks for 1994-2005, the paper finds that credit risk is significantly influenced by individual bank-level variables. The result holds even after controlling for macroeconomic conditions.

There are several policy implications that can be gleaned from the analysis. First, evidence suggests that rapid expansion of lending by banks often leads to poor loan quality, *albeit* with a lag, because the growth of lending may outstrip the lender's capacity to appraise and monitor its borrowers. In this context, Honohan (1997) has advocated 'speed limits' to restrict the

rate of growth of banks' loan portfolios. Such 'speed limits' need not necessarily be applied to the entire loan portfolio, but could be restricted to those types of lending which are perceived as posing significant risk to banks' loan portfolio and can therefore engender problem loans. Such an approach has recently been adopted in the Indian context, where the RBI has raised the risk weight on retail loans, which seemed in danger of overextension.

Second, it is observed that bigger banks tend to have higher problem loans. This suggests that the potential risk-reducing benefit of diversification may need to be traded-off against the paucity of adequate skills in credit evaluation in big banks, akin to the institutional memory hypothesis. This assumes importance in view of the current spate of consolidation witnessed by the Indian banking industry (RBI, 2001).

Finally, from the supervisory standpoint, excessive rapid loan growth, as well as sharp declines in bank capital levels are useful pointers to the deterioration in the financial health of banks and can be employed as early warning indicators of future problem loans.

References

Aghion, P., P.Howitt and D.Mayer-Foulkes (2005): The effect of financial development on convergence: theory and evidence, Quarterly Journal of Economics, **120**, 173-222.

Altman, E. and A.Saunders (1999): Credit risk measurement: developments over the last 29 years, Journal of Banking and Finance, **21**, 1721-1742.

Arellano, M and S.Bond (1991): Some tests of specification for panel data: monte carlo evidence and an application to employment equation, Review of Economic Studies, **58**, 277-297.

Baltagi, B. (2001): Econometrics of panel data, John Wiley and Sons: UK.

Berger, A.N. and G.Udell (2004). The institutional memory hypothesis and the procyclicality of bank lending behavior, *Journal of Financial Intermediation*, 13 (Special Issue), 458-95.

Berger, A.N. and R.DeYoung (1997): Problem loans and cost efficiency in commercial banks, Journal of Banking and Finance, **21**, 849-870.

Caprio, G., I.Atiyas and J.A.Hanson (1994): Financial reform: theory and experience, Cambridge: Cambridge University Press.

Demirguc-Kunt, A., E.Detragiache and P.Gupta (2000): inside the crisis: an empirical analysis of banking systems in distress, IMF Working Paper No.156, Washington D.C.

Dewartipont, M and J.Tirole (1994): The prudential regulation of banks, Massachusetts: MIT Press.

Gabriel, J., V.Salas & J.Saurina (2006): Determinants of collateral, Journal of Financial Economics, **81**, 255-81.

Gonzalez-Hermosillo, B., C.Pazarbasioglu and R.Billings (1997): Determinants of banking system fragility: a case study of Mexico. IMF Staff Papers **3**, 42-66.

Government of India (1991): Report of the committee on the financial system (Chairman: Shri M.Narasimham), New Delhi.

Hawkins, J and P.Turner (1999): Bank restructuring in practice: an overview, BIS Policy Paper No.6, Basel.

Himmelberg, C., R.Hubbard and D.Palia (1999): Understanding the determinants of managerial ownership and the link between ownership and performance, Journal of Financial Economics, **53**, 353-384.

Holmstrom, B and J.Tirole (2000): Liquidity and risk management, Journal of Money, Credit and Banking, **32**, 295-319.

Honohan, P. (1997): Banking system failures in developing and transition countries: diagnosis and prediction, BIS Working Paper No 39, Bank for International Settlements: Basel.

Jalan, B. (2001): Banking and finance in the new millennium, Speech Delivered at the 22nd Bank Economists' Conference, New Delhi.

Jimenez, G and J.Saurina (2006). Credit cycles, credit risk and prudential regulation, International Journal of Central Banking, **2**, 65-98.

King, R and R.Levine (1993): Finance and growth: Schumpeter might be right, Quarterly Journal of Economics, **108**, 717-738.

Kwan, S and R.Eisenbis (1997): Bank Risk, capitalisation and operating efficiency, Journal of Financial Services Research, **12**, 117-131.

Levine, R (2003): More on finance and growth: more finance, more growth, Federal Reserve Bank of St.Louis, July/August, 31-46.

Ghatak, S. (1981): Monetary Economics in developing countries, New York: St.Martin's Press.

Fry, M.J. (1988): Money, interest and banking in economic development, Baltimore: Johns Hopkins University Press.

Levine, R., N.Loayza and T.Beck (2000): Financial intermediation and growth: causality and causes, Journal of Monetary Economics, **46**, 31-77.

Petersen, M.A. and R.G.Rajan (1994): The benefits of lending relationships: evidence from small business data, Quarterly Journal of Economics, **69**, 407-443.

Rajan, R.G. (1994): Why banks credit policies fluctuate? A theory and some evidence, Quarterly Journal of Economics, **109**, 399-441.

Rajaraman, I., S.Bhaumik and N.Bhatia (1999): NPA variations across Indian commercial banks: some findings, Economic and Political Weekly, **34**, 16-23.

Reserve Bank of India (2001): Report on trend and progress of banking in India, RBI: Mumbai.

Reserve Bank of India (2002): Draft of the directions proposed to be issued to securitisation companies/reconstruction companies in the matter of asset reconstruction and matters related thereto, RBI: Mumbai.

Reserve Bank of India: Annual report (various years), RBI: Mumbai.

Reserve Bank of India: Report on trend and progress of banking in India (various years), RBI: Mumbai.

Reserve Bank of India: Statistical tables relating to banks in India (various years), RBI: Mumbai.

Salas, V and J.Saurina (2002): Credit risk in two institutional regimes: Spanish commercial and savings banks, Journal of Financial Services Research, **22**, 203-224.

Santomero, A.M. (1997): commercial bank risk management: an analysis of the process, Journal of Financial Services Research, **2/3**, 83-115.

Williamson, O. (1963): Managerial discretion and business behaviour, American Economic Review, **53**, 1032-57.