Risk and Productivity Change of Public Sector Banks

While the relationship between portfolio risk and capital and its interrelationship with operating efficiency has been explored elsewhere, limited evidence has been forthcoming on the interrelationships among capital, non-performing loans and productivity. The paper makes an attempt to examine the same in the Indian context. Using data on public sector banks (PSBs) for the period 1995-96 through 2000-2001, the paper finds capital, risk and productivity change to be intertwined, with each reinforcing and to a degree, complementing the other. The results imply that inadequately capitalised banks have lower productivity and are subject to a higher degree of regulatory pressure than adequately capitalised ones. Finally, the results lend some credence to the belief that lowering government ownership tends to improve productivity.

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I Introduction

One of the major areas of the economy that has received renewed focus in recent times has been the financial sector. Within the broad ambit of the financial sector, the banking sector has been the cynosure of academia and policymakers alike. Among the various reasons attributable to the resurgence of interest in banking, the worldwide trend towards de-regulation of the financial sector, ascendancy of free market philosophy and the growing number, breadth and severity of bouts of financial distress that have plagued several economies since the 1980s have been dominant. With concerns about financial stability emerging to the forefront of policy challenges now facing central banks worldwide, it is being increasingly realised that promoting healthy financial institutions, especially banks, remains a crucial policy challenge for all central banks worldwide. In consonance of this trend, the traditional face of banking has also been undergoing a change from being a mere intemediator to becoming a provider of quick, cost-effective and consumer-centric services. Not surprisingly therefore, the banking sector in most emerging economies, including India, is passing through challenging times.

Process of liberalisation of the economy initiated in India since 1991-92, aimed at raising the allocative efficiency of available savings, increasing the return on investments and promoting, accelerated growth and development of the real sector. Towards this end, wide-ranging reforms were undertaken across the entire gamut of the financial system in order to promote a diversified, efficient and competitive financial system [Rangarajan 1998]. The thrust of the process has been to cut costs and raise the productive efficiency of the banking sector as a whole.

Internationally, there has been a considerable amount of research examining the productive efficiency for the banking industry for several countries, viz, United States [Bauer et al 1998], Norway [Berg et al 1992], Thailand [Leightner and Lovell 1998] and Korea [Gilbert and Wilson 1998]; not much evidence in this regard has been forthcoming for the Indian banking sector. It is widely recognised that India is one of the fastest growing economies in the present decade [Jalan 2000], with the growth engine propelled to a large extent, by a vibrant banking sector. At a time when the financial sector has been significantly liberalised, it is important to examine as to whether the productivity of banks has concomitantly improved as well. Such insights can provide useful guidance to policy-makers towards understanding the efficacy of the reform process, particularly on the banking sector.

In the light of the aforesaid discussion, the present paper seeks to examine the interrelationships among risk, capital and productivity change of the public-sector banking sector in India. While the relationship between capital and risk, especially for US banks, has been extensively studied [Shrieves and Dahl 1992; Jacques and Nigro 1997] and even their interrelationship with operating efficiency has been explored [Kwan and Eisenbis 1997], limited evidence is available on their relationship with productivity change. There are reasons to believe that both risk and productivity might be endogenously determined, so that such a situation is best examined in a simultaneous equation setup. In a recent study, Leightner and Lovell (1998) using two different specifications of the provision of bank services showed that total factor productivity varied markedly under two different objectives. Illustratively, when the direct objective of profit maximisation by the banks was considered, factor productivity increased sharply; in contrast, when the indirect objective of facilitating growth while safeguarding safety and soundness of the banking system was taken into consideration, productivity growth exhibited a decline. Such differing objectives, not surprisingly, have differing implications for risk-taking behaviour by banks. Under the first scenario, risk-taking tends to be dictated by the individual bank's profitability considerations, which, in turn, will impinge on bank productivity, while in case of the latter, risk-taking will be largely governed by financial stability considerations of the central bank, and to that extent, will impinge indirectly upon productivity.

From the standpoint of a developing country, the interplay among capital, risk and productivity might not be necessarily unambiguous. For one, banking systems

in developing countries still tend to be predominantly government owned, so that any such relationship needs to take cognisance of this fact. To provide an example, as at end 1998, share of SOBs in India were 82 per cent. The comparable figures for China, Indonesia and Brazil during the same period were 99 per cent, 85 per cent and 47 per cent, respectively [Hawkins and Turner 1999]. Second, prudential norms also differ widely across countries, so that studies on such banking behaviour in one country might not provide consistent inferences about the same in another country. More importantly, even within a country, not all banks would be equally well placed to meet the prudential norms. This brings into prominence the concept of regulatory pressure that such banks face towards attaining such standards. Finally, several countries have directed credit programmes, meant to provide credit at concessional rates to the neglected sectors of the economy, so that any analysis would need to factor such considerations into account.

The purpose of the study can presently be outlined. The aim of the study is to examine the interrelationships among risk, capital and productivity for the PSBs in India. In contrast to the standard intermediation approach or production approach towards determining the bank's choice of inputs and outputs, we follow Leightner and Lovell (1998) in assuming that commercial banks have a growth objective, while the central bank seeks to ensure soundness of the banking system, in addition to ensuring higher economic growth. This approach allows for the specification of two differing sets of outputs and a common set of inputs and subsequently, we examine empirically the effects on risk and capital when banks either pursue their objectives in isolation or alternately, internalize the objectives of the central bank.

The analysis reveals that capital adequacy has a negative and significant effect on asset quality when the PSBs are considered in totality. Secondly, it is observed that non-performing assets (NPAs) play a major role in influencing capital levels for the small banks as also for the PSBs as a whole, reiterating the mutually reinforcing relation between credit risk and financial leverage. Thirdly, as regards productivity change, it is observed that depending upon whether the objective of productivity is growth or growth with stability considerations, capital and NPAs remain crucial factors in influencing productivity. Finally, regulatory pressure, both with regard to capital and NPAs play a significant role in influencing the capital adequacy and asset quality of PSBs.

The rest of the paper is structured as follows. In Section II, a brief history of the financial liberalisation and bank regulation in India are discussed, which provides the backdrop for the subsequent empirical exercise. Section III describes the model specification. The discussion of the results is contained in Section IV. The final section syncopates the concluding remarks.

I
Institutional Structure of Indian Banking System

The scheduled commercial banking system comprises of foreign banks operating in India, in addition to Indian banks in the public and the private sectors and the regional rural banks (RRBs). The two rounds of nationalisation – first in 1969 of 14 major private sector banks with deposit liability of Rs 0.50 billion or more, and thereafter in 1980, of six major private sector banks with deposits not less than Rs 2 billion[1] – led to the creation of PSBs with nearly 92 per cent of assets as at end-March 1991. While there were several private sector and foreign banks functioning at that time, their activities were highly restricted through branch licensing and entry regulation norms.

All commercial banks, whether public, private or foreign, are regulated by the central bank, the Reserve Bank of India (RBI). A process of liberalisation of the financial sector was initiated in 1992, which aimed at creating a more diversified, profitable, efficient and resilient banking system, based on the recommendations of the Narasimham Committee on Financial Sector Reforms (1991). The underlying philosophy was to make the banking system more responsive to changes in the market environment and to that end, engendered a shift in the role of the RBI from micro-management of bank's operations to macro-governance.

The reforms sought to improve bank profitability by lowering pre-emptions (through reductions in the cash reserve and statutory liquidity ratios)[2] and to strengthen the banking system through institution of 8 per cent capital adequacy norms, in addition to income recognition, asset classification and provisioning requirements in line with international best practices. Competition was sought to be promoted through entry of new banks in the private sector and more liberal entry of foreign banks. While regulations relating to interest rate policy, prudential norms and reserve requirements have been applied uniformly across bank groups, priority sector credit requirements are quite varied for different categories of banks. Illustratively, while the public sector and private sector banks are required to allocate 40 per cent of their credit to priority sectors (comprising, agriculture, small-scale industry, transport operators, small business, etc), the same for foreign banks was fixed at 32 per cent. These amounts, for both the state-owned/private and the foreign banks are inclusive of several sub-targets, the former comprising a sub-target of 18 per cent for agriculture, while the latter consists of a sub-target of 10 per cent for export[3] and 10 per cent for small-scale industries.

Until 1991-92, all PSBs were fully owned by the government.[4] After the reforms process was initiated, these banks were allowed the access the capital markets to

Table 1: Summary of the Banking Industry
(1990-91 to 2000-01)

Year/Bank Group	1990-91			1995-96			2000-01		
	Pub	Pvt	Forgn	Pub	Pvt	Forgn	Pub	Pvt	Forgn
Number of Banks	28	25	23	27	35	29	27	32	41
Total Deposits (Rs billion)	2087.3	94.3	84.5	3908.2	361.7	306.1	8593.8	1349.2	591.9
Total credit (Rs billion)	1305.7	49.5	50.6	2075.4	219.3	225.0	4146.3	672.1	429.9
Credit-deposit ratio	0.63	0.52	0.60	0.53	0.61	0.75	0.48	0.50	0.73
Share of									
Total Deposits	92.1	4.2	3.7	85.4	7.9	6.7	81.6	12.8	5.6
Total Credit	92.9	3.5	3.6	82.4	8.7	8.9	79.0	12.8	8.2
Total Income (Rs billion)	240.4	10.4	15.3	536.7	71.8	74.99	1034.9	163.9	119.8
Net Profit (Rs billion)	4.7	0.4	1.5	-3.3	15.9	7.4	43.2	12.3	10.2

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

raise up to 49 per cent of their equity. Till 2000-01, as many as 12 PSBs accessed the capital markets and raised an amount aggregating Rs 64 billion. The management of nationalised banks is under the purview of the ministry of finance which has its representatives on the board of directors. The management of SBI, on the other hand, is under the RBI, which has its representative on its board of directors.

Evidence of competitive pressures on the Indian banking industry is seen from the decline in the five bank asset concentration ratio[5] from 0.51 in 1991-92 to 0.44 in 1995-96 and thereafter to 0.41 in 2000-01 and by the increasing number of private and foreign banks (Table 1).[6]

The performance of PSBs has become more responsive to changes in the marketplace, with growing emphasis on profitability as an indicator of performance as opposed to non-commercial considerations in the pre-reform era. Illustratively, there was a distinct improvement in the net profit of PSBs (from 4.6 billion in 1992-93 to Rs 43.2 billion in 2000-01). Reflecting the efficiency of the intermediation process, there has been a decline in the spread between the borrowing and lending rates as attested by the ratio of net interest income to total assets from 3.20 per cent in 1990-91 to 2.84 per cent in 2000-01.

II
The Model Specification

The prior literature suggests that bank risk-taking might be dependent, among others, upon productivity change. The managerial discretion in risk-taking is partially dependent on the quality of management. As a consequence, an efficient bank with a superior management might be better placed in assuming additional risks vis-a-vis a less efficient one, ceteris paribus. This however needs to be tempered by fact that an efficient banking firm, in an attempt to protect its franchise value, might be less inclined to assume greater risks than a less efficient one. The relationship is further compounded by agency problems between management and shareholders. If, for instance, entrenched management is associated with low productivity, it is not altogether clear whether the relation between productivity and bank risk is positive [Saunders et al 1990] or negative [Gorton and Rosen 1995].

At the same time, bank risk might impinge upon productivity. Risks may be costly to manage, since a high-risk firm might require more inputs to produce a given level of output as compared with a banking firm which assumes less risk. Put differently, while the attainment of a given level of productivity might be cost-effective, it might be difficult to increase the same, in view of the problems of high-risk loans that might creep into the loan sanctioning process. This, in its wake, implies a negative effect of bank risk on productivity. The nature of interplay between risk and productivity implies that it may be best modelled within a simultaneous equation framework. While studies examining the interplay between capital and portfolio risk have been considered in literature [Shrieves and Dahl 1992], little work has been forthcoming on the examination of the relationship between capital and credit risk and its interaction with productivity.

Two sources of bank risk are considered in this study. These include credit risk and leverage. Credit risk is the risk of default of the assets of the banking firm, consisting primarily of loans and government securities.[7] Leverage, on the other hand, refers to the amount of borrowing relative to the level of capital provided by shareholders. Since a banking firm can achieve a certain level of overall risk exposure by convex combinations of credit risk and financial leverage, these two types of bank risk are modelled as simultaneously determined. In the present study, credit risk is measured by the ratio of net non-performing loans to net advances (NNPA).[8] Financial leverage, on the other hand, is measured by the ratio of capital to risk weighted assets (CRAR).

The crucial issue in this context is the measurement of productivity change. There has been long-standing disagreement over what banks produce and what resources are consumed in the process. Three approaches have come to dominate the literature: the asset (or intermediation) approach, the user cost approach and the value added (or production) approach. All these approaches utilise generally different, but overlapping sets of inputs and outputs. The present analysis of defining inputs and outputs of Indian commercial banks has been motivated by Leightner and Lovell (1998).

In the Indian context, the commercial banks, especially the public sector banks, serve manifold purposes. As a business entity, while they have a profit-maximising objective, given the governmental concerns for ensuring allocation of credit to neglected sectors of the economy (e g, small scale industries, agriculture, transport operators, small business, etc), they have to serve a social objective as well. The central bank, on the other hand, has a regulatory objective of fostering equitable economic growth, whilst addressing the concerns of financial stability.

We define two different models of measuring productivity change, depending on the choice of the set of inputs. When one has panel data, as in the present study, one may use Data Envelopment Analysis (DEA) like linear programming approach and a (input or output based) Malmquist total factor productivity (TFP) index to measure productivity change. DEA involves the use of linear programming methods to construct a non-parametric piecewise surface (or frontier) over the data, so as to be able to calculate efficiencies relative to this surface.

Suppose we have data on K inputs and M outputs for each of N DMU's. For the i th DMU, these are represented by the vectors x_i and y_i, respectively. The K × N input matrix × and the M × N output matrix Y represent the data for all N DMUs. [Fare et al (1994)[specify an output-based Malmquist productivity change index[9] which is defined as:

$$M_o\ (y_{t+1}, x_{t+1}, y_t x_t) = [\frac{(d_o^t\ (x_{t+1}, y_{t+1})}{d_o^t\ (x_t, y_t)} \times \frac{(d_o^{t+1}\ (x_{t+1}, y_{t+1})}{d_o^{t+1}\ (x_t, y_t)}]^{½} \quad ...(1)$$

This represents the productivity of the production point (x_{t+1}, y_{t+1}) relative to the production point (x_t, y_t); (x, y) indicates the vector of inputs and outputs. A value greater than 1 will indicate positive TFP growth from period *t* to period *t+1*. This index is, in fact, the geometric mean of two output-based Malmquist TFP indices. One index uses period *t* technology, and the other uses periods *t+1* technology. To calculate the index, one needs to calculate the two-component distance function, which involves four linear programming problems. For instance, assuming constant returns to scale technology, we have the formulation

$$[d_o^t(x_t, y_t)]^{-1} = \underset{\varphi, \lambda}{Max}\ \varphi \quad ...(2)$$

$$s.t. \qquad -\varphi\, y_{it} + Y_t\, \lambda \geq 0$$

$$x_{it} - X_t\, \lambda \geq 0$$

$$\lambda \geq 0$$

Similarly, the other distance functions can be calculated.

For the first model, we specify inputs as deposits, borrowings, fixed assets (capital), while an additional input (provisions and contingencies) has been added to define the second model. The additional input is intended to capture the cost of risk-taking, a recurrent problem of the banking sector in India. The selection of this variable is warranted against the background of the objective of the central bank of preserving financial stability as opposed to merely macro-stability. In this study, we have assumed that commercial banks in India seek to pursue the broader objective of fostering economic growth. Towards that end, we specify a common set of two outputs for both sets of models: bank credit and investments. In order to mitigate the price effects, the relevant variables have been deflated by a uniform GDP deflator. Accordingly, we estimate two different indices of productivity for each bank separately and denote them as GR1 and GR2.

Summing up the aforesaid discussion, in the present set-up, NNPA, CAPITAL and PRODUCTIVITY (GR1 and GR2) represent the three endogenous variables in each of the three equations. The model is closed by including exogenous variables that have explanatory power for each of the above endogenous variables. It is to these variables that we turn next.

The NNPA is expected to be related to the composition of the loan portfolio, since different asset categories have different default characteristics. Therefore, in the NNPA equation, we include priority sector loans (as ratios of total loans) as a separate variable. Evidence in the Indian context seem to suggest that, for the PSBs, the share of non-performing loans obtaining from priority sector declined from over 48 per cent in March 1996 to around 46.2 per cent in March 2001 [RBI 2001]. Since loans to priority sector have been prescribed not to exceed the Prime Lending Rate (the rate charged to the borrowers of the bank with highest rating), it remains to be examined whether higher priority sector loans lead to higher NNPA. The effects of loan growth on the quantity of bad loans are controlled by using the one-year loan growth rate (ADVGR). To allow for the possibility of a U-shaped relation between loan growth and bad loan, the square of loan growth term (ADVGRSQ) has also been included as a separate variable to explain bad loan. In line with the analysis of Jacques and Nigro (1997), we introduce the concept of regulatory pressure both with regard to capital and NPAs. As regards NPAs, the union budget of the government for 1998-99 provided certain functional autonomy to the PSBs with regard to their personnel management policies. An important component of the autonomy process included these banks having a NNPA ratio not exceeding 9 per cent, which we adopt as the benchmark for computing regulatory pressure for NPAs. Specifically, the regulatory pressure variable equals the difference between the inverse of the banks actual net NPA to net advances ratio (NNPA) and the inverse of the benchmark ratio of 9 per cent. Because banks with NNPA above and below the 9 per cent stipulation may react differently, this study partitioned regulatory pressure into two variables: RPHNPA and RPLNPA. RPHNPA equals (1/NNPA-1/9) for all banks with a NNPA not less than 9 per cent, and zero otherwise. These banks are under considerable pressure to lower their NNPA. Therefore, RPHNPA should have a positive effect on NNPA, because one of the options available to banks to meet the prescribed asset quality standards is simply by cutting loan growth. The reverse logic holds for banks with NNPA less than 9 per cent. In this case, RPLNPA is defined as (1/9-1/NNPA) for all banks with NNPA not less than 9 per cent, and zero otherwise. Finally, the effect of economic conditions on non-performing loans (ceteris paribus, non-performing loans would tend to rise in bad times than in good times) is controlled, using time effect dummies.

In the second equation, the level of capital is expected to be positively related to the profitability of the banking firm, owing to the plough back of earnings into reserves.[10] This suggests the Return on Assets (RoA) as a plausible explanatory variable to explain CRAR. In addition, we control for the effect of bank size on capital, by including the natural logarithm of total assets (SIZE). In order to capture the effects of capital regulation, we include regulatory pressure variables, denoted by RPHCRAR and RPLCRAR. In particular, the focus is on the response of the PSBs to the 8 per cent risk-based capital standards.[11] In this case, RPHCRAR and RPLCRAR signal the degree of regulatory pressure brought about by the risk-based capital standards on capital ratio. As with regard to NPAs, the regulatory pressure variable equals the difference between the inverse of the bank's total risk-based capital ratio (CRAR) and the inverse of the regulatory minimum risk-based ratio of 8 per cent and accordingly, this study partitioned regulatory pressure into two variables: RPHCRAR and RPLCRAR. In particular, RPLCRAR equals (1/CRAR-1/8) for all banks with a total risk-based capital ratio less than 8 per cent, and zero otherwise. These banks are under considerable pressure to increase capital ratios. Therefore, RPLCRAR should have a positive effect on capital ratios, because one of the options available to banks to meet the prescribed capital standards is simply raising capital.[12]

A second regulatory pressure variable, RPHCRAR equals (1/8-1/CRAR) for all banks with total risk-based ratio greater than or equal to 8 per cent, zero otherwise. Although banks with risk-based capital ratios in excess of 8 per cent are not explicitly constrained by the prescribed capital standards, it might well happen that the risk-based standards induce them to reduce their ratios (the opportunity cost of holding additional capital might be high). Alternately, since banks must meet the minimum prescribed standards on a continuous basis, the risk-based capital standards may cause banks to increase their capital ratios (additional capital might act as a cushion for some loans migrating into non-performance). More importantly, higher capital ratios might act as a signalling device, both to the market and bank regulators, that these banks are in compliance and in the process, lead to an overall reduction in regulatory costs.

Finally, in the PRODUCTIVITY equation, we control for the effect of loan growth on efficiency by introducing two loan growth variables: ADVGR and ADVGRSQ. To the extent that a low to moderate growth rate captures managerial quality, while a high growth rate reflects

Table 2: Summary Statistics – Mean Values of the Variables

Variable	Large	Medium	Small	All
Bank-specific				
TotalAsset	10.645	9.598	9.097	9.780
CRAR	10.18	8.263	11.462	9.968
NNPA	7.726	10.975	7.674	8.792
ROA	0.556	-0.0004	0.556	0.370
ADVGR	15.645	14.609	17.546	15.933
PRIOL	30.741	34.408	37.642	34.264
Productivity				
GR1	1.178	1.223	1.096	1.132
GR2	1.188	1.116	1.096	1.133
Regulatory				
RPHNPA	0.004	0.020	0.006	0.009
RPLNPA	0.032	0.029	0.061	0.041
RPHCRAR	0.023	0.020	0.032	0.025
RPLCRAR	0.081	0.019	0.003	0.034
No of Obs	54	54	54	162

managerial entrenchment, the relation between growth and efficiency might be U-shaped. Finally, to control for the effect of government ownership of the state-owned banking system in India, we define a variable, GOVT, which takes the value one for that year (and for all subsequent years), if a bank has made an equity issue in the particular year and zero, otherwise. In other words, GOVT intends to ascertain whether the divestment of government ownership in SOBs has had an influence on PRODUCTIVITY. If, for example, the relationship is negative, then one might surmise that government ownership tends to improve the productivity of the banking sector. Reverse would be the case if the relationship is positive.

IV
The Data Set and Variables

Yearly data on PSBs from 1995-96 through 2000-01 is obtained from the various issues of *Statistical Tables Relating to Banks in India*, the *Report of Trend and Progress of Banking in India* and the published annual audited accounts of individual banks. The reason for the choice of PSBs can be stated as follows. First, PSBs comprised between 80 and 85 per cent of the total assets of scheduled commercial banks during this period. Second, the PSBs group is sufficiently heterogeneous in terms of geographical location of branches, product sophistication, technological orientation as well as their clientele base, so that a study of PSBs suffices to extract broad inferences about the interrelation between risk and productivity change for the banking sector in India as a whole. As it stands, the PSBs in India comprise of the State Bank of India (SBI) (in which the Reserve Bank of India is the majority shareholder), seven associates of SBI (the majority holding being with SBI) and 19 nationalised banks (the majority holding being with the government). The final sample therefore comprises of 27 PSBs for the period 1995-96 to 2000-01. The choice of the period is dictated by several considerations. The first is the availability of published data on the variables considered in the study. Second, owing to the construction of the one-year loan growth rate, the estimation period covers the years 1995-96 through 2000-01. Thirdly, the year 1995-96 marks the mid-point of the 'first generation' reforms programme initiated in 1991, so that it would be useful to examine the efficacy of banking policies on the behaviour of different bank groups half-way through the initiation of the reform process.

Summary statistics of the sample banking firms in each of the three size classes as well as for PSBs as a whole for the estimation period is reported in Table 2. In order to account for the heterogeneity *within* PSBs, the sample is broken down into three size classes, based on their total assets as at end-March 1996 (the first year of the sample period). The three size classes are defined as 'small', i e, those with total assets less than or equal to Rs100 billion; 'medium', i e, those with assets exceeding Rs100 billion, but less than or equal to Rs150 billion; and finally, 'large', i e, those with assets exceeding Rs150 billion. This classification leaves us with an equal number of banks within each of the three categories.[13, 14] In addition, separating the sample firms into different size classes is also warranted by the overt focus on productivity change.

Among the bank-specific variables, it is observed that on average, banks in the medium category tend to have relatively higher non-performing loans than those in the other two size classes, whereas capitalisation, on average, tends to be highest in the small banks. Of greater interest is the fact that small banks tend to have more priority sector loans than large/medium ones, with the latter making up the shortfall through other loans. Return on assets tend to be larger for smaller firms, attesting a negative relation between size and return on assets; the same is however negative for medium-sized firms. Among the productivity measures, it is found that in consonance with widely held beliefs, there is a general trend that larger firms, on average, have higher productivity, irrespective of whether productivity is measured in terms of economic growth objective or alternately, economic growth with stability considerations. As regards regulatory variables, while RPHCRAR tends to be higher for the small banks, RPLCRAR, on the other hand, is higher in the large banks. Since RPHCRAR identifies banks subject to high regulatory pressure, which would be the case for relatively undercapitalised banks, this would seem to suggest that a greater concentration of such banks in the 'small' category. A similar logic applies to the RPLCRAR variable. Finally, the regulatory pressure for NPA is high (RPHNPA) for the medium bank; the same is the lowest for large banks. This would seem to suggest that large banks are more efficient in pro-actively managing their bad assets vis-a-vis medium ones.

Based on the aforesaid discussion, one can postulate a simultaneous equation system comprising of three linear equations, representing the empirical model to be estimated in the study. Accordingly, we postulate two sets of equations, wherein the first set is as under:

$$NNPA = f_1 (CRAR, GR1, PRIOL, ADVGR, ADVGRSQ, RPHNPA, RPHNPL, TIME\ EFFECT\ DUMMIES) \quad ...(3)$$

$$CRAR = f_2 (NNPA, GR1, RoA, RPHCRAR, RPLCRAR, SIZE, TIME\ EFFECT\ DUMMIES) \quad ...(4)$$

$$GR1 = f_3 (NNPA, CRAR, ADVGR, ADVGRSQ, GOVT) \quad ...(5)$$

where, NNPA=net non-performing loan to net advances; CRAR= capital to risk-asset ratio; GR1= index of productivity as measured by economic growth; PRIOL= ratio of loans given to priority sector to total loans; ADVGR= annual growth rate of total loans; ADVGRSQ = square of ADVGR; RPH_i, (i = NPA, CRAR) and RPL_i, (i = NPA, CRAR) = regulatory pressure variables with respect to asset quality and capital adequacy, respectively; RoA = return on asset (defined as net profit to total asset); SIZE = log of total assets; GOVT = Government ownership, defined as a dummy variable which equals 1 in the particular year (and all subsequent years) in which the bank has made an equity offering and zero, otherwise; T = time effect dummy = one for year *t*, zero otherwise.

In equations (3) and (4), PRODUCTIVITY tests the effects of operating performance on risk-taking. Under moral hazard hypothesis, inefficient firms run by entrenched management are postulated to be more prone to risk-taking due to the lower value of their charters. Hence, PRODUCTIVITY is expected to have a positive effect on the amount of bad loans and a negative effect on the level of capital. However, under the hypothesis that inefficient firms are subject to stricter regulatory scrutiny and consequently, have less flexibility to pursue riskier activities, PRODUCTIVITY could be expected to have a negative effect on NNPA and a positive effect on CAPITAL.

Equation (5) examines the effect of risk-taking on productivity. Credit risk

management involves controlling adverse selection problems by screening loan applicants as well as tackling moral hazard problems through closer and continuous loan monitoring. Depending on the efficacy of utilisation of resources to manage the risk, the costs of controlling credit risk may increase with the level of risk exposure due to monitoring and hedging costs, implying a positive relation between NNPA and productivity. On the contrary, if costs of credit risk management decrease with the level of risk exposure (for example, due to credit screening), the relationship between NNPA and PRODUCTIVITY might well turn out to be negative.

In the second set of equations, ceteris paribus, we replace the variable GR1 with GR2, reflecting the fact as to what extent commercial banks are able to internalise the objective of the Reserve Bank of India (of financial stability) in their pursuit for growth.

V
Results and Discussion

The simultaneous equations system is fitted by pooled time-series, cross-section observations using the two-stage least squares procedure separately for each size class. The estimation results for (1) to (3) are presented in Tables 3-5, respectively.

NNPA: The explanatory power for the NNPA equation in reasonably high, ranging from 88 to 96 per cent (Table 3). CRAR is found to have a significant and negative effect on asset quality for PSBs in totality. This implies that PSBs as a whole, relatively more capital (lower leverage) tends to be associated with less credit risk. To the extent that greater financial leverage tends to have a positive effect on credit risk, the findings lend credence to the fact that the two types of risks tend to reinforce each other. Second, contrary to widely held beliefs, loans to priority sector does not necessarily lead to high NNPA, especially for small banks. As observed earlier, loans to priority sector are subject to regulatory stipulation: banks have to advance of 40 per cent of their net demand and time liabilities to this sector; the shortfall having to be dovetailed to bonds of select financial institutions. To the extent that small banks are not able to meet the stipulations, they tend to invest the same in risk-free bonds of select institutions, which would then imply an inverse relationship between NNPA and priority sector loans.

Table 3: Two-stage Least-squares Regression Estimates of Equation (Dependent Variable: NNPA)

	Large	Medium	Small	All
Intercept	7.997*	2.946	16.048*	10.900*
	(0.783)	(5.901)	(3.185)	(1.332)
CRAR	-0.007	-0.193	-0.052	-0.078***
	(0.030)	(0.123)	(0.047)	(0.028)
GR1	-0.010	5.635	-4.196**	-1.668***
	(0.462)	(5.659)	(2.012)	(1.026)
PRIOL	0.021	0.037	-0.073**	0.002
	(0.014)	(0.059)	(0.041)	(0.014)
ADVGR	-0.045**	-0.078	-0.067***	-0.068*
	(0.021)	(0.089)	(0.039)	(0.022)
ADVGRSQ	0.001**	0.002	0.001	0.002*
	(0.0007)	(0.002)	(0.0008)	(0.0005)
RPHNPA	139.388*	166.166*	142.277*	176.552*
	(6.69)	(24.684)	(14.516)	(6.229)
RPLNPA	-32.085*	-25.769*	-18.172*	-18.843*
	(1.824)	(5.617)	(1.383)	(1.125)
T	-0.014	-0.024	0.152**	0.026
	(0.036)	(0.180)	(0.068)	(0.043)
Adjusted R^2	0.967	0.889	0.934	0.953

Notes: Figures in brackets indicate standard errors.
*, ** and *** indicate significance at 1, 5 and 10 per cent, respectively.

Table 4: Two-stage Least-squares Regression Estimates of Equation (Dependent Variable: CRAR)

	Large	Medium	Small	All
Intercept	5.111**	30.161**	16.232**	14.908**
	(2.413)	(22.864	(7.256)	(7.481)
NNPA	-0.064	-0.058	-0.229***	-0.159**
	(0.060)	(0.240)	(0.126)	(0.082)
GR1	-0.237	-6.884	14.106	-4.569
	(0.952)	(31.308)	(10.399)	(7.292)
ROA	0.559	2.732**	0.321	1.867*
	(0.471)	(1.286)	(0.316)	(0.468)
RPHCRAR	99.187*	105.191	139.399*	108.537*
	(10.082)	(136.349)	(18.061)	(17.303)
RPLCRAR	-2.135*	5.587	16.649	1.180
	(0.214)	(15.462)	(19.767)	(1.290)
SIZE	0.202	-1.797	-2.858***	-0.268
	(0.192)	(2.182)	(1.601)	(0.290)
T	0.359*	0.429	0.809*	0.251***
	(0.068)	(0.585)	(0.297)	(0.144)
Adjusted R^2	0.907	0.597	0.715	0.644

Notes: Figures in brackets indicate standard errors.
*, ** and *** indicate significance at 1, 5 and 10 per cent, respectively.

Table 5: Two-stage Least-squares Regression Estimates of Equation (Dependent Variable: GR1)

	Large	Medium	Small	All
Intercept	1.944*	1.078*	1.183*	1.371*
	(0.399)	(0.183)	(0.141)	(0.150)
NNPA	-0.027	0.002	-0.005	-0.011
	(0.028)	(0.009)	(0.008)	(0.008)
CRAR	-0.008	0.019**	0.004	0.009
	(0.028)	(0.009)	(0.007)	(0.008)
ADVGR	-0.036*	-0.013	-0.012**	-0.021*
	(0.019)	(0.008)	(0.006)	(0.006)
ADVGRSQ	0.0005	0.0001	0.0002***	0.0003**
	(0.0006)	(0.0002)	(0.0001)	(0.0001)
GOVT	-0.223***	-0.008	0.050	-0.073
	(0.133)	(0.101)	(0.041)	(0.051)
Adjusted R^2	0.135	0.039	0.065	0.065

Notes: Figures in brackets indicate standard errors.
*, ** and *** indicate significance at 1, 5 and 10 per cent, respectively.

Third, the coefficient on ADVGR is negative and statistically significant for large as well as small banks, pointing to the fact that for these banks, loan growth has a negative effect on bad loans, possibly because of their superior credit risk management techniques. Juxtaposed with the fact that the coefficient on ADVGRSQ being positive for large banks, this finding suggests that the relationship between nonperforming loans and loan growth is inverse U-shaped. As regards regulatory pressure, it is observed that RPHNPA is significant across all bank groups at conventional levels of significance. It seems that banks subject to high regulatory pressure as regards NPAs will attempt to 'gamble for resurrection': increasing their loan growth in order to raise profits, which in turn, might engender high NPA levels, implying a positive relation between NNPA and RPHNPA. On the contrary, banks with NPAs below the stipulated benchmark will possibly adopt a cautious approach as regards credit sanction in an attempt to curb fresh build up of NPAs, so that low regulatory pressure induces banks across all categories to reduce NPAs.

The important aspect of the finding is with regard to productivity change. When the objective of economic growth is taken as a surrogate for productivity, the results seem to suggest that higher productivity leads to a drop in net NPAs, especially for small banks. The flexibility of small banks in loan sanctioning and monitoring implies that they are better able to manage their bad assets, reflected in the inverse relation between NNPA and GR1.

CRAR: The explanatory power on capital equation is significant but with high variability, with the adjusted R^2 ranging from a low of 60 per cent for medium-sized banks to a high of 91 per cent for large banks. The coefficient on NNPA is negative and statistically significant for banks in the small-size class, reiterating the mutually reinforcing relation between credit risk and financial leverage. Bank size (SIZE) and CRAR tend to be negatively related for the small banks, attesting to the limited scale effects emanating from bank operations. Finally, capitalisation is driven positively by RoA and is significant at conventional levels of significance only for medium banks.

Of particular interest are the regulatory pressure variables, RPHCRAR and RPLCRAR. Since RPHCRAR captures banks with low capital adequacy, which does not meet the regulatory minimum

Table 6: Two-stage Least-squares Regression Estimates of Equation (Dependent Variable: NNPA)

	Large	Medium	Small	All
Intercept	7.384*	4.831	15.309*	10.967*
	(1.009)	(3.906)	(3.312)	(1.361)
CRAR	0.010	-0.175*	-0.039	-0.077*
	(0.037)	(0.099)	(0.055)	(0.029)
GR2	0.341	4.082	-3.498***	-1.621***
	(0.479)	(3.873)	(1.982)	(0.985)
PRIOL	0.022	0.024	-0.075***	0.0006
	(0.015)	(0.053)	(0.046)	(0.015)
ADVGR	-0.044***	-0.078	-0.067***	-0.067*
	(0.023)	(0.070)	(0.042)	(0.022)
ADVGRSQ	0.001***	0.002	0.001	0.002*
	(0.0007)	(0.002)	(0.0009)	(0.0006)
RPHNPA	139.177*	168.416*	143.926*	175.902*
	(7.083)	(20.831)	(15.334)	(6.364)
RPLNPA	-32.179*	-25.099*	-18.497*	-18.944*
	(1.977)	(4.731)	(1.545)	(1.153)
T	-0.011	0.008	0.116***	-0.0004
	(0.039)	(0.164)	(0.070)	(0.047)
Adjusted R^2	0.961	0.915	0.927	0.951

Notes: Figures in brackets indicate standard errors.
*, ** and *** indicate significance at 1, 5 and 10 per cent, respectively.

Table 7: Two-stage Least-squares Regression Estimates of Equation (Dependent Variable: CRAR)

	Large	Medium	Small	All
Intercept	4.819***	24.851	15.994*	10.204
	(2.679)	(15.390)	(5.097)	(7.003)
NNPA	-0.071	-0.118	-0.265**	-0.187**
	(0.054)	(0.183)	(0.090)	(0.069)
GR2	-0.060	3.091	6.178	0.349
	(1.021)	(15.315)	(4.848)	(6.405)
ROA	0.504	2.333**	0.399***	1.605*
	(0.448)	(0.969)	(0.223)	(0.477)
RPHCRAR	99.660*	65.314	133.766*	111.279*
	(11.214)	(77.278)	(12.906)	(16.746)
RPLCRAR	-2.157*	0.994	3.733	-1.912
	(0.265)	(10.643)	(10.632)	(1.078)***
SIZE	0.218	-2.303	-1.835**	-0.338
	(0.189)	(1.745)	(0.876)	(0.256)
T	0.355*	0.582	0.700*	0.285***
	(0.066)	(0.591)	(0.204)	(0.189)
Adjusted R^2	0.911	0.637	0.840	0.704

Notes: Figures in brackets indicate standard errors.
*, ** and *** indicate significance at 1, 5 and 10 per cent, respectively.

Table 8: Two-stage Least-squares Regression Estimates of Equation (Dependent Variable: GR2)

	Large	Medium	Small	All
Intercept	2.144*	1.041*	1.217*	1.427*
	(0.404)	(0.197)	(0.166)	(0.158)
NNPA	-0.031*	0.003	-0.005	-0.013
	(0.028)	(0.010)	(0.009)	(0.008)
CRAR	-0.021	0.022**	0.008	0.009
	(0.028)	(0.010)	(0.008)	(0.008)
ADVGR	-0.039**	-0.013	-0.019*	-0.024*
	(0.019)	(0.009)	(0.007)	(0.006)
ADVGRSQ	0.0006	0.0001	0.0003**	0.0004**
	(0.0006)	(0.0002)	(0.0001)	(0.0001)
GOVT	-0.218	-0.019	0.033**	-0.089***
	(0.135)	(0.109)	(0.048)	(0.051)
Adjusted R^2	0.169	0.051	0.112	0.084

Notes: Figures in brackets indicate standard errors.
*, ** and *** indicate significance at 1, 5 and 10 per cent, respectively.

risk-based standards, they should have a positive effect on capital ratios. In Table 3, the parameter estimate on RPHCRAR is positive and significant for banks in the large and small categories, with the coefficient on RPHCRAR equal to 99.187 and 139.399, respectively. This would suggest that large and small banks in the inadequately capitalised category are under considerable regulatory pressure to increase their capital ratios. At the other end of the spectrum, as regards RPLCRAR, the coefficient is statistically significant only for the 'large' category banks, the magnitude of the coefficient being equal to –2.135. This would attest to the fact that the large, adequately capitalised banks tend to lower their capital ratios in response to regulatory pressure.

GR1: The explanatory power of the GR1 equation is the lowest among the three equations, with the adjusted R^2 ranging from a low of 3 per cent to a high of 13 per cent. Thus a non-linear relationship between productivity and other variables is not ruled out. Here, the coefficient on CRAR is positive and significant for medium-sized banks. This would testify that for the category of medium banks, those with more capital tend to have higher productivity than those with less capital. Finally, coming to the critical issue of government ownership, the results support that productivity tends to improve with lower government ownership for the large banks.

On the other hand, if growth is measured in terms of the ability of the commercial banks to satisfy the objectives of the central bank (i e, growth with stability), the results of the analysis are presented in Tables 6, 7 and 8, respectively. The results of Table 6 are virtually the same as in Table 3, and confirm the fact that higher productivity leads to a reduction in NPA, especially for small banks. This might be attributable to the fact that these banks are able to successfully incorporate the objectives of the central tends into their profit maximising behaviour. It is also observed that greater capitalisation has a dampening influence on credit risk, especially for medium banks, supporting the mutually reinforcing relationship between capital and credit risk.

In a similar vein, the results of Table 7 virtually mimic the results of Table 4. As with the earlier table, the mutually reinforcing interrelation between leverage and credit risk is evidenced from the sign on the NNPA coefficient for small banks, with the magnitude of the coefficient being virtually the same as when growth objective is considered in isolation. Unlike the earlier case, capitalisation is driven positively by RoA, not only for medium, but also for small banks as well.

As regards productivity, there are three salient features as reported in Table 8. First, as in earlier case, it is observed that higher capital leads to a rise in productivity for medium-sized banks. Secondly, for the large and small banks in particular, higher loan growth translates into lower productivity. These categories of banks might be less equipped to handle the objective of economic growth while securing financial stability, and to that extent, for these classes of banks, the results suggest decreasing returns to loan growth on productivity. Finally, increased government ownership tends to increase productivity, especially in the small-sized PSBs. These results run contrary to Caprio and Peria Martinez (2000), who find increased government ownership a deterrent to the development of the banking system.

VI
Conclusion

The purpose of the present article has been to understand the interrelationships between risk-taking and productivity in the state-owned banking system in India. As pointed out earlier, the PSBs are traditionally government-owned and to that extent, it is deemed as essential to understand the relation between risk, capital and productivity, especially in the context of a dominantly government-owned banking system. While it is found that higher productivity leads to a decrease in credit risk, it has a positive influence on bank capitalisation as well. This supports the fact that poor performers are more prone to risk taking than better-performing banking organisations. The positive effect of productivity on capital is attributable to regulatory pressure, especially for banks which fall short of the prescribed minimum capital adequacy standards. Finally, our analysis supports the fact that productivity, capital and risk taking tend to be jointly determined, reinforcing and compensating each other. EPW

Notes

1 The number has since been reduced to 19, with the merger of two state-owned banks in 1993.

2 As at end-December 2001, the cash reserve ratio was 5.5 per cent (statutory minimum of 3 per cent) and the statutory liquidity ratio was 25 per cent (the legal minimum). The corresponding figures as at end-March 1994 were 14.0 per cent and 34.25 per cent, respectively.

3 The number has since been revised upwards to 12 per cent in 1996.

4 The State Bank of India (SBI) was fully owned by the RBI and the 7 associates of SBI were fully owned by SBI itself.

5 Defined as assets of top five public sector banks to total assets of the 27 public sector banks.

6 The five largest banks (in terms of asset) are in the public sector.

7 As at end-March 2001, loans and government securities comprised 78 per cent of total assets of PSBs. The corresponding figures as at end-March 1996 was 73 per cent.

8 Net non-performing loans is measured as gross non-performing loans less (1) balance in interest suspense account, (ii) claims by deposit insurance and credit guarantee corporation and kept in suspense account, (iii) part payment received and kept in suspense account, and, (iv) total provisions held.

9 The subscript '0' has been used to indicate that output-oriented Malmquist index has been computed in our study. Note that input-oriented Malmquist TFP indices can also be defined in a similar way to the output-oriented measures presented in the present study (Grosskopf, 1993).

10 In terms of Section 17 of the Banking Regulation Act, 1949, every banking company incorporated in India is required to create a reserve fund and transfer a sum equivalent to not less than 25 per cent of its disclosed profits to the reserve fund, every year.

11 Up to end-March 1999, SOBs had to comply with a CRAR of 8 per cent. This ratio has been raised to 9 per cent effective April 1, 2000.

12 For banks with risk based capital ratios less than 8 per cent, (1/CRAR-1/8) was positive. Therefore, a positive value implies that greater regulatory pressure, as measured by RPLCRAR, correspond to larger increases in the capital ratio. A similar argument can be applied for RPHCRAR.

13 While there has been a movement within classes in terms of bank assets, there has been no movement from one class to another, so that this has left us with the same number of banks within each size class over the sample period.

14 The banks within each size class in alphabetical order are: 'Large' (Bank of Baroda, Bank of India, Canara Bank, Central Bank of India, Indian Overseas Bank, Punjab National Bank, State Bank of India, Syndicate Bank and Union Bank of India,); 'Medium' (Allahabad Bank, Andhra Bank, Bank of Maharashtra, Dena Bank, Indian Bank, State Bank of Hyderabad, State Bank of Patiala, United Bank of India and United Commercial Bank,) and 'Small' (Corporation Bank, Oriental Bank of Commerce, Punjab and Sind Bank, State Bank of Bikaner and Jaipur, State Bank of Indore, State Bank of Mysore, State Bank of Saurashtra, State Bank of Travancore and Vijaya Bank.

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