Size, Non-performing Loan, Capital and Productivity Change: Evidence from Indian State-owned Banks

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Abstract

While the relationship between portfolio risk and capital and its interrelationship with operating efficiency has been extensively studied, little work has been forthcoming on the interrelationships among credit risk, capital and productivity change. The paper makes an attempt to examine the same in the Indian context. Using data on state-owned banks (SOBs) 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 capitalized banks have lower productivity and are subject to a higher degree of regulatory pressure than adequately capitalized ones. Finally, the results lend support, especially for medium-sized banks, to the belief that lowering Government ownership tends to improve productivity.

JEL Classification: G 21, G 28

Key words: productivity, credit risk, non-performing assets, leverage, priority sector

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Introduction

One of the major segments 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. Among the various reasons attributable to the resurgence of interest in banking, the world-wide trend towards deregulation, ascendancy of free market philosophy and the growing number, breadth and severity of bouts of financial distress that have plagued several economies since the 'eighties have been a dominant one. Such liberalization has raised a gamut of questions relating to the linkages between deregulation and the various categories of risks confronting the banking sector. With concerns about financial stability emerging to the forefront of policy challenges facing central banks worldwide, it is being increasingly realized that promoting healthy financial institutions, especially banks, is a crucial prerequisite. As a result, the traditional face of banking has also been undergoing a change-from one of mere intemediator to one of provider of quick, cost-effective, efficient and consumer-centric services. Not surprisingly therefore, the banking sector in most emerging economies is passing through challenging yet exciting times and India has been no exception to that rule.

A process of liberalization of the economy was initiated in India since 1991-92, which 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).

In the international context, 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), Spain (Grifel-Tatje and Lovell, 1996), Thailand (Leightner and Lovell, 1998) and Korea (Gilbert and Wilson, 1998). Not much evidence, however, has been forthcoming for the Indian banking sector on the interlinkage among non-performing loans, capital and productivity. It is widely recognized that India is one of the fastest growing economies in the present decade, with

the growth engine propelled to a large extent, by a vibrant banking sector (Jalan, 2000). At a time when the financial sector has been significantly liberalized, it is important to examine as to whether the productivity of banks has concomitantly improved as well. Such insights can serve as useful guide to policy makers towards understanding the efficacy of the reform process, particularly on the banking sector.

Against this background, the present paper seeks to examine the interrelationships among risk, capital, productivity change and size of the state-owned 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)[1] and even their interrelationship with operating efficiency has been explored (Kwan and Eisenbis, 1997), not much evidence is available on their relationship with productivity change. There are reasons to believe that both risk and productivity might be endogenously determined, and 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 was varied markedly under the two different objectives. Illustratively, when the direct objective of profit maximization 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-

[1] Shrieves and Dahl (1992) aim at determining the relation between capital and risk taking behaviour of banks. The changes in bank capital ratios and in portfolio risk are explained by discretionary adjustments and exogenous random shocks. The discretionary changes are thought of as reflecting (partial) adjustments to capital and risk targets. The relationship applies to adequately capitalized as well as undercapitalized banks, indicating that if there is no regulatory need, bank risk-taking is self-constrained (managerial risk-aversion). As for undercapitalized banks, their rate of adjustment was higher than that of adequately capitalized banks. Target capital is significantly affected by bank size (inverse relationship) only for undercapitalized banks. This may be because large banks feel less pressure to increase capital when they are undercapitalized (too-big-too-fail effect). Jacques and Nigro (1997) examine the impact of risk-based capital standards on 2,570 US bank capital and portfolio risk during 1990-91.Building on the framework developed by Shrieves and Dahl (1992), they incorporate among the independent variables proxies for regulatory pressure: the response of banks to the 7.25 per cent risk-based capital standards. Regulatory pressure, in their framework, is defined as the inverse of the banks actual risk-based capital ratio *minus* the inverse of the actual stipulated capital ratio (high regulatory pressure or RPH) and vice versa (low regulatory pressure or RPL). Their findings reveal that banks which had capital ratios in excess of the minimum stipulated levels at the end of 1990 responded to risk-based capital by increasing their capital-asset ratios and reducing portfolio risk. On the other hand, even well-capitalised banks lowered their portfolio risk in response to regulatory constraints, even though the impact on capital ratios for these banks is not so clear cut.

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 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 cognizance of this fact. To provide an example, as at end 1998, share of State Owned Banks (SOB) 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 attain such standards. This brings into prominence the concept of regulatory pressure that a bank faces 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.

More specifically, the aim of the study is to examine the interrelationships among risk, capital and productivity for the SOBs in India. In contrast to the standard *intermediation approach* or *production approach* towards determining various choices of inputs and outputs of banks, we follow Leightner and Lovell (1998) and Jemric and Vujcic (2002), in assuming that commercial banks have a profitability 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 inputs and a common set of outputs. Subsequently, we examine empirically the effects on risk and capital when banks either pursue their objectives in isolation or alternately, their ability to satisfy the objectives of the central bank.

The rest of the paper is organized as follows. In Section II, a brief history of the financial liberalization and bank regulation in India are discussed. Section III describes the model specification. The discussion of the results is contained in Section IV. The final Section syncopates the concluding remarks.

2. Institutional Structure of the Indian Banking System

In addition to Indian banks in the public and the private sectors and the Regional Rural Banks, the Scheduled Commercial Banking system comprises the foreign banks operating in India also. The two rounds of nationalization-first in 1969 of 14 major private sector banks with deposit liability of Rs. 0.50 billion or more, and thereafter in 1980, of 6 major private sector banks with deposits not less than Rs.2 billion[2]- led to the creation of SOBs with nearly 92 per cent of assets as at end-March 1991. While there were several private and foreign banks functioning at that time, there 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 liberalization 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-emption (through reductions in the cash reserve and statutory liquidity ratios)[3] and to strengthen the banking system through the introduction 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 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 state-owned and Indian 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-

[2] The number has since been reduced to 19, with the merger of two SOBs in 1993.

[3] As at end-March 2001, the cash reserve ratio was 7.5 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.

target of 18 per cent for agriculture, while the latter consists of a sub-target of 10 per cent for export[4] and 10 per cent for small-scale industries.

Until 1991-92, all SOBs were fully owned by the Government.[5] After the reforms process was initiated, these banks were allowed to access the capital market to raise up to 49 per cent of their equity. Till 2000-01, as many as 12 SOBs accessed to capital market and raised an amount aggregating Rs.64 billion. The management of nationalized banks is under the purview of the Ministry of Finance of the Government, which has its representatives on the Board of Directors. The management of State Bank of India, on the other hand, is under the RBI, which has its representative on its Board of Directors. As observed in the Narasimham Committee Report (1991), such a move has seriously abridged the functional autonomy of these banks and constrained their free and fair functioning.

Evidence of competitive pressures on the Indian banking industry is evidenced from the decline in the five bank asset concentration ratio 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].

[Insert Table 1 about here]

The performance of SOBs 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 (from 4.6 billion in 1992-93 to Rs.51 billion in 1999-2000). Reflecting the efficacy of the intermediation process, there has been a decline in the spread between the borrowing and lending rates as attested by the declining ratio of net interest income to total assets from 3.20 per cent in 1990-91 to 2.70 per cent in 1999-2000.

3. The Model Specification

The prior literature suggests that bank risk-taking might be dependent, among others, upon productivity change [Saunders *et al*., 1990, Gorton and Rosen, 1995]. 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

[4] The number has since been revised upwards to 12 per cent in 1996.
[5] The State Bank of India (SBI) was fully owned by the RBI and the 7 associates of SBI were fully owned by SBI itself.
[6] The five largest banks (in terms of asset) were Government-owned till 2000-01.

in assuming additional risks *vis-à-vis* a less efficient one, *ceteris paribus*. This however needs to be tempered by the 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 the 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 or negative.

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 modeled within a simultaneous equation framework. While studies examining the interplay between capital and portfolio risk have been considered in the 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 the 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 modeled 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 the context of measurement of productivity change in banking has been the absence of appropriate definition of inputs/outputs of banking and financial services. While the multi-product nature of the banking firm is widely

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

[8] Net non-performing loans is measures as gross non-performing loans *less* (i) balance in interest suspense account, (ii) claims by deposit insurance and credit guarantee corporation and kept in

recognized, there is still no agreement as to the explicit definition and measurement of banks' *inputs* and *outputs*. Generally, each definition of input and output carries with it a particular set of banking concepts, which influence and limit the analysis of the production characteristics of the industry. One of the major difficulties in the measurement of bank output resides in the fact there is no consensus on how to define or measure these services. In broad terms, bank output should encompass the portfolio management and advisory services that banks usually provide to depositors in their intermediation capacity. Moreover, the absence of an explicit price also causes significant problems in the measurement of financial services. Without an explicit price, the value would need to be imputed. Whereas banks are viewed as producers of financial services, not all financial services constitute output. A fundamental difficulty arises in the treatment of bank deposits focuses on the input-output status of deposits. Broadly speaking, deposits were viewed as the main input for loan production and the acquisition of other earning assets. However, high value-added deposit products, such as integrated savings and checking accounts, investment trusts, and foreign currency deposit accounts, emphasize the output characteristics of deposits. Indeed, high value added deposit services are an important source of commissions and other fee revenue for specialized commercial banks. Accordingly, in these specialized institutions, the output nature of deposits cannot be overlooked. Deposits are thus "simultaneously an input into the loan process and an output, in the sense that they are purchased as a final product providing financial services" (Griliches, 1993: 222). This argument can be extended *mutatis mutandis* to hold that the classification of deposits should therefore depend on the nature of the financial institutions in any given representative sample and the regulatory regime of the particular nation. For instance, in the context of Indian banking the quantum of high value-added saving deposits is relatively small compared to time deposits, and there may thus be more reason to regard deposits as inputs.

Two major methods have been developed to define the input-output relationship in financial institutions in the literature. In the first place, the *production approach* models financial institutions as producers of deposit and loan accounts, and defines output as the number of these accounts and transactions. Inputs are typically characterized as the number of employees and capital expenditures on fixed assets. Secondly, the *intermediation approach* focuses on the role of financial institutions as

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suspense account, (iii) part payment received and kept in suspense account, and, (iv) total provisions held.

intermediaries that transfer funds from surplus to deficit units. The approach to output definition used in *intermediation approach* was originally developed by Sealey and Lindley (1977) and posits that total loans and securities are outputs, whereas deposits along with labour and capital are inputs to the production process of banking firms. In contrast to *production approach*, *intermediation approach* has been more popular in the literature. One reason for this could be non-availability of number of accounts data at bank/branch level.

In the Indian context, the commercial banks, and especially the public sector banks, serve manifold purposes. As a business entity, they have a profit-maximizing objective, while 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. Accordingly, along with traditional *intermediation approach*, we have used some variation of defining inputs/outputs of banks in this study and have been essentially motivated by Leightner and Lovell (1998).

As far the inputs are concerned, we have considered two different sets according as: (a) deposits, borrowings, fixed assets (capital), which is essentially considered in intermediation approach and (b) an additional input of provisions and contingencies along with (a). 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 an earlier period. For outputs, we have assumed that commercial banks in India seek to maximize their profits. Towards that end, we specify a common set of two outputs as net interest margin and fee income; the former reflecting the gains accruing in the intermediation process, and the latter emanating primarily from customer services. Accordingly, we estimate two different types of indices of productivity for each bank separately and denote them as follows:

PR1: Productivity estimate with inputs as deposits, borrowings, fixed assets and outputs as net interest margin and fee income;

PR2: Productivity estimate with inputs as deposits, borrowings, fixed assets, provisions and contingencies and outputs as net interest margin and fee income;

In order to mitigate the price effects, the relevant variables have been deflated by a uniform GDP deflator. Available studies in the Indian context reveal that public sector banks have less technical efficiency and a substantial portion of the output forgone is the result of underutilization or wastage of resources (Das, 1997).

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 piece-wise 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 decision-making units (DMU's). For the i th DMU, these are represented by the vectors x_i and y_i, respectively. The K x N input matrix X and the M x 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

$$M_o(y_{t+1}, x_{t+1}, y_t, x_t) = \left[\frac{d_o^t(x_{t+1}, y_{t+1})}{d_o^t(x_t, y_t)} * \frac{d_o^{t+1}(x_{t+1}, y_{t+1})}{d_o^{t+1}(x_t, y_t)}\right]^{1/2} \qquad \textbf{(1)}$$

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

$$\begin{aligned} [d_o^t(x_t, y_t)]^{-1} &= \underset{\varphi, \lambda}{Max}\, \varphi \\ s.t. \qquad & -\varphi\, y_{it} + Y_t\, \lambda \geq 0 \\ & x_{it} - X_t\, \lambda \geq 0 \\ & \lambda \geq 0 \end{aligned} \qquad \textbf{(2)}$$

Similarly, the other distance functions can be calculated.

In the present setup, NNPA, CAPITAL and PRODUCTIVITY (PR1, PR2) 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 SOBs, the share of non-performing loans obtaining from priority sector declined from over 48 per cent in March 1996 to around 45 per cent in March 2000 (RBI, 2000). 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 SOBs 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

[9] The subscript 'o' 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).

simply by cutting loan growth[10]. 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.[11] 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 log 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 SOBs to the 8 per cent risk-based capital standards[12]. In this case, RPHCRAR and RPLCRAR signal the degree of regulatory pressure brought about by the risk-based capital standards on capital ratio. Specifically, 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. Because banks with total risk-based capital ratios above and below the 8 per cent regulatory minimum may react differently, this study partitioned regulatory pressure into two variables: RPHCRAR and RPLCRAR. 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 by raising capital.

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

[10]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.

[11] 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.

[12] Upto 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.

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 signaling 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 managerial entrenchment, the relation between growth and efficiency might be U-shaped. Additionally, the composition of the loan portfolio as captured in the ratio of priority sector loans to total loans might affect productivity: since loans to priority sector are capped at the Prime Lending Rate, the opportunity cost of bank loans will vary depending on the portion of their loans dovetailed to this sector. 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. The reverse logic would hold good in case the relationship turns out to be positive.

The simultaneous equation system consists of three linear equations, representing the empirical model of the study. Accordingly, we postulate two sets of equations, wherein the first set is as under**:**

$$NNPA = f_1(CRAR, PR1, PRIOL, ADVGR, ADVGRSQ, RPHNPA, RPHNPL, TIME\ EFFECT\ DUMMIES) \quad \textbf{(3)}$$

$$CRAR = f_2(NNPA, PR1, RoA, RPHCRAR, RPLCRAR, SIZE, TIME\ EFFECT\ DUMMIES) \quad \textbf{(4)}$$

$$PR1 = f_3(NNPA, CRAR, ADVGR, ADVGRSQ, PR1, GOVT) \quad \textbf{(5)}$$

where,

NNPA=net non-performing loan to net advances;

CRAR=capital to risk-asset ratio;

PR1=index of productivity as measured by profitability criteria;

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. A high-level of productivity implies an efficient bank management, which under moral hazard hypothesis should not be willing to take higher risks. This in turn implies less bad loans, so the effect is expected to be negative. 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 utilization 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.

For the other model, *ceteris paribus*, we replace the variable PR1 by PR2 reflecting the fact as to what extent commercial banks are able to internalize the objective of the central bank in their quest for profit maximization.

4. The Data Set and Variables

Yearly data on SOBs from 1995-96 through 2000-2001 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 SOBs can be stated as follows. First, SOBs comprised between 80-85 per cent of the total assets of Scheduled Commercial Banks during this period. Second, the SOBs 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 SOBs 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 SOBs in India comprise of the State Bank of India (SBI) (in which the Reserve Bank of India is the majority shareholder), 7 associates of SBI (the majority holding being with SBI) and 19 nationalised banks (the majority holding being with the Government). The final pooled sample therefore comprises of 27 SOBs for the period 1995-96 to 2000-2001. 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. Secondly, 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.

In order to account for the heterogeneity *within* SOBs, 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 Rs.100 billion; 'medium', i.e., those with assets exceeding Rs.100 billion, but less than or equal to Rs.150 billion; and finally, 'large', i.e., those with assets exceeding Rs.150 billion. This classification leaves us with an equal number of banks within each of the three category.[13,14] In addition, separating the sample firms into

[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 entire 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

different size classes is also warranted by the overt focus on productivity change. The summary statistics across each of the three size classes as well as for SOBs as a whole for the estimation period is reported in Table 2.

[Insert Table 2 about here]

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 capitalization, 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. While return on assets (RoA) tend to be larger for smaller firms, the same is however negative for medium-sized firms; attesting a U-shaped relationship between size and return on assets;. 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 profitability objective or alternately, profitability 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-à-vis* medium ones.

5. Results and Discussion

In view of the interlinkages among the variables, standard OLS regressions might engender misleading inferences. To obviate this possibility, we have employed the two-stage least squares. The advantage of this method rests in the fact that it performs a two-stage process: estimating a reduced form regression of the dependent variable on all the pre-determined variables in the system (stage 1) thereby obtaining estimates of the dependent variable and subsequently, replacing the dependent variable in the original equation by its estimated value (stage 2) and applying OLS estimates. The model is

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of Indore, State Bank of Mysore, State Bank of Saurashtra, State Bank of Travancore and Vijaya Bank.

therefore 'purged' of its endogenous elements, providing asymptotically efficient estimates. In the present case, the simultaneous equations system is fitted by pooled time-series, cross-section observations using 2SLS, separately for each size class. The results of the estimation procedure are captured in Tables 3-5, respectively.

NNPA. The explanatory power for the NNPA equation in reasonably high, ranging from 88 to 95 per cent (Table 3). CRAR is found to have a significant and negative effect on asset quality for the small banks. This implies that for these classes of banks, relatively more capital (lower leverage) tends to be associated with less credit risk. To the extent 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, loans to priority sector do not necessarily lead to high NNPA, especially for small-sized banks. As stated earlier, loans to priority sector are subject to regulatory stipulation: banks have to advance at least 40 per cent of their net bank credit 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. Third, the coefficient on ADVGR is negative and statistically significant for large as well as medium 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 these two categories of banks, this finding suggests that the relationship between non-performing 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 profit maximization is taken as a surrogate for productivity, the results seem to suggest that higher productivity leads to a drop in net NPAs, especially for mediums-sized banks. The flexibility of medium banks in loan sanctioning and

monitoring implies that they are fairly able to manage their bad assets, reflected in the inverse relation between NNPA and PR1.

[Insert Table 3 about here]

CRAR. The explanatory power on capital equation is significant but with high variability, with the adjusted R^2 ranging from a low of 30 per cent for SOBs as a whole to a high of 90 per cent for large banks. The coefficient on NNPA is negative 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, capitalization is driven positively by RoA and is significant at conventional levels of significance only for medium and small banks.

[Insert Table 4 about here]

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 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 97.213 and 142.809, respectively. This would suggest that large and small banks in the inadequately capitalized category are under considerable regulatory pressure to increase their capital ratios. At the other end, as regards RPLCRAR, the coefficient is statistically significant only for the 'large' category banks, the magnitude of the coefficient being equal to –2.142. This would attest to the fact that the large, adequately capitalized banks tend to lower their capital ratios in response to regulatory pressure.

PR1. The explanatory power of the PR1 equation is moderate, the adjusted R^2 ranging from 21 per cent to a high of 28 per cent. In this case, the coefficient on ADVGR is negative and significant for all categories of banks. Thus, higher growth in bank credit tends to lower the productivity of SOBs in India. Even the priority sector loans for small sized banks recorded significant negative relationship with productivity. Finally, coming to the critical issue of Government ownership, the results support that productivity tends to improve with lower Government ownership, especially for the medium banks.

[Insert Table 5 about here]

On the other hand, when productivity growth is measured in terms of the ability of the commercial banks to satisfy the objectives of the central bank, 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, with one important difference. In table 6, it is observed that higher productivity does not lead to a reduction in NPA, which was the case earlier, especially for medium banks. It might possibly be the fact that these banks are not able to successfully incorporate the objectives of the central banks, thus tends to incorporate only profit maximizing behaviour, so that the results turn out to be inconclusive.

[Insert Table 6 about here]

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 CRAR coefficient for small banks, with the magnitude of the coefficient being the same as when profit objective is considered in isolation.

[Insert Table 7 about here]

As regards productivity, the results are fairly similar. Again, across all categories of banks, higher loan growth translates into lower productivity, clearly indicative of decreasing returns to loan growth on productivity change. Second, higher loan to priority sector leads to a drop in productivity, suggestive of the fact that commercial banks are not able to fully internalize the objectives of the central bank in their profit maximization exercise. Finally, increased government ownership tends to increase productivity, especially in the medium-sized SOBs. These results run contrary to Caprio and Martinez Peria (2000), who find increased government ownership as determent to the development of the banking system.

[Insert Table 8 about here]

6. Concluding Observations

The purpose of the present article has been to understand the association between risk-taking and productivity in the state-owned banking system in India. As pointed out earlier, the SOBs are traditionally Government-owned and to that extent, it is deemed as essential to understand the relation risk and efficiency, 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 effect on bank capitalization as well. This supports the fact that poor performers are more prone to risk taking than better-performing banking organizations. 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 efficiency, capital and risk taking tend to be jointly determined, reinforcing and compensating each other.

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Table 1: Summary of the Banking Industry: 1990-91 to 1999-2000

Year / Bank Group	1990-91			1995-96			1999-2000		
	Pub.	Pvt.	Forgn.	Pub.	Pvt.	Forgn.	Pub.	Pvt.	Forgn.
No. 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	7373.1	1136.7	493.2
Total credit (Rs.billion)	1305.7	49.5	50.6	2075.4	219.3	225.0	3521.1	557.4	356.2
Credit-deposit ratio	0.63	0.52	0.60	0.53	0.61	0.75	0.48	0.49	0.72
Share of									
Total Deposits	92.1	4.2	3.7	85.4	7.9	6.7	89.1	12.6	5.5
Total Credit	92.9	3.5	3.6	82.4	8.7	8.9	79.4	12.6	8.0
Total Income (Rs. billion)	240.4	10.35	15.32	536.65	71.78	74.99	909.00	141.57	103.28
Net Profit (Rs. billion)	4.65	0.38	1.46	-3.34	15.88	7.39	51.13	12.24	10.35

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

Table 2: Summary Statistics: Mean values of the variables

Variable	Large	Medium	Small	All
Bank-specific				
TOTAL ASSET	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	16.645	14.609	17.546	15.933
PRIOL	30.741	34.408	37.642	34.264
Productivity				
PR1	1.222	1.223	1.116	1.187
PR2	1.197	1.195	1.118	1.170
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

Table 3: Two-stage least-squares regression estimates: Dependent Variable-NNPA

	Large	Medium	Small	All
INTERCEPT	3.762 *	9.511 *	31.057	9.904 *
	(7.748)	(1.763)	(21.735)	(1.005)
CRAR	0.121	-0.0213	-0.129 **	-0.099 *
	(0.244)	(0.074)	(0.052)	(0.026)
PR1	0.278	-1.995 **	-1.020	-0.820
	(4.974)	(0.874)	(0.345)	(0.719)
PRIOL	0.019	0.048	-0.222 **	0.004
	(0.051)	(0.049)	(0.227)	(0.014)
ADVGR	-0.045 ***	-0.088 ***	-0.077	-0.065 *
	(0.023)	(0.050)	(0.087)	(0.021)
ADVGRSQ	0.001 ***	0.003 *	0.001	0.001 *
	(0.0007)	(0.001)	(0.0002)	(0.0006)
RPHNPA	120.551 *	200.317 *	131.543 *	178.511 *
	(40.910)	(17.155)	(17.843)	(6.410)
RPLNPA	-32.996 *	-23.594 *	-21.425 *	-18.817 *
	(6.700)	(3.427)	(5.795)	(1.079)
T	-0.098	0.060	0.125 **	-0.040
	(0.195)	(0.166)	(0.061)	(0.045)
Adjusted R^2	0.883	0.951	0.911	0.957

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

Table 4: Two-stage least-squares regression estimates: Dependent Variable-CRAR

	Large	Medium	Small	All
INTERCEPT	5.390 **	38.191 **	13.237 **	23.158 **
	(2.574)	(18.991	(5.001)	(11.866)
NNPA	-0.059	0.067	-0.126 ***	-0.047
	(0.064)	(0.232)	(0.076)	(0.239)
PR1	-0.415	-4.139	2.802	-12.448
	(1.098)	(4.057)	(2.519)	(10.393)
ROA	0.553	3.114 *	0.485 **	2.762 *
	(0.423)	(0.899)	(0.187)	(1.087)
RPHCRAR	97.213 *	36.732	142.809 *	48.585 *
	(12.334)	(66.609)	(12.935)	(16.663)
RPLCRAR	-2.142 *	-0.729	-5.252	-1.050
	(0.197)	(8.362)	(7.419)	(1.516)
SIZE	0.196	-3.049	-1.184 **	-0.261
	(0.192)	(1.883)	(0.557)	(0.535)
T	0.367 *	0.841	0.568 *	0.432
	(0.075)	(0.592)	(0.141)	(0.300)
Adjusted R^2	0.901	0.589	0.852	0.308

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

Table 5: Two-stage least-squares regression estimates: Dependent Variable-PR1

	Large	Medium	Small	All
INTERCEPT	2.184 *	1.158 *	1.891 *	1.657 *
	(0.613)	(0.618)	(0.346)	(0.279)
NNPA	-0.022	-0.002	-0.015	-0.013
	(0.032)	(0.019)	(0.013)	(0.012)
CRAR	-0.013	0.001	0.001	-0.022
	(0.033)	(0.022)	(0.012)	(0.015)
ADVGR	-0.021 *	-0.017 *	-0.005 **	-0.009 *
	(0.008)	(0.009)	(0.002)	(0.004)
PRIOL	0.0003	-0.005	-0.015 *	0.0001
	(0.0007)	(0.014)	(0.001)	(0.006)
GOVT	-0.284	-0.370 **	-0.012	-0.009
	(0.180)	(0.196)	(0.067)	(0.074)
Adjusted R^2	0.286	0.274	0.247	0.252

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

Table 6: Two-stage least-squares regression estimates: Dependent Variable-NNPA

	Large	Medium	Small	All
INTERCEPT	7.254 *	8.563 *	10.869 *	9.922 *
	(1.393)	(1.393)	(2.436)	(0.939)
CRAR	0.014	-0.070	-0.086 **	-0.081 *
	(0.046)	(0.055)	(0.042)	(0.028)
PR2	0.369	-0.915	-0.386	-0.789
	(0.646)	(0.794)	(1.037)	(0.606)
PRIOL	0.024	0.044	-0.037	0.003
	(0.016)	(0.035)	(0.039)	(0.015)
ADVGR	-0.046 ***	-0.079 **	-0.057	-0.066 *
	(0.023)	(0.046)	(0.035)	(0.022)
ADVGRSQ	0.001 ***	0.002 ***	0.001	0.001 *
	(0.0007)	(0.001)	(0.0007)	(0.0005)
RPHNPA	139.779 *	190.922 *	144.250 *	178.757 *
	(7.232)	(14.488)	(14.286)	(6.595)
RPLNPA	-32.176 *	-23.724 *	-17.664 *	-18.928 *
	(2.011)	(3.042)	(1.447)	(1.121)
T	-0.007	0.022	0.117 **	0.015
	(0.042)	(0.105)	(0.066)	(0.044)
Adjusted R^2	0.960	0.961	0.945	0.954

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

Table 7: Two-stage least-squares regression estimates: Dependent Variable-CRAR

	Large	Medium	Small	All
INTERCEPT	4.398	32.727 **	14.326 *	15.589 **
	(2.774)	(16.461)	(4.522)	(6.429)
NNPA	-0.071	0.029	-0.148 **	-0.086
	(0.052)	(0.231)	(0.069)	(0.137)
PR2	0.169	-2.849	1.093	-4.703
	(1.242)	(3.854)	(1.371)	(5.257)
ROA	0.464	3.084 *	0.507 *	2.219 *
	(0.408)	(1.012)	(0.177)	(0.727)
RPHCRAR	101.604 *	50.908	137.494 *	88.352 *
	(14.747)	(61.338)	(11.206)	(31.428)
RPLCRAR	-2.172 *	3.085	-5.620	-1.431
	(0.193)	(7.198)	(6.922)	(0.909)
SIZE	0.228	-2.572	-1.050 **	-0.307
	(0.169)	(1.653)	(0.497)	(0.304)
T	0.362 *	0.637	0.553 *	0.187
	(0.079)	(0.492)	(0.135)	(0.184)
Adjusted R^2	0.912	0.624	0.869	0.591

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

Table 8: Two-stage least-squares regression estimates: Dependent Variable-PR2

	Large	Medium	Small	All
INTERCEPT	2.214 *	1.052 *	2.172 *	1.676 *
	(0.439)	(0.600)	(0.464)	(0.282)
NNPA	-0.033	0.011	-0.012	-0.012
	(0.030)	(0.019)	(0.018)	(0.012)
CRAR	-0.021	0.009	0.019	0.018
	(0.032)	(0.022)	(0.016)	(0.015)
ADVGR	-0.018 *	-0.013 **	-0.011 **	-0.011 *
	(0.008)	(0.006)	(0.005)	(0.004)
PRIOL	-0.022 *	-0.023 **	-0.025 **	-0.021 *
	(0.001)	(0.011)	(0.001)	(0.006)
GOVT	-0.319 **	0.371 **	-0.077	-0.024
	(0.171)	(0.202)	(0.091)	(0.078)
Adjusted R^2	0.321	0.276	0.264	0.281

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