Performance and Profitability of Indian Banks in the Post Liberalization Period*

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I. Introduction

The paper seeks to determine the impact of various market and regulatory initiatives on efficiency improvements and profitability of Indian banks since the implementation of financial sector reforms following the recommendations of the Narasimham Committee in 1992 and 1997. The reform process has shifted the focus of public sector dominated banking system from social banking to a more efficient and profit oriented industry. While the reform process has resulted in the private sector replacing the government as the source of resources for public sector banks (PSBs), the infusion of private equity capital has led to shareholders challenges to bureaucratic decision making. PSBs also face increasing competition not only from private and foreign banks but also from growing non-banking financial intermediaries like mutual funds and other capital market entities. The competitive pressures to improve efficiency in the banking sector has resulted in a switch from traditional paper based banking to electronic banking, use information technology and shift of emphasis from brick and mortar banking to use of ATMs. For instance, by March of 2007, 86% of public sector bank branches were fully computerized and ATMs made up approximately 48% of total bank branches in the country.

We use Data Envelopment Analysis (DEA) to identify banks that are on the output frontier given the various inputs at their disposal. Efficiency of each institution is then derived relative to the best-practice bank on the frontier that uses a comparable mix of inputs. We then use the random and fixed effects multiple regression models to explain differences in the relative efficiency of different banks in terms of differences in management structures, regulatory mandates, and macroeconomic environment. Our study is perhaps the first one that recognizes that differences in macroeconomic environment at

the state level may impact bank performance. Subsequently, we attempt to understand the impact of efficiency differences and other factors like non-performing assets, labor costs and market concentration on bank profitability. We again use the random and fixed effects multiple regression models. Fixed effects are incorporated by adding two control variables; time and ownership.

While inputs and outputs are easily identified in most businesses, that is hardly the case in banking. At the heart is the question of whether deposits are input or output. A typical financial intermediation role for banks involves the use of deposits together with physical inputs of land, labor and capital to make loans and earn interest income. Banks also recognize the importance of generating non-interest income as an anti-dote to the variability in interest income. This approach suggests that we should treat the number of bank branches, total operating expenses and deposits as inputs and loans (advances) and non-interest income as outputs. In this formulation, deposits are not coveted as an independent output; instead they are treated only as a conduit to generating loans. In most banking systems, bank investments (in addition to loans) are also considered as a legitimate output. But such investments in India are mostly in government securities which are often thought of as reflections of "lazy" banking. According to this line of thinking, higher investments simply imply that banks are not pushing loans adequately. In view of this, we do not use investments as banks' output.

But the treatment of deposits as an input is far from a universally accepted framework. Indeed, deposit generation is thought of as a legitimate objective of banking by many analysts. The promotion of banking in India was partly motivated by the desire to inculcate banking habits among the masses and generate deposits. Hence, state-owned

banks were encouraged to expand branch networks everywhere, including rural areas. Equally relevant is the observation that "people demand deposits for the services of record-keeping and safe-keeping, and that these services render deposits as outputs of banking activity." (Srivastava, 1999). Thus, it is not unreasonable to specify deposits as an output that is produced together with loans and non-interest income using physical inputs such as the number of bank branches and operating expenses.

We begin in section II by providing a brief overview of the Indian banking system and the principal reforms that have been implemented in recent years. In Section III, we provide a heuristic description of the DEA methodology and present alternative specifications of inputs and outputs in the context of available data. In section IV, we discuss our principal findings under alternative outputs/inputs specifications by focusing on efficiency of banks by ownership (state-owned, nationalized, private – old, private – new, and foreign). In section V, we present regression results to shed light on the regulatory factors impacting differences in the efficiency scores of various banks. We construct a national market size index for each bank that takes into account differences in state level GDP and bank's own presence in various states and the competition it faces in each state from all banks in the country. In section VI, we show that higher efficiency scores are associated with higher profits, thereby providing crucial support for estimating efficiency in a multiple output-input framework. Finally, we summarize our conclusions in section VII.

II. Reforms and the Banking System

The liberalization of the Indian banking system dates back to the 1990s when the government began to implement the recommendations of the Narasimham Committee (1992, 1997). The principal features of the steps taken to liberalize and reform the system include:

1. Increase in competition via more liberal rules for the entry of new domestic and foreign banks, raising the number of banks from 70 to over 90 by March 2004. Recent consolidation in the industry has reduced the number of total number of banks to 80 with number of foreign banks declining from a peak of 40 to 29 and private banks shrinking to 27 by end March 2007. Since 1993, twelve new private sector banks were set up but some of them have already either merged with other PSBs or private banks or have gone out of business. Foreign direct investment in private sector banks is allowed up to 74%.
2. Infusion of Government capital in PSBs followed by Injection of private equity. PSBs are allowed to increase the share of private capital upto 49% of which 20% can be foreign equity. As a result, the share of wholly Government-owned public sector banks in total system assets fell from 90% in 1991 to 10% in 2004[1].
3. Deregulation on interest rates except for certain specific classes such as savings deposit accounts, NRI deposits, small loans up to Rs. 2 lakh, and exports credits.
4. Cuts in Statutory Liquidity Requirements (SLR) and Cash Reserve Requirements (CRR) to reduce pre-emption of bank lending and lower financial repression.
5. Reduction in credit controls to 40% from 80% of total credit.
6. Introduction of a broader definition of priority sector lending.

[1] Address by Dr. Y. V. Reddy, Governor of the Reserve Bank of India, at the Institute of Bankers of Pakistan, Karachi, Pakistan, May 18, 2005.

7. Incentives to increase consumer loans including long term home mortgages.
8. Implementation of micro-prudential measures including Basle-based capital adequacy requirements, income recognition, asset classification and provisioning norms for loans, exposure norms and accounting norms.
9. Emphasis on performance, transparency and accountability.

Table 1: Characteristics of Banks

	Branches (% Total)			ATMS (% Total)	Deposits (% Total)			Advances (% Total)		
Banks	1997*	2004	2007	2007**	1997	2004	2007	1997	2004	2007
State-owned	26.9	25.7	24.6	23.8	28.2	27.6	23.5	31.7	25.7	24.3
Nationalized	65.0	62.9	62.4	36.5	58.6	50.7	50.4	52.5	48	48.4
Private-Old	7.7	8.3	8.1	5.9	6.4	7.0	5.1	7.2	6.8	4.7
Private-New	6.2	2.7	4.4	30.2	2.0	10.1	15.3	2.7	13.1	16.2
Foreign	0.1	0.3	0.5	3.5	4.8	4.5	5.6	6.0	6.5	6.4

*End March
** Data for earlier years not available.

Partly in response to these measures and partly as a result of the economy's improved performance, the Indian banking sector's characteristics have changed and its health has improved. Old and new private banks have increased their market share in terms of number of branches and ATMs as well as share in deposits and loans at the expense of state-owned and nationalized banks (Table 1).

Since 1997, net interest margins have declined in every segment of the banking system save nationalized banks and profit margins with and without taxes have improved across-the-board save new private banks upto 2004 but private banks' net interest margins and profits started improving from 2005 and outstripped overall industry margins. All in all, industry-wide net interest and profit margins peaked in 2004 and have not recovered from

their downward spiral to date. Our subsequent work in this paper will focus on which groups of banks have gained in efficiency in producing the specified outputs and also how individual banks stack up in terms of efficiency gains during the post reform period. We also look at the impact of efficiency gains on bank profitability in the post reform liberalization period.

Table 2: Trend in Bank Spreads and Profits (% Total Assets)1991 – 2007

	1991			**1997**			**1998**		
Banks	**S_1**	**P_1**	**P_2**	**S_1**	**P_1**	**P_2**	**S_1**	**P_1**	**P_2**
Nationalized Banks	1.95	**0.15**	0.15	2.80	0.34	1.47	2.64	0.50	1.19
State Banks	2.13	**0.21**	0.21	3.44	0.67	2.07	3.68	1.11	2.26
Private Banks - Old	2.30	0.31	0.31	2.94	0.85	1.82	2.58	0.46	1.81
Private Banks- New				2.79	1.70	2.71	2.22	1.92	1.88
Foreign Banks	2.97	1.39	1.39	3.87	1.28	3.75	3.75	1.26	3.48
All Banks	1.81	**0.20**	0.20	2.97	0.60	1.66	2.74	0.59	1.62
	1999			**2000**			**2001**		
Nationalized Banks	2.15	0.12	0.62	2.53	0.40	1.20	2.74	0.25	1.14
State Banks	3.09	0.60	1.76	2.94	0.79	1.98	2.71	0.54	1.38
Private Banks - Old	2.18	0.40	1.08	2.33	0.11	1.08	2.42	0.68	1.72
Private Banks- New	2.00	1.51	2.18	1.85	0.93	1.93	2.01	0.76	1.63
Foreign Banks	4.01	1.91	3.72	3.59	0.92	2.77	3.30	1.15	3.00
All Banks	2.26	0.10	1.04	2.59	0.57	1.50	2.70	0.49	1.44
	2002			**2003**			**2004**		
Nationalized Banks	2.63	0.66	1.76	2.99	0.98	2.34	3.05	1.18	2.72
State Banks	2.62	0.74	1.87	2.77	0.91	2.27	2.83	1.02	2.62
Private Banks - Old	2.30	1.04	2.57	2.63	1.19	2.69	2.56	1.16	2.58
Private Banks- New	1.12	0.39	1.17	1.68	0.89	3.35	1.96	0.82	2.05
Foreign Banks	3.08	1.30	3.13	3.45	1.75	3.35	3.54	1.70	3.75
All Banks	2.43	0.71	1.83	2.78	1.011	2.411	2.86	1.13	2.67

	2005			2006			2007		
Nationalized Banks	3.02	0.89	2.17	2.89	0.81	1.79	2.71	0.88	1.77
State Banks	3.06	0.91	2.44	3.07	0.86	2.17	2.79	0.82	1.69
Private Banks - Old	2.70	0.33	1.68	2.75	0.58	1.51	2.83	0.70	1.89
Private Banks - New	2.17	1.05	1.85	2.27	0.91	1.78	2.34	0.91	1.88
Foreign Banks	3.34	1.29	2.98	3.58	1.54	3.34	3.74	1.65	3.45
All Banks	2.83	0.89	2.17	2.81	0.88	1.95	2.69	0.90	1.90

S_1 = Net interest income, P_1 = Net Profits, P_2 = Gross Profits
* End March

III. Data Envelopment Analysis

Data Envelopment Analysis (DEA), developed by Charnes, Cooper and Rhodes (1978), uses principles of linear programming to examine how a particular decision-making unit (DMU) – like a bank in our exercise – operates relative to other DMUs in the sample. Efficiency is defined by the ratio of output to input. This is straight forward when there is only one output and one input. But the task becomes complex where multiple of outputs and inputs are involved. DEA gets around this problem by constructing an efficiency frontier from weighted outputs (virtual output) and weighted inputs (virtual input). DMUs on the frontier are assigned an efficiency score of 1 while those inside receive scores of between zero and one. The further away a bank is from the frontier, the lower its efficiency score.

While inputs and outputs are easily identified in most industries, it is not so in the banking industry. The DEA studies of bank efficiency have typically used either the intermediation approach or the production approach in selecting outputs and inputs. The former considers banks as intermediaries that use deposits together with other inputs such as labor and capital to produce outputs like loans. Hence, the intermediation approach views deposits

as an input. In the production approach, however, banks are thought of as service providers and deposits are considered as an output. Thus, the production approach postulates that banks produce deposits, and loans using labor and capital as inputs. In using the two approaches, we also consider non-interest income earned by each banks as a distinct output in view of the emphasis banks themselves place on it as a stable source of income. As our subsequent quantitative analysis shows, whether deposits are treated as an input or an output does not appear to make any difference to the efficiency scores of various banks.

A few DEA-based studies of efficiency in the Indian banking system have appeared in recent years. They have used a variety of specifications for inputs and outputs as evident from Table 3. Inputs vary from purely financial such as interest and non-interest expenses to purely physical like number of branches and employees. Outputs are either income related -- interest and non-interest income or product/service related – loans, investments and non-interest income. Deposits appear as inputs or outputs depending upon whether the authors work with the intermediation or production interpretation of banking business. The efficiency scores are found to be relatively sensitive to the specification in terms of inputs and outputs, which makes it difficult to reach generalized conclusions on how bank efficiencies stack up by ownership. In a few studies that use a large number of inputs, not surprisingly many more banks are found to be on the efficiency frontier ((Das, Nag and Ray). In earlier papers Ketkar et. al. used deposits as well as physical inputs such as number of full time employees as a proxy for labor and number of branches as a proxy for capital, and loans and investments as outputs. The efficiency scores of most domestic banks were found to be quite low in that specification of inputs and outputs. On reflection,

we conclude that this was due to a shift away from banks' traditional intermediation function of mobilizing deposits and making loans. The financial market reforms of the 1990s increased competition for banks from non-bank intermediaries in the capital markets. Companies were increasingly able to obtain financing via equity issuance, which reduced their captivity to bank lending. Banks recognized this and over time started focusing on earning non-interest income. Cognizant of this evolution, we estimate bank efficiency scores from 1997 to 2004 under the following alternative specifications of outputs and inputs[2]:

Specification 1: Outputs: Loans, Non-interest Income, Deposits
Inputs: No. of Bank Branches, Equity, Total operating expenses

Specification 2: Outputs: Loans, Non-interest Income
Inputs: No. of Bank Branches, Equity, Total operating expenses, Deposits

In the above specifications, owned-funds are used as proxy for equity capital. Role of equity capital has become more significant since the adoption of Basel Accords I and II by all banks in India under guidance from the Reserve Bank of India. Under Basel Accord II, all banks have achieved risk weighted capital adequacy ratio of 10% by 2006 or so. In specification 1, deposits are treated as an output in addition to loans and non-interest income. The input variables in specification 1 include the number of bank branches, equity and total operating expenses. Specification 2 differs from specification 1 only in so far as

[2] We had to restrict our data analysis to 1997 - 2004 period to maintain uniformity in the data set. A lot of changes have taken place in the private banking sector in the last few years. If we were to extend our study beyond 2004, we would loose a number private sector banks as they have either gone out of business or have merged with other banks.

deposits move from being an output to being an input.[3] Atullah and et. al. (2004) estimate efficiency of banks in India and Pakistan using two different measures of bank output but use the same inputs. One estimate is based on loans, advances and investments as outputs and the second estimate is based on interest and non-interest income with operating and interest expenses as inputs. Our model specifications take into account all the variables included in their model but additionally include also equity capital and number branches.

Table 3: Input & Output Specifications

Author(s)		Inputs	Outputs	Period
Bhattacharyya A. C.A.K. Lovell & P. Sahay		Interest Expense, Operating Expense	Advances, Deposits Investments	1986-91
Saha & Ravisankar		No. of Branches, No. of Employees, Establishment & Non-establishment Expenditures	Advances, Deposits, Investments, Spread, Total Income, Interest & Non-interest Income	1991-92 1994-95
Ketkar & Noulas		Capital No. Employees Deposits	Investments Advances	1993
Ketkar, Noulas & Agarwal.		Capital No. of Employees, Deposits	Investments Advances	1990-1995
Ketkar, Agarwal, Singh & Mitra				
	Model 1	Deposits Staff. Branches	Investments Advacnes	1996-2003
	Model 2	Staff. Fixed Assets No. of Branches	Advances Deposits Investments	
Sathye M.				
	Model A	Interest Expense Non-interest Expense	Net Interest Income Non-interest Income	1997-98
	Model B	Deposits & No. of Staff	Net Interest Income Non-interest Income	1997-98
Chakrabarty & Chwala	Model 1	Interest Expense, Operating Expense	Advances, Deposits & Investments	1990-2002
	Model 2	Interest Expense, Operating Expense	Interest Income, Non-interest Income	
Das A. A. Nag & S. Ray		Borrowed Funds, No. of Employees, Fixed Assets, Equity	Investments, Performing Loans , Non-interest Income	1997-2003
Rammohan & Ray		Operating Costs, Deposits	Investments, Loans & Non-interest Income	1992-2000

[3] We also estimated DEA models under several other specifications of inputs and outputs. But the efficiency scores derived from these specifications were found to be largely similar to those for the two specifications reported in the paper.

The number of branches is a very important factor in providing banking products and services, especially in a country like India where a majority of a bank's customers are likely to have only limited ability to travel. An extensive bank branch network should cut the shoe-leather costs of banking and allow a bank to generate more deposits and more loans with the same level of operating expenses.[4] In recent years, banks have been moving towards automation and computerization of operations, adding ATMs across the country and encouraging their customers to use internet banking. As a result of transition to automation and computerization as well as ATMs and internet banking, operating costs are likely to decline while fixed costs increase but we would still expect an overall improvement in bank efficiency and profitability.

IV. Bank Efficiency Scores

We present in Table 4 efficiency scores from end March1997 to end March 2004 under the above two specifications for banks categorized by ownership; namely state-owned, nationalized, old private, new private, and foreign. These results are based on data from the Performance of Indian Banks by the Association of Indian Banks and the Banking Statistics and Annual Reports of the Reserve Bank of India (RBI). Data on individual banks from 1996 to 2003 are used in this paper. Our study includes 62 banks – 8 state-owned, 19 nationalized, 20 old private, 8 new private, and 7 foreign banks[5]. There are close to 40 foreign banks in the country, but many of them are extensions of their embassies servicing only nationals of the country of their origin. Hence, we decided to

[4] But banks that can avail of a large market size and limited competition can also become less efficient, as our regression analysis in section V below shows.
[5] We excluded an old private bank-SBI Investment Bank since it started business operations after March 2007.

include only those foreign banks that had at least two branches in 2003-04 and whose total assets exceeded assets of the smallest private bank in the country. Table 4 presents efficiency scores from 1997 to 2004 under the two input-output specifications for all banks as well as for groups of banks on the basis of their ownership. We can draw several conclusions from this table:

- In recent years, foreign banks are found to be the most efficient regardless of whether deposits are considered output, as in Specifications 1 or an input, as in specification 2. Thus, foreign banks seem to make good use of their inputs (including the limited number of branches) to generate outputs in Specifications 1 and 2. Somewhat behind foreign banks are new private banks.
- State-owned banks rate third in efficiency from 2002 to 2004, behind new private and foreign banks. From 1997-2001, they actually do better than new private banks under specification 2 wherein deposits are considered as input. But state-owned and nationalized banks' efficiency lags behind old and new private banks in specification 1 when deposits are treated as an output. This is due to the RBI's requirement that state-owned and nationalized banks open three branches in rural and semi-urban areas for every newly opened branch in a heavily banked urban region. As this requirement was diluted over time, the discrepancy in the efficiency of state-owned/nationalized banks and old and new private banks diminished.
- Efficiency scores in general have improved for all categories of banks during the period of reforms under both specifications. Regardless of the inputs-outputs specification, nationalized banks gained most in efficiency during the 1997-2004,

reflecting the positive impact of reforms such as their recapitalization as well as their very low efficiency in 1997.

Table 4: Efficiency under Alternative Specifications and CRS

	1997	1998	1999	2000	2001	2002	2003	2004
State-owned								
Spec. 1	0.5878	0.5150	0.5372	0.5907	0.5896	0.6563	0.6647	0.7103
Spec. 2	0.7561	0.6623	0.6924	0.7324	0.7286	0.7677	0.7719	0.8058
Nationalized								
Spec. 1	0.4407	0.4593	0.5268	0.5539	0.5676	0.6071	0.6358	0.6289
Spec. 2	0.5046	0.5072	0.5517	0.5904	0.6304	0.6882	0.7196	0.7087
Private- Old								
Spec. 1	0.6218	0.6458	0.5909	0.6420	0.6466	0.7515	0.7027	0.6723
Spec. 2	0.7202	0.7077	0.6500	0.7042	0.6970	0.7898	0.7649	0.7287
Private - New								
Spec. 1	0.6568	0.6686	0.7399	0.7544	0.7539	0.8227	0.7954	0.8018
Spec. 2	0.6671	0.6419	0.6739	0.6968	0.6841	0.8377	0.8328	0.8342
Foreign								
Spec. 1	0.7487	0.7529	0.7799	0.7844	0.8735	0.8487	0.8492	0.9244
Spec. 2	0.6958	0.7099	0.7425	0.7781	0.8424	0.8373	0.8668	0.9188
All Banks								
Spec. 1	0.5807	0.5868	0.6049	0.6390	0.6545	0.7151	0.7058	0.7091
Spec. 2	0.6492	0.6322	0.6389	0.6803	0.6954	0.7674	0.7722	0.7676

- In sum, the perceived low efficiency of state-owned and nationalized banks appears to result from their mission of generating deposits in addition to other outputs and the low income areas in which they operate. Their profits do suffer in the process; in recent years state-owned and nationalized banks have earned lowest levels of profits (Table 2), perhaps with occasional exception of new private banks.

Turning to the five most efficient banks over the sample period under the two alternative inputs and outputs specifications (Tables 5 and 6), it is clear that foreign and private banks are found to be the most efficient banks whether deposits are treated as output or input. Only two domestic banks -- the Catholic Syrian Bank (#38) and Lord Krishna Bank (#44) – appear in the top five most efficient banks in Specification 1. In addition to banks #38 and 44, bank 28 (Federal Bank Limited) also shows up in the top five in Specification 2. All these are old private banks that have had a good track record in producing non-interest income.

Table 5: Five Most Efficient Banks
Specification 1:
Outputs: Loans, Deposits, Non-interest Income
Inputs: No. of Branches, Equity, Total Operating Expenses

Year/Rank	1	2	3	4	5
1996	59	38	50	49	44
1997	59	38	49	51	61
1998	56	59	48	61	38
1999	49, 56, 57, 51				59
2000	38,51,56,59,62				
2001	38,48,49,51,56,62				
2002	38,49,50,56,58,59				
2003	49, 56, 58, 60, 62				

State-owned
Nationalized
Old Private
New Private
Foreign

Table 6: Five Most Efficient Banks
Specification 2:
Outputs: Loans, Non-interest Income
Inputs: No.of Branches, Equity, Deposits, Total Operating Expenses

Year/Rank	1	2	3	4	5
1996	50	38	60	51	57
1997	38	60	44	52	62
1998	57	52	60	62	28
1999	44,52,57,60				62
2000	52,60,63			57	50
2001	57,63		49	50	52
2002	57,63		51	53	61
2003	57,59,60,61				53

V. Explaining Efficiency Differences

In this section, we attempt to explain differences in bank efficiency scores due to regulatory mandates and managerial decisions. We use multiple regression method with random and fixed effects for this purpose. The dependent variable in the efficiency equation is each individual bank's efficiency score (ES) and the independent variables are:

the percent of bank branches located in rural and semi-urban areas (RSB), the number of officers as percent of its total employees (OS), the level of fixed assets as percent of its total assts (FA), priority sector loans as percent of total loans (PSL), investment as percent of total assets (INV), number of ATMS relative to bank branches (ATM) and each bank's market size index (MSI)[6]. The RSB, PSL, INV variables reflect RBI mandates, the OS variable represents a management decision, the variables FA and ATMs is influenced by both RBI mandates and managerial decisions, and finally the MSI variable is an amalgam of management decisions, regulatory mandates, and macroeconomic environment at the state level.

All employees of new private banks, for instance, are classified as officers and majority of foreign banks' employees are classified as officers. Our results should reveal whether that improves the efficiency with which new private and foreign banks operate. As regards PSL, domestic as well as foreign banks are required to allocate, respectively, 40% and 32% of their net bank credit (NBC) to priority sectors including agriculture and small scale industries and businesses. Domestic banks that fail to allocate the requisite percent of their NBC to PSL are required to contribute the shortfall to the Rural Infrastructure Development Fund. Similarly, foreign banks are required to deposit the shortfall with the Small Industries Development Bank of India. Thus, banks have some ability to deviate from the proscribed PSL levels. Furthermore, the RBI has enforced the PSL mandates a lot more flexibly in recent years. The net result is that the PSL as percent of total loans has varied from low teens to high 60s. Banks undertake investment in government securities (INV) to meet the statutory liquidity requirement (SLR). While the RBI has lowered SLR from a high of 33% to 25% of bank liabilities, many banks (public sector banks in

[6] Due to unavailability of time series data on ATMs, its effect on efficiency could not be estimated.

particular) continue to hold government securities in excess of the proscribed liquidity requirement, sometimes as high as 40%. This is reflection of banks' reluctance to seek loan business aggressively. INV thus measures degree of "lazy" banking in India. As INV increases for a bank, its lending is curtailed and its efficiency score ES is reduced. Finally, the market size index is calculated by weighting state-level GDPs by the share of each bank's branches in each state in the total of all bank branches in that state and then summing the resulting magnitudes across all states.[7] The market size variable is converted into an index. Market size index (MSI) is constructed by first calculating the average market size for all banks for each year. As a second step, we compute market size faced by each bank in relation to the average market size for a given year. The MSI faced by state-owned and nationalized banks partly reflects the mandates on opening bank branches in rural and semi-urban areas triggered by the management's decision to open up branches in urban centers. For all other banks, of course, MSI is a purely managerial decision. MSI takes into account the impact of state-level macroeconomic environment on bank efficiency at the national level. We estimate equation (1) for each of the two efficiency specifications by controlling for ownership and time.

$$ES(i) = a_1 + a_2\, RSB(i) + a_3\, OS(i) + a_4\, FA(i) + a_5\, PSL(i) + a_6\, INV(i) + a_7\, ATM + a_8\, MSI(i) \quad \ldots\ldots\ldots(1)$$

It is observed from the regression results in Table 7 that the RSB regulatory mandate has had a negative impact on ES in specification 1 but when we control for ownership, the impact of RSB is positive and statistically significant implying that branch expansion

[7] Thus, the market size for bank i is given by the SUM across all j of (GDP in state j)*(No. of branches of bank i in state j/No. of braches of all banks in state j. The market size index (MSI) is constructed in relation to the average market size confronting all banks in the country.

improves business by bringing in deposits. RSB has statistically significant positive impact on ES in specification 2 for

Table 7: Determinants of Efficiency Scores Differences						
	Specification 1			Specification 2		
Independent Variables	Random Effects	Fixed Effects Ownership	Time	Random Effects	Fixed Effects Ownership	Time
Intercept	0.792	0.542	0.962	0.969	0.880	1.221
RSB	-0.00036 (0.807)*	0.002 (3.39)	-0.0001 (0.30)	0.0013 (2.77)	0.0024 (3.60)	0.0016 (3.98)
OS	0.0020 (4.80)	0.001 (1.78)	0.0017 (4.27)	0.0019 (4.39)	0.0029 (4.30)	0.0014 (3.77)
FA	-0.020 (4.08)	-0.021 (4.03)	0.013 (2.75)	-0.24 (4.68)	-0.159 (2.81)	-0.0146 (3.17)
PSL	-0.002 (2.48)	-0.001 (1.32)	-0.002 (2.82)	-0.0018 (2.16)	-0.0023 (2.68)	-0.0021 (2.82)
INV	-0.0027 (2.77)	-0.001 (1.01)	-0.0057 (5.72)	-0.0086 (8.33)	-0.007 (6.90)	-0.13 (13.10)
MSI	-0.021 (4.80)	-0.0098 (2.02)	-0.02 (4.92)	-0.015 (3.30)	-0.104 (1.99)	-0.014 (3.48)
R- Square	0.25	0.33	0.34	0.20	0.25	0.15
F- Statistic	28.40	25.06	21.15	21.29	17.89	9.3

**t*-statistics are reported in parentheses below the estimated coefficients. *T*-statistic above or below +/-1.96 implies significance at 5% and above or below +/-1,645 at 10%.

both random and fixed effects models. Thus, a bank's urban-rural presence by itself does not seem to impede efficient operations. A rise in the percent of officers in total employment (OS) does appear to enhance efficiency significantly and that is not surprising. This enhancement in efficiency can be attributed to the officers' ability to work with modern technology. A rise in the percent of fixed assets in total assets (FA) has negative and statistically significant impact, which again is not a surprising result. We observe that

both PSL and INV have the expected negative and statistically significant signs, implying that RBI mandates adversely impact bank efficiency scores. Finally, the MSI's statistically significant negative impact on efficiency suggests that larger market size together with less competition in many states makes banks less efficient in providing banking products and services. The State Bank of India, for instance, has an extensive branch network all over the country to raise its MSI which actually contributes to its relative lack of efficiency.

VI. Efficiency and Profitability

Finally, we attempt to determine the impact of estimated bank-specific efficiency levels under specifications 1 and 2 on their profitability. To do this, we estimate the following regression equation:

$$ROA_{(i)} = b_1 + b_2\, ES_{(i)} + b_3\, IS_{(i)} + b_4\, NPA_{(i)} + b_5\, PSL_{(i)} + b_6\, WS_{(i)} + b_7\, HHI_{(i)} \ldots\ldots\ldots\ldots (2)$$

where ROA is the gross profit margin as percent of total assets , ES is efficiency scores from the DEA model, IS is the net interest spread, NPA is non-performing loans as percent of total loans, PSL represents priority sector loans, WS is total compensation per worker, and HHI is the Herfindahl-Hirschman "concentration" index based on each bank's market share in total loans and deposits . We expect an increase in ES, IS and HHI to increase bank profitability (ROA) and an increase in NPA, PSL and WS to reduce ROA. Equation 2 is estimated using specifications 1 and 2 for ES estimates. For both specifications, we estimate equation (2) using random effects model and then re-estimate for fixed effects by controlling for ownership and time.

From Table 8, we observe that ES, IS and NPA variables have the expected and statistically significant effects. As expected, ROA decreases as NPAs increase and the

decline in ROA is statistically significant. NPAs affect ROA on two fronts. First, NPAs directly reduce interest income and second, RBI mandates banks to make provisions against bad loans. The effect of PSL variable is mixed. When we include ES scores from specification 1, the effect of PSL variable is positive but not statistically significant.

Table 8: Determinants of Bank Profits (ROA)

	Specification 1			Specification 2		
Independent Variables	Random Effects	Fixed Effects Ownership	Time	Random Effects	Fixed Effects Ownership	Time
Intercept	1.32	-1.30	-0.0741	-1.03	-0.97	-0.87
ES	2.79 (8.20)*	2.79 (7.67)	2.51 (7.28)	2.46 (7.69)	2.37 (7.05)	2.14 (6.52)
IS	77.05 (16.03)	75.62 (14.72)	77.13 (16.09)	76.01 (15.74)	75.16 (14.51)	76.35 (15.80)
NPA	-0.036 (4.28)	-0.038 (4.28)	-0.032 (3.86)	-0.-39 (4.65)	-0.035 (3.84)	-0.04 (4.24)
PSL	0.008 (1.45)	-0.013 (2.02)	-0.011 (1.95)	-0.013 (2.37)	-0.01 (1.59)	-0.02 (2.83)
WS	1.41 (0.84)	1.90 (0.98)	1.11 (0.64)	2.034 (1.20)	0.96 (0.49)	1.66 (0.97)
HHI	-0.0003 (0.32)	-0.0003 (0.28)	0.0002 (0.25)	-0.0003 (0.33)	-0.0002 (0.26)	-0.0003 (0.40)
R – Square	0.48	0.47	0.49	0.47	0.47	0.48
F – Statistic	76.16	46.01)	38.47	73.86	44.42	37.01

Significant at 5% (10%) level if t is above or below +/-1.96 (+/-1.645)

However, when we control for ownership and time, the PSL variable has the expected negative and statistically significant effect. When ES from specification 2 are included and the equation is re-estimated, the PSL variable has the expected negative and statistically significant effect. Thus, priority sector lending, PSL, not only negatively impacts bank

efficiency (ES), it also adversely affects bank profitability (ROA). In the Indian context, an increase in WS increases ROA but the effect is not statistically significant. Perhaps, this implies that as banks hire more skilled and educated workers or officers, their efficiency (ES) increases but their profitability (ROA) is not materially impacted. When we control for ownership or time, the results do not change.

VII. Summary and Conclusions

The paper investigates the efficiency of Indian banks since systemic reforms began to be undertaken in the 1990s. Our study is perhaps the first one that examines the long run impact of reforms and liberalization on individual banks' efficiency and profitability. We do this using Data Envelopment Analysis and bank-specific data from 1997 to 2004. We recognize the controversy on the role of deposits as input or output by deriving efficiency scores under alternative specifications. Our DEA results show that the relative efficiency of banks by ownership does not critically depend upon whether deposits are treated as an input (intermediation approach) or output (production approach). In general, we find foreign banks to be the most efficient followed by new private banks. While the efficiency scores of all banks have increased over the reform period, the nationalized banks have registered the strongest gains. This reflects the infusion of new capital and the increase in competition that these banks have experienced in recent years.

The regression analysis undertaken to explain efficiency differences among banks shows that the mandates on priority sector lending have hurt the efficiency of state-owned and nationalized banks but bank branch expansion mandates have not hurt their efficiency. The latter may reflect efforts by banks to locate rural and semi-urban branches close to

population concentrations. The managerial decision by new private and foreign banks to have a high percent of officers in their workforce has added to their efficiency. Excessive bank investment in government securities has negatively impacted bank efficiency. Such overdependence on government securities by public sector banks is an indication of their risk-averse behavior. Finally, the new MSI variable developed to measure the income environment facing each bank is found to be quite relevant in explaining lower efficiency scores of state-owned and nationalized banks. Turning to banks' profitability, we find that efficiency scores and net interest spreads impact it positively while nonperforming assets and priority sector lending have the opposite impact.

Thus, the liberalization and deregulation of banks have raised efficiency scores over time of all banks in India regardless of their ownership. These gains in efficiency have also improved bank profitability. Still, the remaining RBI mandate of priority sector lending continues to hurt both the efficiency and profitability of state-owned and nationalized banks. The practice of hiring more officers in relation to non-officers among foreign and new private banks also appears to have contributed to their enhanced profitability. This reflects perhaps the computer and credit-assessment skills that officer employees bring to the table. Finally, the statistically insignificant impact of the Herfindahl-Hirschman concentration index indicates that the State Bank of India has not been successful in leveraging its relatively large market share to raise either its efficiency or its profitability. In all fairness, however, the Herfindahl-Hirschman index is not that high even for the State Bank of India.

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APPENDIX 1

Bank Numbering

1	State Bank of India	32	The United Western Bank Ltd.
2	State Bank of Hyderabad	33	The South Indian Bank Ltd.
3	State Bank of Patiala	34	The Bank of Rajasthan Ltd.
4	State Bank of Travancore	35	The Karur Vysya Bank Ltd.
5	State Bank of Bikaner & Jaipur	36	Tamilnad Mercantile Bank Ltd.
6	State Bank of Mysore	37	Development Credit Bank Ltd.
7	State Bank of Saurashtra	38	The Catholic Syrian Bank Ltd.
8	State Bank of Indore	39	The Lakshmi Vilas Bank Ltd.
9	Bank of Baroda	40	Bharat Overseas Bank Ltd.
10	Bank of India	41	The Dhanalakshmi Bank Ltd.
11	Canara Bank	42	City Union Bank Ltd.
12	Punjab National Bank	43	The Sangli Bank Ltd.
13	Central Bank of India	44	Lord Krishna Bank Ltd.
14	Union Bank of India	45	Nainital Bank Ltd.
15	Indian Overseas Bank	46	The Ratnakar Bank Ltd.
16	Syndicate Bank	47	The Ganesh Bank of Kurundwad Ltd.
17	Indian Bank	48	ICICI Banking Corporation Ltd.
18	Oriental Bank of Commerce	49	Indusind Bank Ltd.
19	UCO Bank	50	Global Trust Bank Ltd.
20	Allahabad Bank	51	UTI Bank Ltd.
21	United Bank of India	52	HDFC Bank Ltd.
22	Corporation Bank	53	IDBI Bank Ltd.
23	Dena Bank	54	Centurion Bank Ltd.
24	Bank of Maharashtra	55	Bank of Punjab Ltd.
25	Andhra Bank	56	Citibank
26	Vijaya Bank	57	HSBC
27	Punjab & Sind Bank	58	Standard Chartered Bank
28	The Federal Bank Ltd.	59	Bank of America
29	The Vyasya Bank Ltd.	60	Deutsche Bank
30	The Jammu & Kashmir Bank	61	ABN-Amro
31	Karnataka Bank Ltd.	62	American Express

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