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SIZE, EFFICIENCY AND FINANCIAL REFORMS IN INDIAN BANKING

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CONTENTS

Page Nos.

Foreword

This paper by Dr. Pradeep Srivastava presents findings from a cross-section analysis of banking data in India for the fiscal year 1994-95. It focuses on two questions related to the Indian banking sector: Are bigger banks better for cost minimization? Have financial reforms made Indian banks more efficient? Using a multi-output translog cost function, the paper presents three different measures of economies of scale and scope in banking. A similar specification is used to estimate a stochastic

frontier cost function for banks. The results are used to generate bank-specific estimates of cost inefficiency across banks of different size and ownership.

The analysis shows that virtually all banks in India are operating below minimum-cost scale, including the public-sector banks. However, gains in cost efficiency are generally feasible only if scale expansion occurs without further increase in branch networking. The findings also suggest that any effective distancing of the government from the ownership, management and operations of Indian banking would lead to considerable activity in mergers and acquisitions in this sector. There is, therefore, a need to develop a framework for "competition policy" in banking as part of further financial sector reforms.

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Pradeep Srivastava

1. Introduction

For almost two decades now, the new paradigm of economic development has emphasized minimizing the role of a *dirigiste* state and allowing of greater play for free markets in the allocation of resources. Trade restrictions, industrial policy and financial repression are three areas of policy making most radically transformed by the resulting policy reforms implemented in almost all developing countries during this period.[1] In India too, numerous policy reforms in banking have been implemented since 1991, seeking enhanced efficiency in this sector as well as its greater integration with the rest of the world. For example, regulatory constraints on banks' balance sheets, both on the asset and liabilities side, have been progressively relaxed; rules of entry and expansion have been eased; interest rates liberalized; total required reserves of different kinds decreased; and so on. At the same time, there has also been an attempt at tightening regulations aimed at prudential oversight. The net result is a radical transformation of the operating landscape for Indian banks.

Even as these changes are going on at a purely domestic level, the global financial arena is also being transformed by a combination of three factors. First of all, there is the ongoing revolution in information technology and telecommunications. Second, the architecture of the international financial system is also evolving, careening between numerous multilateral and bilateral agreements and diverse financial crises. A third impetus is provided by changes in domestic financial-sector policies in most developing countries stemming from their efforts at greater integration into global financial flows, thus expanding the "globe" for flows of capital and financial services.

The most obvious manifestation of the changes in the global arena is the sharp restructuring and consolidation of financial firms operating in the industrialized economies, including those operating across national boundaries. Indeed, consolidation has been the defining characteristic of the banking world during this decade, exemplified by billion dollar mega-

[1] Policies governing foreign direct investment can also perhaps be added to this list.

mergers between bank holding companies (e.g. in US and Switzerland), across traditional industry lines (Citicorp and Travelers group in the US), and even across international borders (Deutsche Bank and Bankers Trust Corp.). The so-called “big bang” unveiled in Japan this year offers other examples of cross-country consolidations by large players.

In addition to mergers and acquisitions among banking giants, there is also a similar churning across non-bank financial firms too, as increasingly the new technologies underline the old Coasian dilemma of what *exactly* constitutes the *boundaries* of a firm. Thus, banks are tying up with insurance companies even as the latter seek partnerships with super-markets, while other providers of financial services also try alliances with different coalitions. At a fundamental level, what these developments highlight is the changing importance of economies of scale and scope in the provision of banking and other financial services.

Against this backdrop, this study seeks to answer two very basic questions in the Indian context: first, are there economies of scale and scope in Indian banking? In other words, are bigger banks better for India? And, second, to what extent has the domestic impetus, i.e., financial-sector policy reforms during the nineties, made banks in India more efficient?

Both these questions are of obvious policy relevance to the Indian economy where the financial sector, and banking in particular, is viewed as the Achilles heel of robust real economic performance. Thus, the extent to which banks in India are operating close to optimum scale for minimizing costs will affect their ability to cope with the imminent competition from larger foreign banks as greater integration of the economy with outside world is achieved. It also affects the costs at which the banking sector provides its services to the real sector by determining the spread between costs of borrowing and lending in the economy. In addition, the optimal scale for banking is also a critical input into any discussion involving merits of merging banks in the economy to strengthen the banking sector as whole.[2]

From a policy perspective, evaluating the success of financial liberalization in increasing efficiency of the banking sector is also a critical input into assessing future course of action. For example, even in the context of simple trade liberalization, there is no consensus on the impact of liberalization on production efficiency (Rodriguez and Rodrik (1999)). It needs no emphasis that banks are not like butcher shops: financial transactions are far more complex than transactions in goods. The extent

[2] The issue of consolidation among banks has figured prominently in the second Narasimham Committee report of 1998.

to which policy reforms have measured up in practice to their underlying theoretical rationale is thus a useful exercise. In particular, this study seeks to eventually evaluate empirically whether banks have become more efficient in wake of the financial-sector reforms since early 90s.[3]

Although the literature on scale economies in banking is quite voluminous, it has mostly centered on the US economy, where it proliferated with the dismantling of regulation Q ceilings after 1981.[4] Most often these studies found evidence of scale economies for the smaller banks and not so for the largest of the banks. The literature in the Indian context, in contrast, is rather sparse. Two recent studies have analyzed economies of scale and scope in Indian banking and found results similar to those for the US data. Thus, Ray and Sanyal (1995) find fairly large economies of scale in their estimates of the cost structure, which decrease with bank size. However, their sample is confined to public-sector banks and they do not have cost of capital in their specification. On the other hand, the study by Chatterjee (1997) is a lot closer to the research presented here except that bank deposits are not included as an output of the banks.[5] His results also suggest scale economies for the smaller banks and none for the largest ones in India. In contrast, the results presented here indicate not just the existence of scale economies across all sizes of banks, but also that unexploited economies are stronger for the largest banks in India.

Regarding efficiency of banks in India, the only previous study is that by Keshari and Paul (1994) who, as in the present case, do include deposits as part of banking output. However, their approach differs substantially from the one adopted here since they aggregate different outputs of banks into an unweighted sum which is then used to estimate a stochastic production frontier. The research reported here, in contrast, characterizes banking technology using the cost function rather than production function.

A brief outline of the rest of this report is as follows. Section 2 presents some important preliminaries for the analysis to follow. The first part presents a brief description of the sample of banks studied,

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3 Results presented here are for cross-sectional analysis. Subsequent analysis will consider changes in efficiency over time using panel data.

4 See Berger et. al. (1993) for a survey of results and numerous references.

5 As discussed in the next section, there is considerable ambiguity regarding the appropriate output metric for banks. Consequently, the results of Chatterjee (1997), using data for a year earlier than that used here, can be viewed as supplementary to the analysis presented.

highlighting some of their key attributes. Subsequently, the presentation delineates in some depth important issues surrounding a very basic question in the banking literature, namely, what is the appropriate output metric for complex firms such as banks. Section 3 presents the essentials of the econometric specification and methodology adopted, followed by a discussion of the data underlying the results reported here. The last part of section 3 outlines the empirical results relating to economies of scale and scope in Indian banking. In section 4, the focus is efficiency of banks. The methodology of stochastic cost frontiers is briefly illustrated and followed by a presentation and discussion of the results. Finally, some concluding remarks are offered in section 5.

2.A Summary profile of the sample

The study includes all scheduled commercial banks in India, public and private, and excludes regional rural banks. The set of included banks shows quite a large variation in size, in terms of deposits, employment and branches. Since bank size is central to the research discussed here, it is perhaps appropriate to first delineate the size classification adopted for the heterogeneous set of banks.

Bank size is based upon the total deposit base at the end of fiscal year 1995-96. To facilitate comparisons with other countries, the deposit values were converted into US dollars using an exchange rate of Rs.35/$. Subsequently, the sample of 85 banks was divided into six different size classes as shown in Table 1 below. The size intervals for deposits were chosen with a view to have as small intervals as possible while keeping roughly even number of banks in each size group. Otherwise, given a total of only 85 banks, some of the cells would have too few members to infer size attributes from group mean

Table 1: Size Distribution of Sample Banks (1995-96)

Size Category	Deposits in millions of US $*	Number of Banks
1	≤ 100	17
2	100-250	18
3	250-500	12
4	500-1000	8
5	1000-2000	16
6	>2000	14
	Total	85

Note: Exchange rate used is Rs. 35/$

Although not shown in the table, there is of course a strong correlation between bank size and type of ownership. Except for two associates of the State Bank group, all public-sector banks have deposit base exceeding $ 1 billion while only five private and foreign banks belong to either group 5 or 6.[6] Conversely, an overwhelming proportion of private domestic and foreign banks had a deposit base of less than USD 500 million.

Table 2 below provides some summary statistics of these banks for 1995-96, in terms of deposits per employee, ratio of fixed deposits in total, percentage of income from investments and from loans and advances, proportion of total expenditure devoted to interest payments, and return on assets.

Table 2: Summary statistics of banks by size

	A	B	C	D	E	F
Size 1	176.101	.727	22.75	57.58	.624	.009
Size 2	182.15	.713	25.46	60.03	.655	.012
Size 3	171.30	.721	20.81	56.32	.679	.011
Size 4	150.79	.695	32.34	47.02	.647	.012
Size 5	88.30	.655	30.18	48.91	.597	.007
Size 6	47.77	.642	35.27	47.51	.593	.002

Note: A= Deposits per employee (in rupees lacs); B= Time deposits/total deposits; C= investment income/total income; D= income from loans and advances/total income; E= interest expenditure/total expenditure; F= return on assets; Sample size=69.[7]

The data show some clear trends. First, the small, private banks have deposits per employee almost 4 times that of the largest public-sector banks. As will be discussed later, they also pay wages that are correspondingly high, along with higher costs of capital. This probably reflects the qualitative differences in the package of services/output offered by the private banks relative to that of the public-sector banks. However,

6 Banks belonging to the State Bank group have been included as separate entities.

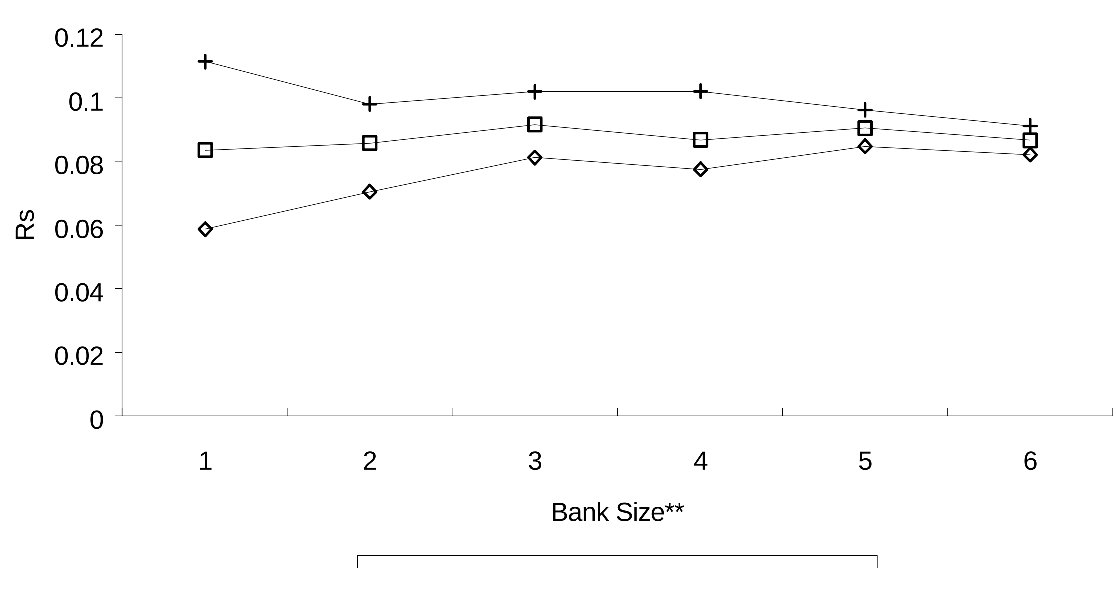
7 Because these are simple averages, outliers were deleted by expunging values beyond 2 standard deviations in case of each ratio reported in the table.

the analysis of cost structure in the later sections does not account for such differences in quality of banks' output.

Second, the data in Table 2 also show unambiguously a much greater emphasis on fixed deposits on part of the smaller, private banks compared to the public-sector ones. It is difficult to discern at this level whether this reflects regulatory constraints on the ability of private banks to garner current and savings accounts from the public (due, for example, to restrictions on branch networking), or choice of a competitive strategy. In either event, given a positively sloping yield curve, it is not surprising that the percentage of total expenditure accounted for by interest payments is also much higher for these banks compared to the larger ones (column 5). Third, large public-sector banks earn a substantially greater proportion of their total income from investments than from loans and advances (columns 3 and 4). This may reflect a greater emphasis on holding of government securities, which constitute an overwhelming proportion of "investments" by the banks. In addition, if restrictions towards lending to priority sector were more effective in case of public-sector banks, this would also tend to lower their relative share of income from loans and advances in total income. Finally, returns on assets (ROA) in the last column of the table are fairly comparable across most size classes except for the largest two. Given that the latter are overwhelmingly public-sector banks, this is hardly likely to raise any eyebrows!

However, while the lower profitability of public-sector banks is clearly manifest in the ROAs in Table 2, it does not translate directly into higher cost ratios. This is evident in Figure 1 below which analyzes dispersion in relative costs across the sample banks. Specifically, it depicts average intermediation costs, measured as the ratio of total operating and interest expenses to total assets, for the different bank sizes defined in Table 1.[8]

Figure 1: Average Intermediation Costs of Banks(1995-96)



In each size class, banks are divided into high and low-cost banks depending up on whether their cost ratio is above or below the mean average cost in that size. Average cost for the whole sample equals Rs. 0.0875 per rupee of asset, while the same for the high-cost (HC) and low-cost (LC) banks is Rs. 0.10 and Rs.0.076 respectively.[9]
**: See Table 1 for definition of bank size in terms of deposits.

The average cost in each bank size is shown in the figure, as also are the average costs of the HC and LC banks in each size category. There is no clear indication that the average intermediation costs increase with bank size. At the same time, there is considerable variation in the average costs among the small banks compared to the larger ones. But while the relative differences between high and low-cost banks decrease with bank size, costs for the HC banks are almost 35% higher on average than costs for the LC banks in the same size. Across sizes, in contrast, the cost differences appear smaller: the maximum difference is less than 7%.

The large *intra-size* cost differentials are significant for two reasons. First, they are indicative of substantial cost inefficiencies across banks, with some banks having costs substantially higher than others with similar scale. Second, these cost differentials can have important effects on financial viability of banks. For example, a typical bank in the sample has a capital to asset ratio of slightly less than 5%. Combined with an average earning per rupee of assets of 0.75 paise, the implicit return on equity is about 15%. Now, an increase in costs by 2 paise, which is less than the average difference between HC and LC banks, would imply a return on equity of –25%, wiping out the bank's equity base in four years, all else being equal.

2.B What do Banks Produce?

A distinctive aspect of intermediation by banks is that they use other people's money. This aspect lies at the heart of the conceptual ambiguity surrounding the question: what products should be considered a part of banking output? The question is of considerable importance in the banking literature and is one on which there is no consensus yet. The issue at stake is the treatment of deposits. Because deposits are an input into the acquisition of earning assets, many argue that they should be treated as inputs into banking operations. On the other hand, it can

9 The average cost for the whole sample at 8.75% is quite comparable to that found in US banking data for the 1980s, (Berger and Humphrey (1993)).

equally well be argued that people demand deposits for the services of record-keeping and safe-keeping, and that these services render deposits as outputs of banking activity. As an extreme example of this, consider the *susu* collectors in West Africa who make regular visits to clients, mostly petty traders, and collect their savings each month.[10] At the end of the month, they return the money *minus* a certain percentage: the negative rate of interest on deposits reflects the costs of their services, to wit, safe-keeping and record-keeping (and, presumably, collection). Banks, in contrast, recoup such charges through providing either no or very small relative return to depositors; unlike *susu* collectors, though, negative nominal rates of interest are not usual.

More generally, if deposits are viewed as only financial inputs with no output content, it would be difficult to explain why people open bank accounts, store money in the banking system, write checks, deposit money, withdraw cash, etc. This is a lot of activity to undertake without compensation. It may perhaps be more appealing conceptually to view deposits as both outputs and inputs simultaneously. Banks receive valuable inputs, i.e., cash, that they can use to generate loans. Depositors, in return, simultaneously receive outputs from banks accruing from their accounts. Since both banks and depositors receive benefits, there is a substantial degree of barter exchange in this process so that the net flows of money are much smaller than the gross volume of the transactions taking place. However, the virtual absence of relevant data makes it difficult to implement such an approach rigorously.

Empirically, therefore, two types of approaches have commonly been used. In one, the so-called "asset approach" or "intermediation approach", banks are viewed as creating output only in terms of their assets, using their liabilities, labour and capital. Deposits are strictly viewed as inputs that are intermediated into banks' outputs (assets). The asset approach implies banks buy funds and sell funds, much the same as any other specialized merchant, (Triplett (1993)). The second approach, known as the "production" or "value-added" approach, views banks' output as defined by whatever banks do that causes operating expenses to be incurred. Deposits would then be viewed as an output of the banks while interest expenses on deposits would *not* be included in the costs.

The choice of the output metric in the present analysis is a modified version of the latter approach following the suggestion by Berger and Humphrey (1991). Specifically, banking functions associated with significant labour and capital expenditure to produce services are defined as outputs, including the value of various types of bank deposits. Implicit here is the assumption that volume of deposits serves as a proxy for the unpriced services produced by the banks and provided to depositors as compensation for the use of their

[10] A similar strategy, of mobile, petty deposit collections was also followed successfully by the Syndicate Bank prior to nationalization.

funds. At the same time, the input characteristics of deposits into banking are incorporated by including expenditures on deposits and other purchased funds as one of the inputs, along with expenditures on labour and capital. Deposits, thus, are treated as both input and output of banks in the analysis below.

3. Cost Structure of Indian Banking

3.A Methodology and Econometric Specification

Two types of costs are specified in the model below – total operating costs owing to labour, physical capital and other expenses, and the cost of purchased funds including expenses incurred for deposits. The outputs are measured by the total deposits of the banks and, second, the total loans and investments made by them on the asset side of their balance sheet.

The functional form for the cost function is assumed to be translog as shown in equation (1) below:

$$\ln C = a_0 + \Sigma_i a_i \ln Y_i + \Sigma_j b_j \ln P_j + (1/2) \Sigma_i \Sigma_r c_{ir} \ln Y_i \ln Y_r + (1/2) \Sigma_j \Sigma_s d_{js} \ln P_j \ln P_s + \Sigma_i \Sigma_j f_{ij} \ln Y_i \ln P_j + g_0 \ln B + \Sigma_i g_i \ln Y_i \ln B + \Sigma_j h_j \ln Pj \ln B + (k/2) \ln B \ln B \qquad (1)$$

where

C denotes total costs inclusive of interest expenses;
Y_i are total deposits and the sum of total advances and total investments; i=1,2,
Pj are the three input prices for labour, capital and purchased funds; j=1,2,3,
B denotes number of branches.

Typically high multi-collinearity of these variables leads to high gains in estimation efficiency if equation (1) is supplemented by input-share equations for operating costs. Specifically, since $(\partial \ln C/\partial \ln Pj) = (\partial C/\partial Pj)(Pj/C)$ which, by Sheperd's lemma for factor demand equals Xj*(Pj/C) or the share of factor j in total costs (Sj), we have --

$$S_j = b_i + \Sigma_s d_{js} \ln P_s + \Sigma_i f_{ij} \ln Y_i + h_j \ln B; \; j=1,2,3 \qquad (2)$$

Given that factor shares sum to one, only two of the shares can be used in the estimation; in the present case, share of capital was excluded.[11]

[11] The right-hand side in equation (2) follows from differentiating equation (1) by the factor price.

Symmetry of coefficients in equation (1) above requires that
$c_{ir} = c_{ri}\ \forall$ i,r and $d_{js} = d_{sj}\ \forall$ j,s (3a)

In addition, linear homogeneity of the cost function in factor prices imposes the following constraints.
$\Sigma_j\, b_j = 1$, j=1-3; $\Sigma_s\, d_{js} = 0\ \forall$ j= 1,2,3; $\Sigma_j\, f_{ij} = 0\ \forall$ i= 1,2;
and $\Sigma_j\, h_j = 0$, j=1-3 (3b)

The system of equations (1) and (2) is estimated subject to the restrictions in equation (3), using the iterative Seemingly Unrelated Regressions (SUR) technique.

The branching variable B is often included in equations (1)-(2) on the grounds that it is a technological condition of production and interacts with other exogenous variables. For example, banks may operate more than the cost minimizing number in order to efficiently provide convenience for deposits and loan customers and recover costs in enhanced revenues. In the Indian context, it could also be argued that at least the public-sector banks might have been implicitly or explicitly encouraged to spread branch network geographically to enhance savings mobilization, especially outside urban areas. To that extent, the number of branches could even be viewed as another output of banks, at least in the earlier years of nationalized banking in India. In any event, given the existence of branches in widely divergent areas, in terms of population density and intensity of economic activity – urban versus rural, for example – the inclusion of branch variable as a condition of banks' production technology seems appropriate.

3.B Economies of scope scale

Three measures of economies of scale and scope in banking are calculated below from the estimated cost function. Ray scale economies (RSCE) are measured by the elasticity of cost with respect to output, taken along a ray that keeps output mix constant. Thus,
RSCE (Y) = $\Sigma_i\, (\partial \ln C/\partial \ln Y_i)$, i=1,2. (4)
RSCE is the relative cost increase caused by increase in outputs where the levels of all outputs are raised proportionately. Values of RSCE < 1 indicate economies of scale in the sense that costs increase by less than proportionately when outputs expand. A given output vector can then be produced in one big firm compared to several smaller firms with the same composition of outputs. Conversely, values of RSCE > 1indicate diseconomies of scale in the banks' operations.

Note that RSCE is computed by differentiating equation (4) keeping number of branches B constant. This is referred to as *branch-level* ray scale economies. This of course seems to suggest that banks may be able to expand their output without increasing the number of branches, an assumption that may not always be correct.[12] In any case, RSCE can also be calculated at the level of the banking firm by re-estimating equations (1)-(3) with the terms involving branch variable B eliminated. Results below report both the branch-level and firm-level estimates of RSCE.

To avoid using the assumption of proportionate changes in all outputs for RSCE, Berger et. al. (1987) propose another measure of scale economies, namely the expansion path scale economies (ESPCE). EPSCE compares costs of two banks that are immediate neighbours in the size distribution but do not necessarily share the same output structure. Thus, for bank A and its immediately larger neigbour B, EPSCE is defined as:

$$EPSCE(Y^B, Y^A) = [C(Y^B)/(C(Y^B)-C(Y^A))]^* \Sigma_i (Y^B{}_i - Y^A{}_i).(\partial lnC(Y^B)/\partial lnY^B{}_i) \quad (5)$$

EPSCE, thus, measures changes in costs relative to changes in outputs from vector Y^B to Y^A. For values of EPSCE < 1, the larger bank (B) enjoys a cost advantage over the smaller one (A). Similarly, EPSCE > 1 indicates diseconomies of scale due to increase in costs proportionately larger than the increase in outputs. As in the case of RSCE, the expansion path scale economies are also calculated at both the branch level and firm level.

Another important indicator of cost structure in banking is that of economies of scope, which are intrinsic to banks' role as producers of multiple outputs. Scope economies are an indicator of the increase in costs of breaking an existing joint production firm into multiple specializing firms. One measure of economies of scope suggested by Berger et. al. (1987) is that of expansion path subadditivity. Again, consider a larger bank B neighbouring a smaller bank A in the size distribution. Define the output of a hypothetical bank D as the difference (Y^B - Y^A) of the output vectors of banks B and A. Then expansion path subadditivity, EPSUB, is defined as

$$EPSUB(Y^B,Y^A) = [C(Y^A) + C(Y^D) - C(Y^B)]/ C(Y^B) \quad (6)$$

EPSUB is the relative cost increase or decrease arising from producing the larger bank B's output in the smaller bank (A) and in the complementary,

[12] Perhaps, though, the notion that banks' output can expand without more branches may not require strong persuasion in the Indian context.

hypothetical bank D. Positive values of EPSUB indicate economies of scope while negative ones indicate diseconomies. Notice though that EPSUB includes both economies of scale and scope.[13]

3.C Data

Data used in this study are obtained from balance sheets and profit and loss accounts of banks published by the Indian Banks Association.[14] The values of total advances and investments and of total deposits are taken as the two outputs. Total costs are defined by the operating expenses which, following the intermediation approach, include expenses owing to labour, physical capital and other expenses, as well as costs of purchased funds including those incurred for deposits. Price of labour is the average wage obtained by taking the ratio of total salaries to total staff in each bank. Price of purchased funds, similarly, is obtained by taking the ratio of total interest expenses to the stock of outstanding deposits and borrowings.

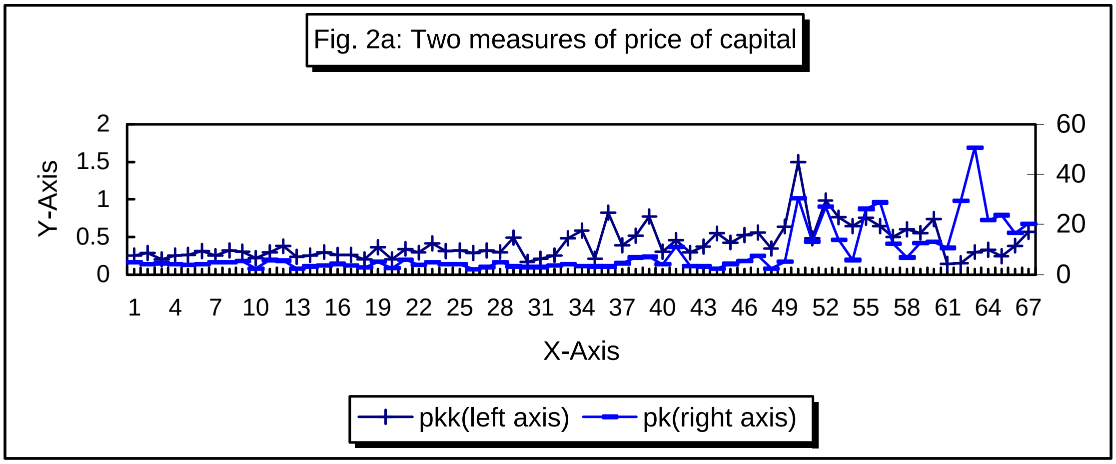
Not surprisingly, the appropriate price for physical capital is relatively more problematic. A number of different ways have been used in the literature to proxy the cost of capital. For example, Berger and Humphrey (1991) assume price of capital is proportional to the replacement cost of office and building space. Some studies have used rental rates for office space in different geographic regions while others have relied on spending on furniture etc. While most of these alternatives have their own specific drawbacks, they are not feasible in the present case due to non-availability of data. In the Indian context, Chatterjee (1997) uses the ratio of rent, repairs and depreciation (RRD) to total assets of the bank while Ray and Sanyal (1994) ignore price of capital altogether.

In principle, the ratio of RRD to total value of fixed assets used by banks could be as good a proxy for price of capital as any. However, there is no data on such assets *rented* by banks, which is ostensibly a

[13] Another measure of scope economies splits the bank's output vector into hypothetical firms specializing in one output each. To calculate this measure, some elements of the output vector need to be set to zero which is not permissible with a translog specification. In practice, the output values are often set to some arbitrary low value to avoid this problem. This still leaves two problems though. First, since there are no specialized firms in practice, evaluating the cost function in regions of full specialization entails substantial extrapolation of the estimated function beyond the range covered by the data. Second, as reported by Lang and Wetzel (1996), the estimated scope economies may be quite sensitive to the arbitrary values chosen to avoid taking logs of zero. This measure of scope economies, which, like EPSUB, also includes scale economies, is not implemented in the present analysis.

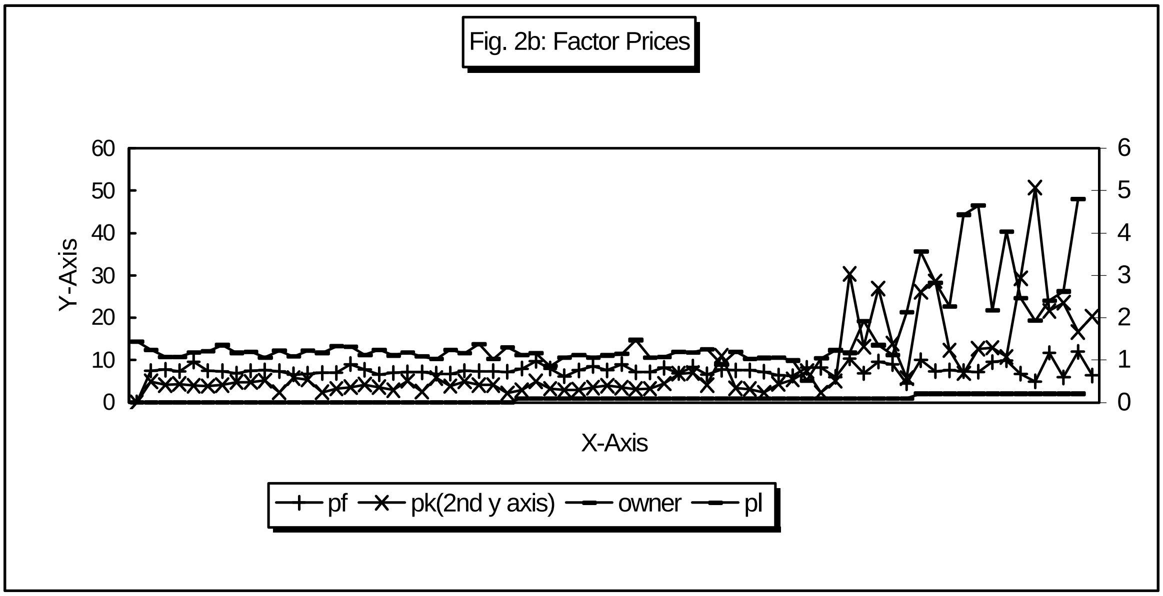
[14] "Performance highlights of Banks, 1995-96", Indian Banks Association, Mumbai, February 1997.

substantial proportion of fixed assets in use in Indian banking. To get around this problem, the analysis below assumes a fixed ratio for office space, furniture, and other components of fixed assets per officer in the bank. This implies a price for physical capital that is proportional to the ratio of RRD to number of officers in each bank. Fig 2a below shows the distribution of price of capital calculated in this manner (pk) as well as that obtained using the ratio of RRD to total assets of the banks (denoted pkk).



Quite evidently, there is considerable correlation between both price series, with lower values in the left half of the graph which subsequently rise. Although not shown in this figure (but in Fig. 2b below), the X-axis plots the public-sector banks first, followed by domestic private ones while the new, foreign banks come on the extreme right in the graph. The differences between these series are mainly two: first, the series pkk ranges in extremely low values, at less than 0.5% for more than half the banks and at less than 2% for the entire sample. In contrast, the series used here, pk, shows much higher values, at around 5% for even the public-sector banks and in excess of 10% for the newer private banks, both domestic and foreign. As a proxy for price of capital, the latter values appear more plausible. Second, and relatedly, pkk dips down significantly towards the extreme right in the figure, implausibly suggesting much lower price for capital for the most recent entrants, foreign and some domestic private banks. Consequently, pk appears a better proxy for price of capital than pkk.

Figure 2b below plots all factor prices used in the analysis to highlight another noteworthy aspect of the data, namely, that not only the price of capital but also the price of labour is significantly higher in the private banks compared to the public-sector ones. Only the price of purchased funds, including payments made for deposits, appears relatively unrelated to the ownership of banks (shown in the figure as "owner", taking values 0 for public-sector banks, 1 for domestic private and 2 for foreign banks).



Note: Contrary to legend in table, pk is measured on the left axis and the other three variables, pf, pl and owner on the 2nd y axis.

3.D Empirical Results

Results of estimating equations (1)-(3) are presented in Table 3 below. [15] Overall, the fit is reasonably good for the translog equation including the branch variable: the adjusted R-square is high, the standard error of the regression a reasonable 0.07, and the estimated parameters are for the most part significant at 1% level of significance. All price coefficients are positive as too is the coefficient for number of branches. In addition, there is no significant evidence in favour of heteroscedasticity in the residuals.[16] The associated regressions for the share equations (not shown) also show high adjusted R-squares and low standard errors of regression.

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15 Regression sample size is 71, reduced due to elimination of outliers.

16 Heteroscedasticity of residuals was tested using an OLS regression on equation (1) and testing the Breusch-Pagan statistic.

Table 3 also reports the estimation results for the model (1)-(3) excluding the branching variable. Not surprisingly, the result is a poorer fit: although the adjusted R-square is still high, the standard error of the regression is much larger. Further, the adjusted R-squares for the associated share equations are also much lower along with higher standard errors for the regression (not shown).

Table 3: Estimates of the Cost Function

Variable	Parameter	Coefficient	Std. Error	Coefficient	Std. Error
Constant	a_0	1.32*	.12	.73*	.15
Y1	a_1	.996*	.19	1.41*	.23
Y2	a_2	-.31**	.18	-.43**	.22
PL	b_1	.51*	.04	.25*	.04
PF	b_2	.43*	.04	.81*	.04
PK	b_3	.06**	.03	-.06#	.03
Y1SQ	c_{11}	.64*	.09	1.00*	.04
Y1Y2	c_{12}	-.72*	.11	-1.04*	.14
Y2SQ	c_{22}	.86*	.13	1.09*	.16
PLSQ	d_{11}	.12*	.01	.07*	.01
PFSQ	d_{22}	.14*	.02	.05*	.01
PKSQ	d_{33}	.05*	.01	.05*	.01
PLPF	d_{12}	-.11*	.01	-.04*	.01
PLPK	d_{13}	-.015*	.01	-.03*	.006
PFPK	d_{23}	.03*	.01	-.015#	.007
Y1PL	f_{11}	.06*	.01	.133*	.02
Y1PF	f_{12}	-.08*	.02	-.13*	.02
Y1PK	f_{13}	.02	.02	-.003	.02
Y2PL	f_{21}	-.11*	.01	-.13*	.02
Y2PF	f_{22}	.14*	.02	.12*	.03
Y2PK	f_{23}	-.03	.02	.009	.02
BB	g_0	.37*	.03		
Y1B	g_1	.05*	.02		
Y2B	g_2	-.10*	.02		
PLB	h_1	.05*	.004		
PFB	h_2	-.06*	.01		
PKB	h_3	.01	.01		
BSQ	k	.045*	.006		
Se of Regression		.074		.131	
Adjusted R^2		.996		.992	

Note: *: Significant at 1% level of significance.
**: Significant at 10% level of significance.
#: Significant at 5% level of significance.

3.E Economies of scale and scope

The estimated cost functions above provide the basis for estimating the different measures of economies of scale and scope, following equations (4)-(6). Table 4 below summarizes the results for estimating branch and firm-level ray-scale economies RSCE for the sample.

Table 4: Ray scale economies at firm level and branch level

	Branch level *(branch variable included)*			Branch level *(branch variable included)*	
Size	$RSCE_b1$	$RSCE_b2$	$RSCE_b3$	$RSCE_f1$	$RSCE_f2$
Size 1	.950	.954	.813	1.023	1.020
	(.015)	(.015)	(.025)	(.018)	(.018)
Size 2	.943	.951	.851	1.018	1.015
	(.007)	(.007)	(.012)	(.009)	(.008)
Size 3	.916	.915	.887	1.024	1.020
	(.007)	(.006)	(.008)	(.007)	(.007)
Size 4	.910	.918	.923	1.025	1.024
	(.007)	(.007)	(.007)	(.006)	(.006)
Size 5	.894	.890	.948	1.021	1.024
	(.009)	(.009)	(.010)	(.006)	(.006)
Size 6	.872	.862	1.010	1.025	1.030
	(.014)	(.014)	(.018)	(.009)	(.010)

N.B. Figures in parentheses are standard errors.

The RSCE calculated from equation (4) are evaluated at the sample means of the right-hand side variables for each size class. As evident in the first column in the table, there exist substantial economies of scale at the branch level across all size classes of banks. From the standard errors, it is clear that the estimated RSCEs are significantly less than 1 for all size classes. These results are similar to those found by Chatterjee (1997) who uses data for 1994-95 and finds scale economies for all sizes except the largest. However, that study, the magnitude of scale economies is in fact greater for the larger, public-sector banks than the smaller banks. The estimated scale economies in Table 4 above are bigger than those calculated by Chatterjee(1997) but smaller than the ones estimated by Ray and Sanyal (1995) for a sample consisting entirely of public-sector banks.

As noted above, these results show scale economies are larger for the bigger banks, implying a declining cost curve for banking. Can this result be attributed to the fact that larger banks face much lower prices for both labour and capital? As shown in fig. 2b earlier, larger bank size in the sample is associated not just with higher outputs but also substantially lower factor prices. To adjust for this effect, the second column shows RSCE calculated at constant factor prices for all size classes, set equal to the (geometric) mean for the whole sample. However, the results are qualitatively and quantitatively quite similar to those in the first column, underlining the robustness of the finding of substantial scale economies in Indian banking. As a further exploration of the existence of scale economies, the third column provides estimates for a hypothetical bank located at the sample (geometric) mean vis-à-vis factor prices *as well as* number of branches, with only the output vector increasing. Again, there is clear evidence of scale economies, even though decreasing with size, at all size classes except the largest.

Estimates for ray-scale economies at the firm level are reported in the last two columns of Table 4. In one case, the scale economies are calculated at the geometric mean of factor prices within the size classes while in the last column, the scale economies are estimated at factor prices fixed for all size classes at the geometric mean of the whole sample. The results in both cases are essentially the same, and show unambiguously there are no scale economies at the firm level. All estimated RSCEs at the firm level are significantly higher than 1 except for the smallest size class where they are insignificantly different from 1.

In sum, therefore, these results indicate that equi-proportionate increases in outputs of banks will lead to relatively lower increase in costs if the number of branches stays unchanged. This result applies for all bank sizes in the sample. At the same time, a similar expansion in output would increase costs more than proportionately if accompanied by greater number of branches. This finding too applies to all classes of banks except to the smallest ones.

We turn now to an assessment of expansion-path scale economies, which allow the output mix to vary along the expansion path. Table 5 below summarizes the results for EPSCEs estimated following equation (5).

Table 5: Expansion path scale economies at firm level and branch level

	(branch variable included)	(branch variable excluded)
Size	$EPSCE_b$	$EPSCE_f$
Size 1	.763	.845
	(.003)	(.003)
Size 2	.563	.636
	(.001)	(.001)
Size 3	.815	.922
	(.001)	(.001)
Size 4	.639	.745
	(.001)	(.001)
Size 5	.710	.848
	(.002)	(.001)
Size 6	-	-

N.B.: Figures in parentheses are standard errors.

Again, the evidence suggests substantial scale economies across all bank sizes, although more pronounced for banks in size classes 2 and 4. Also, as in the case of ray-scale economies, expansion-path scale economies are weaker when output expansion is concomitant with increase in branches. Unlike RSCEs, though, EPSCEs are less than 1 at the firm level also. Once again, the estimated values of EPSCE in Table 5 lie in between those estimated by Chatterjee (1997) and Ray and Sanyal (1995).

The implication of positive scale economies in terms of the EPSCE measure is that banks can acquire higher cost efficiency by expanding their output while, in the process, altering their product mix. To the extent the product mix of banks are constrained by regulatory constraints on their assets and liabilities, (which is not necessarily evident from the analysis here though), such constraints would be directly lowering cost efficiency of the banking sector.

Table 6 below provides estimates on the last metric of banking costs discussed earlier, namely, economies of scope or product mix as measured by expansion-path sub-additivity.

Table 6: Expansion Path Sub-Additivity at Branch and Firm Level

Size	$EPSUB_b$	$EPSUB_f$
Size 1	-.033	-.491
Size 2	.041	-.376
Size 3	.054	-.362
Size 4	.079	-.323
Size 5	.110	-.283

As noted already, EPSUB measures the increase in cost from dividing the output of an existing bank at the mean of size class k into that for two banks, one at the mean of the next-smallest size class k-1 and a "residual" bank producing the difference in output, (Berger and Humphrey (1991)). EPSUB > 0 indicates economies from being consolidated into a single bank while EPSUB < 0 indicates diseconomies. The results in table 6 show these economies for all size classes except the smallest ones when calculated at the branch level. This again suggests existence of scale and scope economies (which are both implicit in this measure) at the branch level for a wide spectrum of Indian banking. In contrast, the consolidation of greater outputs in larger-sized banks is not cost efficient when combined with increased branches. This is shown by the negative values of EPSUB in the second column for all size classes.

In sum therefore, the empirical evidence on economies of scale and scope flowing from the analysis of cost structure in Indian banking presented here shows:

There exist substantial (ray) economies of scale in Indian banks at the branch level but not at the firm level. Equi-proportionate increases in output at the margin can lower average costs provided this is done so with the existing branch network. Output increases accompanied by more branches would result in higher average costs.

However, expansion of scale of operations when banks can alter their output mix can lead to greater cost efficiency at both the branch level as well as firm level. With a changing output mix, therefore, there is scope for greater cost efficiency with scale expansion, both with and without branch

expansion. Once again though, the benefits are relatively larger when not accompanied by branch expansion.
These conclusions are reiterated by the positive economies indicated by estimates of expansion path sub-additivity, which highlight the cost gains of higher output with bigger size.

Estimated results for RSCE, EPSCE and EPSUB all show unambiguously the desirability of exploiting the economies of scale and scope within the existing branch networks. Expansion of branch networks of banks, therefore, can only be justified on extra-economic considerations (e.g. financial deepening in rural areas): at the least the results here highlight the need for such justification.

The declining cost curve implied by these results suggests most banks in India are operating far below the minimum-cost size. Greater financial liberalization in the economy, including privatization, should see substantial efforts by banks to expand their operations. Given the relative cost advantages of expanding from existing branch networks relative to increasing branches, as suggested by these results, one would expect considerable mergers and acquisitions in the banking sector with substantial financial liberalization. Implicit of course is the assumption that the policy reforms would lead to an effective distancing of the government from the ownership, management and operations of banks. The extent to which the government should guide and supervise such activities, as distinct from letting the markets undertake that role, is not addressed by the present research. These results do suggest, however, the need to develop a comprehensive "competition policy" for the banking sector as part of further policy reforms.

Finally, to the extent there exist economies of scope or product mix, the results presented here show little evidence for the need to push for specialized banks in India's financial sector. However, it needs be emphasized that the present analysis does not provide any direct evidence on pure economies of scope – a difficult task even under the best of circumstances.[17]

In closing this section, it is worth returning to the finding that the scale economies appear greater for the larger, public-sector banks in the sample. Since many of these banks have extensive rural branch

[17] For example, pure economies of scope could arise from fixed costs in banking, from advantages to risk diversification and assimilation from product mix, etc. These distinctions have not been analyzed here: treatment of risk in banking activities is, indeed, conspicuous by its absence.

networks, often undertaken for non-economic reasons, it is not surprising these show higher values of scale economies. If the same number of branches, including those in rural areas, generated greater deposits and loans, the average costs for these banks would obviously go down. From a policy perspective, therefore, it would be desirable to differentiate branch-level economies for rural versus urban branch networks.[18]

Cost Efficiency in Indian Banking

4.A Stochastic Cost Frontier and Cost Inefficiency

The starting point for analyzing banking efficiency here is the Farrell measure of technical efficiency defined for a transformation function relating one output y to input vector x. Letting this function be y=f(x), the Farrell-style measure of technical efficiency is defined as:
$TE(y,x) = y/f(x)$

which is essentially the measure of total factor productivity. The econometric framework begins with a model such as

$\ln y_i = \ln f(x_i, \beta) + TE_i = \ln f(x_i, \beta) - u_i$
where $u_I > 0$ is a measure of technical *inefficiency* with $TE_i = e^{-u}{}_i$
This formulation for the production frontier is supplemented by a stochastic error term to capture the fact that deviations from the frontier may not be entirely under control of the decision-making entity being studied. Thus,
$\ln y_i = \ln f(x_i, \beta) + v_i - u_i$ (7)

where v is the unrestricted stochastic error term and u a one-sided disturbance reflecting technical inefficiency. Given specific assumptions about the distribution of u, the regression residuals can be decomposed into purely stochastic component and a residual reflecting technical inefficiency.[19]

Since banks are multiple-output producing firms, a better representation of their technology is using the cost function. Analogous to the stochastic representation of the production frontier in (7), one can then formulate a stochastic cost frontier as shown below –

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[18] Since the translog specification eats up many degrees of freedom as the number of exogenous variables are increased, this exercise will only be considered in later stages of the research reported here, using a bigger, panel data set.

[19] For a more detailed discussion of stochastic frontier and numerous references to the literature, see Greene (1993).

$\ln C_i = \ln C(w_i, \beta) + v_i + u_I$ (8)
where, once again, v is an unrestricted random error and u a one-sided disturbance reflecting positive deviations from the cost frontier due to inefficiency.

However, the mapping from the one-sided error u in (8) to the Farrell-style measure of technical inefficiency is not straight forward except in cases where the production technology is linearly homogeneous. The problem stems primarily from the duality of cost and production functions. E.g., suppose on the production side, the representation of a one-sided error term is reflective purely of technical inefficiency, as in (7). This is of course conditional on the inputs chosen so that whether or not the inputs are efficiently allocated is a moot question. On the cost side, however, any errors in optimizing production, whether technical or allocative, would translate into higher costs. Thus, a producer who is technically efficient may still appear inefficient in terms of the cost function.

One can, in principle, attempt to disentangle technical from allocative inefficiency but the implementation has proved difficult in practice (Greene(1993)). In addition to the econometric problems, the proposed solutions still do not satisfactorily address the conceptual problem that the error terms would be correlated with exogenous variables for cost functions that are not homogeneous.[20] A third problem with the direct mapping of the inefficiency measure in (8) into technical inefficiency as measured in (7) is that deviations from constant returns to scale would tend to dampen empirically observed estimates of inefficiency estimated in equation (8).

In sum, therefore, a simple interpretation of the one-sided error on the cost side in (8) as a Farrell measure of inefficiency is inappropriate unless the measure is redefined in terms of costs rather than output. Interpreted this way, inefficiency measured by (8) is based on costs rather than output as the standard against which efficiency is defined. In what follows, measures of this *cost inefficiency* are presented for the banking sector.

The methodology is based on maximum-likelihood estimation of (8) with the inefficiency estimates derived using the technique of Jondrow et. al. (1982). Specifically, let ε_i denote the observed residual ($\ln C_i - \ln C(w_i, \beta^{\wedge})$) from the estimation of (8), where $\beta^{\wedge}$ represents the estimated parameter

[20] This reinforces the problem of simultaneity in single-equation estimates of the cost function.

vector. Then inefficiency component u_i is inferred indirectly by the explicit form presented by Jondrow et. al. (1982) as:

$E(u_l|\varepsilon_i) = [\sigma\lambda/(1+\lambda^2] [z_i + \phi(z_i)/\Phi(z_i)]$ (9)

where $z_i = -\varepsilon_i \lambda/\sigma$, $\lambda=\sigma_u/\sigma_v$, $\sigma^2 = \sigma^2_u + \sigma^2_v$, σ^2_i is the variance of i, i=u,v, and ϕ and Φ are the pdf and cdf of the normal distribution.

4.B Empirical Results

The same sample of banks used in the estimation of the cost function above is used to estimate the stochastic cost frontier. Since the branch variable provides significant explanatory power, it was also included in the translog specification used here (as in equation (1)). Table 7 presents the results for estimating the stochastic cost frontier using both OLS and the MLE. The OLS results in the first column show a fit comparable to that estimated for equation (1) using SUR in the earlier section, with the unsurprising exception of higher standard errors for the estimated parameters. These standard errors are even higher for the MLE estimates although their values are essentially the same as the OLS estimates, probably because both estimators are consistent in this case.

Table 7: OLS and MLE of Stochastic Frontier Cost Function

Variable	Parameter	OLS Coefficient	OLS Std. Error	MLE Coefficient	MLE Std. Error
onstant	a_0	-.09	4.80	-.11	5.51
Y1	a_1	-1.36	1.67	-1.36	3.27
Y2	a_2	1.87	1.54	1.87	3.31
PL	b_1	1.78	1.14	1.78	1.58
PF	b_2	-3.22**	1.81	-3.22	2.89
PK	b_3	1.05**	.55	1.05	1.02
Y1SQ	c_{11}	1.08*	.35	1.08**	.66
Y1Y2	c_{12}	-1.03*	.38	-1.03	.79
Y2SQ	c_{22}	.98#	.42	.98	.94
PLSQ	d_{11}	.45*	.17	.45	.36
PFSQ	d_{22}	-.55	.46	-.55	.93
PKSQ	d_{33}	-.33*	.09	-.33**	.12
PLPF	d_{12}	-.41	.26	-.41	.41
PLPK	d_{13}	.27*	.09	.27**	.16
PFPK	d_{23}	.09	.13	.09	.26
Y1PL	f_{11}	.44**	.26	.44	.48
Y1PF	f_{12}	-1.36*	.25	-1.36#	.66
Y1PK	f_{13}	-.07	.18	-.07	.37
Y2PL	f_{21}	-.58**	.26	-.58	.46
Y2PF	f_{22}	1.44*	.26	1.44#	.63
Y2PK	f_{23}	.13	.18	.13	.39
BB	g_0	.86**	.42	.86**	.51
Y1B	g_1	-.10	.11	-.10	.24
Y2B	g_2	.10	.12	.10	.25
PLB	h_1	.20*	.07	.20**	.11
PFB	h_2	.04	.08	.04	.14
PKB	h_3	-.14*	.05	-.14**	.08
BSQ	k	-.03	.03	-.03	.05
Adj R^2		99.92		-	
Regre s.e.		0.04		-	
Log likelihood		-		140.31	

Note: *: Significant at 1% level of significance.
**: Significant at 10% level of significance.

#: Significant at 5% level of significance.

Following the methodology of Jondrow et. al. (1982), the bank-specific levels of technical inefficiency can be calculated from MLE residuals as shown in equation (9). These estimates are presented in table 8 below in decreasing order of cost efficiency for all banks in the sample.

Table 8: Bank-specific measures of cost efficiency

	Ownership	Efficiency
1	1	99.054
2	1	98.976
3	0	98.952
4	0	98.935
5	1	98.902
6	2	98.891
7	2	98.860
8	1	98.821
9	1	98.696
10	0	98.695
11	0	98.647
12	0	98.642
13	1	98.639
14	0	98.639
15	1	98.633
16	0	98.610
17	2	98.562
18	1	98.513
19	2	98.497
20	1	98.491
21	0	98.454
22	2	98.437
23	0	98.417
24	0	98.408
25	1	98.408
26	1	98.386
27	0	98.380
28	0	98.372
29	1	98.361
30	1	98.354
31	2	98.352

	Ownership	Efficiency
32	2	98.304
33	1	98.292
34	2	98.291
35	2	98.276
36	0	98.275
37	1	98.273
38	1	98.253
39	2	98.250
40	1	98.172
41	2	98.165
42	2	98.147
43	0	98.109
44	0	98.098
45	1	98.088
46	1	98.080
47	1	98.023
48	1	97.986
49	2	97.917
50	0	97.858
51	0	97.822
52	0	97.820
53	0	97.820
54	1	97.756
55	1	97.712
56	0	97.558
57	0	97.530
58	0	97.463
59	1	97.350
60	0	97.333
61	1	97.325
62	1	97.155
63	0	97.155
64	2	97.001
65	1	96.955
66	1	96.857
67	1	96.807
68	2	96.752
69	0	96.722
70	0	96.706
71	0	96.585

Note: Ownership: 0=public sector; 1=domestic private; 2=foreign

The ranking of banks in terms of cost efficiency appears quite reasonable on the whole.[21] For example, prominent public-sector banks that needed to be re-capitalized in later years (the data used here are for FY95-96) – United Bank of India, Indian Bank, UCO Bank – all figure in the lower half of the rankings. Similarly, other weak banks such as Canara Bank and some associates of the State Bank of India also appear relatively low in the ranking of cost efficiency. Amongst foreign banks, Bank of America, which in later period has been selling off many of its operations in India, ranks the lowest. On the other hand, the unexpectedly lower ranking of Syndicate Bank does highlight the stochastic element in the present exercise.

Three other points are worth noting in the context of Table 8 above. First, *the rankings are with respect to cost efficiency, not profits, nor financial health of the banks*. This is an important point to highlight, even if obvious, because, for example, a bank may have high cost efficiency due to being a favoured destination for some government funds but with no good outlets for loans to be made. It could, then, show high cost efficiency despite being in bad financial health due to poor loan portfolio. Second, the evaluation of cost efficiency is with respect to the sample itself rather than some abstract "most efficient" bank. The benchmark for efficiency, therefore, is endogenous to the sample. Third, the observed differences in the magnitudes of relative inefficiency appear small. This may be because the operating environment for the banks, in terms of regulatory constraints and the dominance of public-sector banks in the market, make most banks appear similar in terms of cost efficiency. It may, on the other hand, also reflect merely the observed skewness in the regression residuals, which would determine the relative magnitude of σ^2_u and σ^2_v. This would be testable in the later stages of this research where panel methods for estimating cost inefficiency will be implemented. A third factor in explaining the relatively small differences amongst banks in cost efficiencies may be the recent entry of many of the foreign and domestic private banks that could turn out over time to be far more efficient, thereby raising the within-sample benchmark for comparisons. This too could be addressed with panel data extending to more recent years.

For the present purposes though, the differences in cost-efficiencies amongst banks can be viewed as at least qualitatively indicative if not

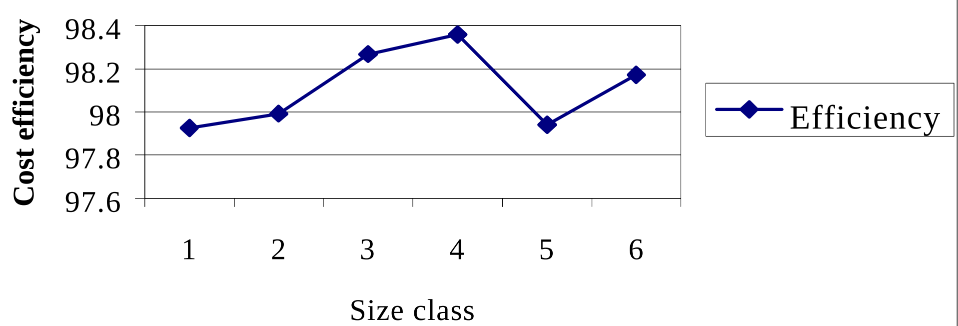
[21] For obvious reasons of confidentiality, the names of banks are with held in the table but are available upon request from the author.

quantitatively exact. Using these results, a few findings are worth highlighting:

At least some public sector banks are reasonably cost efficient with seven of them in the top quartile of the sample. However, the bottom of the pile also has a strong representation of public-sector banks: eight of them figure in the bottom quartile. Public-sector banks, therefore, display considerable heterogeneity in their cost efficiency.
At the same time, the mean cost efficiency of the public-sector banks is the lowest at 98.00% while the foreign banks have the highest average cost efficiency, equaling 98.18%. The mean cost efficiency of domestic private banks lies in between at 98.11%.

These results also suggest that the more recent entrants into the banking sector, mostly foreign banks and some domestic private ones, are relatively more efficient than the incumbent firms.
Finally, figure 3 below shows the mean cost efficiency of banks relative to bank size. The highest cost efficiency, on average, is observed in size classes 3 and 4, i.e. the mid-sized banks, followed by the largest banks. Further, within public-sector banks, which are confined overwhelmingly to size classes 5 and 6, the bigger ones are relatively more cost efficient.

Fig 3: Efficiency and Bank Size



5. Concluding Remarks

The research presented here has analyzed the cost structure in Indian banking, focusing on the issues of economies of size and cost efficiency. This is an area of considerable interest both globally and within India. At the global levels, banking industry has been undergoing significant consolidation for at least a decade now, with “bigger is better” the revealed preference amongst the largest global players. Within India, many policy reforms have been undertaken in the financial sector to make banks more efficient as well as to strengthen them to withstand the turbulence from greater integration of the economy with the rest of the world. This includes competition down the line from the mega-players in the global arena.

The results presented here show unambiguously that most if not all Indian banks are operating at scales below the optimum size. Whether viewed in terms of ray scale economies, expansion-path scale economies or expansion-path sub-additivity, the gains to cost efficiency from larger size are clearly evident. Equally evident is the finding that further expansion of branch networks is not desirable. The cost gains from exploiting scale economies are non-existent or substantially smaller if not constrained to keeping the branch networks unchanged. With greater distancing of the government from the ownership, management and operations of Indian banking, these results indicate the possibility of significant mergers and acquisitions activity in banking over time. There is, therefore, a need to develop a policy framework to guide government decision-making vis-à-vis competition in banking in the near future.

Lastly, the research presented here summarizes results for only a cross-section analysis of Indian banking, confined to the fiscal year 1995-96. While providing useful insights, it leaves scope for further refinement. Specifically, it offers little into the actual dynamics of cost efficiency in the years succeeding financial-sector reforms. Second, given the limited number of banks in India (in the statistical sense at least), lot more information could be gleaned from expanding the data by using a panel covering two to three years. In particular, given the key role of branch expansion, or lack of it, in exploiting scale economies in Indian banking, it would be useful to be able to further differentiate between branch expansion within metros versus in the rural areas. These are some of the issues that will be addressed in the course of further research using a panel-data on banking activity in India.

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