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Are Some Indian Bank Too Large? A Examination of Size Efficiency in Indian Banking

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Abstract

In this paper we use data from the years 1997 through 2003 to evaluate the size efficiency of Indian banks. Following Maindiratta (1990) we consider a bank to be too large if breaking it up into a number of smaller units would result in a larger output bundle than what could be produced from the same input by a single bank. When this is the case, the bank is not size efficient. Our analysis shows that many of the banks are, in deed, too large in various years. We also find that often a bank is operating in the region of diminishing returns to scale but is not a candidate for break up.

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ARE SOME INDIAN BANKS TOO LARGE?
AN EXAMINATION OF SIZE EFFICIENCY IN INDIAN BANKING

Despite the presence of over seventy banks of public, private, and foreign ownership, the Indian banking industry is dominated by only a handful of them. Among them State bank of India (SBI) alone accounted for over 22% of the total assets and more than a quarter of the total employment in the entire banking industry in the year 2003. Though much smaller than SBI, the others, ICICI Bank, Canara Bank, and Punjab National Bank, each accounted for about 5% of the total bank assets in the same year. In this context, it is interesting to ask: are SBI and the other three banks mentioned above in some sense "too large" and if so, are they the only ones? Moreover, if some banks are, in deed, deemed to be large, can we recommend what their optimal size would be? There is, of course, no simple answer to this question. We first need to define the criterion of largeness. For the present study we use the concept of sub-additivity of the production technology to define largeness. The production technology is locally sub-additive if a given input bundle can be broken up into two or more smaller bundles that can together produce greater output than what can be produced unilaterally by a single firm from the bundle under consideration. Thus, in the presence of sub-additivity breaking up a single bank and redistributing its input bundle to several smaller banks would enhance productive efficiency.

Deregulation of banks and other measures of financial liberalization nested within the broader economic reforms introduced over the past years provide the Indian banking industry a unique opportunity for growth. Privatization of selected public sector firms along side entry of private firms into industries previously reserved exclusively for the public sector has greatly increased the demand for funds from the capital market. At the same time, increased competition from existing and newly entering banks (both domestic and foreign) threatens to undercut the profits earned by a bank unless it operates efficiently. Understandably, efficiency and productivity of banks has attracted considerable interest from both policy makers and academics.

Das (1997) analyzed technical, allocative, scale, and overall efficiencies of public sector banks. The study found a decline in overall efficiency in the year 1995-96 driven mainly by a decline in technical efficiency. Sarkar, Sarkar and Bhaumik (1998) compared performance across the three categories of banks, public, private and foreign, in India, using two measures of profitability, return on assets and operating profit ratio, and four efficiency measures, net interest margin, operating profit to staff expense, operating cost ratio and staff expense ratio (all ratios except operating profit to staff expense having average total assets in the denominator). Traded private banks were superior to public sector banks with respect to profitability measures but not with respect to efficiency measures. Non-traded private banks did not significantly differ from public sector banks in respect of either profitability or efficiency.[1] In a more recent study, Das (1999) compares performance among public sector banks for three years in the post-reform period, 1992, 1995 and 1998. Kumbhakar and Sarkar (2003) used a shadow cost function to examine the comparative patterns of total factor productivity growth of private and public sector banks over the period 1985-1996.Ram Mohan and Ray (2004) analyzed revenue maximization efficiency of banks of different ownership. In all of the studies listed above, the question has been whether there is room for improving efficiency or productivity of a bank retaining its existing structure. This paper goes beyond measurement of technical efficiency of a given input-output bundle and investigates whether output from the observed input bundle of a firm could be extended beyond the technically efficient projection by addressing the question of possible sub-additivity at the observed point. This is the first study of its kind in the context of Indian banking. The only other study of size efficiency in the banking literature is by Ray and Mukherjee (1998) analyzing large US banks.

The rest of the paper is organized as follows. Section 2 presents the theoretical background including the conceptual issues and the nonparametric methodology of Data Envelopment Analysis (DEA). Section 3 reports the findings from the empirical analysis. Section 4 concludes.

2. The Theoretical Background

2.1 Conceptual Issues: Technical, Scale, and Size Efficiencies

Consider a firm using a single input, x, to produce a single output, y. Suppose that its observed input-output bundle is (x^0, y^0) and that the maximum output producible from any input level x is given by the production function

$$y^* = f(x). \qquad (1)$$

Clearly, $y^0 \leq f(x^0) = y_0^*$. A measure of the technical efficiency of the firm under consideration is

$$TE(x^0, y^0) = \frac{y^0}{f(x^0)}. \qquad (2)$$

The firm is considered to be technically efficient, if and only if, $y^0 = f(x^0)$. Clearly, when this is the case, it is not possible to produce a higher level of output from the given level of the input, x^0. Further, at this point on the production function, the average productivity is

[1] See also Ram Mohan (2002, 2003).

$$AP(x^0) = \frac{f(x^0)}{x^0}. \qquad (3)$$

Note that improvement in technical efficiency leads to an increase in output without a change in the input. As a result, average productivity increases. When full technical efficiency is attained, average productivity reaches a maximum *for the given level of the input.* There may exist, however, other technically efficient input-output combinations where the average productivity is even higher. An interesting question to ask is whether it is possible to increase average productivity by altering the input scale. All input output bundles that lie on the production function are technically efficient. In the absence of constant returns to scale (CRS), however, the average productivity

$$AP(x) = \frac{f(x)}{x} \qquad (4)$$

varies with the input level. Suppose that average productivity reaches a maximum at the input level x^E that produces output y^E. The scale efficiency of the input level x^0 can then be measured as

$$SE(x^0) = \frac{AP(x^0)}{AP(x^E)} = \frac{\frac{f(x^0)}{x^0}}{\frac{f(x^E)}{x^E}}. \qquad (5)$$

The input-output combination (x^E, y^E) is known as the efficient scale of production.

Any firm using a higher level of input than x^E experiences diminishing returns to scale and is usually regarded as too large. In some cases, however, operating at the efficient scale may not be the best thing to do for a firm. If the firm is technically inefficient, in order to attain full technical efficiency it needs to increase the output level without altering the input. For scale efficiency, however, it would need to change both the input and the output levels. For a firm exhibiting diminishing returns to scale, this may require a decrease in the output as well as the input. In some cases, producing the maximum output from a given input bundle might be of primary importance. For example, in a health care facility in a less developed country, serving the maximum number of individuals from a given bundle of resources would be more important than operating at a level that maximizes average productivity.

It might appear that one could downsize the firm to the efficient scale and create the requisite number of smaller firms that would collectively use up the given input bundle. If, for example, x^0 equals mx^*, one might create m smaller firms each using input x^* and producing output $f(x^*)$. As a result, the total output produced from x^0 would be $mf(x^*)$ which would exceed the output $f(x^0)$ that would be producible from the input x^0 by a single firm. This is not the case, however, unless *m happens to be* an integer. This is best explained by a simple example.

Consider the piece-wise linear production function

$$
\begin{aligned}
f(x) &= 2.5x - 4;\ 2 \leq x \leq 6; \\
&= 6.5 + 0.75x;\ 6 \leq x \leq 18; \qquad (6) \\
&= 20;\ x \geq 18.
\end{aligned}
$$

It is shown by the broken line *ABCDE* in Figure 1. Clearly, the efficient scale is attained at the point *C* where the average productivity attains a maximum level of $\frac{11}{6}$. Now consider a firm shown by the point *F*. It uses 8 units of x to produce 10 units of the output y. Note that at the input level $x = 8$, $f(x) = 12.5$. Thus, if it could eliminate technical inefficiency it would move to the point *G* on the production function. Clearly the firm *F* is operating at a scale that is larger than the optimal scale. The efficient input scale is 75% of the actual input level of this firm. Suppose that the firm is downsized to the input level $x = 6$ where it produces the output level $y = 11$. Another firm using the remaining 2 units of the input would produce only 1 unit of the output. Collectively, therefore, the two firms would be producing 12 units of the output. This is clearly less than what could be produced from the efficient operation of a single firm using 8 units of the input. Thus, the firm cannot be regarded as "too large". Of course, if CRS held, the smaller firm using 2 units of x would produce $\frac{11}{3}$ units of the output. The total output of the two firms would then be $\frac{44}{3}$ units. The point *H* on the ray *OC* shows this. But in the case of CRS the question of scale efficiency becomes irrelevant because average productivity does not change with the input scale.

Consider, next, a firm that uses14 units of the input. In the absence of technical inefficiency, this firm would produce 17 units of output. If the firm was broken up into three firms - two of them using the scale efficient input level of 6 units and the third one using 2 units of the input, the smaller firms would collectively produce 23 units of the output. Thus, this firm is clearly "too large" and breaking it up into several smaller firms would be technically more efficient than operating it as a single firm. But it would be even better to split it into two identical firms each producing 11.75 units of output from 7 units of the input. In this case, the total output produced would be 23.5 units. It may be noted that if the firm was to be broken up into three identical units, the total output would 23 units. Thus, we find that the firm is best broken up into two identical firms. It is important to note that even though the firm is to be broken up into two, the smaller units are not scaled down versions of the pre-existing firm. Each of them is constructed as a 70-30 weighted average of the firm at *C* and the firm at *J*.

Maindiratta (1990) characterized a firm as "size inefficient" when the total output produced collectively by several firms is greater than what could be produced from its input bundle by a single firm operating efficiently.

For the numerical example the underlying production function was assumed to be known. In reality, one must construct a production function from sample data on inputs and output.

2.2 The Nonparametric Methodology

In most empirical applications of productivity and efficiency analysis, some explicit functional form of a production, cost, or profit function (e.g., the Cobb Douglas) is specified and the parameters of the model are estimated by appropriate econometric methods. Validity of results derived from the analysis, naturally, depends on the appropriateness of the functional form specified. The mathematical programming method of Data Envelopment Analysis (DEA) introduced by Charnes, Cooper, and Rhodes (CCR) (1978) provides a nonparametric alternative to econometric modeling. The original CCR model considered technologies that exhibit constant returns to scale globally. In a subsequent paper, Banker, Charnes, and Cooper (1984) generalized the DEA methodology to accommodate variable returns to scale. In DEA one makes only a few general assumptions about the production technology without specifying any functional form. Assume that

(a) each observed input output bundle (x^j, y^j) $(j = 1,2,\ldots,N)$ is feasible,
(b) the production possibility set is convex,
(c) inputs are freely disposable, and
(d) outputs are freely disposable.

By virtue of (a) and(b),any $(\bar{x}, \bar{y})$ satisfying

$$\{\bar{x} = \sum_{1}^{N} \lambda_j x^j, \bar{y} = \sum_{1}^{N} \lambda_j j^j, \sum_{1}^{N} \lambda_j = 1, \lambda_j \geq 0 (j = 1,2,\ldots,N)\} \qquad (7)$$

will be feasible. Hence, utilizing (c) and (d), the production possibility set can be empirically constructed as

$$S = \{(x, y) : x \geq \sum_{1}^{N} \lambda_j x^j ; y \leq \sum_{1}^{N} \lambda_j y^j ; \sum_{1}^{N} \lambda_j = 1; \lambda_j \geq 0 (j = 1,2\ldots,N)\}. \qquad (8)$$

Varian (1984) calls S an inner approximation to the true production possibility set. It is the smallest set satisfying (a)-(d). If, additionally, one assumes constant returns to scale, the restriction $\sum_1^N \lambda_j = 1$ can be dispensed with and the production possibility set would be reconstructed as

$$S^C = \{(x, y) : x \geq \sum_1^N \lambda_j x^j; y \leq \sum_1^N \lambda_j y^j; \lambda_j \geq 0; (j = 1,2,\ldots,N)\}. \tag{9}$$

The DEA LP problem for measuring the output-oriented technical efficiency is:

$$\begin{aligned} &\max \ \varphi \\ \text{s. t.} \quad &\sum_1^N \lambda_j y^j \geq \varphi y^0; \\ &\sum_1^N \lambda_j x^j \leq x^0; \\ &\sum_1^N \lambda_j = 1; \\ &\lambda_j \geq 0; (j = 1,2,\ldots,N). \end{aligned} \tag{10}$$

Inverse of the optimal value of the objective function $(\frac{1}{\varphi^*})$ from the problem provides a measure of the output-oriented technical efficiency of the input-output bundle (x^0, y^0).

When the CRS production possibility set is used as the reference, the measure of technical efficiency is

$$TE^C = \frac{1}{\phi^C}, \tag{11}$$

where

$$\phi^C = \max \phi : (x^0, \phi y^0) \in S^C. \tag{11a}$$

As shown by BCC, the scale efficiency of the firm using the input bundle x^0 is

$$SE(x^0) = \frac{TE^C}{TE} = \frac{\phi^*}{\phi^C}. \tag{12}$$

The measured level of scale efficiency does not, by itself, indicate whether a firm is operating under increasing or decreasing returns to scale. Nor does it identify the efficient scale. Banker (1984) has shown, however, that one can identify the nature of local returns to scale by examining the optimal solution of the CCR problem. Suppose that at the optimal solution of (11a) λ_j equals

λ_j^* *(j=1,2,…,N)* and $\sum_j \lambda_j^*$ equals β. Now define $\mu_j = \frac{\lambda_j^*}{\beta}$. Thus, $\sum_j \mu_j^* = 1$. Note that the input-output combination $(x^0, \phi^C y^0)$ lies on the frontier of the CRS production possibility set. Thus, by virtue of CRS, $(\frac{1}{\beta} x^0, \frac{\phi^C}{\beta} y^0)$ is also located on the CRS frontier. It may be easily verified, however, that $\frac{\phi^C}{\beta}$ is the optimal solution of the output-oriented BCC problem for the input-output bundle $(\frac{1}{\beta} x^0, y^0)$. This shows that $(\frac{1}{\beta} x^0, \frac{\phi^C}{\beta} y^0)$ is a point of tangency between the VRS and the CRS frontiers and, therefore, $\frac{1}{\beta} x^0$ is the efficient input scale. Of course, when β exceeds unity, locally diminishing returns to scale holds and the input bundle x^0 has to be scaled down. Similarly, if β is less than unity, increasing returns to scale holds and x^0 is smaller than the efficient scale.

Break Up of a Large Firm

We now describe a method introduced by Maindiratta (1990) to determine whether it is technically more efficient to break up a large firm with a specific input bundle into a number of smaller firms than to let it operate as a single production unit. Again, consider the single-output, multiple-input case. Clearly, when the production function is sub-additive at the input bundle x^0, there exist K smaller input bundles x^k *(k =1, 2,…, K)* such that $\sum_1^K x^k = x^0$ and $\sum_1^K f(x^k) > f(x^0)$. In this case, It is technically more efficient to break up a single firm using the input bundle x^0 into K smaller firms using the bundles x^k *(k = 1, 2,…, K)*. In that sense, a single firm using input x^0 is too large. Specifically, suppose that (x^0, y^0) is the observed input-output combination of the firm. Further, let $f(x^0) = \varphi_0^* y^0$ be the maximum output producible from x^0. Similarly, let $y_*^k = \varphi_k^* y^0 = f(x^k)$ be the maximum output producible from the input bundle x^k. Then, the K smaller bundles would collectively produce the output $\sum_1^K y_k^* = \left(\sum_1^K \varphi_k^*\right) y^0$ from the input bundle x^0. Thus, the single firm using the input bundle x^0 is too large if $\sum_1^K \varphi_k^* > \varphi_0^*$.

We need to address two questions before we can proceed any further. First, how do we decide the number of smaller firms that the existing firm should be broken up into, if it is to be broken up at all? In other words, how do we determine K ? Second, how do we determine the size of each constituent input bundle after the break up? We address the second question first. To do this, set K to some positive integer value tentatively. Our objective initially is to determine the composition of the K identical smaller input bundles[2] that will maximize the collective output producible from them. Let $\hat{x}$ be the input bundle and $\hat{y}$ the maximum output producible from $\hat{x}$. Clearly, under the usual assumptions of DEA, $(\hat{x}, \hat{y})$ would be a feasible input-output combination so long as there exists some $\lambda = (\lambda_1, \lambda_2, ..., \lambda_N)$ such that $\sum_{j=1}^{N} \lambda_j x^j \le \hat{x}, \sum_{j=1}^{N} \lambda_j y^j \ge \hat{y}, \sum_{j=1}^{N} \lambda_j = 1,$ and $\lambda_j \ge 0 (j = 1,2,..., N)$ .The K firms would together use input $K\hat{x}$ and the collective output would be $K\hat{y}$ The problem is to select the vector λ so as to maximize φ where $K\hat{y} \ge \varphi y^0$ while $K\hat{x} \le x^0$. For this, we solve the following DEA problem.

$$
\begin{aligned}
&\max \quad \varphi \\
&\text{s.t. } \sum_{j=1}^{N} \lambda_j x^j = \hat{x}; \\
&\sum_{j=1}^{N} \lambda_j y^j = \hat{y}; \\
&K\hat{x} \le x^0; \qquad\qquad\qquad\qquad (13) \\
&K\hat{y} \ge \phi y^0 \\
&\sum_{j=1}^{N} \lambda_j = 1;; \\
&\lambda_j \ge 0; (j = 1,2,..., N); K \in \{1,2,.....,\}.
\end{aligned}
$$

Of course, we still need to determine K. At this point, all we know is that K is some positive integer. Now define, $\alpha_j = K\lambda_j (j = 1,2,..., N)$. Then the DEA problem (13) becomes

$$
\begin{aligned}
&\max \quad \varphi \\
&\text{s.t.} \\
&\sum_{j=1}^{N} \alpha_j x^j \le x^0;
\end{aligned}
$$

[2] It can be shown that it makes no difference whether the smaller input bundles are identical or different.

$$\sum_{j=1}^{N}\alpha_j y^j \geq \varphi y^0; \qquad (14)$$

$$\sum_{j=1}^{N}\alpha_j = K;$$

$$\alpha_j \geq 0 (j = 1,2,...,N); K \in \{1,2,....\}.$$

At the optimal solution of this problem, K^* represents the desired number of smaller (identical) units that the single firm should be broken up into. Note that this is a mixed integer programming problem where one variable *(K)* is constrained to be a positive integer while the other variables can take any non-negative value. An interesting feature of this problem is that if *K* is pre-set to 1, it reduces to the familiar BCC problem for a VRS technology. On the other hand, if *K* is allowed to take any positive value (not necessarily an integer), the problem in (14) reduces to the output-oriented CCR problem for a CRS technology. Suppose that the maximum value of the objective function in problem (14) is φ^K while those in the corresponding BCC and CCR problems are φ^V and φ^C, respectively. Then, by virtue of the hierarchy of the feasible sets of the problems,

$$\varphi^V \leq \varphi^K \leq \varphi^C. \qquad (15)$$

As is well known, the scale efficiency of the input bundle x^0 is measured as

$$SE = \frac{\varphi^V}{\varphi^C} \leq 1. \qquad (16)$$

Maindiratta defines the *size efficiency* of the firm as

$$\sigma = \frac{\varphi^V}{\varphi^K} \leq 1. \qquad (17)$$

It is clear from (15) that

$$SE \leq \sigma \leq 1. \qquad (18)$$

If $\sigma = 1$, there is no size inefficiency and even when we are allowed to select *any integer value* for *K* in problem (14), the optimal solution selects $K^* = 1$. If on the other hand, $K^* > 1$, the firm is

For a proof, see Ray (2004).

size inefficient. Deviation of the measure σ from unity shows the shortfall in output from a single-firm production relative to a multi-firm production using the same input bundle x^0.

Although the DEA problem in (14) is a mixed integer programming problem, given that the integer constrain applies to only one variable, one can solve the problem easily using the "branch and bound" algorithm. The steps are as follows.

Step 1: Solve the CRR problem (i.e., without any restriction on the sum of the λ_j s.)

Compute $K^* = \sum_{j=1}^{N} \lambda_j^*$. If K^* is an integer, stop; otherwise go to step 2.

Step 2: Define $K_-^* = \lfloor K^* \rfloor$ = largest integer no greater than K^*.

Solve the problem (14) with the restriction $K = K_-^*$.

Denote the optimal value of the objective function as φ_-^*.

Step 3: Define $K_+^* = \lfloor K^* \rfloor + 1$.

Solve the problem (14) with the restriction $K = K_+^*$.

Denote the optimal value of the objective function as φ_+^*.

Step 4: $\varphi^{**} = \max\{\varphi_-^*, \varphi_+^*\}$. The optimal K is correspondingly determined.

3.The Empirical Analysis

In this study we evaluate the size efficiency of Indian banks for the years 1997 through 2003. The actual number of banks covered in any one year varies between 68 (in 2003) and 73 (in 2000). We follow the intermediation approach in our definition of inputs and outputs. A 4-input 3-output production technology is conceptualized. The inputs included are labor, physical capital, borrowed funds (including deposits), and equity. The outputs are credits (adjusted for non-performing loans), investments, and other incomes.

Table 1 reports the year-wise summary statistics of the input and output variables. While labor is measured by the number of employees, all other variables are in crores (i.e., 10s of millions) of rupees. The yearly means of all the variables show a slight increase over time.

Because all variables except labor are measured in nominal values unadjusted for inflation, an upward trend is only to be expected. At the same time, an overall growth of banking appears to have contributed to this trend. This is evident from the increase in the average level of employment over the years. It may be noted that for State bank of India values of most of the variables (shown in the Max column) are about 15 times the average values for the entire sample.

Table 2 shows the values of K* from the optimal solution of the mixed integer programming problem (14) for the four selected banks for the different years within the sample period. State Bank of India is obviously way too large and should be broken up into more than 25 smaller banks in all years except in 2003 when it is a candidate for break up into 15 banks. Although much smaller than SBI, Canara Bank is also found to be too large in all the years should be broken up - some times into more than 10 smaller units. Punjub National Bank was not a candidate for break up during the first two years. But from 1999 onwards it came up as too large in each year. It is interesting to note that ICICI Bank, often showcased as the most efficient new private sector bank, also was found to be size inefficient in 3 of the 7 years considered. In fact, in the year 2000 it was a candidate for break up into as many as 9 smaller banks!

Table 3 shows the year-wise distribution of K* (from the optimal solution of problem 14). In every year, at least 25% of all banks were too large. In particular, during 1999 nearly 50% of all banks were size inefficient and candidates for break up into smaller units. During the last two years of the study, however, there were no more that 4 banks that were larger than 10 times their optimal size.

For all banks that were found size inefficient in any year the individual levels of VRS technical efficiency (BCCTE), K*, size efficiency (SZE), and scale efficiency (SE) are reported for each occurrence in Table 4. In this Table while BCCTE shows the ratio between the actual and the technically efficient output of a bank, SZE expresses the technically efficient output as a proportion of what could be maximally produced by an appropriate number of smaller banks collectively using the observed input bundle of any individual bank. For example, in 1998 the actual output of ICICI Bank was about 88% of what could be produced from its input bundle at full technical efficiency. The entry in the SZE column shows that this efficient output bundle itself would be 95.8% of what could be produced if it was to be broken up into 2 smaller banks (as shown in the K^* column).

It can be seen that in all of the sample years, SBI is found to be technically efficient. However, its size efficiency shows that its actual output is lower than what could be produced from a number of smaller banks using its total input bundle in all of these years. In fact, it is only 85.8% of what 44 smaller banks could produce in the 1999. Even ICICI Bank exhibits a significant degree of size inefficiency in the year 2000. Although it is found to be technically efficient, breaking it up into 4 smaller banks would result in a nearly 12% increase in all of its outputs. Size efficiency is found to be lower than 0.90 in 33 cases. In 2 cases (ICICI Bank in 2000 and Union Bank in 1999) the size efficiency falls below 0.80.

An interesting point to note is that the measured values of scale and size efficiencies differ little for any individual bank. This is natural given the fact that, as shown in the branch-and-bound procedure above, the optimal K^* and β (the sum of the optimal values of the λ_js from the CCR model) are quite close implying that the size-efficient and the scale-efficient input bundles are not very different. This, in its turn, might suggest that measuring size efficiency adds little new information beyond what is obtained from analyzing the scale efficiency of a bank. This is not true, however. That is because although the scale- and size-efficient input bundles are going to be quite similar, the benchmark bank is to be constructed in quite different ways for the two approaches. This can be illustrated by an example. Consider the case of SBI in the year 1999. The "peer banks" and the associated weights for constructing the scale- and size-efficient benchmark small bank are shown below:

Peer Banks	weights for construction of benchmark	
	scale efficient	size efficient
State Bank of Hyderabad	0.2537	0.2454
Federal Bank	0.0781	0.0725
Bank of Nova Scotia	0.6401	0.6351
Citibank	0.0281	0.0621
State Bank of Indore	0	0.0209

As can be seen from above, not only are the weights assigned to the individual banks in the peer group are different, one bank (State Bank of Indore) features in the construction of the size-efficient benchmark but not in the other one.

Table 5 reports the 23 occasions where banks in different years were found to be size efficient even though in all of these cases they were operating in the region of diminishing returns to scale. Note that in each instance β (the sum of the optimal λ_js from the CCR model) was greater than unity. Thus, by this criterion, they were above their efficient scale size. Yet, the mixed integer programming problem yields an optimal value of K equal to unity in all of these cases. Hence, they are not candidates for break up into smaller units. As noted before, in the popular perception, any firm that is bigger than its efficient scale size and is operating in the region of diminishing returns should be scaled down. But the information from Table 5 drives home the fact that a bank is not necessarily too big even if it exhibits diminishing returns at its observed scale.

Tables 6 and 7 show another interesting finding. Just as a bank operating above its efficient scale is not necessarily too large, when a large bank is indeed a candidate for break up, its size-efficient benchmark itself may fall either in the diminishing returns or the increasing returns region. In the 56 cases shown in Table 6, K^* is less than β. This implies that the benchmark smaller bank in each of these cases would be bigger than the optimal scale size and would therefore be in the region of diminishing returns. The opposite is true in the 108 cases shown in Table 7 where K^* exceeds β and the benchmark bank is in the region of increasing returns.

We may now summarize the main findings of this study:

- SBI was too large in all of the years considered in the sample. The other three – Canara Bank, Punjub National Bank, and ICICI Bank were also found to be too large in some or all years.
- Numerous other banks were also found to be size inefficient in various years and breaking them up into smaller units would result in greater increase in output than what would be producible even if they operated efficiently at their existing sizes.
- Banks that are larger than their scale efficient sizes are not necessarily candidates for break up.
- Even when it is recommended that a banks should be broken up, the benchmark smaller unit may be larger or smaller than its scale efficient size.

4. Conclusion

In this paper we use data covering the period 1997 through 2003 to measure size levels of efficiency of individual Indian banks. The findings do suggest wide spread size inefficiency across banks and years. While results from any one year can be affected by random variation in outputs and inputs, banks like SBI and others that are persistently found to be size inefficient should be examined more closely in order to determine whether the sheer bulk of their size hinders smooth flow of information within the organization thereby lowering (size) efficiency. Two points need to be emphasized here. First, the benchmark smaller banks constructed for any individual bank that is found to be too large are usually convex combinations of other banks of various ownership categories. There may, in deed, be systemic constraints that would not allow a public sector bank like SBI to emulate (even in part) the organizational structure and operating processes of a foreign bank (like Citibank) or a new public sector bank (like UTI Bank). Second, we have not considered any adjustment cost associated with breaking up a large organization. It may very well be the case that such adjustment costs overwhelm the gains from breaking up and restructuring a large bank. Thus, our results should be interpreted with caution. In this sense, our findings should be viewed as broad targets the attainability of which should be assessed in light of specific constraints in any given context.

Table 1. Summary Statistics of Inputs and Outputs

	N	Mean	Std Dev	Min	Max
Borrowed Funds	71	7791.32	15461.96	74.53	117661.7
Labor	71	13541.79	30807.06	85	236204
(Physical) Capital	71	14915.66	20690.35	267	117092
Equity	71	595.8641	1063.3	3.72	7977.17
Credit	71	3116.66	6183.69	17.19	46827.56
Investments	71	3508.01	7369.2	40.46595	57690.18
Other Incomes	71	135.4266	322.719	0.67	2643.07
			YEAR=1998		
Borrowed Funds	72	9181.4	18163.53	95.6	139184.8
Labor	72	13358	30913.93	79	239649
(Physical) Capital	72	17114.46	24541.45	281	150632
Equity	72	719.3601	1282.77	4.82	9608.18
Credit	72	3730.61	7211.01	19.64	54982.24
Investments	72	4116.64	8834.11	52.9051	69731.12
Other Incomes	72	165.0147	347.0429	0.91	2820.17
			YEAR=1999		
Borrowed Funds	71	11226.55	22835.13	115.65	178121
Labor	71	13514.54	30830.42	35	237504
(Physical) Capital	71	19770.23	31113.85	262	219366
Equity	71	745.4559	1380.98	5.6	10402.31
Credit	71	4701.69	9150.88	26.19	71286.52
Investments	71	4732.3	9795.59	61.73208	76446.4
Other Incomes	71	174.9186	401.2011	1.1	3284.69
			YEAR=2000		
Borrowed Funds	73	12865.32	25936.64	139.46	206099.1
Labor	73	13053.23	29991.49	30	233433
(Physical) Capital	73	20954.71	33760.16	264	247761
Equity	73	832.7153	1549.59	6.62	12147.28
Credit	73	5630.04	11399.16	34.2	91878.69
Investments	73	5623.64	11515.72	70.61488	91813.63
Other Incomes	73	215.0726	434.0284	0.9	3569.32

Table 1 (contd)

	N	Mean	Std Dev	Min	Max
			YEAR=2001		
Borrowed Funds	71	15515.08	31825.85	164.4	253550.4
Labor	71	12392.66	27797.93	38	214845
(Physical) Capital	71	22543.51	35483.03	245	259330
Equity	71	928.7914	1714	7.47	13461.54
Credit	71	6863.04	15047.99	43.18	122876.5
Investments	71	6901.65	13638.14	75.31045	106740.8
Other Incomes	71	238.6342	494.6163	0.81	4017.82

YEAR=2002

	N	Mean	Std Dev	Min	Max
Borrowed Funds	71	18338.94	36118.77	178.59	279884.1
Labor	71	11786.31	26877.61	37	209622
(Physical) Capital	71	28115.62	58297.44	404	423934
Equity	71	1157.14	2063.18	8.41	15224.38
Credit	71	8224.75	18055.98	41.11	145142
Investments	71	8562.66	15633.66	76.39147	114005.1
Other Incomes	71	335.563	537.9273	2.76	4174.49

YEAR=2003

Borrowed Funds	68	21108.4	40100.36	188.11	305426.9
Labor	68	12254.76	27355.31	35	209797
(Physical) Capital	68	29495.66	57744.47	386	406073
Equity	68	1397.04	2386.92	10.33	17203.38
Credit	68	10128.81	21766.49	49.06	172347.9
Investments	68	10383.67	18484.03	85.58558	133281.3
Other Incomes	68	460.9	808.8341	4.76	5740.26

Table 2. Values of K* for Selected Banks

	1997	1998	1999	2000	2001	2002	2003
CANARA BANK	6	8	11	9	12	7	8
PUNJUB NATIONAL BANK	1	1	5	7	11	11	7
ICICI BANK	1	2	1	9	4	1	1
STATE BANK OF INDIA	25	33	44	25	54	33	15

Table 3. Distribution of K*

Year	K* =1	2-5	6 - 10	11 - 15	16 - 20	21 - 30	31 - 40	K* > 40	total
1997	48	17	4	1	0	1	0	0	71
1998	54	12	3	1	1	0	1	0	72
1999	36	20	6	5	2	1	0	1	71
2000	51	9	6	4	1	2	0	0	73
2001	41	22	3	3	1	0	0	1	71
2002	53	13	1	2	1	0	1	0	71
2003	50	10	6	1	1	0	0	0	68

Table 4. Technical, Size, and Scale Efficiency of Banks that are “Too Large”

K^*	Year	Bank Name	BCCTE	SZE	SE
2	1997	STATE BANK OF HYDERABAD	0.98724	0.98289	0.98179
2	1997	STATE BANK OF SAURASHTRA	1	0.99752	0.9944
2	1997	ALLAHABAD BANK	0.97788	0.99406	0.99218
2	1997	SYNDICATE BANK	1	0.97618	0.97599
2	1997	VIJAYA BANK	0.87581	0.99765	0.99701
2	1997	BANK OF MADURA LTD.	0.83944	0.99421	0.98809
2	1997	HDFC BANK LTD.	1	0.94207	0.93505
2	1997	VYSYA BANK LTD.	0.89276	0.98727	0.98704
2	1997	BANK OF TOKYO	0.91285	0.98663	0.98594
2	1998	STATE BANK OF SAURASHTRA	1	0.9753	0.97458
2	1998	HDFC BANK LTD.	1	0.9751	0.96419
2	1998	ICICI BANKING CORPORATION	0.87749	0.95838	0.95274
2	1999	ANDHRA BANK	1	0.96257	0.95742
2	1999	BANK OF MAHARASHTRA	0.99649	0.98947	0.98543
2	1999	PUNJAB & SIND BANK	0.94874	0.98992	0.9861
2	1999	BANK OF PUNJAB LTD.	0.93047	0.9811	0.97947
2	1999	DEVELOPMENT CREDIT BANK LTD.	0.90476	0.98819	0.98635
2	1999	KARUR VYSYA BANK LTD.	0.90312	0.9959	0.99289
2	1999	SOUTH INDIAN BANK LTD.	0.94604	0.98955	0.98909
2	1999	TAMILNAD MERCANTILE BANK LTD.	0.86275	0.99036	0.98598
2	1999	BANQUE NATIONALE DE PARIS	0.95224	0.96736	0.96735
2	2000	ALLAHABAD BANK	0.91079	0.97057	0.97043
2	2000	DENA BANK	0.95532	0.97127	0.97119
2	2000	FEDERAL BANK LTD.	1	0.99317	0.99282
2	2000	JAMMU & KASHMIR BANK LTD.	0.87457	0.98516	0.98266
2	2000	VYSYA BANK LTD.	0.8387	0.99084	0.98757
2	2000	STANDARD CHARTERED BANK	0.99919	0.98432	0.98356
2	2001	STATE BANK OF BIKANER & JAIPUR	0.98198	0.95639	0.95636
2	2001	STATE BANK OF TRAVANCORE	1	0.98703	0.98688
2	2001	DENA BANK	0.85281	0.965	0.96476
2	2001	VIJAYA BANK	0.88246	0.97379	0.97197
2	2001	FEDERAL BANK	0.97722	0.97873	0.97856
2	2001	GLOBAL TRUST BANK	0.96341	0.99061	0.98908
2	2001	JAMMU & KASHMIR BANK	0.88309	0.99873	0.99856
2	2001	KARUR VYSYA BANK	0.87573	0.99422	0.9907
2	2002	STATE BANK OF BIKANER & JAIPUR	0.97891	0.98018	0.97928
2	2002	ALLAHABAD BANK	0.92964	0.95564	0.95338
2	2002	DENA BANK	0.90686	0.94423	0.94277
2	2002	VIJAYA BANK	0.93428	0.99397	0.99242
2	2002	JAMMU & KASHMIR BANK	0.90843	0.97839	0.97768
2	2002	VYSYA BANK	0.8179	0.99489	0.99122
2	2002	HONGKONG & SHANGHAI BANK	0.90776	0.99925	0.99729
2	2003	STATE BANK OF SAURASHTRA	0.95207	0.99688	0.97649
2	2003	CENTRAL BANK OF INDIA	0.95358	0.98933	0.98928
K^*	Year	Bank Name	BCCTE	SZE	SE
2	2003	DENA BANK	0.9498	0.96638	0.96552
2	2003	Federal Bank Ltd.	0.93944	0.99993	0.99607

2	2003	ING Vysya Bank Ltd.	0.94534	0.99817	0.9963
3	1997	STATE BANK OF PATIALA	1	0.92183	0.92104
3	1997	CENTRAL BANK OF INDIA	1	0.99925	0.99917
3	1997	ORIENTAL BANK OF COMMERCE	1	0.9901	0.98944
3	1997	GRINDLAYS BANK	1	0.87364	0.87354
3	1998	STANDARD CHARTERED BANK	0.94047	0.932	0.93187
3	1998	STATE BANK OF PATIALA	1	0.95478	0.95408
3	1998	UNITED COMMERCIAL BANK	0.98246	0.95596	0.95436
3	1998	VIJAYA BANK	0.91687	0.99725	0.99589
3	1998	VYSYA BANK LTD.	0.82888	0.9802	0.97766
3	1998	HONGKONG & SHANGHAI BKG.CORPN.	0.8982	0.94448	0.94361
3	1999	STANDARD CHARTERED BANK	0.97457	0.94497	0.94485
3	1999	ALLAHABAD BANK	0.90044	0.94152	0.94143
3	1999	DENA BANK	0.99781	0.95356	0.95305
3	1999	VIJAYA BANK	0.8154	0.99739	0.99727
3	1999	JAMMU & KASHMIR BANK LTD.	0.88457	0.99097	0.9907
3	1999	VYSYA BANK LTD.	0.72878	0.98293	0.9826
3	1999	ABN AMRO BANK N.V.	1	0.98795	0.9838
3	1999	DEUTSCHE BANK (ASIA)	1	0.98437	0.98378
3	2000	STATE BANK OF SAURASHTRA	1	0.93907	0.93891
3	2000	CORPORATION BANK	1	0.93011	0.9301
3	2001	STATE BANK OF SAURASHTRA	0.96253	0.97382	0.96672
3	2001	CORPORATION BANK	1	0.86295	0.86281
3	2001	HDFC BANK	1	0.97521	0.97499
3	2001	VYSYA BANK	0.79382	0.96107	0.95867
3	2001	ABN AMRO BANK	1	0.9975	0.99657
3	2001	HONGKONG & SHANGHAI BANK	1	0.9234	0.92283
3	2002	STATE BANK OF PATIALA	1	0.96922	0.96739
3	2002	CORPORATION BANK	0.95401	0.9138	0.91378
3	2002	INDIAN BANK	1	0.8835	0.88339
3	2003	STATE BANK OF PATIALA	1	0.94561	0.94455
3	2003	ALLAHABAD BANK	0.96425	0.96586	0.96562
3	2003	SYNDICATE BANK	0.94569	0.95181	0.95099
3	2003	Jammu & Kashmir Bank Ltd.	0.93693	0.97492	0.97267
4	1997	UNION BANK OF INDIA	0.98981	0.87718	0.87711
4	1997	FEDERAL BANK LTD.	0.94004	0.96818	0.96774
4	1997	HONGKONG & SHANGHAI BKG.CORPN.	1	0.9025	0.90249
4	1998	INDIAN BANK	0.90137	0.93945	0.93742
4	1998	SYNDICATE BANK	0.9562	0.97159	0.97127
4	1998	GRINDLAYS BANK	1	0.95046	0.94961
4	1999	STATE BANK OF SAURASHTRA	1	0.9588	0.95632
4	2001	STATE BANK OF PATIALA	1	0.89504	0.8947
4	2001	ALLAHABAD BANK	0.89903	0.94087	0.93967
4	2001	INDIAN BANK	0.86384	0.9462	0.94619
4	2001	ICICI BANK	1	0.87964	0.87961
K^*	year	Bank Name	BCCTE	SZE	SE
4	2003	UNION BANK OF INDIA	0.97279	0.94447	0.94415
5	1997	INDIAN BANK	0.79258	0.95673	0.95634
5	1999	PUNJAB NATIONAL BANK	1	0.89371	0.89369
5	1999	STANDARD CHARTERED BANK	0.95779	0.96663	0.96541

K*	year	Bank Name	BCCTE	SZE	SE
5	2000	SYNDICATE BANK	1	0.97433	0.97402
5	2001	INDIAN OVERSEAS BANK	1	0.95053	0.95049
5	2001	SYNDICATE BANK	0.97841	0.94283	0.94209
5	2001	UNITED COMMERCIAL BANK	0.94596	0.94364	0.94353
5	2001	STANDARD CHARTERED GRINDLAYS BANK	0.75986	0.9965	0.99646
5	2002	CENTRAL BANK OF INDIA	0.93705	0.92766	0.92656
5	2002	SYNDICATE BANK	0.94944	0.94631	0.94546
5	2002	UNION BANK OF INDIA	0.93285	0.96269	0.9622
6	1997	BANK OF BARODA	1	0.8577	0.85766
6	1997	CANARA BANK	1	0.86286	0.86258
6	1999	STATE BANK OF PATIALA	1	0.97791	0.97437
6	2000	UNION BANK OF INDIA	0.90735	0.90372	0.90335
6	2003	STANDARD CHARTERED BANK	1	0.93792	0.93617
7	1997	UCO BANK	0.98313	0.95722	0.95625
7	1999	UNITED COMMERCIAL BANK	0.965	0.94943	0.9494
7	2000	PUNJAB NATIONAL BANK	1	0.90992	0.90968
7	2001	ORIENTAL BANK OF COMMERCE	1	0.96764	0.96654
7	2002	CANARA BANK	1	0.86234	0.86227
7	2003	PUNJAB NATIONAL BANK	1	0.89251	0.89225
7	2003	HSBC Ltd.	1	0.96143	0.96102
8	1998	CANARA BANK	1	0.93191	0.93152
8	1999	CORPORATION BANK	1	0.92188	0.92164
8	2000	HONGKONG & SHANGHAI BKG.CORPN.	1	0.90012	0.90008
8	2001	UNION BANK OF INDIA	0.92292	0.92004	0.91957
8	2003	CANARA BANK	1	0.92452	0.92409
8	2003	CORPORATION BANK	0.98951	0.91098	0.90975
9	1999	INDIAN BANK	0.84582	0.93031	0.9303
9	1999	HONGKONG & SHANGHAI BKG.CORPN.	0.99448	0.83848	0.83838
9	2000	BANK OF BARODA	1	0.8169	0.81689
9	2000	CANARA BANK	1	0.88682	0.88669
9	2000	ICICI BANKING CORPORATION	1	0.78687	0.78687
9	2001	CENTRAL BANK OF INDIA	0.92215	0.90659	0.90635
9	2003	BANK OF BARODA	0.9771	0.91406	0.91382
10	1997	CITI BANK	1	0.87727	0.87368
10	1998	BANK OF BARODA	1	0.85538	0.85535
10	1998	UNION BANK OF INDIA	0.93663	0.93008	0.92999
10	1999	CENTRAL BANK OF INDIA	1	0.88355	0.88349
11	1999	CANARA BANK	0.96957	0.86233	0.86221
11	1999	ORIENTAL BANK OF COMMERCE	1	0.9008	0.90049
11	1999	UNION BANK OF INDIA	1	0.79522	0.79515
11	2000	ORIENTAL BANK OF COMMERCE	1	0.9674	0.96602
11	2000	STANDARD CHARTERED GRINDLAYS BANK	1	0.95649	0.9559
11	2001	PUNJAB NATIONAL BANK	1	0.89726	0.89684
11	2002	PUNJAB NATIONAL BANK	1	0.91418	0.91389
12	1998	CENTRAL BANK OF INDIA	1	0.94173	0.94148
12	1999	GRINDLAYS BANK	1	0.87556	0.87507
12	2001	CANARA BANK	1	0.81759	0.81755
13	2000	BANK OF INDIA	1	0.86225	0.86212
13	2001	BANK OF INDIA	1	0.98693	0.9866

14	1997	BANK OF INDIA	1	0.87813	0.87813
14	2002	BANK OF BARODA	1	0.87161	0.87135
15	1999	SYNDICATE BANK	1	0.96198	0.96152
15	2000	CENTRAL BANK OF INDIA	0.96125	0.87675	0.87647
15	2003	STATE BANK OF INDIA	1	0.97407	0.97403
16	1999	INDIAN OVERSEAS BANK	1	0.97338	0.97259
16	2001	BANK OF BARODA	0.93108	0.86664	0.86661
16	2002	UCO BANK	0.92145	0.90363	0.90358
17	1998	BANK OF INDIA	1	0.90015	0.90004
17	1999	BANK OF BARODA	1	0.80761	0.80761
18	2000	UNITED COMMERCIAL BANK	0.97196	0.89976	0.89934
20	2003	INDIAN BANK	0.93196	0.95203	0.95199
25	1997	STATE BANK OF INDIA	1	0.95516	0.9551
25	2000	STATE BANK OF INDIA	1	0.89846	0.89844
25	2000	INDIAN BANK	0.84391	0.87327	0.87325
27	1999	BANK OF INDIA	1	0.89281	0.89259
33	1998	STATE BANK OF INDIA	1	0.94026	0.94015
33	2002	STATE BANK OF INDIA	1	0.92264	0.92262
44	1999	STATE BANK OF INDIA	1	0.85838	0.85837
54	2001	STATE BANK OF INDIA	1	0.87914	0.87914

Table5. Size Efficient Firms Operating Under Diminishing Returns to Scale

Bank Name	year	BCCTE	SE	β
BANK OF MAHARASHTRA	1997	0.99597	0.99904	1.1239
BANQUE NATIONALE DE PARIS	1997	0.8722	0.99888	1.27144
DEVELOPMENT CREDIT BANK LTD.	1997	0.87112	0.99899	1.0665
DHANALAKSHMI BANK LTD.	1997	0.86458	0.99061	1.2014
PUNJAB & SIND BANK	1997	0.94538	0.99794	1.2329
UNITED WESTERN BANK LTD.	1997	0.83792	0.99794	1.20266
UTI BANK	1997	0.9352	0.99893	1.05077
BANQUE NATIONALE DE PARIS	1998	0.85317	0.99543	1.08532
BHARAT OVERSEAS BANK LTD.	1998	0.96673	0.9953	1.197
PUNJAB & SIND BANK	1998	0.97637	0.99982	1.1401
BANK OF RAJASTHAN LTD.	1999	0.83846	0.99928	1.0282
BANK OF TOKYO	1999	0.80354	0.99646	1.0877
CENTURION BANK	1999	0.90212	0.99296	1.3118
KARNATAKA BANK LTD.	1999	0.85479	0.99912	1.3852
STATE BANK OF BIKANER & JAIPUR	1999	0.9476	0.99912	1.0769
TAMILNAD MERCANTILE BANK LTD.	2000	0.87501	0.99357	1.4055
DEVELOPMENT CREDIT BANK	2001	0.87604	0.99993	1.4734
KARNATAKA BANK	2001	0.85664	0.99864	1.07697
TAMILNAD MERCANTILE BANK	2001	0.89894	0.99917	1.57501
UNITED WESTERN BANK	2001	0.88254	0.99989	1.00885
TAMILNAD MERCANTILE BANK	2002	0.8797	0.99805	1.25716
TAMILNAD MERCANTILE BANK	2003	0.87463	0.99785	1.05839
VIJAYA BANK	2003	0.97569	0.99949	1.2873

Table 6. Large Banks with Constituent Smaller Banks Operating under DRS

Obs	bkname	year	K^*	β
1	ABN AMRO BANK N.V.	1999	3	3.731
2	ALLAHABAD BANK	2002	2	2.1294
3	ANDHRA BANK	1999	2	2.3261
4	BANK OF BARODA	2000	9	9.0597
5	BANK OF BARODA	2001	16	16.0147
6	BANK OF BARODA	2003	9	9.2186
7	BANK OF INDIA	1997	14	14.0631
8	BANK OF INDIA	1998	17	17.1994
9	CANARA BANK	2001	12	12.0186
10	CANARA BANK	2002	7	7.6738
11	CENTRAL BANK OF INDIA	1999	10	10.5785
12	CENTRAL BANK OF INDIA	2000	15	15.1754
13	CENTRAL BANK OF INDIA	2001	9	9.5452
14	CORPORATION BANK	1999	8	8.2427
15	CORPORATION BANK	2001	3	3.168
16	DENA BANK	1999	3	3.0865
17	DENA BANK	2000	2	2.0887
18	DENA BANK	2001	2	2.1505
19	DEUTSCHE BANK (ASIA)	1999	3	3.0768
20	DEVELOPMENT CREDIT BANK LTD.	1999	2	2.2852
21	FEDERAL BANK LTD.	1997	4	4.3558
22	GRINDLAYS BANK	1999	12	12.4018
23	HONGKONG & SHANGHAI BKG.CORPN.	1997	4	4.0186
24	HONGKONG & SHANGHAI BKG.CORPN.	2000	8	8.5157
25	HSBC Ltd.	2003	7	7.0661
26	ICICI BANK	2001	4	4.592
27	INDIAN BANK	1997	5	5.2419
28	INDIAN OVERSEAS BANK	2001	5	5.018
29	JAMMU & KASHMIR BANK LTD.	1999	3	3.1893
30	JAMMU & KASHMIR BANK LTD.	2000	2	2.3018
31	ORIENTAL BANK OF COMMERCE	1997	3	3.2333
32	SOUTH INDIAN BANK LTD.	1999	2	2.2665
33	STANDARD CHARTERED BANK	1998	3	3.3833
34	STANDARD CHARTERED BANK	1999	3	3.3831
35	STANDARD CHARTERED GRINDLAYS BANK	2001	5	5.4009
36	STATE BANK OF INDIA	1998	33	33.5626
37	STATE BANK OF INDIA	2001	54	54.7899
38	STATE BANK OF PATIALA	1997	3	3.2364
39	STATE BANK OF PATIALA	1998	3	3.1694
40	STATE BANK OF PATIALA	1999	6	6.8216
41	STATE BANK OF PATIALA	2002	3	3.1229
42	STATE BANK OF SAURASHTRA	1998	2	2.0297
43	STATE BANK OF SAURASHTRA	1999	4	4.3328
44	SYNDICATE BANK	1997	2	2.0934
45	SYNDICATE BANK	1998	4	4.0945
46	SYNDICATE BANK	2001	5	5.1179

47	UCO BANK	1997	7	7.3354
48	UCO BANK	2002	16	16.0681
49	UNION BANK OF INDIA	2001	8	8.1183
50	UNITED COMMERCIAL BANK	1998	3	3.2617
51	UNITED COMMERCIAL BANK	1999	7	7.1679
52	UNITED COMMERCIAL BANK	2000	18	18.1481
53	VIJAYA BANK	1997	2	2.2761
54	VIJAYA BANK	2001	2	2.1405
55	VYSYA BANK	2001	3	3.35352
56	VYSYA BANK LTD.	1999	3	3.1023

Table 7. Large Banks with Constituent Smaller Banks Operating Under IRS

Obs	bkname	year	K^*	β
1	ABN AMRO BANK	2001	3	2.8264
2	ALLAHABAD BANK	1997	2	1.3754
3	ALLAHABAD BANK	1999	3	2.9314
4	ALLAHABAD BANK	2000	2	1.8169
5	ALLAHABAD BANK	2001	4	3.3358
6	ALLAHABAD BANK	2003	3	2.5419
7	BANK OF BARODA	1997	6	5.5233
8	BANK OF BARODA	1998	10	9.9394
9	BANK OF BARODA	1999	17	16.6102
10	BANK OF BARODA	2002	14	13.6491
11	BANK OF INDIA	1999	27	26.5942
12	BANK OF INDIA	2000	13	12.5749
13	BANK OF INDIA	2001	13	12.3392
14	BANK OF MADURA LTD.	1997	2	1.4852
15	BANK OF MAHARASHTRA	1999	2	1.3626
16	BANK OF PUNJAB LTD.	1999	2	1.8738
17	BANK OF TOKYO	1997	2	1.9269
18	BANQUE NATIONALE DE PARIS	1999	2	1.9993
19	CANARA BANK	1997	6	5.4542
20	CANARA BANK	1998	8	7.6676
21	CANARA BANK	1999	11	10.475
22	CANARA BANK	2000	9	8.4771
23	CANARA BANK	2003	8	7.3089
24	CENTRAL BANK OF INDIA	1997	3	2.9377
25	CENTRAL BANK OF INDIA	1998	12	11.7573
26	CENTRAL BANK OF INDIA	2002	5	4.1603
27	CENTRAL BANK OF INDIA	2003	2	1.8251
28	CITI BANK	1997	10	9.3681
29	CORPORATION BANK	2000	3	2.9859
30	CORPORATION BANK	2002	3	2.9914
31	CORPORATION BANK	2003	8	7.435
32	DENA BANK	2002	2	1.6598
33	DENA BANK	2003	2	1.7529
34	FEDERAL BANK	2001	2	1.9489
35	FEDERAL BANK LTD.	2000	2	1.8629
36	FEDERAL BANK LTD.	2003	2	1.0804
37	GLOBAL TRUST BANK	2001	2	1.8249
38	GRINDLAYS BANK	1997	3	2.8264
39	GRINDLAYS BANK	1998	4	3.6841
40	HDFC BANK	2001	3	2.8708
41	HDFC BANK LTD.	1997	2	1.7105
42	HDFC BANK LTD.	1998	2	1.4803
43	HONGKONG & SHANGHAI BANK	2001	3	2.8762
44	HONGKONG & SHANGHAI BANK	2002	2	1.0763
45	HONGKONG & SHANGHAI BKG.CORPN.	1998	3	2.7606
46	HONGKONG & SHANGHAI BKG.CORPN.	1999	9	8.4007

47	ICICI BANKING CORPORATION	1998	2	1.3946
48	ICICI BANKING CORPORATION	2000	9	8.9645
49	INDIAN BANK	1998	4	3.3088
50	INDIAN BANK	1999	9	8.8437
51	INDIAN BANK	2000	25	24.8296
52	INDIAN BANK	2001	4	3.9576
53	INDIAN BANK	2002	3	2.5098
54	INDIAN BANK	2003	20	19.1624
55	INDIAN OVERSEAS BANK	1999	16	15.8759
56	ING VYSYA BANK LTD.	2003	2	1.4749
57	JAMMU & KASHMIR BANK	2001	2	1.9381
58	JAMMU & KASHMIR BANK	2002	2	1.8329
59	JAMMU & KASHMIR BANK	2003	3	2.4043
60	KARUR VYSYA BANK	2001	2	1.19
61	KARUR VYSYA BANK LTD.	1999	2	1.261
62	ORIENTAL BANK OF COMMERCE	1999	11	10.7504
63	ORIENTAL BANK OF COMMERCE	2000	11	10.654
64	ORIENTAL BANK OF COMMERCE	2001	7	6.3265
65	PUNJAB & SIND BANK	1999	2	1.7075
66	PUNJAB NATIONAL BANK	1999	5	4.9331
67	PUNJAB NATIONAL BANK	2000	7	6.3335
68	PUNJAB NATIONAL BANK	2001	11	10.304
69	PUNJAB NATIONAL BANK	2002	11	10.6384
70	PUNJAB NATIONAL BANK	2003	7	6.6375
71	STANDARD CHARTERED BANK	1999	5	4.5427
72	STANDARD CHARTERED BANK	2000	2	1.8084
73	STANDARD CHARTERED GRINDLAYS BANK	2000	11	10.3695
74	STATE BANK OF BIKANER & JAIPUR	2001	2	1.9718
75	STATE BANK OF BIKANER & JAIPUR	2002	2	1.3845
76	STATE BANK OF HYDERABAD	1997	2	1.5622
77	STATE BANK OF INDIA	1997	25	24.3186
78	STATE BANK OF INDIA	1999	44	43.2524
79	STATE BANK OF INDIA	2000	25	24.6034
80	STATE BANK OF INDIA	2002	33	32.8231
81	STATE BANK OF INDIA	2003	15	14.0477
82	STATE BANK OF PATIALA	2001	4	3.3547
83	STATE BANK OF PATIALA	2003	3	2.6231
84	STATE BANK OF SAURASHTRA	1997	2	1.534
85	STATE BANK OF SAURASHTRA	2000	3	2.6171
86	STATE BANK OF SAURASHTRA	2001	3	2.5563
87	STATE BANK OF SAURASHTRA	2003	2	1.4758
88	STATE BANK OF TRAVANCORE	2001	2	1.9609
89	SYNDICATE BANK	1999	15	14.8036
90	SYNDICATE BANK	2000	5	4.5824
91	SYNDICATE BANK	2002	5	4.5391
92	SYNDICATE BANK	2003	3	2.557
93	STANDARD CHARTERED BANK	2003	6	5.3505
94	TAMILNAD MERCANTILE BANK LTD.	1999	2	1.5953
95	UNION BANK OF INDIA	1997	4	3.3385
96	UNION BANK OF INDIA	1998	10	9.9077

97	UNION BANK OF INDIA	1999	11	10.9009
98	UNION BANK OF INDIA	2000	6	5.4906
99	UNION BANK OF INDIA	2002	5	4.5355
100	UNION BANK OF INDIA	2003	4	3.7186
101	UNITED COMMERCIAL BANK	2001	5	4.6795
102	VIJAYA BANK	1998	3	2.6129
103	VIJAYA BANK	1999	3	2.3745
104	VIJAYA BANK	2002	2	1.3931
105	VYSYA BANK	2002	2	1.45382
106	VYSYA BANK LTD.	1997	2	1.72623
107	VYSYA BANK LTD.	1998	3	2.37396
108	VYSYA BANK LTD.	2000	2	1.2182

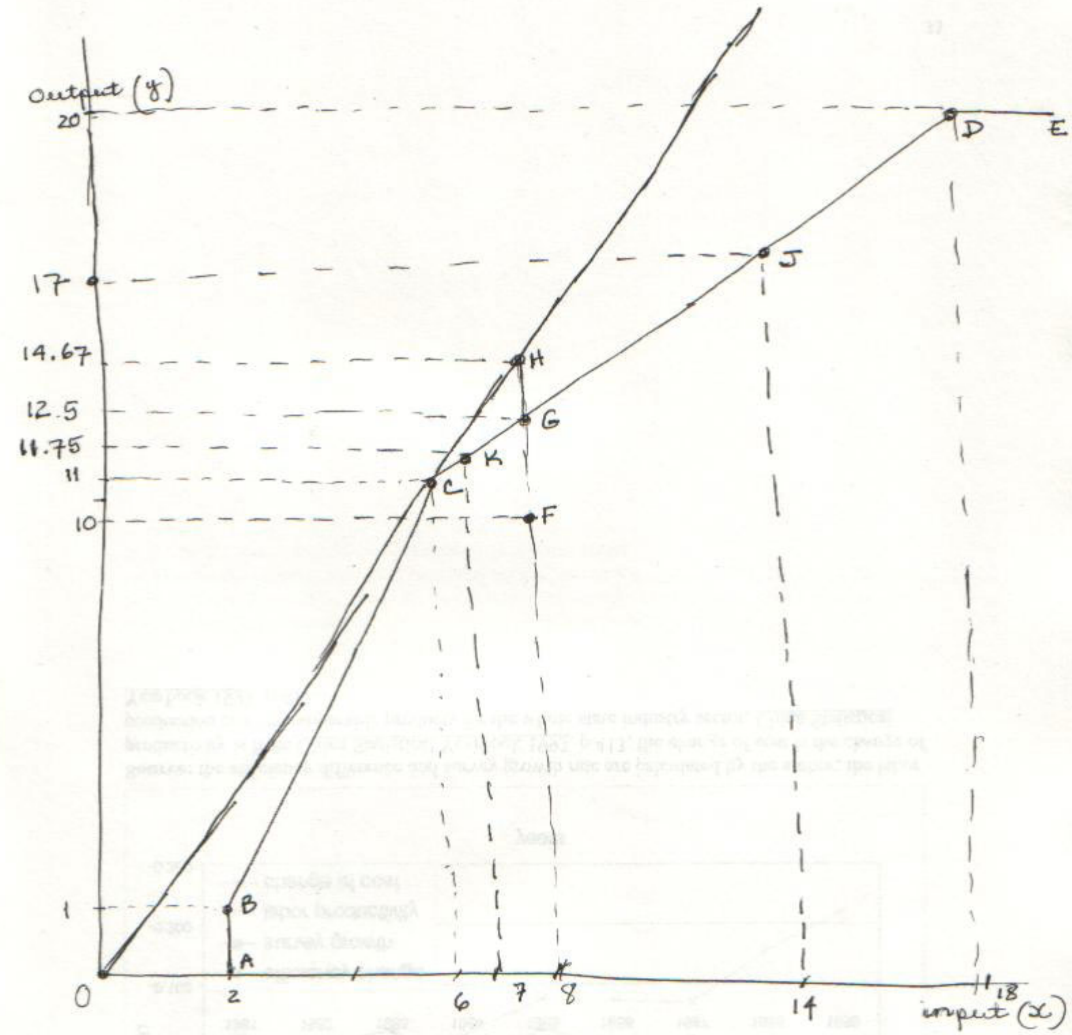

Figure 1. Illustration of Size Efficiency

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