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This paper seeks to examine empirically whether foreign banks on an average operate with greater efficiency and so attain higher levels of productivity and profitability. For this purpose, first, a stochastic frontier production function for the banking industry is estimated and bank-wise technical efficiency is computed. In the second stage, the authors compare the mean efficiency level of foreign banks with that of domestic banks. In addition, foreign and domestic banks are also compared with respect to the other measures of performance, namely, productivity and profitability.

I
Introduction

IT is widely believed that the foreign banks (FBs), as compared to domestic banks (DBs), adopt better management practices and pos-scss better organisational skill and know-how, All these factors make the group of FBs a better performer than DBs in terms of efficiency and profitability. Based on these beliefs, Narsimham Committee (1991) has emphasised that the liberal entry of FBs would provide spillover benefits to financial sector by improving competitive efficiency and by upgrading work culture and technology of the Indian banking industry. Thus, the committee has recommended for an enhanced participation of FBs by allowing them not only to open more branches (which has been the normal practice so far) but also to have subsidiaries and joint ventures with DBs.

In India, affiliates of FBs (mostly in the form of branches) have been co-existing with DBs for several decades. This paper seeks to examine empirically whether FBs on an average operate with greater efficiency and so attain higher level of productivity and profitability. For this purpose, in the first stage, a stochastic frontier production function (FPF) for the banking industry is estimated and thereby bank wise technical efficiency is computed. In the second stage, we compare the mean efficiency level of FBs with that of DBs. In addition, DBs and FBs are also compared with respect to the other measures of performance, namely, productivity and profitability.

The remaining part of the present paper is organised as follows. Section II deliberates on the meaning and measurement of efficiency and provides a brief summary of the approaches used for computing technical efficiency. Section III presents a stochastic FPF model and discusses the techniques used for the estimation of the same. Section IV focuses on the approaches used for measuring outputs and inputs of a bank. Section V discusses sample and data used and accomplishes the task-of estimating a deterministic FPF and thereby computes bankwise technical efficiency. In addition, the mean value of technical efficiency of FBs and DBs are compared. In Section VI, DBs and FBs are compared with respect to some additional measures of performance. Section VII concludes the study.

II
Measurement of Efficiency

In order to test the argument advanced in Section I about relative efficiency of DBs and FBs, we require a proper measure of efficiency. For a long time, it was thought adequate to measure efficiency either by average productivity of labour (or capital) or by a total factor productivity index (a ratio of output to weighted sum of all factors). These measures of efficiency, however, cannot be considered satisfactory for several reasons. First, an average productivity measure ignores the contribution of 'other' factors in production. Second, although an index of total factor productivity can take into account all the factors of production, in construction of index one faces the usual index number problems while aggregating the inputs. Third, the measures of total factor productivity are deduced from explicitly or implicitly defined average production function but the production functions by definition are frontier functions. Thus, the total factor productivity index should be constructed on the basis of a frontier production function.

A measure of efficiency which avoids the aforementioned problems was first suggested by Farrell (1957). Farrell defined efficiency as the ability of a production organisation to produce a good at minimum cost. Efficiency (or more appropriately productive efficiency) is viewed by him as a relative concept which is measured as a deviation from best performance in a representative peer group. He dichotomised efficiency into two parts, namely, technical efficiency and allocative efficiency.

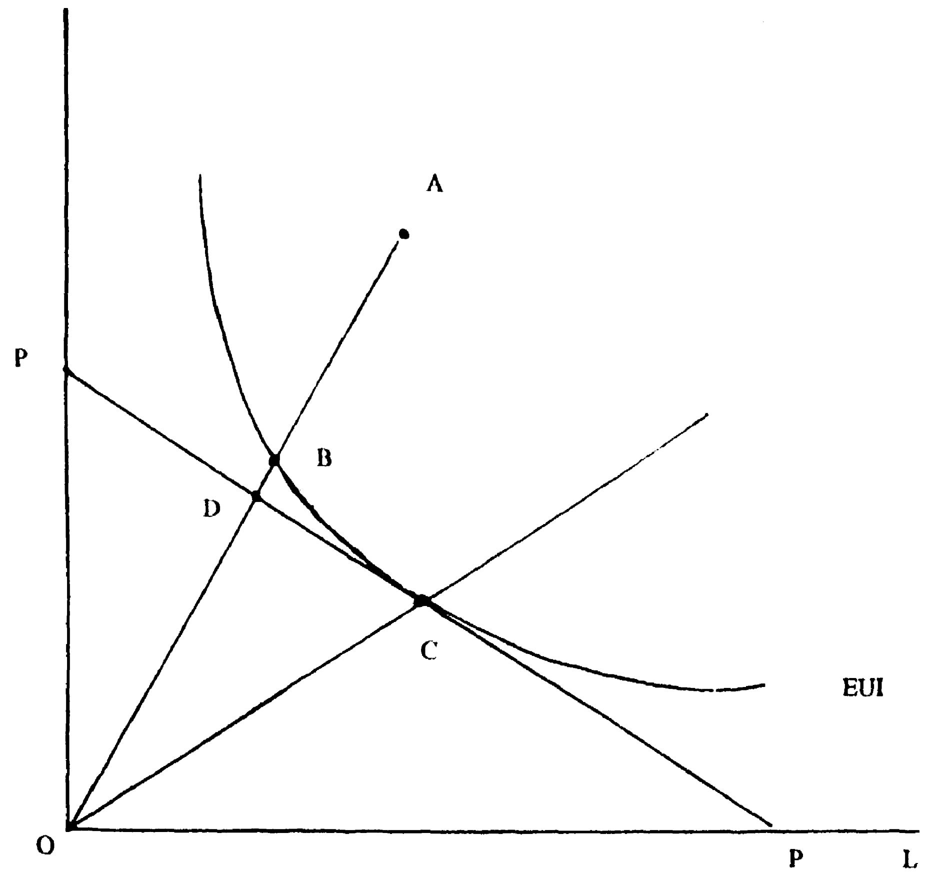
Two types of measures of technical efficiency was proposed by Farrell An input-based measure is calculated as the ratio of best practice input usage to actual usage. holding the output constant. Output-based measure is computed as the ratio of actual output obtained from a given vector of inputs to maximum possible output achievable from the same input vector. A decision-making unit is said to achieve allocative efficiency in production of a given level of output if it could allocate the factors of production at a given set of factor prices in such a way as the marginal rate of substitution between two factors becomes equal to their factor price ratio.

FARRELL APPROACH

The figure illustrates Farrell's input-based measures of productive efficiency and its two components. To represent conveniently through a diagram, it is assumed that a good Q is produced only by using two factors of production L and K. Besides, it is assumed that production takes place under the condition of constant returns to scale, and the firm has knowledge of its efficient unit isoquant (EUI). The EUI represents the locus of all minimum input combinations of 1 (=L/Q) and k (= K/Q) which can produce one unit of output Q, ie, EUI is the "best practice" unit isoquant. Since firm B produces on the EUI. it will represent a technically efficient firm. Now consider another firm A on OA ray, which uses the same input ratio as firm B and produces the same level of output, nevertheless, B employs only a fraction OB/OA(<1) of each input 1 and k that firm A utilises. The ratio OB/OA is considered as the measure of technical efficiency (TE).

For measuring allocative efficiency (AE) we again focus on the figure which shows that firm B and C are technically efficient as they operate on the same EUI. But, the slope of EUI is equal to the ratio of the prices of two factors only at point C, and so firm C realises minimum cost of production at point C. In other words, the profit maximising output is obtained only at point C, reflecting both the technical as well as allocative efficiency. Any point other than C on the isoquant will represent a higher than minimum cost of production at given factor prices. For the factor price ratio represented by PP,

FIGURE: INPUT- BAM D MEASURES OF PRODUCTIVE EFFICIENCY



the cost of production of firm B will be given by the cost of production at C multiplied by OB/OD(>1), whereas the cost of production of firm C will be equal to a fraction OD/OB(<1) of that at B. Farrell defined the ratio OD/OB as a measure of allocative efficiency. A product of TE and AEmeasures yields a single index termed as overall productive efficiency (OPE) which is given by the ratio OD/OA.

Several features of Farrell's approach of measuring productive efficiency can be discerned from the above discussion. First of all, it provides an input-based measure of efficiency in which the differences in input use between firms for the standardised unit output on EUI are calculated. Secondly, it is non-parametric. Thirdly, it assumes a constant returns to scale technology. Fourthly, in order to arrive at the separate measures of TE and AE, Farrell had to use primal production function rather than its dual, the cost function. One can derive an OPE index from a cost function but not the measures of its different components. Finally, Farrell's efficiency measures are relative in the sense that the performance of the individual firms are compared with the best performer in a peer group.

FRONTIER PRODUCTION FUNCTIONS APPROACH

While the major concern of Farrell was to offer an input-based radial measure of efficiency and its two components, he, as mentioned earlier, also proposed an output-based measure of technical efficiency that could be derived by estimating a FPF with a specific functional form such as the Cobb-Douglas. A FPF is defined as the locus of points representing maximum levels of output achievable from the given input vectors. In the framework of FPF, technical efficiency is gauged as a ratio of actual output obtained from a given combination of inputs to the corresponding level of output shown by the production frontier.

Farrell did not follow up his own suggestion of estimating a FPF. However, a number of scholars [Aigner and Chu 1968, Afriat 1972, Richmond 1974, Greene 1980, Aigner et al 1977, Meeusen and van den Broeck 1977, Jondrow et al 1982, Schmidt and Sickles 1984, Cornwell et al 1990, etc] in later years developed methods for estimating FPFs, and for computing technical efficiency. Two types of FPFs, namely, deterministic and stochastic are estimated by the researchers. A deterministic FPF envisages a deterministic optimal relationship between inputs and output, unaffected by random events and statistical noise such as measurement errors. Thus, in the deterministic FPF models the actual level of output of a firm is assumed to lie below the frontier only due to the existence of technical inefficiency in the production process of a firm.

In reality, however, random events like machine or equipment failures, product defects and supply bottlenecks in addition to measurement errors do occur frequently which often affect the optimally planned output of a firm. Consequently, the *ex ante* output of a firm becomes, instead of a fixed number, a random variable. This led to the conceptualisation of stochastic FPFin which the optimal relationship between inputs and output is considered to be stochastic, rather than deterministic. The stochastic FPF thus attributes the shortfall in a firm's observed output from the corresponding point on the frontier to the technical inefficiency as well as to the random events and statistical noise.

Technical efficiency measure obtained with reference to a stochastic FPF is considered superior because it gives less biased measure of efficiency. However, estimation

TABLE 1: ESTIMATES OF EQUATION (1) AND THE OTHER STATISTICS

Variables	Coefficient	T-Statistics
Intercept	4.58	17.90
Labour	0.41	9.65
Capital	0.43	6.24
Material input	0.19	2.46

R-squared	= 0.95	σ_v	= 0.362129
F-Statistics	= 418.53	σ	= 0.513988
μ_2	= 0.179485	λ	= 1.007249
μ_3	= -0.01058	λ/σ	= 1.959673
σ_μ	= 0.364754		

TABLE 2: BANKWISE TECHNICAL EFFICIENCY

No	Banks	TE	No	Banks	TE
1	SBI	0.94	36	SANGLI	0.94
2	PATLA	0.95	37	CATHL	0.93
3	HYDER	0.94	38	MADURA	0.94
4	BKJP	0.94	39	KRVYS	0.94
5	TRVCR	0.94	40	TMRCL	0.93
6	MYSOR	0.94	41	BARAT	0.91
7	SRSTR	0.94	42	VILAS	0.93
8	INDOR	0.93	43	BANRS	0.96
9	INDIA	0.96	44	NDGD	0.92
10	PNB	0.96	45	CITUN	0.94
11	BRODA	0.96	46	BARLY	0.95
12	CNTRL	0.96	47	DHANL	0.94
13	CANRA	0.95	48	NAINI	0.95
14	UCO	0.96	49	RATNA	0.96
15	INDIN	0.96	50	KRSHN	0.92
16	SYNDI	0.94	51	PUNJAB	0.93
17	IOB	0.96	52	CITI	0.93
18	UNION	0.94	53	CNDBK	0.91
19	ALAHA	0.95	54	HONGKG	0.91
20	UNTED	0.96	55	STDCHRTD	0.94
21	ANDRA	0.94	56	AMEXP	0.96
22	MAHA	0.95	57	AMRCA	0.97
23	DENA	0.97	58	TOKYO	0.95
24	ORNTL	0.95	59	DEUTSCHE	0.97
25	PNSB	0.95	60	DUCH	0.96
26	VIJYA	0.94	61	FRNCH	0.94
27	NEWBK	0.95	62	SOCIETE	0.98
28	CORPN	0.95	63	OMAN	0.97
29	J&K	0.97	64	SUEZ	0.96
30	VYSYA	0.95	65	OMINI	0.94
31	FEDRL	0.96	66	MITSU	0.98
32	RAJAS	0.95	67	ABUDHA	0.96
33	KRNTK	0.95	68	SCOTIA	0.96
34	STHIN	0.94	69	SONALI	0.82
35	UNWST	0.94	70	BARCLAYS	0.88

of a stochastic FPF is fraught with some difficulties. For instance, if the failure of type I, as discussed by Olson et al (1980), occurs in which third moment of OLS residuals carries positive sign, the stochastic FPF cannot be estimated.

Two alternative techniques are employed in the construction of frontier production functions, viz, mathematical programming and econometric techniques. The main advantage of using mathematical programming techniques *vis-a-vis* econometric technique is that it does not impose any explicit functional form (e g, Cobb-Douglas) on production function to be estimated. However, the chief limitation of this technique is that it can estimate only deterministic frontier and produces 'estimates' which have no statistical properties such as standard errors or t-ratios, etc. On the contrary, the econometric approach is capable of estimating deterministic as well as stochastic frontiers and provides estimates with statistical properties. Because of these advantages researchers prefer to use econometric methods.

We prefer to estimate a stochastic FPFs for the Indian banking industry. To compute bankwise technical efficiency Jondrow et al' s (1982) formula is used. The next section describes the model and econometric technique used for the estimation of stochastic FPF in our study.

III

Stochastic Frontler Production Function Model

The stochastic FPF model was simultaneously introduced by Aigner et al (1977) and Meeusen and van den Broeck (1977). It was further extended by Jondrow et al (1982) for computing firm-specific technical efficiency. The main idea behind modelling a stochastic FPF is that the disturbance term of the model is composed of two parts, viz, symmetric and asymmetric. The symmetric part of the disturbance term captures the effect of statistical 'noise' and the random shocks outside the control of the firms, all making the production frontier stochastic. The asymmetric component reflects technical inefficiency relative to the stochastic FPF.

A Cobb-Douglas form of stochastic FPF for analysing cross-section data can be written as follows:

$$Y_j = \alpha \, . \prod_{i=1}^{K} X_{ij}^{b_i} \, . \exp(v_j) \, . \exp(-u_j) \quad \ldots (1)$$

Alternatively, the log-linear form of (1) can be presented as

$$Y_j = a + \sum_{i=1}^{K} b_i X_{ij} + v_j - u_j$$

or

$$Y_j = a + \sum_{i=1}^{K} b_i X_{ij} + \omega_j \quad \ldots (2)$$

The disturbance terms v_j^i s represent the symmetric component and so are assumed to be independently and identically distributed as $N(0,\sigma^2)$. The $\exp(v_j)$ are distributed in the (0,) interval. The component u_j^i are one-sided and assume only non-negative values. The u_j's may be derived from any one-sided distribution, for example, half-normal distribution, gamma distribution, or exponential distribution. The $\exp(-u_i)$ is a measure of technical efficiency and is distributed in the (0,1) interval. We assume here that the u_j's are independently and identically distributed as the absolute value of a $N(0,\sigma_u^2)$ variable. In other words, the distribution of u_j's is half-normal. The probability density functions of u_j^i s and v_j^i's can be expressed as

$$g(u) = \frac{1}{\sqrt{2\pi} \, . \, \sigma_u} \exp[-\tfrac{1}{2}(u/\sigma_u)^2] \text{ for } u > 0$$

$$= 0, \text{ otherwise} \quad \ldots (3)$$

where, $E(u) = \sqrt{2\pi} \, . \, \sigma_u$ and $\mathrm{Var}(u) = \left(\frac{\pi - 2}{\pi}\right) . \sigma_u^2$

$$h(v) = \frac{1}{\sqrt{2\pi}\,\sigma_v} \exp[-\tfrac{1}{2}(v/\sigma_v)^2] \quad \ldots (4)$$

The $w_j = v_j - u_j$ is the composed error term related to the observation j. The terms v and u_j which constitute are assumed to be independent of each other for every j and are also independent of X_{ij}'s (eg, under the Zellner et al' s 1966 assumption of expected profit maximisation). The joint probability density function of for every j is given by the following expression

$$f(\omega_j) = \frac{\sqrt{2}}{\sqrt{\pi} \, . \, \sigma} [1 - F(\omega_j \lambda / \sigma)] \exp[-(\tfrac{1}{2}\sigma^2) \, . \, \omega_j^2] \quad \ldots (5)$$

$$-\infty \leq \omega_j \leq +\infty$$

where $\sigma = (\sigma_u^2 + \sigma_v^2)^{1/2}$, $\lambda = \frac{\sigma_u}{\sigma_v}$, and

F(.) is the standard normal cumulative distribution function evaluated at $\omega_j \lambda/\sigma$. The density function of ω_j's is asymmetric around zero, and its mean and variance are given by

$$E(\omega) = -E(u) = -\sqrt{2/\pi} . \sigma_u \quad \ldots (6)$$

$$\mathrm{Var}(\omega) = \mathrm{Var}(v) + \mathrm{Var}(u)$$

$$= \sigma_v^2 + \left(\frac{\pi - 2}{\pi}\right) \sigma_u^2 \quad \ldots (7)$$

The estimates of the parameters of the equation (2) may be obtained either by the M L E or the COLS method. We consider first the M L E method. In Aigner et al (1977), the M L E problem is posed by forming the following log-likelihood function for a sample of N observations.

$$\mathrm{Log}\,L(Y_j/a, b_i\text{'s}, \lambda, \sigma^2) = \frac{N}{2} \log(2/\pi) - N \log \sigma + \sum_{j=1}^{N} \log[1 - F(\omega_j \lambda \sigma^{-1})] - \frac{1}{2\sigma^2} \sum_{j=1}^{N} \omega_j^2 \quad \ldots (8)$$

TABLE 3: DESCRIPTIVE STATISTICS

(Rs lakh)

Variable	Public Sector Banks		Private Sector Banks		Foreign Banks	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Output	1066270	1462359	55191	45021	79164	107189
Labour (nos)	63270	82803	4610	3294	1411	2281
Capital	3266	5901	149	108	1140	2227
Materials	502	813	60	69	171	276
Technical efficiency (ratio)	0.9493	0.0094	0.9416	0.0134	0.9410	0.0399

TABLE 4: PRODUCTIVITY AND PROFITABILITY MEASURES BY BANK GROUPS

Indicators	State Bank Group		Nationalised Bank		Private Banks		Foreign Banks	
	1991	1992	1991	1992	1991	1992	1991	1992
Deposit per branch (Rs lakh)	494.2	600.3	473.3	535.2	249.0	328.5	7977.2	12166.1
Advances per branch (Rs lakh)	392.1	423.6	275.2	301.3	132.8	172.3	4984.2	6522.2
Deposit per employee (Rs lakh)	20.7	25.1	24.6	27.8	17.7	23.4	86.3	126.2
Advances per employee (Rs lakh)	16.5	17.7	14.3	15.6	9.4	12.3	53.9	67.7
Profit as per cent of own fund	9.2	12.7	5.9	6.8	18.3	26.4	44.1	35.9
Profit as per cent of working fund	0.2	0.2	0.2	0.3	0.3	0.6	1.5	1.3
Profit as per cent of total income	1.5	1.8	1.5	1.9	3.2	5.3	10.3	8.7

Sources: Calculated from the data given in: (i) IBA, *Public Sector Banks: Performance Highlights, 1991-92*, IBA, 1993, Bombay, (ii) IBA, *Private Sector Banks: Performance Highlights, 1991-92*, IBA, 1993, Bombay and (iii) IBA, *Foreign Banks: Performance Highlights, 1991-92*, IBA, 1993, Bombay.

where $\omega_j = Y_j - a - \sum_{i=1}^{K} b_i X_i$

In order to obtain the MLE estimates $\hat{a}$, $\hat{b}_i$'s, $\hat{\lambda}$ and $\hat{\sigma}^2$, the log-likelihood equation (8) is maximised by setting its partial derivatives with respect to a, b_i's, σ^2 and λ equal to zero, and then the resulting set of simultaneous equations is solved by some algorithm (the Fletcher-Powel algorithm, for example).* The maximum likelihood estimators are consistent and asymptotically efficient.

Once the stochastic frontier production function has been estimated, we can calculate the average as well as bank-specific technical efficiencies. In our case, the appropriate measure of average technical efficiency would be $Exp[E(-u_j)]$. Since u_j's have half-normal distribution, therefore

$$Exp[E(-u_j)] = Exp(-\sqrt{2/\pi}.\sigma_u) \quad ...(9)$$

It is to be noted that equation (9) is free from the $\hat{a}$ and $\hat{b}_i$'s terms but the value of σ_u is needed for the calculation of the average efficiency. It is possible to determine the values of σ_u and σ_v (say $\hat{\sigma}_u$ and $\hat{\sigma}_v$) by replacing λ and σ^2_u by their estimates ($\hat{\lambda}$ and $\hat{\sigma}^2_u$) in $\sigma^2 = \sigma^2_u + \sigma^2_v$ and $\lambda = \sigma_u/\sigma_v$. The solution of these equations will provide $\hat{\sigma}_u$ and $\hat{\sigma}_v$ which will be equal to $\hat{\sigma}/(1+\lambda^2)^{1/2}$ and $\hat{\sigma}\hat{\lambda}/(1+\hat{\lambda}^2)^{1/2}$ respectively. By replacing σ_u by its estimate $\hat{\sigma}_u$ in (9) we can readily compute the average technical efficiency of the sample banks.

However, the main aim of our investigation is to obtain the technical efficiency level of each bank so that we can compare the performance of the FBs and DBs. Following Jondrow et al (1982) this can be done by evaluating the mean or mode of the conditional distribution of the efficiency term u_j given ω_j. The conditional distribution of u_j given ω_j is

$$\frac{f(u_j, \omega_j)}{f(\omega_j)} = f(u_j/\omega_j) \text{ for all j} \quad ...(10)$$

where $\omega_j = v_j - u_j$, $j = 1, ..., N$

The mean of the conditional distribution is

$$E(u_j/\omega_j) = \frac{\sigma^2_u \cdot \sigma^2_v}{\sigma^2} \cdot \left[\frac{f(\omega_j\lambda/\sigma)}{1-F(\omega_j\lambda/\sigma)} - \frac{\omega_j\lambda}{\sigma}\right] \quad ...(11)$$

where f(.) is the standard normal density function and F(.) is the standard normal distribution function. Again the mode of the conditional distribution is

$$M(u_j/\omega_j) = -\omega_j(\sigma^2/\sigma), \text{ if } \omega_j \leq 0$$
$$= 0 \quad \text{if } \omega_j \geq 0 \quad ...(12)$$

Since σ, σ_u, σ_v, ω_j and λ are unknowns in the equations (11) and (12), we have to replace them by their estimates $\hat{\sigma}$, $\hat{\sigma}_u$, $\hat{\sigma}_v$, $\hat{\omega}_j$ and $\hat{\lambda}$ for finding out mean or mode of the conditional distribution u_j. Suppose the calculated mean and mode of conditional distribution of u_j obtained from this procedure are $\hat{E}(u_j/\omega_j)$ and $\hat{M}(u_j/\omega_j)$, respectively. Measure of technical efficiency of each bank j can then be expressed as

$$TE_j = \exp[-\hat{E}(u_j/\omega_j)] \quad ...(13)$$

or

$$TE_j = \exp[-\hat{M}(u_j/\omega_j)] \quad ...(14)$$

where, $0 \leq TE_j \leq 1$.

In order to estimate the frontier production function through COLS method, we first estimate equation (2) by the OLS technique. The OLS estimators of the slope coefficients ($\hat{b}_i$'s) are unbiased and consistent, but the estimate of the intercept term ($\hat{a}$) is biased. The bias of the constant term is equal to the mean of ω, $\mu = \sqrt{2/\pi}.\sigma_u$ [Olson et al 1980]. We can then correct the constant term by adding to the OLS estimated intercept term the negative of the bias, $\sqrt{2/\pi}.\sigma_u$. However, we do not know σ_u since it is unobservable. Waldman (1978) has shown that the variances $\hat{\sigma}^2_u$ and $\hat{\sigma}^2_v$ can be consistently estimated with the help of higher order moments of the estimated OLS residuals. The σ_u and σ_v are consistently estimated by

$$\hat{\sigma}^2_u = [\sqrt{\pi/2}(\pi/\pi-4)\mu_3]^{2/3} \quad ...(15)$$

$$\hat{\sigma}^2_v = [\mu_2 - \frac{(\pi-2)}{\pi}\hat{\sigma}^2_u] \quad ...(16)$$

where $\mu_2 = \Sigma e^2_j/N$ and $\mu_3 = \Sigma e^3_j/N$ are the second and third moments of the OLS estimated residuals e_j's. The equations (15) and (16) can be solved for $\hat{\sigma}_u$ and $\hat{\sigma}_v$. The $\hat{\sigma}_u$ can be substituted for σ_u for obtaining the unbiased COLS estimate of intercept term as $\hat{b}_o = \hat{a} + \sqrt{2/\pi}\hat{\sigma}_u$. The $\hat{b}_o$ and $\hat{b}_i$'s are also consistent but not asymptotically efficient [Greene 1980].

The $\hat{\sigma}_u$ and $\hat{\sigma}_v$ can also be used to calculate $\hat{\lambda}$ ($= \hat{\sigma}_u/\hat{\sigma}_v$) and $\hat{\sigma}$ ($=\sqrt{\hat{\sigma}^2_u + \hat{\sigma}^2_v}$). Having obtained the $\hat{\lambda}$, $\hat{\sigma}$, $\hat{\sigma}_u$, $\hat{\sigma}_v$ and e_j's, we can substitute them for λ, σ, σ_u, σ_v and ω_j's, respectively in (11) or (12) to find $\hat{E}(u_j/e_j)$ or $\hat{M}(u_j/e_j)$. Thus the $\exp[-\hat{E}(u_j/e_j)]$ and $\exp[-\hat{M}(u_j/e_j)]$ will again be the two alternate measures of technical efficiency for each bank j.

IV
Measuring Output and Inputs

In the banking literature, there exists considerable disagreement on how to define output and inputs for a banking unit. Two approaches have been followed by the researchers, namely, intermediation approach and production approach (Berger, et al 1987 and Clark 1988]. Intermediation approach views banks as collectors of deposits and buyers of funds to be subsequently intermedialed into bans and other assets. In this approach, a bank's total value of earning assets are treated as measures of output and deposits are considered as inputs along with capital and labour. On the contrary, in the production approach, banks arc seen as producers of services associated with individual loan and deposit accounts. According to this approach, the number of accounts of each type serviced by labour, capital and other inputs measures the output of a bank.

In our study, we follow a slightly modified version of production approach because the measurement of output by the number of accounts serviced does not take into account the differences in average size of deposit (or loan) held by the banks. For instance, average size of deposit (or loan) account serviced by FBs has been found larger than that serviced by DBs (Nag and Shivaswami 1990]. We, therefore, measure output by the sum of amount of total deposits and advances of a bank.

The inputs used in our analysis have been divided into three categories, namely, labour, capital and material input. Labour can be measured by the number of employees comprising of officers, clerks and subordinate staff. However, the banks vary in composition of their employees that in turn may vitiate the regression results. With a view to minimise distortion in the result, we have preferred to use employees by converting them into the homogeneous units of subordinate staff. Practically following Subrahmanyam and Swami(1992), we have used the ratio of 1/3:1/2:1 for expressing officers, clerks and subordinate staff respectively into the homogeneous unit of subordinate staff.

Capital can be measured by the annual value of services provided by the fixed assets of a bank. The book value of premises, furniture and fixtures represents the

Table 5: Indicators of Return and Expenditures by Bank Groups

Indicators	Public Sector Banks	Private Sector Banks	Foreign Banks
Total expenses as per cent of total deposits	13.2	12.0	17.5
Total expenses as per cent to total advances	20.4	22.5	25.8
Total expenses as per cent to working fund	10.3	10.4	12.4
Interest income as per cent of working fund	9.5	9.9	11.7
Other income as per cent to working fund	0.9	0.9	2.5
Spread as per cent to working fund	2.9	4.0	3.6

Sources: Same as in Table 4.

fixed assets of a bank. However, in the banks' balance sheets, book value of premises includes only the value of owned premises to the exclusion of rented premises. As the rented premises are used for performing a significant proportion of bank's business, the exclusion of rent element from the measure of capital is not desirable.

We adopt a flow measure of capital in our analysis which assumes that a bank consumes every year services worth of 5 per cent of the value of owned premises, 10 per cent of the value of furniture and fixtures and full value of rent, insurance and taxes. Thus, capital is approximated by the summation of one-twentieth of the value of premises, one-tenth of the value of furniture and fixture and full value of rent insurance and taxes paid by a bank.

As the banks have to perform a lot of paper work while processing information and maintaining loan and deposit accounts of their customers, they have to (spend a significant amount on stationery. We use amount of money spent per year under the head of stationery and printing as a measure of material input of a bank.

V
Sample and Data Sources

Sample used for the estimation purpose includes 70 scheduled commercial banks (out of total population of 75) in which 51 banks belong to the category of domestic banks (28 public sector banks and 23 private sector banks) and the remaining 19 banks constitute the group of foreign banks.

Bankwise data on number of each type of employees; value of premises, furniture and fixture, rent, insurance and taxes; expenses incurred on stationery and printing; total deposits and advances are collected from a publication of Indian Banks Association: *Financial Analysis of Banks, 1990-91,* Vol 1, 1992.

EMPIRICAL ESTIMATION AND RESULTS

For estimating a stochastic FPF for the Indian banking industry we have chosen a single equation three-input production function with Cobb-Douglas specification. The loglinear form of production function is written as follows:

$$\log Y = a + b_1 \log L + b_2 \log K + b_3 \log M + w$$

where,

Y = Output, measured by total deposits plus advances

L = Labour input, measured by subordinate staff equivalent of number of employees.

K = Capital input, approximated by summation of fixed proportions of the value of premises and of furniture and fixtures, and expenditure on rent insurance and taxes.

M = Material inputs, measured by expenses on stationery and printing,

a = Natural logarithm of intercept term

$b_1 b_2 b_3$ a Elasticities of output with respect to labour, capital and material input, respectively

w = Composite disturbance terms, i e, v-u

Equation (1) is estimated by the COLS method as described in Section III. Table 1 presents the results of OLS estimates of equation(1) as well as the estimates of certain statistics used in the above mentioned formula developed by Jondrow et al (1982), giving bankwise technical efficiency.

Table 2 presents technical efficiency of each bank belonging to the sample. The table shows that the level of technical efficiency of each bank is quite high and differences in technical efficiency across banks are little. Two most efficient banks each with 98 per cent efficiency are FBs. The least efficient bank with 82 per cent efficiency too is aFB.

Table 3 displays the descriptive statistics regarding technical efficiency output, labour, capital and material input for different group of banks.

The following important conclusions can be drawn from Table 3. First, as it is well known, average size of the public sector banks whether measured by average level of output, number of labour or amount of capital is considerably higher as compared to that of private sector domestic banks or foreign banks. Average size of private sector domestic banks is somewhat comparable with that of foreign banks. Second, despite differences in the size of different bank groups mean level of technical efficiency achieved by each group is almost the same. In fact, public sector banks are about 1 per cent more efficient than private sector domestic banks or the foreign banks. The variation in efficiency level across foreign banks, as shown by standard deviation (SD), is higher than that across public sector or private sector domestic banks.

VI
Productivity and Profitability

It has been found by the past studies (e g, Nag and Shivaswami 1990) that FBs on the averagerealise greater productivity and profitability. The recent data given in Table 4 too confirm the earlier findings. The average labour productivity, measured either by deposit per employee or by advances per employee, is much higher in the case of FBs than that in the case of DBs. Similarly, the average productivity of the branches of FBs is also greater than that of DBs. Furthermore, the various indicators of profitability such as profit as a proportion of total income, of working fund and of own fund are respectively greater for the group of FBs than those for the group of DBs.

On the basis of the higher values of these performance indicators, it is widely believed that FBs in comparison to DBs enjoy superior efficiency. However, this is not so as our analysis in the last section has shown that the efficiency of FBs and DBs are almost the same. What accounts then for the higher productivity and profitability of FBs *vis-a-vis* DBs? We argue here that the higher productivity and profitability attained by FBs are the result of different set of priorities and distinctive business strategies followed by them and to some extent the preferential treatment given to them by the government.

Two studies, namely, Keshan (1993) and Nag and Shivaswami (1990) have shown that a large proportion of FBs' deposits come from the corporate customers, NRI businessmen and professionals, and most of the advances go to the industrial sector, as a result, advances (or deposits) per account for FBs are much larger in comparison to those of DBs.

The larger average size of accounts coupled with the concentration of operation in metropolitan centres and elite clientele of FBs have not only led to higher labour and branch productivity but also to a greater ease in their business.

Several factors have led to greater profitability of FBs' operation in India. Notable among them are the minimal contribution to priority sector lending, a greater involvement in highly profitable activities like bill discounting, portfolio management services, investment in securities, foreign exchange dealings, maintenance of NRI accounts, fee related business, buy-back, ready forward and double ready forward operations [Keshan 1993], Apart from involvement in these businesses, confinement of FBs' activities in metropolitan centres, a much larger proportion of NRI deposits in their total deposits, larger proportion of officers in their total workforce, introduction and aggressive marketing of new financial services and greater involvement in real estate and consumer durable financing have also boosted the FBs' profit in recent years [Keshari 1993}.

Consumer Service Group (CSG) introduced by Citibank in 1983, for instance, has grown explosively in recent years, offering variety of services and products, viz, instalment lending, credit cards, leasing and hire-purchase. Citibank is considered leader in consumer finance with its pioneering contribution in automobile finance and other consumer loans. A number of foreign banks have installed automated teller machines (ATMs) which can provide banking services for 24 hours. FBs' gift-wrapped schemes with attractive packages such as 'Unfixed deposit', 'Smart money', X-chequer option, Easy access and Flexible deposits have made them financial boutiques. With the recent introduction of two significant instruments—Certificate of Deposits (CDs) and Commercial Papers (CPs)—FBs have become very active in the money market too. The CDs enable a bank to easily raise funds for the short term. Therefore, FBs have concentrated in this segment with attractive schemes; MaxiBond of Citibank is a good example.

Table 5 shows that the operations of FBs are more expensive than those of DBs. However, at the same time FBs' operations yield greater revenue as a proportion to their total deployment of working fund. This is the reason why spread as a proportion of working fund is larger in the case of FBs than that in the case of public sector banks. Notably, the other income as a proportion of working fund is much larger in the case of FBs. All these factors coupled with other unquantifiable factors may have resulted into greater profitability for FBs' operation in India.

VII
Conclusions

This paper aimed at examining the viewpoint that the superior productivity or profitability performances of FBs *vis-a-vis* their domestic counterparts in the Indian banking industry is the result of the superior efficiency enjoyed by the former group. For this purpose we first estimated a stochastic frontier production function for the banking industry. With the help *of* this frontier, bankwise technical efficiency for the underlying sample was computed. Thereafter, mean and standard deviations of technical efficiency for DBs and FBs were calculated. The result showed that FBs as a group was 1 per cent less efficient than DBs while the standard deviation of technical efficiency of FBs was slightly higher than that of DBs. Thus, we can say that FBs and DBs are not significantly different In terms of their efficiency.

The comparison of labour (or branch) productivity and profitability between DBs and FBs carried out in Section VI revealed that the same are respectively higher for the latter group, thus confirming the earlier findings of Nag and Shivaswami (1990). However, in the wake of our finding that DBs attain slightly higher level of efficiency, we cannot interpret the greater productivity and profitability of FBs to be the indicators of their greater efficiency in resource utilisation. We rather tend to support an alternative explanation' that the higher productivity and profitability of FBs are the consequence of their particular operational characteristics and strategies and preferential treatment rendered to them by the government of India [Nag and Shivaswami 1990 and Keshari 1993].

Note

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* A computer package LIMDEP can be used for estimating the stochastic frontier production function by the MLE procedure. The LIMDEP provides the MLE estimators a b' s, σ^2 and λ as well as the individual efficiency measure for each observation by applying the method suggested by Jondrow et al (1982).

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