SIRI KERTAS KERJA

WORKING PAPER SERIES

FEA Working Paper No. 2008-13

Would Its Past Reflect Its Future Performance: Indian Banks?

Gurcharan Singh Pritam Singh and Susila Munisamy

Fakulti Ekonomi dan Pentadbiran
Universiti Malaya

http://www.fep.um.edu.my/

Faculty of Economics and Administration
University of Malaya
50603 Kuala Lumpur
MALAYSIA

FEA Working Paper No. 2008-13

Would Its Past Reflect Its Future Performance: Indian Banks?

Gurcharan Singh Pritam Singh and Susila Munisamy

April 2008

Would its past reflect its future performance: Indian Banks?

Gurcharan Singh Pritam Singh[1] and Dr. Susila Munisamy[2]

[1] Faculty of Business and Accountancy
2. Faculty of Economics and Administration
University of Malaya
Lembah Pantai,
Kuala Lumpur.

Abstract

The purpose of this study is to investigate the performance of the Indian Banks in terms of its productivity and efficiency of the Indian Foreign Banks, Nationalised Banks and the Other Commercial Banks in India. In this study, the data envelopment analysis (DEA) approach is used to measure the productivity and efficiency of these banks from the year 2002 to 2006. A detailed sensitivity analysis is carried out to test the variable selection process followed by the test of robustness on the model. The empirical findings indicate a wide diversity of productivity and efficiencies exist among these types of Indian Banks. These banks had shown an efficiency improvement of approximately 5 to 9 percent improvement when compared with year 2002. This growth in improvement was mainly represented by the foreign banks performance however the Nationalized Banks showered a regression of 11 percent during the analysis period.

Keywords: Productivity and Technical Efficiency, DEA, Malmquist Indices, Sensitivity Analysis.

I. Introduction

India has a well developed banking system which can be broadly classified into nationalized banks / public sector banks, private banks and foreign banks. Currently, it has 88 Scheduled Commercial Banks (SCBs), 28 Public Sector Banks (banks with the Government of India holding a stake), 29 Private Banks (banks without government stake, which could either be publicly listed and traded on stock exchanges) and 31 foreign banks. These banks have a combined network of over 53,000 branches and 17,000 ATMs.

According ICRA Limited (Rating Agency), the public sector banks hold over 75 percent of total assets of the banking industry, with the private and foreign banks holding 18.2% and 6.5% respectively. However with the growth of Indian economy expected to be strong in future, the demand of banking services would escalate. As a consequence it would be worth while to observe the direction of these three banking groups (Foreign Banks, Nationalized and Other Scheduled Commercial Banks) is heading from their past results.

This paper is interested in observing the past performance of the Indian bank in terms of their productivity growth from year 2002 to 2006 utilizing the Data Envelopment Analysis (DEA) through the Malmquist Index. In depth emphasis through a detailed sensitivity will be made in the selection of the input-output variables in order to provide a better reflective of these banks performance. The robustness of the scores will also be tested on its reliability.

The rest of the paper is organized as follows. Section II describes the structure of Indian Banks. Section III reviews the existing literature on the productivity of Indian banks. Section IV explains the measurement process through Malmquist Productivity Index. Section V presents the data used, variable selection and the productive measures for the banks in this study. Section VI explains the empirical results and Section VII concludes.

II Indian Banks

Bank of Hindustan, set up during the1870, was the earliest Indian Bank followed by three presidency banks under Presidency Bank's act 1876 which were the Bank of Calcutta, Bank of Bombay and Bank of Madras. In 1921, all presidency banks were amalgamated to form the Imperial

Bank of India. Imperial bank carried out limited central banking functions also prior to establishment of RBI. It engaged in all types of commercial banking business except dealing in foreign exchange. Reserve Bank of India Act was passed in 1934 & Reserve Bank of India (RBI) was constituted as a central bank without major government ownership. Banking Regulations Act was passed in 1949 and it brought Reserve Bank of India under government control. Under the act, RBI got wide ranging powers for supervision and control of banks.

In 1955, RBI acquired control of the Imperial Bank of India, which was renamed as State Bank of India and in 1959; SBI took over control of eight private banks, making them as its 100% subsidiaries. RBI was empowered in 1960, to force compulsory merger of weak banks with the strong ones. The total number of banks was thus reduced from 566 in 1951 to 85 in 1969. In July 1969, government nationalised 14 banks having deposits of Rs.50 crores and above and in 1980, government acquired 6 more banks with deposits of more than Rs.200 crores. Nationalisation of banks through banking regulation was to make them play the role of catalytic agents for economic growth.

The Indian financial system has been regulated for most of its existence. The main regulatory features were interest rate regulation, credit restrictions, equity market controls and foreign exchange controls. Though some restrictions are still in operation, regulations, which are affecting banks, are being relaxed after implementing the Narasimhan Committee Report (1991).

However it is important to note that none of these deregulatory measures implemented were strong enough to diminish the important role played by the largely inefficient public sector banks. Even with some improvements within the sector, the overall inefficiency remained the same (Verma Report, 1999). One of the stumbling blocks towards full deregulation may be the public sector banks which are not open for full scale competition. The significant reason why the Indian public sector banks are able to survive even while making losses is the stringent regulations imposed on general economic activities of the country. As a result of deregulation private sector institutions are growing rapidly however, major commercial banks and specialized institutions still remain within the public sector.

Of the 298 commercial banks in India, the regional rural banks account for sixty-six percent. The public sector banks account for approximately eighty percent of the total assets of the banking and financial institutions sector, while the private sector banks and foreign banks each account for eight percent of the total assets. Table 2.1 shows the current state of the largest ten commercial banks in India in year 2002.

Table 2.1: Top Ten Largest Indian Commercial Banking 2002

Name of the bank	Total assets (S$ '000)	Equity (S$ '000)	Net income (S$ '000)	Net interest margin (%)	Return on average Assets (%)	Return on average Equity (%)	Cost to income ratio (%)
State Bank of India	104,726,109	4,917,108	910,810	3.088	0.913	19.966	48.482
Punjab National Bank	18,529,586	950,082	192,517	4.197	1.128	22.127	45.711
ICICI Bank Limited	23,014,337	1,478,294	242,178	1.599	1.065	17.099	51.995
Canara Bank	17,509,794	963,247	223,995	2.945	1.279	23.254	45.121
Bank of Baroda	16,478,330	949,337	176,708	2.965	1.072	18.614	48.802
Bank of India	16,114,988	744,643	178,969	2.895	1.162	26.653	44.819
Union Bank of India	10,738,273	539,817	116,233	3.322	1.158	23.65	43.845
Central Bank of India	12,009,498	509,770	64,252	3.738	0.557	13.822	62.308
UCO Bank	7,342,604	253,554	43,636	2.911	0.643	18.727	58.162
HDFC Bank Ltd	6,398,334	472,099	81,514	3.266	1.43	18.514	44.868

Notes: The figures are obtained from the Bank Scope database.

The banking sector witnessed accelerated growth during 2006-07. This growth was mainly contributed by the sharp increase in term deposits, however, the loans and advances and the operating profits of these banks as a percentage of total assets seems to be deteriorating (Table 2.2). This later resulted in the consolidation of the three old private sector banks, bringing down the total number of scheduled financial banks to 82 from 85 at end-March 2006.

Table 2.2: Financial Indicators of Indian Commercial Banks

Category	Indicator	2005-06	2006-07
Commercial Banks	**Growth in Major Aggregates (%)**		
	Aggregate Deposits	17.8	24.6
	Loans and Advances	31.8	30.6
	Investment in Government Securities	-1.2	9.3
	Financial Indicators (% of total asset)		
	Operating Profits	2.0	1.9
	Net Profits	0.9	0.9
	Spread	2.8	2.7
	Non-Performing Assets(% of advances)		
	Gross NPAs	3.1	2.4
	Net NPAs	1.2	1.0

With India moving towards an economic superpower by year 2020, it's relatively important to have a solid up trend growth in its banking system. So this paper intent to analyse the performance of the Indian banks from its past performance and observe if it do reflect an uptrend move through Malmquist Productivity Index.

III Literature Review

A few numbers of studies have assessed Indian banking performance using the data envelopment analysis (DEA) technique. Bhattacharyya *et al.* (1997) first examined the productive efficiency of Indian commercial banks during 1986-1991 and reported a marginal increase in overall average performance after 1987 and the average efficiency of publicly owned banks is much higher than in the privately owned or foreign owned banks.

Das (1997), looked at the overall efficiency, technical, allocative and scale of Indian banks for year 1990 to 1996. He found there was a decline in overall efficiency which was due to the drop in technical efficiency, both pure and scale. The study also pointed out that the deterioration in technical efficiency was mainly on accounted by the nationalized banks. In another study Das (1999) compared the performance among public sector banks for three years in the post-reform period, 1992, 1995 and 1998. Results showed a convergence in performance among these banks.

Sarkar *et. al.* (1998) then compared the performance across all three categories of banks, the public, private and foreign banks 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. Results showered the private banks were much superior to the other banks with respect to the profitability measures but not with respect to efficiency measures. The authors conclude that the results showed that private enterprises may not be unambiguously superior to public enterprises in a developing economy.

Later Sathya (2001), compared the productive efficiency of publicly owned, privately owned and foreign owned banks operational in India in the year 1997/1998 and reported that private sector commercial banks as a group is paradoxically lower than that of public sector and foreign banks. Meanwhile Shanmugam and Das (2004) on the other hand investigated the efficiency of Indian commercial banks during the reform period, 1992-1999 using a parametric methodology. Results showed that the state and foreign banks are more efficient than their counterparts namely, nationalized and privately owned domestic banks.

Having a mixed outcome of results, this study firstly plans to conduct a sensitivity study to select the most appropriate input-output variables that will be used in analysing the productivity growth of all the three groups of Indian banks for the period 2002 to 2006 through Malmquist Index.

IV. Concept and Measurement of Productivity Efficiency

The term 'productive' is referred as the level of performance of a production unit in terms of its utilization of input resources in generating outputs. Koopmans (1951) defined it in relation to efficiency as a feasible input/output vector where it is technologically impossible to increase any output without simultaneously reducing another output.

There are two basic approaches to the measurement of productivity change, firstly the econometric estimation of a production, cost or some other function, and secondly the construction of index numbers base measurement. In this paper the latter approach is adopted because it does not require the formation of a possibly unwarranted functional form, as required by the econometric approach.

Three different indices are frequently used to evaluate technological changes: the Fischer (1922), Tornqvist (1936), and Malmquist (1953) indexes. According to Grifell and Lovell (1996), the Malmquist index has three main advantages relative to the Fischer and Tornqvist indices. Firstly, it does not require the profit maximization, or the cost minimization, assumption. Secondly, it does not require information on the input and output prices. Finally, if the researcher has panel data, it allows the decomposition of productivity changes into two components (technical efficiency change or catching up, and technical change or changes in the best practice). Its main disadvantage is the necessity to compute the distance functions. However, the Data Envelopment Analysis (DEA) technique can be used to solve this problem.

In this section we present the Malmquist productivity index between period's t and $t+1$, (Rebelo and Mendes, 1998). Let x^t represent the input vector, $x^t = (x_1^t,....,x_m^t)$, and y^t represent the output vector $y^t = (y_1^t,\Lambda\ ,y_n^t)$, in time period $t = 1,2,.....,T$. The Malmquist productivity index between periods t and $t+1$ can be defined as[1]

$$M_{t,t+1}(y^{t+1},x^{t+1},y^t,x^t) = \left[\frac{D^t(y^t,x^t)}{D^t(y^{t+1},x^{t+1})} \times \frac{D^{t+1}(y^t,x^t)}{D^{t+1}(y^{t+1},x^{t+1})}\right]^{1/2} \qquad (1)$$

Where, D represents the inverse of the distance function introduced by Caves *et al.,* (1982). M is the geometric mean of two ratios of input inverse distance functions[2]. The first ratio represents the period t Malmquist index; it gives a measure of productivity change from period t to period (t+1) using period t technology as a benchmark. The second ratio is the period (t+1) Malmquist index and gives a measure of productivity change from period t to period (t+1) using period (t+1) technology as a benchmark. M>1 means that period (t+1) productivity is greater than period t productivity, whilst M<1 means productivity decline and M=1 corresponds to stagnation.

A useful feature of the Malmquist productivity index, first noted by Fare *et al.,* (1995), is that it can be decomposed into the product of an index of technical efficiency change and an index of technical change, by rearranging (1) as follows:

---

1 See, Fare, et al. (1994), Pastor (1995), Coelli (1996), and Grifell and Lovell (1996, 1997).

2 Since the two technologies can be non-neutrally related, or even non-nested, the Malmquist productivity index computes the geometric mean of the two ratios (Griffell and Lovell, 1996).

$$M_{t,t+1}(y^{t+1},x^{t+1},y^{t},x^{t}) = \frac{D^{t}(y^{t},x^{t})}{D^{t+1}(y^{t+1},x^{t+1})} \times \left[\frac{D^{t+1}(y_{t+1},x_{t+1})}{D^{t}(y^{t+1},x^{t+1})} \times \frac{D^{t+1}(y^{t},x^{t})}{D^{t}(y^{t},x^{t})} \right]^{1/2} \qquad (2)$$

In (2), the first component is the catching up effect; it is greater than, equal to, or less than one if the producer is moving closer to, unchanging, or diverging from the best practice. The square root expression represents technical change; it is greater than, equal to, or less than one when the best practice is improving, unchanged or deteriorating, respectively.

M and its two components are local indices. Their values can vary across banks and between different adjacent time periods. Thus, some banks may exhibit an increase and others may exhibit a decrease in technical efficiency, and this can change over time. Similarly, some banks may exhibit technical progress and others may exhibit technical slippage, and this can also change over time. This feature allows considerable flexibility in explaining the observed pattern of productivity change, both across banks and over time.

Calculation and decomposition of the adjacent period version of the Malmquist index expressed by (2) includes four different functions, $D^{t}(y^{t},x^{t}), D^{t}(y^{t+1},x^{t+1}), D^{t+1}(y^{t},x^{t}), D^{t+1}(y^{t+1},x^{t+1})$, which are the reciprocal of the technical efficiency indicators. The Data Envelopment Analysis technique is used to estimate frontier functions, upon which compute the radial measures of the efficient bank is computed. Seiford and Thrall (1990), Fare et al. (1994), and Fare and Grosskopf (1996), among others, offer a good literature review on this subject. With a sample of H firms producing n outputs using m inputs, and using period r frontier as a benchmark, the DEA optimization problem for bank *h* in period *s* is

$$\begin{aligned} &\text{Min} E^{h}_{rs} \quad h = 1,.....,H; r,s = 1,.....,T \\ &\text{s.t.} \quad \sum_{h=1}^{H} \mu_h y^{r}_{nh} \geq y^{s}_{nh} \quad n = 1,.....,n \text{ outputs} \\ &\quad -\sum_{h=1}^{H} \mu_h x^{r}_{mh} \leq E^{h}_{rs} x^{s}_{mh} \quad m = 1,.....,m \text{inputs} \\ &\quad \mu_h \geq 0 \end{aligned} \qquad (3)$$

Solving the problem for each firm we get E^{h}_{rs}, that is, Farrel's index of technical efficiency[3] for the constant returns to scale case. For the variable returns to scale case we need to include in (3) one additional restriction, $\sum \mu_h = 1$. In this paper it follows the procedure adopted by Pastor (1995), Grifell and Lovel (1996), and Price and Weyman-Jones (1996), and where the technical efficiency (TE) is decompose into scale efficiency (SE) and pure technical efficiency (PTE), with:

$$E_h = \frac{x_h^{CRS}}{x_h} = \frac{x_h^{VRS}}{x_h} \times \frac{x_h^{CRS}}{x_h^{VRS}} = PTE_h \times SE_h \qquad (4)$$

Where x is the observed input consumption, x^{CRS} is the optimal input consumption under constant returns to scale, and x^{VRS} is the optimal input consumption under variable returns to scale. If SE is equal to, or less than one, the firm is operating at the optimal and sub-optimal scale, respectively, and (1-SE) is the potential reduction in input quantities were the firm able to

[3] The E index provides a partial picture of the efficiency status of the firm. To obtain a broader standing of a firm's efficiency, we also need to have a measure of the overall productive efficiency (OPE) and allocative efficiency (AE), with OPE = E*AE. A bank is overall efficient if it is both technically and allocatively efficient

operate at the constant returns to scale frontier. Finally, the decomposition in (4) allows decomposing the sources of catching up, using:

$$CU(y^{t+1}, x^{t+1}, y^{t}, x^{t}) = \frac{E^{t+1,t+1}}{E^{t,t}} = \frac{PTE^{t+1,t+1}}{PTE^{t,t}} \times \frac{SE^{t+1,t+1}}{SE^{t,t}} \quad (5)$$

Where, the first and second components represent changes in technical efficiency as a result of changes in pure technical efficiency and scale efficiency, respectively.

V. Data and Variable Selection

The data set used in this study was obtained from Federal Reserve Bank of India data base. It consists of records of 28 foreign banks, 19 nationalized banks and 23 other scheduled commercial banks of India for the year 2002 until year 2006. All figures a represented in Indian Croroes.

In the process of the productivity score computation the selection of variables are extremely important. It's commonly acknowledged that the choice of variables in such studies significantly affects the results. (Favero and Pappi, 1995; Hunter and Timme, 1995). This is further amplified when unnecessary variables clutters the analysis and makes it even difficult to interpret. Due to the nature of DEA modeling, adding more variables not only inflates DEA efficiency scores. So the burden is on the study to tediously justify the selection process.

The variable selection for most DEA banking efficiency study relied mainly on the classical banking theory which depends on the approach selected. The common two approach discussed in most banking literature is the production approach and the intermediation approach. In the production approach, banking activities are described as the production of services to depositors and borrowers. While the intermediation approach, which is a complementary to the production approach, describes the banking activities as transforming the money borrowed from depositors into the money lent to borrowers (Berger and Mester, 1997).

During recent years, the issue of the sensitivity and stability of Data Envelopment Analysis results on the combination of variables has been extensively studied. The first DEA sensitivity analysis paper by Charnes *et. al.,* (1985), examined the change in a single output. This was followed by a series of sensitivity analysis articles by Charnes and Neralic (1990).

In this paper the input output combination utilised are base on Yue (2002), applying the intermediation approach where deposit and operating expenses are treated as inputs while loans and interest income will represent the outputs. Five different input-output models are derived from the combination of the variables as indicated in table 5.1 below.

Table 5.1: Model Selection

Model	Inputs			Outputs			
	Deposit	Operating Expenses	Wages	Investment	Loan	Interest Income	Interest expenses
1	√	√	√	√	√	√	√
2	√	√	√	√	√	√	
3	√	√		√	√	√	
4	√	√		√	√		
5	√	√		√			

In justification of the input-output variable selection, a sensitivity analysis is carried out with these five alternative input-output models. The initial model selection process was done through Spearman Rank Correlation approach and its robustness was further tested through the methodology introduced by Resti (1997). The results of the sensitivity of the model selection are as below:

Table 5.2: Correlations of Models

			Model 1	Model 2	Model 3	Model 4	Model 5
Spearman's rho	**Model 1**	Correlation Coefficient	1.000	.860(**)	.744(**)	.717(**)	.447(**)
		Sig. (2-tailed)	.	.000	.000	.000	.000
	Model 2	Correlation Coefficient	.860(**)	1.000	.924(**)	.901(**)	.430(**)
		Sig. (2-tailed)	.000	.	.000	.000	.000
	Model 3	Correlation Coefficient	.744(**)	.924(**)	1.000	.969(**)	.387(**)
		Sig. (2-tailed)	.000	.000	.	.000	.000
	Model 4	Correlation Coefficient	.717(**)	.901(**)	.969(**)	1.000	.360(**)
		Sig. (2-tailed)	.000	.000	.000	.	.000
	Model 5	Correlation Coefficient	.447(**)	.430(**)	.387(**)	.360(**)	1.000
		Sig. (2-tailed)	.000	.000	.000	.000	.

** Correlation is significant at the 0.01 level (2-tailed).

From the results above, it's found that the efficiency score for model 3rd's combination of inputs and outputs are highly correlated as compared to the other models as a combination. This indicates that the choice of deposit and operating expenses as inputs and investment, loan and interest income would best represent the efficiency scores of the sample set. This selection of model is further tested for its robustness based on the Resti's (1997) approach. This is done by initially solving the DEA problem (model 3) and all banks presenting an efficiency score equal to 1 was deleted and followed by solving again for DEA score. Next the correlation between these two set of scores are observed. The results obtained are as shown in Table 5.3 below.

Table 5.3: Robustness of Model 3

			Original Model	Second Model
Spearman's rho	**Original Model (Model 3)**	Correlation Coefficient	1.000	.972(**)
		Sig. (2-tailed)	.	.000
	Second Model	Correlation Coefficient	.972(**)	1.000
		Sig. (2-tailed)	.000	.

** Correlation is significant at the 0.01 level (2-tailed).

It's noticed that the score showed a significant (at 0.01 probability level) correlation between both models which indicates that the scores obtained in model 3 are relatively stable and acceptable. This do confirms the choice of input-output variables selected in the DEA analysis.

VI. Empirical Results

The descriptive statistics of the financial variables of the Indian banks in the study is as table 6.1 below (Figures are in Indian Crores);

Table 6.1: Average Descriptive Statistics of Indian Foreign Banks

Year	Bank Categories	Deposits	Operating expenses	Wages	Investments	Loans	Interest income	Other income	Interest expense
2002	Foreign Banks	2337	105	12682	1381	1773	299	100	167
2003		2725	123	17827	1429	2088	309	129	143
2004		3002	147	22392	1491	2633	317	129	139
2005		3982	198	40714	1835	3412	430	181	178
2006		5290	264	69764	2483	4455	633	234	266
2002	Normalized Bank	36215	972	445999	16963	18907	3493	696	2245
2003		41812	1075	566137	19941	21712	3610	901	2125
2004		48199	1220	751129	21077	27581	3877	742	2182
2005		55477	1299	925055	20181	35888	4379	584	2498
2006		69335	1394	1247337	22490	47117	5525	634	3364

2002	Other Commercial Banks	7941	224	57081	4237	5388	966	285	737
2003		10201	283	100911	5327	6583	1011	297	691
2004		12867	348	181330	5821	9060	1077	264	670
2005		17785	491	432652	7527	12959	1459	335	895
2006		23164	631	798247	8901	17284	2139	463	1382

From table 6.1 above, its notice that on average all the variables in this analysis utilised showed an upward trend in terms of its values. Normalized Banks are the leading banks with the highest figures through out the analysis period followed by the Other Commercial Banks and lastly the Foreign Commercial Banks.

Table 6.2: The Average Indian Commercial Banks Malmquist Index

Indian Banks	Malmquist Index	INPUT DISTANCE FUNCTION	
Years	Average Industry Index	Technical Change	Technological Change
2002-2203	**1.141**	**0.982**	**0.918**
2003-2004	**1.107**	**0.794**	**1.180**
2004-2005	**1.055**	**1.036**	**0.978**
2005-2006	**1.006**	**1.019**	**1.049**
INDUSTRY AVERAGE	**1.077**	**0.958**	**1.031**

Next, the Malmquist Indices indicates an improvement in all four years of study, with the highest improvement in year 2002-2003. However it does indicate a downward trend in its productivity. This increase in productivity over the sampling period is attributed to both the technical change and the technological change; however on average during the sample period, it showed an improvement of 3.1 percent

In brief the technical change represents the catching up in terms of productivity of the banking Industry while the technological indicates denotes the technological progress by utilizing the latest technology in increasing the organizational productivity. Results do indicate that there is a regress in terms of technical productivity among the Indian banks with an average of approximately of 4 percent during the sample period.

For a further detailed observation of the Malmquist indices, the results above is decompose according to the type of these banks over the analysis period. These results are presented as in the Table 6.3 below.

On average all three types of banks had shown an improvement in their productivity since year 2002 to 2006, with the foreign banks indicating the highest improvement of 11 percent followed by the other commercial banks. The nationalised banks showed the least amount of improvement of approximately only 2.2 percent.

Tracking these changes from year 2002, it's found that the foreign bank is on an upward trend while the other two types of banks showed a regression in terms of productivity when compared with the preceding year. The nationalised showed a huge reduction of 11 percent in terms its productivity performance in year 2006 when compared to year 2005. Similarly the other commercial banks too showed a reduction of approximate of 5.2 percent.

Table 6.3: The Average Malmquist Index: Bank Type

Types of Indian Banks	Malmquist Index	INPUT DISTANCE FUNCTION	
Foreign Banks	**Average Industry Index**	**Technical Change**	**Technological Change**
2002-2203	**1.190**	**0.960**	**0.925**
2003-2004	**1.083**	**0.815**	**1.199**
2004-2005	**1.063**	**0.988**	**1.087**
2005-2006	**1.128**	**0.901**	**1.105**
GEOMETRIC AVERAGE	**1.116**	**0.916**	**1.079**
Nationalised Banks			
2002-2203	**1.086**	**0.985**	**0.937**
2003-2004	**1.077**	**0.819**	**1.143**
2004-2005	**1.028**	**1.101**	**0.888**
2005-2006	**0.897**	**1.127**	**1.002**
GEOMETRIC AVERAGE	**1.022**	**1.008**	**0.993**
Other Commercial Banks			
2002-2203	**1.126**	**1.005**	**0.892**
2003-2004	**1.160**	**0.748**	**1.187**
2004-2005	**1.068**	**1.041**	**0.920**
2005-2006	**0.948**	**1.073**	**1.021**
GEOMETRIC AVERAGE	**1.075**	**0.967**	**1.005**

Next looking at the decomposition of the Malmquist Index, all three types indicate mix results. On average both foreign and other commercial banks notice to have a catch up of 8.4 and 3.3 percent respectively. However the average Indian nationalised banks do indicates a regress in technological change of 1 percent. Next a more in depth analysis of efficiency is made by further computing the scale and pure technical efficiency of each individual bank.

Table 6.4: VRS and CRS Efficiency Score of the Indian Banks

	2002			2003			2004			2005			2006		
Bank Type	**CRS**	**VRS**	**Scale**	**CRS**	**VRS**	**Scale**	**CRS**	**VRS**	**Scale**	**CRS**	**VRS**	**Scale**	**CRS**	**VRS**	**Scale**
Foreign Bank															
Min	0.20	0.56	0.20	0.29	0.55	0.36	0.24	0.41	0.27	0.13	0.46	0.15	0.08	0.38	0.08
Max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average Efficiency	0.79	0.91	0.87	0.73	0.89	0.82	0.60	0.86	0.70	0.57	0.88	0.66	0.50	0.84	0.62
No of Efficient Bank	7	13	7	6	11	6	4	15	4	5	15	5	3	15	3
% of Efficient Banks	25	46	25	21	39	21	14	53	14	17	53	17	10	53	10
Nationalised Bank															
Min	0.51	0.65	0.59	0.48	0.71	0.57	0.40	0.85	0.46	0.44	0.83	0.51	0.48	0.76	0.56
Max	0.78	1.00	0.82	0.70	1.00	0.80	0.62	1.00	0.62	0.61	1.00	0.61	0.78	1.00	0.78
Average Efficiency	0.61	0.85	0.72	0.60	0.90	0.67	0.49	0.96	0.51	0.53	0.94	0.57	0.60	0.90	0.67
No of Efficient Bank	0	1	0	0	5	0	0	9	0	0	5	0	0	3	0
% of Efficient Banks	-	5	-	-	26	-	-	47	-	-	26	-	-	15	-
Other Commercial Bank															
Min	0.53	0.54	0.63	0.55	0.63	0.65	0.32	0.48	0.42	0.27	0.44	0.38	0.24	0.41	0.39
Max	1.00	1.00	1.00	1.00	1.00	1.00	0.66	1.00	0.93	0.83	1.00	0.98	0.80	1.00	0.97
Average Efficiency	0.65	0.75	0.90	0.66	0.81	0.81	0.49	0.85	0.58	0.51	0.78	0.67	0.54	0.78	0.70
No of Efficient Bank	1	4	1	1	5	1	0	6	0	0	7	0	0	4	0
% of Efficient Banks	4	17	4	4	21	4	-	26	-	-	30	-	-	17	-

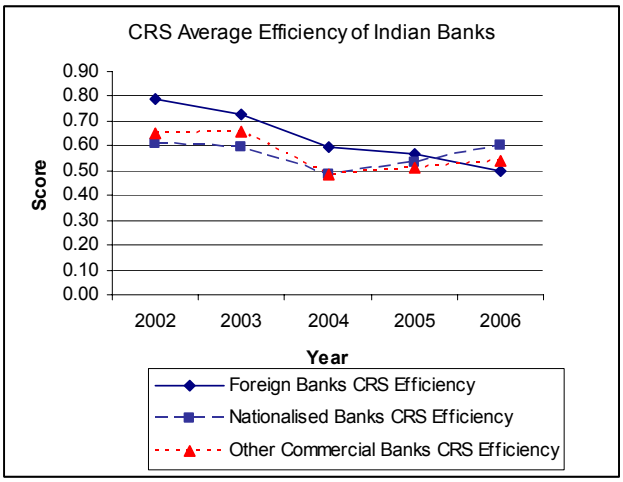
From table 6.4 above, Foreign Banks seems to dominate the frontier with the highest number of efficient banks followed by the Other Commercial Banks throughout the analysis period. During 2004 until 2006 there had been 15 Foreign Banks had form the frontier as compared with the other two types of Indian Banks. Refer to Appendix II for a detailed list. Among the Indian Banks studied, Foreign Banks also had the highest number of banks that were efficient in all measurement of efficiency, technical and pure technical efficiency as listed below.

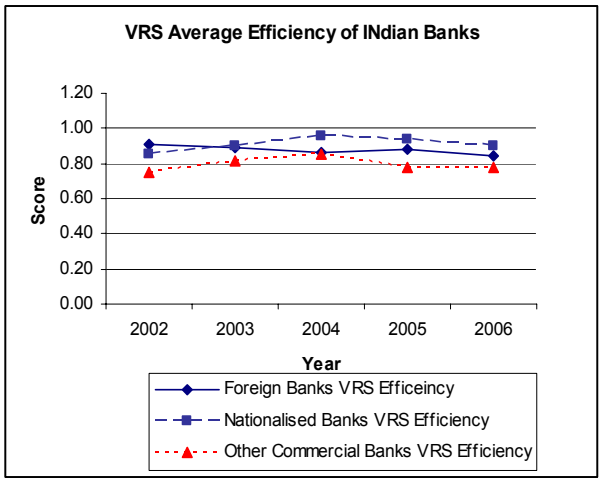
Table 6.5:
Technical and Pure Technical Efficient Indian Banks

Year	Type of bank	Technical and Pure Technical Efficient Banks
2002	Foreign Banks	Abu Dhabi Commercial Bank, Bank of America, Barclay Bank, DBS Bank, JP Morgan Chase Bank
	Other Commercial Banks	ICICI Bank
2003	Foreign Banks	Abtwerp Diamond Bank, Abu Dhabi Commercial Bank, Barclay Bank, Mashreq Bank, Mizuho Corporate Bank, State Bank of Mauritius
	Other Commercial Banks	ICICI Bank
2004	Foreign Banks	Abtwerp Diamond Bank, Barclay Bank, Mashreq Bank, State Bank of Mauritius
2005	Foreign Banks	Abtwerp Diamond Bank, JP Morgan Chase Bank, Mashreq Bank, State Bank of Mauritius
2006	Foreign Banks	Abtwerp Diamond Bank, Bank of Nova Scotia, JP Morgan Chase Bank

As for the constant return to scale efficiency (CRS) scores, it's found that all the banks are on a downward trend with Foreign Banks being the having the largest reduction 29 percent when compared with year 2002. The other two types of banks do indicate similar results however they seems to be improving when compared with year 2004 figures (refer to Figure 6.1 below).

Figure 6.1: CRS and VRS Average Efficiency of Indian Banks





Similar results were also present in the variable return to scale (VRS) efficiency score of the Foreign Banks. However, as for the Nationalised and other Commercial Banks do show some improvement in year 2006 when compared with year 2002 scores suggesting that some of its banks could be extremely efficient in allocating its resources (refer to Figure 6.1 below). Findings also indicates that the overall the average technical efficiency of these Indian Banks were around 78 percent (Other Commercial Banks) and 90 percent (Nationalised Banks) for year 2006 suggesting an inefficiency range of 10 to 22 percent. This nature of technical inefficiencies can be due to the ineffective implementation of the production plan in converting inputs to outputs (pure technical inefficiency) and due to the divergence of the DMU from the most productive scale size (scale inefficiency).

Further, decomposing technical efficiency (TE) into pure technical efficiency (PTE) and scale efficiency (SE) allows an insight into the source of inefficiencies. It's found that the scale efficiency of all these banks range from 62 percent (Foreign Banks) to a high of 70 percent (Other Commercial Banks). This suggests that in general there exists approximately 30 to 38 percent of inefficiency. This is because inappropriate size of a bank (too large or too small) may sometimes be a cause for technical inefficiency. This is referred to as scale inefficiency and takes two forms, decreasing returns to scale and increasing returns to scale. Decreasing returns to scale (also known as diseconomies of scale) implies that a bank is too large for the volume of activities that it conducts. Unit costs increase as outputs increases. In contrast, a bank with increasing returns to scale (economies of scale) is too small for its scale of operation. Unit costs decrease as outputs increase while a bank that is scale-efficient is said to operate under constant returns to scale.

Table 4.5 indicates how the average technical efficiency is decomposed into pure technical efficiency and scale efficiency of banks based on its country of operation (refer to appendix 1 for the complete list). Mathematically TE equals PTE multiplied by SE. Technical inefficiency refers to the extent to which a bank fails to produce maximum output from its chosen combination of factor inputs, while the scale inefficiency refers to sub-optimal bank size.

This size difference among the banks is relatively wide, from table 6.1 above it seems that the Nationalized seems to have the largest capabilities in terms of size and recourses. However in terms of efficiency achievement these banks do not outperform its peers. These finding do comprehend Shanmugam and Das (2004), finding that the foreign banks are more efficient than their counterparts namely, nationalized and privately owned domestic banks in utilizing its limited recourses.

V. Conclusion

An input-oriented DEA model was used for estimating the productivity of the Indian Banks from year 2002 to 2006. The variables used in this study are deposit and operating expenses as inputs while investments, loans and interest income as outputs. This selection of variables was done through a sensitivity analysis followed by the testing of the robustness of the model. A comprehensive analysis of efficiency among the Indian Banks found that on average of there is an improvement of 5 to 29 percent in the VRS scores among these banks when compared to years 2002 results.

Next, looking at the Malmquist indices performance for the industry average, it also indicates some small improvement which is basically attributed to the technological change which was approximately around 3.1 percent. As for the detailed productivity performance of these banks foreign banks showered vast improvement while the Nationalised Banks saw a 11 percent regression in terms of its productivity performance in year 2006 when compared to year 2005. The Other Commercial Banks also indicated a reduction of approximate of 5.2 percent when compared with its past performance.

This findings signal that banking efficiency and productivity of the Indian Banks are critically important in ensuring in the preparation for a global economic force. Performance of the Indian Banking Industry has to be constantly compared with their counterparts in its own and other countries to help bankers make better decisions regarding the direction of their banking industry.

References

Berger, A. N. and Mester, L. J. (1997) Beyond the black box: what explains differences in the efficiencies of financial institutions?, Journal of Bank and Finance, 21, 87–98.

Bhattacharya, A., Lovell, C. A. K. and Sahay, P. (1997) The impact of liberalization on the productive efficiency of Indian commercial banks, European Journal of Operational Research, 98, 332–45

Caves, D. W., L. R. Christensen and W. Diewert (1982). The Economic Theory of Index Numbers and the Measurement of Input. Output and Productivity. Econometrica 50, 1393-1414.

Das, Abhiman (1997). Technical, Allocative and Scale Efficiency of Public Sector Banks in India, RBI Occasional Papers, 18, June-September.

Das, Abhiman (1999) Profitability of Public sector Banks: A Decomposition Model; RBI Occasional Papers, 20, 1.

Fare, R. and S. Grosskopf (1996). Intertemporal Production Frontiers: With Dynamic DEA. Kluwer Academic Publishers. Boston.

Fare, R., S. Grosskopf and C. A. K. Lovell (1994). Production Frontiers. Cambridge University Press. Cambridge.

Fare, R., S. Grosskopf, B. Lindgren and P. Roos (1995). Productivity Developments in Swedish Hospitals: A Malmquist Output Index Approach, In: A. Charnes, W.W. Cooper, A. Y.

Fisher, I. (1922). The Making of Index Numbers. Boston: Hougton-Miflin.

Grifell-Tatie, E. and C. A. K. Lovell (1996). "Deregulation and Productivity Decline: The Case of Spanish Saving Banks". European Economic Review 40, 1281-1303.

Koopmans, T.C. (1951). An analysis of production as an efficient combination of activities, in T.C. Koopmans (ed.), Activity Analysis of Production and Allocation, Cowles Commissionfor Research in Economics Monograph 13, Wiley: New York.

Malmquist, S. (1953). Index Numbers and Indifference Curves. Trabajos de Estatistica 4(1). 209-242.

Narasimhan Committee Report. (1991). Report of the committee on the financial sector reforms, Government of India.

Pastor, J. M. (1995). Eficiencia. Cambio Productivity Cambio Técnico en los Bancos y Cajas de Ahorro Espanolas: Uma Análys Fronteira no Paramétrico. Working Paper-EC 95-09. Instituto Valenciano de Investigaciones Economicas.

Price, C. W. and T. Weyman-Jones (1996). Malmquist Indices of Productivity Change in the UK Gas Industry Before and After Privatization. Applied Economics 28, 29-39.

Rebelo, J. and V. Mendes (1998). Produtividade. Eficiência e Alterações Tecnológicas no Sector Bancário Português: Uma Análise Não Paramétrica. Mimeo. UTAD/FEP. Vila Real. 20 pp.

Resti, A. (1997). Evaluating the cost-efficiency of the Italian banking system: what can be learned from the joint application of parametric and non-parametric techniques, Journal of Banking and Finance, 2, 221-250.

Sathya, M. (2001). Efficiency of banks in a developing economy: the case of India. In Proceedings of Examining ten years of economic reforms in India, ANU, Canberra, Australia

Sarkar, Jayati, Sarkar, Subrata and Bhaumik, Suman K. (1998) Does ownership always matter? Evidence from the Indian banking industry', Journal of Comparative Economics 26: 262-81.

Shanmugam, K.R. and Das, A. (2004). Efficiency of Indian commercial banks during the reform period, Applied Financial Economics, 14, 681-686.

Seiford. L. M. and R. M. Thrall (1990). Recent Developments in DEA: The Mathematical Programming Approach to Frontier Analysis. Journal of Econometrics 46, 7-38.

Tornqvist, L. (1936). The Bank of Finland´s Consumption Price Index. Bank of Finland Monthly Bulletin 10, 1-8.

Verma Report. (1999). Report of the working group on restructuring weak public sector banks, Reserve Bank of India.

Yue, P. (2002), Data envelopment analysis and commercial bank performance: a primer with applications to Missouri banks, Federal Reserve Bank of St Louis, pp.31-45.

FEA Working FEA Working

2007-1 Chris Fook Sheng NG, Lucy Chai See LUM, NOOR AZINA Ismail, Lian Huat TAN and Christina Phoay Lay TAN, “Clinicians’ Diagnostic Practice of Dengue Infections”, January 2007.

2007-2 Chris Fook Sheng NG and NOOR AZINA Ismail, “Analysis of Factors Affecting Malaysian Students’ Achievement in Mathematics Using TIMSS”, January 2007.

2007-3 Mario Arturo RUIZ ESTRADA, “Econographicology”, January 2007.

2007-4 Chris Fook Sheng NG and NOOR AZINA Ismail, “Adoption of Technology in Malaysian Educational System”, January 2007.

2007-5 Mario Arturo RUIZ ESTRADA, “New Optical Visualization of Demand & Supply Curves: A Multi-Dimensional Perspective”, January 2007.

2007-6 Mario Arturo RUIZ ESTRADA and Park Donghyun, “Korean Unification: A Multidimensional Analysis”, January 2007.

2007-7 Evelyn DEVADASON and CHAN Wai Meng, “Globalization of the Malaysian Manufacturing Sector: An Agenda for Social Protection Enhancement”, January 2007.

2007-8 CHAN Wai Meng and Evelyn DEVADASON, “Social Security in a Globalizing World: The Malaysian Case”, January 2007.

2007-9 NIK ROSNAH Wan Abdullah, “Eradicating Corruption in Malaysia: ‘Small Fish’ and ‘Big Fish’”, March 2007.

2007-10 Evelyn DEVADASON, “Producer-Driven versus Buyer-Driven Network Trade in Manufactures: Evidence from Malaysia”, April 2007.

2007-11 ABDILLAH Noh, “Institutions and Change: The Case of Malaysia’s New Economic Policy”, April 2007.

2007-12 TAN Tok Shiong, “Effects of Foreign Workers On the Employment Opportunities For Local Citizens”, June 2007.

2007-13 FATIMAH Said and AZLINA Azmi, “Kepentingan Industri Telekomunikasi dalam Ekonomi Malaysia”, July 2007.

2007-14 Su Fei YAP and Mario Arturo RUIZ ESTRADA, “An Alternative Visualization of Business Cycles in Chaos”, August 2007.

2007-15 ABDILLAH Noh, “Remaking Public Participation in Singapore: The Form and Substance”, August 2007.

2007-16 Mario Arturo RUIZ ESTRADA, Su Fei YAP and Shyamala NAGARAJ, “Beyond the *Ceteris Paribus* Assumption: Modeling Demand and Supply Assuming *Omnia Mobilis*”, August 2007.

2007-17 Evelyn DEVADASON and CHAN Wai Meng, “Inflow of Foreign Labour into Malaysia: Conceptualizing Economic and Legal Issues”, September 2007.

2008-1 Mario Arturo RUIZ ESTRADA, “The Gross Domestic Product Surface (GDP-Surface)”, January 2008.

2008-2 Evelyn DEVADASON, “Emerging Trade Patterns of Malaysia with China, US and Japan: A Comparative Analysis”, January 2008.

2008-3 Shyamala NAGARAJ (with Lee Kiong-Hock, Tey Nai-Peng, Ng Chiu-Wan, Jean Pala), “Counting and Integration: The Experience of Malaysia”, January 2008.

2008-4 Mario Arturo RUIZ ESTRADA, “Is the Market in a Dynamic Imbalanced State?”, January 2008.

2008-5 THIRUNAUKARASU Subramaniam, Evelyn DEVADASON, SIVACHANDRALINGAM Sundararaja, “Cross-border Shopping Behaviour of Bruneians in Limbang, Sarawak: A Preliminary Analysis”, January 2008.

2008-6 Mario Arturo RUIZ ESTRADA and PARK Donghyun, “A New Multi-Dimensional Framework for Analyzing Regional Integration: Regional Integration Evaluation (RIE) Methodology”, January 2008.

2008-7 Mario Arturo RUIZ ESTRADA, “The Multi-Dimensional (MD) Physical Spaces: An Alternative Graphical Modeling Approach for Economics”, February 2008.

2008-8 Shyamala Nagaraj, Susila Munisamy, Noor Ismawati Mohd Jaafar, Diana Abdul Wahab and Tala Mirzaei, “How Do Undergraduates Choose Their University? A Study of First Year University of Malaya Students”, March 2008.

2008-9 Shyamala Nagaraj, Tey Nai Peng, Ng Chiu Wan and Balambigai Balakrishnan, “Gender and Ethnic Dimensions of Changes in the Leading Causes of Death in Malaysia, 1970-2004”, April 2008.

2008-10 Evelyn DEVADASON, “Product Quality Changes and Skills’ Demand: An Empirical Study of Malaysia’s Trade in Manufactures”, April 2008.

2008-11 Susila Munisamy and Lee Kee Huat, “An AHP-based Mutual Fund Portfolio Selection Model”, April 2008.

2008-12 Susila Munisamy and Gurcharan Singh Pritam Singh, “A Cross Country Comparison of Banking Efficiency: Asia Pacific Banks”, April 2008.

2008-13 Gurcharan Singh Pritam Singh and Susila Munisamy, “Would Its Past Reflect Its Future Performance: Indian Banks?”, April 2008.

FEA Working Paper Series

Objective and Scope:

The Faculty of Economics and Administration (FEA) Working Paper Series is published to encourage the dissemination and facilitate discussion of research findings related to economics, development, public policies, administration and statistics. Both empirical and theoretical studies will be considered. The FEA Working Paper Series serves mainly as an outlet for research on Malaysia and other ASEAN countries. However, works on other regions that bear important implications or policy lessons for countries in this region are also acceptable.

Information to Paper Contributors:

1) Two copies of the manuscript should be submitted to:
   Chairperson
   Publications Committee
   Faculty of Economics and Administration
   University of Malaya
   50603 Kuala Lumpur
   MALAYSIA

2) The manuscript must be typed in double spacing throughout on one side of the paper only, and should preferably not exceed 30 pages of A4 size paper, including tables, diagrams, footnotes and references.

3) The first page of the manuscript should contain
   (i) the title,
   (ii) the name(s) and institutional affiliation(s) of the author(s), and
   (iii) the postal and email address of the corresponding author.
   This cover page will be part of the working paper document.

4) The electronic file of the manuscript must be submitted. The file can be a Word, Word Perfect, pdf or post-script document. This will be posted at the Faculty's website (http://www.fep.um.edu.my/) for public access.

5) Contents of the manuscript shall be the sole responsibility of the authors and publication does not imply the concurrence of the FEA or any of its agents. Manuscripts must be carefully edited for language by the authors. Manuscripts are vetted and edited, if necessary, but not refereed. The author is, in fact, encouraged to submit a concise version for publication in academic journals.

6) When published, the copyright of the manuscript remains with the authors. Submission of the manuscript will be taken to imply permission accorded by the authors for FEA to publicize and distribute the manuscript as a FEA Working Paper, in its hardcopy as well as electronic form.