International Journal of Applied Engineering Research ISSN 0973-4562 Volume 10, Number 18 (2015) pp 39157-39162

Cost Efficiency of Foreign Banks in India with Information Technology (IT) Investments- A Stochastic Frontier Approach (SFA)

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Abstract

This research paper is an attempt to identify the Cost efficiency of foreign banks operating in India by employing Stochastic Frontier Approach (SFA). This paper empirically evaluated the impact in cost efficiency of the foreign banks operating in India by the investment in Information Technology (IT). The present study is based on panel data over the period of 2008-2012. For this paper, all the 27 foreign banks in India are being considered. This paper identifies the average cost efficiency of foreign banks operating in India found to be 64.6 percent over the entire period of study. The findings of this paper suggest that to some extent IT impact the cost efficiency of foreign banks operating in India. The difference in cost inefficiency between the banks (Best and Worst) is significantly increased by 11.5 % in the period 2008-2012 by Information technology. Thus, some of foreign banks cost efficiency reduced by 11.5 % for the period 2008-2012. The information technologies contribute to cost inefficiency. This is due to the higher cost for IT expenditure and realized benefit is comparatively smaller

Keywords: Information Technology (IT), Foreign banks in India, Cost efficiency, Stochastic Frontier Approach (SFA), cost efficiency.

1. INTRODUCTION

Banking system is the backbone of any economy. The growth of various banking technologies changed the nature and functioning of commercial banks all over the world. Banking technology is defined as the information and communication technologies used by banks to provide various services to its customers in a secure and reliable way in an electronic platform. In India, the IT has brought uprising in the functioning of the banks. The level and utilization of IT depends upon the investment in technology.

Banks in India have been investing and continued to invest enormous amount of funds on computer and related technologies expecting substantial payoff. In the present day rigorous banking environment, a cost benefit analysis of the investments in IT is bound to be a difficult exercise. It has been a question whether investments in IT provides efficiency in banking performance. Many scholars failed to identify the relationship between higher IT Investment by banks and their efficiency. So they coined the term "IT Productivity Paradox". Frontier efficiency is a methodology to explore in to the performance of the banks. If a bank capable of producing a same level output with minimizing the inputs, achieve the cost advantage. It is known as cost efficiency. **Cost efficiency (CE) is** a measurement indicates how efficiently a bank can reduce its cost. Sometimes, IT provides cost efficiency to the banks because it reduces the operating expenses. But this impact will be realized after long run.

The frontier efficiency Studies of banks divided in to parametric approach (PA) and non-parametric approach (NPA). The, the Stochastic Frontier Approach (SFA) was often used in parametric approaches. **Berger (2003)** identified out 60 studies in parametric approaches, 24 studies used Stochastic Frontier Approach (SFA). This research paper is an attempt to identify the Cost efficiency of foreign banks operating in India by employing Stochastic Frontier Approach (SFA). This paper empirically evaluated the impact in cost efficiency of the foreign banks operating in India by the investment in Information Technology (IT). The present study is based on panel data over the period of 2008-2012. For this paper, all the 27 foreign banks in India are being considered.

1.1 OBJECTIVES OF THE STUDY

This paper consists of the below objectives:

1. To identify the variables influencing cost efficiency (CE) of foreign banks operating in India.
2. To measure the cost efficiency (CE) of foreign banks operating in India.
3. To compare the cost efficiency of banks in bank-wise and year-wise.

1.2 HYPOTHESIS

H_{01}: Among the foreign banks operating in India, there is no significant difference in the
H_{01a}: bank-wise cost efficiency
H_{01b}: year-wise cost efficiency

2. LITERATURE REVIEW

Rai et al. (1997) identified that IT investments influence the business performance positively.**Lee and Menon (2000)** found that higher investment in IT contribute higher efficiency. They employed non parametric approach to analyze the performance of hospitals. **Shao and Lin (2001)** identified IT had impact on efficiency. The authors explored in to performance of the firms by IT investments. They considered 370 firms for their study and concluded that there is a influence of IT towards the various performance of the firms. **Simon H. Kwan (2001)** identified cost efficiency of banks. He used the SFA and found that the efficiency of banks was in between 16 percent to 30 percent. **Namchul Shin (2006)** identified the importance of business value of IT in relation to strategic firm performance to reduce the cost of coordinating business resources across multiple markets. **William et al. (1991)** examined technological changes and its impact on output for U.S. commercia1 banks. They suggested that technological change can lower the real costs by 1% per year. **Costas Lapavitsas and Paulo L. Dos Santos (2008)** identified the money transaction cost reduced due to investment in IT.**Shirley J. Ho and Sushanta K. Mallick (2008)** examined that IT can improve efficiency of banks in two ways. The two ways are known as cost effect and network effect.

Baker and Berenblum (1996), identified IT is one of the important factor decides the success or failure of organizations. **Morrison and Berndt (1990)** identified marginal IT investments provided negative impact to efficiency. They also found that compared to cost, the benefit is lesser and thus provided negative contribution to efficiency. **Kaparakis et.al (1994)** found that, there is a significant (strong negative) correlation between cost efficiency and size of the banks. They also found significant (strong positive) correlation between cost efficiency (CE) and the ratio between total capital to total asset. **Meeusen and vanden Broeck (1977)** and **Aigner et. al. (1977)** provided the fundamental model of stochastic frontier approach. They applied SFA in many studies related to cost efficiency in the banks.

Jeffrey et. al. (2002) recommended for including off-balance-sheet (OBS) items in the cost efficiency measurement.

Surulivel.S.T and Charumathi.B (2013) identified the Information Technology increased cost inefficiency to both Nationalised banks and SBI & its associate banks old and new public sector banks. **Altinkemer, Kemal, Ozdemir, Zafer (2006)** investigate the reengineering of companies by Information Technology (IT) in their business processes improved their productivity.

Claudia Girardone et al(2004) explored in to the cost efficiency(CE) of banks in Italy. They used a Fourier-flexible (FF) model of stochastic cost function to estimate the cost efficiency. They found cost inefficiency decreased over the study period.

Laurent Weill (2009) employed three efficiency approaches SFA, DFA and DEA. The authors measured the cost efficiency of banks and found some similarities exist between the approaches. **Sealey and Lindley (1977**) introduced variables (Input and Output) for intermediation approach. The output variables are Y1 = loans, Y2 = investment. The inputs are P1=prices of labor, P2=physical capital and P3=borrowed funds.

Lapavitsas, Costas and Dos Santos, Paulo L (2008) argued that technological innovation changed the functions of banking operations. But the changes may be positive side or negative side of the performance of the banks. Some times the cost efficiency (CE) of banks has not improved because of high investment costs.

Yao Chen and Joe Zhu (2004) recognized that the connection between information technology and firm performance is indirect.it is due to the effect of inter-mediating and inter-moderating variable. The IT investments (IT) can mobilize deposits from customers. By using these deposits as investments, then the profits are generated. **Barbara Casu & Claudia Girardone, (2005)** identified the impact of the OBS in the productivity. The impact of OBS is higher in technological change, not in the efficiency. **Altunbas et al. (2000)** identified proxy variables to measure the P1=price of labor, P2=price of physical capital and P3=price of borrowed funds.

3. RESEARCH METHODOLOGY

This study is an empirical study to identify the Information Technology (IT) impact to cost efficiency of foreign banks in India. Cost efficiency is measured using the translog cost function and employed stochastic cost frontier approach. A panel data were used and the sample includes 27 foreign banks in India.

Cost inefficiency was estimated by using Frontier 4.1. To estimate the cost function the Maximum Likelihood (ML) estimator is used. The likely-hood ratio test (LR test) is used to identify the suitability of a cost function.

For measuring the cost efficiency of banks, the below relationship has to be assumed.

$$\ln C_{it} = f(y_{it}, w_{it}; \beta) + e_{it} \quad (1)$$

Where,

C_{it} = Cost of bank (i),

y_{it}, = Output in natural logarithm

W_{it}=***prices of*** *input* in natural logarithm of

β =the unknown parameter.
e*it* is a one-sided error.

The error is used to measure effects of inefficiency. The general assumption is, e*it* is half normally distributed.

Translog cost function is used for efficiency estimation in many studies. The translog cost function was first introduced by Cristensen et al. (1971). Hence, this study used translog cost function in the place of standard production model.

For the definition of variables (input and output), this study used intermediation approach considering three inputs (**labour, deposits and physical capital**) and two outputs (**loans and Investments**).

This study used three basic inputs for the banking sector.

The input prices are defined as

P_1= Input Price of labour (Salaries and employee benefits/ the total number of the employees)

P_2 = Input Price of deposit (Total interest expenses of deposits/ saving deposits+ other deposits) and

P_3 = Input Price of Physical capital (Physical capital expenses/Physical capital)

The outputs used include loans & advances and investment. Where Y_1 = Loans and Advances; Y_2 = Investment.

The stochastic translog cost model is expressed as follows:

$$C = \beta_0 + \sum_{n=1}^{N}\beta_{yn}y_n + \sum_{m=1}^{M}\beta_{pm}p_m + \frac{1}{2}\left(\sum_{n=1}^{N}\sum_{l=1}^{N}\beta_{yn\,yl}y_n y_l + \sum_{m=1}^{M}\sum_{k=1}^{M}\beta_{pmpk}p_m p_k\right) + \sum_{n=1}^{N}\sum_{m=1}^{M}\beta_{ynpm}y_n p_m + V_{it} + U_{it} \quad (2)$$

Where

y_n = Outputs(N) in logs

$p_{m=}$ Prices of the inputs(M) in logs.

Standard symmetry and linear homogeneity conditions are imposed. For simplicity notations 'i'(for bank) and 't' (for time) have been omitted in the model.

U_{it} is the cost inefficiency measure. It indicates how the costs of a bank (i) at time 't' are to the banks on the frontier of cost efficient.

V_{it} stands for the usual error term.

The variables for analyzing the If

U_{it} = zero,

Ci*(Frontier Cost Function) = f (yi, xi, β) and () of bank

CE (Cost efficiency) = $CE = C_i / C_i^* = f(y_i, x_i, \beta) \exp(U_{it}) / f(y_i, x_i, \beta)$

$$\mathbf{CE = \exp(U_{it})} \quad (3)$$

Cost inefficiency estimation from OLS, is then regressed with Information Technology (IT) investment by maximum likelihood model (Technical efficiency) is as:

$$\mathbf{U_{it} = \Delta_0 + \Delta_1 Z_{it} + e_{it}} \quad (4)$$

Here Δ_0 = Intercept;

Δ_1 = maximum likelihood regression Coefficient;

Z_{it} = IT investment by the bank i and the year t; and

e_{it} is a error term.

TABLE – 1 Input and Output Variables

Notation of Variable	Name of the Variable	Definition
C	Total costs	Interest and operating expenses
Π	Pretax Profit	Income before tax
OUTPUT VARIABLES		
Y_1	Loans and Advances	Loan
Y_2	Investments	Investments
PRICES OF INPUT OF VARIABLES		
P_1	Input Price of labour	Salaries and employee benefits/ Total number of the employees
P_2	Input Price of deposit	Total interest expenses of deposits/ saving deposits+ other deposits
P_3	Input Price of Physical capital	Physical capital expenses/Physical capital
REGRESSION VARIABLE(ML estimation)		
Z	Information Technology Investment	Various Expenses involved in IT

Note: Variables identified and grouped by the researchers.

Frontier efficiency is a methodology to explore in to the performance of the banks. If a bank capable of producing a same level output with minimizing the inputs, achieve the cost advantage. It is known as cost efficiency (CE). **Cost efficiency (CE)** is a measurement indicates how efficiently a bank can reduce its cost. Sometimes, IT provides cost efficiency to the banks because it reduces the operating expenses. But this impact will be realized after long run.

3.1 Cost Efficiency of Foreign Banks

Table 2, Provides SFA -Cost Translog Estimates for Foreign bank. For Foreign bank, 27 banks are considered. The negative sign in the significant coefficients indicates that, the respective variables try to reduce the cost inefficiency. So the respective variables increase the cost efficiency (CE) of foreign banks operating in India.

3.2 The Input and Output variables which increased the cost efficiency of Foreign bank are:

Joint significance of Loan and advances and Labour [-15.003(-3.551)* significant at 1 %] indicate, Foreign banks are increasing their Loan and advances and increase the labour efficiency to attain the cost efficiency for the period 2008-2012. The Business per Employees is increased from Rs 914.19 lakhs to Rs 1384.78 lakhs for the period 2008-2012. For foreign Banks, Business per Employees improved by 51.47 % for the period 2008-2012.

Joint significance of Investments and Physical capital [-10.187 (-2.077) ** significant at 5 %] indicate Foreign banks are increasing their Investments and reducing the rent expenses to attain the cost efficiency for the period 2008-2012.

3.3 The Input and Output variables which reduced the cost efficiency of foreign banks in India are:

Labour [27.906(2.933)* significant at 1 %] indicate the labour expenses are increased significantly which leads to cost inefficiency in Foreign banks for the period 2008-2012. This is due to the number of Employees improved by 9.57 % for the period 2008-2012.

The log –likelihood function (Full stochastic model: Inefficiency is assumed to be half-normal) is calculated to be -48.015 and the value for OLS function is -60.77.

LR test statistics for testing the absence of the technical inefficiency effect from the frontier is calculated to be 25.503. This value is significantly higher than the critical value 2.706 at 5% level of significance (Kodde and Palm (1986) for df equal to 1).

The null hypothesis (H_{01a}) is rejected. Thus, ***there is a significant difference among Foreign banks in their cost inefficiency.***

The sigma-square is 0.119 and significant.It indicates the correctness of the specified assumptions related to the error term.

The delta value represents the variation in cost efficiency decreased over the study period. The difference in cost inefficiency between the banks (Best and worst in practice) is significantly increased by 11.5 % for the period 2008-2012 by Information technology.

Thus, some of foreign banks cost efficiency reduced by 11.5 % for the period 2008-2012. The information technologies contribute to cost inefficiency.

Table 3, provides cost inefficiency estimate of foreign banks. For Foreign banks, 27 banks are considered. The results showed that the foreign banks are 35.4% Cost inefficient. i.e. 64.6 % Cost efficient. The A B Bank Ltd. is the most Cost efficient and Citibank N A. is the least. The average inefficiency score for A B Bank Ltd. is 1.121, implying that its inefficiency is 12.1 % higher than it should be. The average inefficiency score for Citibank N A. is 2.236, implying that its inefficiency is 123.6 %.

TABLE 2 SFA -COST TRANSLOG ESTIMATES -FOREIGN BANK

VARIABLES	VARIABLES	OLS		CORRECTED OLS COEFFICIENT	ML	
		COEFFICIENT	t VALUE		COEFFICIENT	t VALUE
beta0	Intercept	0	-0.004	-0.222	-0.149	-1.299
beta1	Y1	-2.719	-0.215	-2.719	-5.432	-1.068
beta2	Y2	-4.366	-0.326	-4.366	-6.787	-0.856
beta3	P1	21.243	1.692	21.243	**27.906**	**2.933***
beta4	P2	19.503	1.606	19.503	11.689	1.488
beta5	P3	**26.916**	**1.927*****	26.916	**26.777**	**6.862***
beta6	Y1*Y1	**19.62**	**2.125****	19.62	**18.229**	**3.475***
beta7	Y1*Y2	-11.67	-1.043	-11.672	**-9.55**	**-3.122***
beta8	Y2*Y2	12.067	1.253	12.067	**11.393**	**2.099****
beta9	P1*P1	-6.546	-0.646	-6.546	**-11.679**	**-1.735*****
beta10	P1*P2	8.908	1.364	8.908	**6.93**	**1.724*****
beta11	P1*P3	-15.43	-1.299	-15.434	**-10.504**	**-1.822*****
beta12	P2*P2	-5.735	-0.823	-5.735	-2.645	-0.712
beta13	P2*P3	-13.24	-1.691	-13.237	**-10.439**	**-2.962***
beta14	P3*P3	**14.099**	**1.852*****	14.099	8.707	1.508
beta15	Y1*P1	**-16.48**	**-1.758*****	-16.483	**-15.003**	**-3.551***
beta16	Y1*P2	0.38	0.183	0.38	0.593	0.366
beta17	Y1*P3	-8.672	-0.895	-8.672	-6.967	-1.257
beta18	Y2*P1	14.793	1.507	14.793	**13.98**	**2.605****
beta19	Y2*P2	-4.319	-1.64	-4.319	**-3.49**	**-2.47****
beta20	Y2*P3	-17.68	-1.406	-17.68	**-16.187**	**-2.077****
delta0				0	0.114	1.175
delta1				0	**0.115**	**5.301***
sigma-squared		0.171		0.193	**0.119**	**8.139***
Gamma				0.4	0	0
log likelihood		**-60.77**			**-48.015**	
LR test (one-sided error)					**25.503**	

Note : Computed using FRONTIER 4.1

* 1% significance level, ** 5 % significance level, *** 10% significance level

TABLE – 3 COST INEFFICIENCY ESTIMATE OF FOREIGN BANK

SL. NO	NAME OF THE BANK	COST INEFFICIENCY ESTIMATE					AVERAGE
		2008	2009	2010	2011	2012	(BANK WISE)
1	A B Bank Ltd.	1.121	1.121	1.121	1.121	1.121	1.121
2	A B N-Amro Bank N.V.	2.002	1.966	1.996	2.005	2.002	1.999
3	Abu Dhabi Commercial Bank	1.820	1.820	1.121	1.121	1.121	1.191
4	American Express Bank Ltd.	1.793	1.793	1.793	2.227	1.121	1.721
5	Antwerp Diamond Bank N V	1.121	1.121	1.121	1.121	1.121	1.121
6	B N P Paribas	1.121	1.121	1.121	1.121	1.121	1.121
7	Bank International Indonesia	1.121	1.121	1.121	1.121	1.121	1.121
8	Bank Of Bahrain & Kuwait Bsc	1.941	1.941	1.121	1.121	1.121	1.203
9	Bank of Ceylon	1.121	1.121	1.121	1.121	1.121	1.121
10	Bank of Nova Scotia	1.121	1.121	1.121	1.121	1.121	1.121
11	Bank of Tokyo-Mitsubishi U F J Ltd.	1.121	1.121	1.121	1.121	1.121	1.121
12	Barclays Bank Plc.	1.121	1.121	1.121	1.866	1.860	1.566
13	Calyon Bank	1.121	1.121	1.121	1.121	1.121	1.121
14	Chinatrust Commercial Bank	1.121	1.121	1.121	1.121	1.121	1.121
15	Citibank N A.	2.221	2.201	2.240	2.239	2.237	2.236
16	D B S Bank Ltd.	1.121	1.121	1.121	1.121	1.121	1.121
17	Deutsche Bank A G	1.121	1.925	1.948	1.948	1.903	1.892
18	Hongkong & Shanghai Banking Corpn. Ltd.	2.000	1.989	1.980	1.986	1.986	1.985
19	J P Morgan Chase Bank	1.121	1.121	1.121	1.121	1.121	1.121
20	J S C Vtb Bank	1.121	1.121	1.121	1.121	1.121	1.121
21	Krung Thai Bank Public Co. Ltd.	1.121	1.121	1.121	1.121	1.121	1.121
22	Mizuho Corporate Bank Ltd.	1.121	1.121	1.121	1.121	1.121	1.121
23	Oman International Bank	1.760	1.820	1.820	1.820	1.121	1.607
24	Shinhan Bank	1.121	1.121	1.121	1.121	1.845	1.338
25	Societe Generale	1.121	1.121	1.121	1.121	1.121	1.121
26	Sonali Bank	1.121	1.121	1.121	1.121	1.121	1.121
27	Standard Chartered Bank	1.866	1.879	1.888	1.906	1.919	1.901
	AVERAGE (YEAR WISE)	1.3594	1.389	1.336	1.381	1.34	1.354

Note: Computed using FRONTIER 4.1

4. RESULT AND DISCUSSION

- Foreign banks are increasing their Loan and advances and increase the labour efficiency to attain the cost efficiency for the period 2008-2012.
- The Business per Employees is increased from Rs 914.19 lakhs to Rs 1384.78 lakhs for the period 2008-2012.
- For foreign Banks, Business per Employees improved by 51.47 % for the period 2008-2012.
- Labour expenses are increased significantly which leads to cost inefficiency in Foreign banks for the study period (2008-2012). This is due to the number of Employees improved by 9.57 % for the period 2008-2012.
- There is a significant difference among foreign banks in their cost inefficiency.
- The difference in cost inefficiency between the best practice and worst practice banks is significantly increased by 11.5 % for the period by Information technology. Thus, some of foreign banks cost efficiency reduced by 11.5 % for the study period (2008-2012). The information technologies contribute to cost inefficiency.
- The results showed that the foreign banks operating in India are 35.4% Cost inefficient. i.e. 64.6 % Cost efficient.
- The A B Bank Ltd. is the most Cost efficient and Citibank N A. is the least. The average inefficiency score for A B Bank Ltd. is 1.121, implying that its inefficiency is 12.1 % higher than it should be. The average inefficiency score for Citibank N A. is 2.236, implying that its inefficiency is 123.6 %.
- There is a significant difference among the foreign bank operating in India in their cost efficiency.
- There is no significant difference in cost inefficiency among the foreign bank in year-wise.
- The information technologies contribute to cost inefficiency. This is due to the higher cost for IT expenditure and realized benefit is comparatively smaller

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