Relationship between `Profitability, Efficiency and Risk: Evidence from Private Sector Banks in India

Srabani Ghosh
Assistant Professor, Department of Commerce, Dr. Kanailal Bhattacharyya College, Howrah

Tapas Kumar Tripathy
Assistant Professor, Department of Commerce, Prabhat Kumar College, Contai

Gautam Mitra
Professor, Department of Business Administration, The University of Burdwan

Ram Pratap Sinha
Associate Professor of Economics Government College of Engineering & leather Technology

Abstract

The main objective of this paper is to estimate the impact of bank efficiency score and Capital Adequacy ratio on its Return on Assets (ROA) and Return on Equity (ROE) in the context of Indian private sector banks. The study is based on data pertaining to 16 private sector banks. The study uses a two stage approach in which, the first stage is devoted to the estimation of output oriented technical efficiency under variable returns to scale. The second stage uses panel data models for estimating the impacts of efficiency and capital adequacy on ROA and ROE. The outcome indicates that the impact of the two explanatory variables is more pronounced in case ROA than ROE.

Key Words: *Private Sector Banks; DEA, Panel Regression; Efficiency Score.*

JEL Code: *E58; C19; C23; D61.*

Introduction

The banking sector plays a crucial role in a modern economic system for the efficient functioning of the productive and financial activities. Inter alia, the banks performs three major functions including provision of a payment system, mobilization of financial saving and allocation of financial resources to the investing community. In the Indian context the public sector banks played a dominant role during the period 1969 to 1991 as the government took over or nationalised 20 commercial banks in two phases (1969 and 1980). However, not all private sector banks were nationalised in 1960, 1969 and 1980. These Private non nationalized banks are together known as the old private sector banks. The Government of India prohibited the formation of private sector banks during the post nationalization period. No new license was issued for setting up commercial banks in the private sector till early 1990s. In 1991 India faced a serious balance of payment crisis and the Government of India adopted a policy of economic liberalization. An expert Committee under the Chairmanship of Shri M. Narasimham recommended opening up of the banking sector to the private ownership in order to bring in competition and efficiency, thereby paving the way for

licensing of new commercial banks in the private sector. However, in July, 1993, the RBI allowed the private sector to enter into the banking system. The Government allowed the entry of private banks in order to accelerate the banking reform process and to stimulate competition in the banking sector. As an integral part of liberalisation policy, an expansion in the role of private sector banks was contemplated to promote financial inclusion foster competition and thereby reduce costs and improve the quality of services. As per the Census of 2001, only 30.1% of the households in rural areas and 49.5% of the households in urban areas availed of banking services, and as per 2011 Census, 54.4% of the rural households and 67.8% of the urban households availed the services of banks. In aggregate, only 58.7% households are availing banking services in the country. The above statistics shows the huge untapped banking market in India and this provided a huge business potential for the new entrance in the banking sector in view of the vast geographical spread and unaddressed customer base (Nargundkar, 2010). Capital inadequacy in public sector banks is another driver for the emergence of private players. Presently, the share of public sector banks constitutes about 72 per cent of the total banking assets in India. After the implementation of Basel III norms, banks will need to increase more capital as the Government's share in the capital of public sector banks is close to the minimum of 51 per cent, rising of any additional capital by the public sector banks. Financial Performance in broader sense of the term refers to the degree to which financial benchmarks being or has been accomplished and is an important aspect of financial risk management. It is a continuous process of measuring firm's policy outcome within the domain of money measurement concept. The purpose of this analysis refers to either (i) measuring firm's financial health across time or (ii) inter industry comparison. In order to be successful in such an environment they must carry out their activities efficiently. Productivity and efficiency are two yardsticks of evaluating the performance of a productive unit. Productivity is defined as the ratio of output to input whereas efficiency is the ratio of observed productivity to optimal productivity. For explaining the concept of efficiency we consider a single input or single output technology. In the new classical framework we implicitly assume that there is no X- inefficiency in the productive system. However, in actual circumstances we know that the observed output can be less than the potential output due to the presence of inefficiency. In this paper a comparative analysis was done between old and new private sector banks in terms of efficiency and profitability. Determining the relationship between them can help management of banking companies better manage its performance and better identify the tasks that must be accomplished in order to achieve the goals set by shareholders. In the past two decades several research studies addressed the issues of banking sector efficiency and the impact of various efficiency drivers. However, none of them focused specifically on the private sector commercial banks. Secondly, very few of them considered the impact of efficiency on the financial parameters of the in sample banks. The objective of the current study is to remove the aforementioned research gap. Broadly speaking the present study is a two stage exercise. In the first stage the study constructs a performance frontier comprising solely of private sector commercial banks operating in India and computes efficiency score relative to the frontier. In the second stage, panel data models have been used to estimate the impact of efficiency and capital adequacy on the return on equity and return on asset of the in-sample private sector banks.

The study has four sections and proceeds as follows. Section 1 provides a brief description of related literature. Section 2 describes the framework of analysis and the methodologies applied. Section 3 includes result and discussion, section 4concludes.

1.0 Review of related literature

Aftab et al (2011), revealed the relationship between bank efficiency and share performance. According to their study a positive and significant relation exist between stock performance and bank efficiency. Aygoren et al (2015) , explained the relationship between efficiency and stock performance in Turkey. As per their studies the concentration ratios and capital adequacy ratio have a positive effect on the efficiency of stocks, whereas the number of employees per unit of branches and age influences stock. Avery and Berger analyzed the new risk based capital standards using data on US banks from 1982 to 1989. Beccalli et al (2006) described the relationship between stock price and efficiency. They had measured efficiency both in parametric and non parametric approach. According to this study changes in cost efficiency influenced the share prices and as a result cost efficient banks tend to outperform their inefficient counterparts. Demirguc kunt et al (2013), they studied whether better capitalized banks experienced higher returns during financial crisis. They had used various capital ratios like Basel risk adjusted ratios, leverage ratios, tangible ratio. Fiordelisi et al (2011), estimated the reputational risk for a large sample of banks in Europe and the U.S between 2003 and 2008.They showed that a higher level of capital invested and intangibles reduce the profitability of reputational change. Grmanova and Strunz (2017) analysed the relationship between technical efficiency and profitability of insurance companies. They had examined the profitability of insurance companies in terms of Return on assets, Return on equity and size of assets. Jacques and Nigro (1979), analysed the impact of risk based standards on both bank capital and portfolio risk. The paper used a three stage least squares model to examined the relationship between bank capital, portfolio risk and risk based capital standards. Koehn & Santomero (1980), examined explicitly the issue of portfolio reaction to capital requirements by investigating the effect of capital ratio regulation on the portfolio behavior of commercial banks. Lannotta et al (2007), compared the performance and risk of a sample of 181 large banks from 15 European countries over the 1999-2004 period and evaluate the impact of alternative ownership models together with the degree of ownership concentration on their profitability, cost efficiency and risk. Lee and Hsieh (2013), investigated the impact of bank capital on profitability and risk variables persistently from one year to another. Liao (2019), examined whether the efficiency and ownership structure of bank is related to their stock performance in China and Taiwan. According to the study, ownership structure does not play an important role in stock return. Mousa (2015), examines the efficiency of banking sector in Bahrain Bourse using financial ratio analysis and DEA. According to him increasing financial efficiency of the banks have played a significant role in financial sector and emerging market. Pasiouras (2008) et al examined the association between efficiency of Greek banks and their share price performance. They calculate the annual share price returns of each bank and using DEA to measure the efficiency of bank from 2000 to 2005. Sharma (2018), examined an empirical relationship between market performance indicators and efficiency of Indian banks. The study revealed that a significant association exists between scale efficiency and stock market return whereas technical and pure technical efficiencies exhibited a positive and significant association with EVA and MVA respectively. Socol and Damuletiu (2013) had examined how banking profitability which is expressed in terms of Return on assets and Return on equity, affected by the credit risk ratio in Romanian banking system during the year 2008 to 2013.

2.0 Framework of analysis and Methodology

2.1 Selection of inputs and outputs

As indicated in the introduction the purpose of the present study is to conduct two stage analysis of private bank performance. In the present context, we have computed technical efficiency of the observed commercial banks. Since we are using an implicit production function approach it is essential to specify the inputs and outputs of the bank. The choice of inputs and outputs, however, depends on the viewpoint taken for analyzing banking activities. Broadly speaking, there are three standpoints for defining the banking sector outputs: the production approach, the intermediation approach and the modern approach. The production approach [Benston (1965) and Bell and Murphy (1968)] takes in to account such banking sector performance indicators as the number of accounts opened by the bank, number of transactions performed etc. Research studies following this approach have also considered (in some instances) deposits and loans etc as outputs of the banking industry which are produced by inputs like labour and physical capital. The intermediation approach [Benston, Hanweck and Humphrey (1982)] considered net interest income (interest earned minus interest expended) as the indicator of bank performance. Finally, the modern approach [Huges and Mester (1993, 1994)] considers risk management and information processing activities as the prime outputs of commercial banks. On the expense side, deposit servicing cost, labour cost and fixed capital related over heads constitute the major expenses on inputs by banks. Thus deposits and equity capital are the two major inputs of the banking sector. Some have also taken branches maintained by commercial banks as one of the inputs. In the present we have adopted the financial intermediation approach as it is most widely accepted.

We have considered bank as financial intermediaries which convert owned and borrowed resources to generate credit and fee based activities. Therefore, we have included equity capital and bank deposits as the two input of the banking sector. On the output side we have included advances and other income as the two outputs.

Table 1 Description of Inputs and Outputs

	Input	Output
Equity Capital	✓	-
Deposit	✓	-
Advances	-	✓
Other Income	-	✓

As mentioned earlier, for the second stage analysis we have considered two financial performance variables – return on assets (ROA) and return on equity (ROE).

The current study includes sixteen private sector commercial banks out of the 22 in operation. We had to drop six banks out of the twenty two because of the non availability of information in respect of them all the observed years. The period of study includes fourteen financial years (from 2004-05 to 2017-18). The related information has been collected from the annual reports of the observed commercial banks of Indian Banks' Association and Profile of Banks in RBI website.

We have estimated efficiency using data envelopment analysis and DEA Solver LV-8 has been used. For estimating panel data model we have used STATA 12.0.

2.2 Estimation of technical efficiency using DEA

DEA is the most popular technique of efficiency estimation and is essentially a non parametric approach. DEA uses linear programming for measuring the efficiency performance of organizational units termed as Decision Making Units (DMUs).[8] Using DEA we can estimate either the output oriented performance (for a given level of input) or the input oriented performance (for a given output level). In the DEA approach we construct a performance frontier which is then used to estimate performance of an observed DMU based on its distance from the frontier.

Presently, we provide a very brief introduction to DEA. Based on Charnes et al (1978), Banker et al (1984), Coelli (1996), and Coelli et al (1999) let us assume that there are K numbers of inputs and M number of outputs for N number of DMUs. The input and output vectors are x_i and y_i, respectively for each i^{th} DMU. The X represents a K × N input matrix and Y represents an M× N output matrix for all N number of DMUs. To obtain efficiency scores we need to estimate the ratios of all outputs. So we have $U'V_i/ V'X_i$ where U is an M×1 vector of output weights and V is a K× 1 vector of input weights.

Therefore the mathematical fractional equation is as follows:

$$\text{Max } UV\ (u'\ y_i/v'\ x_i)$$

$$\text{Subject to } u'\ y_i/v'x_i \leq 1,\ i= 1,2,3\text{----------},N$$

$$u,v \geq 0$$

Transforming this equation into linear programming with the constraint $v'x_i= 1$, Charnes, Cooper and Rhodes (1978) formulates output oriented constant return to scale model as follows:-

$$\text{Max } \mu y\ (\mu'\ y_i)$$

$$\text{Subject to } v'x_i =1$$

$$\mu'y_j\_x_j \leq 0,\ j=1,2,\text{--------}N$$

$$\mu,\ v \geq 0$$

The equation is the transformed equation and is known as a multiplier form of linear programming. Further this linear programming equation can be solved based on duality and is written in envelopment form as follows:

$$\text{Max}\theta$$

$$\text{Subject to } \theta y \leq \lambda Y,\ x \geq \lambda,\ \lambda \geq 0$$

Here θ represents Farrell (1957) technical efficiency and is the inverse of Shephard technical efficiency (1953,1970).

The aforementioned model is based on the assumption of constant returns to scale. It implies the technology is global in nature. In actual circumstances, however, technology is local in nature and different banks can experience different types of returns to scale depending on

[8] R.Ramanatham, *An introduction to DEA: A tool for Performance Measurement* ,Sage Publications,2003,pp.25-26

their scale of activity. The Farrell approach to efficiency was based on constant returns to scale. Afriat (1972) introduced the concept of variable returns to scale model conceptually and was made operational by Banker, Charnes and Cooper (1984). The BCC model in its envelopment form with output orientation can be written as:

Maxθ

Subject to $\theta y \leq \lambda Y$, $x \geq \lambda$, $\lambda \geq 0, \sum \lambda = 1$

2.3 Panel data regression

Panel data is simply cross section data over time subject to the clear identification of regressors (independent variables) and the regressed (dependent variable). Cross section implies that the data have been collected from different cross section units and this cross section may be chosen from different categories. The time series dimension of panel data is reflected when the data have been collected for chosen cross section units for more than one time period. In case of balanced panel, each cross sectional unit has same number of time series observations while the number of time series observations differs between cross sectional units in an unbalanced panel. In short panel, the number of cross section units (N) is greater than the number of time points (T). Otherwise, in case of long panel, the number of time points exceeds the number of cross section units.

While it is possible to apply pooled OLS to panel data in certain cases, the most popular panel regression methods include the Fixed Effect and the Random Effect models. The fixed effect model estimates the firm effect and time effect or both. This approach allows individuality among the firms by accommodating firm specific intercepts. The model is called fixed effect due to the fact that though it has different intercept values across the cross-sectional units i.e. across the firm but the intercept is time-invariant. Further, the model includes the individual effects through dummy variables. For this very reason this model is also called Fixed Effect Least Square Dummy Variables (FELSDV) model, or in short LSDV model. The basic equation of this model is

$$Y_{it} = \alpha_i + \beta_1 x_{it} + \varepsilon_{it} \quad \ldots\ldots(1)$$

$$\text{or,} \quad Y_{it} = \alpha_1 D_{1t} + \alpha_2 D_{2t} + \cdots + \alpha_r D_{rt} + \beta_1 x_{it} + \varepsilon_{it} \quad \ldots\ldots(2)$$

Here, Y is the dependent variable, X is the independent variables, i = 1,2,3,…..50 and t = 1,2,3….10, α_1 is the first cross-sectional intercept and α_2 is the second intercept and so on up to α_r and D_{1t} is the first cross-sectional unit and D_{2t} is the second cross-sectional unit.

The Random Effect model does not use dummy variables for capturing the individual effect. This model has the common mean value for the intercept and assumes individual effect itself to be a random variable. Here, random error term reflects the individual differences in the intercept values across the cross section and in this model random error term is the composition of both individual error term as well as individual and time series random error term.

The model is

$$\mathbf{Y_{it} = (\alpha_1 + \mu_i) + \beta_1 x_{it} + \varepsilon_{it}} \quad \ldots\ldots(3)$$

$$\text{or,} \quad \mathbf{Y_{it} = \alpha_1 + \beta_1 x_{it} + \gamma_{it}} \quad \ldots\ldots(4)$$

Here, $\gamma_{it} = (\mu_i + \varepsilon_{it})$ represents the random error term of two elements at a time first one is μ_i for individual random error item and ε_{it} is the combination of both individual and time series random error part[9].

2.4 Selection between Fixed Effect Model and random Effect Model: The Hausman Test

After running both the model that is fixed effect model and random effect model, Hausman Specification Test helps us to determine which model is appropriate for the study. Hausman (1978) proposed a test based on the difference between the Fixed Effect and Random Effect estimates. Here,

H_0= Random Effect Model is appropriate;

H_1= Fixed Effect Model is appropriate.

If the test result shows that the p-value is statistically significant then we shall apply fixed effect model otherwise random effect model is suitable for the study.

3.0 Results and discussion

3.1 Descriptive Statistics of the observed variables

In the present study, we have estimated technical efficiency scores in the first stage and the same has been included as one of the explanatory variables for the panel data regressions carried out in the second stage. The efficiency scores are included in appendix tables A1 and A2. Data for the remaining variables used in the panel regression have been obtained from sources indicated earlier. The descriptive statistics related to the four variables are presented in table 2.

. **Table2: Descriptive statistics of selected variables**

Variables	Mean	Standard Deviation	Minimum	Maximum
ROA	1.130893	.7279119	-3.38	2.13
ROE	.2053571	1.131941	-.75	17
Efficiency Score	.893503	.1476228	.250986	1
Capital Adequacy Ratio	14.36004	2.373523	9.58	22.46

Source: Authors' calculation.

3.2 Model selection and regression estimates

We have estimated the relationship between the dependent variable (ROA and ROE respectively) and the two explanatory variables (efficiency and capital adequacy) by using two models: fixed effects and random effects. Tables 3 and 4 present the outcomes for ROA

[9] Sankar Kumar Bhowmik, *Principles of Econometrics- A modern approach using EViews*, Oxford University Press, 2015, pp. 240 - 249

as the dependent variable and tables 5 to 6 represent the outcomes for ROE as the dependent variable.

Table 3: Fixed Effect Model (dependent variable-ROA)

	Coefficient	Standard Error	t(Observed)	Probability of type 1 error
Intercept	-.6776267	.3745786	-1.81	0.072
Efficiency	.6692008	.3254797.	2.06	0.041
Capital Adequacy	.0843024	.0202523	4.16	0.000

Source: Authors' calculation

Table 4: Random Effect Model (dependent variable-ROA)

	Coefficient	Standard Error	Z(Observed)	Probability of type 1error
Intercept	-.8008856	.3653241	-2.19	0.063
Efficiency	.5797852	.3118455	1.86	0.000
Capital Adequacy	.0984495	.0194019	5.07	0.028

Source: Authors' calculation.

Table 5: Fixed Effect Model (dependent variable-ROE)

	Coefficient	Std Error	t(Observed)	Probability of type 1error
Intercept	.2626307	.7944463	0.33	0.741
Efficiency	-.0155491	.690312	0.28	0.783
Capital Adequacy	-.0155491	.0429532	-0.36	0.718

Source: Authors' calculation

Table 6: Random Effect Model (dependent variable-ROE)

	Coefficient	Std Error	Z(Observed)	Probability of type1error
Intercept	.9670893	.5872524	1.65	0.100
Efficiency	-.6219292	.5303922	-1.17	0..241
Capital Adequacy	-.0140712	.0329881	-0.43	0.670

Source: Authors' calculation

3.3 Model appropriateness

The tables presented above show that the coefficient of efficiency is much higher than that of capital adequacy. However, the exclusion of capital adequacy as an explanatory variable

reduces the explanatory power of the model. Restricted 'F' test also suggests that both explanatory variables should be retained in the regression models. The second issue is the comparative suitability of Fixed Effect and Random Effect Model in the present context. For this, we have taken the help of Hausman Specification Test. We have accordingly compared the Fixed Effect Model with the Random Effect Model. This has been done for both the dependent variables (ROA and ROE). The results are presented in tables 7 and 8.

Table 7: Hausman test for panel regression (dependent variable-ROA)

Explanatory Variable	FEM Coefficient	REM Coefficient	Difference	Standard Error	Chi sq	Prob>chi sq
Efficiency	0.6692	0.5798	.0894	.1022	5.59	0.0610
Capital Adequacy	0.0843	.09844	-.01414	.00636		

Source: Authors' calculation.

Table 8: Hausman test for panel regression (dependent variable-ROE)

Explanatory Variable	FEM Coefficient	REM Coefficient	Difference	Standard Error	Chi sq	Prob>chi sq
Efficiency	.19024	-.62192	.81217	.43833	3.44	0.1789
Capital Adequacy	-.01554	-.01407	.00147	.2729		

Source: Authors' calculation.

For the model with ROA as the dependent variable, the value of Chi square is 5.59 and the probability > Chi square value is 0.0610. Since the value is greater than 0.05, we are unable to reject the null hypothesis that the difference in coefficient is not systematic. Similar kind of results is obtained for the regression with ROE as the dependent variable. Here the Chi square value is3.44 and probability > Chi square value is 0.1789. Consequently we have tested for the suitability of the random model using Breusch Pagan Lagrang Multiplier Test. The outcome of the test indicate that the validity of the null hypothesis that the random variance is equal to zero. Thus the regression outcomes suggest in favour of Fixed Effect Model for both the regression model (having ROA and ROE as the dependent variables).

4.0 Conclusion

The present study departs from the extant research literature on the banking sector in two respects. First, the study focuses solely on the private sector banks instead of including both public and private sector banks in this study, Secondly while most of the research studies are oriented towards computation of efficiency and finding out the impact of the selected contextual variable. In the present study we have done the reverse and tested the impact of efficiency and capital adequacy on the two popular financial parameter of the banking sector. The result indicates that efficiency of performance is highly significant variable in determining ROA and ROE of the private sector commercial banks. Inter alia, the present study can be extended in two directions. More explanatory variables can be considered for explaining ROA and ROE. Second, a dynamic panel data model can be considered instead of the static model used in the present article. Future research studies may take up the aforementioned research agenda.

References

Aftab,M, Ahamad,S., Ullah,W., & Sheikh,R.A. (2011) The Impact of Bank Efficiency on Share Performance: Evidence from Pakistan , *African Journal of Business Management,* 5(10), 3975-3980.

Hakan, A.,Yesilyurt,E.M., Kucukkaaplan,I.G.B.(2015).The Relationship between Stock Performance and the Efficiency in Turkish Banking Sector, *Dogus Universitesi Dergisi*,16(2),203-215

Beccalli, E., Casu,B. & Girardone,C. (2006) Efficiency and Stock Performance in European Banking. *Journal of Business Finance and Accounting,* 33(1-2), 245-262.

Bhowmik,Kumar,S. (2015). Principles of Econometrics- A modern approach using EViews, Oxford University Press, 240 – 249

Bell, F.W., & Murphy, N. B.(1968). Economies of scale and division of labor in commercial banking, *Southern Economic Journal,* 35(2), 131-39.

Benston, G.J.(1965). Branch banking and economies of scale. *Journal of Finance* 20(2), 312-331.

Benston, G.J., Hanweck, G.A. & Humphrey, D.B.(1982).Scale economies in banking, *Journal of Money, Credit and Banking*, 19(1), 435-546.

Fiordelisi,F.,Soana Schwizer, P.(2011).The Determinants of Reputational Risk in the Banking Sector, *Journal of Banking and Finance*, 37(5)

Gramanova,E. & Strunz,H (2017). Efficiency of Insurance Companies: Application of DEA and Tobit Analysis. *Journal of International Studies*, 10(3), 250-263.

Hughes, J. P. and Mester, L.J. (1994). Bank managers' objectives. *Working paper no.94-8, Federal Reserve Bank of Philadelphia, Economic Research Unit.*

Huges, J.P., & Mester, L.J.(1993) A quality and risk-adjusted cost function for banks: evidence on the 'too-big-to-fail' doctrine, *Journal of Productivity Analysis*, 4 (3), 293-315.

Ioannidis,C., Molyneux,P., Pasiouras,F. (2008) The Relationship between Bank Efficiency and Stock Returns : Evidence from Asia and Latin America, University of Bath, Working Paper Series,2008-10.

Jacques, K., & Nigro, P.(1997). Risk based capital portfolio risk and bank capital: A simultaneous equations approach, *Journal of Economies and Business*, 49(6),533-547

Koehn, M.,& Santomero,M. A. (1980). Regulation of Bank Capital and Portfolio Risk, *The Journal of Finance*,35(5)

Kunt, D.A and Detragiache, E. & Merrouche, O. (2013). Bank Capital: Lessons from Financial Crisis

Lannotta, G.,Nocera, G., & Sironi, A.(2007). Ownership structure, risk and performance in the European banking industry, *Journal of Banking & Finance*, 31(7), 2127-2149

Lee, C.C., and Hsieh, F.M. (2013). The impact of bank capital on profitability and risk in Asian banking, *Journal of International Money and Finance*, 32(c), 251-281

Lema, T. (2017). Determinants of Bank Technical Efficiency: Evidence from Commercial Banks in Ethiopian Banks. *Cogent- Business & Management*, 4(1),1-13.

Liao, C.,S.,(2019). Stock Performance, Corporate Governance and Efficiency of China and Taiwan Banks:Isthere a relationship? *Asian Economic and Financial Review*, 9(2),176-190

Mousa,G.A.(2015) Financial Ratios versus Data Envelopment Analysis: The Efficiency Assessment of Banking Sector in Bahrain Bourse. *International Journal of Business and Statistical Analysis,* 2(2),74-85.

Ramanathan, .R. (2003). An introduction to DEA: A tool for Performance Measurement, Sage Publications, New Delhi, Thosands Oaks, Londan

Sharma, Dipasha (2018). Stock Market Performance and Efficiency of Banks in a Developing Economy: Evidence from Indian Banking Sector, *IIM Kozhikode Society & Management Review,* 7(2),1-16.

Shephard, R.W.(1953). *Cost and Productions*. Princeton: Princeton University Press.

Shephard, R.W.(1970). *Theory of Cost and Productions*. Princeton: Princeton University Press.

Socol, A. & DÄƒnuleÅ£iu, A. E. (2013) Analysis of the Romanian Banks' Performance through ROA, ROE and Non Performing Loans Models. *Annales Universitatis Apulensis Series Oeconomica*, 15(2), 594-604

Efficiency Scores of the observed private sector banks

Appendix Table 1 (2004-05 to 2008-09)

DMU No.	DMU Name	2004-05	2005-06	2006-07	2007-08	2008-09
1	Catholic Syrian Bank	.943214	.992918	.951425	.8328	1
2	City Union Bank	.957076	1	1	.85597	.999504
3	Federal Bank	.916223	.835084	.862576	.806972	.742755
4	Jammu & Kashmir Bank	1	1	1	1	1
5	Karnataka bank	.664417	.685414	.817118	.713016	.645863
6	Karur Visya Bank	1	1	.967688	.888335	.83374
7	Nainital Bank	1	1	1	1	1
8	South Indian Bank	.829395	.801909	.808156	.779775	.737964
9	Tamilnad Mercantile Bank	1	1	1	1	1
10	Axis Bank	.591523	.745714	.761391	.930954	1
11	ICICI Bank	1	1	1	1	1
12	HDFC Bank	.856631	1	.855707	1	1
13	DCB Bank	.807063	.757919	.903881	1	1
14	Indusind Bank	.741961	.688052	.68244	.718335	.720549
15	Kotak Mahindra Bank	1	1	1	1	1
16	Yes Bank	1	1	.857906	.840721	.834404

Source: Authors' calculation

Appendix Table 2 (2009-10 to 2013-14)

DMU No.	DMU Name	2009-10	2010-11	2011-12	2012-13	2013-14
1	Catholic Syrian Bank	1	.947648	1	.914558	.866105
2	City Union Bank	.889178	.884439	.890841	.886911	.885974
3	Federal Bank	.874055	.813614.	.81988	.815185	.76653
4	Jammu & Kashmir Bank	1	.998554	1	1	1
5	Karnataka bank	.718195	.684724	.690137	.733084	.720184
6	Karur Visya Bank	.8763	.817071	.815729	.834671	.851267
7	Nainital Bank	1	1	1	1	1
8	South Indian Bank	.823011	.771781	.812724	.775706	.819527
9	Tamilnad Mercantile Bank	1	1	1	1	1
10	Axis Bank	1	1	1	1	1
11	ICICI Bank	1	1	1	1	1
12	HDFC Bank	1	1	1	1	1
13	DCB Bank	1	1	1	.971024	.984452
14	Indusind Bank	.88131	.765259	.860023	.92044	.926629
15	Kotak Mahindra Bank	1	1	1	.982544	1
16	Yes Bank	.949447	.778912	.778429	.720709	.753633

Source: Authors' calculation

Appendix Table 3 (2014-15 to 2017-18)

DMU No.	DMU Name	2014-15	2015-16	2016-17	2017-18
1	Catholic Syrian Bank	.429813	.697339	1.	.872957
2	City Union Bank	.390428	.940736	1	1
3	Federal Bank	.424125	.730036	.813805	.823643
4	Jammu & Kashmir Bank	.84907	.861102	1	1
5	Karnataka bank	.250986	.682779	.721239	.775901
6	Karur Visya Bank	.404609	.844355	.879166	.833779
7	Nainital Bank	.999821	1	1	1
8	South Indian Bank	.382296	.788955	.785399	.784238
9	Tamilnad Mercantile Bank	1	1	.801432	.808364
10	Axis Bank	1	1	1	1
11	ICICI Bank	1	1	1	1
12	HDFC Bank	1	1	1	1
13	DCB Bank	.999846	1	1	.982851
14	Indusind Bank	.292134	.958305	.95823	1
15	Kotak Mahindra Bank	1	1	.923214	.86964
16	Yes Bank	.290763	.86608	.992283	1

Source: Authors' calculation