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Scale Economies And Returns To Scale In Large Versus Small Banks - Special Reference To Indian Commercial Banks: A Dea Analaysis.

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Abstract

This paper envisages to studythe scale efficiency and returns to scale during 2007-2017. For appraising the efficiency DEA model is employed. Banking Experts all over the world used DEA model to assess the performance of commercial banks in order to bring out performance variances, if any, which are working under the same ownership, economic, regulatory and market conditions. This study carried out based on the Indian commercial banks from the three categories, such as SBI group, public sector banks and Private sector banks. The appropriate data were collected from the RBI data base and various journals. Scale efficiency scores and RTS values were calculated through intermediation approach of DEA and the results were analysed. The estimated results were presented in every part and conclusion of the study.

Introduction

This paper presents a comparative study of the scale economies and Returns to scale in large versus small banks of SBI group, Public Sector Banks (PSBs), and Private Banks.

Clamour for consolidation of commercial banks assumed significance after the introduction of financial sector reforms in early nineties. The various committees constituted in this regard recommended the consolidation of small state run banks into a few large banks on the surmise that large banks are too big to fail and thereby would reap economies of scale and economies of scope. In this context, Prasad (2011) concluded that size enhancement after merger improved scale efficiency. RBI (2013) has recorded that large banks may be more efficient and generate economies of scale and scope. D. Subbarao (2013) underscored that large banks would derive cost benefits due

to economies of scale and economies of scope. R.Gandhi (2016) emphasised that large banks do benefit from economies of scale in terms of risk diversification. Arundhati Bhattachariya (2016) Anil Sai (2016) Ashwin Pareke (2017) confirmed that large banks would reap economies of scale and scope. Thus all stake holders such as RBI, Bank Economists, RBI governors and finally the Government of India are convinced that large sized banks would bring in substantial scale economies and economies scope. Accordingly the government of India took a policy decision in favour of consolidation and approved the merger of SBI and its subsidiaries into one large unit in 2016.Hence this study envisages to test the following Hypothesis.

H_0: Large banks would reap better scale Economies and Economies of Scope.

2 .Models on Scale Efficiency

The measure of SE provides the ability to the management to choose the optimum mix of resources. It can be used to indicate increase in productivity caused by moving to the technically optimal production scale. In other words, SE is related to the most efficient scale of operation. In sum, overall technical inefficiency can be thought of being attributable to pure technical and scale inefficiencies. Pure technical inefficiency is mainly due to managerial (controllable) and environmental (uncontrollable) factors, while scale inefficiency is caused by operating at non-optimal scale i.e., either with increasing returns-to-scale
(at suboptimal scale) or with decreasing returns-to-scale (at supra-optimal scale). A bank is scale efficient if it operates at constant returns-to-scale.

To quantify a measure of OTE, we need to find out the divergence between actual production and production on the boundary of the feasible production set. This set summarizes all technological possibilities of transforming inputs into outputs that are available to the bank. A bank is technically inefficient if production occurs within the interior of this production set. A measure of SE can be obtained by comparing OTE measures derived under the assumptions of constant returns-to-scale (CRS) and variable returns-to-scale(VRS).

Based on CCR and BCC scores, scale efficiency is defined as:

Let the CCR and BCC scores of a DMU beθ*CCR andθ* BCC, respectively. The scale efficiency is defined by

$$\mathrm{SE} = \frac{\theta * \mathrm{CCR}}{\theta * \mathrm{BCC}}$$

SE is not greater than one. For a BCC-efficient DMU with Constant returns to scale (CRS) characteristics, i.e., in the most productive scale size, its scale efficiency is one. The CCR score is called the overall (Global) technical efficiency (TE), since it takes no account of scale effect as

distinguished from PTE. On the other hand, BCC expresses the PTE under variable returns to scale circumstances. These concepts demonstrate a decomposition of efficiency relationship as:

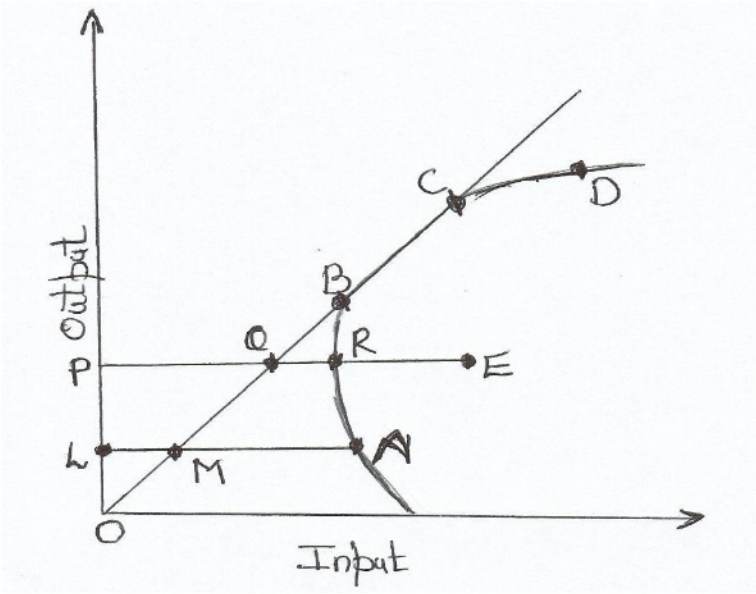
θ*CCR= θ*BCCX SE or

OTE= (PTE) X (SE)

This decomposition depicts the sources of inefficiency, i.e., whether it is caused by inefficient operation (PTE) or by disadvantageous conditions displayed by the scale efficiency (SE) or by both.

Below figure depicts scale efficiency for a single input-output case.

Diagram 1 Scale efficiency in DEA



Source: Author's construction

For the BCC-efficient A with IRS, its scale efficiency is given by:

SE (A) = θ*CCR (A) = LM / LA < 1; which denotes that A is operating less efficient (PTE = 1) and its overall inefficiency (TE) is caused by its failure to achieve scale inefficiency (SE) represented by LM/LA as shown in the diagram. For DMUs B and C, their scale efficiency is one, i.e., they are operating at the most productive scale size. Their technical efficiency is also one so they are both scale and technically efficient for both the CCR and BCC models. For the BCC-inefficient DMU E, we have SE (E) =

$\frac{PQ}{PE}\frac{PE}{PR}=\frac{PQ}{PR}$;

Which is equal to the scale efficiency of the input- oriented BCC projection R. The decomposition of E is

TE (E) = PTE (E) X SE (E) or $\frac{PQ}{PE} = \frac{PR}{PE}\frac{PQ}{PR}$

Thus E's overall inefficiency is caused by the technically inefficient operation of E and at the same time by the disadvantageous scale condition of E measured by PQ/PR.

The above outlined scale efficiency is for input-oriented, as the current study is using input-oriented method.

3. Models on Returns to Scale

In DEA the envelopment surface, which is the efficiency frontier created by the efficient firms, will differ depending on the scale assumptions that underpin the model. Two scale assumptions are generally employed in DEA: constant returns to scale (CRS), and variable returns to scale (VRS). The latter encompasses both increasing and decreasing returns to scale. CRS reflects the fact that output will change by the same proportion as inputs are changed (e.g. a doubling of all inputs will double output); VRS reflects the fact that production technology may exhibit increasing, constant and decreasing returns to scale. Returns to scale under DEA is explained below:

In a single-output, single-input technology characterized by the production possibility set

$$T = \{(x, y) : y \le f(x); x \ge a\}$$

where

y = f(x) is the production function showing the maximum quantity of output y producible from input x and a is the minimum input scale below which the production function is not defined. When there is no minimum scale, a equals 0. At some specific point (x, y) on this production function, the average productivity is $AP = \frac{f(x)}{x}$.

Locally increasing returns to scale holds at this point if a small increase in x results in an increase in AP. Similarly, diminishing returns to scale exists when AP declines with an increase in x. Under constant returns, an increase in x leaves AP unchanged. Thus, $\frac{dAP}{dx}$ is positive under increasing returns, negative under diminishing returns, and 0 under constant returns.

For an efficient input-output combination (x_0, y_0) satisfying $y_0 = f(x_0)$.

Let $x_1 = \beta x_0$, and $f(x_1) = y_1$. Further, assume that $y_1 = \alpha y_0$. Thus, $\alpha y_0 = f(\beta x_0)$. Clearly, α will depend on β. Thus, $\alpha(\beta) = \max \alpha : (\beta x_0, \alpha y_0) \in T$.

For any efficient pair (x, y),

$\alpha(\beta)y = f(\beta x)$.

Differentiating with respect to β,

$$\alpha'(\beta)y = xf'(\beta x) = \alpha'(\beta)f(x).$$

Further, at β=1,

$$\alpha'(1) = \frac{xf'(x)}{f(x)} = \varepsilon.$$

Thus, at (x, y),

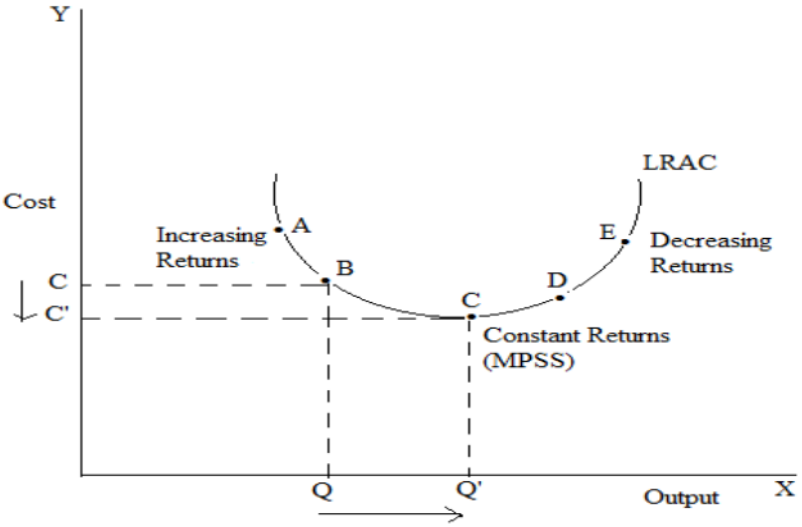
$\alpha'(1) > 1$ implies increasing returns to scale,

$\alpha'(1) = 1$ implies constant returns to scale, and

$\alpha'(1) < 1$ implies diminishing returns to scale.

The below diagram shows the returns to scale measurement as explained above.

Diagram 2 Returns to Scale



Source: Author's construction

The scale efficiency =1 Constant Returns to Scale (CRS) The scale efficiency is less than 1, the DMU will be operating either at decreasing returns to scale (DRS) if a proportion increase of all input levels produces a less-than-proportional increase in output levels or increasing returns to scale (IRS) at the converse case. This implies that resources may be transferred from DMUs operating at DRS to those operating at IRS to increase average productivity at both sets of DMUs.

4. Economies of Scope and Scale

Economies of scope are conceptually similar to economies of scale. Economies of scope refers to lowering the average cost of a firm in producing two or more product.

Banks have economies of scope when they offer multiple financial services at one place. Offering checking accounts, loans, and investment services together allows a bank to spread the cost of its branches, staff, automatic teller machines, and its Internet site over all products instead of having a separate infrastructure for each product. The costs of providing each of these services individually would be much greater than the costs of providing all services together. For example State Bank of India (SBI) provides multiple financial services at one place such as Acceptance of deposits (on term or at demand etc.) Purchase and Sale of money (including foreign currency exchange),Advancement of Loan, Opening and management of accounts, Providing services on the securities market via the Treasury Department, Providing services of keeping, cashing and transportation of money and values Contracts of issuance and service of banking cards, Acceptance of payments in favour of beneficiaries (utilities, State taxes, etc.). Through these multiple services, SBI is able minimize its cost of providing services to the consumer and this helps in profit maximization.

Economies of scale is doing things more efficiently with increasing size or speed of operation. This refers to how an organization can focus on reducing the average per unit cost of its products/services by increasing the scale of production. Economies of scale often originate with fixed capital. AFC is lowered when production increases.
In wholesale and retail distribution, increasing the speed of operations, such as order fulfillment, lowers the cost of both fixed and working capital. Other common sources of economies of scale are purchasing (bulk buying of materials through (long-term contracts), managerial (increasing the specialization of managers), financial (obtaining lower-interest charges when borrowing from banks and having access to a greater range of financial instruments), marketing (spreading the cost of advertising over a greater Range of output in media markets), and technological (taking advantage of returns to scale in the production function). Each of these factors reduces the long run average costs (LRAC) of production by shifting the short-run average total cost (SRATC) curve down and to the right.

Both economies of scale and economies of scope are conceptually the same, and the nature of these two can change the structure of the competition in the industry over a time, as well as the profitability. They both provide companies different ways of increasing the market share and being competitive. But the basic difference in both of them is Economies of scale focuses on Efficiency while the Economies of scope focuses on Diversification of product or services.

5. Input and Output data of SBI Group

Table 1 presents the input and output data set of the SBI group for the study period (2007-17) based on which we have estimated scale efficiency scores and Returns to scale (SE and RTS).

Table 1 Input–Output data: SBI Group (2007-2014)

Rs. in (Million)

Table 1.1 Large Banks							
Decision Making Unit	Total Employees (I)	Interest Expenses (I)	Non-Interest Expenses (I)	Deposits (I)	Advances (O)	Interest Income (O)	Other Income (O)
SBI	207423	462677.75	190631.87	7772763.29	6411964.62	734156.86	117460.98
SBH	13981	49452.44	12123.03	571519.72	537728.67	71541.08	7128.02
SBP	12607	42836.62	10117.44	573951.71	450694.91	58546.67	5682.93

Source: RBI&IBA Data Base

Rs. in (Million)

Table 1.2 Small Banks							
Decision Making Unit	Total Employees (I)	Interest Expenses (I)	Non-Interest Expenses (I)	Deposits (I)	Advances (O)	Interest Income (O)	Other Income (O)
SBJ	12093	29002.09	10015.41	441197.1	35218.59	43856.42	5121.49
SBM	10122	24340.49	7382.71	345758.68	299073.66	35848.99	3904.32
SBT	12095	35745.95	9393.52	503933.39	393272.71	49475.57	4810.63

Source: RBI&IBA Data Base

6Scale Efficiency (SE), Returns to Scale (RTS) and Inefficiency Scores of SBI Group

Scale efficiency is the ratio of OTE to PTE. If the ratio is 1, the firm exhibit CRS. If scale efficiency is not equal to 1, the respective firm exhibits VRS (Increasing/Degreasing).The measure of SE provides the information for the management to choose the optimum size.

The present study undertakes to measure SE score through intermediation approach using both CCR and BCC model and we have estimated two measures of efficiency viz: SE and RTS from the DEA Excel solver developed by Zhu (2003).
The OTE is known as global technical efficiency and the banks which score 1 under CCR are considered globally efficient. It is an input oriented measure which address the question, "By how much can input quantities be proportionally reduced without altering the output quantities produced?" With reference to efficiency scores corresponding inefficiency scores have been calculated with reference to SE as 1-SE= inefficiency.
The relevant results are presented table 2.

Table 2. Scale efficiency (SE), Returns to Scale (RTS) and Inefficiency scores of SBI Group

Large Group				Small Group			
Decision Making Unit	**SE Score**	**SIE (%)**	**RTS**	**Decision Making Unit**	**SE Score**	**SIE (%)**	**RTS**
SBI	1	0	IRS	**SBT**	0.9572	4.28	DRS
SBH	1	0	IRS	**SBJ**	1	0	IRS
SBP	1	0	IRS	**SBM**	1	0	CRS
Mean	**1**	**0**		**Mean**	**0.986**	1.427	
S.D	**0**	**0**		**S.D**	**0.025**	2.471	
C.V	**0**	**0**		**C.V**	**2.507**	173.205	

Table 2 presents the SE scores and their corresponding inefficiency scores and returns to scale of the large and small banks in SBI group.

The measure of scale efficiency (SE) helps to evaluate the managerial performance of the banks. If SE score 1, it implies that DMU has obtained the best possible economies of scale since the efficiency level is cent-percent.The mean SE score of the large banks was 1 and across the firms, all member banks have obtained uniformly the SE score of 1. Evidenced by theSE scores, it is concluded

that all the three large banks of SBI has achieved the optimal scale economies without any input wastage nor potential loss in output realisation. The optimality in scale economies fetched IRS in their operations. Whereas the mean SE score of the small banks was 0.986 which implies that the scale efficiency of small banks was 98.6 percent indicating a slight inefficiency in their scale of operations by 1.4 percent.

It is evident from the analysis that large banks in SBI group have achieved cent percent scale efficiency and reap increasing returns to scale in their operations where as small banks (especially SBT) were slightly inefficient with a mixed results in their scale of operation.Across the small banks, SBT appears to be inefficient to the tune of 4.28 percent. Regarding RTS there were mixed results across small banks.

The results confirm that large banks of SBI group were relatively more efficient than the small banks in the scale economies and have uniformly experienced increasing returns to scale.

This partis presents a comparative study of the scale economies and RTS in large versus small Public Sector Banks.With reference to assets size, six large banks and six small banks have been chosen for the study.

7. Input and Output Data of Public Sector Banks

Table .3 presents the input and output data set of the Public Sector banks for the study period (2007-14) based on which we have estimated scale efficiency scores and Returns to scale (SE and RTS).

Table 3. Input – Output data: Public Sector Banks (2007-2017)

Rs. in (Million)

Large Banks							
Decision Making Unit	**Total Employees (I)**	**Interest Expenses (I)**	**Non-Interest Expenses (I)**	**Deposits (I)**	**Advances (O)**	**Interest Income (O)**	**Other Income (O)**
BOI	40945	135507.3	36658.09	2402969	1399537	195507.2	25071.81
PNB	58663	148836.7	50654.18	2531458	1945987	239597.9	29569.62
CANARA	43742	153095.9	34243.16	2310323	1643913	207305.3	22950.72
CENTRAL	35964	95788.89	26982.5	1442907	1037294	130751.6	11478.19

IOB	26462	85004.83	21984.82	1224989	941802.9	118273.1	12383.23
SYNDICATE	26054	71570.47	19944.57	1176909	919242.3	104283.9	8404.15

Source: RBI&IBA Data Base

Rs. in (Million)

Small Banks							
Decision Making Unit	**Total Employees (I)**	**Interest Expenses (I)**	**Non-Interest Expenses (I)**	**Deposits (I)**	**Advances (O)**	**Interest Income (O)**	**Other Income (O)**
UCO	23805	71425.78	15055.64	1136700	817491.5	99755.59	7852.74
CORPOR	13784	65153.51	12862.74	985979.8	702187.9	86611.09	10923.06
INDIAN	19580	53409.79	16599.11	878108	642321.7	82766.56	9518.63
ANDRA	33977	113750.6	30749.84	1961682	1470692	164280.2	21041.56
VIJAYA	11708	42655.33	9773.94	628299.8	425572.3	55887.69	4784.44
DENA	10589	34442.49	8647.911	561462.3	391661.1	48307.26	4738.59

Source: RBI&IBA data base

8 SE and RTS: Results and Discussion

Table 4 presents SE scores, their inefficiency percentage and Returns to scale (RTS) of the large and small Public Sector Banks (PSBs) for the study period of 2007-2017.

Table 4 . SE scores, RTS and Inefficiency score of PSBs

Large Banks				**Small Banks**			
Decision MakingUnit	**SE Score**	**SIE (%)**	**RTS**	**DecisionMakingUnit**	**SE Score**	**SIE (%)**	**RTS**
BOI	1	0	CRS	ANDHRA	1	0	CRS
PNB	1	0	CRS	CORPORA	1	0	CRS
CANARA	1	0	DRS	INDIAN	1	0	CRS
CENTRAL	0.914	0.086	DRS	UCO	1	0	CRS

IOB	1	0	CRS	DENA	1	0	IRS
SYNDICATE	1	0	CRS	VIJAYA	0.9271	0.0729	IRS
Mean	**0.986**	**0.014**		**Mean**	**0.988**	**0.012**	
S.D	**0.035**	**0.035**		**S.D**	**0.030**	**0.030**	
C.V	**3.575**	**244.95**		**C.V**	**3.013**	**244.95**	

The mean SE score of the large banks was 0.986 indicating an overall efficiency level of 98.6 percent in their operations. In otherwords the inefficiency proportion of the large banks was 1.14 percent. Across the DMUs, 5 banks have secured cent percent scale efficiency but central bank dragged down the mean SE to below 1.

The mean SE score of small banks was 0.988. Under this category also the SE score of 5 banks was 1 and Vijaya bank dragged down the mean SE below 1.It may be observed that the mean efficiency levels of both large as well as small banks were almost identical, indicating that asset size does not enhance scale economies of PSBs.

Regarding RTS, 4 large PSBs experienced CRS and 2 large PSBs DRS. Infact, no large PSB recorded IRS during the period of study. Whereas in small PSBs 4 banks experienced CRS and 2 banks IRS.

It is evident from the analyses that in scale efficiency, the performance of both large as well as small PSBs was almost identical. But in RTS small banks had an advantage over large banks. Therefore consolidation may not improve scale efficiency and RTS in PSBs.

However,Part third presents a comparative study of the scale economies and RTS in large versus small private banks.With reference to assets size, Six large banks and Six small banks have been chosen for the study.

9. Input and Output Data of Private Sector Banks

Table 5 presents the input and output data set of the Private sector banks for the study period (2007-17) based on which we have estimated scale efficiency scores and Returns to scale (SE and RTS).

Table 5. Input – Output data: Private Banks (2007-2017)

(Rs. in Million)

Large banks

DecisionMaking Unit	Total Employees (I)	InterestExpenses (I)	Non-Interest Expenses (I)	Deposits (I)	Advances(O)	Interest Income (O)	Other Income (O)
ICICI	50549	172475.7	60223.79	1966860	1925888	257310.2	61974.54
HDFC	52857	104731.8	64747.4	1807501	1417343	197730.7	40681.21
AXIS	24723	91623.91	40633.33	1520270	1168440	148241.6	38914.51
YES BANK	14468	30049.54	7086.18	351694.4	263941.4	41481.44	6909.03
FEDERAL	8045	24194.83	7215.95	352879.6	262455.4	37680.29	4405.05
ING VYSYA	7314	17880.89	8805	252858.9	197313.4	26731.31	5196.25

Source: RBI&IBA Data Base

(Rs. in Million)

Small banks							
Decision Making Unit	Total Employees (I)	Interest Expenses (I)	Non-Interest Expenses (I)	Deposits (I)	Advances (O)	Interest Income (O)	Other Income (O)
SIB	5240	17087.46	4339.23	252272.8	181653.9	24162.48	1927.74
KVB	4912	16346.64	4239.27	219758.4	163423.5	22813.25	2713.34
KARNATAKA	5591	16832.82	4306.37	228441.5	149884.6	22040.72	2852.82
CITY UNION	2910	8312.88	2094.64	113975.6	82501.67	11888.86	1525.28
LVB	4912	7433.43	2018.4	219758.4	163423.5	22813.25	2713.34
CSB	2762	5365.16	2156.24	74579.9	50281.94	7357.8	693.98

Source: RBI&IBA Data Base

10 SE and RTS: Results and Discussion

Table 6.6 presents SE scores, their inefficiency percentage and Returns to scale (RTS) of the large as well as small Private Sector Banks for the study period of 2007-2017.

Table 6 SE scores, RTS and Inefficiency score of Private Banks

Large Banks				Small Banks			
Decision Making Unit	**SE**	**SIE (%)**	**RTS**	**Decision Making Unit**	**SE**	**SIE (%)**	**RTS**
ICICI	1	0	CRS	SIB	0.9179	0.0821	DRS
HDFC	1	0	CRS	KARUR VYSYA	0.9529	0.0471	DRS
AXIS	1	0	CRS	KARNATAKA	0.8919	0.1081	DRS
YES BANK	1	0	CRS	CITY UNION	0.9436	0.0564	DRS
FEDERAL	0.9233	0.0767	DRS	LVB	1	0	CRS
INGVYSYA	0.9387	0.0613	DRS	CSB	1	0	IRS
Mean	**0.977**	**0.023**		**Mean**	**0.951**	**0.049**	
S.D	**0.036**	**0.036**		**S.D**	**0.043**	**0.043**	
C.V	**3.681**	**156.36**		**C.V**	**4.571**	**88.81**	

It is evident that the mean SE score of large banks was 0.977 indicating an efficiency level of 97.7 percent in their scale of operations. In otherwords the mean inefficiency level of the large banks was 2.3 percent. Across the DMUs four out of 6 banks achieved cent percent SE score and only two banks viz: Federal and ING Vysya slipped into the inefficiency levels of 7.67 percent and 6.13 percent respectively. The implication is that for every unit of output produced Federal bank is using 7.67 percent and ING Vysya6.13 percent excess input respectively.

Where as in small banks the mean SE score was 0.951 indicating an efficiency level of 95.1 percent. In otherwords, the inefficiency percentage in small banks was 4.9 percent. Across the small banks, four out of 6 DMUs showed varied levels of inefficiencies, the maximum being 10.81 percent in Karnataka followed by 8.21 percent in SIB and 5.64 percent in City union bank. Only two banks viz: LVB and CSB achieved

cent percent scale efficiency under this category. Thus it may be concluded that, with reference to SE scores, large private banks appear to be relatively more efficient than the small banks during the period of Study.

Regarding RTS, the same scenario witnessed in SE scores continued in RTS also. For instance in large banks, 4 DMUs experienced CRS and two units DRS. Where as in small banks 4 units reaped DRS and 2 units CRS/IRS.

Thus the results confirm that large private banks recorded marginally a better efficiency levels in their scale of operations than small banks. The same scenario reflects in RTS also.

11. Summary and Conclusion

This study was envisaged to test the hypothesis that large banks would reap better scale economies and economies of scope. Large and small banks under three different categories viz: SBI group, Public sector banks and Private Banks were chosen. Scale efficiency scores and RTS values were calculated through intermediation approach of DEA and the results were analysed. Based on the analyses the following conclusions emerge:

1. Large banks of SBI has achieved optimal scale economies without any input wastage nor potential loss in output realization. The optimality in scale economies fetched IRS in their operations.
2. Whereas small banks could not achieve cent percent scale efficiency, indicating a slight inefficiency in their scale of operations by 1.4 percent. Regarding RTS there were mixed results.
3. The result confirm that large banks of SBI group were relatively more efficient than the small banks in scale economies and RTS and therefore the government decision to consolidate the SBI group with reference to efficiency improvementsis justified.
4. In scale economies the performance of both large as well as small PSBs were identical. But in RTS small banks had a better show than the large banks.
5. Asset size does not enhance scale economies in PSBs and therefore consolidation may not improve SE and RTS in PSBs.Private banks with reference to SE scores and RTS large private banks appear to be relatively more efficient than the small banks.

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