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Operational Efficiency and Productivity Change in Cross-country Commercial Banking Industries: Evidence From South Asia

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Abstract: *South Asia (SA) predominantly consists of developing economies with massive growth potential in their banking industries. To this end, this paper examines the efficiency and productivity change in 136 commercial banks (CBS) of 6 countries: Afganistan, Bangladesh, India, Nepal, Pakistan and Sri Lanka in South-Asia from 2013 to 2019. Data envelopment analysis (DEA) method is employed to identify the efficiency frontier for South Asian CBS (SA-CBS). DEA-based Malmquist productivity index (MPI) is used to determine whether a change in total factor productivity of SA-CBS is due to technical efficiency change or technology change. Findings indicate that the average technical efficiency of SA-CBS is 62.45 percent, which reveals that 37.55 percent of inefficiency exists under the study period. In addition, results show that technical inefficiency in SA-CBS is attributed to pure technical inefficiency rather than scale inefficiency. Results further indicate a marginal decline in productivity over the study period, where the average total factor productivity score is 0.998. This deterioration is mainly attributed to technical efficiency decline since the average technological change increased, thus causing a negative impact on the total factor productivity.*

Keywords: *South Asia, Commercial Banks, DEA, Efficiency, Total factor productivity*

1. Introduction:

A region or country's economic growth depends on regional cooperation and financial development Hamadi and Bassil [41]. Moreover, financial services contribute to industrial expansion and economic growth Prasad et al [57]. Commercial banks are the backbone of any economy's financial sector as it provides capital for different development projects that foster economic growth ([21], [78]). As commercial banking efficiency positively impacts financial development Fernandes et al [35], CBS's efficiency level improvement greatly concerns banking authorities and financial policymakers. South Asian Association for Regional Cooperation (SAARC) was established on 8 December 1985 in Dhaka, Bangladesh. It consists of 8 member countries, including Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka.

One of the main objectives of SAARC is to promote regional economic growth and strengthen the business ties between member countries to improve the quality of life in South Asia. Commercial banks in South Asia have a massive potential to boost financial development by providing credit to development projects in the region (Anwar & Cooray, 2012). Perera et al. [55] argued that commercial banks in South Asia can still earn high profits despite the negative impact on profitability due to the increased market competition. Commercial banks work as financial intermediaries between the savers and borrowers, thus making profit through efficient operational strategies. Performance evaluation of CBS is an extensively debated topic and has great importance for financial authorities. Ratios in annual bank statements like ROA and ROE give and financial performance of any CB; however, it doesn't show the overall performance of financial institutions. Two famous techniques, parametric stochastic frontier analysis (SFA) and non-parametric data envelopment analysis (DEA), are mostly used for efficiency estimation. Emrouznejad & Yang [31] described that DEA is an extensively used technique to measure the efficiency and productivity change in commercial banking industries around the globe. Numerous studies estimate the different types of efficiencies and productivity change in south Asia on a single-country basis. For example, many studies measure the operational efficacies of Indian banking, a big industry in South Asia ([20], [28], [45], [61], [68]). Silva et al [71] used both DEA and SFA to measure the technical efficiency of 60 Indian CBS from 1998 to 2012 and revealed that efficiency trends for each year are very similar. Bhattacharyya & Pal [20], Sharma et. al [69]; Tabak & Cajueiro [73] revealed that India's public sector commercial banks are more efficient than foreign CBS. Similarly, many studies estimate the efficiency and productivity of Pakistan's CBS over time; , Akthar [4],[5], Ataullah et. al [9],[10] , Burki & Niazi [22],[23] , Mustafa & Mehmood [52] , Zhu et al [81] found that foreign CBS operating in Pakistan are more efficient than domestic CBS. Recent research studies measure different types of efficiencies for CBS in Bangladesh ([1], [13], [63]).

Moreover, the efficiency literature of CBS for Nepal and Sri Lanka is also available for different periods ([38], [40],[53],[56],[76]). Technical efficiency (TE) of SA-CBS is mainly attributed to pure technical efficiency (PTE) or scale efficiency (SE)? An important research question still to be investigated. Moreover total factor productivity change is mainly attributed by technical efficiency change or technological change also has great importance of banking authorities in South Asia. Literature of banking performance of South-Asia advocates that none of the studies estimate the efficiency and productivity change of south-Asian CBS in single group frontier and compare the cross-country banking efficiency and productivity. To this end, our study contribute in following ways; firstly we applied DEA to measure the efficiency of 136 SA-CBS and distinguish the average efficiency scores for CBS of 6 different countries in South Asia from 2013 to 2019. In addition, gauging the change in TE is mainly due to a change in PTE or SE. Secondly, this research elaborated the efficiency level of CBS of each country concerning ownership change. Thirdly, a DEA-based Malmquist productivity index approach is applied to measure the productivity change in SA-CBS over the period to distinguish the change in total factor productivity (TFP) is mainly attributed to TE change or Technological Change. Finally paper also differentiates the productivity change in different groups (Countries) of CBS in SA. The rest of the paper is organized as follows: Section 2 describes the relevant literature review of banking efficiency and productivity. Section 3 and 4 present the DEA methodology and result discussion, respectively. Finally, section 5 gives the conclusion of the study.

2. Literature Review

This section reviews the relevant literature of banking efficiency and productivity change in different regions and countries to give a solid theoretical background for efficiency and productivity estimation in SA-CBS.

2.1. An overview of studies on efficiency estimation of CBS

Among numerous performance evaluation techniques, DEA, introduced by Charnes et al [26], [27], was an extensively used tool to estimate the efficiency of financial institutions, and CBS are not distinguished. Emrouznejad & Yang [31], [32] described that DEA application in banking is among the top industries for efficiency and productivity estimation. In the first two decades after DEA introduction as an efficiency measurement tool, it was primarily used in the USA and European countries ([18],[29], [36], [62],[70]). However, in the 21st century, DEA has been widely used as a famous performance evaluation tool in commercial banking around the globe ([12], [16], [65], [66],[79], [80]).

In addition, many studies are available in the literature that quantifies the efficiency of CBS in South Asian countries. Sathye [65],[66] applied DEA in commercial banking of India and found that mean efficiency scores of Indian CBS are lower than world mean efficiency Scores. The author further elaborates that private sector banks are less efficient than their public and foreign counterparts. Shanmugam & Das [68] also strengthened Sathye [65],[66] argument that state-owned are more efficient than their other counterparts. Jayaraman & Srinivasan [44] employed DEA to measure cost, revenue and profit efficacies of Indian banks and disclosed that revenue efficiencies scores are higher than cost and profit efficacies. Further, ([51], [19], [47]) differentiate the efficiency level of Indian banking sectors.

Using conventional DEA, Ali Rizvi [7] estimated CBS's efficiency in Pakistan for specific time duration and revealed that local commercial banks are more efficient than foreign CBS. He further argued that the efficiency of local banks improved over time. Studies proved that privatization policy in Pakistan had improved the technical efficiency of CBS ([4], [5] ,[22], [23]). After structural reforms and continuous foreign investment flow in commercial banking, foreign banks working in Pakistan improved their efficiency level ([58],[81],[82]).

Sufian & Kamarudin [72] estimated the efficiency level of commercial banks in Bangladesh and found that profit efficiency has no significant relationship with ownership style. Technical efficiencies with different ownership banks were gauged to distinguish the inefficient CBS from efficient in Bangladesh by Hossain Raju Md [42]. Similarly, Miah et al [49] and Ahmed et al [3] also quantified the different banking sectors of Bangladesh's commercial banking and revealed the different efficiency levels for other banking sectors. Gajurel [38] used DEA to measure the cost efficiency of Nepalese CBS and found that Inefficiency in Nepalese CBS is primarily due to technical inefficiency. Hada et al [40] argued that Nepalese state-owned performed better than other domestic, commercial banks while foreign CBS is most efficient. Liyanagamage [46] measured the efficiency scores of Sri Lankan CBS and revealed that domestic CBS is the most efficient, and macroeconomic shocks impact the technical efficiency of the banking industry. Similarly, few studies used DEA models to gauge the efficiency level in afghan commercial banking and revealed that most of the CBS are on an efficient frontier by Ahmadzai [2].

2.2. An overview of studies on productivity change in CBS

The DEA-based Malmquist productivity index measures the total factor productivity (TFP) change over the period and further decomposes the TFP change into technical efficiency and technology changes. DEA-based TFPI has become a vital tool to estimate productivity change in commercial banks. Berg et al [17] revealed that productivity growth in Norwegian banking increased rapidly after deregulation. Wheelock & Wilson [77] measured the productivity change in US banking for 1984-1993 and found that the decline in TFP was due to technological regress. Small banks were found to have lower efficiency and productivity level compared to large banks. Alam [6] employed

DEA and decompose the productivity change in large US commercial banks and revealed that productivity decline is due to technological deterioration. Chang et al [25] found that technological progress is the key source of total factor productivity growth in Chinese banks for 2002-2009. Similarly, numerous research studies applied the DEA-based Malmquist productivity index to find the productivity change in different parts of the world ([11], [30],[48]).

Focusing on the performance evaluation of CBS in South Asia, several studies evaluate the productivity change in banking industries for a single country. Reddy A.A. [60] distinguished the productivity change of different banking sectors in India for 1991 reforms and concluded that private banks had significant productivity growth compared to their public and foreign counterparts. Meanwhile, Fujii [37] argued that for the years 2004-2011, aggregate TFP growth is on a declining trend. While decomposing the different sectors of Indian banking, it was noted that foreign CBS has grown in TFP mainly due to technological advancement. Thota & Subrahmanyam [74] used data of 53 scheduled banks of India from 1992 through 2018 and employed MPI to measure the productivity change based on ownership change. Results indicated that, on average, productivity growth in state-owned banks was sustainable and continues, while in private and foreign CBS level of productivity growth was relatively lower than government CBS. Shair et al [67] found that Pakistan's CBS's total factor productivity change is equally attributed to technological and technical efficiency change. Further elaborating the productivity change of different banking sectors, authors found that private CBS had higher productivity growth than their public and Islamic counterparts for 2007-2017. Zhu et al [82] argued a declining trend in mean total factor productivity scores of Pakistani CBS, primarily due to technological change.

Pathak [54] investigated the TFP change of Nepalese CBS and found an average of 1.008 percent growth. The further author elaborated that domestic private CBS have higher productivity growth than public and joint-venture CBS. Jahan [43] applied the Malmquist productivity index and found that Islamic CBS has relatively higher productivity growth than conventional CBS in Bangladesh.

Some studies measure the cross-country efficiency and productivity change of commercial banks. Tuškan & Stojanović [75] used 28 countries and employed DEA to estimate the cost efficiencies of CBS across the European continent. Their results suggest that the banking system of post-transition countries has higher cost-efficiency. The efficiency of Islamic CBS in Arab and Asian countries was estimated by employing DEA and found that most Islamic banks are scale inefficient. Casu et al [24] and Rosman et al [64] conducted productivity analysis revealed that European CBS have productivity growth attributed to technological development. After an extensive review of literature about banking performance of SA-CBS, authors weren't able to find a cross-country performance evaluation of banking industries of south Asia except for the study by ([9],[10]) which compare the technical efficiency of Indian and Pakistani CBS.

3. Methodology

3.1 Data envelopment analysis

Charnes et al. [26] proposed a non-parametric efficiency measurement tool known as DEA to estimate homogeneous DMUs. The TE of DMUs was initially measured using this linear programming technique. Sherman et al. [70] were the first researchers to apply DEA to the banking sector to calculate the relative efficiency scores of various DMUs.

3.1.1 CCR Model

Considering a set of *J* DMUs with *n* input and *m* output in *T* (*t*=1,…, *T*) periods. Suppose in time *t*, decision-makers are using inputs $x^t \in R_+^n$ to produce outputs $y^t \in R_+^m$. Define the input requirement set in period *t*, which is:

$$L^t(y^t) = \{ x^t: x^t \text{ can produce } y^t \}.$$

Assume $L^t(y^t)$ is non-empty, closed, convex, and bounded, and that it satisfies the substantial disposability property of inputs and outputs $L^t(y^t)$ is bounded from below by the input isoquant (a constant returns to scale (CRS) production boundary), that is:

$$\text{Isoq}L^t\left(y^t\right) = \left\{x^t : x^t \in L^t\left(y^t\right),\ \ \lambda x^t \notin L^t\left(y^t\right) \text{ for } \lambda < 1\right\}.$$

Define the input distance function of period *t* as follows:

$$D^t\left(y^t, x^t\right) = \sup_{\theta}\left\{\theta : \left(x^t / \theta\right) \in L^t\left(y^t\right),\ \ \theta > 0\right\}.$$

Hence, the DEA-CCR model for measuring TE in period *t is* as follows:

$$\text{TE}^t\left(y^t, x^t\right) = 1 / D^t\left(y^t, x^t\right). \tag{1}$$

Usually, TE<1 suggests that a certain DMU is being evaluated compared to other DMUs. This DMU is productively inefficient since it uses excessive inputs, while TE=1 indicates that the DMU is fully efficient.

3.1.2 BCC Model

Furthermore, without assuming a functional form of the production technology, Banker et al. [14] constructed the production possibility set from an observed data set of input-output bundles. The DEA-BCC model was developed, which stated that TE could be further decomposed into pure technical efficiency (PTE) and scale efficiency (SE):

$$\text{TE} = \text{PTE} \times \text{SE}. \tag{2}$$

The BCC model represents the PTE without including the SE and assumes variable returns to scale (VRS). For the PTE, the BCC model is as follows:

$$Max\ h_k = \sum_{r=1}^{s} u_r\, Y_{rk} + \omega$$

Subject to:

$$\sum_{i=1}^{m} v_i\, X_{ik} = 1$$

$$\sum_{r=1}^{s} \mu_r\, Y_{rj} - \sum_{i=1}^{m} v_i X_{ij} + \omega \le 0 \tag{3}$$

$$u_r \ge 0;\ v_i \ge 0;$$

$$r = 1, \cdots, s;\ i = 1, \cdots, m;\ j = 1, \cdots, n;$$

$$\omega = free.$$

The DEA model that is also called the input-oriented radial VRS model, comes with increasing returns to scale (IRS) when $\omega > 0$. It becomes decreasing returns to scale (DRS) when $\omega < 0$. It is the DEA-CCR model (1) when $\omega = 0$. In general, a value of TE, PTE, or SE<1 means that the DMU under consideration is pure technically inefficient or scale inefficient as compared to other DMUs.

3.2 Malmquist Productivity index

The Fisher index, Malmquist productivity index (MPI), and Tomqvist index are commonly used indices to measure productivity change. MPI approach is more valuable because it doesn't need cost minimization and profit maximization assumptions. In Färe & Grosskopf [33] , a method for the value of MPI is obtained as follows

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

To decompose productivity change into TE change and technological change (TC), the MPI approach could be used:

$$M(y^{t+1}, x^{t+1}; y^t, x^t) = \frac{D^t(y^{t+1},x^{t+1})}{D^t(y^t,x^t)} \times \left[\frac{D^t(y^{t+1},x^{t+1})}{D^{t+1}(y^{t+1},x^{t+1})} \times \frac{D^t(y^t,x^t)}{D^{t+1}(y^t,x^t)}\right]^{1/2} \quad (4)$$

where TE Change = $\frac{D^t(y^{t+1},x^{t+1})}{D^t(y^t,x^t)}$, Technical Change =$\left[\frac{D^t(y^{t+1},x^{t+1})}{D^{t+1}(y^{t+1},x^{t+1})} \times \frac{D^t(y^t,x^t)}{D^{t+1}(y^t,x^t)}\right]^{1/2}$.

Some ratios outside the brackets in equation (4) indicate TE change between time t and time t+1, while the ratios within the brackets indicate a shift in technology. Since our observed industry is commercial banking, the above equation can be further elaborated to obtain the efficiency and technology change over time. MPI can solve a series of linear programming equations; see Färe & Grosskopf [33] in detail.

Suppose MPI >1 (MPI <1), the Malmquist index progress (regress) between t and t+1 is implied. There is no noticeable difference in efficiency from time t to time t+1 if the MPI value is 1. If TEC$>$ 1, TEC $<$1 and TEC = 1, the technical efficiency will increase, decrease, or remain constant between periods t and t+1, respectively. TC >1 and TC < 1 reflect progress and regress in production technology between periods t and t+1, respectively. TEC can be further broken down into scale efficiency change (SEC) and pure technical efficiency change (PTEC): TEC = SEC × PTEC.

3.3 Input-output selection and data collection

Two inputs (Interest expenses, Non-interest expenses) and two outputs (Net Interest income, Non-interest income) were selected from a previous study of Sathye [65],[66] for efficiency evaluation of 136 commercial banks from 6 South Asian countries. The sample includes 8 Afghan, 23 Bangladeshi, 36 Indian, 23 Sri Lankan, 26 Nepali and 20 Pakistani CBs. Ownership details of south Asian CBs are given in table 1. Inputs-outputs data of all 136 CBs was extracted from the bank-focus database for 7 years (2013-2019). The collected data were analysed by using Max DEA software.

Table 1. No of CBs and ownership style of South Asian CBs included in the sample

Country	No of CBs	Ownership Style		
		Public	Private	Foreign
Afghanistan	08	02	06	0
Bangladesh	23	01	20	02
India	36	12	18	06
Sri Lanka	23	04	14	05
Nepal	26	03	17	06
Pakistan	20	03	17	0

4. Empirical Results

4.1. Efficiency estimation

Table 2 shows us the mean operational efficiencies scores of all 136 SA-CBS for 2013-2019. The mean TE score is 0.6245, which indicates that there is still 37.55% inefficiency in CBS's operations in south Asian countries. Further decomposing the technical efficiency, we found that the mean pure technical efficiency score is 0.7342, and the mean SE score is 0.8598. Moreover, the highest TE score was noted in 2015 in all sample years. Figure 1 shows the annual TE scores of all 136 SA-CBS.

Table 2.
Mean Operational Efficiencies of 136 South Asian CBs (2013-2019)

Years	Mean TE	Mean PTE	Mean SE
2013	0.6550	0.7235	0.9132
2014	0.5573	0.7398	0.7629
2015	0.6699	0.7626	0.8886
2016	0.5982	0.7278	0.8339
2017	0.6293	0.7498	0.8446
2018	0.6455	0.7423	0.8757
2019	0.6165	0.6934	0.8996
Ave.	0.6245	0.7342	0.8598

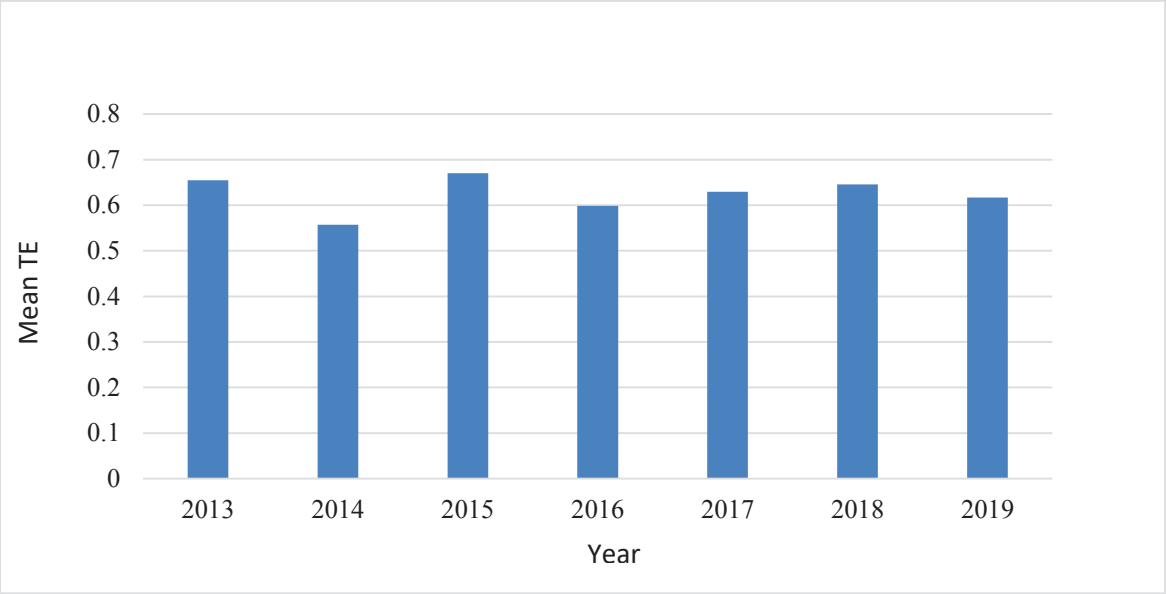

Figure 1. Average TE scores of all 136 SA-CBS

Table 3 results indicate the mean operational efficiencies of CBS for each country. Mean TE score indicates that 8 Afghan CBS under evaluation is most efficient in all 136 CBS with an average TE score of 0.8036. Nepal CBS ranked second with a mean TE score of 0.7241. Pakistani CBS with the least TE scores of 0.5238 indicates a high level of inefficiency compared with other CBS in the south Asian region. Besides this, Bangladeshi CBS was ranked third with a mean TE score of 0.6223, India fourth with 0.6025 and Sri Lanka fifth with 0.5702. Figure 2 shows us the annual variation of mean TE scores of SA-CBS.

Table 3.
Country-wise mean operational efficiencies of South Asian CBS (2013-2019)

Country	Mean TE (2013-2019)	Mean PTE (2013-2019)	Mean SE (2013-2019)
Afghanistan	0.8036	0.8606	0.9288
Bangladesh	0.6223	0.7415	0.8462
India	0.6025	0.7750	0.7933
Sri Lanka	0.5702	0.6545	0.8829
Nepal	0.7241	0.8059	0.8994
Pakistan	0.5283	0.6001	0.8892
Mean All	0.6245	0.7342	0.8598

4.1.1 Operational efficiency change with ownership style

Table 4 elaborates the efficiency results with ownership-style and distinguishes the efficiency level of sub-sectors of commercial banking industries of each country in south-Asia (see figure 2). CBS included from Afghanistan in Sample were 8 out of which two were public and remaining 6 were private CBS, results show that TE of public CBS is higher than private CBS (0.878>0.778) proving the results of Ahmadzai [2] who researched afghan CBS for the years 2009-2014. Sample of CBS for Bangladesh includes 20 private domestic CBS, two foreign and one public CB. Results reveal that foreign CBS operating in Bangladesh are more efficient than domestic CBS, as average TE scores of foreign CBS are higher than of those domestic public and private CBS (0.804 > 0.616 > 0.604). The study results by (Muhammad Masum et al [50] strengthened our argument with a similar outcome of efficiency evaluation of Bangladeshi CBS. Indian CBS display similar results as foreign banks are more efficient from domestic public and private, average TE scores for sample period were as TE scores foreign = 0.757, Private = 0.581, public = 0.557. The study by Sathye [65],[66] found different results where Public banks were more efficient than foreign and private CBS; however, the period was from 1997-1998, well before the structural reforms of Indian commercial banking. However, one recent study by Gulati & Kumar [39] endorsed our results that foreign banks operating in India are more efficient than domestic CBS. Like Indian and Bangladeshi CBS, foreign banks of Sri Lanka also have higher efficiency than domestic CBS; however, in domestic banking, public-owned CBS are more efficient than private (0.715 > 567 > 0.519).

Elaborating the different sectors of Nepalese CBS, we found that joint-venture banks are most efficient compared to local private and public CBS with a technical efficiency score of 0.817. While in domestic banking, public CBS is more efficient than private (0.710>0.694). These efficiency evaluation results of Nepalese CBS are aligned with the results of Gajurel [38]. Empirical analysis of Pakistani CBS reveals that private CBS are more efficient than public CBS. The average TE score of private CBS is 0.537, which is relatively higher than the public CBS score of 0.480. Due to a lack of data from 2017 to 2019, the foreign CBS of Pakistan was excluded from the efficiency estimation. Results favor the efficiency outcome of Akhtar [4] and Ratnam [59]. However, Zhu et al [82] found that public CBS of Pakistan is more efficient than private CBS for 2006-2017.

Table 4.
Mean Operational efficiencies of SA-CBS for all 6 countries with different ownership styles

Ownership	Mean TE	Mean PTE	Mean SE
AF all	0.803	0.860	0.930
AF private	0.778	0.831	0.932
AF Public	0.878	0.948	0.920
BD all	0.622	0.742	0.846

BD foreign	0.804	0.943	0.853
BD private	0.604	0.711	0.856
BD public	0.616	0.959	0.641
IN all	0.602	0.775	0.793
IN foreign	0.757	0.869	0.872
IN private	0.581	0.747	0.803
IN public	0.557	0.770	0.739
Lk all	0.570	0.655	0.883
LK foreign	0.715	0.825	0.883
LK private	0.519	0.595	0.883
Lk public	0.567	0.650	0.881
NP All	0.724	0.806	0.899
NP Foreign (joint venture)	0.817	0.850	0.959
NP Private	0.694	0.796	0.875
NP Public	0.710	0.775	0.916
PK all	0.528	0.600	0.889
PK private	0.537	0.600	0.905
PK Public	0.480	0.603	0.800

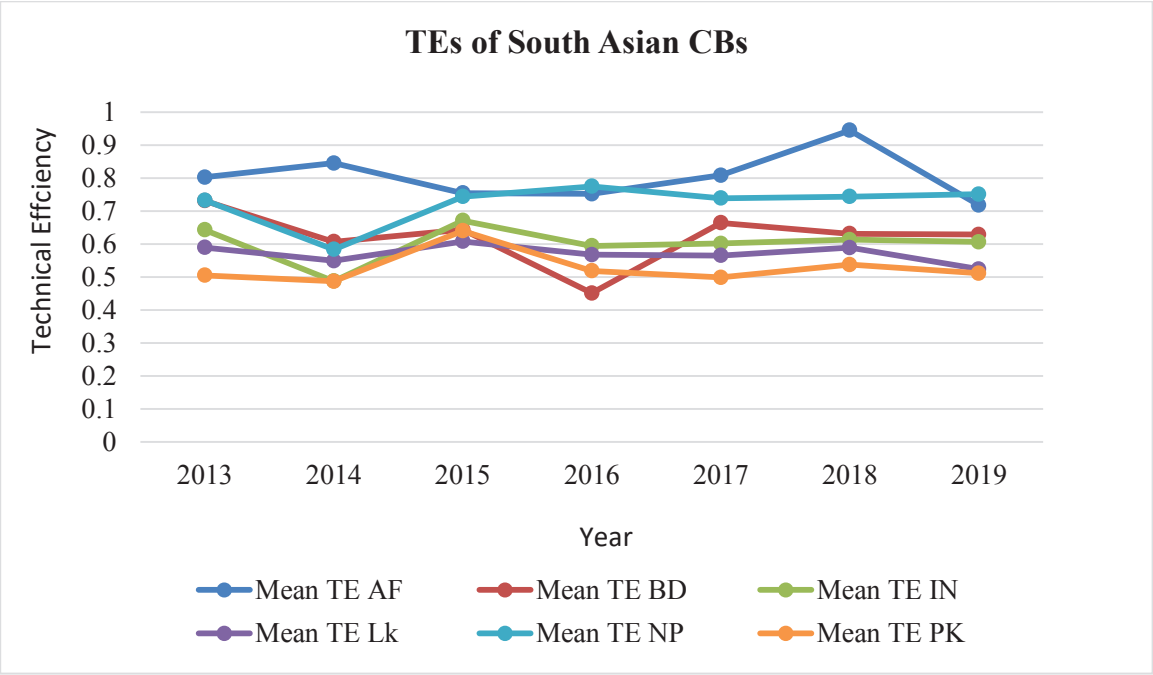

Figure 2. Mean TE scores of CBS for each country in South Asia (2013-2019).

4.2 Productivity Estimation

Table 5 explains the total factor productivity change scores and their decomposition in 136 SA-CBS from 2013 to 2019. For the sample period, south Asian CBS experienced an average decay of 0.002 percent as TFP change is 0.998, which is less than 1 and shows a declining trend mainly attributed to the efficiency decline (0.991) rather than technical change (1.008). Moreover, change in technical efficiency is attributed to both pure technical (0.994) and scale efficiency (0.997). Results further reveal that for the year 2013-2016, there is continued growth in TFP, but then a sudden decline was recorded for the next two years, 2016-2018, an increase of 0.004 was noted in 2019 (see figure 3).

Table 5.
Malmquist Index Summary of Annual Means of All 136 CBs

years	effch	techch	pech	sech	Tfpch
2013-2014	0.846	1.188	1.028	0.823	1.004
2014-2015	1.218	0.83	1.037	1.174	1.011
2015-2016	0.881	1.162	0.945	0.932	1.023
2016-2017	1.07	0.896	1.043	1.026	0.959
2017-2018	1.025	0.967	0.989	1.036	0.991
2018-2019	0.952	1.054	0.928	1.026	1.004
Mean	0.991	1.008	0.994	0.997	0.998

Note: Technological change (techch), efficiency change (effch), pure technical efficiency change (Pech), sech (scale efficiency change) and total factor Productivity change (tfpch).

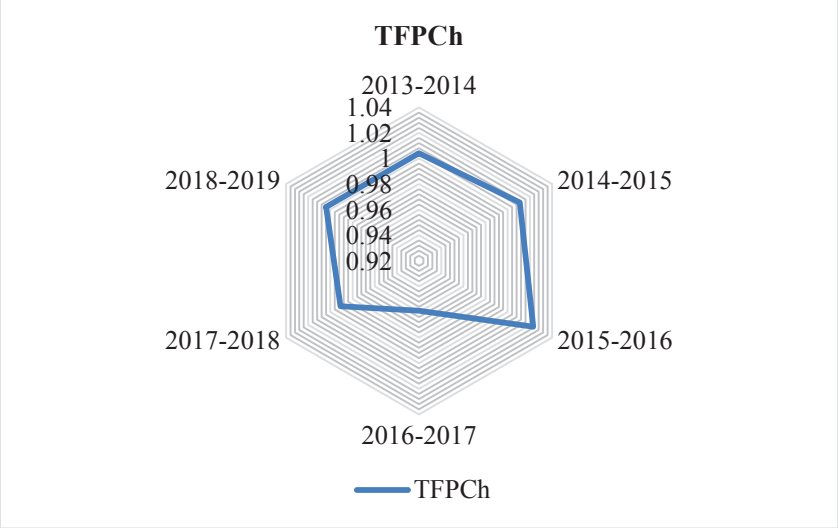

Figure 3. TFP change in SA-CBS for 2013-2019.

Table 6 of manuscripts shows us an average TFP change in CBS of each country of South Asia from 2013-2019. Results indicate productivity growth in the commercial banking industries of Nepal, Sri Lanka, and Pakistan for the sample period. At the same time, a decline in TPF was noticed in Afghan, Bangladeshi and Indian CBS. TFP decay in Afghan CBS (0.964) is attributed to both technical inefficiency (0.978) and technological decline (0.986), while the change in technical efficiency is mainly due to scale inefficiency. Elaborating the results of Bangladeshi CBS, we found that deterioration in TFP (0.993) is primarily due to technical inefficiency (0.975) instead of technological improvement (1.018); similar kind of results were observed by the study of Fatema et al [34] for the years 2013-2107. Similarly, TFP change (0.992) in Indian CBS is attributed to a decline in technical efficiency (0.991). However, technological change indicates an improvement (1.001) over the period; the results of our study oppose the outcome of Behera [15], who conducted the productivity evaluation of Indian CBS from 2007 to 2014 and found that growth in TFP is due to the efficiency growth. However, aligned with the results of Reddy A. A. [60].TFP growth of CBS in Sri Lanka was sighted with a tfpch score of 1.009 and mainly due to technological improvement (1.022), although a decline of 0.012 in technical efficiency. CBS of Nepal shows the highest score of TFP change (1.012) and is equally attributed to growth in technical efficiency and technological innovation; study results of (Neupane, 2013) who conducted the productivity evaluation of Nepalese CBS, favour our argument. Finally, CBS of Pakistan also shows us growth in TFP (1.008) and due to improvement in technology (1.006) and technical efficiency (1.001) for the years 2013-2019; not aligned with the productivity estimation results of Zhu et al [82]. However, Shair et al [67] found similar results in their productivity estimation of Pakistani CBS for 2007-2017.

Table 6.
Malmquist Index summary of CBS Means for all 6 Countries

DMUs	effch	techch	pech	sech	Tfpch
Afghanistan CBs	0.978	0.986	1.014	0.964	0.964
Bangladesh CBs	0.975	1.018	0.984	0.991	0.993
India CBs	0.991	1.001	0.991	1.001	0.992
Sri Lanka CBs	0.988	1.022	0.988	1.001	1.009
Nepal CBs	1.008	1.005	1.005	1.003	1.012
Pakistan CBs	1.001	1.006	1.002	1	1.008
All CBs	0.991	1.008	0.994	0.997	0.998

5. Conclusion and Policy Implication

This study estimates the efficiency level and productivity change in commercial banking industries of 6 countries in South Asia with a sample of 136 commercial banks for the years 2013-2017. Investigating the technical efficiency of SA-CBS mainly attributed to its decomposing factor pure technical efficiency or scale efficiency for the sample period. Further, deep insights into technical efficiency variation with changing ownership style of CBS for each country were investigated. Moreover, productivity change in SA-CBS is mainly due to efficiency change or technological change was another major concern of our research. To this end, data envelopment analysis (DEA) with two of its conventional models CCR and BCC, was employed to measure the efficiency level in SA-CBS. DEA-based Malmquist productivity index (MPI) was used to estimate the productivity change in SA-CBS. Results reveal that there is still 37.55 percent of Inefficiency in CBS operations in south Asia for the sample period of 2013-2017.

Further decomposing the technical efficiency, we found that technical inefficiency is mainly attributed to pure technical inefficiency instead of scale inefficiency. Therefore, it is advised to managers and banking authorities of south Asia to strengthen their operational strategies to improve the pure technical efficiency level, which is the main source of technical inefficiency. Further, an opportunity of 15 percent improvement in scale efficiency in SA-CBS still exists to arrive at the efficient frontier. Efficiency scores of afghan CBS are higher among all CBS in 6 countries of South Asia, Nepal and Bangladesh are ranked second and third respectively while Pakistani CBS were least efficient among all with an average inefficiency of 48 percent in their operations. Our findings suggest that Pakistan (SBP) needs to take rapid measures to improve the pure technical efficiency, which is a significant source of technical inefficiency to bring Pakistani CBS to achieve an efficient regional frontier of commercial banking. Efficiency level with different ownership style indicates that foreign banks operating in south Asian commercial banking industries are more efficient than domestic public and private CBS. Therefore, commercial banking authorities can advise the local banks to follow foreign banks' operation and market strategies to improve their technical efficiency. The technical efficiency level of local CBS has a variation for each south Asian country; therefore, local banking authorities can figure out the sources of inefficiencies in domestic private and public CBS and benchmark the efficient sector to improve each sector's efficiency.

Total factor productivity results advocate the argument that there is a decline in the average TFP of SA-CBS for the sample period. Decomposing factors disclose that decline in TFP is mainly attributed to efficiency decline rather than technology. To this end, commercial banking authorities of south Asia are advised to take steps for TE improvement in commercial banks. Elaborating the productivity change results for each country's commercial banks, TFP of Nepalese, Pakistani and Sri Lankan CBS demonstrate growth (due to increasing TE and technology). While Indian, Bangladeshi and afghan CBS shows a decline in TFP and mainly attributed to efficiency decline. Commercial banking authorities of India, Bangladesh and Afghanistan are advised to improve the TE of commercial banks in each country to improve the total factor productivity of commercial banking industries.

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