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The Technical Efficiency of South Asian Commercial Banks and the Effects of Income Diversification

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Abstract

A banking sector demonstrates its efficiency by providing a higher rate of return on deposits and lower interest rates on loans made possible through cost savings of efficient operations. Duplication of these efficient operations may help to attain sustainable economic growth in developing South Asian economies. In this paper, we analyzed three types of efficiency: the overall technical efficiency (OTE), the pure technical efficiency (PTE) and scale efficiency (SE) of commercial banks of South Asian countries, over the period 2000-2014. We further examined the impact of income diversification on bank efficiency. In the first stage analysis, using data envelopment analysis, we found that the OTE and PTE are the major source of inefficiency in South Asian commercial banks, while the SE is relatively higher. In the second stage, the panel Tobit Model regression results prove that income diversification has a positive and significant relationship with all three types of efficiencies OTE, PTE, and SE. Our results are robust in the use of alternative regression models.

Keywords: Bank efficiency, commercial banks, South Asia, Data Envelopment Analysis, Tobit Model regression.

1. Introduction

Technical efficiency reflects the firm's ability to obtain maximum output from a given bundle of inputs, relative to other best performing firms in the same industry (Farrell M. [20]). Ample research has been done on the technical efficiency of commercial banks in developed countries (see Berger and Humphrey [9], Berger and Mester [10], Resti, [43], San-Jose et al. [47], Moradi-Motlagh and Babacan [32] and Degl' Innocenti et al. [18]), while the literature on the efficiency of commercial banks in developing countries is still in progress (see Sathye [48], Petti and Hardy [38] and Das and Ghosh [15]). Further, the existing empirical evidence on the technical efficiency of banks is inconsistent, seemingly due to the use of different methodologies as well as differences in regulatory and macroeconomic conditions across countries (Seelanatha S. L. [51]). Therefore, it is not appropriate to generalize the findings derived from the studies of other regions to South Asian commercial banks, because the South Asian banking sectors have their own

distinct financial history, operating environment and macroeconomic conditions. Previously, in almost all south Asian countries, the banking sectors were dominated by state-owned banks which were highly regulated and severely plagued by government directed financing to priority sectors, over-staffing, high non-performing loans and inefficiency. During the 1990s, the financial reforms, such as the privatization of state-owned banks and deregulation, were implemented in almost all south Asian countries. Consequently, South Asian banking sectors have largely transformed from heavily regulated institutions to market based competitive sectors, with a variety of commercial banks (public sector, private sector and foreign banks) competing with each other to maintain and increase their market share (see Das and Ghosh [15], Jaffry et al. [27], Petti and Hardy [38] and Seelanath [50]).

To survive in this competitive market and to enhance their efficiency, commercial banks in South Asian countries started diversifying their income from traditional interest based income to non-interest income sources to get full benefit of the available resources due to the economies of scope. There are many studies available which have studied the effects of income diversification on profitability and stability of the banking sector in developed and developing countries (see De Young and Rice [17], Mercieca et al. [29], Chiorazzo et al. [12] and Meslier et al. [30]). But, to the best of our knowledge no one has investigated how income diversification interacts with the technical efficiency of commercial banks. Along with measuring the technical efficiency of South Asian commercial banks, providing empirical evidence on how income diversification has affected the technical efficiency of south Asian commercial banks, is an important contribution of this study to the existing literature. In absence of sophisticated capital markets the banking sector is the major source of funds for the corporate sector and sustainable economic growth of these developing countries (Nisar et al. [33]). As put forth by Luintel et al. [28] the financial system of all South Asian countries is predominantly bank-based rather than market based with exception of India, which has a somewhat better capitalized stock market. Even if stock markets are present the market depth is not satisfactory as most of the market capitalization is made up by a few blue chip companies. In South Asia about one-fourth of the world's population resides, most of them living in poverty and illiteracy. One reason for the South Asian financial structure's dependence on commercial banks is the low levels of journal literacy and financial education. Commercial banks help the uneducated masses of these developing countries to overcome problems of asymmetric information, adverse selection, and moral hazard. Secondly, small and medium enterprises which have significant presence in these developing countries also rely on the banking sector as the only source of funding as they do not have access to capital market, Luintel et al. [28].

The above facts make it more important to study the performance and efficiency of South Asian commercial banks as compare to other developed and developing countries. An efficient banking sector, by providing higher rate of return on deposits, and lower interest rates on loans because of cost savings from efficient operations, may help to attain sustainable economic growth in these developing economies. This economic growth will

result in human development and improvement in living conditions resulting in reduced poverty and improved literacy levels.

Banking literature generally determines the banks' performance using accounting centered profitability measures, market-based ratios and cash flow-based analysis (see Beccalli et al. [8]). However, the efficiency method is more suitable to measure the banks' technical efficiency (see Charnes et al. [11] and Banker et al. [3]). Berger and Humphrey [9] stated that frontier analysis provides an overall, objectively determined, numerical efficiency value and ranking of firms (also called X-efficiency) which otherwise is not available. Conventional regression-based methods deal with single output and multiple input cases, while the DEA models analyze multiple outputs and multiple inputs (Cooper et al. [14]). Literature proposes several frontier techniques for measuring bank efficiency, such as the Stochastic Frontier Approach (SFA), the Distribution Free Approach (DFA) and the Data Envelopment Analysis (DEA) (see Mlambo and Ncube [31]). Sathye [48] reported that Sherman and Gold [52] were the first to apply DEA to the banking sector. We have used the DEA because, now it is widely used in banking literature to measure technical efficiency of the banking sector (Berger and Humphrey [9] and San-Jose et al [47]).

In this paper, following Rosman et al. [45] and San-Jose et al. [47] we used a two-stage estimation methodology. In the first stage, we applied the non-parametric DEA methodology, with variable return to scale assumption, to measure the input-oriented technical efficiency scores of sample commercial banks. We calculated overall technical efficiency (OTE), pure technical efficiency (PTE), and scale efficiency (SE) for each bank. Further, we also specified the return to scale (RTS) of sample banks; whether the sample banks are operating on increasing return to scale (IRS), decreasing return to scale (DRS) or constant return to scale (CRS). In the second stage, we used the panel Tobit Model Regression to identify the determinants of the efficiency of commercial banks in all South Asian countries with special focus on how income diversification affects the technical efficiency of South Asian commercial banks. Simar and Wilson [53] provided references of 48 articles that have used this two-stage procedure. Further, for robustness purposes, we included industry-level variables, such as banking industry regulations and competition, and country-level variables, such as interest rates and financial crisis, in our models and again performed the panel Tobit Model Regression analysis.

The remainder of the paper is arranged as follows; the second section provides literature review. Section three provides details of data and methodology. Section four presents results and discussion. Section five will conclude the findings and recommendations.

2. Literature Review

In this section, we have provided the review of previous literature on technical efficiency and income diversification and have tried to find the gap in literature which needs further investigation. Berger and Humphrey [9] surveyed the results of 130 financial institutions' efficiency studies, employing at least five major efficiency techniques

in 21 countries. They concluded that the majority of efficiency studies had used the DEA meathodology as compared to other frontier analysis method. Fethi and Pasiouras [21] after review of 196 articles about bank efficiency, concluded that 151 out of the 196 articles they reviewed had used the DEA methodology to measure bank efficiency. Therefore, in this study, we have used DEA which is the most commonly used methodology to measure the technical efficiency scores. Berger and Mester [10] concluded that a significant body of research is available on the efficiency of banking sectors of developed countries but there is no sufficient literature available on developing countries like South Aisan countries. Many researchers concluded that technical inefficiencies are fairly large, up to 20% or more of the total banking sector cost. Therefore, it is very important to measure the technical efficiency of South Asian commercial banks, to take corrective measures to enhance the efficiency and to save the input costs which can be saved, but are being wasted due to inefficiency.

Wang et al. [57] using network DEA methodology concluded that the overall efficiency of the Chinese banks had improved during 2003-2011. Further, they found that the public sector commercial banks are more efficient than the private commercial banks. Sathye [48] concluded that the mean efficiency scores of Indian banks are comparable with commercial banks in other countries and the efficiency of private sector commercial banks is lower than that of public sector banks and foreign banks. Petti and Hardy [38] studied the effect of banking sector liberalization and privatization reforms on profit and cost efficiency of Pakistani banking during 1981-2002. They concluded that bank productivity, in terms of profits, has increased and new banks are more efficient.

Perera et al. [36] studied the cost efficiency of 111 commercial banks over the period 1997-2004. They applied the translog-form composite-error cost efficiency model. They concluded that the overall efficiency of banks in four South Asian countries deteriorated in the sample period. Bigger banks and listed banks proved relatively more cost efficient than government owned banks. Jaffry et al. [27] measured changes in productivity and technical efficiency levels within banking sectors of India, Pakistan, and Bangladesh over the period 1993-2001. They showed that the regulatory changes made throughout the 1990s in financial sectors have increased the levels of technical efficiency. Das and Ghosh [15] studied the impact of financial deregulation on cost and profit efficiency of Indian commercial banks during the post-reform period 1992-2004 using DEA. They found a higher level of cost efficiency and a lower level of profit efficiency. A multivariate regression highlights the importance of bank size and ownership.

A second strand of literature has studied the effect of income diversification on profitability, risk and stability of banking sectors in developed and developing countries. In the U.S. mostly a negative impact of bank income diversification on profitability and risk has been reported (De Young and Rice [17]). Similalry, Mercieca et al. [29] investigated whether the shift into non-interest income activities improves performance of small European credit institutions for the period 1997-2003. They found no direct diversification benefits, rather discovered an inverse association between non-interest income and bank performance. In contrast, some studies in the U.S.A, Europe and Asia found different relationships. Chiorazzo et al. [12] used annual data from 85 Italian banks for

the period 1993-2003, and concluded that income diversification increases risk-adjusted returns. Meslier et al. [30] using a unique dataset from the Philippines, found that a move toward non-interest activities increases banks risk-adjusted profits particularly when banks are dealing in government securities.

A few recent studies have tried to investigate the effect of bank income diversification on cost and profit efficiencies using the Stochastic Frontier Analysis (SFA). Alhassan [1] applied the SFA technique to 26 Ghanaian banks data for 2003-2011 to measure cost and profit efficiency scores. He found a non-linear effect of non-interest income activities on cost and profit efficiency. Doan et al. [19] studied the relationship between income diversification and bank efficiency across multiple countries over the period 2003-2012. Using the SFA to estimate bank cost efficiency, they found that increased income diversification has a tendency to improve bank efficiency but the benefits are offset by the increased exposure to volatile non-interest income generating activities.

Our study is different from the above two studies in three important ways: First, they have used the SFA which is a parametric (econometric) methodology and we are using the non- parametric DEA methodology which is totally different from the SFA, as detailed in methodology section. Second, the above studies examine the effect of income diversification on cost and profit efficiencies while we are investigating the effect on OTE, PTE and SE. Third, our sample countries and time-period are different.

In a detailed analysis of literature, we found that the majority of the literature on commercial banks technical efficiency consists of studies in developed countries. Few studies are available on Asian countries. The literature available, specifically, on South Asian commercial banks is scarce and dominated by the Indian banks and to a lesser extent on the Pakistani and Bangladeshi banking sectors. These are also limited to the measurement of change in efficiency as a result of deregulation and liberalization of banking sectors in the above three countries at the end of the 20th century. There is no evidence available regarding the efficiency of the other five South Asian countries (Sri-Lanka, Nepal, Bhutan, Maldives, and Afghanistan). Therefore, there is a gap in literature on technical efficiency of commercial banks of all South Asian countries after the great revolution in the technology of banking sector in the first decade of the 21st century until the recent years. Further, there is no evidence available about how income diversification interacts with the technical efficiency scores of South Asian commercial banks, obtained from the DEA. In the current study, we have tried to bridge this gap in literature using the panel Tobit Model Regression.

3. Data and Methodology

3.1. Data

We have used an extensive data set, taking the annual, unbalanced panel data of 200 commercial banks as detailed in Table 1, from all South Asian countries for 2000-2014 to gain insights into the current status of technical efficiency of South Asian commercial banks. Countries included in the study are Afghanistan, Bangladesh, Bhutan, India,

Maldives, Nepal, Pakistan, and Sri-Lanka. Our sample also covers the period of the global financial crisis, which amplified pressures on banks to operate with more increased efficiency than ever before. The data is taken from the well-known international data base Bankscope. All data are in thousand USD and we have used ratios of the variables as inputs, outputs and determinants of efficiency scores, as described in Table 2 and 3, respectively.

Table 1: Sample summary.

No.	Country Name	No. of Banks	Listed	Unlisted	Public	Private	Foreign
1	Afghanistan	8	0	8	1	7	0
2	Bangladesh	35	28	7	4	30	1
3	Bhutan	3	0	3	2	1	0
4	India	74	41	33	30	38	6
5	Maldives	2	0	2	0	2	0
6	Nepal	29	22	7	1	26	2
7	Pakistan	32	21	11	4	26	2
8	Sri-Lanka	17	10	7	3	11	3
	Total	200	122	78	45	141	14

Source: Information taken from central banks and the Bankscope database.

Data for the macroeconomic variables i.e. Government regulation, and bank competition is based on data from World Bank surveys on bank regulations conducted for 180 countries in 1999, 2003, 2007 and 2011, presented by Barth et al. [5] . Following the recent study of Ashraf et al. [2] we have used information from the survey conducted in 2003 for bank observations over the period 2000-2003, and from the 2007 survey for bank observations over the period 2004-2007 and from the 2011 survey for bank observations over the period 2008-2014. Yearly data for the interest rate (IR) policy for each country is taken from the world development indicators report of the World Bank.

Structure of South Asian banking sector:

The number of banks included in the sample from each country and their detail of listing and ownership status is provided in Table 1. India is the largest economy in South Asia with a relatively developed financial system. The banking sector is the major part of the Indian financial system; bank assets comprised over 80 percent of the GDP during 2014-2015, (Ghosh [22]). Commercial banks account for more than 90 percent of the total assets of the banking system. The share of state-owned banks in total assets is approximately 73 percent. Whereas is 1992, when financial reforms started, state-owned banks held approximately 90 percent of banking assets (see Reserve Bank of India [42]). The increase in the market share of private and foreign commercial banks is a result of banking reforms which started in 1992 to increase the efficiency of the Indian banking sector (see Reddy [40, 41], Rangarajan [39] and Roland [44]).

Pakistan is the second largest economy in South Asia. Starting in the early 1990s, massive privatization and liberalization has increased competition in the banking sector (Tahir [56]). Currently its financial sector is also dominated by commercial banks. Bank assets account for about 48 percent of the GDP at the end of 2014. As compared to the Indian banking sector, Pakistani commercial banking market is dominated by private commercial banks.

Bangladesh, being the third largest economy in South Asia, has total banking sector assets of about 61 percent of the GDP at the end of 2014. At the end of 2012, there were four state-owned commercial banks (SCBs), thirty private commercial banks (PCBs), and nine foreign commercial banks (FCBs) in Bangladesh (Bangladesh Bank [4]). Like Pakistan and India, Bangladesh also started reforms in its financial sector by privatization of its banking sector in 1991 to curtail mounting non-performing loans and widespread inefficiency in the banking sector (Jaffry et al. [27]). After privatization and increased competition, efficiency of the banking sector increased, to a large extent.

The Sri-Lankan Government started reforms in the banking sector as early as 1977 to increase the efficiency of the financial system. As a result of gradual reforms in the financial sector, development in information and communication technologies (ICT) has significantly changed the market structure of the banking industry in Sri-Lanka (Seelanatha [50]). Now, the total banking sector assets are approximately 68 percent of the GDP at the end of 2014. According to the Central Bank of Sri Lanka's annual report of 2012, commercial bank assets were 46.4 percent of total assets of the financial system and 66.6 percent of the total assets of the entire banking sector in the country. Nepal's total banking sector assets were about 64 percent of the GDP at the end of 2013. Afghanistan, Bhutan and Maldives are smaller economies in South Asia and their total banking sector assets are about 21 percent, 71 percent, and 85 percent of the GDP, respectively, at the end of 2014.

3.2. Methodology

In this paper, we have used a two-stage estimation methodology to study the efficiency of South Asian commercial banks. In the first stage, we have used the non-parametric Data Envelopment Analysis (DEA) to measure the input-oriented overall technical efficiency, pure technical efficiency and scale efficiency of South Asian commercial banks. In the second stage, we have used random-effects the panel Tobit Model Regression. The details of the two methodologies are given as follows:

3.2.1. Data Envelopment Analysis (DEA)

The term "data envelopment analysis" was first introduced in a model developed by Charnes et al. [50] (commonly known as the CCR model). This methodology identifies an efficiency frontier. Efficient banks with efficiency scores of unity form the frontier, while relatively less efficient ones with efficiency scores below unity are located inside the frontier. The advantages of DEA include: that it can work with smaller sample sizes, and it does not require specific functional form (Bauer et al. [2]). On the other hand,

its disadvantage is that it assumes no measurement errors and no mistakes caused by accounting rules (Berger and Humphrey [9]).

The CCR model assumes that there is no significant relationship between the scale of operations and efficiency by assuming the constant return to scale (CRS) and it provides the overall technical efficiency (OTE) scores. The CRS assumption is valid only when all the banks are operating at an optimal scale, which is not suitable for our sample. Therefore, the application of variable return to scale (VRS) is more appropriate in the banking efficiency evaluation (Wang et al. [57]). Banker et al. [3] extended the CCR model by relaxing the CRS assumption. The resulting BCC (Banker, Charnes and Cooper) model was used to measure the efficiency of the DMUs with variable returns to scale (VRS). The VRS assumption provides the measurement of pure technical efficiency (PTE) (Rosman et al. [45]). The input-oriented DEA model with VRS is represented by the following linear programming problem:

$$\begin{aligned} &\min_{\theta,\lambda} \theta \\ &\text{s. t.} - y_i + Y\lambda \geq 0, \\ &\theta x_i - X\lambda \geq 0, \\ &N1'\lambda = 1 \\ &\lambda \geq 0 \end{aligned} \tag{3.1}$$

Where θ is a scalar and λ is a $N \times 1$ vector of constants. The value of θ obtained will be the efficiency score for the ith DMU. It will satisfy $\theta \leq 1$, with a value of 1 indicating a point on the frontier and, hence, a technically efficient DMU, according to the Farrell's [20] definition. As we have considered input orientation, if some DMU gets a value of 'θ' less than '1' it can come to the efficiency frontier by decreasing its inputs by $1 - \theta$. The value of θ is obtained for each DMU (Coelli [13]). Note that without the convexity constraint $N1'\lambda = 1$, Eq. (3.1) becomes a DEA model with CRS technology. If technical efficiency scores for a particular firm with or without the convexity constraint imposed, are the same then the firm is operating under CRS. If these scores are different, the firm operates under the VRS technology. However, in such a case, it would be necessary to identify whether the firm operates with IRS or DRS. To do this, an assumption of non-increasing returns to scale (NIRS) is imposed in Eq. (3.1) and the convexity constraint $N1'\lambda = 1$ is substituted with $N1'\lambda \leq 1$, (Coelli [13]). This expression is given as follows:

$$\begin{aligned} &\min_{\theta,\lambda} \theta \\ &\text{s. t.} - y_i + Y\lambda \geq 0, \\ &\theta x_i - X\lambda \geq 0, \\ &N1'\lambda \leq 1 \\ &\lambda \geq 0 \end{aligned} \tag{3.2}$$

The solution of Eq. (3.2) reveals the nature of the scale efficiencies. The IRS exists if the technical efficiency score obtained with NIRS technology differs from the technical efficiency estimates with VRS technology. If both of these efficiency scores are equal, then the corresponding firm operates with DRS (see Coelli [13] and Rosman et al. [45]).

We will use an input-oriented DEA model. Scale Efficiency (SE) is calculated by dividing the efficiency scores from the CRS model by the efficiency scores from the VRS model. The VRS efficiency scores are always higher and the scale efficiency measures, therefore, are in the range of 0 to 1, (Rosman et al. [45]).

$$\text{Scale Efficiency (SE)} = \frac{\text{CCR efficiency scores}}{\text{BCC efficiency scores}} \tag{3.3}$$

Input − output specification **:** Two major approaches to input-output classification and measurement have been widely used. The production approach and the intermediation approach (Sealey and Lindley [49]). Berger and Humphrey [9] state that the production approach is better for assessing the efficiency of bank branches and the intermediation approach is more suitable for measuring the efficiency of entire banks. In the intermediation approach, banks intend to reduce transactional costs in depositors-borrowers relationships (Hermes and Nhung [25]). Then, the main inputs are bank liabilities (deposits and administrative expenses) and outputs are bank assets (loans, investments) (San-Jose et al. [47]). We have used the intermediation approach.

Three Inputs (capital, deposits, and administrative expenses) and three outputs (loans, investments, and non-interest income) are used in this study to measure the efficiency of commercial banks in all South Asian countries. According to Gulati and Kumar [23], the exclusion of non-interest income from bank's output is likely to cause the underestimation in the bank's output. As total profit is the sum of interest income received on loans and investments and non-interest income from fee, commission, and other non-interest income sources.

The inputs and outputs used are well supported by related literature, (see Gulati and Kumar [23, 24] Sathye [48], Sufian [55] Das and Gosh [15] Jaffry et al. [27], Pasiouras [35], Wang et al [57] and San-Jose et al. [47]). Table 2 provides the details and descriptive statistics of inputs and outputs. The efficiency frontier is constructed by using an unbalanced sample of 200 commercial banks operating in all South Asian countries for the extended period of 15 years, yielding a panel data set of 1774 observations.

3.2.2. Tobit model It is generally believed in the banking efficiency literature, that the use of the Tobit Model can handle the characteristics of the distribution of efficiency measures and, thus, can provide important policy guidelines (see, for example, Das and Ghosh [15] and De Young and Hasan [16]). Since the DEA technique produces efficiency scores which are between 0 and 1, it is appropriate to use a limited dependent variable approach, such as the panel Tobit Model to perform the multivariate analysis. Therefore, we applied the random-effects panel Tobit Model regression to study the determinants of the efficiency of South Asian commercial banks as suggested by Rosman et al. [45] and Jaffry et al. [27]. Following previous literature, we will test three models using OTE, PTE and SE scores as dependent variables against a set of common independent variables. The econometric model to be used is as follows:

$$\begin{aligned} Y_{it} = {} & \beta_0 + \beta_1 \mathrm{FC}_{it} + \beta_2 \mathrm{AE}_{it} + \beta_3 \mathrm{LA}_{it} + \beta_4 \mathrm{IA}_{it} + \beta_5 \mathrm{ROA}_{it} + \beta_6 \mathrm{LOA}_{it} + \beta_7 \mathrm{Liq}_{it} \\ & + \beta_8 \mathrm{NII}_{it} + \beta_9 \mathrm{Listed}_{it} + \beta_{10} \mathrm{Public}_{it} + \beta_{11} \mathrm{Foreign} + \beta_{12} \mathrm{AC}_{it} + \mu_{it} \end{aligned} \tag{3.4}$$

Table 2: Descriptive statistics of inputs and outputs, sample 2000-2014.

Inputs / Outputs	Description	Mean	Std. Dev.	Min	Max
Inputs					
Capital CA	Equity /total assets	9.57	7.30	0.62	74.57
Deposits DP	Deposits/total assets	74.50	15.67	0.00	98.75
Administrative expenses (AE)	Non- interest expenses / Average Earning Assets	2.586	1.427	0.350	22.450
Outputs					
Loans (LA)	Net loans / total assets	54.45	13.22	0.22	94.79
Investments (IA)	Investments / total assets	25.47	12.11	0.00	77.66
Non-interest income (NII)	Non-interest income/ gross revenues	32.02	15.21	-30.95	253.74

Note: All figures are in percentage.

In the above Tobit Model, dependent variable Y_{it} represents the sample banks' overall technical efficiency (OTE), pure technical efficiency (PTE), and scale efficiency (SE) scores, in three different models, as measured by the DEA methodology. Each bank is denoted by 'i'; 't' is the time period/year; FC, AE, LA, IA, ROA, LIQ, and LOA are the internal control variables. Non-interest income (NII) is our main variable of interest and Listed, Public, Foreign and AC are the industry specific control variables, and 'μ' is the error term. Detailed definitions of all independent variables and their hypothesized relationship with efficiency scores are given in Table 3.

Explanation of the variables included:

The FC is included in the regression model to represent cost of funding which is an important indicator of efficiency and profitability. It may be considered as the first step in banking to accumulate low cost funds in the form of different type of accounts like current and saving deposits. The banks which are able to secure low cost deposits will be considered as the most efficient in the intermediation process, as they will enjoy higher interest margins with higher profitability and efficiency.

Administrative Expenses (AE) are another avenue for banks' management to enhance their operational and technical efficiency. Commercial banks which can effectively control their expenses will be more efficient by producing higher outputs while utilizing the minimum inputs. Following Sufian [55] we will expect a negative relationship of (AE) with efficiency. After securing low cost deposits and working at the minimum expenses the most important factor and the main business of banks is the disbursement of various types of loans (LA) to their customers. According to the market conditions the commercial banks' management needs to carefully allocate their funds into various corporate, commercial and personal loans to attain the highest efficiency level by effectively utilizing the available resources. Following Jaffry et al. [27] and Sufian [55], we will expect a positive relationship of LA with efficiency, as banks with better loan policies and higher volume of loans tend to be more efficient.

Table 3: Description of variables used in Tobit Model.

Dependent / Independent Variable	Description	Expected Sign
OTE, PTE, SE	Overall Technical Efficiency, Pure Technical Efficiency and Scale Efficiency scores obtained from DEA methodology.	NA
Funding cost (FC)	Interest expense / Average interest-bearing liabilities	-
Admin. expenses (AE)	Non-interest expense / average assets	-
Loans (LA)	Net Loans / Total Asset	+
Investments (IA)	Investments/total assets	+
Return on assets (ROA)	Net-income / total assets	+
Liquidity (LIQ)	Liquid assets / total asset	+/-
Bank size (LOA)	Natural log of total assets	+/-
Income diversification (NII)	Non-interest income/ gross revenue	+
Listed	Dummy variable 1 for listed banks 0 for unlisted	+
Ownership (Public)	Dummy variable 1 for public sector banks 0 for Private banks	-
Ownership (Foreign)	Dummy variable 1 for foreign 0 for domestic banks	+
Regulations of bank industry (BR)	Capital regulation index values for each country taken from World Bank Surveys Barth at al. [5]	-
Competition of banking Sector (AC)	5 largest bank's share in total assets of all commercial banks taken from Barth at al. [5]	-
Interest rate policy (IR)	Average annual lending rate charged by commercial banks of a country taken from World Bank WDIs	-
Global Financial Crisis (GFC)	Dummy variable 1 for 2009, 0 otherwise	-

Investments (including investment in government securities and equity markets) also form a sizable portion of the South Asian commercial bank portfolios, i.e., on average approximately 25% of the total assets. Therefore, it is also important to study their effect on bank efficiency. We expect that investments have a positive effect on all three types of efficiency. Return on assets is the measure of profitability. Following Saha et al. [46] and Sufian [55], we expect a positive effect of ROA on efficiency as more profitable banks are considered more efficient and vice versa. Liquidity (LIQ) and bank size (LOA) may have positive or negative effects on efficiency depending how the liquid assets are used and whether the banks are able to efficiently utilize the economies of scale or it results in mismanagement of extra available resources. Das and Ghosh [15] and Saha et al. [46] also used liquidity and bank size as determinants of efficiency scores in the Tobit Model regression

Our main variable of interest is non-interest income (NII) which is used to represent income diversification. South Asian commercial banks have earned a sizeable portion (about 32 percent) of their operating income from non-interest income sources which

highlights the importance of studying its effects on technical efficiency of South Asian commercial banks. Sufian [55] also measured the effect of a similar measure (non-interest income/ total assets) on Malaysian banks efficiency. We expect a positive effect of NII (non-interest income/ gross revenues) on all three efficiency measures. Because, it is expected to diversify the risk of commercial banks, which is concentrated in loan portfolios. It is particularly important to diversify the risk in the case of South Asian commercial banks. According to data provided by world development indicators for 2000-2014, South Asian commercial banks have the highest NPLs ratio as compared to other developed and developing countries and the world average. Mostly non-interest income services are provided by the same staff of commercial banks using the same fixed assets, hence, benefiting from the economies of scope, and thus increasing the technical efficiency of commercial banks. The effect of listing status and ownership on efficiency scores is also investigated (Sufian [55]).

3.2.3 Robustness analysis:

In the robustness, analysis along with all the control variables and NII we have introduced some macroeconomic variables, listed in Table 3, and run the same random effect Panel Tobit Model regression again to test the robustness of the previous results. The Capital regulation index is used as proxy for banking regulation (BR), and the five largest banks asset concentration ratio (AC) is used as a proxy for bank competition, both calculated by Barth et al. [5]. If more assets are held by five largest banks, concentration ratio is higher and there will be less competition and vice versa. So, we will expect a negative relation between asset concentration and efficiency scores. In an environment of low competition there will be lower pressure on banks to be more efficient, hence overall low efficiency will prevail in the banking sector. Interest rates (IR) charged by banks are used as proxy for interest rate policies of the monetary authority as the interest rate charged is normally based on the central bank policy rate, plus the interest margin charged by commercial banks. The Global Financial Crisis (GFC), which is used as the dummy variable for year 2009, accounts for the effects of the global financial crisis on the efficiency of South Asian commercial banks. The econometric model to be used for robustness analysis is as follows:

$$\begin{aligned} Y_{it} = {} & \beta_0 + \beta_1 \mathrm{FC}_{it} + \beta_2 \mathrm{AE}_{it} + \beta_3 \mathrm{LA}_{it} + \beta_4 \mathrm{IA}_{it} + \beta_5 \mathrm{ROA}_{it} + \beta_6 \mathrm{LOA}_{it} + \beta_7 \mathrm{Liq}_{it} \\ & + \beta_8 \mathrm{NII}_{it} + \beta_9 \mathrm{Listed}_{it} + \beta_{10} \mathrm{Public}_{it} + \beta_{11} \mathrm{Foreign} + \beta_{12} \mathrm{AC}_{it} + \beta_{13} \mathrm{BR}_{it} \\ & + \beta_{14} \mathrm{IR} + \beta_{15} \mathrm{GFC}_{it} + \mu_{it} \end{aligned} \tag{3.5}$$

4. Results and Discussion

4.1. Efficiency of South Asian commercial banks

In this section, we will discuss the efficiency scores obtained from the DEA. Overall technical efficiency (OTE), pure technical efficiency (PTE) and scale efficiency (SE) scores are measured by DEA methodology. Further, the nature of the returns to scale is also specified as increasing, decreasing, or constant return to scale, for each bank year observation, in order to provide more specific policy recommendations to improve efficiency. Following Isik and Hassan [26], and De Young and Hasan [16] we have constructed an annual frontier specific to each year using window model for panel data in Max DEA software.

There are separate annual frontiers for each year for all banks, separately, rather than a single common frontier for all years. The main benefit of using panel data is that we can observe each bank more than once over the sample period (see Isik and Hassan [26]). This benefit is very important in a dynamic economic environment, as the technology of a bank that is efficient in one year might not be efficient in coming years (see Sufian and Noor [54]).

Table 4: Descriptive statistics 2000-4014.

Type of Efficiency	Mean	Std. Dev.	Min.	Max.
Overall Technical Efficiency (OTE)	0.818	0.165	0.197	1.000
Pure Technical Efficiency (PTE)	0.854	0.149	0.306	1.000
Scale Efficiency (SE)	0.955	0.074	0.374	1.000
Funding cost (FC)	6.205	2.329	0.000	50.790
Administrative expenses (AE)	2.586	1.427	0.350	22.450
Loans (LA)	54.458	13.222	0.226	94.792
Investments (IA)	25.473	12.115	0.003	77.669
Income diversification NII	32.027	15.211	-30.950	253.740
Return on assets (ROA)	0.911	1.883	-34.880	18.040
Liquidity (LIQ)	7.688	7.512	0.000	75.370
Bank Size (LOA)	14.325	1.865	9.230	19.880

Note: efficiency scores are from $0-1$, $1 = 100\%$ other figures are in percentage.

Descriptive statistics of efficiency scores calculated by the DEA methodology are provided in Table 4. This shows that throughout the sample period, South Asian commercial banks experienced a mean overall technical efficiency of 81.8 percent. In terms of input orientation, it means that the sample banks on average could have saved about 18.2 percent of the inputs to produce the same amount of outputs. This efficiency level is relatively higher than other developing countries. For example, Mlambo and Ncube [31] used the DEA methodology and found 67.2 percent mean technical efficiency of South

African banks over the period 1999-2008. Average efficiency scores for each year for OTE, PTE, and SE are provided in Table 5.

Figure 1 shows the efficiency trends for all South Asian commercial banks over the entire sample period of 15 years. The average overall technical efficiency (92.4 percent) was the highest in 2004. The higher efficiency of South Asian commercial banks in the early 2000s can be attributed to the boom in the banking industry, during that period. This was partly because of higher profitability, resulting from fast economic growth in the early 2000s in these countries and also due to technological advancements in the banking sector like, the proliferation of ATMs and online banking in the South Asian commercial banks. The average OTE was at its lowest in 2009 (61.17 percent), which may be caused by the global financial crisis which reduced the efficiency and profitability of commercial banks throughout the world (Nisar et al. [**?**]). Although after the global financial crises, the average OTE of the sample banks has improved but still has not fully recovered to where it was in the early 2000's. In order to further improve their efficiency, commercial banks in South Asia need to use their inputs more prudently. They can utilize excess capital and deposits into more productive avenues and should reduce their administrative expenses to further improve their efficiency.

Table 5: Yearly average efficiency scores.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
OTE	0.772	0.853	0.832	0.915	0.924	0.896	0.831	0.815	0.828	0.612	0.836	0.752	0.801	0.825	0.871
PTE	0.801	0.888	0.881	0.927	0.940	0.917	0.854	0.844	0.865	0.678	0.880	0.801	0.837	0.865	0.898
SE	0.959	0.957	0.946	0.986	0.982	0.976	0.971	0.957	0.952	0.905	0.946	0.940	0.954	0.953	0.967

Note: OTE= Overall technical efficiency, PTE =Pure technical efficiency, SE= Scale Efficiency. Efficiency scores are from $0-1$, $1 = 100\%$.

The breakdown of the overall technical efficiency (OTE) into pure technical (PTE) and scale efficiency (SE) shows that the SE of sample banks is higher than the PTE during all the years under study. South Asian commercial banks have become relatively scale efficient as a result of market reforms and consolidation in the banking sector throughout 1990s in South Asia (see Petti and Hardy [38] and Das and Ghosh [15]). This implies that during the sample period the dominant source of inefficiency of the commercial banks in South Asian countries is pure technical efficiency. This finding can be supported by the fact that all South Asian countries are developing countries and their banking sectors technologically are not so advanced as the banking sectors of developed western countries. Again the PTE was also at its lowest in the year 2009 because of the negative effects of the global financial crisis. As concluded by Moradi-Motlagh and Babacan [32], the global financial crisis also had an adverse effect on PTE of Australian banks. DeglInnocenti et al. [18] also found constant reduction in the productivity of banks from 28 European countries during the global financial crisis years.

To improve their efficiency South Asian commercial banks need to improve their technology of providing services to their customers. Services to customers may be improved by introducing innovative service delivery channels like internet banking, mobile banking and ATMs. Currently, South Asia is one of the fast growing regions in the use of the mobile phones and use of the internet on mobile devices. This change has come due to the introduction of 3G and 4G mobile internet services, in recent years. If commercial banks in South Asia encourage their customers to use mobile devices to carry out their financial transaction by introducing new products like mobile wallets and by providing some incentives like lower fees on mobile banking as compared to over-the-counter transactions. This could also attract more customers from remote areas as well, which would enhance the deposit base of these banks, which is a cheaper source of financing for loans and investments. Mobile banking could further the goal of financial inclusion which is a global concern, in recent times, and specifically in developing countries like South Asia where numbers of people having bank accounts and access to bank financing is very low as compared to developed countries. This effort could be further strengthened by the use of advanced ATMs, which along with dispensing cash could also accept deposits. Currently the majority of ATMs in South Asian countries can only dispense cash and do not accept cash deposit.

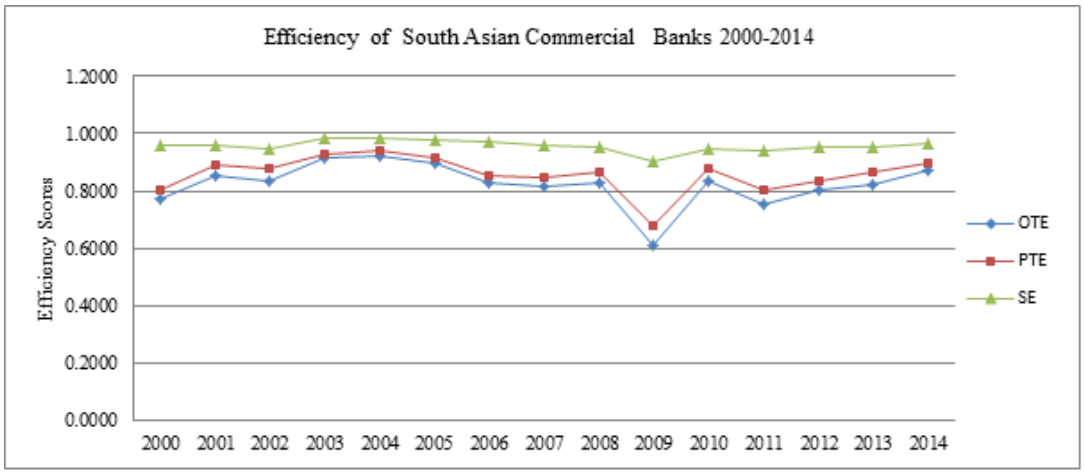

Figure 1: Graphical presentation of average efficiency scores of commercial banks in South Asia. OTE=Overall technical efficiency, PTE =Pure technical efficiency, SE= Scale efficiency.

Yet, another avenue for efficiency enhancement is the use of technology in the internal business processes of commercial banks. The banks can introduce the concept of the paperless office which will reduce administrative costs, minimize service delivery time, and improve the quality of service. Banks can use online submissions, as well as evaluation and approvals for loan applications by different departments and branches located in distant places. If all commercial banks in South Asia adopt these recommendations there can be visible improvement in the efficiency of South Asian commercial banks.

There could be huge cost savings in terms of reduced branch staff and related administrative expenses to maintain extensive branch networks. This efficiency will bring about improvement in quality of service and at the same time yield higher profits, which is the bottom line of every commercial organization

According to the data in Table 6, the highest numbers of banks (728/ 41.03 percent) were operating at IRS, where an increase in inputs brings about higher increase in outputs. Following these findings, the banks which are operating at increasing return to scale can benefit by increasing their size of operations until they reach a stage of constant return to scale. Although as a result of banking reforms in these countries there have been mergers and acquisitions but according to above results, there is room for further consolidation in the scale of operations of commercial banks which may be attained either by organic growth of existing banks or by further mergers and acquisitions.

Table 6: Descriptive statistics of return to scale (RTS).

Return to scale (RTS)	Number of observations	Percentage
Increasing return to scale (IRS)	728	41.037
Decreasing return to scale (DRS)	726	40.924
Constant return to scale (CRS)	320	18.033
Total	1774	100

The second highest number of banks (726 / 40.92 percent) was found operating at DRS during the sample period. DRS means, when a particular bank increases its inputs, it results in, proportionally, lower increase in its outputs. The banks which are found operating at DRS should curtail their size of operations and thereby can gain cost savings because currently they are earning less by spending more. The banks operating at DRS are, most likely, the public sector banks which are generally operating vast branch networks in underdeveloped areas in these countries to fulfill social goals. Perera et al. [36] and Petti and Hardy [38] also found efficiency of public sector banks lower than private and foreign banks. The least number of commercial banks (320 / 18.03 percent) were operating at CRS which means that they were operating at the most favorable scale of operations. They should concentrate on maintaining their position in the competitive market.

4.2. Determinants of efficiency

To better understand the factors affecting the efficiency of South Asian commercial banks, we have performed three random effects panel Tobit Model regressions as given in methodology section. We took OTE, PTE, and SE scores obtained from DEA methodology respectively as dependent variables against a set of common independent variables. The determinants we have used and their Tobit Model regression results are given in Table 7. The Tobit model results demonstrate that the values of likelihood

ratio are highly significant for all three models which imply that the models are good for estimating the desired econometric relationships. Year dummies are introduced to control for yearly effects.

Table 7: Tobit Model Regression results.

Dependent variable	Model 1 OTE	Model 2 PTE	Model 3 SE
Independent variables	Coef.	Coef.	Coef.
Funding cost (FC)	-0.001**	-0.001**	-0.001
Admin. expenses (AE)	-0.048***	-0.042***	-0.009***
Loans (LA)	0.005***	0.014***	0.012***
Investments (IA)	0.005***	0.004***	0.002***
Income diversification NII	0.003***	0.003***	0.001***
Return on assets (ROA)	0.008***	0.007***	-0.001
Liquidity (LIQ)	0.012	0.012	0.001*
Bank size (LOA)	0.007**	0.008**	0.001
Listed	-0.007	-0.003	-0.006
Ownership (Public)	0.011	0.014	-0.001
Ownership (Foreign)	-0.006	0.023	-0.004
Bank competition (AC)	0.001**	0.001**	0.002
Year	Yes	Yes	Yes
Constant	0.319***	0.413***	0.832***
Likelihood ratio (LR)	1537.581***	1537.150***	2494.463***
Wald chi2(27)	1702.350***	1229.060***	393.010***

Note: ***, ** and *, are representing 1%, 5% and 10% level of significance.

Cost of funding (FC) has a negative and significant effect on OTE and PTE efficiency in model 1 and 2 at the 5% level of significance. It implies that to enhance their technical efficiency the South Asian commercial banks need to decrease their cost of funding. This target may be achieved by generating low cost current and saving deposits and by reducing the external financing which is generally more expensive than deposits. The economic significance of this result is also noteworthy: a one standard deviation change in funding cost (2.33) is associated with a change in OTE of -0.0019 (-0.001*2.33), where the mean value of OTE is 81.8 percent. The FC has no significant relation with the SE. It implies that funding cost has negative relation with OTE and PTE, irrespective of scale of operations. All banks can enhance their efficiency by reducing the cost of funding.

Administrative expenses (AE) have shown a negative and highly significant relation with dependent variables at the 1% level of significance in all three models. Sufian [55] also found a negative and significant relation of AE with technical efficiency. This implies

that as South Asian commercial banks reduce administrative expenses their OTE, PTE, and SE will increase. As prudent utilization of administrative expenses result in reduced inputs for the same amount of outputs, efficiency will improve for the resources used. The economic significance of this result is also considerable: a one standard deviation change in administrative expenses (1.427) is associated with a change in OTE of -0.069 (-0.048 *1.427), where, the mean value of OTE is 81.8 percent.

Advancing loans (LA) which is the main business and source of earning for commercial banks, has shown a positive and significant relationship with dependent variables in all three models. Jaffry et al. [27], Pasiouras [35], Sufian [55] and Batir et al. [6] also found similar relationships of loans with efficiency in the banking sector. This result has considerable economic significance: a one standard deviation change in loans/total assets (13.22) is associated with a change in OTE of 0.061 (0.005*13.22), where the mean value of OTE is 81.83 percent. It means that as the volume of loans increases, the efficiency will be improved because it will enhance the profitability of the banks. It also implies that efficient utilization of available funds to finance various projects according to market conditions of demand and supply in different industries, taking into account all the risk factors, may enhance the technical efficiency of South Asian commercial banks.

Investments (IA) have also shown a positive and highly significant relationship with OTE, PTE, and SE. A one standard deviation change in investments (12.115) is associated with a change in OTE of 0.056 (0.004*12.11), while the mean value of OTE is 81.83 percent. This means that as the investments increases, the profitability, hence, efficiency of commercial banks will increase. Return on assets (ROA), which represent overall profitability, have also shown a positive and highly significant relationship with OTE and PTE, but an insignificant relationship with SE. Pasiouras [35] found a positive relationship of ROA with technical efficiency in Greek banks. Sufian [55] also found a positive and significant relationship of ROA with technical efficiency in Malaysian banks. Batir et al. [6] also found the same relationship for Turkish banks. A one standard deviation change in ROA (1.88) is associated with a change in OTE of 0.0159 (0.008*1.88), while the mean value of OTE is 81.83 percent. It means as the ROA increases the efficiency of commercial banks will also increase.

Our main variable of interest income diversification (NII) has shown a positive and highly significant relation with OTE, PTE and SE at a 1% level of significance. Therefore, with this result we can conclude that diversification into non-interest income generating activities has increased the Overall Technical Efficiency, Pure Technical Efficiency and Scale Efficiency of South Asian commercial banks. It means that South Asian commercial banks have benefited from Economies of Scope to enhance their efficiency. This result also has considerable economic significance. A one standard deviation change in non-interest income (15.21) is associated with a change in OTE of 0.047 (0.003*15.21), where the mean value of OTE is 81.83 percent.

Liquidity (LIQ) has shown a positive but insignificant relation with OTE and PTE and a positive and significant relationship with SE in Model 3, at a 10% level of significance. We can conclude that in the given context OTE and PTE is not affected by the level of liquidity of South Asian commercial banks. One possible reason is the liquidity

is more related to operational efficiency and solvency of commercial banks than the OTE or PTE. Positive and significant relationship of liquidity with the SE shows that commercial banks with more liquid asset can increase their scale of operations by lending or investing the available liquid funds according to market demand. Bank size (LOA) has shown a positive and significant relationship with OTE and PTE at a 5% level of significance and a positive but insignificant relationship with SE. This means that in South Asian banking sector commercial banks with bigger size (higher total assets) are more technically efficient because they have more funds to invest in new technology to increase technical efficiency. Sufian, F. [55] also found a positive and significant effect of bank size on technical efficiency of Malaysian banks. This positive relationship of bank size with OTE also has considerable economic significance. A one standard deviation change in bank size (1.865) is associated with a change in OTE of 0.013 (0.007*1.865), where the mean value of OTE is 81.83 percent.

Bank competition (AC= five largest banks asset concentration ration) contrary to our expectation, has shown a positive and significant relationship with OTE and PTE at 5% level of significance and a positive but insignificant relationship with SE. Perera et al. [37] also reported higher asset concentration in South Asian banks. From this result we can conclude that despite, relatively low competition (as a result of higher concentration) in the South Asian banking sector OTE and PTE is still higher. This situation is prevailing because due to low competition the commercial banks are able to charge higher interest rates and service charges from customers which increases their ability to earn higher profits by using limited inputs which in turn increase their OTE and PTE (ability to get maximum output by using minimum inputs). This argument is supported by our data section; in India the largest economy in South Asia, about 77 percent of the commercial banking sector is dominated by Public sector banks and in Bhutan 100 percent of banking assets are held by the five largest banks. It is concluded from our results that listings on stock exchange and ownership status does not have any significant effect on the three types of efficiency scores.

4.3. Robustness of results

The Tobit Model 4, 5, and 6 regression results, after adding the macroeconomic and country specific variables to verify the robustness of previous results, are given in Table 8. As can be seen from Table 8 the values of the Log-likelihood ratio are highly significant for all three models which imply that the models are good for estimating the intended econometric relationship. Year dummy is introduced to control for yearly effects. As in previous models all the control variables have shown similar results including FC, AE, LA, IA, LIQ, LOA and dummy variables for ownership. There are few exceptions: the FC has also shown a significant relationship with SE in Model 6; the LIQ has shown an insignificant relationship with the SE in Model 6; The relationship of AC with OTE in Model 4 has become insignificant, but has become significant with SE in model 6.

The dummy variable, GFC, has shown a negative but insignificant relationship with all three types of efficiency scores. This means that the global financial crisis has not

affected the efficiency of South Asian commercial banks, significantly. These banks had almost no exposure in innovative financial derivatives, and no stake in western banks which were liquidated as a result of the global financial crisis. That is why; they were saved from the direct negative effects of the GFC, as no commercial bank failure was reported in South Asia. Gulati and Kumar [24] also reported a slight, negative effect of the GFC on efficiency of Indian banks and a quick recovery after the crisis. The variable, GR representing the capital regulation index as measured by Barth et al. [6], which is used as a proxy for government regulation, has shown an insignificant relationship with OTE and PTE but a negative and significant relationship with the SE at a 5% level of significance. From this we can conclude that government regulation to increase the minimum capital requirements and to increase the paid-up capital of commercial banks according to risk weighted assets may impede the scale efficiency of South Asian commercial banks.

Table 8: Tobit Model Regression results for robustness test.

Dependent variable	Model 4 OTE	Model 5 PTE	Model 6 SE
Independent variables	Coef.	Coef.	Coef.
Funding cost (FC)	-0.001**	-0.001**	-0.002**
Admin. expenses (AE)	-0.044***	-0.037***	-0.009***
Loans (LA)	0.004***	0.004***	0.002***
Investments (IA)	0.005***	0.004***	0.002***
Income diversification NII	0.003***	0.003***	0.001***
Return on assets (ROA)	0.007***	0.006***	0.001
Liquidity (LIQ)	0.001	0.001	0.000
Bank size (LOA)	0.007*	0.007*	0.000
Listed	-0.010	-0.005	-0.007
Ownership (Public)	0.021	0.023	0.000
Ownership (Foreign)	-0.005	0.003	-0.007
Bank competition (AC)	0.000	0.001*	0.000***
Global financial crisis (GFC)	-0.016	-0.026	0.015
Government regulation (GR)	-0.003	0.000	-0.003**
Interest rate policy (IR)	0.000	-0.005**	0.004***
Year	Yes	Yes	yes
Constant	0.360***	0.442***	0.843***
Log Likelihood ratio	1446.296***	1435.684***	2282.589***
Wald chi2(27)	1574.770***	1143.880***	341.930***

Note: ***, ** and *, are representing 1%, 5% and 10% level of significance.

The interest rate policy of the monetary authority (IR) has shown negative and

an insignificant relationship with the OTE but has shown a negative and significant relationship with the PTE and the SE of South Asian commercial banks at a 5% and a 1% level of significance, respectively. This implies that as the monitory authority raises the interest rate to tighten the credit supply, loan demand decreases due to the high price of loans and as the banks interest income declines, banks are unable to increase their loan assets, hence, their scale efficiency declines. As a result of higher interest rates, the cost of deposits (input) increases and due to low demand for loans, the interest income on loans (output) decreases. Therefore, there is a negative effect on pure technical efficiency. Overall the robustness test confirms the previous results.

5. Conclusion

In this paper, we have a twofold objective. First, we studied the different types of bank efficiency. Second, we examined the impact of bank income diversification on efficiency. We considered a large sample of 200 commercial banks from all South Asian countries, including Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri-Lanka, for an extended period of 15 years from 2000 to 2014.

In the first stage, we have used the Data Envelopment Analysis (DEA) methodology to measure overall technical efficiency (OTE), pure technical efficiency (PTE) and scale efficiency (SE) of sample banks. We found that the OTE and PTE are the major sources of inefficiency in South Asian commercial banks, over the sample period. South Asian commercial banks should efficiently use the available resources and introduce new technologies to improve the OTE and the PTE. While, the SE is found to be relatively higher throughout the period studied. SE may have been improved due to consolidation, mergers, and acquisitions caused by the financial sector reforms in these countries throughout the 1990s. South Asian commercial banks faced significant reduction in efficiency during 2009, because of the global financial crisis, which deteriorated the efficiency of banking sectors throughout the world. Further, we found that almost an equal number of banks (41.03 percent) and (40.92 percent) were operating at the IRS and DRS, respectively. A few banks (18%) were operating at the CRS. This means that South Asian commercial banks need extensive efforts to bring themselves to the CRS to be able to operate at an optimum scale of operations. This can be achieved by scaling down the banks which are operating at the DRS and increasing the size of banks which are operating at the IRS.

In the second stage analysis, we investigated how income diversification and other macroeconomic factors have affected the OTE, PTE and SE efficiency of South Asian commercial banks by using the panel Tobit Model regression. We found that income diversification has improved all three types of efficiencies OTE, PTE and SE. We also found that the higher cost of funding and higher administrative expenses are the main causes of lower efficiency, while loans, investments, bank size, and profitability have a positive effect on the technical efficiency of South Asian commercial banks. These findings suggest that South Asian commercial banks can improve their efficiency by decreasing their cost of funding and administrative expenses and increasing their non-interest income, bank size, loans, investments and profitability. The results of our study

may help bank managers and regulators improve the efficiency of South Asian commercial banks.

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