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Impact of Non-Interest Income on Bank Efficiency: Evidence from Sri Lanka

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ABSTRACT

Purpose: To explore the impact of non-traditional activities on both the cost and profit efficiency of banks as the measures of banks' performance for the context of Sri Lanka.

Design/Methodology/Approach: This study has considered systemically important banks in Sri Lanka as the sample and a panel data set for the period 2009 to 2019 obtained from annual reports of the banks. Estimation of bank efficiency was based on Stochastic Frontier Analysis (SFA). The efficiency of banks estimated using Cobb-Douglas and Translog Frontier forms.

Findings: The efficiency scores indicate that profit efficiency of banks have decreased due to the involvement in non-traditional activities while the cost efficiency of banks have increased due to the involvement in non-traditional activities.

The analysis shows that technology development has a significant impact on profit inefficiency under both cobb-douglas and translog models, while ATM development has only a significant impact on cost inefficiency under translog model when banks engage in both traditional and non-traditional banking activities. Yet, both profit and cost inefficiency of banks does not influence due to the ownership status of banks under the both models.

Originality: This study contributes to the extant literature by highlighting the impact of inclusion of non-interest income as the secondary source of banks' income to the banks' performance in terms of profit and cost efficiencies as existing literature is silent regarding in this aspect.

KEYWORDS

Cost Efficiency, Cobb-Douglas Model, Non-traditional activities, Profit Efficiency, Sri Lankan Commercial Banks, Translog Model

JEL

CLASSIFICATION

C6, D24, D61, G2

I. Introduction

Survival and the progress of a banking system depends on the profit and the cost efficiencies of the banks. In this aspect, maintaining a mixture of both interest income and non-interest income sources are important for banks as it has cost advantages and it leads to reduction of risk. Yet, there is a theoretical debate regarding the impact of non-interest income on bank performance since existing literature is inconclusive in this aspect. Therefore, this issue should be further addressed.

More specifically, Stiroh (2002) ascertain that non-interest income in U.S. banking system accounted for 43% of net operating income by 2001, and more dependence on trading revenue as a non-interest income is

related with high risk and lower risk-adjusted profits. Further, Stiroh (2004) highlights that greater amount of income earns through non-traditional sources is adversely related with the performance in the Community Banks in U.S. by using the data during the period 1984-2000. Coincide with this finding, Stiroh and Rumble (2006) highlight that the diversification benefits are not profitable than lending activities in financial holding companies in U.S. by using the data during the period of 1997-2002. (Mercieca, Schaeck & Wolfe, 2007) also find that Europe credits granting institutions could not have benefited from diversification by analyzing the data during the period of 1997-2003 and non-interest income is negatively related with risk-adjusted performance. Moreover, Hahm

(2008) states by considering the banks in OECD countries that banks cannot achieve desired performance outcomes by moving towards the non-interest activities. Further he states that banks in U.S and Europe have come across with declining market share and profitability by moving towards the non-interest income sources.

Contrast to the negative effects of non-interest income on bank performance, Chiorazzo, Milani and Salvini (2008) highlight through an empirical analysis on Italian banking system and, by using the data over the 1993-2003 period, they have concluded that the movement towards the non-interest income is beneficial for banks because the relation between diversification of income and risk-adjusted banks' returns has been positive. The gains derive through non-interest income has been weakened with bank size. Further Sanya and Wolfe (2011) state by investigating eleven banks in emerging economies that the both interest earning and non-interest earning activities reduce the insolvency risk and boost the profitability of banks. More recently, Park, Park and Chae (2019) state that U.S. bank holding companies have come across with positive effects during the crisis era on bank risk and return by moving towards non-interest income.

Thus, the existing literature indicates that the influence of non-traditional income sources on bank performance is somewhat doubtful as it has both positive and negative effects. Therefore, this study extends to address this problematic background for the context of Sri Lankan banking sector to access the impact of non-interest income on bank performance, in terms of profitability and cost efficiency. Further, existing literature has only considered how banks profitability and efficiencies arises in the context of Sri Lanka. Weersainghe and Perera (2013) discuss the determinants of profitability in Sri Lankan banks while Bandaranayake and Jayasinghe (2013) have carried out their study to identify the factors influence the efficiency of banks in Sri Lanka. Here, they have not measured the efficiency of banks, rather they have

discussed the factors matter. Therefore, this study extends to measure the efficiencies of banks in the context of Sri Lanka. Further, few studies such as Thilakaweera, Harvie and Arjomandi (2014) have extended their studies to identify the impact of ownership status of banks on efficiency, yet they are failed to address the issue of not including non-interest income as an additional output. Therefore, further this study considers those matters when measuring efficiency.

This study is organized as follows: The literature review has been carried related to study area in section two. Section three represents the methodology used by the study to analyze the data. The findings and discussion of the study are presented in the section four and the final section concludes the study.

II. Literature Review and Hypotheses development

Literature Review

Reasons to moving towards Non-Interest Income

Banking industry have been affected with several incidents during the past thirty years due to the development of new technology, evolvement of non-banking institutions, requirement of various products and the financial crisis. Due to these incidents, banks have taken different precautionary measures in order to conduct day-to-day operations smoothly and to ensure banks' performance. As one of the precautionary measures, banks have moved towards revenue diversification, where the banks engage in traditional and non-traditional activities.

Atellu (2012), and Haubrich and Young (2019) define non-interest income as the income generated through off-balance sheet activities and it is not related with interest earnings. One of the main non-interest income earning sources is the service income which consists with ATM charges, internet banking fees, charges for guarantees and safety locker charges. Other than that trading income, securitization income can be considered as non-interest income sources.

As Haubrich and Young (2019) state banks mainly engage in traditional business activity where they issue loans to customers and obtain an interest payment. But, after banks encountered with financial crisis, they consider the other revenue sources such as earning income through off-balance sheet activities.

According to Nguyen, Skully and Perera (2012) banks moved towards non-interest activities due to the competition arose with the evolvement of foreign banks and depository institutions. Deyoung and Rice (2004) state that the banks manage their operations under competitive background being cost-efficient and revenue-efficient and banks have started to provide non-interest income earning services to their customers. As Hahm (2008) highlights banks have diversified their services as it helps to come up with better profitability through achieving economies of scale in a situation where the competition is high. According to Atellu (2012), interest income has lost its importance with the competition arose with the evolvement of Non-Banking Institutions and banks paid their attention towards other income sources in order to tackle with this situation.

Impact of Non-Interest Income on Banks' Performance

Moving towards non-interest income have differently impacted on banks' financial performance. As Almazari (2014) states financial performance is one of the key indicators of profitability and it shows the success of an economy as it measures the efficiency of banks. According to Park et al. (2019), secondary source of income has involved different roles on banks risk and return prior to and at the stage of financial crisis and revenue diversification allows banks to stabilize the revenue. Further, they state that non-interest income increases stock return and reduce bank risk. During the crisis era, income generated through investment banking activities as a non-traditional income source has no effect to banks return and risk, while the non-interest income earns through

commercial banking activities have progressive impact on financial performance. Sanya and Wolfe (2011) state by investigating eleven emerging economies that banks can reduce its insolvency risk and earn a higher profit through revenue diversification within traditional and non-traditional activities and these advantages are high for the banks with moderate risk exposures. Hahm (2008) have also discussed the effect of secondary income sources on efficiency by considering twenty-nine OECD countries during the period of 1992-2006 and according to his findings, banks show a greater ROA and equity asset ratio when the portion of non-interest income is relatively high. Further he states that moving towards non-interest income leads to variability in profits. Moreover, Davis and Tuori (1998) state banks can smoothen its' profitability and reap the benefits of revenue diversification through expand the share of non-interest income.

Contrast to these findings, Stiroh (2002) states by investigating U.S. banking system that the banks depend more on non-interest income such as trading revenue, it leads to a greater risk and lesser risk-adjusted profit. Further, Stiroh and Rumble (2006) highlight that although the financial benefits arise from income diversification, there is a possibility to off-set the benefits reap by highly depending on non-interest income and non-interest income as an income source is not profitable as interest income for financial holding companies. Moreover, Mercieca et al. (2007) states risk adjusted performance of banks are adversely related with income generated through off-balance sheet activities.

These diverse results make a doubt about positive impact of non-interest income on banks performance due to contrast findings of various studies. Some argue that moving towards non-interest income have a positive impact on banks performance in terms of profitability and cost efficiency, while some disagree with this finding. Therefore, this study carries out to fill up the gap in the existing literature regarding the theoretical

debate by considering Sri Lankan banking sector.

Exploring how cost efficiency arises as a result of the inclusion of non-interest income is less in the extant literature. Only few studies have paid attention to this aspect and most of the studies have disregarded inclusion of off-balance sheet activities in estimation of cost efficiency. As Rogers (1998) states most of the studies have measured banks efficiency by only considering about the on-balance sheet activities. This is also documented in the researches done by Boyd and Gertler (1994) and Kaufman and Mote (1994). They have explored that the banks have moved towards non-interest income activities and calculations of industry output is significantly underestimated due to focus only on on-balance sheet activities. The impact of ignorance of off-balance sheet activities also have documented in the existing literature. Clark and Siems (2002) state that it is not meaningful and precise to estimate cost and profit efficiency in banks without considering the off-balance sheet activities. Isik and Hassan (2003) along with Rogers (1998) state that when banks ignore off-balance sheet activities, it underestimates the performance indicators as the resources employed to generate off-balance sheet outputs have included in the input vector, while the output created using these inputs have ignored in the output vector. According to Lozano-vivas and Pasiouras (2008), off-balance sheet activities improve the cost-efficiency. Therefore, this study further examines about this aspect by considering the non-interest income sources to measure the cost efficiency in Sri Lankan Banking sector as the existing literature is silent in this scenario.

Hypotheses Development

Profit and Cost Efficiencies

Farrell (1957) was first to introduce the concept of technical efficiency and divided the concept of efficiency into two sections as technical efficiency and allocative efficiency.

Shen, Liao and Weyman-Jones (2009) state two reasons for inefficiency in a firm, it can be either due to usage of beyond the required minimum input which is sufficient for a given output level which is known as “Allocative Inefficiency” or due to a firm fail to produce maximum output level for inputs which is known as “Technical Inefficiency”. They further state that most of the studies have measured the technical efficiency through constructing production frontier and cost and profit efficiencies can be measured under technical efficiency.

Maudos, Pastor, Pérez, and Quesada (2002) state both cost and profit efficiency are two main economic objectives that a firm tends to achieve, where they want to maximize their profits while minimizing the cost. He defines that the “cost efficiency is the ratio between the minimum cost at which is possible to attain a given volume of production and the realized cost”. Clark and Siems (2002) state, the cost efficiency measures the degree to which a firm’s cost reaches the best practice cost. Cost function of a firm can be estimated using the total cost as the dependent variable and outputs, input prices, factors capture the variations in the economic environment, random error and inefficiency variables as the independent variables.

Further, Maudos et al. (2002) state concept of profit efficiency is much comprehensive as it is comprised with both revenues and the cost of a firm and he defines profit efficiency as “the ratio between the actual profit of a bank and the maximum level that could be achieved by the most efficient bank while Clark and Siems (2002) outline that the profit measure the degree to which a firm’s profits are below compared to the best practice firm. As the cost, profit also depends on the outputs, input prices and factors capture the variations in the economic environment, random error and inefficiency variables as the independent variables.

This study estimates both cost and profit efficiencies of banks in Sri Lanka in order to identify that whether inclusion of non-interest income as an additional output in estimating efficiency will generate a

significant difference with the efficiency which has estimated without inclusion of non-interest income.

Clark and Siems (2002) claim that inclusion of non-traditional activities as additional output in the profit efficiency functions will not generate a statistically significant difference with the model which only comprised with traditional activities. Moreover, Lozano-vivas and Pasiouras (2008) state that there is no difference in the in the profit efficiencies with and without inclusion of non-traditional activities as an additional output. Accordingly, our first hypothesis is;

Hypothesis 1: There is a significant difference in Profit Efficiency between Model 1a (engage only in traditional activities) and model 1b (engage in both traditional and non-traditional activities).

Moreover, there are only few studies discuss the impact of the inclusion of non-interest income on cost efficiency. Lozano-vivas and Pasiouras (2008) state that cost efficiency increases when non-traditional activities included as an additional output. Rogers (1998) states that cost efficiency of banks increases when both interest and non-interest income included as the outputs. Accordingly, our second hypothesis is;

Hypothesis 2: Cost Efficiency in Model 2a (engage only in traditional activities) is less compared to Model 2b (engage in both traditional and non-traditional activities).

Inefficiency Model

Maudos et al. (2002) state that the efficiency of a bank depends on the assessment between the optimum profit or cost and realized values. Variations of the efficiency from its optimal status arises only due to the inefficiency of banks. As Perera, Skully and Wickramanayake (2008) state theory does not provide any guidance regarding what factors should be included in the inefficiency model and it is up to the researcher to decide what should be included by considering the past researches in the field of bank efficiency.

Manlagñit (2011) states that it is important to identify the factors effect on inefficiency is important for policy decisions.

Ownership Status

Thilakaweera, Harvie and Arjomandi (2014) have done a research on how bank efficiency can be altered due to the ownership status of the banks. According to their findings, it was identified that state owned banks relatively have a high efficiency compared to private owned banks. Contrast to this, Doan, Lin and Doong (2017) state that state owned bank less efficient compared to private owned banks. Further, Altunbas, Evans and Molyneux (2001) claim that there is no evidence for the superiority of privately-owned banks to state-owned banks in terms of efficiency. Further, Fernando and Nimal (2014), and Thilakaweera, Harvie and Arjomandi (2014) have extended their studies to identify the impact of ownership status of banks on efficiency, yet they are failed to address the issue of not including non-interest income as an additional output. Therefore, our third hypothesis is;

Hypothesis 3: Banks' Inefficiency is not significantly associated with the ownership status of the banks.

ATM Development

Ou, Hung, Yen and Liu (2009) have conducted a research on how ATM intensity could impact on cost efficiency of banks by evaluating the banks in Taiwan and he states that investments in ATMs has a positive impact on cost efficiency. Contrast to this finding, Lin, Hu and Kang-Liang (2005) state that bank efficiency cannot be improved introducing ATMs. Moreover, Sathye and Sathye (2017) found that ATM intensity is negatively related with technical efficiency of banks. Haynes and Thompson (2000) claim that there is no influence of ATM development on the efficiency of the banks. Also, Sathye and Sathye (2017) state ATM intensity is negatively related with technical efficiency of banks. Due to the inconclusive results, our fourth hypothesis is;

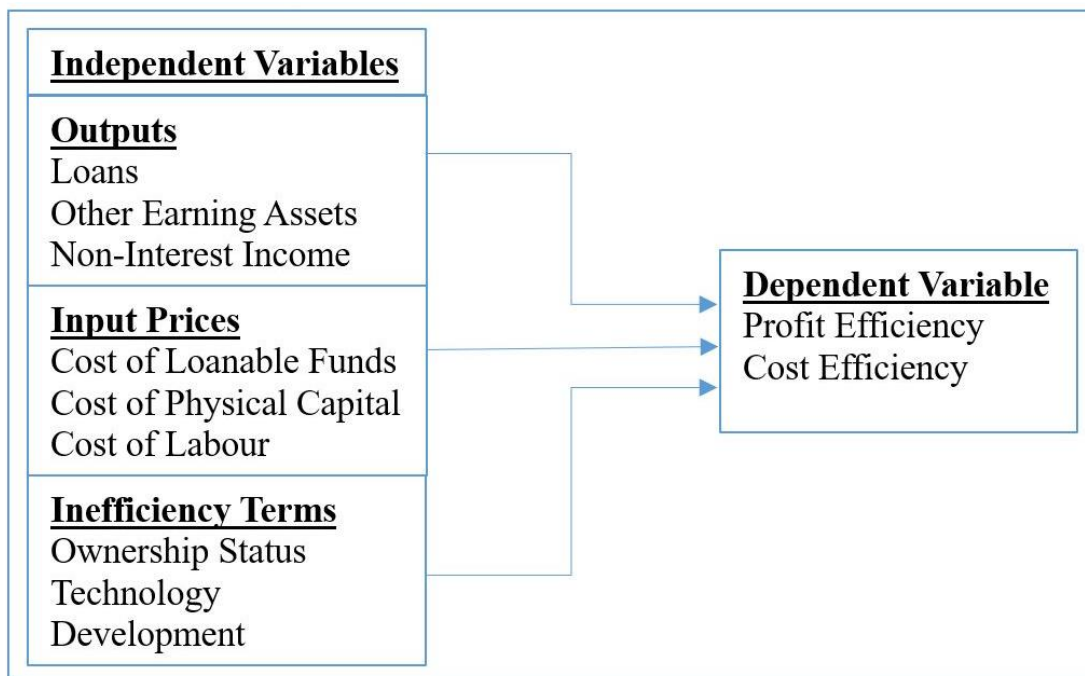
Hypothesis 4: Banks' Inefficiency is not significantly associated with ATM development.

III. Methodology

Data

In order to recognize the factors, effect on bank efficiency in Sri Lanka, this study used unbalanced panel data covering six commercial banks for the period from 2009 to 2019. The study period restricted to 11 years' time period due to the availability of

data and also to maintain the consistency of data during the study period. The study mainly used secondary data sources. It includes audited financial reports which are published in annual reports of the banks and industry wise banking performance data were sourced from the world banks data base. Experts' knowledge in the banking sector were traced to have an idea about nature and the operations of the banks in relation to traditional and non-traditional activities. The conceptual framework is given is figure 1.



Figure

1. Conceptual framework

Data collection method

Data were extracted from the annual financial reports of systemically important banks to analyze the efficiencies in banking sector in Sri Lanka. To have an overall view of banking sector and calculations of certain study variables, knowledge of an expert and specialists who are in the process of

preparing the financial statements were utilized. This was mainly used to identify the importance of conducting this research in Sri Lankan context as well as to maintain the consistency of data used to analyze the study variables.

Measurements of Data

The study variables were measured as follows:

Table 1. Measurement of Data

Variable	Measurement
Total Cost	the total cost a bank incurred due to its operations
Profit before Taxes	profitability of the bank
Loans	total loans provided by a bank
Other Earning Assets	the earning assets of a bank except loans
Non-Interest Income	income earned by a bank other than to interest income
Cost of Loanable Funds	
	the ratio of interest expense to Customer deposits & short-term funding
Cost of Physical Capital	the ratio of overhead expenses except personnel expenses to the value of fixed assets
Cost of Labor	the ratio of Personnel expenses to Total Assets

Source: Author Compiled

Data Analysis and Methodology

Data Analysis

Quantitative data analysis has used to assess the impact of non-interest income on bank performance and it includes both descriptive and inferential analysis. Efficiencies of individual banks have measured using Frontier 4.1 software. Under the descriptive analysis, central tendency and dispersions mainly, mean and standard deviation have been measured for the study variables as the first step. Efficiency scores of individual banks and parameter estimates have been obtained using Frontier 4.1 software.

Methodology

Measuring Bank Efficiency

The main objective of this study is to examine the impact of non-interest traditional banking activities on determining the banks efficiency in terms of profit and cost efficiencies. In order to assess this aspect, this study estimates both bank performance with and without inclusion of off-balance sheet activities.

Theoretical Model: Approaches to Measure Cost Efficiency

As Fries and Taci (2005) states the Stochastic Frontier Approach (SFA) and the

Distribution Free Approach (DFA) can be used as two parametric approaches to measure the efficiency of banks. These two approaches differ according to the way they differentiate inefficiency of banks from random error. As Doan et al. (2017) and Sun and Chang (2011) state DEA is underlined by the assumption that it does not include a random error, while SFA is able to control the measurement errors and the random effects. Moreover, they highlight that due to the differences in two methods, most of the studies which aimed at measuring efficiency have used SFA.

Accordingly, this study employs SFA to measure efficiencies in individual banks. As Pilar, Marta and Antonio (2018) state SFA assumes the error term compounds, and it is consisted with inefficiency and random error. Therefore, the efficiency will variate due to the inefficiency in the bank as well as due to random fluctuations which are out of the control of the bank from the optimal efficiency frontier. Further, Mailena, Shamsudin, Radam and Mohamed (2014) state SFA isolate the random fluctuations from the inefficiency by incorporating an error term.

The Battese and Coelli Model

Fries and Taci (2005) state that many cases use two step procedure to measure the bank efficiency. First, calculates the efficiency scores, and afterwards, it will be regressed

with the independent variables. Yet, Battese and Coelli (1995) state that estimates obtained through the two-step procedure are not efficient as in single stage procedure. Therefore, this study also employs the single step procedure, which uses the maximum likelihood procedure in Battese and Coelli Model to estimate the bank efficiency. As Fries and Taci (2005) mentions single step procedure is superior to two-step procedure as it violates the assumption of error terms of bank inefficiency in cost efficiency frontier are distributed identically and independently. As Coelli (1996) states FRONTIER 4.1 software can be used to measure efficiency through estimating maximum likelihood in parameters.

As Lozano-vivas and Pasiouras (2008) specifies, General Form of Battese and Coelli Model can be presented as follows:

Cost Efficiency Function:

$$\ln C_{i,t} = C(q_{i,t}, w_{i,t}, \beta) + u_{i,t} + v_{i,t} \dots \dots \dots (1)$$

where, $i = 1, 2, 3, \dots, N$, $t = 1, 2, 3, \dots, T$; $C_{i,t}$ = the total cost of bank i th bank at time t ; $q_{i,t}$ = vector of outputs; $w_{i,t}$ = vector of input prices; β = vector of unknown scalar parameters to be estimated; $u_{i,t}$ = non-negative inefficiency effects; $v_{i,t}$ = random error terms.

Profit Efficiency Function:

Specification of profit frontier model is same as the cost frontier that have been specified above.

$$\ln PBT_{i,t} = PBT(q_{i,t}, w_{i,t}, \beta) - u_{i,t} + v_{i,t} \dots \dots (2)$$

Where, $I = 1, 2, 3, \dots, N$, $t = 1, 2, 3, \dots, T$; $PBT_{i,t}$ = Profit before taxes of bank i th bank at time t ; $q_{i,t}$ = vector of outputs, $w_{i,t}$ = vector of input prices; β = vector of unknown scalar parameters to be estimated; $u_{i,t}$ = non-negative inefficiency effects; $v_{i,t}$ = random error terms.

Battese, and Coelli (1995) assumes that the random errors which are $v_{i,t}$ are identically and independently distributed (i.i.d $N(0, \sigma^2)$) and they are independent from $u_{i,t}$. $u_{i,t}$ represent the non-negative random variables.

Model Specification

This study estimates two models as two dimensions to measure the bank performance. First model is to measure profit efficiency and second model is to measure cost efficiency. Each model is consisted with two specifications as this study considers the impact of with and without inclusion of non-interest income on bank performance. Efficiency stochastic frontiers are estimated under both cobb-douglas and translog frontier forms since the existing literature is failed to provide the differences in estimating efficiency in banks according to both forms.

Model 1 – Estimation of Profit efficiency of banks

Model 1a - Estimation of Profit efficiency without inclusion of non-traditional banking activities

Model 1b - Estimation of Profit efficiency with inclusion of non-traditional banking activities

Model 2 – Estimation of Cost efficiency of banks

Model 2a – Estimation of Cost efficiency without inclusion of non-traditional banking activities

Model 2b – Estimation of Cost efficiency with inclusion of non-traditional banking activities

Based on the general form of the cost function, cost efficiency model is specified as follows:

Cobb-Douglas Form:

$$\ln TC = \alpha_0 + \alpha_1 \ln(Q1) + \alpha_2 \ln(Q2) + \alpha_3 \ln(Q3) + \alpha_4 \ln(W1) + \alpha_5 \ln(W2) + \alpha_6 \ln(W3) + u + v \dots \dots (3)$$

Translog Form:

$$\ln TC = \alpha_0 + \alpha_1(Q1) + \alpha_2 \ln(Q2) + \alpha_3 \ln(Q3) + \alpha_4 \ln(W1) + \alpha_5 \ln(W2) + \alpha_6 \ln(W3) + \sigma_7 (\ln [(Q1)]^2) + \sigma_8 ((\ln Q1) * (Q2)) + \sigma_9 ((\ln Q1) * (Q3)) + \sigma_{10} ((\ln Q1) * (W1)) + \sigma_{11} ((\ln Q1) * (W2)) + \sigma_{12} ((\ln Q1) * (\ln W3)) + \sigma_{13} (\ln [(Q2)]^2) + \sigma_{14} ((\ln Q2) * (Q3)) + \sigma_{15} ((\ln Q2) * (\ln W1)) + \sigma_{16} \ln(Q2 * W2) + \sigma_{17} \ln(Q2 * W3) + \sigma_{18} (\ln [(Q3)$$

$$\sigma_{19} ((\ln Q3)^*(W1)) + \sigma_{20} ((\ln Q3)^*(\ln W2)) + \sigma_{21} ((\ln Q3)^*(\ln W3)) + u + v \dots\dots\dots(4)$$

Where, ln TC = Total Cost, ln (Q1) = Loans (Rs. Millions), ln (Q2) = Other Earning Assets (Rs. Millions), ln (Q3) = Non-Interest Income (Rs. Millions), ln (W1) = Cost of Loanable Funds, ln (W2) = Cost of Physical Assets, ln (W3) = Cost of Labour, u_i = one sided half-normal error, v_i = two-sided random error, ln = natural logarithm

Inefficiency Model

$$U_{it} = \delta_0 + \delta_1 \text{Own} + \delta_2 \text{ATM} + W_{it} \dots\dots\dots(5)$$

Where, Own = Ownership Status, ATM = ATM Development, W_{it} = the random error

Stochastic Profit Function

In order to determine the profit efficiency in individual banks in Sri Lanka, this study uses Production Function Model as a proxy for Profit Function Model. When data is in absolute form, most profit efficient firm denotes high values, while this decreasing value means the less profit efficient firm. Moreover, as Lozano-vivas and Pasiouras (2008) states if the function is in log form, profit efficiency of a firm takes a value between zero and one while cost efficiency takes value between zero and infinity. Cost efficiency can be calculated using 1/cost efficiency score. In both scenarios, the efficiency scores closer to one means particular firm has a high efficiency.

This study uses the log form of the profit function and the stochastic profit function can be expressed as:

Cobb-Douglas Form:

$$\ln \text{PBT} = \alpha_0 + \alpha_1 \ln(Q1) + \alpha_2 \ln(Q2) + \alpha_3 \ln(Q3) + \alpha_4 \ln(W1) + \alpha_5 \ln(W2) + \alpha_6 \ln(W3) - u + v \dots\dots(6)$$

Translog Form:

$$\ln \text{PBT} = \alpha_0 + \alpha_1(Q1) + \alpha_2 \ln(Q2) + \alpha_3 \ln(Q3) + \alpha_4 \ln(W1) + \alpha_5 \ln(W2) + \alpha_6 \ln(W3) + \sigma_7 (\ln [(Q1)]^2) + \sigma_8 ((\ln Q1)^*(Q2)) + \sigma_9 ((\ln Q1)^*(Q3)) + \sigma_{10} ((\ln Q1)^*(W1)) + \sigma_{11} ((\ln Q1)^*(W2)) + \sigma_{12} ((\ln Q1)^*(\ln W3)) + \sigma_{13} (\ln [(Q2)]^2) + \sigma_{14} ((\ln Q2)^*(Q3)) + \sigma_{15} ((\ln Q2)^*(\ln W1)) + \sigma_{16} \ln(Q2*W2) + \sigma_{17} \ln(Q2*W3) + \sigma_{18} (\ln [(Q3)]^2) + \sigma_{19} ((\ln Q3)^*(W1)) + \sigma_{20} ((\ln Q3)^*(\ln W2)) + \sigma_{21} ((\ln Q3)^*(\ln W3)) - u + v \dots\dots\dots(7)$$

Where, ln PBT = Profit before taxes, ln (Q1) = Loans (Rs. Millions), ln (Q2) = Other Earning Assets (Rs. Millions), ln (Q3) = Non-Interest Income (Rs. Millions), ln (W1) = Cost of Loanable Funds, ln (W2) = Cost of Physical Assets, ln (W3) = Cost of Labour, u_i = one sided half-normal error, v_i = two-sided random error, ln = natural logarithm

Inefficiency Model

$$U_{it} = \delta_0 + \delta_1 \text{Own} + \delta_2 \text{ATM} + W_{it} \dots\dots\dots(8)$$

Where, Own = Ownership Status, ATM = ATM Development, W_{it} = the random error

IV. Findings and Discussion

Descriptive Statistics

As per the Table 2, the mean of profit before taxes and total cost are Rs.13824 and Rs.67143 respectively. The minimum value of profit before taxes is Rs.1181 and the maximum is Rs.33416 while minimum of total cost is Rs.17249 and maximum is Rs.198911. Compared to profit before taxes, the variability of total cost of the banks on average is higher where the standard deviation was Rs.42197 in total cost and Rs.8178 in profit before taxes. When consider about the outputs and input prices, the variability of outputs is higher compared to input prices. The mean value of no of ATMs is 447 which implies that most of the banks have developed the ATM facility over time. On the other hand, the mean value of ownership status which is 0.66 implies that most of the banks are private owned banks.

Table 2. Descriptive Statistics of Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
PBT (Rs.000')	13824.01	8178.32	1181	33416.08
TC (Rs.000')	67142.84	42197.46	17249.48	198911
Q1 (Rs.000')	525685.7	351843.2	85622.17	1549805
Q2 (Rs.000')	244113.1	178292.3	46690.46	763600
Q3 (Rs.000')	9932.585	5230.95	1858.68	25626.7
W1 (%)	06.34	01.23	04.07	09.45
W2 (%)	95.07	37.24	44.98	203.55
W3 (%)	1.32	00.36	00.76	2.55
OWN (State owned = 0, Private owned = 1)	66.15	47.69	0	1
ATM (No.)	447.48	197.84	125	885

Source: Annual Reports of the Systematically Important Banks with the aid of Stata Statistical Package

Results of the Efficiency Estimation¹

Table 3. Mean Cost and Profit Efficiency of Banks

Mean Efficiency Estimates				
	Cobb-Douglas Form		Translog Form	
	Model 1a	Model 1b	Model 1a	Model 1b
Profit Efficiency				
Mean	0.7835	0.7280	0.7321	0.7290
Cost Efficiency				
Mean	0.9330	0.9363	0.9405	0.9547

Source: Annual Reports of Systemically Important Banks with the aid of Frontier 4.1 Software

Table 3 shows the mean profit and cost efficiency of a bank with and without inclusion of non-interest income as an output where profit efficiency has decreased and cost efficiency has increased due to the non-interest income compared to when banks only engage in traditional business activities. The mean profit efficiency of Model 1a is 0.7835, which was further decreased to 0.7280 with

inclusion of non-interest income in cobb-douglas form and in translog form, profit efficiency has decreased from 0.7321 to 0.7290 where both models provide similar finding. This can be occurred due to the non-interest expenses incur when engage in non-traditional banking activities. On the other hand, cost efficiency has increased from 0.9330 to 0.9363 in cobb-douglas form and

¹ Cost and Profit efficiency estimation was done using the FRONTIER 4.1 software package.

from 0.9405 to 0.9547 in translog form due to non-interest income. The reason behind this pattern occurs due to the fixed costs banks incur regardless of the functions that they engage in.

This results further implies that the profit efficiency of banks according to cobb-douglas form is on average 22% lower compared to best practice banks when only engage in traditional business activities and when engage in both traditional and non-interest income activities, banks' profit efficiencies are on average 27% lower relative to best practice. Costs are higher compared to best-practice in banks and Manlagñit (2011) states that this indicates cost inefficiency in banks. Accordingly, average costs of banks are 6.7% above without engage in non-interest income

activities and it has decreased up to 6.37% due to non-interest income. In other words, it shows the amount of banks' costs wasted due to engage in traditional business and due to non-interest income activities.

Distribution of Efficiency Scores obtained from Cobb-Douglas and Translog Frontier Models

The efficiency estimates are obtained on the basis of frequency distribution for both Cobb-Douglas and Translog stochastic frontier models. Under both Cobb-Douglas and Translog frontier function. As per the Table 4 and 5, the profit efficiency scores have been distributed over the efficiency level 21% to 100%. But no single bank operated below cost efficiency level of 71%.

Table 4. Distribution of Efficiency Scores in Banks according to Cobb-Douglas Frontier Model

Cobb-Douglas Form								
Efficiency Range	Profit Efficiency				Cost Efficiency			
	Model 1a		Model 1b		Model 2a		Model 2b	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
0.21-0.30	1	1.5	1	1.5	0	0.0	0	0.0
0.31-0.40	2	3.1	5	7.7	0	0.0	0	0.0
0.41-0.50	6	9.2	10	15.4	0	0.0	0	0.0
0.51-0.60	5	7.7	3	4.6	0	0.0	0	0.0
0.61-0.70	6	9.2	6	9.2	0	0.0	0	0.0
0.71-0.80	4	6.2	10	15.4	2	3.1	1	1.5
0.81-0.90	15	23.1	7	10.8	9	13.8	9	13.8
0.91-1.00	26	40.0	23	35.4	54	83.1	55	84.6

Source: Compiled by the researcher from the Efficiency Scores obtained with the aid of Frontier 4.1 Software

Table 5. Distribution of Efficiency Scores in Banks according to Translog Frontier Model

Translog Form								
Efficiency Range	Profit Efficiency				Cost Efficiency			
	Model 1a		Model 1b		Model 2a		Model 2b	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
0.21-0.30	2	3.1	1	1.5	0	0.0	0	0.0
0.31-0.40	4	6.2	3	4.6	0	0.0	0	0.0
0.41-0.50	10	15.4	9	13.8	0	0.0	0	0.0

0.51-0.60	2	3.1	8	12.3	0	0.0	0	0.0
0.61-0.70	10	15.4	6	9.2	0	0.0	0	0.0
0.71-0.80	6	9.2	7	10.8	0	0.0	1	1.5
0.81-0.90	7	10.8	10	15.4	8	12.3	5	7.7
0.91-1.00	24	36.9	21	32.3	57	87.7	59	90.8

Source: Compiled by the researcher from the Efficiency Scores obtained with the aid of Frontier 4.1 Software

Correlates of Profit and Cost Efficiency

Table 6 and 7 present the maximum likelihood estimates of profit and cost efficiencies obtained from Frontier 4.1.

Maximum-likelihood estimates of profit function

Table 6. Correlates of Profit Efficiency

Variable	Parameter	Profit Frontier			
		Cobb-Douglas		Translog Form	
		Model 1a	Model 1b	Model 1a	Model 1b
Constant	α_0	1.0445	1.4072*	1.5381*	0.6293
Loans	α_1	0.3915***	0.3339***	-759.6532***	-235.2927***
Other Earning Assets	α_2	0.1540	-0.1443	-682.7859***	-518.2999***
Non-Interest Income	α_3		0.2430***		544.1879***
Cost of Loanable Funds	α_4	-0.1815	-0.2852**	769.6007***	123.7734***
Cost of Physical Capital	α_5	-0.0420	0.0274	-113.2184***	-318.9108***
Cost of Labour	α_6	-0.2556	-0.5636***	-518.5199***	-508.9073***
Loans*Loans	α_7			-430.5819***	33.5144***
Loans*Other Earning Assets	α_8			1482.9075***	2607.9082***
Loans*Non-Interest Income	α_9			-600.6661***	-168.6144***
Loans*Cost of Loanable Funds	α_{10}				-500.2895***
Loans*Cost of Physical Capital	α_{11}			738.8692***	373.9682***
Loans*Cost of Labour	α_{12}			-261.7583***	-2144.3104***
Assets*Other Earning Assets	α_{13}			0.1756*	-378.9693***
Other Earning Assets*Non-Interest Income	α_{14}				-694.4131***
Other Earning Assets*Cost of Loanable Funds	α_{15}			-169.1106***	47.9821***
Other Earning Assets*Cost of Physical Capital	α_{16}			-625.6244***	-1522.6831***

Other Earning Assets*Cost of Labour Non-Interest Income*Non-Interest Income Non-Interest Income*Cost of Loanable Funds Non-Interest Income*Cost of Physical Capital Non-Interest Income*Cost of Labour	α_{17}			517.9296***	837.3483***
	α_{18}				-1646.1298***
	α_{19}				328.2923***
	α_{20}				1467.6550***
	α_{21}				1815.4275***
		Variance Parameters			
Sigma	σ^2	0.0819*	0.0485***	0.0446***	0.0415***
Gamma	Γ	0.8941***	0.8659***	0.7973***	0.8972***

Source: Compiled by Author with the aid of Frontier 4.1 Software

Maximum-likelihood estimates of cost frontier function

Table 7. Correlates of Cost Efficiency

Variable	Parameter	Cost Frontier			
		Cobb-Douglas		Translog Form	
		Model 2a	Model 2b	Model 2a	Model 2b
Constant	α_0	1.8760*	1.8896*	1.8683*	1.4630***
Loans	α_1	0.6699	0.6606	242.9907***	296.9626***
Other Earning Assets Non-Interest Income	α_2	0.2816	0.2505	-394.1999***	-338.2026***
Cost of Loanable Funds	α_3		0.0559		8.8036***
Cost of Physical Capital	α_4	0.7714	0.7670	251.7521***	296.8097***
Cost of Labour	α_5	0.0041	-0.0018	-395.5433***	-306.7435***
Loans*Loans	α_6	0.2209	0.2281	-122.1128***	-141.9475***
Loans*Other Earning Assets	α_7			-41.3421***	-178.1637***
Loans*Non-Interest Income	α_8			-18.4724***	-159.4597***
Loans*Cost of Loanable Funds	α_9			-168.7232***	132.5244***
Loans*Cost of Physical Capital	α_{10}				-79.1090***
Loans*Cost of Labour	α_{11}			107.4672***	180.4181***
Other Earning Assets*Other Earning Assets	α_{12}			-79.9031***	-14.3631***
Other Earning Assets*Non-Interest Income	α_{13}			-2.4441**	5.5346***
Other Earning Assets*Cost of Loanable Funds	α_{14}				-41.8320***
Other Earning Assets*Cost of Physical Capital	α_{15}			-82.2609***	-78.6521***
Other Earning Assets*Cost of Labour	α_{16}			288.0843***	424.6015***

Other Earning Assets*Cost of Labour	α_{17}			202.2377***	182.7755***
Non-Interest Income*Non-Interest Income	α_{18}				181.6803***
Non-Interest Income*Cost of Loanable Funds	α_{19}				-138.2885***
Non-Interest Income*Cost of Physical Capital	α_{20}				-298.2517***
Non-Interest Income*Cost of Labour	α_{21}				-26.2779***
Variance Parameters					
Sigma	σ^2	0.0079	0.0073	0.0066	0.0435
Gamma	Γ	0.9300	0.9100	0.8800	0.9826***

Source: Compiled by Author with the aid of Frontier 4.1 Software

Criterion for estimating significance

This study discusses the significance of the parameters estimated under 3 levels. If the t-statistic is greater than 2.576, particular parameter is significant at 1%, if the t-statistic is between 1.96 to 2.576, it is significance at 5% and if the t-statistic is between 1.64 to 1.96, the parameter is significant at 10% significant level.

Interpretation

The maximum likelihood estimates of the profit and cost efficiency functions are obtained using both cobb-douglas and translog stochastic frontier. The coefficients of variance parameter in profit efficiency model show that in both Cobb-Douglas and translog stochastic frontiers, the coefficients of variance parameter in profit efficiency model show (σ^2) sigma squared and Gamma (γ) were significantly different from zero.

Only Gamma (γ) in Model 1b in cost efficiency is statistically significant in translog form. Aigner, Lovell, & Schmidt (1977) define the goodness of fit of the model and confirmation of distribution assumption of the composite error term through the variance-parameter (σ^2). The Gamma (γ) values, which are 89% (model 1a) and 87% (model 1b) in the Cobb-Douglas estimate and 80% (model 1a) and 90% (model 1b) in the Translog estimate imply that the deviation of

profit efficiency was due to technical inefficiency effects. In cost efficiency, 98% in model 1b in the Translog estimate show that deviation of cost efficiency was due to technical inefficiency effects.

All the outputs of profit efficiency frontiers are positive and highly significant except the other earning assets the Cobb-Douglas stochastic frontier form. When loans increase by 1 percent, it increases the profit by 0.39 percent when only engage in traditional activities while profit increases only by 0.33 percent when engage in both traditional and non-interest income activities under the cobb-douglas stochastic frontier form. When consider about the translog form, profit efficiency decreases by 759.65 percent for a 1 percent increment in loans. According to the findings, the input prices are not significant determinants of the profit efficiency of banks when only engage in traditional activities while cost of loanable funds has a moderately significant impact on profit efficiency and cost of labour has a highly significant impact on profit efficiency when engage in both traditional and non-interest income activities based on Cobb-Douglas frontier form.

When cost of loanable funds increases by 1%, profit efficiency decreases by 0.29% while profit efficiency decreases by 0.56% for 1% increment of cost of labour. When consider about the results obtained through Translog

frontier form, all the input prices have a significant impact on profit efficiency.

None of the outputs and input prices have a significant impact on cost efficiency under the Cobb-Douglas frontier form. Yet, when consider about translog form, it reveals that all the output and input prices have a significant impact on cost efficiency. When loans increase by 1% cost efficiency increases by 242.99% when only engage in traditional business activities while cost efficiency increases by 296.96% when engage in both traditional and non-interest income activities. For 1% increment in other earning assets, it tends to decrease cost efficiency by 394.20% when only engage in traditional business activities while cost efficiency decreases by 338.20% when engage in both traditional and non-interest income activities. At the same time, banks can increase their cost efficiency

by 8.80% for a 1% increment in non-interest income.

When cost of loanable funds increases by 1%, cost efficiency increases by 251.75% and 296.815 in model 2a and model 2b respectively. But when consider about cost of physical assets and cost of labour, for a 1% increment, cost efficiency decreases by 395.54% and 122.11% in model 2a and 306.74% and 141.95% in model 2b respectively. As Mailena et al. (2014) showed the elasticities obtained from Cobb-Douglas were small and inelastic in the estimated models, and on the other hand elasticities obtained through the Translog model were larger and elastic because of interaction effects of the variables. The Cobb-Douglas and Translog forms provide differential results due to the interaction effects come from the different input and output combinations in Translog form.

Correlates of Inefficiency Model

Profit Efficiency

Table 8. Correlates of Inefficiency Model in Profit Efficiency Function

Inefficiency Model		Profit Frontier			
		Cobb-Douglas		Translog Form	
Variable	Parameter	Model 1a	Model 1b	Model 1a	Model 1b
Constant δ_0		1.7845***	1.3595***	1.2855***	1.1102***
Own	δ_1	-0.2412	0.1648	0.1947	0.2173
ATM	δ_2	-0.0042**	-0.0029*	-0.0028*	-0.0024***

Source: Compiled by Author with the aid of Frontier 4.1 Software

As per the Table 8, in both Cobb-Douglas and Translog frontier forms, the ownership status does not have a significant impact on profit inefficiency while the ATM development has a negative significant impact on profit inefficiency.

Cost efficiency

Table 9. Correlates of Inefficiency Model in Cost Efficiency Function

Inefficiency Model		Cost Frontier			
		Cobb-Douglas		Translog Form	
Variable	Parameter	Model 1a	Model 1b	Model 1a	Model 1b
Constant	δ_0	-0.0000	0.0000	0.0000	1.1025***
Own	δ_1	-0.0000	0.0000	0.0000	0.2173

ATM	δ_2	0.0000	0.0000	0.0000	-0.0024***
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Source: Compiled by Author with the aid of Frontier 4.1 Software

Table 9 shows that in both Cobb-Douglas and Translog frontier forms, ownership status does not have a significant impact on cost inefficiency while the ATM development has a negative significant impact on cost inefficiency under translog frontier form when engage in both traditional and non-interest income activities. It implies that cost inefficiency decreases by 0.0024 percent when ATMs developed by 1 unit.

V. Conclusions

This study aims to explore the effect of non-traditional activities on bank efficiency in terms of profit and cost efficiency since most of the studies have not consider about these activities in measuring efficiency in banks. In order to estimate the effects, both cobb-douglas and translog stochastic frontier forms were used. This study contributes to the existing literature by analyzing the effects of non-traditional activities on bank efficiency for the context of Sri Lanka by using both cobb-douglas and translog stochastic frontier forms.

This study has taken into account the systemically important banks in Sri Lanka where six banks have been identified as systemically important banks and this sample consisted of 65 observations covering the period from 2009 to 2019. The estimated model was specified according to Battese and Coelli (1995) model and Frontier 4.1 software has been used to obtain efficiency scores and parameter values. There were two specifications under both models, where both cost and profit efficiency have estimated with and without inclusion of non-traditional activities.

Model 1a and 2a were only consisted with traditional activities. At the same time, we have estimated two models, namely model 1b and 2b, with inclusion of non-interest income which take into account the effect of engage in non-traditional activities. Both Cobb-Douglas and Translog forms provide similar

findings where profit efficiency of the banks has decreased due to non-interest income, while cost efficiency has increased due to non-interest income. Impact of non-interest income on profit efficiency has a statistically significant impact under both forms. Yet, the effect of non-traditional income on cost efficiency is statistically insignificant in cobb-douglas form, while it has become significant in translog form. This shows that translog form of estimating efficiency of banks provide better results. Based on that, it can be concluded that all the inputs and outputs of the banks and ATM development has a significant effect on the bank efficiency. The findings of this study are complied with the findings presented by Elsas, Hackethal and Holzhaeuser (2006) and Sanya and Wolfe (2011), where non-interest income has a positive impact on profit efficiency.

The study can conclude that it is a choice of banks to either to engage in both traditional and nontraditional banking activities and be a most cost-efficient bank or be the profit efficient bank by engage only in traditional banking activities. If the banks' ultimate objective is to be the most cost-efficient bank, they can engage in both traditional and nontraditional banking activities and if the banks want to be most profit efficient bank, they can engage only in traditional banking activities. The study can give some suggestions to future studies as well. One can extend a study on instances different models could be used to estimate efficiency of banks and come up with the reasons for differences in the efficiency score.

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