J Bangladesh Agril Univ 23(4): 524–531, 2025 https://doi.org/10.3329/jbau.v23i4.86491

ISSN 1810-3030 (Print) 2408-8684 (Online)

Journal of Bangladesh Agricultural University

Journal home page: http://baures.bau.edu.bd/jbau

Research Article

Identifying Technical Efficiency Differences between Online and Traditional Banking System in Bangladesh

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ARTICLE INFO

Article history
Received: 16 March 2025
Accepted: 21 December 2025
Published: 30 December 2025

Keywords
Bank efficiency, Online banking, Traditional banking, Digitalization, Bangladesh

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ABSTRACT

Banking business has become very dynamic in recent days and has undergone rapid changes because of technological innovation, increased awareness and demand from customers, which makes the environment of the banking industry more complex and competitive. Currently, Banks are utilizing ICT in its each activity for better, error-free and prompt customer service, organized management decisions as well as managing risks. Among the banks operating in Bangladesh, Janata Bank PLC has been at the forefront of embracing digitalization and contributing to the country's overall digital transformation. The aim of this study is to analyze the theoretical foundations of bank efficiency, understand the measures of technical efficiency at the branch level briefly and find out the variables that affect the performance of the online banking system and traditional banking system in Janata Bank PLC. The data were collected from all the 909 branches of Janata Bank PLC. during the year 2019 and the sample bank was selected by using purposive sampling technique based on the availability of data and convenience of the study. The DAE input-oriented analysis is employed to find out the technical efficiency of performance between online and traditional banking systems. However, comparing the performance of technical efficiency between online and traditional branches of Janata Bank PLC., it was found that traditional branch units were less potential than online branch units. Therefore, the findings suggest that the traditional branches will be more efficient by adopting new technology-based online services, as well as investing in new technologies to change the banking service quality.

Introduction

Electronic banking (e-banking) or digital banking is a relatively new concept in Bangladesh, as the technological infrastructure in this sector is still under development. Practicing electronic banking means using information technology in every aspect of banking operation, which ensures operational effectiveness and improves efficiency (Rahman *et al*., 2017). Due to technological advancement, the world banking industry has undergone a rapid transformation in the last two decades. Online and real time transaction system has become the key feature of banking system in many developed countries of the world; such as the Unites Kingdom, the United States and many other technologically advanced countries in European nations (Buckley and Balakrishnan, 2021). Although this digital transformation has increased many cybersecurity threats (Al-Daraba and Sharif, 2025); banking customers are drastically shifting from branch-based banking system to app-based banking system (Vives, 2017).

Since 2001, banks operating in Bangladesh have begun enforcing an electronic banking system in their activities (Rahman, 2007). Earlier, the entire banking industry was operated under non-electronic, analog system (Siddik *et al*., 2016), where all banking activities and financial transactions were completed manually, requiring a significant amount of time and considerable human resources to carry out these activities. As a result, Bangladesh was far behind in capturing the advantages of the enormous opportunities that can be leveraged through technology-grounded business activities such as e-business and e-commerce (Ahmed and Islam, 2008). However, over time, both the private sector and public sector banks operating in Bangladesh, have begun to use electronic banking system (Hossain *et al.*, 2013). This is also imperative for the country to adopt ICT-based banking system to survive in this competitive

Cite This Article
Khandaker, T., Datta, A., Yesmine, T. and Mitra, S. 2025. Identifying Technical Efficiency Differences between Online and Traditional Banking System in Bangladesh. *Journal of Bangladesh Agricultural University*, 23(4): 524–531. https://doi.org/10.3329/jbau.v23i4.86491

world (Chaluvadi *et al*.,2018). In many Asian countries, commercial banks are restructuring their branching operations and networks to maintain viability in this competitive world. Therefore, it is essential to measure the performance of bank branches after the adoption of e-banking to track the actual progress and potential opportunities of using e-banking systems which will ultimately affect the technology adoption decisions of the organizations (Azam, 2014).

Janata Bank PLC., the second largest state-owned commercial bank operating Bangladesh, has embraced digitalization and contributed to the country's overall digital transformation, and also facilitating customer convenience. Since the beginning of its operation, the bank has been providing distinguished banking services to its customers through its rural, semi-urban and urban branches. Recognizing the needs of the customers, Janata Bank PLC. has incorporated digital technology in every aspect of its operation. From mobile banking to online banking, the bank serves its customers with various digital services, including mobile banking and online banking, while ensuring a secure banking experience for them. Although the number of literatures related to banking efficiency has been increasing rapidly in recent years (Quaranta *et al*., 2018), this study will contribute to reflect the situation of not only Janata Bank PLC but also the condition of public sector banks of the country. Hence, an analysis of the efficiency of banks at the branch level will provide helpful and practical recommendations to shape the performance of banking institutions as a whole and ultimately provide suggestions to improve the performance (Shyu and Chiang, 2012). An efficient bank has the capability to meet the demand of its customers and handle different types of risks arising in business more precisely and quickly. Moreover, it is also understood that the banking system is responsible for overall economic growth of the country (Kashian *et al*., 2019).

However, it is quite difficult to understand the contribution of any bank to the whole banking industry as well as on the economic development of the country without knowing its efficiency level at the branch root level (Das *et al*., 2005). Thus, to evaluate the technical efficiency of bank branches in Janata Bank PLC, the study employs the Data Envelopment Analysis (DEA) method to measure efficiency and adopt the intermediation approach in measuring inputs and outputs. One of the unique aspects of this study is the proposed efficiency framework that considers the impact of the online banking system at the branch level. The analysis of banking efficiency at the branch level will also provide valuable information to the bank in formulating its policies and degerming the level of supervision and control the banks should impose on their branches to increase their efficiency. In the operation and management of bank branches, the DEA method is found to be one of the most important tools for performance analysis. Along with benchmarking the branches, it enables improvement capabilities and also identifies sources of inefficiency.

However, this study is particularly significant in the context of Bangladesh, where, despite remarkable digitalization in banking industry, a large segment of population continues to rely on traditional banking methods. Many customers are still reluctant to adopt digital banking services due to limited accessibility, lack of trust and limited digital literacy. This scenario is true not only for Bangladesh, but also for other developing and underdeveloped countries such as Nepal in South Asia and countries from Sub-Saharan Africa as they are in the midst of transiting from traditional banking to digitalized banking (Okoye *et al*., 2024). Therefore, the findings of this study offer valuable insights for strategic planning-not only for Bangladesh to improve branch level efficiency, but also for other countries undergoing digital transformation in banking industry.

Methodology

Sample set and data collection methods

This study selected Janata Bank PLC because it is one of the largest service providers in the banking sector of Bangladesh. The sample bank is already recognized for large-scale digitalization in its operations, and it also brought urban and rural areas into its branch network to contribute substantially for the economic development of the country. The total number of branches was 922 including four overseas branches, as of 30 June 2024. The period of this study covered the year of 2019 among the 909 branches of Janata Bank PLC. which included special corporate, corporate-1, corporate-2, grade-A, grade-B, grade-C, and grade-D branches (where total number of online branches was 680 and traditional branch was 229). The data provided by the bank was based upon its overall operations. Due to missing information, inconsistencies, and irregularities; the total number of branches was reduced, as appropriate, to 909.

Primary and secondary sources of data

The online banking adoption date of the sample bank was collected through personal communication with the IT departments of the respective bank, and the secondary data were collected from the annual report, various financial reports and internal records of Janata Bank PLC as well as the bank website.

The method and its rationale

In recent years, frontier-based methods such as DEA technique have been applied by researchers for measuring bank performance. Considering the restriction that all decision-making units (DMUs) fall on or fall below the efficiency frontier, this method tends to measure the efficiency of a single DMU relative to other similar DMUs (Berger *et al.,* 1997). If a DMU is found on the frontier, then it is considered to as an efficient unit; otherwise, it is referred to as an inefficient one. The efficiency of DEA ranges between 0 to 1; whereas a DMU with an efficiency score of 1 will be considered as the best practice firm. A single efficiency score is given to every DMU which facilitates the ranking of the DMUs in the sample and suggests possible improvements for every single DMU. Also, estimations under the parametric approach produce fixed rankings that do not change from year to year which means a bank cannot improve its position, whereas parametric approach can be applied on yearly basis as there is sufficient data available. The analysis under bootstrap DEA is concerned with understanding how each DMU is performing relative to other DMUs who are providing similar services and also have similar size, the causes of inefficiency and how a DMU can improve its performance to become efficient and does not consider predetermined benchmark of performance measurement. Studies have been done using DEA input-oriented approach to measure bank branch technical efficiency of Janata Bank PLC. of Bangladesh is an addition to the literature.

For this model, multiple inputs and multiple outputs are necessary to measure the relative efficiency and to set an efficiency frontier to measure the most efficient DMUs and to measure the distance of less efficient DMUs from the frontier. By implying DEA method, the performances of each bank can be measured relative to the best practice bank where separate weights are attached to inputs and outputs of each bank.

The basic DEA CCR model

According to Cooper *et al.* (2006), the first one is output-oriented model which tries to maximize output with the given input level. And the second type is known as the input-oriented model that attempts to minimize the use of inputs while delivering a given output level. The linear programming equation of input-minimization DEA CCR model is also known as dual model (Cooper *et al.*, 2006; Ramanathan, 2007). In this study, input oriented DEA model was utilized in this study to estimate the efficiency score of different branches of Janata Bank PLC.

min Θ such that

$$\sum_{n=1}^{N} y_{nj}\ \lambda_n \geq ymj;\ j = 1,2.....J$$

$$\sum_{n=1}^{N} x_{ni}\ \lambda_n \leq \theta_m x_{mi;}\ i = 1,2.....I$$

$$\lambda_n \geq o; n = 1,2.....N; \theta_m\ free$$

Where, θ_m = Efficiency ratio of m^{th} DMU

Selection of input and output variables

Specification of inputs and output variables are required for the measurement of efficiency. Both production approach and intermediation approach can be used for the specification and both dominate the banking literature. This study adopts the most employed intermediation approach because it suits the characteristics of the banking industry more than the other approaches. It treats banks to use deposits, manpower, interest expenses, loans and advances and classified loans which contribute to the generation of output variables such as total revenue and foreign remittance for the bank. Thus, all online and traditional branches of Janata Bank PLC, within the intermediation framework, are modeled as multi- product firms, producing outputs employing inputs as summarized in Table 1. The database with data for each branch is created in Excel to form panel data and then used in the DEA input-oriented approach for determining technical efficiency of performance for each branch of Janata Bank PLC, for year 2019.

Table 1: Input-Output variables for technical efficiency measurement of Janata Bank PLC

Input variables	Output variables
Deposits Manpower	Total revenue
Interest expense Loan and advance Classified loan	Foreign remittance

Result and Discussion

Empirical results and discussion

The first section tests the descriptive statistics of the input and output variables of the panel dataset. The second section measures the technical efficiency of bank branches using DEA. The third section provides the analysis of the findings.

Descriptive analysis of variables

For the analysis, sample data were collected from 909 non-public financial reports of the bank branches of Janata Bank PLC's branches for the year 2019. As a snapshot of the variables used, Table 2 summarizes the descriptive statistics on inputs and outputs of this study. The descriptive statistics are measured on 909 observations, where data from 680 online branches and 229 traditional branches were collected, respectively. The study obtained the minimum, maximum, mean, and standard deviation for input and output variables, where the mean value of the input variables —deposits, staff no, loan and advance, and interest expense —is higher for traditional branches, followed by online branches. This reflects that still the traditional branches have to handle more deposits, need more manpower for maintain face to face interaction with customers and provide lending services because many customers of this country rely on traditional branches for banking transactions. However, the mean value for the input variable; classified loan is higher for online branches than for traditional branches which indicates that there are more chances of defaulting a loan in online banking because of lower monitoring capacity. Standard deviation for deposit, staff no, and interest expense is higher for traditional branches than online branches. But the standard deviation for the input variables; loan and advance and classified loan is higher for online branches than that of traditional branches. Standard deviation for input variables- loan and advance and classified loan; and output variables- total revenue, are the higher for online branches followed by traditional branches which indicates that online branches are more heterogenous. They can perform well in favorable conditions but also suffer much in adverse situations. On the other side, standard deviation for foreign remittance is higher for traditional branches than that of online branches because the locations of traditional branches are more diversified-some located in high remittance area, and some located in low remittance area. Whereas the customer base for foreign remittance using online branches is relatively stable.

The current findings also align with the previous studies, where other studies revealed that traditional branches are more physical and human resource intensive and handle more deposits and provide larger loan portfolios (Das & Ghosh, 2006; Drake & Hall, 2003). Whereas the mean value of classified loan is found to be higher for online branches indicating higher credit risk which is the result of wake monitoring capacity of online branches but tend to grow faster than the traditional branches (DeYoung, 2005).

Table 2: Inputs-Outputs and descriptive statistics

Variable	Description	Mean (Online)	Mean (Traditional)	Standard Deviation (Online)	Standard Deviation (Traditional)	Online		Traditional	
						Min.	Max.	Min.	Max.
N	Observations	680	229	-	-	-	-	-	-
Input variables									
Dep	Deposits (In crore Tk.)	51.193	136.130	190.838	559.006	0.1	4281.88	3.22	7274.51
Staff	Manpower/Staff (Number)	12.530	14.295	12.937	14.564	06	333	04	213
IE	Interest Expense (In crore Tk.)	1.899	5.651	8.089	29.237	0.09	177.37	0.08	390.26
LA	Loan and Advance (In crore Tk.)	54.578	75.037	779.841	371.786	0.09	14933.84	0.16	4153.22
CL	Classified Loan (In crore Tk.)	16.561	13.968	286.008	76.131	0	5453.84	0	727.28
Output variables									
TR	Total Revenue (In crore Tk.)	27.208	34.406	340.18	131.014	0.29	7767.83	0.45	1333.7
FR	Foreign Remittance (In crore Tk.)	7.705	10.067	23.77665	28.753	0.01	585.42	0.07	417.10

Technical efficiency measurement of bank branches

This section presents the overall empirical result of technical efficiency of online and traditional banking systems with DEA input-oriented analysis with empirical evidence of Janata Bank PLC. This study considered 680 online branches and 229 traditional branches, i.e. a total of 909 branches operated at the unit efficiency level (Table 3 and Table 4). All the branches generate

the same product using the same inputs and operate in the same environment with two different dimensions, i.e., online and traditional banking systems. For the DEA input-oriented approach, the same 5 inputs and 2 outputs were used. In December 2019 year end data of inputs and outputs and descriptive statistics are listed in Table 3. Since total revenue and foreign remittance are assumed to be index, covering deposit, loan and advance, classified loan and advance, interest expense and manpower, as inputs. Although service quality and customer satisfaction are two important aspects in the banking sector; the study could not obtain any regular data about service quality and its measurement was not covered by the scope of the study, no service quality parameter was included in calculations also. For the input-oriented model, we determine the efficiency of branches of bank based on input variables deposit, loan and advance, classified loan and advance, interest expense and manpower. This model indicates a proportional reduction in input that would allow the branch to produce the same number of outputs as other branches operating on the efficiency frontier. Those branches whose optimum value of the assigned function is equal to one, work within the observed group of branches effectively, and those branches whose optimum value of the assigned function is less than one work inefficiently and need to improve. In a DEA analysis the typical measure of performance is the overall technical efficiency score.

Table 3: Technical efficiency score of the branches

Branch Type	Technical Efficiency scores level		
	Minimum score	Maximum score	Average score
Online branch	0.18	1	0.54
Traditional branch	0.06	1	0.52

The findings of technical efficiency over the study period of different branches are shown in Table 3. The average technical efficiency score of online branches was 0.54, and 23 DMUs were ranked as efficient as their scores were 1. The lowest individual DMU score was 0.18 (DMU 680). In online banking, the efficiency score of 7% branches (50 DMUs) was within 0.81-1, which was very close to efficient. For example, a branch with a score of 0.80 is considered 80% efficient, meaning that it could have been operating on the efficient frontier if it used only 80% of the inputs. The medium efficiency score was 0.61-.080 which shows (Figure 1) 21 % (142DMUs) of online bank branches were moderately efficient, which can be considered as a good score. Many branches of online banking i.e. 53 % (358 DMUs) showed low-efficiency level and their score was 0.41- 0.60 (Table 4). Thus, most of the branches could utilize their input by only 40-60%. The very low efficiency score was 0.21-0.40, that shows 19% (130DMUs) of online branches were very low efficient units. This means for online branches, 130 DMU units would have to decrease their input use by an average of 60% to 80% to become efficient.

Table 4: DEA result (Efficiency score) of online branches

Branch Type	Efficiency scores				Total Branches
	0.21-0.40	0.41- 0.60	0.61- 0.80	0.81- 1	
Online Branches (Nos.)	130	358	142	50	680

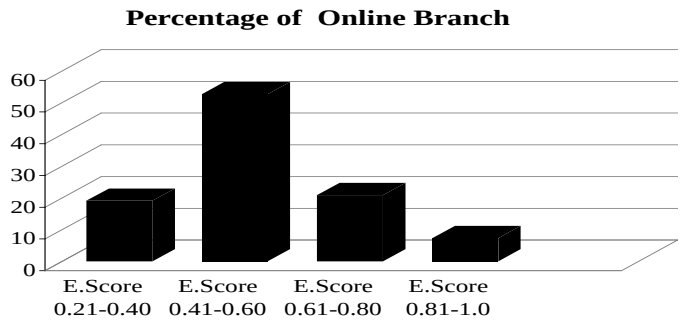

Figure 1: The Percentage of the online branches on average efficiency scores

The overall average score of traditional branches for the CCR model was 0.52 and 19 DMUs were recognized as efficient as their scores were 1. At the same time, the lowest individual DMU score was 0.06 (DMU 229). In traditional banking, the efficiency score of 13% branches (29 DMUs) was 0.81-1, which was very close to efficient. The medium efficiency score was 0.61-.080 that shows 18% (41 DMUs) of traditional banking, which can be considered good scores. Many branches on traditional banking, i.e. 38% (86 DMUs) were in the low-efficiency group which score was 0.41- 0.60 (Table 5). Thus, most of the branches could utilize their input by only 40-60%. The very low efficiency score was 0.21-0.40 which (Figure 2) indicates that 32% (73 DMUs) of traditional banking were considered very low efficient units. This means that for traditional banking, 73 units would have to decrease their inputs to an average of 60-80% to become efficient. In terms of performance of technical efficiency measurement of branches, the online branches were more satisfactory than the traditional branches. The results show that, on average, online branches were comparatively technically efficient. The results of this study tend to align with previous studies (e.g. Egland, *et al.*,1998; Furst *et al.,* 2000a and 2000b; DeYoung, 2005) where the researchers found that banks in all size categories offering internet banking were generally more profitable and tended to rely less heavily on traditional banking activities in comparison to non-internet banks. The other studies, Hassan *et al.* (2003), Rahman (2007), DeYoung *et al.* (2007), Oyewole *et al.* (2013), Siddik *et al.* (2016), also concluded with positive remarks on the e-banking/online banking effects on bank performance.

Table 5: DEA result (Efficiency score) of Traditional branches

Branch Type	Efficiency scores				Total Branches
	0.21-0.40	0.41- 0.60	0.61- 0.80	0.81- 1	
Traditional Branches	73	86	41	29	229

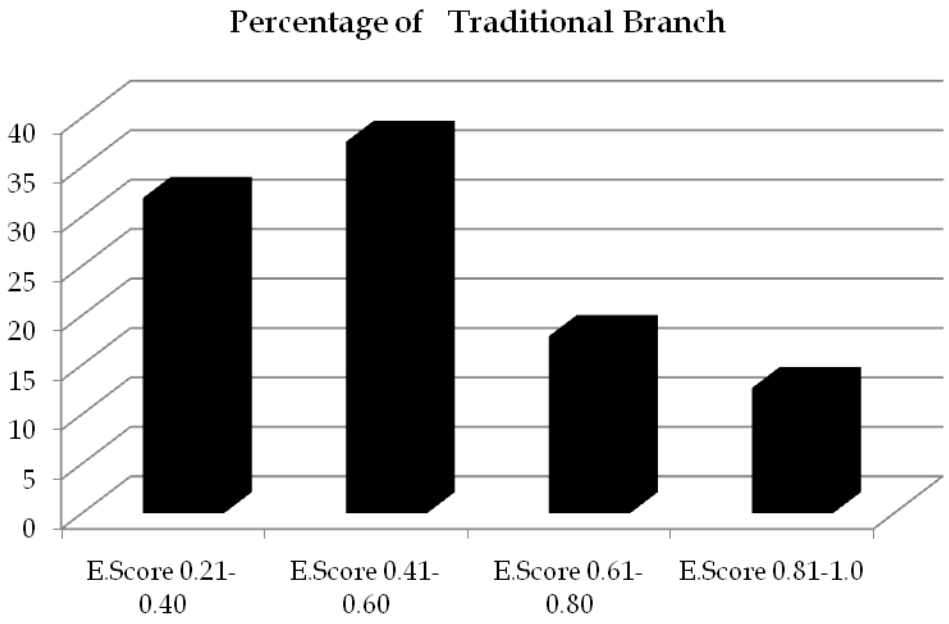

Figure 2: The Percentage of the traditional branches on average efficiency scores

However, comparing the performance of technical efficiency between online and traditional branches of Janata Bank PLC, it was found that traditional branch units were less potential than online branch units to produce same amount of output from a given set of inputs. Online branches not only deploy their resources efficiently but also tend to choose the right mix of resources to manage. So, inefficient branches should either increase their total revenue and simultaneously, they should try to decrease one of the inputs of branches to reach the efficient frontier.

Therefore, the findings suggest that the traditional branches will be more efficient by adopting new

technology-based online services, as well as investment in new technologies to change the banking service quality. This study finds a positive relationship between online banking and profitability, which suggests that online banking systems are generating higher revenue. The results reveal that the traditional bank branches were less efficient than the online bank branches during the study period.

Conclusion

This study examines the efficiency of 909 branches of Janata Bank PLC., from the bank's own database and runs a radial DEA input-oriented model to get maximum discrimination among the branches of the bank. Technical efficiency evaluation by using DEA in banking systems (online and traditional) offers valuable insights into their respective operational performances. The DEA results indicate that the average technical efficiency score of online branches was 0.54 and 23 DMUs being ranked efficient as their scores were 1. The lowest individual DMU score was 0.18 (DMU 680). By using CCR model of DEA, the overall average score of traditional branches was 0.52 and 19 DMUs being ranked efficient as their scores were 1. The lowest individual DMU score was 0.06 (DMU 229), i.e., online branches demonstrated a higher efficiency score on average compared to traditional branches. Thus 42 DMUs (online 23 and traditional 19) highly referenced the "best practice" branches had superior results compared to the overall average. Those branches deemed efficient but not referenced, still showed better than average results in both online and traditional banking, supporting the possibility that branch managers can and do choose to focus on specific areas of performance. These results underscore the evolving landscapes of banking, emphasizing the potential advantages of digital transformation. However, it is crucial for banks to strike a balance, ensuring that while leveraging online capabilities, the essence of personalized service inherent to traditional branches is not compromised. Further research and adaptive strategies are recommended to harness the strengths of both banking models for optimizing performance and customer satisfaction. However, in an increasingly digitized banking environment, it is imperative for Janata Bank PLC., to consider strategic enhancements to its online banking system, ensuring it aligns with contemporary customer expectations while maintaining the efficiency standards set by its traditional counterpart.

The contributions of this paper can help bank management and managers to set a progress plan for future years and also in determining the target points (both input and output) for the banks. Moreover, the implications of this study extend beyond Janata Bank PLC to inform broader banking sector reforms not only in Bangladesh and but also other developing and underdeveloped countries undergoing digital transformation.

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