

ASSESSING RELATIVE EFFICIENCY OF
COMMERCIAL BANKS IN BANGLADESH USING THE
INTERMEDIATION, PRODUCTION AND
PROFITABILITY APPROACHES

BY

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INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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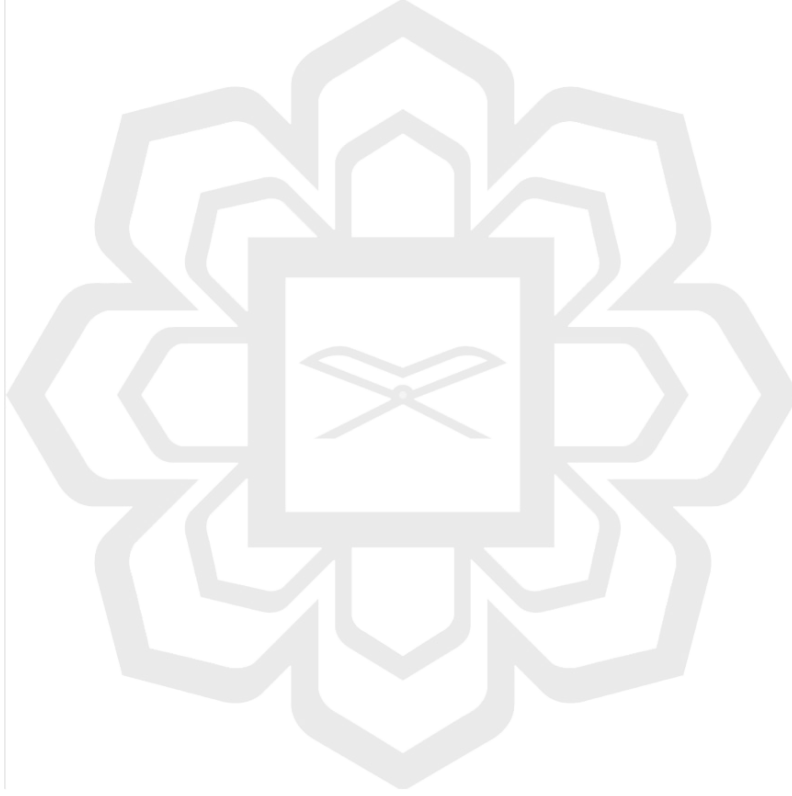
ABSTRACT

The economy of Bangladesh has shown an upward trend in the past decade, indicating improved performance overall. Accordingly, banking efficiency is essential for financial stability as well as an economy's development. It is obvious to have a positive linkage between bank efficiency and economic growth due to the equivalent and effective circulation of money in the market that supports businesses or investments. An efficient banking sector offers sound financial activities with quality loan provisions and, thus, better performance. However, extensive evidence indicates that the banking system in Bangladesh experiences considerable inefficiencies, despite decades of reforms and regulatory scrutiny. Multiple sources have reported that the Bangladeshi banking sector is facing a significant liquidity crisis and record-high levels of non-performing loans. This large amount of non-performing loans (NPLs) indicates inadequate credit evaluation, insufficient oversight, and political meddling in the loan approval procedures. As a result, the efficiency of the banking sector is questionable, suggesting a high level of inefficiency. Therefore, measuring the efficiency level of Bangladeshi commercial banks is crucial. Besides, Islamic banks have been demonstrated to be more efficient than conventional banks. Prior studies further suggested structural deficiencies and inefficiencies in the Bangladeshi banking industry, underscoring the necessity for changes aimed at governance, credit risk management, and resource optimisation. Banks operate their business in several ways in the age of technology and due to the financial crises experienced in recent decades. This research is set to evaluate the relative efficiency of commercial banks and compare the efficiency level between state-owned and private-owned commercial banks, as well as between Islamic and conventional banks in Bangladesh. To achieve these objectives, a total of 38 commercial banks, including 27 private conventional banks, 7 Islamic banks, and 4 state-owned banks, were selected for data collection. Secondary data was collected from the annual reports of each bank, and the Data Envelopment Analysis (DEA) technique was used to measure both the Constant returns to scale (CRS) and Variable returns to scale (VRS) efficiency scores. The results demonstrated a gradual improvement in banking efficiency level, except in the recent period (pandemic period) under the intermediation and production approach. The production approach showed that banks had the highest average efficiency score during the study period compared to other approaches. The findings also showed that private commercial banks were more efficient than state-owned banks in the intermediation and profitability approach. In contrast, publicly owned banks outperformed privately owned banks in the production approach. Henceforth, Islamic banks outperformed conventional banks in terms of efficiency levels under the production and intermediation approaches while underperforming under the profitability approach. The findings of this research contribute in three ways. Firstly, they enhance the literature by aiding empirical evaluation of the efficiency of the banking sector via three banking operations perspectives. Secondly, the results can assist banks in developing inclusive financial products, such as low-income savings accounts or community microfinance instruments, that bolster national initiatives in poverty alleviation and equitable development. Finally, efficient banking practices foster sustainable economic stability and resilience by minimising systemic inefficiency and encouraging financial innovation.

خلاصة البحث

لقد شهد اقتصاد بنغلاديش اتجاهاً تصاعدياً خلال العقد الماضي، مما يشير إلى تحسن في الأداء العام. وبناءً على ذلك، تُعدّ كفاءة القطاع المصرفي أساسية للاستقرار المالي وتنمية الاقتصاد. ومن البديهي وجود علاقة إيجابية بين كفاءة القطاع المصرفي والنمو الاقتصادي، وذلك بفضل التداول المتساوي والفعال للأموال في السوق، مما يدعم الأعمال أو الاستثمارات. يوفر القطاع المصرفي الكفؤ أنشطة مالية سليمة مع مخصصات قروض عالية الجودة، وبالتالي أداءً أفضل. ومع ذلك، تشير أدلة كثيرة إلى أن النظام المصرفي في بنغلاديش يعاني من قصور كبير في الكفاءة، على الرغم من عقود من الإصلاحات والتدقيق التنظيمي. وقد أفادت مصادر متعددة أن القطاع المصرفي البنغلاديشي يواجه أزمة سيولة حادة ومستويات قياسية من القروض المتعثرة. ويشير هذا الكم الكبير من القروض المتعثرة إلى قصور في تقييم الائتمان، وضعف في الرقابة، وتدخل سياسي في إجراءات الموافقة على القروض. ونتيجة لذلك، تُعدّ كفاءة القطاع المصرفي موضع تساؤل، مما يشير إلى مستوى عالٍ من عدم الكفاءة. لذلك، يُعدّ قياس مستوى كفاءة البنوك التجارية البنغلاديشية أمراً بالغ الأهمية. علاوة على ذلك، فقد ثبت أن البنوك الإسلامية أكثر كفاءة من البنوك التقليدية. أشارت الدراسات السابقة إلى وجود أوجه قصور هيكلية وعدم كفاءة في القطاع المصرفي البنغلاديشي، مما يؤكد على ضرورة إجراء تغييرات تهدف إلى الحوكمة وإدارة مخاطر الائتمان وتحسين الموارد. تدير البنوك أعمالها بعدة طرق في عصر التكنولوجيا وبسبب الأزمات المالية التي شهدتها العقود الأخيرة. وتم إعداد هذا البحث لتقييم الكفاءة النسبية للبنوك التجارية ومقارنة مستوى الكفاءة بين البنوك التجارية المملوكة للدولة والمملوكة للقطاع الخاص، وكذلك بين البنوك الإسلامية والتقليدية في بنغلاديش. لتحقيق هذه الأهداف، تم اختيار ما مجموعه 38 بنكاً تجارياً، بما في ذلك 27 بنكاً تقليدياً خاصاً و 7 بنوك إسلامية و 4 بنوك مملوكة للدولة، لجمع البيانات. كما تم جمع البيانات الثانوية من التقارير السنوية لكل بنك، واستُخدمت تقنية تحليل مغلف البيانات (DEA) لقياس كل من درجات كفاءة العوائد الثابتة للحجم (CRS) والعوائد المتغيرة للحجم (VRS). أظهرت النتائج تحسناً تدريجياً في مستوى كفاءة البنوك، باستثناء الفترة الأخيرة (فترة الوباء) في ظل نهج الوساطة والإنتاج. أظهر نهج الإنتاج أن البنوك حققت أعلى متوسط درجة كفاءة خلال فترة الدراسة مقارنةً بالمنهج الأخرى. كما أظهرت النتائج أن البنوك التجارية الخاصة كانت أكثر كفاءة من البنوك الحكومية في نهج الوساطة والربحية. في المقابل، تفوقت البنوك المملوكة للدولة على البنوك الخاصة في نهج الإنتاج. وبالتالي، تفوقت البنوك الإسلامية على البنوك التقليدية من حيث مستويات الكفاءة في نهج الإنتاج والوساطة، بينما كان أدائها أقل من المتوسط في نهج الربحية. تساهم نتائج هذا البحث بثلاث طرق. أولاً، تُعزز هذه النتائج الدراسات السابقة من خلال المساعدة في التقييم التجريبي لكفاءة القطاع المصرفي من خلال ثلاثة مناظير للعمليات المصرفية. ثانياً، يمكن أن تساعد النتائج البنوك في تطوير منتجات مالية شاملة، مثل حسابات التوفير لمحدودي الدخل أو أدوات التمويل الأصغر

المجتمعية، والتي تدعم المبادرات الوطنية في مجال التخفيف من حدة الفقر وتحقيق التنمية العادلة. أخيرًا، تُعزز الممارسات المصرفية الفعالة الاستقرار الاقتصادي المستدام والمرونة من خلال الحد من عدم الكفاءة النظامية وتشجيع الابتكار المالي.



APPROVAL PAGE

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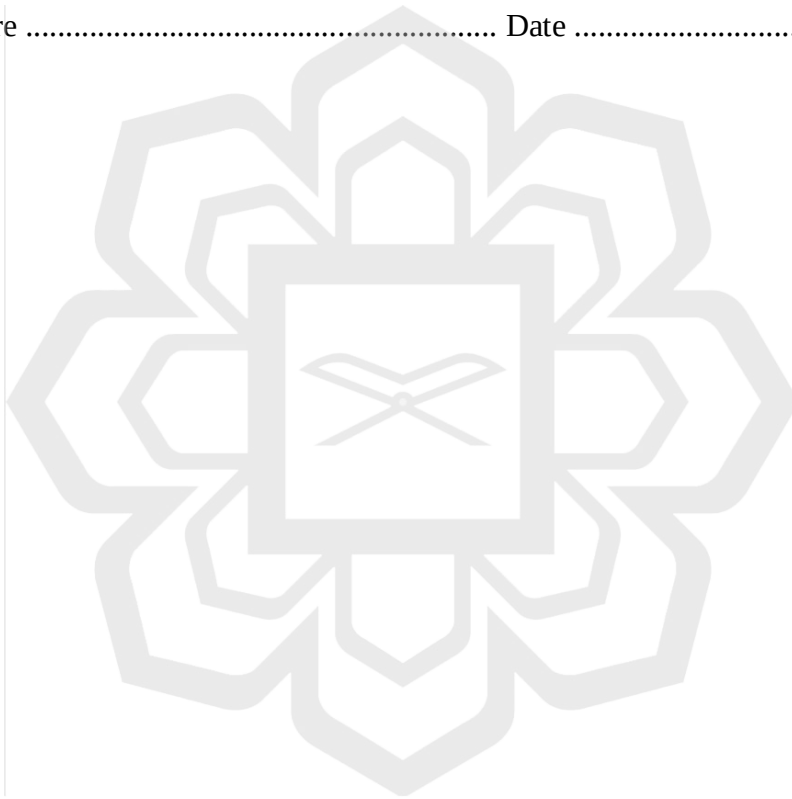
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DECLARATION

I hereby declare that this dissertation is the result of my own investigation, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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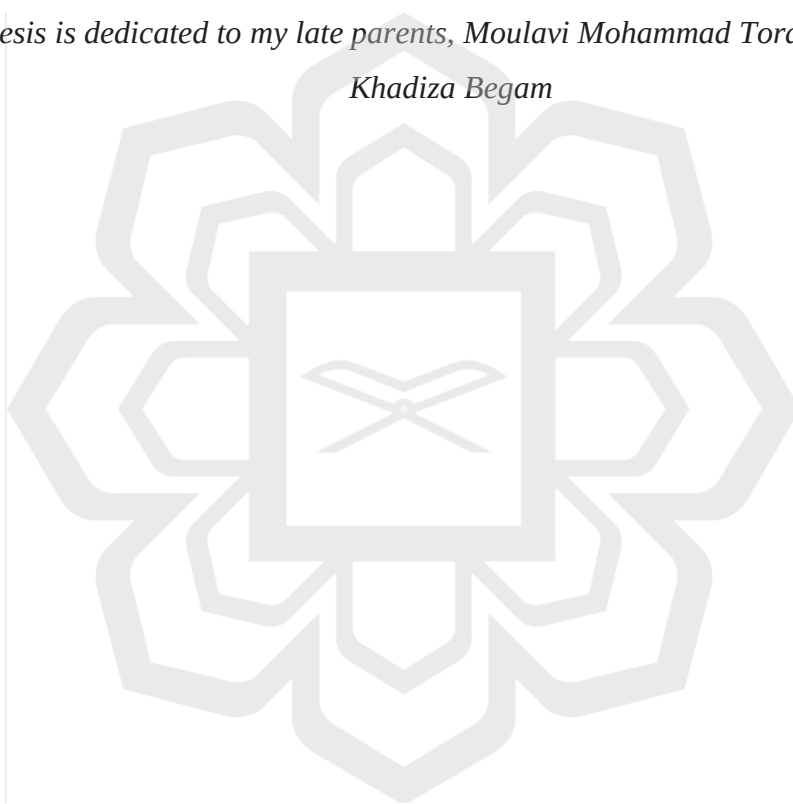
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DEDICATION

*This thesis is dedicated to my late parents, Moulavi Mohammad Torab Ali, and Late
Khadiza Begam*



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Alhamdulillah. All praises are to Allah SWT, the most Merciful. First of all, I would like to thank Allah for giving me the patience and strength to complete the dissertation.

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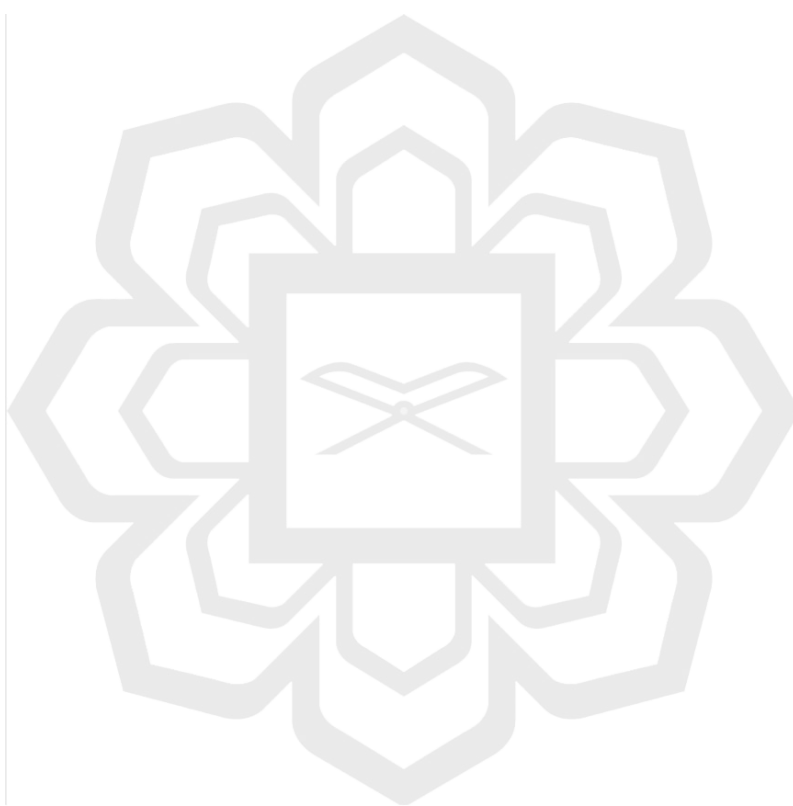
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LIST OF ABBREVIATIONS

DEA	Data Envelopment Analysis
GMM	Generalised Method of Moments
SFA	Stochastic Frontier Analysis
CRS	Constant Returns to Scale
VRS	Variable Returns to Scale
TE	Technical Efficiency
PTE	Pure Technical Efficiency
SE	Scale Efficiency
GDP	Gross Domestic Product
PCB	Private Commercial Bank
SCB	State-owned Commercial Bank
ICB	Islamic Commercial Bank
BDT	Bangladeshi Taka
SAARC	South Asian Association for Regional Cooperation
CSR	Corporate Social Responsibility
EU	European Union
US	United States
NIM	Net Interest Margin
ROE	Return on Equity
ROA	Return on Assets
WAEMU	West African Economic and Monetary Union
BRICKS	Brazil, Russia, India, China, Korea, South Africa
HK	Hong Kong
MO	Macau
UK	United Kingdom
UAE	United Arab Emirates
GCC	Gulf Cooperation Council
ASEAN	Association of Southeast Asian Nations
MENA	Middle East and North Africa
SEA	Southeast Asia
SSBs	Shariah Supervisory Boards



CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

This chapter presents the background and justification for the research. It commences with a contextual overview, followed by the historical background of the Bangladeshi banking sector, a problem statement, research questions, and research objectives. The chapter then delineates the scope, significance, and organisation of this research.

1.2 BACKGROUND OF STUDY

The financial crisis of 2007- 2009 revealed significant inefficiencies in the banking sector, underscoring the need for financial institutions to uphold a high standard of operational efficiency. The crisis exposed how inadequate asset utilisation, excessive risk-taking, and diminished productivity of banking assets can result in systemic failure. In this situation, efficiency, which responds to the bank's ability to transform inputs (such as labour, assets, and capital) into outputs (such as loans or financing and financial services), has emerged as a crucial indication of financial health and resilience. Efficient banks are more capable of withstanding shocks, sustaining profitability, and fostering economic stability, particularly during times of market turbulence. Nevertheless, the banking sector plays a vital role in any economy, especially in serving as a key source of funding for long-term investment (Henriques et al., 2018; Sarker et al., 2017; Schumpeter, 1934; Tamatam et al., 2019). In other words, the banking sector stimulates individual saving and enables the growth of business and industry in an economy through channelling funds from savers to borrowers (Parsa, 2022). Undeniably, the banking sector plays a substantial role in the growth of an economy (Abdulahi et al., 2023; Parsa, 2022; Phan et al., 2018; Sadekin et al., 2014; Tsolas & Charles, 2015). Consequently, a laborious fiscal scheme is crucial for a vigorous and vibrant economy (Mengesha, 2016). The soundness of the banking sector supports the strength and progress of a country's financial condition (Alemu, 2015; Amin et al., 2021; Yahaya et al., 2022). On the other hand, the disruptions of smooth functions

in the banking sector may intensify overall output fluxes and cause significant output losses over time (De Jonghe, 2010). Thereby, a better financial environment with a consolidated and advanced banking system will make the nation more competitive (Svitalkova, 2014; Tamatam et al., 2019). In other words, an efficient banking sector smoothes the circulation of money flow from surplus to deficit (Fonseka & Farooque, 2024). To substantiate this, they collect deposits from individuals with excess cash and provide loans to individuals who require them, thus enabling the transfer of funds from savers to borrowers (Casu et al., 2022; Fonseka & Farooque, 2024).

Banks generate profit through the extension of credit in the form of personal loans, housing loans (mortgages), and credit cards, among others, thus increasing the money supply within the economy. The process of credit generation is essential for fostering economic growth as it provides the necessary funding for consumption and investments (Abbas et al., 2023). Efficient banking sectors transfer cash to economic endeavours by evaluating creditworthiness and financing feasible businesses. This allocation facilitates economic expansion and advancement (Chowdhury et al., 2022). In addition, the efficient and effective money flow encourages entrepreneurs and businesses to grow, which contributes to economic growth in terms of investment, income, and consumption. So, the banking sector's efficiency is crucial for sustaining stable economic circumstances, promoting growth, and effectively controlling deficits through proficient financial intermediaries and risk management methods (Yahaya et al., 2022). More so, the efficiency and thus performance of the banking industry are referred to as a foremost subject for policymakers since it unswervingly narrates the tranquil functioning of the financial system (Alshammari, 2021).

In addition, banks posited their importance for the overall welfare of the economy as well as local communities, thus articulating consumer satisfaction-oriented approaches (Kheng et al., 2010). Nevertheless, a competitive system for banks endorses efficiency, hence crucial for growth (Rahaman et al., 2020); however, market power is deemed necessary for the banking system's stability (Avkiran, 2000). Besides, the banking industry provides several services for the growth of the national economy, such as allocation of investment funds (Kenourgios & Samitas, 2007). For instance, banking stimulates economic activity, including infrastructure, technology, and corporate developments, by providing loans to individuals, businesses, and governments (Abbas et

al., 2023). This financing promotes economic growth by facilitating productive investment and corporate expansion (Abbas et al., 2023; Boachie et al., 2023). Besides, banks aid impoverished and marginalised groups to promote financial inclusion and banking services like savings accounts and credit to boost economic participation and inclusive growth (Koomson et al., 2023; Úbeda et al., 2023). As a result, commercial banks grasp a large portion of the economic endeavours of an economy (Gazi et al., 2021) by projecting funds in the financial market that are available for investors. Since the efficiency of financial intermediation is crucially contributing to economic growth, inefficiency may lead to a disturbance of financial stability and thus economic growth (Jeris, 2021; Levine, 1998). Therefore, better sustainable and proper banking efficiency may lead to economic recovery by providing higher credit during the financial crisis (Ivanovi, 2016; Lakić et al., 2016). A sound banking sector is one of the key players in an economy to sustain growth and robustness.

Due to the changes in market focus, the regulatory setting, technological progress, corporate objectives, and customer preferences, the banking industry has experienced remarkable deviations in its structure, operating context, and performance that both external and internal factors have exaggerated over the last two decades (Boubaker et al., 2023b; Fonseka & Farooque, 2024; Gökgöz et al., 2023; Jeris, 2021; Shi et al., 2023). Banks are operating their activities to expand their profitability. As a result, they are providing various services and offering their customers many other financial and business products (Antunes et al., 2024). For instance, banks offer several services linked to payment, bills, and documentation with a fee. Moreover, banks provide several products that allow them to become partners and investors and actively participate in the securities market to collect equity. In consequence, banks have become business entities rather than intermediary entities. Accordingly, banks should focus more on their efficiency as financial innovation, deregulation, and technological advancements are more stimulating for market participants (Altunbaş et al., 2001).

Notwithstanding, financial system uncertainty led to the financial crisis, such as the 2007-2009 financial crisis, which was attributed mainly to a liquidity issue (Yahaya et al., 2022). Liquidity risk triggers bank operations, as savers withdraw money in large amounts due to bank solvency concerns that lead to economic turmoil and spill over to other banks (Adalsteinsson, 2014). Accordingly, it is the banks' responsibility to confirm

liquidity provision to both institutions and depositors. The existence of banking assets and liabilities synergies was traced by accounting standards (Diamond & Dybvig, 1983), which illuminates the cause of liquid liabilities in the method of wholesale and retail deposits and non-liquid assets in the method of loans are balanced, disposed to shocks (Yahaya et al., 2022). Kashyap et al. (2002) underlined the variances between credit and deposit, as both are credited to shocks. Subsequently, they sustain their position so long as credit line declines and deposit extraction are not impeccably associated, offering all the products the chance to accomplish expensive liquidity bumpers (Yahaya et al., 2022). As a consequence, such situations lead to the inefficiency of the banking sector.

Traditionally, the banking sector makes a profit by mediating between parties with a lack of funds and those with an excess of funds (Chowdhury et al., 2022; Milenković et al., 2022). In the current era, the depositor's interest has been deteriorating to the point of fetching emblematic (Milenković et al., 2022). In other words, nowadays, the interest paid to depositors is so low that it is almost just a formality or a symbolic gesture, rather than a valuable or worthwhile return on their deposits. This decline in interest rates induces the banks' operations in various ways (López-Penabad, Iglesias-Casal, & Silva Neto, 2022). Individuals make more profit by investing their financial savings in higher gainful placements than by keeping deposits in banks (Milenković et al., 2022). It motivates depositors to withdraw their savings from banks, jeopardising their liquidity (Kashyap et al., 2002). In this circumstance, the level of deposits is potentially reduced, thus the potential of both the loan and financing levels is accumulated from deposits. So, the monetary policy unintentionally indirectly affects the loan generation and the profits of banks (Junttila et al., 2021; Sá & Jorge, 2019). Banks can evade the deterioration of their profits by forming more efficient activities with the available sources (Milenković et al., 2022). Responsively, banks provide innovative services to consumers and perform business activities related to revenue-generating endeavours (Adesina, 2021; Chowdhury & Haron, 2022; Milenković et al., 2022). By straightening the placements of loans/financing and investments, coupled with operational efficiency, banks can expand the interest/investment income and non-interest income flows. Substantially, banks' efficiency improvements decrease the banks' risk (Gupta et al., 2021).

Meanwhile, profits elucidate the ability of a business entity to sustain its income year after year. Accordingly, the shift in the banks' profitability leads to economic growth

by affecting businesses' savings and spending strategies (Jeris, 2021). Besides, the enhancement of incomes upsurges the cash flow of entities and creates substantial stability in the route of investment portfolio capital. Henceforth, easier external investments permit more focus on enhancing efficiency and performance, further creating employment opportunities (Menicucci & Paolucci, 2016). In light of the evidence, it can be clearly demonstrated that soundness and an efficient banking sector are important factors in the momentum of economic growth. In the recent period, with several business and financial activities, banks perform their operations based on the three approaches: *Production* - converting equities and deposits into earning assets, *Intermediation* - converting earning assets to loans/financing, and *Profitability* - converting financing or loans to net income (Azad et al., 2021). Moreover, banks provide a diversity of financial services, comprising of long-term earnings, mortgages, loans, insurance, payments, securities, and loans to eradicate poverty (Jeris, 2021). As a result, the banking sector demonstrates complex and deviating business models based on its current operations.

The economic growth of Bangladesh has been noted to be significant in recent years. For instance, GDP growth was recorded at 7.11 per cent in 2016, 6.59 per cent in 2017, 7.32 per cent in 2018, 7.88 per cent in 2019, 3.45 per cent in 2020, 6.94 per cent in 2021, 7.10 per cent in 2022, and 5.78 per cent in 2023, respectively (The World Bank, 2024) (Figure 1.1). Subsequently, the economy of Bangladesh is profoundly contingent on the banking sector (Jeris, 2021). Thus, the commercial banking system plays a vital role in Bangladesh's financial sector (Dutta & Saha, 2021). However, the recent vulnerable position of the banking sector, drenched in defaulting loan stances, poses a significant risk to the nourishment of the remarkable growth of Bangladesh (Byron, 2020). Furthermore, Bangladesh has ranked the lowest in terms of banking dependability among South Asian countries, which is mainly blamed for its irregularities and unavailability of good governance in the financial sector (Ovi, 2019). Based on the above discussions, the banking sector provides mixed findings and consequences related to its contribution to economic growth, as it seems not to be operating efficiently. The banking sector is one of the most significant and primary sources of a country's wealth (Paradi, Rouatt, et al., 2011). According to Wang et al. (2014), the banking sector is becoming more important to the evolution of the financial system.

Consequently, measuring and evaluating the bank efficiencies would help identify the contributing drivers to this growing trend.

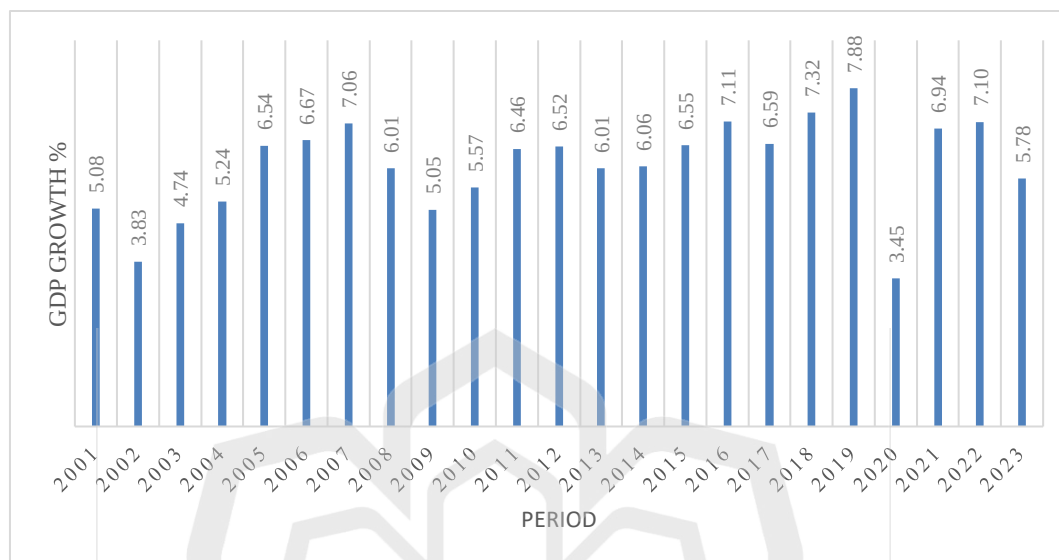


Figure 1.1 GDP growth in Bangladesh. Source: World Bank (30th July, 2024)

Meanwhile, the Islamic banking industry is becoming more popular worldwide, so it is important to ascertain the efficiency of Islamic banks in Bangladesh (Ibrahim et al., 2014). Islamic banks have transformed their presence from a little-known financial entity to a considerable force in the broad financial sector (Mirzaei et al., 2022). Accordingly, Islamic banks are also booming in the banking industry of Bangladesh, with the majority of citizens being Muslim, 89.1 per cent of the total population (World Population Review, 2020). However, their management and asset quality are worse than in conventional banks, while capital adequacy and liquidity conditions are better for Islamic banks in Bangladesh (Uddin et al., 2017). However, Islamic banks do not have solid legal support from the Bangladesh central bank, nor adequate experts or skilled human capital to review, observe, appraise, and audit the financial transactions to comply with the *Shariah principles* (Islamic law) (M. Solaiman et al., 2012). As a result, it is arguable that Islamic banks perform less than conventional banks; even Islamic banks pose fewer scams and fraud cases. Fraud and scams significantly impede the efficiency of banks. These illegitimate operations often result in substantial financial losses, thereby diminishing a bank's ability to deploy resources efficiently for profitable investments or

lending endeavours. Furthermore, incidents of fraud impede operational workflows, necessitating the reallocation of staff and time for investigations, legal actions, and internal audits.

Like other financial institutions in the world, Islamic banks are rapidly finding scope to enhance their product diversities and services to contribute to economic growth due to higher competition, globalisation density, and market volatility (Abduh et al., 2013). Meanwhile, Islamic banks are deemed to be more robust in the financial crisis period than conventional banks (Mirzaei et al., 2022). Therefore, it is imperative to assess and analyse the efficiency of Islamic banks relative to other banking institutions functioning in Bangladesh (Chaity & Islam, 2022) to comprehend their comparative performance and impact on the financial sector. In the context of the increasingly competitive and diverse banking sector in Bangladesh, evaluating efficiency is necessary to determine if Islamic banks are optimally using their resources and providing financial services in accordance with *Shariah principles*. Further, this assessment will provide important insights for policymakers and stakeholders concerning the sustainability, risk management, and operational strengths or weaknesses of Islamic banks in comparison with conventional banks.

1.3 THE STRUCTURE OF BANKS IN BANGLADESH

Bangladesh's banking sector progressed by establishing its central bank (Bangladesh Bank) in 1972. All local banks were publicly owned and combined into six operating banks (Asmild et al., 2022). After a decade of modest economic growth, the Bangladesh government embarked on de-nationalising and setting up privately owned commercial banks (Asmild et al., 2022). Upon its liberation, the banking industry in Bangladesh began its journey with six nationalised commercial banks, two public-owned specialised banks, and three foreign banks. In the 1980s, the banking industry attained significant expansion with the arrival of private banks. The first privately owned bank was set up through a transfer of control from the public to the private sector in 1982, while some public banks remained under the government, and five more private commercial banks were formed in 1983 (Asmild et al., 2022). In 2015, 39 Private Commercial Banks (comprising 8 Islamic banks), including 4,226 branches, with 6652.9 billion (BDT) of assets, had a share of 64.5

per cent of total bank assets in Bangladesh (Bangladesh Bank, 2018). Public and other government-owned development banks measured 30.3 per cent, and foreign banks measured 5.2 per cent of the market (Asmild et al., 2022).

Presently, the Bangladeshi banking sector is primarily categorised into two types: scheduled and non-scheduled banks. Scheduled banks that get the license to operate under the Bank Company Act of 1991 (Amended in 2003) are termed scheduled banks. Bangladesh has a total of 62 scheduled banks, comprising public-owned, private, foreign, conventional, Islamic, and specialised banks. The banking system comprises six state-owned commercial banks, 43 private commercial banks, 33 conventional banks, 10 Islamic banks, nine foreign commercial banks, three specialised banks (Bangladesh Bank, 2023b), and one digital commercial bank (yet to get approval). Besides, Bangladesh Bank has reported five non-scheduled banks. Scheduled banks are categorised into the following types (Figure 1.2 and Table 1.1).

Bangladeshi Banks' Category	Scheduled Banks The banks that remain in the list of banks maintained under the Bangladesh Bank Order, 1972.	▪ State-owned commercial bank ▪ Private commercial bank ▪ Conventional commercial bank ▪ Islamic commercial bank ▪ Foreign commercial bank ▪ Specialised bank
	Non-Scheduled Banks The banks which are established for special and definite objective and operate under any act but are not Scheduled Banks. These banks cannot perform all functions of scheduled banks.	• Grameen Bank

Figure 1.2 Categories of Bangladeshi Banks, Source: Bangladesh Bank

Table 1.1: Categories of Banks in Bangladesh

BANKS	DESCRIPTION
State-Owned Commercial (Public-Owned) banks	The Bangladesh Government majorly or fully owns these banks.
Private Commercial banks	A total of 43 private commercial banks are currently operating, mostly owned by individuals or private entities. These banks are categorised into two types: Conventional and Islamic.
Conventional banks	Conventional banks perform their operations according to an interest-based fashion.
Islamic banks	Bangladesh introduced an Islamic banking system based on profit-loss sharing in 1983, operating alongside conventional interest-based banks. Six of the country's 48 fully Islamic banks, and ten conventional banks, offer Islamic banking in 21 branches. Since its inception, the Islamic banking sector has shown robust growth, increasing its market share in assets, deposits, and financing in line with the country's economic expansion.
Foreign Commercial banks	These banks operate as the branches of foreign banks that are incorporated abroad.
Specialised banks	These banks were established with particular objectives, such as agricultural or special sector development, and are mostly owned by the government.
Non-Scheduled banks	The banks established for special and definite objectives and under the acts enacted to meet those objectives are termed non-scheduled banks. These banks cannot perform all functions like scheduled banks. Grameen Bank, Karmasangsthan Bank, Probashi Kallyan Bank, Progoti Co-operative Land Development Bank Limited (Progoti Bank), and Anser VDP Unnayan Bank are non-scheduled banks.

1.4 PROBLEM STATEMENT

The economy of Bangladesh has shown an incredible upward trend in the recent decade, exhibiting better performance in the economy. The financial sector, particularly the banking sector, plays an important role in economic growth (Kamarudin et al., 2016a). Idiosyncratically, the creation of employment, the growth of trade and commerce, and the advancement of the industrial revolution in a country require the expansion of the banking industry (Yesmine et al., 2023). Accordingly, banking efficiency is important for financial stability as well as an economy's development (Barros et al., 2018; Ruza et al., 2019).

Besides, the banking efficiency level gradually increases with the development of an economy (Aghimien et al., 2016; Barros et al., 2018; Solaiman et al., 2021). Consequently, there is expected to be a positive linkage between bank efficiency and economic growth due to the equivalent and effective circulation of money in the market that supports businesses or investments. More so, the efficiency of banks defines the managerial adequacy and optimal usage of resources. As a result, an efficient banking sector offers sound financial activities with quality loan provisions and, thus, better performance (Solaiman et al., 2021). Accordingly, Bangladesh's banking sector, with better efficiency, is deemed to be an essential driver of simultaneous economic growth.

Extensive evidence shows that the banking system in Bangladesh experiences considerable inefficiencies, despite decades of reforms and regulatory scrutiny. Several sources indicated that the Bangladeshi banking sector is contending with a severe liquidity crisis and unprecedented levels of non-performing loans (NPLs), which exceeded BDT 2.85 trillion or 17 per cent of total distributed loans (Jahan, 2024), as reported on 30 September 2024, and accompanied by a sector-wide NPL percentage over 9.6 per cent (Ittefaq, 2024). The World Bank reported 8.7 per cent of NPLs in 2022 by the Bangladeshi banking sector (World Bank, 2025), showing how the percentage of NPLs has substantially increased in recent decades. These substandard loans indicate inadequate credit evaluation, insufficient oversight, and political meddling in the loan approval procedures (Ittefaq, 2024; Jahan, 2024).

Nevertheless, Bangladesh's commercial banking sector has gradually been plagued by illegitimate loan dismemberment and scams in the current decade (M. M. Hasan, 2023). In the last decade, ninety-six cases of significant financial anomalies and scams have been linked to Bangladeshi commercial banks as well as the Bangladesh Central Bank (Jeris, 2021; Karim, 2020). Bangladesh Bank (Central Bank of Bangladesh) lost USD81,001,662 from its account in 2016 to a computer hacker (Carvajal et al., 2020).

Nevertheless, default loans jeopardise the financial strength of banking institutions. The defaulted loans in ten banks, including four public-owned banks, reached a frightening rate in the fiscal year 2022-2023, indicating deteriorating financial condition (Hasan, 2023). Non-performing loans thus provide a great deal of

heterogeneity and inequality in regard to the interest income revenues in banks (Diakomihalis & Economakou, 2021). In other words, illegitimate loan outflow affects the interest income for banks due to ineffective loan outflow. In contrast, banks still provide interest on deposits to the depositors, which leads to less revenue for the banks. So, illegitimate loans, financial fraud, and scams negatively affect bank efficiency (Phung et al., 2022). Henceforth, some private and state-owned commercial banks have capital shortfalls due to loan defaults and bank scams (Emran, 2019; Hasan, 2023). Commercial banks should retain provisions against their non-performing loan, which are deteriorating banks' profits. When the sum of provisions exceeds the bank's profits, it has to provide amounts from its capital, resulting in capital deficits hindering financing activities (Chowdhury, 2020). Lack of strong governance, capital sufficiency, liquidity, growth of non-performing loans, and other factors led to slow development, resulting in disappointing efficiency and performance (Yesmine et al., 2023). The authority subsidises capital injections into the banking sector to stabilise the industry every year (Rob, 2023); still, the improvement is invisible in the sector (Uddin & Bristy, 2014). Moreover, higher non-performing loans lead to lower banking efficiency (Syed, 2020). These scenarios lead to an argument over the efficiency level of commercial banks in Bangladesh.

Although studies relevant to Bangladeshi banks' efficiency measurement have not been widely carried out, a few studies have reported low-efficiency levels of commercial banks. For instance, Begum et al. (2022) unveiled an average cost efficiency score of 65.8 per cent and a profit efficiency score of 50.5 per cent for Bangladeshi private commercial banks. Uddin et al. (2022) and Shah et al. (2022) reported 70.3 per cent of profitability efficiency and 62.99 per cent technical efficiency of the Bangladeshi banking sector, respectively. Subsequently, Hossain (2025) indicated an average technical efficiency score of 63 per cent for Bangladeshi publicly listed banks. In addition, selecting an appropriate banking operating approach, whether intermediation, production, or profitability, continues to be contentious, as each framework highlights distinct facets of banking performance. Considering the distinctive structural and contextual attributes of Bangladesh's banking sector, it is crucial to identify the approach that most effectively reflects its operational efficiency and offers valuable insights for reform. Prior studies predominantly emphasise the

intermediation approach while evaluating the banking efficiency (Chowdhury et al., 2022; Chowdhury & Haron, 2021; Darko et al., 2025).

Although there is a worldwide interest in evaluating the efficiency of state-owned and private commercial banks, the lack of studies in Bangladesh is particularly evident. This disparity may be ascribed to restricted access to extensive data and the comparatively recent deregulation of the banking sector. Recent studies revealed that private banks in Bangladesh exhibit superior efficiency compared to state-owned banks due to liquidity management, inadequate management, and operational inflexibilities, underscoring the necessity for additional comparative studies (Chokroborty & Hasan, 2024; Yesmine et al., 2023).

Meanwhile, Islamic banks operate in accordance with *Shariah principles*, which avoid interest and prioritise risk-sharing, hence distinguishing them from conventional banking systems. These divergences may result in fluctuations in operational efficiency. Studies have yielded inconclusive findings; some studies claim that Islamic banks in Bangladesh demonstrate superior cost efficiency (Chowdhury et al., 2023; Hassan et al., 2023; Yusof et al., 2023), but others have outlined that conventional banks excel in specific efficiency parameters (Nobi et al., 2024). These findings collectively emphasise the structural deficiencies and inefficiencies of the banking industry in Bangladesh, underscoring the necessity for changes aimed at governance, credit risk management, and resource optimisation.

In the last two decades, the banking sector has not only mediated the surplus and deficits but also undertaken remarkable changes in its operation. It broadened its operational scopes and diversified its assets by shifting from lending to non-traditional banking endeavours such as mutual and brokerage fund services, real estate investments, insurance, security underwritings, and other non-interest income-generating services (Adesina, 2021). As a consequence, the banking sector drives other business activities rather than only mediating surplus and deficit. Besides, banks are obliged to run their business efficiently in order to sustain themselves in the competitive market (Rashid et al., 2020). Accordingly, the banking sector recently adopted several business models, such as production and operating approaches, along with an intermediation approach (Chowdhury & Haron, 2022). Three approaches are mainly observed in the banking

efficiency literature, namely production, intermediation, and profitability (Azad et al., 2021; Chowdhury & Haron, 2022). However, limited studies have focused on measuring efficiency levels based on these approaches (Alam et al., 2021; Azad et al., 2021; Chowdhury & Haron, 2022). From this perspective, commercial banks are deemed to be operating various approaches, thus influencing relative efficiency measurement. These approaches are used to identify the most suitable approach for banking performance.

Meanwhile, commercial banks in Bangladesh are classified into three categories, namely, Private commercial banks (PCBs), State-owned commercial banks (SCBs), and Islamic commercial banks (ICBs). Nonetheless, banks' ownership significantly affects their efficiency (Kamarudin et al., 2016a). A commercial (conventional) bank (Farmer Bank) allegedly amassed and embezzled loan disbursement and a large number of default loans by authorities in 2017 (Abdullah, 2020). In addition, Bangladesh's commerce bank posited a lower standard of return when they could have achieved better financial positions by optimising operational efficiencies (Gazi et al., 2021). Meanwhile, three renowned public-owned banks were also claimed for default loans, which made the banks vulnerable (Jeris, 2021; Sengupta, 2020). Besides, public-owned commercial banks worldwide perform higher and more pervasive in the least emerging countries, categorised by sluggish financial productivity (Alshammari, 2021).

In the recent decade, Islamic banks have posited a sharp growth in Bangladesh with 17.54 per cent (2020), 16.83 per cent (2021), 9.91 per cent (2022), and 4.59 per cent (2023) in deposits, and 14.34 per cent (2022) and 4.29 per cent (2023) in investment (Bangladesh Bank, 2024). Besides, this sector holds more than one-fourth of the Bangladeshi commercial banking sector in regard to deposits and investment (Bangladesh Bank, 2024). Unpredictably, Islamic banks in Bangladesh were not affected by the pandemic crisis in the collection of deposits. Non-investment income has driven the better efficiency level of conventional banks than Islamic banks in Bangladesh (Haque & Sohel, 2019). However, Islamic banking efficiency as well as public banking efficiency remain ignorant in relation to different business models or approaches in the literature (Ikra et al., 2021). In light of this evidence, it is argued that public and private banks demonstrated several criticisms regarding operational efficiencies, and Islamic banks demonstrated a contrary situation related to their efficiency level compared to conventional banks in Bangladesh.

In light of significant financial irregularities, indications of inefficiencies, and the distinct attributes of various banking models in Bangladesh, an intensive assessment of bank efficiency is both pertinent and essential. This research can enrich scholarly discussion, guide policy-making, and assist in formulating mechanisms to improve both the efficiency and the stability of the financial sector. As mentioned, banking institutions represent one of the main pillars of the financial system. The fundamental goal of every commercial bank, as stated in banking literature, is to maximise shareholder wealth by minimising expenses and increasing profits (i.e., operating efficiently). Therefore, it is noteworthy to measure the efficiency level of commercial banks in order to look at their contribution to gradual economic growth. Besides, it is also necessary to identify a better bank approach for commercial banks operating in Bangladesh. More so, it is important to observe the efficiency level between public and private commercial banks as well as Islamic and conventional banks in Bangladesh.

1.5 RESEARCH QUESTIONS

Based on the above consequences and scenarios, several questions have been articulated as follows:

- 1) What are the efficiency levels of Bangladeshi commercial banks?
- 2) Which banking approach is appropriate to evaluate the efficiency level of Bangladeshi commercial banks?
- 3) Is there any difference in the efficiency level between Bangladesh's private and public commercial banks?
- 4) Is the efficiency level of Islamic banks different from that of conventional banks?

1.6 RESEARCH OBJECTIVES

According to the above research questions, several research objectives are demonstrated as follows:

- 1) To measure the efficiency level of commercial banks in Bangladesh.
- 2) To determine an appropriate banking approach for assessing the efficiency of Bangladeshi commercial banks.
- 3) To compare the efficiency scores between public and private commercial banks in Bangladesh.
- 4) To evaluate and compare the efficiency level between Islamic and conventional commercial banks in Bangladesh.

Table 1.2 Alignment of Research Objectives with Research Questions and Instrument

RESEARCH QUESTION	RESEARCH OBJECTIVE	RESEARCH INSTRUMENT
1	1	DEA: Technical efficiency, Pure technical efficiency, Scale efficiency
2	2	DEA using Intermediation, Production and Profitability banking approaches
3	3	Mean comparison on DEA scores (all banking approaches)
4	4	Mean comparison on DEA scores (all banking approaches)

Source: Author's elaboration

1.7 SCOPE OF STUDY

Bangladesh's banking sector agonises from low-quality assets, capital deficits, loan defaults, non-performing loans, lack of transparency, lack of accountability, non-compliance with the central bank, and lack of good governance in the current decade (Hasan, 2023; Rob, 2023). The banking sector is a well-structured entity in the financial sector and holds the maximum share of formal financing. This sector offers different types of time and demand deposits, comprising innovative banking, for example, women's banking, school banking, and agent banking (Solaiman et al., 2021). Besides, banks also provide a large number of diversified loans and investment services, including automobile and housing, consumer banking, education, microfinance and digital banking. In addition,

mobile banking, electronic banking, and remittance services are the most common forms of modern banking provided by the Bangladesh banking sector (Solaiman et al., 2021). As mentioned, the banking sector is the crucial intermediary for capital mobilisation to the production sector (Bikker & Bos, 2009; Eyuboglu, 2016). Thus, sound and sustainable capital injection in the economy relies on the efficiency of the banking sector (Solaiman et al., 2021). As a result, maintaining and controlling banking efficiency is indeed crucial for any economy, especially emerging economies such as Bangladesh. Therefore, this research urges the measurement of the efficiency levels of the Bangladeshi commercial banking sector from multiple perspectives by employing three banking approaches.

In many Asian countries, including Bangladesh, the debt and stock markets-which play a significant role in the financial development of the wealthiest nations-are less efficient. Because the financial system's stability in this region depends on the effectiveness of banking institutions, the banking industry is more significant in Bangladesh than in industrialised countries. However, the efficiency of banking institutions in Bangladesh is still a subject that has to be resolved. Accordingly, this research covers the measurement of the efficiency level of commercial banks in Bangladesh. To compare their efficiency level, the Bangladeshi commercial banks are categorised into public-owned and private-owned banks. Henceforward, efficiency comparisons are carried out between conventional and Islamic banks. All the data for research is collected from either the annual report of the Bangladeshi commercial banks or the bank database. However, this research did not cover non-commercial or social development banks.

1.8 SIGNIFICANCE OF STUDY

Efficiency is crucial in the banking sector as it directly affects the stability, profitability, and resilience of financial institutions. The efficiency of a bank indicates its effectiveness in leveraging assets to generate income and provide financial services at a reduced cost. Optimal efficiency guarantees the productive allocation of limited resources, such as capital and deposits. Thereby enhancing profits. The efficiency of a bank's assets, especially regarding loans and investments, dictates its ability to generate profits, mitigate risks, and compete in a fluctuating financial landscape. If banks do not efficiently utilise

their assets, they may experience diminished profitability, inadequate service delivery, and heightened susceptibility to financial shocks. Conversely, an effective banking system enhances economic stability by enabling credit distribution, bolstering corporate operations, and cultivating investor trust. Consequently, attaining and sustaining a high degree of efficiency serves as both a standard for institutional performance and a condition for enduring growth and stability within the financial sector.

Through the application of three approaches (intermediation, production, and profitability) within the Data Envelopment Analysis (DEA) framework, this study presents a novel empirical way to assess the efficiency of commercial banks in Bangladesh. This research offers a multi-dimensional and comparative efficiency analysis, contrasting with other studies that predominantly focused on only a particular aspect of operation, cost efficiency, profit efficiency, or asset transformation, thus facilitating a more comprehensive understanding of bank performance. The comparative assessment of Islamic and conventional banks, along with state-owned and private ownership structures, is notably innovative in Bangladesh, where such differentiated studies are limited.

This research employed a quantitative method to evaluate the banking efficiency of Bangladeshi commercial banks. It is expected that this research will enrich the literature towards identifying an appropriate banking approach for assessing the efficiency level of Bangladeshi commercial banks. Based on the author's best knowledge, this will be the first study concurrently using three different banking approaches to extend the knowledge of banking efficiency, particularly the Bangladeshi commercial banking sector. Therefore, the outcome of this research contributes to the literature in terms of efficiency and demonstrates contributions and utilisation of different banking approaches. Nevertheless, it is set to enhance the understanding of Bangladeshi commercial banks' operations and provide a more practical approach to monitoring and evaluating performance. It further has great importance to shareholders, external investors, bank managers, depositors, borrowers, and policymakers in pursuing informed decisions. Thus, it will lead to sound banking systems and better banking regulations in Bangladesh.

Moving forward, this research remarkably aids the existing literature by providing evidence on the efficiency of the Bangladeshi commercial banking sector for

more recent years (2021), covering the pandemic period. This research is also set to compare the efficiency level of public versus private, and Islamic versus conventional commercial banks in Bangladesh. The findings unfold several benefits for consumers, practitioners, and policymakers. Consumers are able to identify the most efficient banking sector, which may help to find the most reliable and financially healthy bank when making decisions to engage in banking activities. Bank managers have scientific tools to identify the operational inefficiencies that allow them to improve managerial adequacy and competencies, thus allowing for better, more efficient governance. Besides, managers can identify the most efficient banking approach, allowing them to focus more on that model while improving the less efficient approach to form an efficient banking entity. With findings from scale efficiency, bank managers can identify their optimal level of resource efficiency. In other words, how were the resources utilised, and to what extent has the output been brought to the bank? Banks' managers can identify the shortcomings and sources of inefficiency, allowing them to focus on those matters to improve the current situation and performance. Policymakers may use these findings to implement better policies in association with the central bank in order to keep the momentum of economic growth. The findings of the comparison between conventional and Islamic banks underpin the necessary steps to implement some legal initiatives to comply with Islamic principles to boost the performance of Islamic banks, thus assuring the Islamic principles in the operation of Islamic banks.

1.8.1 Possibilities of the Banking Sector of Bangladesh

The Bangladesh banking industry possesses significant potential, supported by many economic and structural drivers. Nonetheless, actualising this pledge requires addressing current inefficiencies and governance shortcomings.

Economic Expansion and Financial Accessibility: Bangladesh has had constant GDP growth, averaging approximately 6-7 per cent over the last decade. This expansion has augmented the middle class and heightened the need for banking services. Furthermore, initiatives focused on financial inclusion have integrated more people into the official banking system, signifying an expanded population of customers and heightened financial activity. Financial inclusion expands market access but

necessitates the provision of financial services. Assessing the comparative efficiency of banks is essential in this environment to ascertain how effectively banks employ resources to address increasing and diverse demands.

Infrastructure Advancement and Capital Market Growth: Substantial expenditures in infrastructure initiatives, including highways, seaports, and power stations, have created opportunities for banks to engage in both financing and consulting capacities. Furthermore, the evolution of the capital market offers banks options to participate in underwriting, managing assets, and various investment-banking functions. These developments require competent resource allocation, risk oversight, and operational flexibility-elements closely linked to efficiency measurements. Financial institutions that can effectively mobilise capital and mitigate risk will possess a competitive edge.

Legal Reform and Technological Innovations: The Bangladesh Bank has commenced reforms to improve regulatory oversight and foster sustainability in banking activities. The implementation of green finance laws and the promotion of digital banking services demonstrate a dedication to modernising the sector and conforming to global best practices. Reforms to regulations and digital banking are anticipated to enhance efficiency by lowering operational expenses, broadening outreach, and increasing customer satisfaction.

1.9 ORGANISATIONS OF CHAPTERS

This research is organised into five chapters as follows;

1.9.1 Chapter One

This chapter provides a broad overview of the study in order to help readers better understand banking efficiency. It is followed by an outline of Bangladesh's banking system. Afterwards, the problem statement of this research is explained. In addition, the research objectives and research questions are presented. The scope of this research is also discussed, followed by its significance. A definition of the key terms used in this

research is provided afterwards. The research's significance is then discussed in order to support the necessity of this research in Bangladesh. The final element is the chapter organisation. Chapter One concludes with a conclusion that enumerates all the topics covered in the chapter.

1.9.2 Chapter Two

Chapter Two elaborates on relevant literature and the underlying framework for the reported study. This chapter begins with an overview of banks and economic growth. This is followed by banking efficiency and its empirical evidence. After that, banking theories, mainly intermediation, production, and profitability, are discussed. There is also a discussion of Bangladeshi banking studies, comparing private and public-owned banks and their performance, followed by Islamic and conventional. The conceptual framework is then expanded upon. The chapter ends with a conclusion.

1.9.3 Chapter Three

Chapter Three provides an overview of the research methods used to measure the banking efficiency of commercial banks in Bangladesh from 2016 to 2021. This chapter's introduction emphasises research design. The sampling technique and data collection were presented afterwards. The application of research techniques is the next in line. The variables used in this study are discussed according to three banking approaches. The model specifications are also described in this section.

1.9.4 Chapter Four

Chapter Four presents the findings and analysis related to this research project. At the beginning of this chapter, the reporting and analysis of the findings from the descriptive statistics are presented. This is followed by the findings from the DEA analysis, presented coherently based on the research objectives.

1.9.5 Chapter Five

Chapter Five summarises the research, providing a concise explanation of the key findings of the data analysis. Afterwards, each objective is discussed based on the findings of the data analysis. After that, this chapter presents the implications of the research findings. Finally, this chapter presents the conclusion, limitations, and suggestions for further study.

1.10 KEY TERMS

Efficiency implies a peak level of performance that applies the least number of inputs to achieve the greatest number of outputs.

Banking Efficiency measures the productivity of a firm's assets (Hamid et al., 2017). Most early studies used efficiency as a measure of banking performance. Another means to the concept of efficiency is the capacity to produce the maximum outputs with the least amount of input. According to Tzeremes (2015), a bank is deemed efficient if it can employ its resources effectively to produce a sufficient profit. In a nutshell, banking efficiency measures each bank's total performance or financial soundness.

Production Approach- banks are regarded as providers of services, particularly loans and deposit services, utilising labour, capital, and expenses as inputs (Miller & Noulas, 1996).

Intermediation Approach assumes that banks obtain deposits and acquire cash by the utilisation of labour and capital, subsequently intermediating these financial sources into loans and other assets (Miller & Noulas, 1996).

Profitability/Operating Approach views banks as commercial entities that generate revenue and incur costs in their operational activities (Panah et al., 2014).

Commercial Banks are financial institutions that provide checking accounts, demand deposits, personal and company loans, savings options, and several other financial services (Casu et al., 2022).

Output-oriented DEA model optimises outputs without necessitating an increase in any observed input values (Y. Ji & Lee, 2010).

Corporate Social Responsibility (CSR) signifies approaches that firms put into action as part of corporate governance that their operations comply with ethics and are beneficial for society.

1.11 CHAPTER SUMMARY

Chapter 1 begins with an introduction to the research, providing a broad overview of banking efficiency and its relationship with economic growth. It then highlights key issues concerning commercial banks and economic growth in Bangladesh. The chapter summarises Bangladesh's banking sector concisely, noting that Bangladesh, a member of the South Asian Association for Regional Cooperation (SAARC), is a significant and continuously growing economy. The banking industry plays a dominant role in the country's financial system, primarily due to the inefficiency of other financial institutions, such as debt, equity, and derivative markets. The problem statement is clearly defined, followed by the research objectives and questions that the study seeks to address. These objectives aim to guide the research in answering the posed questions. The significance of the research is discussed to emphasise its contribution to the measurement and comparison of banking efficiency in Bangladesh. The chapter concludes by outlining the organisation of the thesis, summarising the main themes addressed in each chapter, and ends with a brief summary.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter mainly discusses the prior literature concerning the nexus between banking performance and economic growth, banking theories, and applications in the modern banking system. Further, it illustrates the research on banking from various perspectives and the depth of scholarly works. Henceforth, it also highlights and presents the findings from prior studies in relation to banking efficiency and the comparison between private and public banks, as well as Islamic and conventional banks. Finally, this chapter presents the contextual research gaps.

2.2 BANKS AND ECONOMIC GROWTH

The banking sector plays a vital role by providing various services intended to increase economic growth for any economy (Chowdhury & Haron, 2021; Paulet & Mavoori, 2021). Traditionally, literature linked to finance growth theorises a positive linkage between banking sector development and economic growth (Haini, 2021). Financial intermediaries are essential for fostering economic growth because they reduce information asymmetry and effectively allocate financial resources (Efayena, 2014; Kale & Eken, 2022). By serving as an intermediary between savers and borrowers, banks transfer funds from surplus to deficit units (Casu et al., 2022). Investment and entrepreneurial activity are critical for economic growth and are facilitated by this process (Efayena, 2014). Financial intermediaries support the growth of economically productive areas of the economy by providing individuals and businesses with a platform to access finance (Casu et al., 2022). Additionally, by reducing the information asymmetry between lenders and borrowers, these intermediaries contribute to improving the effectiveness of the financial markets (Efayena, 2014; Fakhrunnas, Chowdhury, et al., 2023). Financial intermediaries lower the cost of acquiring financing and increase borrower accessibility through their expertise in assessing creditworthiness and managing risks (Kale & Eken, 2022). This makes it feasible for businesses to grow, invest in new technology, and create

employment, all of which support economic expansion (Efayena, 2014). In broad terms, banks play a vital role in stimulating economic growth by improving the effectiveness and efficiency of the financial system through the mobilisation of savings and facilitation of investment.

The literature has addressed the relationship between the banking industry and economic growth in great detail. Many scholarly investigations have examined the significance of the banking sector in promoting economic expansion and advancement. For instance, Zhuang et al. (2009) asserted that the banking sector is crucial for mobilising savings and effectively channelling them toward profitable endeavours. As it makes it easier for funds to move from savers to borrowers, this intermediation role is crucial for economic growth since it promotes investment and productivity. Furthermore, the banking industry supports economic expansion by offering crucial financial services, including credit facilities, payment systems, and risk management instruments (Casu et al., 2022; Chowdhury & Haron, 2022). Businesses and individuals require these services in order to engage in the economy effectively. In addition, the vibrant banking sector fosters financial stability, which is essential for long-term, consistent economic growth. According to Zhuang et al. (2009), a stable banking sector encourages investor confidence and aids in the prevention of financial crises, which in turn stimulates investment and economic growth. Moreover, Levine (2005) asserted that financial development encompasses various advancements such as greater ex-ante information for feasible investment options, improved corporate governance and investment monitoring, improved risk management and diversification, improved financial resource allocation and movement, and improved exchange of goods and services. He highlighted the various perspectives on how the financial sector works and how economic growth unfolds. One theory holds that financialisation only meets demands from the real economy and has no influence on economic growth. Unconventional viewpoints state that financial markets have a positive impact. He concluded that while reverse causality is not important, markets and intermediaries are both useful for growth, despite the compelling and well-supported arguments on both ends (Levine, 2005). Overall, the research points to the need for a robust and effective banking industry for economic expansion since it promotes capital flow, offers important financial services, and maintains financial stability (Zhuang et al., 2009).

Nevertheless, progress in the banking sector plays an imperative role in economic growth (Chowdhury et al., 2022). For example, Kchikeche and Khallouk (2021) demonstrated the causal link between Moroccan banking development and economic growth in both the short and long run. Similarly, using the dynamic panel Generalised Method of Moments (GMM) on 17 Southeast European countries, Zeqiraj et al. (2020) acknowledged the positive impact of the banking sector on economic growth. Following, Stewart and Chowdhury (2021) examined the effect of banking stability on the relationship between economic growth and bank crises in 140 economies with GMM estimation. Their results indicated that bank stability reduces the negative effect of bank crises on economic growth, hence affording economic resilience in the period of crises in both developing and developed economies. However, banking sector liquidity provides economic resilience for high-income countries, while regulatory capital is crucial for developing economies.

Xu (2016) demonstrated a significant positive link between financial development and economic growth in 28 Chinese provinces by applying the system Generalised Method of Moments (GMM). On the other hand, Santana (2020) doubted the positive effect of financial development on economic growth from a dynamic GMM method applied in 16 Latin American countries. The author found that financial liberalisation had not supported the positive linkage between financial development and economic growth, further confirming the theory that financial liberalisation causes financial crises. Similarly, Haini (2021) found a nonlinear relationship between banking development and economic growth and suggested the existence of an optimal level. They also stated that high levels of development in the banking sector push away the positive effect of private investment. Besides, larger banks enable the demolition of some debtors and the real economy, thus not constantly increasing real growth, as evidenced in Germany by the digitalised microdata of firms and associated banks (Huber, 2021). In light of this evidence, it is argued that the banking sector was not always supporting economic growth, which could demonstrate a negative impact on economic development.

Henceforth, sound banking efficiency and performance are indeed a requirement for economic success (Eyuboglu, 2016). Banking efficiency is one of the most significant factors influencing economic expansion. This relationship is supported by a number of theoretical frameworks, including neoclassical theory, which asserts that banks are

essential in encouraging entrepreneurship and mobilising savings for investments, which in turn drives economic growth (Kale & Eken, 2022). The agency theory of banking management explains the conflicting interests of bank managers and stockholders (Jensen & Meckling, 1976). Given that shareholders provide funds and carry out all associated risks, those who carry out the daily operations or banking activities are bank managers (Tiamgne, 2022). Despite the fact that every commercial bank seeks to maximise profits, bank management occasionally enters into agreements that disregard shareholders' interests. In practice, bank managers may prioritise their interests over those of the shareholders during decision-making (Tiamgne, 2022). For instance, bank managers may take on riskier initiatives in an effort to increase profit expectations while paying less attention to the risk involved, thus raising the issue of information asymmetry. According to Sony and Bhaduri (2021) and Shen et al. (2019), information asymmetry implies a discrepancy in information between shareholders and bank managers or a lack of trustworthy information. This affects financial intermediaries, notably banks that transfer funds from surplus to deficit units, as well as the stability and expansion of the economy. This is because banks are the primary financial intermediaries that supply capital for investment projects in the economy; as a result, any decline in confidence in this sector is likely to jeopardise the stability of the economy and restrict growth (Fakhrunnas, Chowdhury, et al., 2023; Tiamgne, 2022). In general, moral hazard and adverse selection result from information asymmetry. The information asymmetry derived from agency theory has a direct impact on the efficiency of banks (Nanda & Nicholas, 2014). For example, the net interest margin (NIM) ratio of banks fluctuates depending on borrowers' reliance on the banking system and bankers' level of confidence in potential borrowers based on information availability.

In another context, banks are more inclined to avoid illiquid loans or default borrowers, which might result in a higher number of non-performing loans, when there is effective risk management or mitigation of the moral hazard and adverse selection issues. As a result, this significantly improves bank efficiency since banks feel at ease providing more loans at lower interest rates, which raises the NIM ratio and directly affects economic stability through a strong financial system and promotes economic growth. According to Gehrig and Stenbacka (2007), the credit information theory can be applied as a tool to reduce information asymmetry, which will improve bank operations and ensure consistent expansion and a stable economy. This information-based strategy aids

in preventing bank failures, which have the potential to extend to economies in other parts of the world, as is the case with the US financial crisis that spanned from 2007 to 2009. Likewise, Doblas-Madrid and Minetti (2013) demonstrated in their study how information asymmetry can impact the effectiveness of the US banking industry as well as the overall economy. Numerous studies show that a more effective banking system encourages the provision of outside funding for entrepreneurial endeavours, reducing the issues of moral hazard and adverse selection (I. Hasan et al., 2017; Mirzaei & Moore, 2019). As a result, this encourages investment and ensures consistent growth in the economy through a stable financial system (Diallo, 2018; Ferreira, 2018; Fu et al., 2018). According to the aforementioned discussions, businesses that depend more on external funding are more likely than their counterparts that operate in settings with weak banking systems to grow quickly when those environments have an efficient banking system (Levine, 2005; Mirzaei & Moore, 2019; Peia & Roszbach, 2015).

The neoclassical theory (Solow, 1956; Swan, 1956) implies that labour, capital, and technological innovation contribute to economic growth. These three components greatly influence the overall output. According to this model, GDP grows at an increased rate when capital accumulation, productive labour, and technical advancements are integrated. Because Solow (1956) viewed technological advancement as an external element influencing economic growth, his model is regarded as exogenous. According to this notion, growth can only be attained by effectively utilising capital and labour as elements of production in the production process, along with improved technology, in order to produce a maximum GDP. Neoclassical economists suggest that effective financial intermediaries like banks can improve an economy's productivity. They create employment by increasing business investments and stimulating capital formation by channelling savings from savers to borrowers at competitive interest rates. In addition, these establishments offer risk management strategies via loans, thereby reducing the potential risks connected with establishing new ventures or growing existing ones. This makes it obvious why many believe that access to and quality of banking services are important factors in economic expansion. Moreover, empirical research has repeatedly demonstrated the positive correlation between increased GDP per capita and improved banking services. According to Aluko and Ajayi (2018), banking institutions that serve as financial intermediaries are vital to the accumulation of investment capital that businesses require to boost productivity, thus contributing to economic growth. Because

the majority of businesses in an economy depend on the amount of funds provided by banking institutions, the profitability and efficiency of banking institutions are thus important factors that affect economic growth (Wang et al., 2019).

The existing banking literature has provided ample evidence of the banking system's important influence on an economy's pace of economic growth (Kale & Eken, 2022). An analysis of this relationship and its consequences for financial and economic strategies is supported by Nyasha and Odhiambo (2014). The authors argued that fostering economic growth is largely dependent on banking efficiency. Resource allocation is made possible by efficient financial systems, encouraging investment and increasing production (Kale & Eken, 2022). Effective banks are also better able to manage risk and offer financial intermediation services, both of which are critical to the growth of the economy (Chowdhury et al., 2022). The notion that banking efficiency and economic growth are positively correlated has been supported by empirical research (Beck et al., 2007; Demirgüç-Kunt & Huizinga, 2010). According to Beck et al. (2007), economies with more effective banking institutions witnessed higher levels of economic growth. In a similar vein, Demirgüç-Kunt and Huizinga (2010) established that efficient banking contributes to economic growth, especially in economies that have robust financial systems. Belke et al. (2016) applied Stochastic Frontier Analysis (SFA) and system GMM to examine the relationship between bank efficiency and economic growth over 12 EU countries for the period of 2000 to 2013. They demonstrated that more profit-efficient banks enhance economic growth in both normal and bad periods.

By employing the Data Envelopment Analysis (DEA) and system GMM technique on 28 EU countries from 1998 to 2012, Ferreira (2018) concluded that banking performance can contribute positively to economic growth. Similarly, Bernini and Brighi (2018) found a positive impact of banking efficiency and credit availability on the local economy from the investigation of 101 provinces of Italy from 2006 to 2013 by employing SFA and system GMM techniques. Using the SFA and Regression analysis, Mirzaei and Moore (2019) used data from 49 countries between 2001 and 2010 to assess the link between bank efficiency and industrial growth. According to their findings, industries grow faster in economies with efficient banking, which supports economic growth. Earlier, Fu et al. (2018) examined the effect of bank efficiency on GDP growth

for 14 Asia-Pacific countries from 2003 to 2015. They posited the positive impact of both financial quantity and quality on economic growth.

Diallo (2018) analysed data from 38 provinces of China from 1998 to 2008 and applied Regression analysis to investigate the effect of bank efficiency on GDP growth. Their results supported the notion of the positive impact of bank efficiency on economic growth and aiding in improving growth during a crisis. Earlier, Hasan et al. (2017) revealed that bank efficiency critically played a significant role in managing funds for entrepreneurial activities by applying SFA and regression analysis on 30 provinces of China from 1998 to 2008. However, Yusifzada and Mammadova (2015) indicated the deviation of bank efficiency and economic growth based on the development levels of economies by examining the linkage on 118 countries covering the period of 2004 to 2011. These results emphasise how crucial it is to increase banking efficiency in order to foster economic expansion. Therefore, policymakers ought to concentrate on putting into practice changes that boost the effectiveness of banking institutions, like bolstering corporate governance, boosting competition, and encouraging financial innovation (Nyasha & Odhiambo, 2014).

2.2.1 Efficiency

Productivity in the banking industry is basically measured by two main concepts: effectiveness and efficiency (Sherman & Zhu, 2006). The capability of a bank to set and achieve goals and objectives is referred to as effectiveness. In contrast, the ability of a bank to produce output by using minimal input or resources is efficiency. Generally, the ratio of output to input sketches the efficiency; higher output per unit of input parades better efficiency, whereas optimum efficiency is replicated by maximum output per unit of input (Chen et al., 2008; Cooper et al., 2007; Sherman & Zhu, 2006). Besides, efficiency also signifies the measurement of relative performance for entities being assessed (Azad et al., 2017). In other words, efficiency denotes how well a mechanism functions to produce the maximum outputs for a given input (Alrafadi et al., 2016). It is not assessed by the market's success but by operational fineness in utilising resources (Gulati & Kumar, 2017). The concept of efficiency was first presented by Farrell (1957). He projected a few concepts, such as a single output from the two factors of production

and, in multifaceted cases, multiple outputs from multiple inputs. The bottom line is that efficiency is the utilisation of input to produce maximum output (Wahyudi & Azizah, 2018).

Prior studies emphasised banking performance articulated by productivity, effectiveness, and profitability (Bikker & Bos, 2009). Bank performance contemplates how the resources of a bank are applied in a form that enables it to attain its desired outcomes (Rengasamy, 2012). In addition, banking performance denotes the application of a set of indicators to evaluate banks' present condition and improve their capability to attain goals (Yesmine et al., 2023). Bank efficiency is a crucial metric for assessing the efficiency of management and performance. Efficiency for banks is defined by profitability, capital inflows, consumer prices, better service quality, and the stability to raise capital buffers and absorb risk (Berger et al., 1993). It provides pertinent information to support policy decisions, particularly those pertaining to bank governance (Thaker et al., 2022). Further, measurement of efficiency leads to maximising output and profitability while minimising costs (Mokhtar et al., 2008). The evaluation of efficiency associates and identifies the scope for bank managers to scale the performance and outline the areas of insufficiency for further improvements (Mostafa, 2007).

Alternatively, bank efficiency refers to the difference between the maximum outputs that feasibly can be produced using the available input combination and the outputs that have actually been produced (Kwateng et al., 2020). Banking institutions may become efficient in two ways: either by utilising the same amount of inputs but producing higher output, or by using fewer inputs but producing the same output (Chowdhury & Haron, 2022). In the first case, output remains constant while inputs are reduced; in the second case, inputs remain constant while output increases (Kwateng et al., 2020). By doing this, bank efficiency demonstrates a scenario in which the bank producing outputs does not encounter any waste (Radam et al., 2010). Because, in the absence of production waste, the banking institution's actual output should equal the maximum output that can be anticipated given the particular combination of input usage (Kwateng et al., 2020).

In brief, efficiency is demarcated as an organisation's aptitude to make the most of its output by means of certain inputs or with nominal input to yield a certain output. Concerning performance measurement, efficiency refers to the bank's management's

ability to transform inputs into outputs based on their behavioural objectives (Fare, Grosskopf, Norris, et al., 1994). Undoubtedly, maintaining efficiency in the banking sector is very important due to its significant contributions to increasing the capability of an economy to compete with its global and domestic affairs more smoothly (Uddin & Bristy, 2014). Past studies acknowledged that the efficiency of financial institutions has been commonly, widely, and extensively studied for the last few decades due to the importance of assessing the performance of the institutions and its captivating role in economic growth (Achi, 2021; Agarwala et al., 2023; Assaf et al., 2011; López-Penabad et al., 2022; Masum et al., 2015; Nisar & Ashraf, 2018). Banking competition influences banks to operate efficiently, thus considered a strategic step to survive in all situations (Mostafa, 2007; Wahyudi & Azizah, 2018). Efficiency can be transformed due to technological innovation, institutional improvement, and financial inclusion, regardless of the competition (Apergis et al., 2016; Weill, 2013). Moreover, banking inefficiency does not necessarily happen due to management incapability; it might also be caused by technical, socio-economic, and managerial consequences (Sherman & Zhu, 2006). Prior studies evidenced the significant and positive impact of banking efficiency on economic growth at the macro level (Abedifar et al., 2016; Banya & Biekpe, 2018; Berger et al., 2004). Besides, bank managers and policymakers can find the benchmarking information to improve banks' performance at the micro level (Johnes et al., 2018; P. Wanke et al., 2017).

The components that impact the absorption of expenses and the provision of services to clients, whether directly or indirectly, determine the efficiency of financial institutions. In this regard, financial institutions' performance is influenced by factors other than defined costs (Abreu et al., 2019). On the one hand, the variety of issues that impact banks' capacity to gather data on the market and the borrowers themselves may also have an impact on the efficiency and productivity of financial institutions (Abreu et al., 2019). Conversely, banks have become more adept at completing transactions rapidly and securely (Chowdhury & Haron, 2022). Thus, a number of variables, including the type of accounting procedures used, the regulations governing them, the presence of databases, and the degree of market concentration, are crucial for assessing and illuminating efficiency (Abreu et al., 2019). Efficiency is categorised into four segments, namely: *technical efficiency* measures the ability of a financial institution to produce the maximum possible output with given inputs or to use the minimum inputs to produce a

given output; *scale efficiency* refers to producing at an optimal level of output to achieve the most cost-effective scale of operations; *price efficiency* evaluates whether inputs are purchased at minimum cost, reflecting the use of cheaper inputs to reduce expenses; and *allocative efficiency* assesses the optimal combination of various inputs to produce outputs at minimum cost (Sherman & Zhu, 2006). Technical efficiency generally denotes the capability of a firm to maximise outputs by utilising specific inputs, or to minimise inputs to produce the same level of outputs. In contrast, allocative efficiency considers the optimal utilisation of inputs and outputs in a given price (Cooper et al., 2007). In literature, technical efficiency is applied chiefly to measuring financial institutions' efficiency level (Alam et al., 2021; Salleh et al., 2022; Chowdhury & Haron, 2021).

Academic research interests have changed significantly as a result of operational and technological changes experienced by financial institutions (Abreu et al., 2019; Chowdhury & Haron, 2022; Kwateng et al., 2020). For instance, the main focus areas on financial institution efficiency that were classified at the end of the 1990s by Berger and Humphrey (1997) or by Berger et al. (1995) no longer maintain the same position. As seen in recent studies, the main thrust of research in the majority of studies has shifted away from the efficiency of public and private financial institutions (Adesina, 2021; Azad et al., 2021; Bhattacharyya et al., 2021; Chaity & Islam, 2022; Paulet & Mavoori, 2021). On the other hand, the effects of banks' diverse business models on efficiency continue to be of considerable interest, and the factors that determine the efficiency of financial institutions have grown to be so complicated as to require division into multiple important sub-areas of study (Azad et al., 2017; Chowdhury & Haron, 2022).

2.3 BANKING THEORIES

The banking industry has acknowledged a substantial transformation over the last few decades. In other words, the banking sector has slanted its business activities from comparatively narrow to full financial service institutions (Casu et al., 2022). Banks used to be defined as institutions that collected funds from surplus units and provided loans to deficit units (Allen & Santomero, 2001), and most of their revenues were generated from lending activities (Casu et al., 2022). In other words, banks were seen as intermediary institutions that strategically emphasised deposit-taking, loan-providing and making

profits from the difference between interest revenues and interest expenses. Until the early 2000s, the banks were strictly regulated banking businesses in terms of the limited business they were allowed to operate (Casu et al., 2022). However, Bhattacharya and Thakor (1993) reconceptualised the contemporary banking model as market-based banking, where banks offer products and services that can be traded on financial markets to manage risk, allocate credit, price assets and liabilities, and create new financial products. In 1992, the enactment of the 'EU's Second Banking Directive' formally recognised banks under the universal banking approach (Casu et al., 2022). Under this approach, banks are permitted to provide a wide range of financial services, including securities operations, pensions, insurance, leasing, and other financial activities (Casu et al., 2022).

Nevertheless, criticisms of the contemporary or universal banking approach have been observed, such as those of Hardie and Howarth (2013), who blamed universal banking theory for the financial crisis and slowed the pace of recovery. Besides, Gorton (2010) and De Jonghe (2010) called for a return to narrow banking (limited to the intermediary function). Nevertheless, the proposals for reforms have been excluded by negotiations with market-based views of banking (Lall, 2012) and seem incompetent to reverse the trend to a universal banking approach in commercial banks (Butzbach & Von Mettenheim, 2015). Credit rationing, systematic stability, bank diversity, capital drain, and bank performance in times of the business cycle, inter-temporal maturity transformation, and resilience offer promising areas to apply unorthodox approaches of the institutional and organisational foundations of competitive benefits to form an institutional banking approach (Butzbach & Von Mettenheim, 2015). Undeniably, deregulation, technological advancement, financial inclusion, financial conglomeration, competition, and globalisation have led to the transformation of traditional banking to modern banking (Casu et al., 2022). As a result, the modern banking sector not only limits its intermediary functions, but also offers financial products and services to its customers as full financial institutions to sustain itself in the long run by maximising revenue. Table 2.1 demonstrates how the modern banking sector differs from the traditional banking sector.

Table 2.1 How Modern banking differs from traditional banking

CATEGORIES	TRADITIONAL BANKING	MODERN BANKING
Products and Services	Deposits Loans	Deposits Loans Insurance Securities Pensions Other financial services
Income sources	Net interest	Net interest Fee and commission
Competitive environment	Restricted	High competition
Strategic focus	Asset's size and growth	Returns to shareholders Creating shareholder value (<i>generating ROE greater than the cost of capital</i>)
Customer focus	Supply led	Demand led Creating value for customers

Source: (Casu et al., 2022)

Based on Table 2.1, it is observed that the restricted and uncompetitive banking model transformed into more dynamic banking activities. Banks are operating their business as full financial firms, and this transformation has been motivated by the strategic purpose of meeting a broad range of customers' demands for financial services. Besides, an increase in sales of products and services aids customer relationships and enhances returns to the bank over a more extended period (Casu et al., 2022). Nevertheless, banks have to diversify their revenues by selling and providing products and services such as insurance, securities, and other financial services alongside interest revenues from lending services in a competitive environment. In the bottom line, banks must concentrate on performance in order to reward their shareholders. Therefore, operating in a complex market setting, banks employ different operational approaches or models in providing products and services.

Nonetheless, according to Werner (2014), three common banking theories have been acknowledged over the centuries: credit creation, and fractional reserve. *Credit creation theory* elucidates the role of money formation in accounting processes and loan disbursement. *Financial reserve theory* illustrates that the banking system can create

money together, where an individual bank operates as a financial intermediary by accumulating deposits and loaning them out (Werner, 2016). *Fractional reserve theory* underlines the banks' role in managing liquidity, which is crucial to handling smooth operational procedures (Werner, 2016). Besides, it defines banks as financial intermediaries, both jointly and individually, inferring them as fuzzy from non-bank financial institutions in their nature, exclusively regarding the surplus and deficit businesses, in which the non-banks are incompetent of forming money jointly or individually (Ravn, 2019; Werner, 2016). Meanwhile, *credit creation theory* stimulates economic growth through creating new money by issuing loans, which leads to enhanced production and operational efficiency (Werner, 2014). It is also regarded as more impactful because of its emphasis on the active part of banks in generating new money, which may boost operational activities (Werner, 2014). Consequently, both fractional reserve and credit creation theories emphasise the crucial role of financial resources in banking production and operation (Werner, 2014, 2016).

Banks are traditionally treated as a financial intermediary between surplus and deficit. In the last two decades, banks have been mediating funds and operating in different approaches, such as production and operation or profitability. In other words, banks offer diverse products and services in terms of investment, insurance, security underwriting, real estate investment, and other non-interest income-generating activities (Adesina, 2021; Chowdhury & Haron, 2022). Meaningfully, banks finance and offer different types of investment products and services to enhance their profitability. Besides, banks offer several services to consumers, such as bill payment, receiving, and other services, with a service fee. Several experts have demonstrated three banking theories: production, intermediary, and operating approach (Azad et al., 2017, 2021; Chowdhury & Haron, 2022). The choice of approach is influenced mainly by specific circumstances and environmental factors that shape banking operations (Wagner & Shimshak, 2007). Hence, applying these three approaches is considered comparative among similar banks, as each bank in practice engages with all of them simultaneously (Azad et al., 2017).

Chowdhury and Haron (2022) measured the efficiency level of Malaysian Islamic banks using the three approaches, production, intermediation, and profitability, covering the period of 2011 to 2018. In line with this, Azad et al. (2021) also examined bank efficiency in Malaysia, comparing Islamic and conventional banks from 2009 to 2015.

While Chowdhury and Haron (2022) specifically compared full-fledged Islamic banks with conventional-owned ones, Azad et al. (2021) emphasised the broader comparison between Islamic and conventional banks operating in Malaysia. Despite these different emphases, both studies highlight the Malaysian context, where Islamic banks are particularly significant, and both employed the same set of efficiency approaches. Extending this line of research to a different context, Akin Aksoy and Kandil Goker (2022) applied the production and profitability approaches to examine the efficiency of Turkish banks. More broadly, many studies on banking efficiency have predominantly utilised the intermediation approach (Adesina, 2021; S. M. S. Alam et al., 2021). Reflecting these established practices, the present study adopts a model built upon the three widely recognised operations of banks: the production process, which transforms resources into deposits; the intermediation process, which channels deposits into loans and investments; and the revenue generation process, which converts these loans and investments into interest and non-interest income (Dia et al., 2020).

2.3.1 Production or Value-added Approach

According to this viewpoint, banks use tangible inputs such as physical capital, labour, materials and floor space to provide a variety of deposit categories (for example, savings), loans (for example, consumer and commercial), and other services for customers (Mester, 1992). The simplest method to measure the outputs is to look at the quantity and type of transactions completed in a certain amount of time. This strategy is also known as the service provision approach since it demonstrates the commercial behaviours of banks when they offer services to account holders (Bergendahl, 1998). This method excludes interest payments from the total expenditures of the bank and only includes operating expenses. According to this approach, the bank's total costs consist only of operating costs, ignoring revenue and interest costs associated with deposits since deposits are considered outputs in any circumstance, and only physical inputs are required to carry out transactions or provide other services (Camanho & Dyson, 1999).

This approach considers banks as financial institutions and produces some services for their consumers, for instance, depositors and account holders (Benston & Smith, 1976). In other words, this approach infers that financial institutions play a role in

providing services to their customers, performing transactions on surplus units, and processing documents such as financing (Sealey & Lindley, 1977). Benston (1965) and Berger and Humphrey (1991) were the first to put forward the production approach. Benston (1965) documented this approach by accentuating depositors' transactions and dispensing documents. However, this approach illustrates both financial and non-financial bank activities (Azad et al., 2017; Fethi & Pasiouras, 2010). Few studies have been found in the context of measuring efficiency for Malaysian banks using this approach, such as Azad et al. (2017), Hamid et al. (2017) and Sufian (2009). This reported study also adopted a similar approach to evaluate the efficiency of Islamic banks. In particular, the present study chose labour cost, capital and total distributable income as inputs, while deposits, financing and investments as outputs (Azad et al., 2017; Chowdhury & Haron, 2022).

2.3.2 Intermediation Approach

The intermediation approach deduces that financial institutions play the role of intermediaries between surplus and deficit units by collecting funds from savers, transferring them to the borrowers, and making profits from the difference between interest spreads. According to Sealey and Lindley (1977), financial institutions act as intermediaries, transferring money between savers and investors. They do this by converting financial capital, such as deposits and other funds and liabilities, into loans, securities, investments, and other earning assets through the use of labour, physical capital, and occasionally equity capital. The bank is providing intermediation services in this way. The outputs of the bank are represented by the currency (monetary) units of its assets in different loan and investment categories, whilst the inputs are the expenses incurred in the liabilities. The overall cost of the bank is made up of both interest and operating charges (Ferrier & Lovell, 1990).

Traditionally, banks act as financial intermediaries that collect funds from depositors to lend to investors (Chen et al., 2008; Malim & Masro, 2018; Panah et al., 2014). It also sheds light on the necessity of frontier efficiency (Malim & Masro, 2018). The intermediation approach is applied extensively to measure banking efficiency (Kwan 2002). Accordingly, Islamic banks do not apply interest between depositors and

borrowers; instead, profit distribution is based on profit-loss-sharing mechanisms between parties (Sufian, 2007). Hence, banks are viewed as gathering resources, labour, and deposits to generate investments and loans (Amanda & Sudrajad, 2023). Figure 2.1 exhibits the financial intermediation for Islamic banks. The majority of past researchers used the intermediation approach to evaluate banking efficiency (Ab Rahim, 2016; Ahmad & Prentice, 2019; Echchabi et al., 2015; Kamarudin et al., 2016a, 2019; San et al., 2011; Sufian, 2016; Tahir et al., 2009a; Wahid, 2016). Total deposits, labour costs, and capital are selected as inputs, while total financing and total investments are selected as outputs for this study based on the intermediation approach (Alam et al., 2021; Chowdhury et al., 2022; Chowdhury & Haron, 2021, 2022).

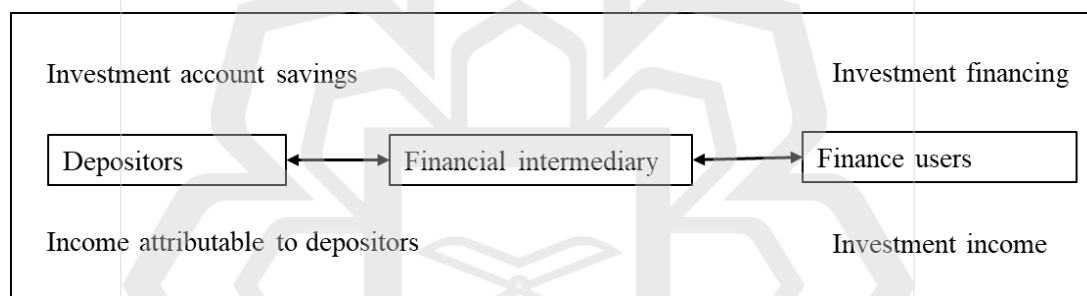


Figure 2.1 Financial intermediation for Islamic banks, adopted from Batchelor (2005)

2.3.3 Profitability approach

The profitability model was proposed by Drake et al. (2006) in the context of Data Envelopment Analysis (DEA) and by Berger and Mester (1997) in the context of Stochastic Frontier Analysis (SFA) profit efficiency. Chowdhury and Haron (2022), Sturm and Williams (2010), Drake et al. (2009), Avkiran (2000), and Chu and Lim (1998) are just a few of the authors who have tested the profitability model empirically. According to Leightner and Lovell (1998) and Panah et al. (2014), a financial institution is a business unit with the objective of making revenue from all current operating costs. According to Drake et al. (2006), from the standpoint of an input-oriented DEA relative efficiency analysis, the more efficient units will be better at maximising profits and, consequently, better at minimising the various costs incurred in generating the various revenue streams. As the competitive environment changes dynamically, they argued that

the analyst will better represent the variety of strategy responses by banks using the profitability approach. Nevertheless, this approach views banks as institutions that prioritise generating profit from the costs incurred to maintain the business as well as customer relationships (Das & Ghosh, 2006). This approach, also well known as the profit-oriented or operating approach, considers revenue factors (interest income, non-interest income) as outputs and expenses (personnel expenses, interest expenses) as inputs (Avkiran, 2000). Although very limited studies focused on bank efficiency under this approach, Nguyen and Nguyen (2022) applied the operating approach to examine the effect of mergers and acquisitions on Vietnamese banking efficiency. Another study conducted by Chowdhury and Haron (2022) used an operating approach to measure Islamic banks' efficiency in Malaysia. Therefore, there is a significant gap in the prior studies by ignoring this approach, while modern banking offers several services to enhance profitability (Casu et al., 2022). Therefore, this research finds that this approach is a contemporary demand to assess efficiency along with the other two approaches. As adopted for this approach, distributed income, labour costs, and other operating expenses are inputs, while total distributable income and other comprehensive income are outputs.

2.3.4 Selection of Banking Theories

In a competitive market, banks operate within complex environments involving multiple resources (inputs) and a diverse range of products and services (outputs). Therefore, relying on a single theory or approach to measure their efficiency or performance may result in unreliable scores (Assaf et al., 2011).

Berger and Humphrey (1997) demonstrated that the intermediation approach is more suitable for assessing the efficiency of financial firms due to the focus of bank managers on lessening total costs instead of just non-interest costs. Supporting this view, Worthington (1998) emphasised that the intermediation approach better reflects the function of deposits as inputs, since deposits are combined with other funds to create loans and investments. By contrast, the production theory is more appropriate for branch efficiency studies (Berger & Humphrey, 1997). It is useful when the objective is to evaluate cost reduction from an operational perspective, as it largely reflects operating expenses (Ferrier & Lovell, 1990). In comparison, the intermediation approach provides

a broader perspective, being linked to total costs and offering stronger insights when analysing the overall economic viability of banks. Nevertheless, neither approach fully captures the dual role of banks in both delivering transaction or paper-processing services and acting as intermediaries between depositors and borrowers (Berger & Humphrey, 1997). A further limitation arises from the difficulty of classifying deposits exclusively as inputs or outputs, since they simultaneously serve both roles in applied efficiency analyses. Thus, scholars have increasingly regarded the two approaches as complementary rather than mutually exclusive. To enhance analytical accuracy, recent studies have integrated non-interest income and off-balance-sheet activities into efficiency models, reflecting the expanding scope of modern banking operations beyond traditional lending and borrowing (Alam et al., 2021; Chowdhury & Haron, 2022). Such activities not only diversify revenue sources but also reinforce the need to move beyond conventional models of efficiency. In this sense, the intermediation and production approaches remain desirable foundations, but incorporating income-generating activities provides a more holistic framework for evaluating efficiency (Berger & Humphrey, 1997).

Building on these theoretical and practical considerations, the present research model adopts a comprehensive perspective by including three widely recognised dimensions of bank operations: the production process, which converts resources into deposits; the intermediation process, which allocates deposits toward loans and investments; and the revenue generation process, which produces both interest and non-interest income from these financial activities (Dia et al., 2020). This integration ensures that the model not only reflects conventional measures of bank efficiency but also aligns with the emerging realities of diversified banking functions.

2.4 STUDIES IN BANKING

Recently, many studies have been unveiled related to the banking sector (Alam et al., 2021). However, these studies demonstrated dissimilarities in the nature of research constituents. For instance, Lehmann-Hasemeyer and Wahl (2021) investigated the effect of saving banks on economic development in the 19th century, using population growth as a measure of economic development, steam engines and factories as a reference to the

Industrial Revolution, and a number of saving banks were included from Germany. Rehman et al. (2021) attempted to identify the relationship between board independence and banking efficiency; they identified a negative relationship and applied both parametric and non-parametric analysis along with an econometric model (GMM) to achieve the objectives of Chinese banks. Similarly, Tam et al. (2021) stated that the hierarchy of independent directors affects the bank's performance and cost-efficiency in a positive manner with negative performance variability. Consequently, Buallay et al. (2020) examined the effect of environmental, social, and governance scores on the banks' performance after the financial crisis. The results reported a significant negative effect on banks' performance.

Meanwhile, Isnurhadi et al. (2021) examined the effect of bank capital on risk and stability and showed a positive effect on bank stability and a negative risk on credit risk. They have posited that efficiency encourages reducing credit risks, including when bank capital is lower. However, Bhattacharyya et al. (2021) demonstrated that the level of CSR expenses and financial inclusion does not relate to banks' financial performance when measured in accounting terms, but exhibited a negative relation when measured by stock market return. In a different context, Chen and Lu (2021) examined the effect of macroeconomic factors on the banks' efficiency, and they found a positive relationship between the GDP per capita and the urban population, which was negatively associated.

Nevertheless, Li et al. (2021) found a significant effect of nonperforming loans on banking efficiency during economic transition. Ryu and Yu (2021) unveiled a negative relationship between subordinated debt (unsecured) and bank performance. In addition, they reported that the issuance of debt unpleasantly and significantly impacts bank performance. Idiosyncratically, Adesina (2021) found that higher diversification in the banking services reduces the performance of traditional banking services, while the efficiency in human capital may improve the inefficiency that occurred by diversification in the African banking sector. Proença et al. (2023) examined the impact of earnings management on Eurozone banking efficiency and unveiled a negative effect of earnings management on banking efficiency and a positive effect of loan provisions on allocative efficiency. Chalampalakakis et al. (2023) considered the financial and post-financial crisis (2009-2018) to evaluate the banking efficiency in Greece, Ireland, Italy, Spain, and Portugal. They found that financial crises affected each country or bank in different ways

due to their different levels of efficiency. In China, Li et al. (2020) investigated the effect of credit risk shocks on the measurement of banking efficiency. They have posited a significantly higher level of efficiency among state-owned banks and joint stock commercial banks than rural or urban commercial banks, and the difference in efficiency increases during economic shocks, and rural or urban commercial banks adjust to the shock slowly.

Henceforward, Liu et al. (2023) examined the effects of intelligent technology on Chinese banking efficiency for the period of 2007 to 2017. They have revealed that intelligent technology. Another study conducted by Kuessi et al. (2023) revealed the negative effect of competition on banking efficiency in the Western African Economic and Monetary Union (WAEMU) countries. They also identified a non-linear relationship between competition and efficiency, and multinational banks were seen as less efficient while more resilient to competition because of their capitalisation from 141 banks from 2000 to 2019. In Contrast, Al-Gasaymeh et al. (2023) posited a positive relationship between competition and bank efficiency in the Middle East and North African countries from 2012 to 2021 by applying Stochastic Frontier Analysis. In a different context, Jreisat et al. (2022) investigated the effect of oil price volatility on the efficiency of 112 banks in BRICKS countries for the period of 2003 to 2018. Their findings unveiled that Chinese banks are the most efficient, followed by South African, Brazilian, and Indian banks, while Russian banks are the least efficient from a two-stage data envelopment analysis. Recently, Amanda and Sudrajad (2023) evaluated the digital banking efficiency in the Indonesian banking sector using the DEA approach for the period of 2012 to 2020. They found that digital banks are more efficient than non-digital banks and posited a significant effect of digital transformation on cost efficiency in banks. In a similar context, Syed et al. (2022) investigated the effect of digital financial services on banking efficiency in India for the period of 2004 to 2018. They concluded that the expansion of digitalised financial services has a negative and significant effect on banking efficiency and stability in the short run, while it increases stability and efficiency in the long run. In a different context, Nguyen and Nguyen (2022) examined the impact of mergers and acquisitions on Vietnamese banks' efficiency between 2011 and 2019 using intermediation and operating approach using data envelopment analysis. They demonstrated a negative effect of mergers and acquisitions on banking efficiency.

In light of these empirical shards of evidence, it is established that recent banking studies have mostly been attentive to the effect of corporate governance and macroeconomic factors on banking performance. Besides, prior studies considered the effects of several factors on banking efficiency, such as credit risk, technology, financial crisis, digitalisation, mergers and acquisitions, and other factors. Thus, such indicators imply and confirm the various functions and business approaches employed by the commercial banking sector. Most importantly, the findings from past studies failed to establish a consensus result in terms of the contribution of banking performance and efficiency to economic growth, as well as the determinants of banking efficiency.

2.4.1 Empirical Evidence on Banking Efficiency Studies

The current decades have transformed the banking industry into a large sector that includes several crucial roles in an economy as a whole industry due to regulatory rules and financial liberalisation (Paulet & Mavoori, 2021). Accordingly, the banking industry is thriving and is the backbone of a country's economy; measuring its efficiency is necessary (Chowdhury et al., 2022; Kamarudin et al., 2019; Samad, 2019). Hence, it is important to maintain the stability of the banking sector by ensuring the banks are efficient in profitability and stability (Banya & Biekpe, 2018; Grmanová & Ivanová, 2018; Rahman & Islam, 2018; Sufian & Kamarudin, 2014). Efficiency, which refers to the minimum effort or resources, may be an indicator to rationalise the accomplishment of a bank (Abduh et al., 2013). It is also widely discussed that stability in profit efficiency may increase the profitability of a bank and, at the same time, ensure the sustainability of the economic growth of a country (Kamarudin et al., 2014a, 2019; Sufian & Kamarudin, 2013). Subsequently, Zeqiraj et al. (2020) implied that banking efficiency is one of the key determinants of overall economic growth.

Proaño-Rivera and Feria-Dominguez (2023) measured the technical efficiency of 24 banks from 2015 to 2019 in Ecuador using the DEA output-oriented model. They showed an average of 84.26 per cent technical efficiency considering interest income and 73.22 per cent technical efficiency considering other operating income as output. Shah et al. (2023) showed an improving banking efficiency level from 2007 to 2018 using the DEA technique for BRI countries. Hence, Chalampalakakis et al. (2023) studied banking

efficiency for five European countries, namely Portugal, Ireland, Italy, Greece, and Spain, during and post-crisis period (2009-2018) using an output-oriented DEA technique. Their results showed an overall decline in banks' efficiency from 2009 to 2011 (financial crisis) and a significant improvement afterwards (2011-2013). Thus, Greek banks improved their efficiency levels significantly from 2015 to 2018 while other countries maintained a relatively stable efficiency level. Kale and Eken (2022) examined the intermediation efficiency for 3039 OECD banks from 2011 to 2019 applying the DEA technique. Their results showed a decrease in banking efficiency till 2015 and efficiency started to recover afterwards.

Gu et al. (2023) measured and compared bank efficiency among three Chinese regions, namely, Mainland China, Hong Kong (HK), and Macao (MO). Their findings estimated a standard level of bank efficiency similar to that of developed economies for Hong Kong and Macao over time, while China was found below that level, but caught up to the level more quickly. From their cross-sectional estimation of banking performance, they suggested that determinants of banking efficiencies are similar in the impacts of different interest rates, forex reserve accumulations, interbank financing scopes, bank capital positions, and liquidity mismatch issues. However, the differences in the impacts of bank size, government ownership, property, revenue diversification, and stock market development affect banking efficiency. Abdulahi et al. (2023) estimated the commercial banks' efficiency in Ethiopia with an output-oriented DEA technique whereby they indicated an average technical efficiency score of 95.5 per cent, pure technical efficiency score of 99.85 per cent, and scale efficiency score of 96.95 per cent during 2014-2020. Henceforth, Milenković et al. (2022) examined the sustainability of the intermediary function of banks in the western Balkans using an output-oriented DEA approach between 2015 and 2019. Their findings posited different efficiency levels in countries within the studied period. In a similar context, Algeri et al. (2022) investigated the effect of financial intermediaries on the operational efficiency of small Italian banks from 2011 to 2020 using an input-oriented DEA approach. The authors unveiled that small cooperative banks' efficiency is complex to bank networks that interact with other similar banks in the same area. Kolia and Papadopoulos (2022) unveiled the higher efficiency level of the US banking sector than the Eurozone and the European banks by employing the two-stage DEA method.

Yu et al. (2021) measured the dynamic banking performance using a two-network DEA approach in the Taiwanese banking sector. They have categorised the efficiency based on deposit and loan efficiency that were categorised separately and identified the issue of inefficiency incurred due to the process of deposit efficiency. Achi (2021) performed two-stage DEA techniques to assess the efficiency of deposit-producing (production approach) and revenue-earning (profitability approach) in Algerian banks for the period of 2013-2017. They unveiled that deposit-producing efficiency outperformed revenue-earning efficiency although the overall efficiency needs to be improved. Their findings also demonstrated the necessity of improvement in efficiency level in both approaches. Aghimien et al. (2016) measured the technical efficiency, pure technical efficiency, and scale efficiency for 43 GCC banks for the period of 2007-2011. They found an optimal level of bank efficiency within GCC countries and thus observed inefficiency of managerial inefficiency in regard to the usage of resources by applying the DEA technique. According to (Tahir et al., 2009b), local banks were technically more efficient than foreign-owned banks when they observed the technical efficiency (TE) of commercial banks in Malaysia. Furthermore, investigating the relative effectiveness of Jordanian banks, Bdour and Al-khoury (2008) applied data envelopment analysis (DEA), and the results indicated that the liberalisation strategy in the country's banking sector has led to a significant increase in bank-level efficiency. Thus, enormous studies have been carried out to measure the efficiency level of commercial banks while mostly focusing on developed and emerging countries under different contexts and circumstances (Aissia & Ellouz, 2021; Alam et al., 2021; Dutta & Saha, 2021).

2.4.2 State-owned vs Private-owned

Sharma and Rawat (2023) examined the efficiency level of Indian banks from 2018 to 2021 using the Bootstrapped DEA technique. According to their findings, bank efficiency level declined in 2020 during the pandemic crisis while an improvement was observed in 2021. Additionally, they observed that state-owned banks outperformed private-owned banks in terms of efficiency. In a similar vein, Agarwala et al. (2023) stated that Indian state-owned banks performed better in terms of efficiency compared to private banks, especially in expanding financial inclusion. Bhatia and Mahendru (2016) measured the technical efficiency scores of Indian state-owned banks for the period of 2007 to 2012.

Their results depicted more than 0.9 efficiency score. In contrast, by employing the DEA method on 40 Indian banks, Kumar and Kar (2023) unveiled higher efficiency of private-owned banks than state-owned banks in terms of profitability approach while state-owned banks outperformed private-owned banks in regard to intermediary function. Akin Aksoy and Kandil Goker (2022) posited the highest average efficiency level for state-owned banks, and operational performance is the reason behind the inefficiency in Turkish banks. This study employed a two-stage input-oriented DEA method using the production and profitability approach in 2018.

Boateng et al. (2015) examined the performance of Chinese commercial banks for the period of 2000 to 2012 where they found that state-owned banks are more profitable and have better liquidity positions than other banks. An earlier study conducted by Shen et al. (2014) found no difference in financial performance between state-owned and private-owned commercial banks in China for the period of 1993-2007. In addition, Jiang et al. (2013) posited the poor performance of state-owned banks from an investigation of the effect of ownership structure and the dynamic effect of privatisation on the Chinese banking sector from 1995 to 2010. Nevertheless, by examining the banking efficiency of Vietnamese banks from 2008 to 2016, Le et al. (2022) posited a decline in technical efficiency during liberalisation. Further, bank ownership unveiled an influence on banking efficiency levels-privatisation improves efficiency levels. By comparing the financial performance of Korean banks, Lee and Kim (2013) found a negative relationship between state-owned banks and financial performance. Charles et al. (2016) assessed the efficiency score of Argentina's public banks and demonstrated the period of 1999 and 2002 as black periods for the public banking sector. In contrast, (Shawtari, 2018) found a positive relationship between state ownership and the financial performance of Yemeni commercial banks. However, these findings contradict a past study conducted by Akhigbe et al. (2017) who found no significant difference between private and public-owned banks' efficiency. They studied and compared the profit efficiency between public and privately-owned US banks before pre-crisis and during the financial crisis.

2.4.3 Islamic vs Conventional Banks

Parallel with the propagation of Islamic banking and finance around the world, Islamic banking and financial services have received their exponents (Iqbal & Mirakhor, 2013) and opponents (Kuran, 2004). The opponents call Islamic banking and finance only a transformation of terminology (e.g., mark-up rate, and profit rate are used for the interest rate in debt contracts), although exponents clearly distinguished the differences in business models between conventional and Islamic banking (Beck et al., 2013; F. Khan, 2010). Islamic banking in Bangladesh has experienced substantial growth since the inception of Islami Bank Bangladesh Limited in 1983. Sharia-compliant finance explicitly prohibits the imposition of interest payments (*riba*), permits only commodities and services to accept a price, prohibits speculation, and prohibits financing of certain unlawful actions (Beck et al., 2013). Shariah compliance is a fundamental obligation for Islamic banks, governed by the directives of their Shariah Supervisory Boards (SSBs), which ensure that all products and services conform to Islamic jurisprudence (Bangladesh Bank, 2024b). Conventional banks, governed chiefly by the Bank Company Act 1991, do not necessitate religious adherence, hence lacking the dual-layer supervision present in Islamic institutions (Bangladesh Bank, 2024b).

Simultaneously, Sharia-compliant finance is predicated on the principles of profit-and-loss sharing, encompassing both liabilities and assets, and asserts that all transactions must be substantiated by a genuine economic activity involving a tangible item (Beck et al., 2013; Salman & Nawaz, 2018). These contracts underscore equity and collaboration between the bank and its clients. This indicates distinct disparities in the financial and operational frameworks of Islamic and conventional banks. Conversely, conventional banks depend on loan agreements with fixed interest rates, positioning the bank as the creditor and the client as the debtor, devoid of shared risk (Dusuki & Abdullah, 2007). In Bangladesh, Islamic banks have progressively adapted their contract forms to align with religious mandates and local economic conditions, despite ongoing hurdles in legal harmonisation. Islamic banks are forbidden from participating in or financing haram activities, including gambling, alcohol, pork products, or interest-based financial instruments. This limitation arises from the ethical principles of Islamic finance, which require that all actions promote social justice and economic equity (Siddiqi, 2006). In Bangladesh, Islamic banks are diligent in ensuring their portfolios are exempted from any

engagement in these prohibited sectors, frequently employing negative screening techniques. Conversely, traditional banks have no such ethical limitations, prioritising profits and adherence to regulations. This has resulted in varied portfolio compositions, especially in investment banking and capital market operations. In fact, Islamic scholars have created products that mimic mainstream banking offerings, substituting interest payments and discounts with fees and conditional payment arrangements (Beck et al., 2013). Islamic banks in Bangladesh utilise *Ijara* (lease), *Istisna'a* (manufacturing contracts), and *Salam* (advance purchase) to categorise their funding. These arrangements seek to guarantee that finance is connected to the real economy rather than being speculative. Conversely, conventional banks often participate in money lending and imitative trading, wherein transactions may lack backing by tangible assets, resulting in critiques of excessive speculation and systemic risk (Chapra, 2008). The asset-based characteristics of Islamic finance enhance the resilience of Islamic banks during financial volatility, as evidenced in Bangladesh amid global economic downturns. Another distinguishing feature of Islamic banks is the Shariah Supervisory Board (SSB), an autonomous assembly of academics responsible for ensuring adherence to Islamic rules. These boards evaluate product frameworks, agreements, and operational strategies to guarantee Shariah conformity. The central bank of Bangladesh has mandated that all Islamic banks establish an operational Shariah Supervisory Board (Bangladesh Bank, 2024b).

Nevertheless, the practices of modern Islamic banking and finance were observed in the early period of Islam (Bhatti et al., 2019). Thus, Beck et al. (2013) posited significant theoretical differences between conventional and Islamic banking models. For example, Islamic banking is defined as asset-backed, interest-free, prohibition of speculation, risk-sharing, and uncertainty (M. Iqbal & Molyneux, 2005). Interest rate, risk transfer, and speculation are not allowed in Islamic banking as they contradict the principle of fairness and justice (Parsa, 2022). Besides, Islamic principles entail all practices of an Islamic bank should be backed through a real economic transaction that encompasses a tangible asset (Beck et al., 2013). Table 2.2 distinguishes the principal differences between conventional and Islamic banking systems.

Accordingly, Islamic banks follow the principles that are guided by *Shariah*, most commonly avoiding debt interest payment, short-selling, multifaceted derivative

products, trade with alcohol and tobacco, and gambling (Azzam & Rettab, 2020; Johnes et al., 2018). Islamic banks are importantly purported to be more profitable (Hasan & Dridi, 2010), holds similar risks as conventional counterparts (Abedifar et al., 2013; Pappas et al., 2017), and depict higher technical efficiency (Johnes et al., 2014). However, Islamic banks are still subject to economic shocks while the claim is more subdued (Azzam & Rettab, 2020; Olson & Zoubi, 2017). Prior studies evidenced the significant and positive impact of banking efficiency on economic growth at the macro level (Abedifar et al., 2016; Banya & Biekpe, 2018; Berger et al., 2004). Significantly, Saâdaoui and Khalfi (2022) found a linkage between Islamic banks' efficiency and GDP in developing countries.

Table 2.2 The main differences between conventional and Islamic banking

FEATURES	CONVENTIONAL BANKING	ISLAMIC BANKING
Legal basis	Conventional banks are based on secular and liberal laws. They are permitted to make interest-based investments and are free to trade and invest in various projects.	Islamic banking is guided by Islamic principles (<i>Shariah</i>). According to Islamic jurisdictions, interest (<i>Riba</i>), Speculation (<i>Maysir</i>), uncertainty (<i>Gharar</i>), and investment in an unethical business are prohibited.
Customer relation	The relationship between customers and banks is that of debtor-creditor.	An Islamic follows profit-loss sharing (PLS); therefore, the bank and customer relationship is between investor-entrepreneur and partnership.
Money treatment	Money is treated as a commodity. Conventional banks make profits by purchasing funds at a lower rate and selling them at a higher rate.	Money is only a medium of exchange and a store of value that cannot be rented out or bought and sold at a price higher than its face value.
Business model	Conventional banks do not emphasise the physical existence of commodities for credit creation.	Islamic banks' business models are focused on profit/risk sharing and real economic activities. They use instruments in which the physical existence of the commodities traded is essential.
Social Orientation	Conventional banks are profit-oriented, and they do	The business model of Islamic banking includes a mechanism

	not have the obligation to redistribute income.	called zakat for income redistribution.
Shariah board	Conventional banks do not have such a body.	Islamic banks have a Shariah supervisory board that authenticates the bank's instruments and business activities.

Source: Parsa (2022)

Islamic banks have been experiencing significant growth globally compared to conventional banks (Kamarudin et al., 2019). Islamic banks operate their business in accordance with the *Shariah* principles, whereby all financing or deposit transactions must be free from *riba* (interest) (Ibrahim et al., 2014; Kamarudin et al., 2019). Subsequently, Islamic and conventional banks respond differently during the period of the financial crisis (Sarker et al., 2017). Successively, the development of Islamic banks is being observed around the world, including in the Muslim majority countries such as Bangladesh, Pakistan, Indonesia, and Malaysia. Due to its significance, it is therefore important to measure the efficiency and contribution of Islamic banks to the country's economic growth (Ibrahim et al., 2014; Kamarudin et al., 2019; Sarker et al., 2017). In the past, several studies exhibited no significant difference (Hassan et al., 2009a; Mohamad et al., 2008), while some denoted higher efficiency for Islamic banks (Muharrami, 2008; Olson & Zoubi, 2008), and others exhibited conventional banks are having higher efficiency (Abdul-Majid et al., 2011; Kamarudin et al., 2014b).

In a recent study, Polyzos et al. (2023) used a machine-optimised, agent-based financial model with respect to banking efficiency, financial stability, and societal happiness in several Islamic countries (UAE, Malaysia, Turkey, Morocco, Egypt, and Jordan), and non-Muslim countries (the UK, Switzerland, and Estonia) from 2009 to 2019. They unveiled that Islamic banks are better at dealing with banking crises and aid in keeping these crises from proliferating into the real economy and also from abolishing societal happiness. More so, an increase of Islamic banks in the financial sector limits lending activities, even though uniformly more funds are distributed to corporate loans, subsequently in a more efficient banking sector. Banna et al. (2023) also evaluated bank efficiency for seven dual-banking countries (Nigeria, Bangladesh, Indonesia, Malaysia, Qatar, Pakistan, and Sudan) using the DEA technique for the 2011-2020 period. They

showed that Islamic banks are more efficient than conventional banks. Subsequently, Ikhwan and Riani (2023) showed a better efficiency level for Malaysian Islamic banks compared to Indonesian Islamic banks from 2017 to 2022 applying the DEA technique. Thus, the results also demonstrated the stable efficiency level of Islamic banks in both countries.

Chowdhury and Haron (2022) applied three approaches, namely production, intermediation, and profitability, to measure the Islamic banks' efficiency in Malaysia for the period 2011-2018. According to their findings, full-fledged Islamic banks outperformed Conventional-owned Islamic banks in terms of intermediation, while conventional-owned Islamic banks posited better efficiency in the production and operating approaches. Similarly, Azad et al. (2021) found that Malaysian banks have a higher efficiency level in the production approach than the intermediation approach, while few banks posited higher efficiency in the profitability approach from 2009 to 2015. Meanwhile, Islamic banks revealed higher efficiency levels than conventional banks in the production and profitability approach. However, conventional banks posited a higher efficiency level in the intermediation approach (Azad et al., 2021). In 2019-2020, Boubaker et al. (2022) found lower efficiency scores for 31 Islamic banks in ten countries due to the reduction in outputs. During COVID-19, Mirzaei et al. (2022) unveiled the robust performance of Islamic banks by protecting their profitability rather than conventional banks in the first quarter of 2020. On the contrary, El-Chaarani et al. (2022) divulged that conventional banks had greater financial performance, financial liquidity, and higher capacity to manage their risk during COVID-19 using the GMM estimation in Gulf Cooperation Council (GCC) countries. Similarly, Safiullah and Shamsuddin (2022) reported less technical efficiency for Islamic banks compared to conventional banks under intermediation approach in 28 countries using a stochastic meta-frontier model from 2003 to 2014.

Using the intermediation approach, Chowdhury and Haron (2021) assessed and compared Islamic banks' efficiency level in South-East countries. They found Malaysian Islamic banks are consistent with higher efficiency level; Indonesian Islamic banks showed a gradual progress in productivity, and higher efficiency levels; and Brunei's Islamic banks proved a significant improvement in efficiency level during 2014-2019. Similarly, Rodoni et al. (2020) found ASEAN Islamic banks are efficient and did not

depict any significant difference in efficiency level. In contrast, Banna et al., (2020) unveiled that most of the countries demonstrated inconsistent efficiency levels of Islamic banks by revisiting bias and non-biased corrected efficiency of Islamic banks between 2011 and 2017 for MENA and Asian countries. On the other hand, Alshammari (2021) unveiled a significant positive influence of state ownership on the performance of conventional banks, not Islamic banks, from 2003 to 2018 in Gulf Cooperation Council (GCC) countries. In a different context, Islamic banks were more resilient in terms of overall asset qualities than conventional banks before and after the financial turmoil in GCC countries (Azzam & Rettab, 2020). But, Saleh et al. (2020) depicted a significantly higher inefficiency score of Islamic banks compared to conventional banks in GCC countries between 2005 and 2014. In line, Alexakis et al. (2019) apprehended conventional banks with higher performance than Islamic banks in the 2006-2012 period in the GCC region. A similar result was found by Ben Slimen et al. (2022) who proved a higher efficiency level of conventional banks than Islamic banks in regards to cost efficiency from 2006 to 2015 among GCC banks. In an earlier study, Doumpos et al. (2017) did not find any statistically significant differences in the performance of Islamic and conventional banks in GCC countries. Similarly, Johnes et al. (2014) posited an insignificant efficiency level between conventional and Islamic banks in the GCC region. Kamarudin et al. (2016) examined the effect of national-level governance on the revenue efficiency of conventional and Islamic banks in GCC countries. They found the significant effect of national-level governance on the banks' revenue efficiency which is greatly impacted by the rule of law, the efficiency of government, voice, and accountability.

Belanès et al. (2015) examined the influence of the financial crisis (2007-2009) on the Islamic banks' efficiency in the GCC region and they found a slight decrease in the efficiency level similar to conventional banks. However, few of the Islamic banks remained efficient while some experienced a minor decline in their efficiency level, thus significantly dropping on average in 2009. In addition, Beck et al. (2013) found that Islamic banks are less efficient compared to conventional banks though Islamic banks but Islamic banks posited higher asset quality and intermediation ratio with the inclusion of better capitalised. Similarly, Abedifar et al. (2013) found greater stability and lower credit risk in Islamic banks rather than conventional banks. More so, Safiullah and Shamsuddin (2018) unveiled that Islamic banks have lower insolvency and credit risks compared to

conventional banks while unveiled higher liquidity risks in Islamic banks. This liquidity risk may lead Islamic banks inefficient in relation to the optimal usage of resources. However, Wei et al. (2020) evaluated the revenue efficiency, price efficiency, and cost efficiency of conventional and Islamic banks in 18 different nations. The findings revealed no significant distinction between Islamic and conventional banks.

In the context of ownership of Islamic banks, Kamarudin et al. (2019) argued that foreign-owned Islamic banks are a prominent group of business entities rather than locally-owned Islamic banks in Malaysia. In contrast, Basri et al. (2018) reported that Malaysian locally-owned Islamic banks were more efficient than foreign-owned during 2005-2014. Supportably, Kamarudin et al. (2017) stated that domestic Islamic banks depicted higher efficiency than foreign-owned Islamic banks in the ASEAN (SEA) region. Similarly, Wanke et al. (2016) portrayed a lower efficiency level for foreign-owned Islamic banks than locally-owned Islamic banks due to the cultural and regulatory barriers to foreign banks imposed by the Malaysian Islamic banking market. These contradictory findings might be backed by the selection of data, method, and approach of the studies (Johnes et al., 2018). Besides, banks are assumed to face a variety of situations formed by economic and political operations in different countries over time. Islamic banks' efficiency has been investigated precisely following intermediation approach leaving different approaches over the past few years. More significantly, Islamic banks' efficiency received less attention in the economics that have full or partial Islamic banking in their corresponding countries (Ikra et al., 2021).

2.5 BANGLADESHI BANKS' EFFICIENCY

A significant number of studies were conducted related to the Bangladeshi commercial banking sector. For example, Gazi et al. (2021) observed a stable growth in deposits, loans and advances, and net profit of Bangladesh Commerce Bank through a case study from 2015 to 2019. They have identified that the financial position of Bangladesh Commerce Bank was strong enough, as they unveiled the lower standard of ROA, ROE, NIM, and other ratios. Subsequently, Jeris (2021) posited that the size and capital ratio are significant, while the effect of loans is an insignificant factor of bank profitability in Bangladesh, according to a Regression analysis of panel data from 2014 to 2018. Bose et

al. (2021) performed a Multivariate Regression analysis on the effect of green banking on the financial performance of banking firms in Bangladesh. Their study concluded that the political connections of board directors posited negative relationships between green banking and financial performance. Henceforth, Miah et al. (2021) suggested that Islamic banks were likely to be exaggerated by the COVID-19 effect as their investment pattern is slanted to trade and merchant financing. The authors adopted a balance sheet approach to positing the investment distribution and income sources of Islamic banks in Bangladesh. However, Dutta and Saha (2021) identified the existence of efficiency in contributing to banks' stability by investigating Bangladesh commercial banks. In addition, banks' efficiency improvement lessens the banks' risk, as observed in Bangladeshi commercial banks by Gupta et al. (2021).

Moudud-Ul-Huq (2019) posited a substantial impact of the business cycle on the bank's capital buffer, risk, and efficiency adjustments. Further substantiated by Moudud-Ul-Huq (2020), who found that competition affects banks' risk-banking performance and risk-taking behaviour in the region. In a stable market condition, larger banks are more efficient than smaller banks, while smaller banks are more efficient during financial crises than larger banks. Meanwhile, Asmild et al. (2022) illustrated a more evident difference in inefficiency level between family-owned and non-family-owned banks that arose from particular outputs (net interest revenue and non-interest revenue) in 2007-2009 using an intermediation approach. Subsequently, Akter (2020) showed that foreign branches performed efficiently based on an estimation of the operation efficiency of foreign branches of Bangladesh public-owned banks from 2012 to 2017. Fatema et al. (2019) indicated that commercial banks were technically inefficient by investigating the productivity of commercial banks for the tenure of 2013-2017 from the perspective of the intermediation banking approach. Nonetheless, Robin et al. (2017) investigated the cost efficiency of commercial banks in Bangladesh from 1983 to 2012, employing both DEA and SFA methods. The findings elucidated the fall in the cost of banking institutions due to financial deregulation.

In the interim, Chowdhury et al. (2023) investigated the effect of both liquidity and credit risk on the efficiency of Islamic banks, finding that their efficiency level is 86 per cent. Yesmine et al. (2023) examined the efficiency of 20 scheduled banks, categorising public-owned, private-owned, local, and foreign-owned banks for the period

of 2013-2018. They unveiled that all categories did not perform equally, nor did all banks in the same category have similar efficiency levels. Public-owned banks performed the worst, while foreign-owned banks performed optimally. However, all banks showed a significant level of efficiency from 2013 to 2018. Nonetheless, Lien-Wen and Altankhuyag (2019) showed that higher interest rate spreads lead to larger cost and profit efficiencies, while higher market concentration lowers the cost-efficiencies in developing Asian economies (India, Thailand, Bangladesh, Malaysia, and Mongolia). Haque and Soheli (2019) compared the efficiency level of Bangladeshi conventional and Islamic banks from 2011 to 2017 using the output-oriented DEA and SFA methods. According to their findings, Conventional banks were more efficient than Islamic banks, which were driven by non-investment income. Likewise, Khan (2018) unveiled that the overall efficiency measurement of conventional banks was better than that of Islamic banks between 2007 and 2016. In contrast, Nabi et al. (2019) found that Islamic banks were less inefficient than conventional and public-owned commercial banks from 2009 to 2014. Likewise, Samad (2019) estimated the efficiency of Islamic banks between 2008 and 2012 and found that Islamic banks were managerially efficient. In addition, Hassan and Hassan (2018) applied SFA and found that the cost efficiency is lower in conventional compared to Islamic commercial banks. Based on a case study, Sarker et al. (2017) investigated the performance of a single Islamic bank from 2010 to 2014 through Ratio analysis. The findings acknowledged that the ability, product diversity, and efficiency of the Islamic bank are increasing gradually. Meanwhile, Banna et al. (2017) unveiled better efficiency for commercial banks in 2001, while lower efficiency in 2010 by measuring efficiency using the DEA technique. However, Muhammad Masum et al. (2015) investigated the influence of human resource management practices on Bangladeshi bank efficiency for the period of 2008-2013. They unveiled better technical efficiency for foreign-owned banks, while locally owned banks outperformed in terms of pure technical and scale efficiency. Meanwhile, Uddin and Suzuki (2011) depicted an increase of income and cost efficiency by 15.28 per cent in 2001 and 37.84 per cent in 2008 from an investigation of commercial banks' performance.

In a separate context, Akter and Barua (2016) mentioned that private commercial banks are more efficient than public-owned commercial banks in their study from 2003 to 2012. Masum et al. (2015) unveiled that local bank performed better than foreign banks in terms of pure efficiency and scale efficiency, while foreign banks progressed in

technical efficiency for the period of 2008-2013. Based on the shards of evidence, it can be concluded that banking studies were carried out mainly in two categories: the effect of external factors on banking performance and internal factors in efficiency measurement. Further, efficiency measurement was taken from three central angles: overall efficiency for commercial banks, efficiency comparison between Islamic and conventional banks, and evaluation of efficiency between private and public commercial banks.

2.6 DATA ENVELOPMENT ANALYSIS (DEA) AND EFFICIENCY

Although several techniques have been used to measure efficiency, such as ratio analysis (Heizer & Render, 2006) and Regression analysis (Hensel, 2003), these techniques have certain limitations (Tamatam et al., 2019). For instance, ratio analysis does not provide individual performance scores through multiple ratios in a demonstrable way (Colbert et al., 2000) and also does not rank the assessed entities based on their performance (Tamatam et al., 2019). Regression analysis, on the other hand, compares average performance to the best performance (Colbert et al., 2000; Kweh et al., 2024). Consequently, these methodologies are ineffective for assessing bank performance when multiple inputs and outputs are involved (Kweh et al., 2024). This is because traditional ratios and Regression techniques often assume a simplified relationship between variables and are not designed to handle the complexity and multidimensionality inherent in banking operations, where various factors interact simultaneously to affect performance. Therefore, they fail to capture the true efficiency levels when multiple inputs and outputs must be considered holistically. For these reasons, non-parametric methods are considered more appropriate than parametric methods for evaluating banking efficiency (Svitalkova, 2014). Among the techniques used to measure the efficiency of financial institutions, two prominent non-parametric approaches have emerged: Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA) (Tamatam et al., 2019).

Efficiency frontier techniques have become the prevailing approach for evaluating the performance of banks, as evidenced by numerous studies (Chowdhury & Haron, 2021; Islam et al., 2022; Kwateng et al., 2020). Among these frontier methods, the non-parametric technique, especially Data Envelopment Analysis (DEA), stands out as the most widely used and effective method for assessing efficiency in banking (Achi, 2021;

Alam et al., 2021; Boubaker et al., 2023a; Hoque & Rayhan, 2012; Kumar & Kar, 2023; P. Wanke et al., 2016). The superiority of DEA over other non-parametric and parametric methods, such as Stochastic Frontier Analysis (SFA), has been consistently demonstrated in the literature (Parman & Featherstone, 2019; Ruggiero, 2007). For example, Sakouvogui (2020) empirically compared SFA and DEA techniques to assess the stability of cost efficiency scores across US commercial banks and domestic banks, concluding that DEA yielded more stable and reliable efficiency scores. This evidence underscores the robust capability of DEA in capturing the relative efficiency of banks under varying operational contexts.

Besides, the DEA technique enables banks to evaluate the efficiency and estimate the most efficient of their branches or banks by recognising multiple inputs and multiple outputs without defining the prevailing production technology and establishing a benchmark for other branches or banks to follow (Fu et al., 2015; Paradi, Yang, et al., 2011). By identifying inefficiencies, DEA facilitates improved resource allocation, ensuring optimal utilisation of resources to boost outputs (Paradi, Rouatt, et al., 2011). The DEA can also monitor efficiency trends over time, assisting banks in comprehending the effects of new technology, regulatory modifications, and market conditions on their performance (Paradi, Yang, et al., 2011). This is especially beneficial in intricate contexts where financial ratios may be inadequate and insights from DEA facilitate grounded strategic decision-making by identifying areas for operational and profitability improvement in banks (Kweh et al., 2024). Thus, this technique is employed in the current study to assess the efficiency of Bangladeshi banks. Using DEA, banks are the entities being evaluated. They are known as a homogeneous group of decision-making units (DMUs) formulated using mathematical programming to consume multiple inputs (utilised resources) to generate multiple outputs (created services or products) (Achi, 2021; Contreras et al., 2021; Charnes et al., 1978). DMUs or entities being evaluated must be homogeneous, meaning they execute similar functions and utilise parallel inputs to generate similar outputs. DMUs can include a set of banks or bank branches, firms, hospitals, teams, shops, and players (Achi, 2021).

The theory of efficiency is the theoretical foundation of the DEA technique. It is one of the ground-breaking frontier methods first developed by Charnes et al. (1978) for measuring the efficiency score of similar entities that utilise multiple inputs to produce

multiple outputs (Achi, 2021). This method unravels the comparative efficiency of entities (DMUs) by using linear programming based on a linearised summation of weighted inputs and outputs (Wanke, 2012). The fundamental idea behind this is to apply an optimum 'shell' to envelop the dataset of inputs and outputs (Farrell, 1957). The 'shell' refers to the optimum technical frontier (Li et al., 2021). The optimum technical frontier denotes the collection of the most efficient DMUs that constitute the "efficient frontier." This frontier signifies the optimal performance attainable based on the observed inputs and outputs of the assessed DMUs, functioning as a benchmark for other DMUs (Kwateng et al., 2020; Tamatam et al., 2019). DMUs forming the frontier are regarded as efficient, while DMUs that are not on the frontier are regarded as inefficient. Frontier DMUs outperform them, and the efficiency score of inefficient DMUs is calculated as the distance between the frontier and them.

Data Envelopment Analysis can be described as a prescriptive analytics-oriented technique that provides recommendations for enlightening the efficiency of the assessed units by ascertaining the best practice frontier (Charles et al., 2021). In addition, this approach estimates the relative efficiency of DMUs based on multiple inputs and outputs, and it aims to ascertain the most efficient DMUs that can be treated as benchmarks for enlightening the efficiency of other DMUs (Gulati et al., 2023). Furthermore, without any prior assumption about the connections between the inputs and outputs, one can benchmark the DMUs to find the most efficient ones using the DEA results (Dia et al., 2020). When it comes to evaluating efficiency, this illustrates the significant advantages of DEA models over parametric models (Banker et al., 1984). The DEA technique has established itself as a powerful technique that is able to aid firms in augmenting their performance and making better decisions, offering prescriptive insights on the best course of action to take (Gulati et al., 2023). Due to this, it is an effective method for assessing units that share similar production or market characteristics; otherwise, variations in efficiency scores could be attributed to factors other than inefficiencies, such as the environment (Haas et al., 2003).

Data Envelopment Analysis has become an indispensable and evolving tool for measuring efficiency in the banking sector (Emrouznejad & Yang, 2017). DEA excels by simultaneously considering multiple inputs and outputs, which enables a comprehensive and precise evaluation of bank performance beyond what traditional financial ratios can

provide (Paradi et al., 2011). By identifying the most efficient banks or branches, DEA establishes benchmarks for others to emulate, promoting best practices and fostering a culture of continuous improvement. Additionally, DEA helps pinpoint specific areas where banks can enhance their operations, facilitating better resource allocation to maximise outputs, which is crucial for maintaining competitiveness in the dynamic banking industry. DEA's flexibility allows it to effectively capture the complexity of banking activities, including the impacts of emerging technologies, regulatory changes, and shifting market conditions, making it a vital instrument for strategic decision-making.

Most of the prior studies that applied DEA are based upon radial efficiency measures, which assume either outputs or inputs are exogenous, and cannot be altered by management (Saleh et al., 2020). Nonetheless, DEA remains a powerful tool enabling bank officials to distinguish between efficient and inefficient banks while providing insightful diagnostics across various financial dimensions related to operational decisions (Yeh, 1996). This adaptability and depth make DEA especially suitable for assessing and comparing efficiencies across diverse banking institutions with different banking operations approaches. The widespread adoption of DEA in banking efficiency research, demonstrated by studies in various countries such as Řepková (2014); Sokic (2015); Wanke, Kalam and Barros (2016); Abdul-Wahab and Haron (2017) and Kamarudin *et al.* (2017), and its first application by Sherman and Gold (1985) to evaluate bank branches, further testifies to its robustness and relevance. Subsequent studies, including those by Akter (2020), Anouze & Bou-Hamad (2019), Gulati & Kumar (2017), Karray & Chichti (2013), Kwon & Lee (2015), Nafla & Hammas (2016), and Sufian (2015), continue to confirm DEA as a core and reliable method for performance evaluation in the banking sector. Considering the above advantages and flexibilities of DEA, this technique is deemed appropriate for banking efficiency assessments and comparisons.

2.7 RESEARCH GAPS

Based on the review of prior literature, several research gaps are identified. First, while recent studies predominantly focus on the impact of corporate governance, industry factors, competition, and macroeconomic factors on Bangladeshi Banking performance (Alvi et al., 2021; Chowdhury et al., 2023; Dutta & Saha, 2021; Gazi et al., 2021; Gupta

et al., 2021), they largely overlook the simultaneous measurement of operational and managerial efficiencies. Assessing managerial and operational efficiencies is crucial for banks because it directly affects their profitability, performance, and stability in the financial market. It further allows banks to optimise costs, strengthen customer service, effectively control risks, adhere to rules and regulations, uphold competitiveness, expand financial performance, promote innovation, and assure long-term stability in an evolving and competitive industry. Without capturing these internal performance dimensions, evaluations remain incomplete and potentially misleading.

Secondly, prior literature broadly and significantly prioritised the intermediation approach, which is considered a traditional approach to banking operation (Achi, 2021; Agarwala et al., 2023; Grżeta et al., 2023; López-Penabad, Iglesias-Casal, Neto, et al., 2022). At the same time, very few studies adopted two or three approaches in evaluating or measuring banking efficiencies. Likewise, no prior study in the Bangladeshi banking efficiency context was found to adopt three approaches, while the intermediation approach was dominantly applied (Chowdhury et al., 2023). It is crucial to employ multiple approaches simultaneously when measuring banking efficiency in order to have an accurate representation of a bank's operational and performance effectiveness across different dimensions (Chowdhury & Haron, 2022). Various efficiency indicators encompass distinct facets of a bank's activities. Managers and directors can thoroughly evaluate several facets of the bank's performance by employing diverse approaches; hence, this study employs intermediation, production, and operating approaches. Banks can gain better insights into their strengths and shortcomings across several operational processes by concurrently conducting a comprehensive analysis of many indicators. Thorough efficiency assessments provide valuable information for making well-informed decisions at strategic levels.

Efficiency indicators aid banks in mitigating risks linked to operational inefficiencies. Banks' managers can manage risks associated with financial performance, regulatory compliance, and operational stability by monitoring several efficiency factors such as cost control, revenue generation, and asset quality. Besides, a particular bank uses various methods to compare its performance with other banks in the industry or to identify and adopt best practices. This comparison analysis facilitates the identification of areas in which the bank demonstrates excellence and those in which improvements are

necessary to strengthen competitiveness. The banking sector is characterised by its dynamic nature, as it constantly adapts to changing client demands, technological progress, and regulatory obligations. Employing various efficiency metrics enables banks to swiftly adjust to shifts in the market landscape by pinpointing opportunities for enhancement and novelty. In addition, it helps to promote continuous attempts to improve processes, increase productivity, and innovate in delivering services. Thirdly, although many studies have evaluated the performance of individual banks, a comprehensive assessment encompassing the entire banking sector is absent (Yesmine et al., 2023). The evaluation of the efficiency level between state-owned and privately-owned commercial banks was scarcely applied in the Bangladeshi banking literature. Due to several criticisms relevant to state-owned banks' operations and their performance, it is thus noteworthy to assess their efficiency levels. Finally, comparison studies linked to Islamic and conventional banks' efficiency provided inconsistent and contradictory findings.

Although several studies have been conducted to assess the efficiency of Islamic and conventional banks, extensive, large-scale comparison evaluations have not considered diverse performance measures and contextual factors (Akdeniz et al., 2024). While confined to 38 banks within a single economy (Bangladesh), the present research offers significant insights due to its multiple operational frameworks and the institutional diversity of the sample. This research transcends the unidimensional studies prevalent in the literature by comparing private, state-owned, Islamic, and conventional banks through three distinct banking operational theories, namely, intermediation, production, and profitability approaches. Moreover, Bangladesh, a developing country characterised by a multifaceted banking landscape, augments the findings' external validity and policy significance, especially for economies with comparable institutional and regulatory frameworks. Therefore, this study fulfils the gap of an "extensive comparative evaluation" by employing multiple banking theories and a broader contextual focus, in addition to its sample size alone. Besides, Islamic banking studies primarily emphasise one single model or approach, which leaves another significant gap in Islamic banking efficiency. To the best of the researcher's knowledge, this is the first study that applies the DEA model to evaluate financial services using three banking approaches in the Bangladeshi banking sector. In these circumstances, this research attempts to fill the above gaps by measuring the efficiency level of commercial

banks using three approaches, comparing efficiency levels between public and private-owned as well as conventional and Islamic commercial banks in Bangladesh.

2.8 RESEARCH FRAMEWORK

Building upon the preceding discussions and identified research gaps, this study develops a comprehensive research framework closely aligned with the stated research objectives. As illustrated in Figure 2.2, the framework guides the assessment of commercial banks' efficiency through evaluating multiple inputs and outputs for each bank. Specifically, the framework adopts three banking operational approaches, profitability, production, and intermediation, to calculate efficiency scores. This results in three independent efficiency scores per bank, each derived from tailored input-output combinations relevant to the respective approach. For each approach, technical efficiency, pure technical efficiency, and scale efficiency scores are computed and compared. This multi-faceted evaluation provides insights into banks' operational performance by revealing overall technical efficiency, managerial effectiveness, and resource utilisation optimisation. To deepen the analysis further, efficiency scores are calculated separately for different bank categories: public-owned versus private-owned banks, and Islamic versus conventional commercial banks, highlighting variations across ownership and banking types. Finally, to contextualise the findings, each bank's efficiency scores are benchmarked against the mean efficiency values, facilitating the identification of the most efficient banks within the sample. This structured approach enables a nuanced and comprehensive understanding of banking efficiency across multiple operational dimensions and institutional contexts, addressing the complex realities outlined in earlier research gaps.

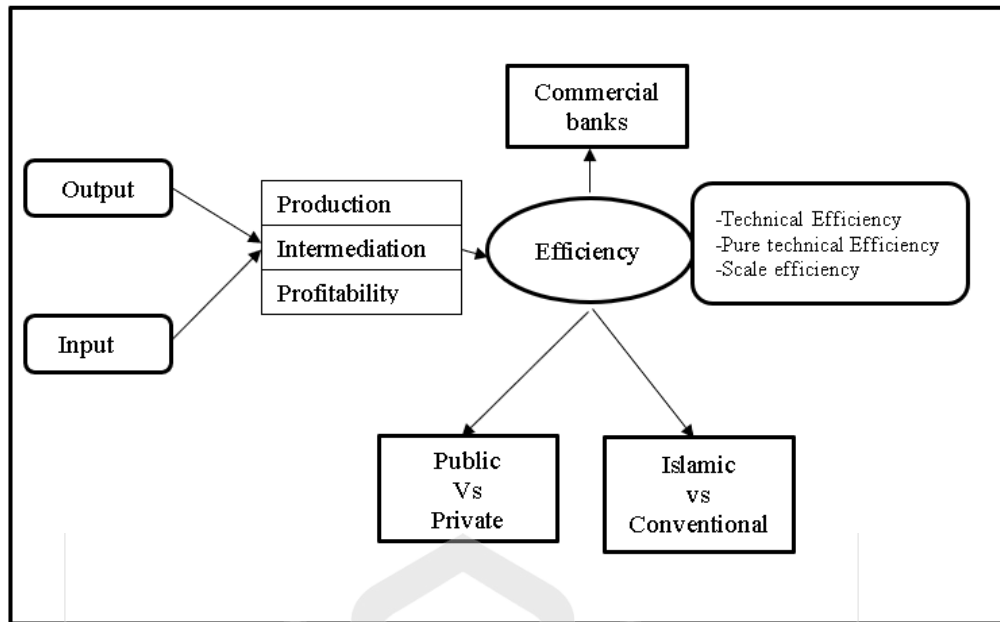


Figure 2.2 Research Framework

2.9 CHAPTER SUMMARY

This chapter has reviewed the findings from previous studies on banking efficiency, exploring its links to economic growth and foundational banking theories. It has examined the comparative efficiency of conventional and Islamic banks, as well as distinctions between public-owned and private commercial banks. Importantly, the chapter has identified key contextual and methodological gaps in the literature, highlighting areas where existing research remains limited or inconclusive. These gaps underscore the need for further investigation to understand efficiency dynamics in diverse banking contexts better. Finally, the chapter concluded by presenting a conceptual framework underlying the proposed research.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter outlines the research methodology employed to achieve the research objectives of this study. It begins by exploring various research designs and approaches to select the most appropriate framework for the investigation. Following this, the chapter details the research design process, including the underlying research philosophy and the rationale for the chosen research method. The chapter then describes the sampling strategy, covering the study population, unit of analysis, sampling design, and sample size determination. Subsequently, it elucidates the data types utilised, operational definitions of key variables, and the data analysis procedures employed in this research. The focus is only on the nonparametric technique, specifically, Data Envelopment Analysis (DEA). Finally, it concludes with a summary.

3.2 RESEARCH DESIGN

Research design is a crucial element of any study. It provides a systematic plan to guide the investigation and ensure clarity in addressing the research questions (Adebiyi & Abayomi, 2016; Saunders et al., 2012, 2019). It outlines the procedures for conducting research activities, minimising errors that could threaten the validity of the findings (Kothari, 2013). This study's research design defines the overall approach and specifies how data will be collected, measured, and analysed to achieve the research objectives (Blumberg et al., 2014; Cooper & Schindler, 2013). Beyond being a simple plan, research design serves as a strategic framework for choosing appropriate data collection methods and analytical techniques (Dudovskiy, 2018; Smith, 2015). In particular, it involves clearly defining the research problem and formulating focused research questions that address the what, how, where, when, and why of the pursued study (Adebiyi & Abayomi, 2016). Effective research design thus directs research efforts and provides a solid foundation for data collection and analysis (Saunders et al., 2019). For this research, the design process includes selecting data collection methods, research approach,

methodology, data sources, and types of data. The research framework is illustrated in Figure 3.1.

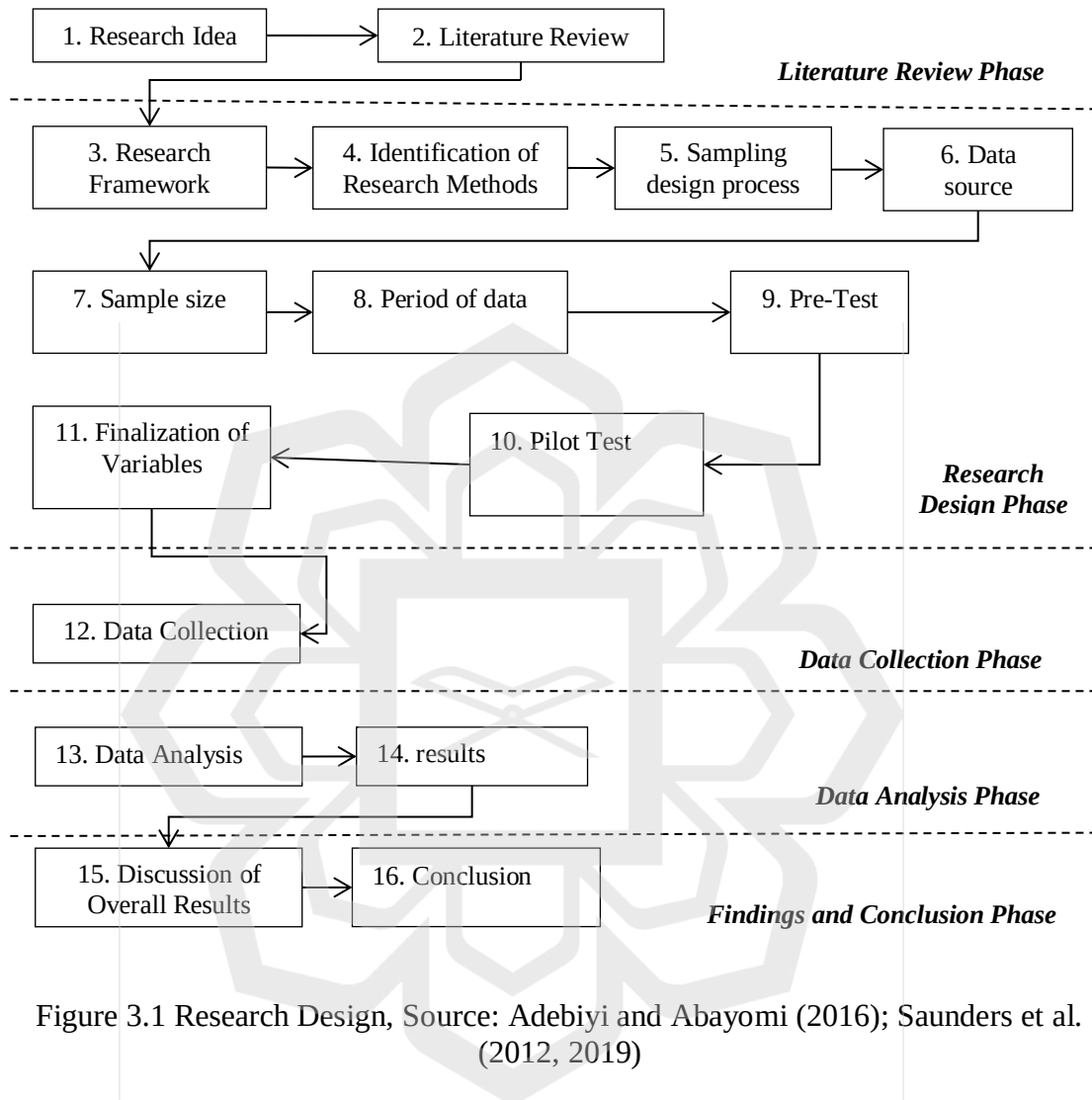


Figure 3.1 Research Design, Source: Adebisi and Abayomi (2016); Saunders et al. (2012, 2019)

3.3 RESEARCH APPROACH

It is crucial to understand and select the best research methodology for the research. According to Gray (2022) and Neuman (2011), researchers typically take into account two distinct and constructive teaching strategies for thinking: deductive and inductive approaches. These two approaches derive from the views of two different schools of thought and are not precisely the same. Although these approaches are remarkably dissimilar, they are nevertheless crucial in different ways for developing hypotheses and expanding knowledge (Lancaster, 2005). The primary component of the viable strategy

is the deductive method, which enables the researcher to establish a range of conjectures by using the data and then validate or disprove the theory to validate the phenomenon (Lancaster, 2005). This method is sometimes known as the top-down approach (Trochim & Donnelly, 2006).

For further clarification, Gray (2022) stated that the deductive technique, which logically draws inferences from information at present, is more general than particular. The deductive research approach is particularly adequate for research where researchers begin with a hypothesis and then use statistical testing to verify the results (Lancaster, 2005). According to Finn et al. (2000), this approach deals with quantitative data, but the other approach, which is an inductive approach, improves theories and or hypotheses through empirical testing through perception. Moreover, the deductive and inductive approaches differ entirely in that the researcher initially observes something in places of interest before moving toward more abstract assumptions and conceptions (Neuman, 2011). In contrast to the deductive approach, the inductive research strategy is a flexible methodology that does not rely on a predetermined theory to collect data. According to Trochim and Donnelly (2006), inductive reasoning begins with a specific phenomenon that the researcher intends to explore and then seeks patterns and regularities. Some tentative hypotheses have been put out (Mertens, 2010). Finally, the researcher develops a few generalisations or theories in light of the findings. The inductive research approach is a bottom-up approach, whereas the deductive approach is a top-down one (Trochim et al., 2011; Trochim & Donnelly, 2006).

When applying the DEA technique, this research starts with established theories of productivity and efficiency. Then, units being assessed, called decision making units (DMUs), are analysed by testing the validity of these theories using empirical data. Therefore, it aligns with the deductive approach, where theoretical frameworks guide empirical analysis. Furthermore, this research is largely explanatory in nature, with the objective of measuring the efficiency scores among and between commercial banks to assess how Bangladeshi commercial banks have performed in recent years.

3.4 RESEARCH PARADIGM

As the stance of theory informs the research method, the research paradigm provides a context for the research procedure and grounds its criteria and logic (Crotty, 1998). The term “paradigm” refers to the scholarly framework and underlying assumptions that underpin research and advancement in a field of inquiry (Kuhn, 1962, 1996). According to Patton (2015), a paradigm is a global perspective that illustrates a way to deconstruct the multifaceted nature of the real world. According to Guba (1990), a paradigm is a notion that eventually becomes an emotion about the environment and should be comprehended and researched. Ontology, epistemology, and methodology are the three categories into which Denzin and Lincoln (2017) classified these beliefs and experiences. *Ontology* addresses the topic of what is real. In contrast, *epistemology* focuses on the nature of knowledge, the methods used to acquire and verify it, as well as the interaction between the knower and the inquirer (Table 3.1). *Methodology* is the all-embracing strategy or plan of action that links ontology and epistemology to the specific methods used in research. It defines the rationale and principles guiding data collection, measurement, and analysis to address the research questions (Al-Ababneh, 2020). Methodology includes choosing between qualitative, quantitative, or mixed approaches based on the ontological and epistemological stance. Furthermore, Denzin and Lincoln (2017) have stated that the technique refers to an individual’s knowledge of the world, atmosphere, and knowledge gained from it. Therefore, the key to designing a feasible study design is understanding diverse research paradigms’ purpose, rationale, and potential consequences (Gray, 2022). According to Guba (1990), the research paradigm directs the researcher’s activity and the inquiry process. Kuhn (1996) also stated that researchers take the general standards seriously in providing information and facts, even though they may advise or expose it to their particular idea.

The social world is acknowledged by positivists (Saunders et al., 2019). According to positivism, reality is what researchers can see and feel. Researchers also adhere to similar methodological philosophies that deal with facts rather than values. Empirical investigations are used to gather facts, and one of the methods used is testing hypotheses to determine whether or not they support the suggested relationship between constructs (Gray, 2022; Neuman, 2011). According to Easterby-Smith et al. (1991), ontology is always objective in the positivist paradigm, both as a societal reality and at the individual

level. Furthermore, the researcher maintains that positivism is based on the idea that social interactions follow universal laws. Empirical methods have legitimate applications that are fundamental to knowledge creation because they solve the problem of providing consistent queries against logical research in a positivistic inquiry (Babbie, 1997). Subsequently, the epistemological basis of this research is positivism, which is why the current research adopted the positivist paradigm. Methodological positivism signifies a notion of knowledge, scientific concepts, and the concept of social reality (Riley, 2007). The main thrust of this mythological positivism is that the view about the social world exists through external factors (Denzin, 1978). It indicates the need for measurement via objective methods rather than inferred through intuition. The use of critical paradigms in organisational research requires the production of knowledge that would be both valid and reliable, where it can be rendered as reality regarding the phenomenon at the research objectives of this current research.

Table 3.1 Summary of Ontology, Epistemology, and Methodology in Relation to Research Paradigms

ASPECT	QUESTION ADDRESSED	DESCRIPTION	ROLE IN PARADIGM
Ontology	What is reality?	Nature of existence and reality	Defines what is considered real
Epistemology	How can we know reality?	Nature and acquisition of knowledge	Defines what counts as valid knowledge
Methodology	How do we study reality?	Strategies and methods for inquiry	Defines how to investigate and analyse

Source: Al-Ababneh (2020), Linking Ontology, Epistemology and Research Methodology

3.5 RESEARCH METHOD

Research method is defined as selecting an approach to data collection and the data analysis method (Saunders et al., 2012). It is also referred to as a strategy to facilitate the research activities successfully by addressing research questions (Bryman & Bell, 2011). However, three primary methods, qualitative, quantitative, and mixed methods, are applied in the research methodology chosen based on research objectives. Based on the nature of the research objectives, a quantitative method has been proposed to collect and analyse data.

3.5.1 Quantitative Method

Quantitative research comprises questions related to causality, degree of effect, or generalisability (Fetters et al., 2013), which is also regarded as a deductive approach (Rovai et al., 2014). This method generally examines the causal linkage between and among variables, thus responding to research questions with numeric or mathematical descriptions (Almalki, 2016). More so, it assumes a theory that is exposed within a theoretical framework and proceeds with statistical analysis; thus, the results determine the acceptance or rejection of hypotheses or demonstrate the significance of findings from a mathematical calculation from observations and data analysis (Rovai et al., 2014). This research adopts a quantitative method for data collection and analysis, as the theoretical framework is designed to identify the efficiency scores for comparison within and between observations.

3.5.2 Type of Data

In the initial stages of research, researchers must deliberately select the type of data that guides the investigation. According to Kothari (2013), in order to proceed to the next stage, a researcher has to be mindful of the data collection technique. In a quantitative method, both primary and secondary data can be used to carry out a research project. Primary data can be estimated as the most suited strategy for carrying out a research project using quantitative measurement and survey methods (Kothari, 2013; Sekaran, 2003). Since this type of data is being collected for the first time, it is regarded as raw

(Kothari, 2004). Furthermore, by using primary data, the researcher is able to measure all aspects of the dimension, including both subjective and objective ways (Davis, 1986). Secondary data refers to data collected by others than the one using it (Sekaran, 2003). Typically, obtaining secondary data entails establishing relationships with institutions and analysts in areas somewhat related to the researcher. This facilitates the sharing of disciplinary knowledge. Further, some data cannot be collected by the researcher, especially in determining the causal effects of operational activities of organisations and economies. Therefore, secondary data is more appropriate since this research aims to measure banking efficiency.

3.6 SAMPLING DESIGN PROCESS

This section discusses the sampling plan procedure, which is crucial for guiding research so that the sample is representative of the research's entire population. Kothari (2004) emphasised the importance of sampling design procedures and referred to them as the substance of research. The sampling design process demonstrates the process of a real data collection procedure. It starts with defining the sample, study population, selection of data, determining the sample size, period or length of data, and sampling technique. However, Sekaran (2007), Kothari (2004), and Malhotra et al. (2012) suggested and proposed their own sample procedure in relation to the sampling process. This research follows seven design processes adapted from Malhotra et al. (2012), presented as Figure 3.2. As such, the entire sampling procedure is explained in this section, particularly the study population, unit of analysis, sample size, data selection and data collection.

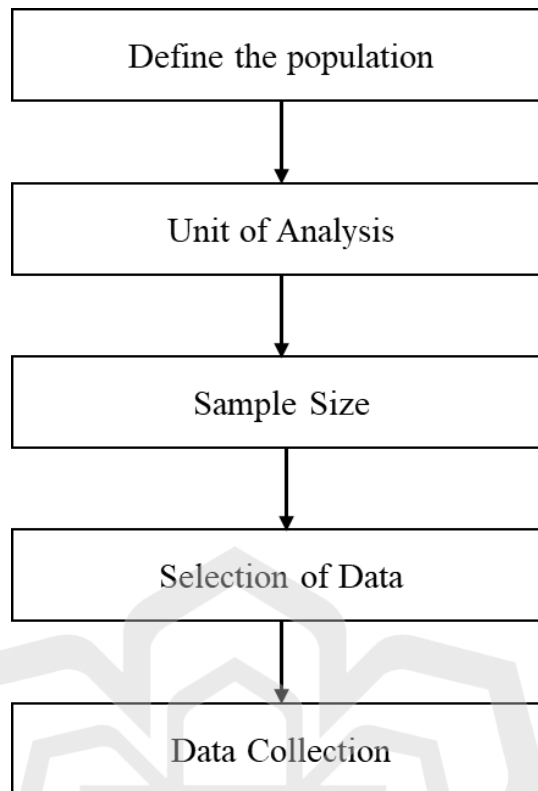


Figure 3.2 Sampling design process (C)

Source: Malhotra et al. (2012)

3.6.1 Study Population

The entire group that is the focus of the study, as defined by the research objective with reference to the study's sampling unit, is referred to as the study population. Given that measuring Bangladeshi commercial banks' efficiency is the main objective of this research, the research's intended population consisted of Bangladeshi commercial banks, including both public and private commercial banks, as well as Islamic private and conventional commercial banks. However, this research only focused on banks that have been operating for at least ten years in the market.

3.6.2 Unit of Analysis

The analysis unit is an essential component that articulates "what" or "who" is the focus of inquiry. Individuals, groups, organisations, and so forth are referred to as the unit of investigation in social science research. Nonetheless, in order to achieve the objectives of

this research (see chapter one), which emphasised the level of banking efficiency of commercial banks in Bangladesh, the unit of analysis in this research was the organisations, namely, banking institutions. As a result, the target group consists of Bangladeshi commercial banks that satisfy specific requirements to be selected as respondents.

3.6.3 Sample Size

According to Hair et al. (2019), sample size is a crucial factor that plays a crucial part in obtaining significant, reliable estimates and interpretations of the data. In general, selecting the appropriate sample size depends on a number of factors, including the size of the population, the amount of time and money and the suitability of the analysis. This research collected data from 38 Bangladeshi commercial banks comprising four state-owned commercial banks (out of 6), 27 private conventional commercial banks (out of 33), and seven Islamic commercial banks (out of 10). Due to the unavailability of data, the rest of the banks, including digital banks, were not considered for this research. According to Nunamaker (1985), for the purpose of facilitating statistical robustness, taking complexity, minimising the risk of excess fitting, and offering a more thorough examination of efficiency outcomes in real-life scenarios, the recommendation requiring at least triple the number of variables as compared to inputs and outputs for efficiency measures ought to be followed. This technique contributes to the production of efficiency assessments that are both trustworthy and relevant, which can help enable informed decision-making and provide support for changes in organisational performance. Table 3.2 presents the banks selected for this research.

Table 3.2 Selected banks for this research

NUMBER	LIST OF THE BANKS	TYPE OF BANKS
1	BCB Bank	Private-Owned Conventional
2	Bank Asia	
3	BRAC Bank	
4	City Bank	
5	Dhaka Bank	
6	Dutch Bangla Bank	
7	Eastern Bank	
8	IFIC Bank	
9	Jamuna Bank	
10	Mercantile Bank	
11	Midland Bank	
12	Mutual Trust Bank	
13	National bank	
14	NRB Bank	
16	Premier Bank	
17	Prime Bank	
18	Pubali Bank	
19	Southeast Bank	
20	Trust Bank	
21	United Commercial Bank	
22	Uttara Bank	
23	Union Bank	
24	Sbi Bank	
25	AB Bank	
26	Standard Bank	
27	HSBC Bank	
28	Islami Bank	Private Islamic
29	Al-Arafah Islami Bank	
30	Islami Social Islami Bank	
31	First Security Islami Bank	
32	Shahjalal Islami Bank	
33	Exim Bank	
34	Bank Al Falah	
35	Janata Bank	Public-owned conventional
36	Rupali Bank	
37	Sonali Bank	
38	Agrani Bank	

3.6.4 Selection of Data (Input and Output)

Choosing the input and output variables for studying banking efficiency is always challenging (Achi, 2021; Ji & Lee, 2012). In addition, prior literature did not set a

universal rule to select input and output variables (Berger & Humphrey, 1997), nor specific variables for production, intermediation, and operating approach (Abdulahi et al., 2023b). In this regard, researchers have been discussing the selection of inputs and outputs (Banya & Biekpe, 2018). Despite this, several factors, such as the concept and nature of banking firms, are important criteria in determining the inputs and outputs (Banya & Biekpe, 2018). The selection of inputs and outputs in banking efficiency studies is primarily shaped by the availability of data, previous empirical findings, and the prevailing theoretical models of banking (Achi, 2021). Building on this foundation, researchers typically rely on two major banking approaches, production and intermediation, to determine the relevant variables for efficiency analysis (Achi, 2021; Adesina, 2021; Banya & Biekpe, 2018; Z. Chen et al., 2018; Kumar & Kar, 2023; Sherman & Gold, 1985; P. Wanke et al., 2016). In the production banking approach, key elements such as physical capital, human capital and associated costs are regarded as inputs, complemented by equities and cash reserves that help expand the pool of customer loans and deposits. These components collectively enable banks to build profit-generating assets (Achi, 2021; Chen et al., 2018). Conversely, the intermediation approach recognises banks as intermediaries that aggregate physical and human capital inputs to generate outputs like total assets (Achi, 2021; Banya & Biekpe, 2018). Expanding further, the profitability approach characterises banks as entities focused on generating revenue by incurring expenses to support their operational activities (Panah et al., 2014). Following this perspective, expenses are viewed as investments made with the goal of producing revenue within the banking business (Chowdhury & Haron, 2022).

This study selected inputs and outputs by considering the findings from the literature review and the availability of relevant variables for all commercial banks in Bangladesh. The variables were chosen based on their impact on productivity and the specific nature of the selected banks' business operations (Azad et al., 2021; Chowdhury et al., 2022; Chowdhury & Haron, 2022; Safiullah & Shamsuddin, 2022; Tsionas & Mamatzakis, 2017). The data that is used in this study is written in local currency (BDT).

3.6.4.1 Variables for Production Approach

The selection of variables for the production approach is rooted in the function of banks as providers of multiple products and services to consumers, depositors, and account holders (Benston & Smith, 1976). Traditionally, emphasis is placed on transactions related to depositors, reflecting the core service aspect of banking operations (Benston, 1965). This perspective parallels financial and non-financial institutions, where a production framework utilises inputs to create outputs, much like manufacturing firms that transform raw materials, investment, and labour into final products and revenue (Azad et al., 2017). For banks, the essential role is to deploy capital and labour to attract savers, thereby increasing deposits and expanding lending activities as primary outputs (Achi, 2021). In line with previous research, this study incorporates labour, capital (shareholders' equity), and interest expenses or distributable income as input variables, while treating deposits, investments, and financing or loans as outputs. This configuration ensures that the production approach captures the transformation of resources into bank products that drive profitability.

3.6.4.2 Variables for Intermediation Approach

In the intermediation approach, banks are predominantly viewed as intermediaries channelling funds from depositors to borrowers and investors (Achi, 2021). Banks' primary function as financial intermediaries involves collecting deposits and efficiently allocating these funds to loans for consumption and other investments, thus supporting broader economic activity (Malim & Masro, 2018). Unlike the production approach, deposits are classified as input variables because they represent resources mobilised by the bank to facilitate lending. The intermediation approach has gained broad acceptance in the efficiency literature, as it aligns closely with the actual flow and utilisation of funds within bank operations (Alam et al., 2021). For this reason, the current research specifies deposits, capital, and labour as inputs, with investments and financing or loans designated as outputs. This selection reflects the intermediary function of banks and is consistent with current empirical practices.

3.6.4.3 Variables for Profitability Approach

The profitability approach centres on banks as entities that drive revenue generation through the expenditure required to maintain commercial operations (Panah et al., 2014). Often referred to as the operating or revenue-based approach, this perspective highlights the use of various resources to maximise income and profits (Chowdhury & Haron, 2022). Accordingly, this approach advocates for including distributable income or interest expenses, labour, and operating expenses as input variables, contrasted with investment income, interest revenue, and other operating income as output variables. This configuration allows for a comprehensive assessment of how banks convert operational expenditures into revenue streams, directly reflecting their financial performance and operational efficiency.

Table 3.3 Selection of inputs and outputs

APPROACH	INPUT	OUTPUT
Production	Labour Capital Interest expenses	Deposits Investments Financing/loans
Intermediation	Deposits Labour Capital	Investments Financing/loans
Profitability	Labour Interest expenses Other expenses	Interest revenue Non-Interest revenue

The input and output variable selection for this research is firmly anchored in prior empirical findings and established theoretical perspectives (Azad et al., 2017; Chowdhury & Haron, 2022). By adopting variable sets that are consistently validated in the literature, the study ensures methodological rigour and theoretical alignment with the prevailing models of bank performance. Table 3.3 presents the understudy inputs and outputs for three approaches separately, whilst Table 3.4 displays the brief operational definition of understudy variables for this research. Enabling a clear, comparative analysis across different efficiency measurement approaches.

Table 3.4 Description of variables

VARIABLES	DESCRIPTIONS
Deposits	Customers placed deposits in the bank comprising savings, fixed and checking accounts (in Millions, BDT)
Labour	Salaries and wages expensed in a particular year (in Millions, BDT).
Capital	Shareholders' equity claimed after deducting liabilities from assets (in Millions, BDT).
Loans/Financing	Total loans disbursed by conventional banks and total financing by Islamic banks (in Millions, BDT).
Interest expenses	Interest paid to its depositors (in Millions, BDT).
Other expenses/ Other operating expenses	Subtract personal expenses from total operating expenses (in Millions, BDT).
Interest revenue	Incomes that are primarily generated from loans/financing (in Millions, BDT).
Non-Interest revenue	Comprises fees, investment and other business incomes, and commissions (in Millions, BDT).
Investments	Investments for sale, trade, maturity, subsidiaries, groups, and properties (in Millions, BDT).

3.6.5 Pre-Test

Past studies recommended a pre-test before pursuing the full-scale investigation. A pre-test was applied to assess the accessibility of data for the DEA and suitability for data measurement and analysis. By doing a pre-test, the researcher is able to assess the approximated time, possible issues in data collection, and measurements that could be acknowledged. Further, it enables the researcher to identify the requirements and limitations of the data analysis technique related to data. According to Presser et al. (2004), utilising 5 per cent to 10 per cent of the total sample size is typically deemed sufficient to guarantee the reliability and clarity of the study's instruments prior to initiating full-scale data collecting. Accordingly, this research proceeded with pre-testing of data analysis by collecting data from five banks. These five banks were chosen from each category of commercial banks, for example, two private commercial banks, one public-owned commercial bank, and two Islamic commercial banks. The pre-test on efficiency assessment has chosen 2020 as its base year because of its importance as a structural breakpoint in both local and international financial systems. The emergence of COVID-19 in early 2020 caused remarkable economic chaos, necessitating banks to

urgently adapt their operating frameworks, risk management approaches, and digital infrastructures (Jaiyeoba et al., 2024). These developments present a distinctive opportunity to evaluate the efficiency with which banks, especially in Bangladesh, managed their assets amid a crisis. Utilising 2020 data for a pre-test facilitates the assessment of the appropriateness and responsiveness of the selected efficiency measurement technique (e.g., DEA) in severe economic situations. Pre-test results from the DEA technique implied no issues.

3.6.6 Finalisation of Inputs and Outputs

To ensure robust variable selection for the final efficiency analysis, this research undertook a pre-testing phase that guided the choice of inputs and outputs across all three methodological approaches. During pre-testing, the selected variables were assessed using DEA results generated by the DEAP 2.1 software, which were then shared with a domain expert for validation. The expert confirmed the appropriateness and acceptability of both the chosen variables and the preliminary results, reinforcing confidence in the measurement framework and methodology. Recognising the importance of data consistency and comparability, the researchers standardised all monetary values to millions, as the original dataset included values reported in thousands, full amounts, and BDT currency. This data normalisation ensured uniformity and facilitated accurate benchmarking and analysis; a practice supported in methodological literature on banking efficiency studies.

3.7 DATA COLLECTION

This study used data from annual reports of Bangladeshi commercial banks, comprising public-owned, private-owned, conventional and Islamic commercial banks. Four public-owned banks and 27 private-owned banks operate under conventional, while seven private-owned banks operate under an Islamic umbrella. Thus, no public-owned bank operating under Islamic banking is included in the sample. The sample only covered all available banks that have been in the market for at least ten years. The data were extracted from the banks' consolidated or audited annual reports of balance sheets and income

statements from 2016 to 2021. These annual reports are available on the bank's webpage, and all data were measured in millions of Bangladeshi Taka (BDT). Among the selected banks are four public-owned banks, seven Islamic banks, and the remaining private conventional banks. Several banks were excluded from the data sample due to the embryonic stage of banking operations and the unavailability of data.

3.8 APPROACHES OF EFFICIENCY MEASURES

Ratio analysis was the foundation for the initial measurements of bank efficiency. However, this approach is too problematic and straightforward due to the multitude nature of bank inputs and outputs (Sherman & Gold, 1985). This led to the introduction of two newer techniques for measuring bank efficiency: parametric and non-parametric methods. In recent times, these parametric and non-parametric approaches have been the two primary approaches for assessing bank-level efficiency, which are well discussed in the literature on banking efficiency (Boubaker et al., 2023a). The distribution-free approach (DFA) (Berger, 1993), thick frontier analysis (TFA) (Berger & Humphrey, 1991, 1992), and Stochastic Frontier Analysis (SFA) (Aigner et al., 1977) are the subcategories of the parametric techniques. Two equivalent measures for the non-parametric approach have been identified in the body of the prevailing literature. These are the Free Disposal Hull (FDH) technique created by Deprins et al. (2006) and Data Envelopment Analysis (DEA) (Charnes et al., 1978). In essence, the DEA's convexity assumptions are eased by the FDH method. Techniques known as parametric approaches drive the idealised production frontier and all its variations to take on a functional form. Two components make up deviations from the idealised frontier: the inefficiency component, which symbolises the amount of waste in the banking institution's operations, and the random noise component, which is thought to be beyond the realm of management control (Kwateng et al., 2020). The inefficiency component would take a form dependent on distributional assumptions, which include truncated normal, exponential, and half-normal distributions. The Distribution-free approach, Thick Frontier Approach (TFA), and Stochastic Frontier Analysis (SFA) are a few of the methods employed under the parametric techniques. The SFA proposed by Aigner et al. (1977) has been employed in the majority of research that estimates efficiency using parametric models. The significance of parametric approaches is argued to lie in their capacity to distinguish between deviations from the best practice

frontier into the component that is solely attributable to random noise and inefficiency. Otherwise, it is condemned for mandating the form that the inefficiency should take based on statistical assumptions (Kwateng et al., 2020).

In order to estimate bank efficiency, the parametric approach requires the specification of a functional form, whereas the non-parametric approach employs mathematical programming techniques instead of this requirement. This is the key difference between the two approaches. First proposed by Aigner et al. (1977), the Stochastic Frontier Analysis (SFA) is based on a production function with a two-component error term to account for the random effect and technical inefficiencies. This model can be expressed as the following equation:

$$y_i = x_i\beta + (V_i + U_i), \quad i = 1, \dots, N$$

Where y presents the maximum production output of i -th firm, x is a vector of the quantities of input of i -th firm, β is the vector of unknown parameters, V are the random variables, U are non-negative random variables which are assumed to account for technical inefficiency in the model and forms the error term of the regression model. This frontier model has been extended in several ways since its original specification to comprise more general distributional assumptions for the truncated normal or two-parameter gamma distributions, and the inclusion of systems of equations. The SFA is very useful for separating statistical noise from inefficiency (Bogetoft & Otto, 2011). Nevertheless, SFA models entail widespread model specifications (Jacobs, 2001), which are perhaps impractical. Berger and Humphrey (1991) proposed the Thick Frontier Approach (TFA) as a substitute for addressing some of the criticisms raised at the SFA approach. According to the authors, the observation in stochastic frontier estimation should be clustered close to full efficiency because SFA assumes a half-normal specification of the constructed error factor. Thus, TFA compares the lowest and highest (thick-frontier) average costs to estimate the cost function of banks. The discrepancies are subsequently divided into inefficiency residuals and random noise. This method fails to provide accurate estimations of efficiency for individual firms, nor does it impose distributional assumptions on efficiency and random error. Further, in response to criticisms of the SFA and TFA, Berger (1993) presented the Distribution-free approach (DFA). This technique implies that each firm's management efficiency is constant over

time and that random errors eventually average to zero, resulting in a functional form of the frontier and distinct ways to split the inefficiencies. In contrast to the SFA, the DFA does not specify the type of distribution for inefficiency terms; instead, it assumes that the error terms shall have enough time to be wiped out to a zero value in a panel data set.

On the contrary, non-parametric methods do not require any assumptions on the functional form of the frontier or distributional assumptions regarding inefficiency; instead, they depend on mathematical linear programming to compute piecewise linear portions of the efficient frontier. The discrepancy between an inefficient observed DMU and an efficient referenced DMU on the frontier is entirely attributed to inefficiency according to this deterministic layout of the frontier (Kwateng et al., 2020). Therefore, it is hypothesised that non-parametric approaches estimate a random noise error due to their inefficiency (Fiorentino et al., 2006). One of the main advantages of the non-parametric approach over the parametric approach is its robustness and flexibility, which enable the use of numerous inputs and outputs (Berger & Humphrey, 1992). The most important drawback of this linear programming paradigm is that it avoids integrating an error term to account for mistakes (Alrafadi et al., 2016). Additionally, this method is immune to functional ambiguity of any kind, as the parametric technique may expose (Kwateng et al., 2020). Since linear programming is non-stochastic, linear programming models are typically tainted by missing variable error measurement and other types of statistical noise (Kwateng et al., 2020). DEA and Free Disposal Hull methods are two examples of non-parametric techniques widely utilised in the empirical literature (Chowdhury et al., 2022; Sakouvogui, 2020). Berger and Humphrey (1997) stated that there is no statistically significant difference between the two principal efficiency approaches. Nonetheless, in measuring the efficiency of financial institutions, two prominent frontier techniques are SFA (Stochastic Frontier Analysis) and DEA (data envelopment analysis) (Boubaker et al., 2023a; Tamatam et al., 2019). Although there is no clear superiority among the approaches presented in the literature, it is agreed that choosing a method depends on the availability of data (Mester, 1992) and assumptions on the distribution of the inefficiency component (Bauer et al., 1998). Therefore, the researcher has the ultimate authority over the methodologies to be used. However, the researcher must base these judgments on the type and availability of data as well as their understanding of the production function (Kwateng et al., 2020).

3.9 DEA AS DATA ANALYSIS TECHNIQUE

This research employed Data Envelopment Analysis (DEA), which is appropriate for assessing the relative efficiency of banks, based on numerous inputs and outputs without necessitating a predetermined functional structure. In contrast to econometric models like Generalised Method of Moments (GMM), Vector Error Correction Model (VECM) or Autoregressive Distributed Lag Model (ARDL), which aim to elucidate dynamic correlations and causality, DEA is explicitly formulated for benchmarking decision-making units. To tackle variability among banks (such as ownership, Islamic versus conventional), subgroup analysis is employed to elucidate variances in efficiency scores. Since this study aimed to measure and compare the efficiency scores of commercial banks relevant to current banking practices as well as the influence of ownership orientation (Private vs Public) and structural orientation (Islamic vs Conventional) of the banks, DEA is the most appropriate technique for this study, as justified in Chapter Two on Literature Review. DEA enables the assessment of efficiency scores based on multiple inputs and operational choices that banks utilise. Further, this technique will determine the most technically efficient banks for less efficient banks to emulate. In addition, DEA can be used to effectively examine and compare each bank's efficiency to the sample's most significant degree of efficiency (Milenković et al., 2022). A priori assumptions on the analytical form of the chosen variables are not necessary in this analysis (Milenković et al., 2022). The significant advantage of DEA is the ability to include various heterogeneous input and output variables in the model, each of which can be represented by a different metric type (Rubem et al., 2017). Relative efficiency metrics are displayed in the DEA models' results since efficiency score values depend extensively on sample and variable selection (Radovanov et al., 2020).

Prior studies have articulated several essential criteria for correctly applying the DEA technique in efficiency assessments. One fundamental requirement concerns the number of decision-making units (DMUs) relative to the input and output variables involved in the analysis (Kao, 2014). It is imperative that the DMUs under study belong to a homogeneous class of institutions, such as banks, ensuring comparability despite variations in their operational environments. Even when operating under comparable business conditions, the baseline data for different DMUs may vary significantly, which DEA can effectively accommodate (Milenković et al., 2022). To avoid biased or

unreliable efficiency scores, prior literature recommends that the number of DMUs be at least two to three times greater than the total number of input and output variables selected for the study (Golany & Roll, 1989). This ensures sufficient degrees of freedom for discriminating between efficient and inefficient units. The data and selected banks in this research meet these critical requirements, exhibiting an adequate number of DMUs relative to the number of inputs and outputs considered. By adhering to these established methodological guidelines, the DEA technique emerges as an appropriate and robust tool for measuring banking efficiency in this context. This foundational rigour enhances the credibility and validity of the efficiency scores subsequently generated, aligning with best practices recognised in empirical banking efficiency research.

According to Kamarudin et al. (2017), specifying a DEA model involves two primary assumptions regarding returns to scale: constant returns to scale (CRS) and variable returns to scale (VRS). To accurately evaluate efficiency, this study applies both the CCR (Charnes, Cooper, and Rhodes) and BCC (Banker, Charnes, and Cooper) models, which are widely recognised and employed in DEA literature. The CCR model assumes constant returns to scale, meaning that any proportional increase or decrease in inputs results in an equivalent proportional change in outputs, thus measuring overall technical efficiency (TE). In contrast, the BCC model relaxes this assumption by allowing variable returns to scale, enabling it to isolate pure technical efficiency (PTE), which reflects managerial and operational performance independently of scale effects (Henriques et al., 2018).

Scale efficiency then emerges as the ratio of TE to PTE, providing insight into whether inefficiencies arise from suboptimal operating size rather than managerial capability alone. Both CCR and BCC models have been extensively applied to assess comparative performance and efficiency across organisational units (Achi, 2021), as well as to diagnose the sources of inefficiencies, whether attributable to managerial, administrative factors or the scale at which an entity operates (Henriques et al., 2018; Řepková, 2014; Yilmaz & Güne, 2015). By employing these complementary models, the study gains a nuanced understanding of efficiency drivers, enhancing the robustness and interpretability of the results.

3.9.1 Output-Oriented DEA Model

In recent times, numerous DEA model variations have been developed (Milenković et al., 2022). The DEA model can be input-oriented or output-oriented, based on what the decision-making unit requires (Cooper et al., 2007; Ramanathan, 2007; Milenković et al., 2022). An output-oriented DEA model focuses on the maximisation of output by using inputs. In contrast, an input-oriented DEA model is applied to minimise the inputs in order to achieve a fixed level of output. The output-oriented DEA is a technique employed to assess the efficiency of decision-making units (DMUs) by emphasising the maximisation of outputs while maintaining constant inputs (Y. Ji & Lee, 2010). The objective of this approach is to ascertain the extent to which a DMU can augment its outputs without mandating additional input values (Fare, Grosskopf, & Lovell, 1994; Y. Ji & Lee, 2010). Output-oriented models reflect the essence of neo-classical production functions, which are defined as the maximum attainable output based on specified input amounts (Fare, Grosskopf, & Lovell, 1994). This approach is especially advantageous when the main goal is to improve productivity, rendering it a significant asset in industries such as banking, healthcare, and education, where output maximisation is essential (Y. Ji & Lee, 2010).

For various reasons, the output-oriented DEA technique is often viewed as more appropriate for assessing banking efficiency than the input-oriented model. For instance, banks primarily seek to optimise their outputs, including loans, interest income, deposits, and various financial services, rather than to minimise their inputs (V. Bhatia et al., 2018). The output-oriented approach coincides with this objective by prioritising the maximisation of outputs relative to a certain number of inputs. Henceforth, banking's growth and expansion are essential in the competitive banking industry. The output-oriented model assists banks in determining methods to enhance their banking activities and expand their market reach (Shah et al., 2023). Banks operate under a customer-centric landscape where the quality and volume of activities rendered are paramount. The output-oriented model emphasises improving client satisfaction by augmenting the availability and quality of financial services (Shah et al., 2023). Nonetheless, banks recurrently encounter regulatory obligations that necessitate specific standards of service delivery, and the output-oriented model assists banks in fulfilling these requirements by emphasising output maximisation (S. Kumar & Gulati, 2014). Finally, an output-oriented

approach enables banks to measure their performance against top-performing institutions, thereby discovering areas for enhancement in operating activities and efficiency (S. Kumar & Gulati, 2014).

This research argued that current financial institutions are disposed to maximise their outputs using inputs in the competitive market. Moreover, in the competitive market, banks aim to maximise their output by enlarging their services to customers. Therefore, output-oriented DEA with constant returns to scale (CRS) and variable returns to scale (VRS) models are used in this study to examine the degree of banking efficiency.

3.9.2 Constant Returns Scale (CRS)

Charnes et al. (1978) developed the CRS model, which assumes that every bank functions at its ideal scale. However, a bank may operate below its ideal scale for various reasons, including little competition or financial restraints. Therefore, when some institutions are not functioning at an ideal size, the application of the CRS specification will lead to estimates of TE (technical efficiency) that are distorted by scale efficiencies.

The output-oriented CCR (CRS) model (Charnes et al., 1978) undertakes a set of 'j' DMUs where every DMUj yields n divergent outputs by means of divergent inputs that are implied by B_{rj} output and A_{ij} input. The equation of output-oriented CCR is presented as follows;

$$\begin{aligned}
 & \text{Max} \sum_{r=1}^n U_{rj} B_{rj} \\
 & \text{Such} \sum_{i=1}^m V_{ij} A_{ij} = 1; \\
 & \sum_{r=1}^n U_{rj} B_{rj} - \sum_{i=1}^m V_{ij} A_{ij} \leq 0; J = 1, 2, \dots, J \\
 & U_{rj} V_{ij} \geq 0; r = 1, 2, \dots, A; i = 1, 2, \dots, B; \dots \dots \dots (Model 1)
 \end{aligned}$$

Source: Adapted from Chowdhury et al. (2022)

Model 1 displays the weighted outputs to the weighted inputs; the optimum values V_i and U_r of weights of variables to be programmed according to the CCR model.

3.9.2.1 Technical Efficiency (TE)

The term “technical efficiency” (TE) describes the state in which a bank may produce the greatest amount of output with the least amount of inputs (Wong & Deng, 2016). In mathematical concepts, technical efficiency (TE) is calculated as the ratio of the actual output produced given the set of inputs (Kwateng et al., 2020). According to Greene (2005), researchers may accurately estimate a financial institution’s technical efficiency by analysing how its observed output deviates from an anticipated output level. To be technically efficient, a bank must determine the maximum amount of output while altering its assortment of inputs (Kwateng et al., 2020).

Olson and Vu (2007) defined this concept by stating that a bank is technically efficient if it can use the best technology available to produce an output level in the most efficient manner. Subsequently, a technically efficient bank generates the greatest quantity of banking products at the lowest feasible cost (Kwateng et al., 2020). Therefore, a bank is considered to have achieved TE during a period if it can use less of at least one financial input (such as labour) and still generate the same level of financial outputs as it did previously. Similarly, a technically efficient bank would be the one that can enhance at least one aspect of overall financial output (like savings) for an equal amount of input.

3.9.3 Variable Returns Scale (VRS)

Banker et al. (1984) introduced the VRS model, which is similar to the CRS model, considering it is predicated on the radial minimisation (or maximising) of all inputs (or outputs). However, in the CRS model, a bank may be benchmarked against banks that are significantly larger (or smaller) in size than it; the VRS model stipulates that an efficient bank is only benchmarked against banks of comparable size. The BCC (VRS) model is the extended version of the CCR model and was formulated by Banker et al. (1984). Notwithstanding, the BCC model is moderately equivalent to the CCR model, as it breaks

the calculation to weigh input indulgences and output discrepancies (Y. B. Ji & Lee, 2012). The efficiency derived from the VRS model can be subdivided into two categories: management effectiveness and operational scale. We can assess the scale efficiency (SE) (Banker et al., 1984) as the ratio of the pure technical efficiency (calculated by the BCC model) to the overall technical efficiency (calculated by the CCR model), as the BCC model computes the efficiency driven by management effectiveness (Dia et al., 2020). This model is mainly adopted to identify the reasons for the inefficiency of DMUs (Chowdhury & Haron, 2022). The equation of the BCC model is presented as follows:

$$\begin{aligned} \text{Max}_{U_r, V_i} P_c &= \frac{\sum_{r=1}^n U_r B_{cr} - U_0}{\sum_{i=1}^m V_i A_{ci}} \\ \text{Subject to, } &\frac{\sum_{r=1}^n U_r B_{cr} - U_0}{\sum_{i=1}^m V_i A_{ci}} \\ &\text{Is } < 1 \dots\dots\dots (\text{Model 2}) \end{aligned}$$

Note: P_d = efficiency of $^{th}_c DMU$
 U_0 = negative or positive or 0 (Scalar free sign)

In this research, both the CCR and BCC models will be applied to measure the efficiency score, specifically technical efficiency (TE), pure technical efficiency (PTE), and scale efficiency (SE).

3.9.3.1 Pure Technical Efficiency (PTE)

Pure Technical Efficiency (PTE) measures an institution's ability to minimise inputs while remaining on the variable returns to scale (VRS) efficiency frontier, thus isolating the efficiency attributable solely to managerial performance (Q. Iqbal & Awan, 2015). Unlike overall technical efficiency, which combines managerial performance and scale effects, PTE specifically captures how effectively management organises and utilises resources in the production process without the confounding influence of scale efficiency (S. Kumar & Gulati, 2008; Coelli, 1998). As such, PTE serves as a reliable indicator of managerial efficiency, highlighting the institution's capacity to optimise input use and operational processes independent of size or scale. This focus on managerial ability makes

PTE an essential component for diagnosing performance variations attributable to management practices and operational effectiveness.

3.9.3.2 Scale Efficiency (SE)

Scale Efficiency (SE) reflects how well an institution exploits economies of scale in its operations, which is critical in the banking sector where resource allocation, cost control, and profit maximisation are closely linked to operational scale (Banker et al., 1984). SE is quantitatively defined as the ratio of total technical efficiency (TE) to pure technical efficiency (PTE), thereby capturing the extent to which an institution could further reduce inputs by moving to the most productive scale size under the assumption of constant returns to scale (Q. Iqbal & Awan, 2015). This measure reveals the operational effectiveness related to scale, indicating whether a Decision-Making Unit (DMU) is operating at an optimal size or suffers inefficiencies due to being either too large or too small. Understanding scale efficiency provides important managerial insights into whether performance improvements should focus on scaling operations or enhancing managerial capabilities. By decomposing overall efficiency into PTE and SE components, this approach distinctly identifies the sources of inefficiency, enabling more targeted strategic interventions.

$$SE = \frac{\phi_0 CCR}{\phi_0 BCC}$$

3.10 DATA ANALYSIS

Rigorous data quality is essential for any efficiency analysis, especially when employing advanced techniques such as Data Envelopment Analysis (DEA), which fundamentally depend on the accuracy and reliability of the underlying data to ensure credible results. In this research, banks' efficiency levels were measured using audited financial data, which offers the most objective and verifiable basis for assessing organisational performance. All data were systematically collected from annual reports published on each bank's official website, leveraging the authenticity and completeness of audited disclosures.

To uphold data integrity throughout the analysis, meticulous procedures were followed during data entry and extraction, minimising the risk of errors or missing values.

Following initial compilation, data were carefully cross-checked against the original annual reports to verify consistency and eliminate discrepancies. This rigorous data validation process assured that all figures accurately reflected the actual financial performance of the banks under study. After the data cleaning phase, the dataset was subjected to efficiency analysis using DEAP 2.1 software, a specialised tool widely recognised in DEA literature for its robustness and reliability (Coelli, 1996). By adopting these methodical steps, the research not only aligns with best practices in banking efficiency evaluation but also strengthens the validity of the findings and the credibility of the conclusions drawn from the DEA results.

3.11 CHAPTER SUMMARY

This chapter presented the methodology applied by the researcher. The research design and philosophical worldview of positivism have been applied, and several reasons for it are demonstrated in this chapter. As an output of this positivist assumption, a quantitative method research design is considered for this thesis, which has been discussed in this chapter. In addition, this chapter presents and discusses sample size, methods of data collection, variables, and their operational definitions. It further demonstrates the identification of variables for this research. Finally, it ends with a description of the data analysis technique.

CHAPTER FOUR

DATA ANALYSIS AND RESULTS

4.1 INTRODUCTION

The previous chapter highlighted the data analysis technique applied in this research. In particular, Data Envelopment Analysis (DEA) is used to analyse data using three banking approaches: intermediation, production, and profitability. This chapter presents the results of data analysis according to the research objectives. It starts with descriptive statistics of the data and is followed by scores for technical efficiency (TE), pure technical efficiency (PTE), and scale efficiency (SE) for all three banking approaches. The chapter ends with a summary.

4.2 DESCRIPTIVE STATISTICS

Malhotra (2011) explains that in quantitative research, descriptive analysis is used to summarise and present data from a defined population or sample. This analytical approach provides essential statistical measures, such as means and standard deviations, that enable researchers to describe and interpret patterns across all study constructs. Table 4.1 presents the descriptive statistics for the selected input and output variables of the sample banks over the years 2016 to 2021. It shows each variable's average and standard deviation, offering a clear overview of the data's central tendencies and variability within the assessed sample.

Table 4.1 Descriptive Statistics of inputs and outputs

Year	2016		2017		2018		2019		2020		2021	
Variables	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Deposit	222.84*	194.04	246.34	200.85	268.42	212.96	302.19	228.46	317.74	231.99	349.58	50.96
Salaries	3.48	3.13	3.74	3.22	3.98	3.20	4.21	3.27	3.47	1.93	3.67	0.59
Equity	21.47**	15.49	22.24	15.15	24.43	16.21	25.83	16.13	28.39	17.7	38.55*	7.19
Investment	53.79	85.72	48.63	79.12	50.28	75.13	63.48	85.34	67.23	64.77	78.44*	13.49
Loans	174.55**	111.09	205.56	124.70	233.91	142.49	258.22	159.91	280.29	182.63	314.7*	66.03
Int. exp.	11.1**	9	11.30	8.22	13.93	8.5	16.31	9.56	15.59	9.28	14.03	2.95
Other exp.	0.978**	0.835	1.07	0.90	1.15	1	1.28	1.12	1.40	1.17	1.5*	0.20
Int. Rev.	15.59**	9.29	16.7	9.45	20.66	11.19	23.66	12.5	21.49	12.39	20.58	5.18
Non-int. rev.	0.59**	0.58	0.69	0.75	0.77	0.83	0.83	0.95	0.76	0.82	0.87*	0.11

Noted: highlighted scores predicted the highest(*) and lowest (**) average value on the particular variable

Based on the descriptive statistics, it can be observed how the deposits in commercial banks gradually increased throughout the study period (Figure 4.1). Commercial banks received an average of 222.84 million BDT of deposits in 2016, which gradually increased throughout the study period. For instance, 246.34 million in 2017, 268.42 million in 2018, 302.19 million in 2019, and 317.74 million BDT of deposits received by understudied commercial banks in Bangladesh. The average deposit for all banks in 2021 exhibited the highest (BDT 349.58 million) and a standard deviation of 50.96. It could be explained how commercial banks are thriving in regards to attracting depositors and attracting more deposits every year.

However, the standard deviation posits that some of the banks are sounder in the collection of deposits. In contrast, some banks are unable to utilise their resources to collect desired deposits. Accordingly, the banking sector is also flourishing in its loan disbursement following the growth trend of deposits. For example, an average amount of 174.55 million BDT was disbursed in 2016, which increased by 18 per cent in 2017 (205.56 million BDT). Subsequently, an average of 233.91 million BDT was distributed in 2018, followed by 258.22 million BDT, 280.29 million BDT, and 314.7 million BDT, respectively. It is quite relevant to admit that commercial banks have not only acquired more deposits but also allocated those deposits into loans, which helps circulate money in the economy. Besides, commercial banks have also shown how they diversify their businesses through steady growth in investments apart from loan distribution. For example, commercial banks on average invested 53.79 million BDT in 2016, which increased by nearly 46 per cent in 2021 (78.44 million BDT). Following the growth trend of deposits, loans, and investments, banks have also unveiled a growing interest in acquiring equity from the financial market. An average of 21.47 million BDT equity amount was held in 2016, which increased to 38.55 million BDT in 2021, with an approximate growth of 80 per cent in six years. Based on trends in deposits, loans, investments, and equities, commercial banks are acknowledging the consistent growth over the study period.

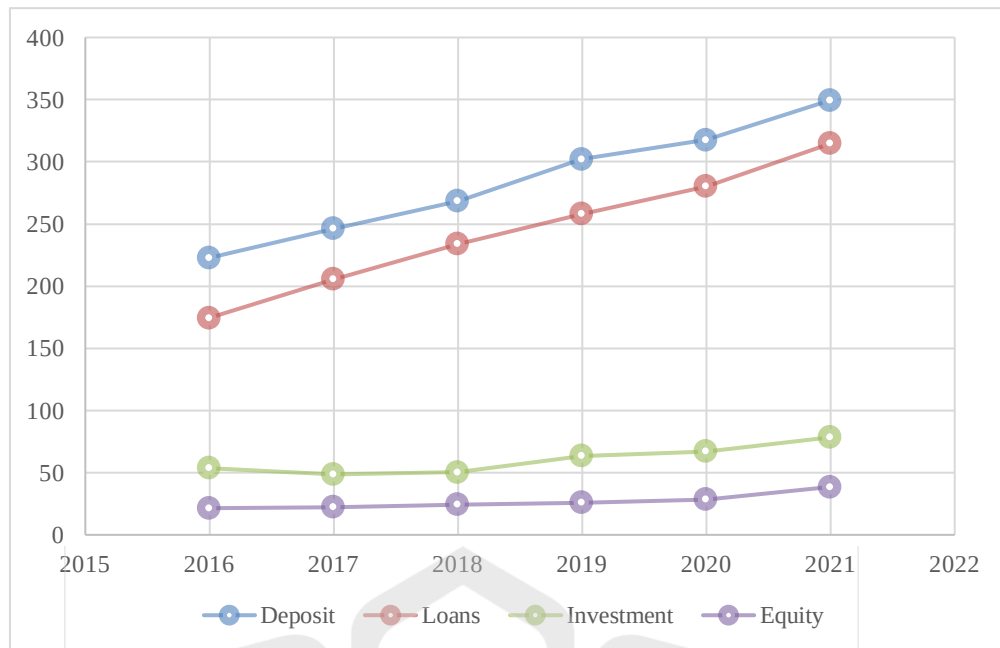


Figure 4.1 Growth trends of Assets and Liabilities of Bangladeshi Commercial banks

Figure 4.2 presents the average revenue growth trend and understudy commercial banks' expenses for the study period. According to the trend, interest revenue has depicted a gradual growth, keeping the glow of growing loan disbursement until 2019. However, the interest revenue growth deteriorated afterwards, although loan disbursement maintained stable growth. The pandemic has affected the interest revenue, and a moratorium was introduced in 2020 by the Central Bank of Bangladesh. Until 2019, commercial banks reported a substantial growth in interest revenue streams, for instance, on average, 15.59 million BDT was received in 2016, 16.6 million BDT in 2017, 20.66 million BDT in 2018, and 23.66 million BDT in 2019 (Table 4.1). Hence, commercial banks received interest income of an average of 21.49 million BDT and 20.58 million BDT in 2021. Meanwhile, a similar trend has been observed regarding non-interest revenue received from investment and other financial services that banks offer to their customers. Surprisingly, the highest non-interest revenue was received in 2021, and the lowest average amount was in 2016. Therefore, it can be implied that banks have kept the growth momentum of their business improvement throughout the period. Nevertheless, expenses are crucial for all organisations, including the banking sector. Employees' salaries and wages are one of the significant expenses for organisations, including commercial banks. Based on the descriptive statistics and trend analysis, average salaries

for commercial banks increased by approximately 7 per cent from 2016 to 2017, and 6 per cent in 2018 and 2019. Thus, there was an almost 18 per cent decline in salaries in 2020, then an increase of 5 per cent in 2021. This trend can be explained by the fact that commercial banks have acquired more deposits and revenue by increasing salaries and wages. However, the pandemic has deteriorated the salaries and wages of commercial banks due to the layoff of employees and or a pause in recruiting new employees. A similar trend is observed in relation to interest expenses. Interest expenses mainly refer to the interest provided to banks' depositors. Surprisingly, the deposits increased throughout the study period, even during the pandemic. However, interest expenses were reduced during the pandemic period. Based on the descriptive results, an average of 11.1 million BDT and 11.3 million BDT were paid out to depositors in 2016 and 2017, respectively. Significant growth was noticed in 2018 (13.93 million BDT), followed by 2019 (16.31 million BDT); however, it reduced to 15.59 million BDT in 2020 and 14.03 million BDT in 2021. Commercial banks have shown a gradual growth in other expenses as well. The highest average of 1.5 million BDT of other expenses was reported in 2021, and the lowest (BDT 929,911,392) in 2016. Unlike deposits and loans, interest revenue and expenses have gradually grown until 2019, but started to decline in 2020 and onwards. This declining trend could result from COVID-19's effect on financial institutions.

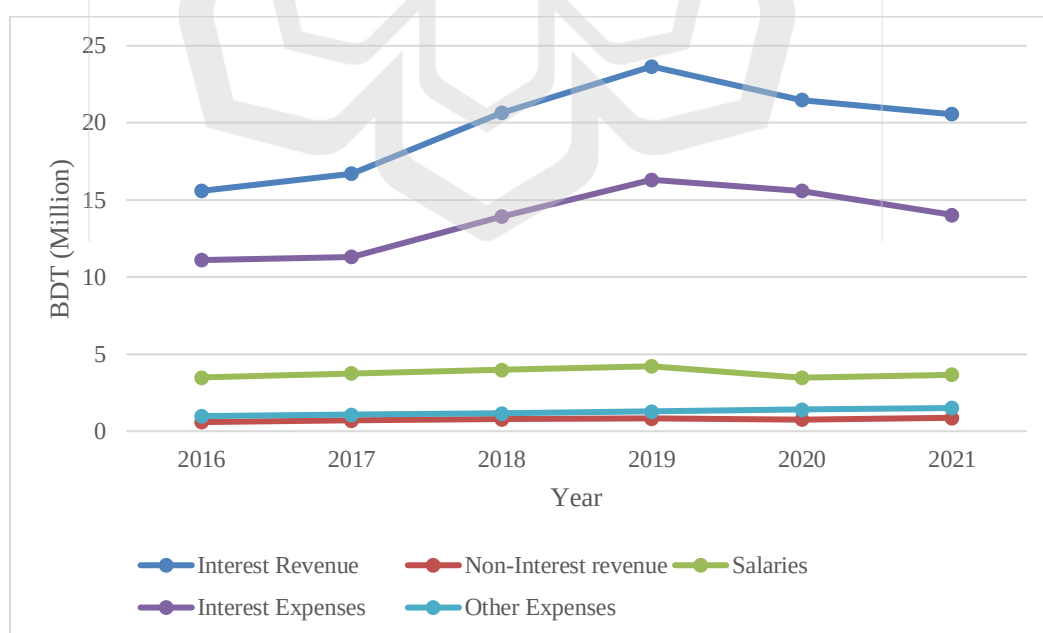


Figure 4.2 Growth trend of Income and expenses

4.3 RESULTS OF DATA ENVELOPMENT ANALYSIS (DEA)

As discussed in the earlier chapters, this study employed the DEA technique to calculate technical efficiency, pure technical efficiency, and scale efficiency for all approaches. In particular, Section 4.3 addresses Research Question 1 and Research Question 2. The following subsections present the efficiency results based on the categories discussed in the earlier chapters.

4.3.1 Constant Returns to Scale (CRS): Technical Efficiency

Technical efficiency (TE) is all about transforming interminable resources into innumerable monetary services. Being technically efficient involves maximising outputs while minimising inputs or minimising inputs while maximising outputs. Technical efficiency scores emphasise the weaknesses and strengths of a bank's operations. Banks can identify operational inefficiencies using technical efficiency measures, including high expenditures, inadequate use of resources, or inefficient input-output allocation. Further, TE scores enable banks to compare their performance to that of industry counterparts or best practices, which assist banks in determining how well they are operating in relation to similar institutions in terms of output creation and resource utilisation. A TE metric ranges from 0 to 1, where 1 denotes an efficient bank, reflecting that the bank is able to utilise its inputs to optimally produce desirable outputs. On the other hand, a score of less than 1 to 0 indicates an inefficient bank that is unable to produce the optimal outputs using given inputs (Akhtar, 2010). The technical efficiency of understudy banks was assessed using three banking approaches: intermediation, production, and profitability. Between 2016 and 2021, TE measurements were calculated using the DEA technique for each bank separately, employing the three banking approaches.

4.3.1.1 Production Approach

Table 4.2 and Figure 4.3 display the technical efficiency (TE) results based on the production approach for individual banks from 2016 to 2021. Based on the measurement of efficiency under the production approach, the TE of commercial banks was not stable during the period, indicating volatility of performance over time.

Table 4.2 Technical Efficiency (TE) for Banks - Production Approach

Bank	2016	2017	2018	2019	2020	2021	Avg.
AB Bank	1.00	1.00	0.99	0.96	0.44	0.60	0.83
BCB	0.24	0.02	1.00	0.03	0.17	0.90	0.39
Bank Asia	0.79	0.58	0.48	0.49	0.92	0.58	0.64
BRAC	0.24	0.33	0.58	0.88	0.40	0.48	0.49
City	0.77	0.34	0.60	1.00	0.50	0.37	0.59
Dhaka	0.85	1.00	0.58	1.00	0.95	0.39	0.80
DBBL	0.39	0.27	0.76	0.61	0.89	0.33	0.54
Eastern	0.42	0.42	0.94	0.60	0.69	0.33	0.57
IFIC	0.41	0.63	0.58	1.00	1.00	0.47	0.68
Jamuna	0.87	0.46	0.62	0.35	0.60	0.33	0.54
Mercantile	0.68	0.98	1.00	0.96	0.61	0.40	0.77
Midland	0.77	0.04	0.23	1.00	0.43	0.06	0.42
MTB	0.46	1.00	0.91	1.00	0.51	0.65	0.76
NBL	0.67	1.00	0.82	0.67	0.41	0.61	0.70
NRB	1.00	0.01	0.15	1.00	1.00	1.00	0.69
One Bank	0.97	0.60	0.85	1.00	0.46	0.77	0.77
Premier	0.72	0.63	0.53	0.54	1.00	0.24	0.61
Prime	1.00	0.55	1.00	0.37	0.26	0.44	0.60
Pubali	0.37	0.48	0.92	0.36	0.44	0.46	0.50
Southeast	1.00	1.00	1.00	0.92	0.65	0.28	0.81
Trust	1.00	1.00	0.74	0.62	0.55	0.69	0.77
UCB	0.92	0.52	0.38	0.26	0.98	1.00	0.68
Uttara	0.99	0.26	0.24	0.67	0.61	1.00	0.63
Islamic Bank (IBBL)	1.00	1.00	0.75	0.72	1.00	1.00	0.91
AIBL	0.47	0.71	0.41	0.66	1.00	0.50	0.62
SIBL	0.56	0.97	0.49	0.50	0.78	0.26	0.59
FSIB	1.00	1.00	1.00	0.92	1.00	1.00	0.99
Union Bank	0.06	0.33	1.00	1.00	0.40	1.00	0.63
Shahjalal Islami Bank	0.98	0.36	0.85	0.55	0.41	1.00	0.69
EXIM Bank	1.00	0.89	0.62	0.83	0.37	0.52	0.71
Standard Bank	1.00	0.76	0.67	0.98	0.42	1.00	0.81

Janata Bank	0.68	0.58	0.96	0.52	0.82	0.72	0.71
Rupali Bank	0.63	0.88	0.59	1.00	1.00	0.82	0.82
Sonali Bank	1.00	0.72	0.65	0.52	1.00	0.49	0.73
Agrani Bank	0.55	0.40	1.00	0.56	0.92	1.00	0.74
SBI Bank	0.72	0.51	0.42	1.00	0.79	0.11	0.59
Bank Al Falah	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSBC Bank	0.48	1.00	1.00	1.00	1.00	0.14	0.77
Mean	0.73	0.64	0.72	0.74	0.69	0.60	0.69

According to the result, Bangladeshi commercial banks showed a moderate efficiency score throughout the study period. The banks achieved an efficiency level between 60 per cent and 74 per cent; hence, the recent period showed a gradual fall in efficiency scores. At the individual level, only Bank Falah displayed a consistent full efficiency level for consecutive years. Likewise, First Security Islamic Bank exhibited consistency in achieving full efficiency in most years except 2019, which slightly dropped, hence an average 99 per cent efficiency level. In 2016 and 2017, AB Bank was the most efficient at 100 per cent. However, in 2020, it was the least efficient at 43.8 per cent, showing an average 83 per cent efficiency level, greater than the average of understudied commercial banks. Likewise, Dhaka Bank, Mercantile Bank, MTB, NBL, One Bank, Southeast Bank, Trust Bank, Islamic Bank Bangladesh (IBBL), EXIM Bank, Standard Bank, Janata Bank, Rupali Bank, Sonali Bank, Agrani Bank, and HSBC Bank showed a greater efficiency score than the aggregate efficiency of all commercial banks. Mercantile Bank's efficiency level rose steadily over the course of the first three years, only to decline steadily over the course of the subsequent three years. 2017 and 2018 saw the highest efficiency rates, while 2021 saw the lowest at 39.1 per cent; hence, it scored 77 per cent on average in the study period. Agrani Bank attained a full efficiency score in 2019, with an average of 74 per cent, whilst Janata Bank attained an average of 71 per cent efficiency score during the study period.

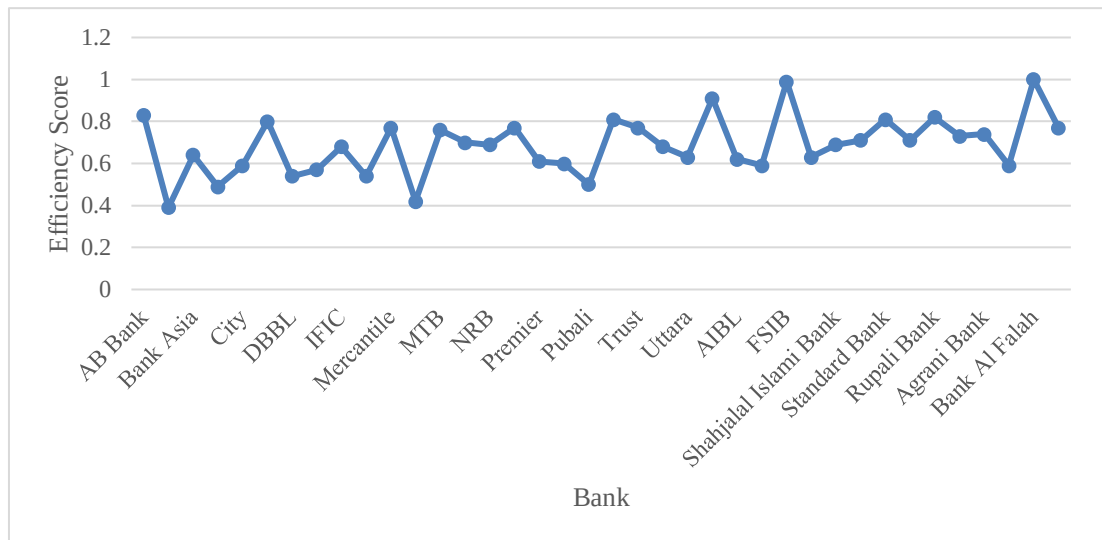


Figure 4.3 Average TE score for commercial banks for the study period

Notably, several commercial banks had poor and less-than-average efficiency scores throughout the study period. For instance, Bank Asia demonstrated an efficiency level within a 50-60 per cent range throughout the study period. In particular, its best efficiency level of 92 per cent was achieved in 2020, and its average score of 64 per cent is still less than the aggregate average score. In addition, Bangladesh Commercial Bank's (BCB) efficiency peaked at 100 per cent in 2018, plummeted dramatically to 25 per cent in 2019, and significantly improved to 90.4 per cent in 2021. Consequently, it showed the lowest average efficiency score for the study period among all banks. Another renowned bank, BRAC Bank, unveiled a less than 50 per cent average efficiency level during the study period, although it has shown a slight, gradual improvement in recent years (2019-2021). Henceforth, Midland Bank revealed only a 42 per cent average efficiency score, which is far from the average efficiency level of aggregate commercial banks. The City Bank's efficiency level also falls below the average; however, it was satisfactory in 2016, but it plummeted dramatically to 33.9 per cent in 2017, and it attained full efficiency in 2018. Then the efficiency score dropped gradually in 2019 and 2020, with a slight improvement in 2021. In a similar trend, DBBL and Eastern Banks followed the same pattern in terms of ups and downs in efficiency level and posted quite close to average levels (54 per cent and 57 per cent consecutively). Next, Jamuna Bank's efficiency peaked at 87 per cent in 2016, fell to 46 per cent in 2017, and jumped to 62 per cent in 2018. Over the course of the past three years, it has gone up and down again. Moreover, Midland and

MTB's efficiency levels declined year after year from 2016 to 2018. The efficiency level has fluctuated during the remaining three years. Midland had the lowest efficiency at 19.1 per cent in 2017, whilst MTB dipped to 51.3 per cent in 2020. In 2021, the two banks reached their peak levels of 100 per cent and 75.8 per cent, respectively. On the other hand, the NBL efficiency level fluctuated between 54.4 per cent in 2016, 100 per cent in 2018, and 80.6 per cent in 2019, then remained at that level ever since. The NRB bank posited full efficient in 2016, however it drastically fell to 10 per cent in 2017 and 15 per cent in 2018. However, it became efficiency again from 2019 to 2021. One Bank was full efficient in the year 2019 and least efficient (46 per cent) in 2020. On the other hand, Premier and Southeast were both efficient banks, with their performance being constant year after year. For Prime Bank, however, efficiency peaked at 76.9 per cent in 2016 but dipped to 32.3 per cent in 2021. The range for Pubali Bank was similarly wide, from 52.8 per cent in 2019 to 100 per cent in 2020.

In summary, the average efficiency scores of all commercial banks remained relatively stable before the onset of the pandemic, averaging 73 per cent in 2016, 64 per cent in 2017, 72 per cent in 2019, and 74 per cent in 2020. This consistency indicates that technical efficiency (TE) across commercial banks was maintained mainly during normal economic conditions. However, during the pandemic, the average TE for the sample banks displayed notable volatility, with efficiency declining to 69 per cent and then to 60 per cent in consecutive years. These findings highlight the disruptive impact of the pandemic on banking efficiency and underscore the sector's vulnerability to external shocks.

4.3.1.2 Intermediation Approach

Table 4.3 and Figure 4.4 present the efficiency measurement via the intermediation approach for all commercial banks in Bangladesh from 2016 to 2021. Evidently, the overall banks' technical efficiency (TE) was not steady, indicating the instability of TE over time with a fluctuating efficiency score. The result demonstrated an average efficiency level of 65 per cent; the highest was 74 per cent in 2019, and the lowest was 57 per cent in 2021.

Table 4.3 Technical Efficiency (TE) for Banks - Intermediation Approach

Bank	2016	2017	2018	2019	2020	2021	Avg.
AB Bank	0.71	1.00	0.58	1.00	1.00	0.53	0.80
BCB	0.08	0.16	1.00	0.02	0.34	0.11	0.28
Bank Asia	0.64	0.75	0.72	0.66	0.82	0.67	0.71
BRAC	0.82	0.61	0.66	0.43	0.30	0.29	0.52
City	1.00	0.45	0.50	0.47	1.00	0.26	0.61
Dhaka	0.72	0.39	0.54	1.00	0.60	0.61	0.64
DBBL	0.63	0.87	0.54	0.81	0.53	0.85	0.70
Eastern	0.68	1.00	0.50	0.71	0.29	0.35	0.59
IFIC	1.00	0.63	1.00	1.00	1.00	0.77	0.90
Jamuna	0.60	0.45	1.00	0.49	0.50	0.55	0.60
Mercantile	0.47	1.00	1.00	0.77	0.35	0.39	0.66
Midland	0.13	0.19	0.42	0.30	0.16	1.00	0.37
MTB	0.71	0.51	0.56	0.59	0.27	0.73	0.56
NBL	0.54	0.91	1.00	0.81	0.51	0.82	0.77
NRB	0.05	0.18	0.15	1.00	0.41	0.99	0.46
One	0.49	0.58	0.78	1.00	1.00	0.60	0.74
Premier	1.00	1.00	0.88	1.00	1.00	1.00	0.98
Prime	0.74	0.38	0.42	0.48	0.59	0.32	0.49
Pubali	0.57	0.72	0.58	0.53	1.00	0.55	0.66
Southeast	1.00	1.00	1.00	1.00	0.82	1.00	0.97
Trust	0.75	0.74	1.00	0.79	0.36	1.00	0.77
UCB	0.97	0.48	0.41	0.49	0.77	0.34	0.58
Uttara	0.77	0.41	0.25	0.79	0.26	0.48	0.49
IBBL	0.71	1.00	0.85	0.69	0.13	0.03	0.57
AIBL	1.00	0.88	0.48	0.70	0.71	1.00	0.80
SIBL	0.83	1.00	0.59	1.00	0.46	0.96	0.81
FSIB	0.84	0.95	0.65	0.91	0.66	0.62	0.77
Union Bank	0.20	0.11	1.00	0.91	1.00	1.00	0.70
Shahjalal Islami Bank	0.43	0.73	1.00	0.81	0.40	0.58	0.66
EXIM Bank	1.00	1.00	0.75	0.80	0.55	0.74	0.80
Standard Bank	1.00	0.85	1.00	1.00	0.67	0.51	0.84
Janata Bank	1.00	0.80	0.75	1.00	0.43	0.01	0.66
Rupali Bank	0.87	0.72	0.85	1.00	0.96	0.61	0.83
Sonali Bank	0.02	0.11	0.09	0.05	0.36	0.05	0.11
Agrani Bank	0.61	0.63	0.72	0.53	1.00	0.00	0.58

SBI Bank	0.85	0.51	1.00	1.00	0.22	0.54	0.68
Bank Al Falah	0.48	0.02	1.00	0.71	1.00	0.33	0.59
HSBC Bank	1.00	0.57	0.45	0.92	0.30	0.42	0.61
Mean	0.68	0.64	0.70	0.74	0.60	0.57	0.65

According to the results, AB Bank showed full efficiency in the years 2017, 2019, and 2020, while it depicted the lowest score of 52.5 per cent in 2021. Further, it attained an average efficiency score of 80 per cent, which outperformed the average score of all commercial banks. Next, IFIC Bank showed a significant performance in the study period, achieving full efficiency in four years, although only above 60 per cent in 2017 and 2021; its efficiency is 90 per cent on average. Notwithstanding, Premier and Southeast Bank demonstrated better efficiency levels with an average of 98 per cent and 97 per cent respectively, whereby both banks achieved five times full efficiency during the study period. Banks such as IFIC and Southeast have maintained more substantial and more diversified financial portfolios, characterised by balanced engagement across retail, SME, and corporate banking sectors. By offering a wide range of competitive products and services, including digital banking platforms, SME-focused lending schemes, and specialised solutions for remittance, the banks have succeeded in attracting new customers while retaining existing ones. This strategic approach to portfolio management and product innovation has enhanced these banks' efficiency and positioned them among the top performers in the sample.

Bank Asia did not achieve full efficiency during the study period; nonetheless, its efficiency scores exhibited an upward trend until 2018, followed by a decline in 2019, a recovery in 2020, and another decrease in 2021. Despite these fluctuations, Bank Asia maintained an average efficiency score of 71 per cent, which is above the aggregate efficiency score for all commercial banks. Similarly, DBBL managed to uphold an average efficiency level of 70 per cent, even though it did not reach full efficiency at any point. DBBL is recognised for its pioneering digital banking efforts and extensive ATM and branch network. Its strategic investment in technology has helped lower operational costs and improve service delivery efficiency. Mercantile Bank maintained full efficiency from 2017 to 2019, but experienced a notable decline to 35 per cent - 40 per cent in subsequent years. National Bank (NBL) consistently performed well, reaching full

efficiency in 2018, while One Bank displayed strong results between 2018 and 2020 before seeing a drop in 2021. Pubali Bank's efficiency fluctuated widely, ranging from 53 per cent in 2019 to a perfect score in 2020, ultimately achieving a slightly above-average aggregate score. Trust Bank averaged 77 per cent efficiency, attaining full efficiency in 2018 and 2021. Al-Arafah (AIBL), EXIM Bank, and First Security Islamic Bank demonstrated robust performance throughout the study period, maintaining approximately 80 per cent efficiency on average. Union Bank was also consistent, with a 77 per cent average efficiency and multiple years of full efficiency from 2018 to 2021. Standard Bank, Social Islamic Bank (SIBL), and Rupali Bank recorded more than 80 per cent efficiency in six separate years. In addition, Shahjalal Islamic Bank, Janata Bank, and SBI Bank achieved slightly above the average aggregate efficiency level for commercial bank.

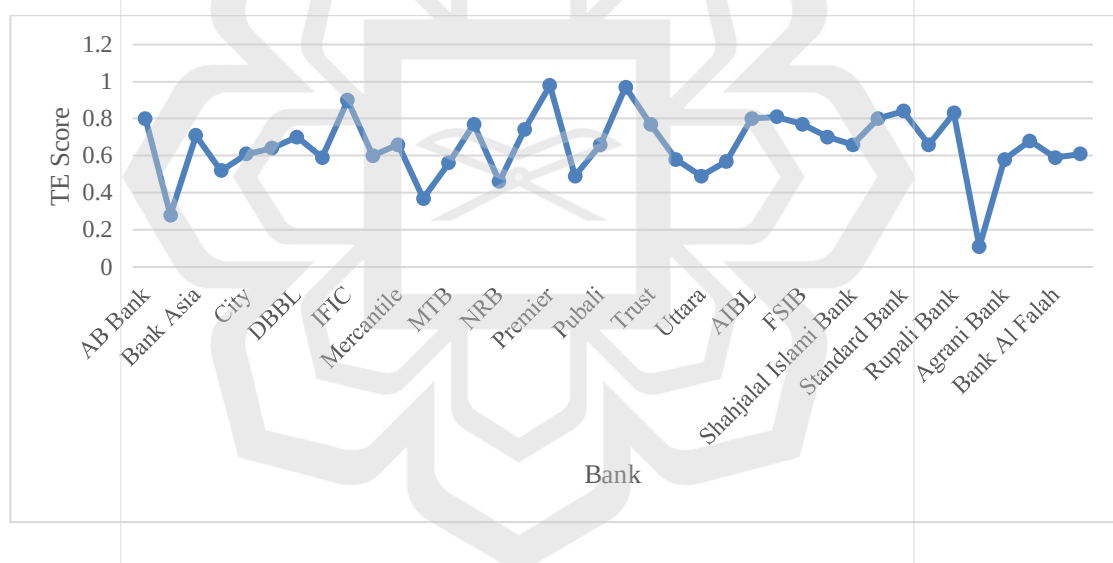


Figure 4.4 TE average scores for selected banks

On the other hand, several banks posted poor and less-than-average efficiency scores throughout the study period. Sonali Bank unveiled the worst efficiency level for the study period with an average of 11 per cent. The second-worst efficiency score was reported by Bangladesh Commerce Bank (BCB) with an average score of 28 per cent. Its efficiency peaked at full efficiency level in 2018 and plummeted dramatically to 2 per cent in 2019. Surprisingly, BRAC bank unveiled a downward efficiency in the study period, which indicates their efficiency level gradually dropped over the period and

attained an average of 52 per cent, lower than all commercial banks' aggregate average. Another renowned bank, City Bank, displayed a dynamic pattern throughout the study period, such as a full efficiency level in 2016, less than 50 per cent from 2018 to 2019, a full efficiency level again in 2020, and then significantly dropped to 25 per cent in 2021. It also reported a lower average efficiency score (61 per cent) than the average of all studied commercial banks. A similar pattern is observed for Dhaka Bank, which achieved full efficiency in 2019 but recorded a lower (64 per cent) score than the aggregate average score. Eastern Bank attained a full efficiency score in the year 2017, the lowest (29 per cent) in 2020 and an average score of 59 per cent. In the meantime, Jamuna Bank showed full efficiency in 2018 with a 60 per cent average efficiency, which was less than the average of all commercial banks. Remarkably, Midland Bank posited a poor efficiency level from 2016 to 2020 while achieving a full efficiency level in 2021; thus, the average efficiency score for the studied period was 37 per cent, far from the aggregate average efficiency level. Likewise, NRB bank posited poor efficiency in the first few years and improved in recent years, yet attained an average score of 65 per cent only. Consistently, Prime Bank also acknowledged a lower average efficiency level of 49 per cent, although it reported comparably better efficiency in 2016. In a quite similar manner, Mutual Trust Bank (MTB) showed better efficiency in 2016 and 2021 and achieved an average of 56 per cent. United Commercial Bank (UCB) failed to surpass an average aggregate efficiency score, although it revealed a better efficiency in 2016. Likewise, Uttara Bank outperformed in the study period by depicting only a 49 per cent efficiency level. Astonishingly, Islamic Bank (IBBL) attained a poor efficiency score in 2020 and the lowest efficiency score in 2021, which lowered their average efficiency level below the average efficiency score of all commercial banks. Another bank, Agrani Bank, showed a stable efficiency score until 2020, but drastically fell to 0.1 per cent in 2021, which worsened their average efficiency level. Bank Al-Falah and HSBC bank showed relatively better efficiency in 2016 and 2019 compared to other years, though acknowledged a lower average than the aggregate average level.

According to the data, commercial banks such as BCB, Midland, NRB, and Prime were generally technically inefficient prior to the pandemic. At the same time, IFIC, Premiere, and Southeast Banks demonstrated superior technological efficiency during this period. During the pandemic, BCB, BRAC, Eastern, and Mercantile banks remained inefficient, whereas DBBL, IFIC, Premiere, and Southeast banks were among the most

effective performers. Overall, technical efficiency (TE) for commercial banks was relatively stable before the pandemic; however, during the pandemic, TE became volatile, dropping significantly from an average of 74 per cent to 57 per cent. This decline reflects the disruptions caused by the pandemic, underscoring its impact on banking sector performance and the need for strategic resilience measures moving forward.

4.3.1.3 Profitability Approach

According to the efficiency measurement for 2016 to 2021 presented in Table 4.4 and Figure 4.5, the TE of the sampled banks was not steady over time. In particular, the efficiency level was 57 per cent in 2016, 69 per cent in 2017, 55 per cent in 2018, 61 per cent in 2019, 51 per cent in 2020, and 54 per cent in 2021. Evidently, throughout the pandemic, the TE of sampled banks was unstable, with efficiency dropping from 61 per cent to 51 per cent.

Table 4.4 Technical Efficiency (TE) for Banks - Profitability Approach

Bank	2016	2017	2018	2019	2020	2021	Avg.
AB Bank	0.65	0.84	1.00	0.77	0.38	0.07	0.62
BCB	1	1	0.93	1	1	1	0.99
Bank Asia	0.30	0.73	1	0.23	0.66	0.77	0.62
BRAC	0.35	0.68	0.59	1	0.69	0.53	0.64
City	1	0.27	0.67	0.23	0.32	0.26	0.46
Dhaka	0.66	0.15	0.21	0.49	0.54	0.33	0.40
DBBL	0.09	0.79	1	1	0.31	0.73	0.65
Eastern	1	0.12	0.49	1	0.66	0.18	0.58
IFIC	1	0.87	0.47	0.47	0.38	0.08	0.55
Jamuna	0.42	0.75	0.22	0.72	0.69	0.78	0.60
Mercantile	0.54	0.30	0.36	0.52	0.34	0.14	0.37
Midland	1	1	1	1	1	1	1.00
MTB	0.15	0.60	0.72	0.26	0.83	0.98	0.59
NBL	0.44	1	0.53	0.69	0.08	0.67	0.57
NRB	0.99	1	1	1	1	0.20	0.87
One	0.24	1	0.60	1	1	1	0.81
Premier	0.27	0.76	0.12	0.33	0.78	0.36	0.44

Bank	2016	2017	2018	2019	2020	2021	Avg.
Prime	0.58	0.72	0.23	0.05	0.12	0.24	0.32
Pubali	0.27	0.57	0.23	0.87	0.32	1	0.54
Southeast	0.48	0.56	1	0.22	0.03	0.97	0.54
Trust	0.91	0.98	0.74	0.18	0.30	0.68	0.63
UCB	0.16	0.50	0.46	0.20	0.30	0.26	0.31
Uttara	0.62	0.53	0.91	1	0.67	0.73	0.74
IBBL	0.43	0.38	0.27	0.08	0.10	0.51	0.30
AIBL	0.58	0.56	0.15	0.11	0.86	0.43	0.45
SIBL	0.35	0.83	0.21	0.22	0.35	0.26	0.37
FSIB	0.43	0.91	0.17	1	0.08	0.84	0.57
Union Bank	1	0.95	0.18	0.37	0.33	0.30	0.52
Shahjalal Islami Bank	0.76	0.88	0.48	1	0.91	1	0.84
EXIM Bank	0.47	0.88	0.11	0.48	0.16	0.05	0.36
Standard Bank	0.74	1	0.13	0.94	1	0.59	0.73
Janata Bank	0.21	0.04	0.60	0.46	0.18	0.17	0.28
Rupali Bank	0.12	0.59	0.50	0.52	0.60	0.42	0.46
Sonali Bank	0.22	0.38	0.47	0.57	0.18	0.62	0.41
Agrani Bank	0.14	1	0.34	0.18	0.03	0.06	0.29
SBI Bank	1	0.88	1	0.83	0.93	1	0.94
Bank Al Falah	1	0.38	1	1	0.16	0.17	0.62
HSBC Bank	1	1	0.90	1	1	1.00	0.98
Mean	0.57	0.69	0.55	0.61	0.51	0.54	0.58

According to the result, Midland Bank showed a full efficiency score throughout the study period, consistently outperforming its peers. BCB, HSBC, and SBI Bank also maintained near-perfect efficiency levels, with average scores gradually declining to 99 per cent, 98 per cent, and 94 per cent, respectively. This trend highlights the sustained operational effectiveness of Midland Bank, while the slight downward adjustments in efficiency averages for BCB, HSBC, and SBI Bank still reflect strong overall performance within the sector. NRB Bank showed an average score of 87 per cent but their 2016 to 2020 scores were better in 2021 and dropped to 20 per cent, which is too low. Shahjalal Islami Bank and One Bank gradually increased their performances, with their respective average score of 84 per cent and 81 per cent. Likewise, Uttara Bank's performance gradually increased from 2016 to 2019 but dropped from 2020 to 2021, so

the average is 74 per cent. Standard Bank's technical efficiency level increased from 2016 to 2017, but in 2018 it dropped to 13 per cent, which is too low compared to 2019 to 2020, when they again increased, and finally in 2021, they decreased to 59 per cent so their average score was 73 per cent. DBBL Bank from 2016 to 2019 positively increased its score to the highest level, but in 2020, that dropped to 31 per cent. In 2021, they tried to overcome it, but their final average was 65 per cent. BRAC Bank's score from 2016 to 2019 gradually increased, but from 2020 to 2021, it decreased, so finally, its average score is 64 per cent. Trust Bank's average score was 63 per cent; their score gradually decreased from 2016 to 2021. Jamuna Bank from 2016 to 2017 gradually increased its performance level, but in 2018, it decreased to 22 per cent. Then again, in 2021, it gained 78 per cent but the average score is 60 per cent. Besides, AB Bank, Bank Asia, and Bank Al Falah had an average score of 62 per cent. MTB Bank's average score was 59 per cent. From 2016 to 2018, the score increased, but in 2019 it decreased to 23 per cent, and finally, in 2021 it increased to 98 per cent. Eastern Bank achieved the highest score in 2016 and 2019, but then its performance level decreased, and finally, its average score was at a medium level of 58 per cent. NBL and First Security Islami Bank's average score was 57 per cent. From 2016 to 2021, IFIC Bank's performance decreased from the highest level of achievement, and its final average score was 55 per cent. Pubali and Southeast Bank achieved a medium level, averaging 54 per cent. Union Bank also gradually decreased from the highest level of achievement to a 52 per cent average performance level.

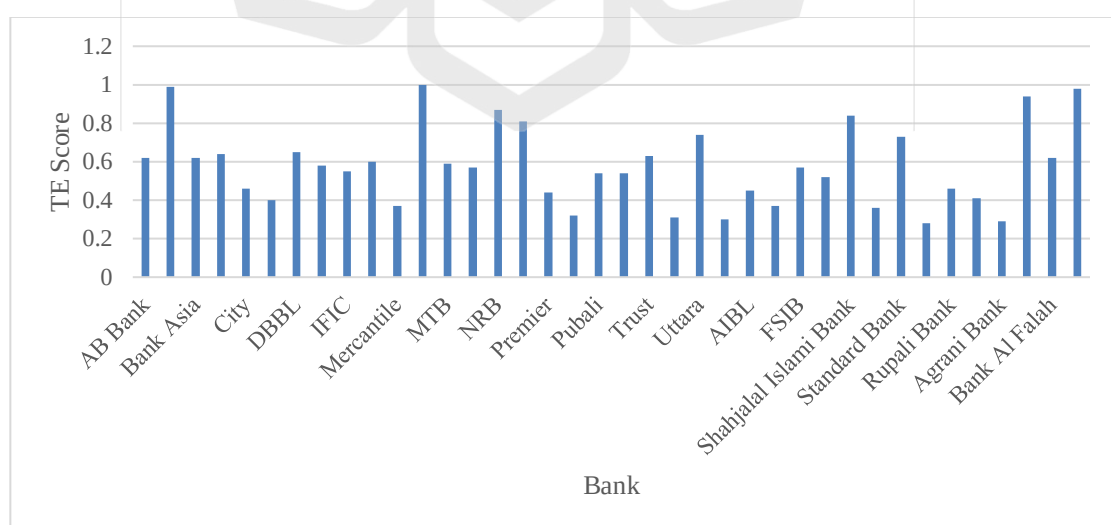


Figure 4.5 Average TE scores for commercial banks for the study period

Rupali Bank, AIBL, Premier, Sonali, and Dhaka Bank reported some of the lowest average efficiency scores during 2016-2021, with averages of 46 per cent, 45 per cent, 44 per cent, and 41 per cent, indicating consistently poorer performance compared to other banks. Mercantile, SIBL, and Exim Bank exhibited even lower averages, at 37 per cent and 36 per cent, respectively, signalling significant inefficiency. The performance of Prime, UCB, and IBBL is also concerning, as their average scores were only 32 per cent, 31 per cent, and 30 per cent. Janata and Agrani Bank had the lowest average efficiency levels among the sample, at 28 per cent and 29 per cent. Following the pandemic, efficiency for many of these banks declined further, reflecting substantial challenges and a deterioration in operational performance.

4.3.2 Technical Efficiency under Three Approaches

Table 4.5 presents the mean technical efficiency scores for each bank across the three banking approaches considered during the study period. Specifically, the table highlights how each bank's average efficiency score varies under different operational models, enabling a comparative assessment of their relative performance based on production, intermediation, and profitability approaches. This analysis offers valuable insights into the strengths and weaknesses of each bank within the context of the chosen methodologies.

Under the **intermediation approach**, Premier Bank achieved the highest efficiency score (98 per cent) among peer banks, followed by Southeast Bank (97 per cent) and IFIC Bank (90 per cent). These banks also outperformed under the intermediation approach compared to the other two approaches. Acknowledging their efficiency level, it can be elucidated that these banks are efficiently utilising their resources, such as employees, customer deposits, and capital, to enhance productive investments, loans or financing. In other words, these banks are efficiently converting customer deposits to productive loans, which allows them to attain an efficiency level under the intermediation approach. Despite the evolution of modern banking, these banks are still embarking on their intermediary role in the financial system. Several other banks that relatively underperformed in terms of overall efficiency score (in all approaches) showed their best abilities in the intermediation approach. For example, Bank Asia

achieved an average of 71 per cent, DBBL scored 70 per cent, NBL scored 77 per cent, Pubali bank scored 66 per cent, Trust bank scored 77 per cent, AIBL achieved 80 per cent, SIBL scored 81 per cent, Union bank scored 70 per cent, EXIM bank achieved 80 per cent, Standard bank achieved 84 per cent, and Rupali bank achieved 83 per cent for the understudy period. It can be inferred that these banks performed better in terms of their efficiency level under the intermediation approach than the other two approaches.

Only Bank Al-Falah consistently achieved full efficiency (100 per cent) throughout the period under the **production approach**. First Security Islami Bank demonstrated the highest efficiency score (99 per cent) under this approach, but lower scores via the other two approaches, closely followed by IBBL Bank at 91 per cent. By demonstrating a high efficiency level under the production approach, these banks are expected to efficiently utilise employees, capital, and interest expenses to collect deposits, make effective investments and produce loans or financing. These banks demonstrated strong operational practices by encouraging deposit collection and channelling resources into productive investments and loan disbursement. Besides, these banks have demonstrated a strong ability to allocate capital efficiently, prioritising both deposit mobilisation and productive investments. This suggests a strategic focus on maximising deposit collection by leveraging available resources, while simultaneously channelling capital into investments that enhance overall financial performance. Other banks also showed relatively better performance under the production approach: City Bank achieved an efficiency score of 59 per cent, Dhaka Bank posted a superior score of 80 per cent, and Mercantile Bank led its approaches with a score of 77 per cent. Mutual Trust Bank (MTB), Prime Bank, United Commercial Bank (UCB), and Islami Bank Bangladesh Limited (IBBL) similarly posted their highest scores under the production approach, with values of 76 per cent, 60 per cent, 68 per cent, and 91 per cent, respectively. Standard Bank, Janata Bank, Sonali Bank, and Agrani Bank also exhibited their best efficiency scores under this approach: 81 per cent, 71 per cent, 73 per cent, and 74 per cent, respectively. Collectively, these banks effectively allocate operating costs to maximise deposits and loan production, reflecting a strategic focus on resource utilisation and value creation within the production framework.

Only 10 out of the 38 banks analysed demonstrated superior performance when evaluated using the **profitability approach** compared to the production and intermediation

approaches. For example, Midland Bank showed a full efficiency level whilst BCB Bank showed a nearly full efficiency level (99 per cent) in the profitability approach. A similar trend was also observed for HSBC bank, which achieved the highest efficiency level (98 per cent) under this approach. In addition, SBI Bank also achieved a very high score of 94 per cent. This suggests that these banks efficiently utilise their operating costs to enhance interest and non-interest income. Under this approach, some other peer banks have also shown the highest efficiency score compared to the other two approaches. For example, One Bank (81 per cent), Uttara Bank (74 per cent), Shahjalal Bank (84 per cent), NRB Bank (86 per cent), and BRAC Bank (64 per cent) depicted the highest efficiency score in the production approach. Based on their highest efficiency scores in this approach compared to other banking approaches, it can be explained that these banks have been emphasising contemporary financial services tailored to customer demands rather than only focusing on loans and financing activities to generate revenue.

Table 4.5 Mean Technical Efficiency Scores for each bank under three approaches

Bank	Intermediation	Production	Profitability
AB Bank	0.80	0.83	0.62
BCB	0.28	0.39	0.99
Bank Asia	0.71	0.64	0.61
BRAC	0.52	0.49	0.64
City	0.61	0.59	0.46
Dhaka	0.64	0.80	0.40
DBBL	0.70	0.54	0.65
Eastern	0.59	0.57	0.58
IFIC	0.90	0.68	0.55
Jamuna	0.60	0.54	0.60
Mercantile	0.66	0.77	0.37
Midland	0.37	0.42	1.00
MTB	0.56	0.76	0.59
NBL	0.77	0.70	0.57
NRB	0.46	0.69	0.86
One	0.74	0.77	0.81
Premier	0.98	0.61	0.44
Prime	0.49	0.60	0.32
Pubali	0.66	0.50	0.54

Bank	Intermediation	Production	Profitability
Southeast	0.97	0.81	0.54
Trust	0.77	0.77	0.63
UCB	0.58	0.68	0.31
Uttara	0.49	0.63	0.74
IBBL	0.57	0.91	0.30
AIBL	0.80	0.62	0.45
SIBL	0.81	0.59	0.37
First Security Islami Bank	0.77	0.99	0.57
Union Bank	0.70	0.63	0.52
Shahjalal Islami Bank	0.66	0.69	0.84
Exim Bank	0.80	0.71	0.36
Standard Bank	0.84	0.81	0.73
Janata Bank	0.66	0.71	0.28
Rupali Bank	0.83	0.82	0.46
Sonali Bank	0.11	0.73	0.41
Agrani Bank	0.58	0.74	0.29
SBI Bank	0.68	0.59	0.94
Bank Al Falah	0.59	1.00	0.62
HSBC Bank	0.61	0.77	0.98
Mean	0.65	0.69	0.58

Figure 4.6 presents the mean efficiency scores of understudied commercial banks under three different approaches for the period of 2016 to 2021. Based on the mean technical efficiency score (TE), commercial banks failed to achieve a significant efficiency level throughout the study period. For example, in 2016, commercial banks performed relatively better under the production approach, achieving an average efficiency score of 73 per cent, compared to 68 per cent under the intermediation approach and 57 per cent under the profitability approach. In 2017, however, banks attained the highest efficiency under the profitability approach with an average score of 69 per cent, while both the intermediation and production approaches recorded average efficiency scores of 64 per cent. The following year, 2018, saw a substantial decline in profitability efficiency to 55 per cent, whereas intermediation and production efficiencies remained relatively higher at 70 per cent and 72 per cent, respectively. Profitability again reported

the lowest efficiency score of 61 per cent in 2019, compared to 74 per cent for both intermediation and production approaches. During the pandemic years, all banks experienced efficiency deterioration due to restricted activities and financial losses. Despite this, the production approach maintained the highest efficiency scores of 69 per cent in 2020 and 60 per cent in 2021, outperforming the intermediation approach (60 per cent in 2020 and 57 per cent in 2021) and the profitability approach (51 per cent in 2020 and 54 per cent in 2021).

Overall, the production approach appears to be the most suitable for evaluating the efficiency of many commercial banks in Bangladesh. In contrast, the intermediation and profitability approaches may better represent performance for certain banks. Efficiency scores across these approaches suggest that the most appropriate methodology may vary by individual bank rather than uniformly across the entire sector. Banks exhibiting the highest efficiency scores should be considered benchmarks, with others encouraged to adopt similar operational strategies. Furthermore, commercial banks should align their practices with regulatory guidelines and focus on accelerating lending in key productive sectors such as textiles and ICT. Tailoring products and services to meet evolving customer demands will also be critical to enhancing their efficiency in the future.

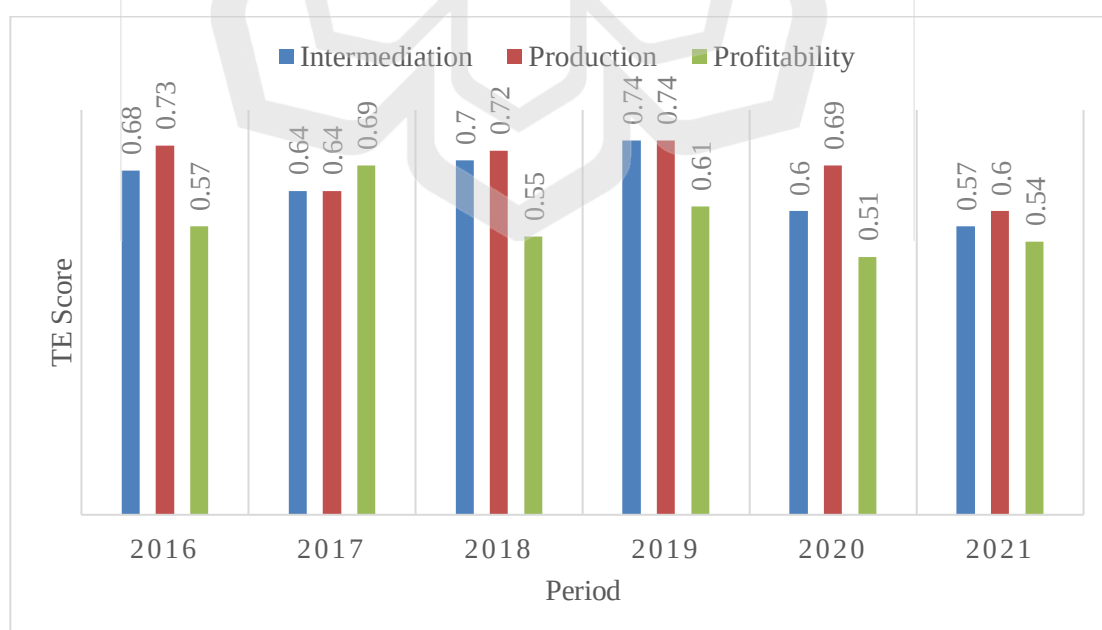


Figure 4.6 Mean TE score for aggregate commercial banks

4.3.3 Variable Returns to Scale (VRS): Pure Technical Efficiency (PTE) and Scale Efficiency (SE)

Technical efficiency based on the CRS presumptions reflects the overall technical efficiency. It captures inefficiencies caused by the input or output structure and the scale of operation. The efficiency measure associated with the VRS assumption indicates pure technical efficiency (PTE), which quantifies inefficiencies solely attributable to managerial underperformance (Kumar & Gulati, 2008). The relationship that **Scale Efficiency** is calculated as *Overall Technical Efficiency* divided by *Pure Technical Efficiency* provides a quantitative assessment of scale efficiency (Kumar & Gulati, 2008). In detail, PTE refers to the extent to which a firm effectively utilises its resources, such as labour, assets, and materials, to provide goods or services. The primary focus is on the efficiency of the production process, irrespective of the magnitude of operations. It further indicates how well the firm is able to reduce waste, make the most use of its resources, and boost output throughout its operation. PTE scores closer to 0 suggest greater inefficiencies associated with production processes, such as incompetent managerial actions, inefficient workflows, or inappropriate allocation of inputs (Chowdhury et al., 2022; Othman et al., 2016). Henceforth, the SE score implies whether a firm is functioning at an appropriate scale in relation to its size (Altunbaş et al., 2001; Bergendahl, 1998; Berger et al., 1993). The SE scores assess the degree to which the firm is realising economies of scale, whereby an increase in production results in a correspondingly higher output without a corresponding increase in inputs. Greater SE (closer to 1) scores imply that the firm has experienced advantages from economies of scale. Low SE (close to 0) scores indicate that the firm improves its cost efficiency by either growing or decreasing its scale of resources. SE evaluates if the firm is operating at an optimal efficiency level, avoiding overcapacity and underutilisation of resources (Chowdhury et al., 2022; Othman et al., 2016).

4.3.3.1 Intermediation Approach

Table 4.6 exhibits the pure technical and scale efficiency scores for individual banks based on the intermediation approach for the period of 2016 to 2021. These scores generally represent banks that adequately operate their businesses through effective management and at an optimal scale. According to the results, all commercial banks

aggregately showed a lower pure technical efficiency score throughout the study period, which suggests ineffective managerial competency, underutilised input, or inefficient workflows. For example, pure technical efficiency (PTE), which depicts managerial competency, lower than scale efficiency (SE), which represents the optimal utilisation of resources in the year 2016; hence, the scale efficiency score was higher than in the other periods. This trend demonstrated that the commercial banks showed managerial incompetency over the optimal usage of resources and underutilisation of economies of scale. However, at the individual bank level, the PTE and SE scores varied over the study period.

Table 4.6 VRS score for Banks - Intermediation approach

Bank	2016		2017		2018		2019		2020		2021		Avg.	
	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE
AB Bank	0.99	0.72	1.00	1.00	0.78	0.74	1.00	1.00	1.00	1.00	0.67	0.78	0.91	0.87
BCB	0.26	0.32	1.00	0.16	1.00	1.00	0.06	0.33	0.56	0.61	0.20	0.56	0.51	0.50
Bank Asia	0.70	0.91	0.77	0.98	0.82	0.88	0.80	0.83	1.00	0.82	0.97	0.70	0.84	0.85
BRAC	1.00	0.82	0.68	0.90	0.75	0.88	0.57	0.76	0.40	0.74	0.82	0.36	0.70	0.74
City	1.00	1.00	0.59	0.76	0.57	0.87	0.74	0.64	1.00	1.00	0.49	0.52	0.73	0.80
Dhaka	0.72	1.00	0.55	0.72	0.59	0.92	1.00	1.00	0.80	0.75	0.61	1.00	0.71	0.90
DBBL	0.71	0.89	0.96	0.91	0.76	0.71	0.83	0.98	0.58	0.91	1.00	0.85	0.81	0.88
Eastern	0.72	0.95	1.00	1.00	0.74	0.68	0.77	0.93	0.43	0.68	0.52	0.68	0.70	0.82
IFIC	1.00	1.00	0.68	0.93	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.85	0.93	0.96
Jamuna	0.76	0.79	0.64	0.70	1.00	1.00	0.60	0.81	1.00	0.50	0.57	0.96	0.76	0.79
Mercantile	0.55	0.84	1.00	1.00	1.00	1.00	0.78	0.99	0.39	0.91	0.72	0.54	0.74	0.88
Midland	0.73	0.17	0.26	0.73	0.77	0.55	0.51	0.58	0.17	0.96	1.00	1.00	0.57	0.67
MTB	0.84	0.84	0.52	0.97	0.77	0.74	0.59	1.00	0.32	0.87	1.00	0.73	0.67	0.86
NBL	0.72	0.75	1.00	0.91	1.00	1.00	0.96	0.84	0.85	0.60	1.00	0.82	0.92	0.82
NRB	0.23	0.20	0.30	0.62	0.16	0.93	1.00	1.00	1.00	0.41	0.99	1.00	0.61	0.69
One	0.66	0.75	0.73	0.79	0.80	0.98	1.00	1.00	1.00	1.00	0.61	0.97	0.80	0.92
Premier	1.00	1.00	1.00	1.00	0.90	0.98	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00
Prime	1.00	0.74	0.56	0.67	0.60	0.70	0.73	0.65	1.00	0.59	0.48	0.68	0.73	0.67
Pubali	0.64	0.88	0.92	0.78	0.96	0.60	0.74	0.71	1.00	1.00	1.00	0.55	0.88	0.75
Southeast	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.82	1.00	1.00	1.00	0.97
Trust	0.75	1.00	0.74	1.00	1.00	1.00	0.79	1.00	0.50	0.72	1.00	1.00	0.80	0.95
UCB	1.00	0.97	0.64	0.75	0.57	0.72	0.87	0.56	1.00	0.77	1.00	0.34	0.85	0.69
Uttara	1.00	0.77	0.58	0.70	0.35	0.71	1.00	0.79	0.34	0.77	0.70	0.68	0.66	0.74
IBBL	1.00	0.71	1.00	1.00	1.00	0.85	1.00	0.69	0.26	0.50	0.40	0.08	0.78	0.64
AIBL	1.00	1.00	0.95	0.93	0.65	0.74	0.75	0.93	0.83	0.86	1.00	1.00	0.86	0.91
SIBL	0.89	0.94	1.00	1.00	0.68	0.87	1.00	1.00	0.51	0.90	1.00	0.96	0.85	0.95
FSIB	0.97	0.87	1.00	0.95	0.82	0.80	1.00	0.91	0.85	0.78	0.89	0.69	0.92	0.83
Union	0.31	0.63	0.21	0.52	1.00	1.00	1.00	0.91	1.00	1.00	1.00	1.00	0.75	0.84

Shahjalal Islami	0.57	0.75	1.00	0.73	1.00	1.00	0.81	1.00	0.52	0.77	0.58	1.00	0.75	0.88
EXIM	1.00	1.00	1.00	1.00	0.99	0.76	1.00	0.80	0.62	0.89	1.00	0.74	0.94	0.87
Standard	1.00	1.00	0.85	1.00	1.00	1.00	1.00	1.00	0.77	0.87	0.51	1.00	0.86	0.98
Janata	1.00	1.00	1.00	0.80	1.00	0.75	1.00	1.00	0.90	0.48	0.02	0.26	0.82	0.72
Rupali	1.00	0.87	0.93	0.77	1.00	0.85	1.00	1.00	1.00	0.96	1.00	0.61	0.99	0.84
Sonali	0.04	0.55	0.14	0.77	0.11	0.76	0.16	0.28	1.00	0.36	0.07	0.68	0.25	0.57
Agrani	1.00	0.61	0.82	0.76	1.00	0.72	1.00	0.53	1.00	1.00	0.01	0.10	0.81	0.62
SBI Bank	1.00	0.85	0.96	0.53	1.00	1.00	1.00	1.00	0.34	0.64	0.82	0.65	0.85	0.78
Al Falah	1.00	0.48	0.03	0.48	1.00	1.00	1.00	0.71	1.00	1.00	0.79	0.41	0.80	0.68
HSBC	1.00	1.00	0.79	0.72	0.52	0.87	0.93	0.99	0.31	0.96	0.42	1.00	0.66	0.92
Mean-PTE	0.81		0.76		0.81		0.84		0.74		0.73		0.78	
Mean-SE		0.80		0.81		0.86		0.85		0.80		0.73		0.81

For instance, AB Bank showed managerial competence in the year 2016, but incompetence in the year 2021, yet on average, it showed better managerial competency in the optimal usage of resources. BCB mostly showed the inefficiency of managerial competence in their inefficiency level, except in 2017 and 2018, and slightly better managerial competency on average than scale efficiency in the study period. Henceforth, the National Bank (NBL) demonstrated better PTE over SE in most of the years in the study period. In a different trend, Prime Bank posited better managerial competency than scale efficiency, although, throughout the period, in most years, scale efficiency was better. However, Pubali Bank demonstrated a competent managerial team, but could not utilise resources well. Southeast Bank posited higher and better PTE over scale efficiency, though both are in a better shape. Janata Bank posited a significant efficiency level in management adequacy, while inefficiency in optimal usage of resources from 2016 to 2019 significantly dropped in 2021. In a similar context, PTE of UCB outperformed SE on average, which refers to better management capabilities. IBBL, FSIB, EXIM, Rupali, Agrani, SBI, and Al-Falah Islami Bank showed higher PTE than SE, which indicates better managerial competencies compared to optimal usage of resources. Agrani Bank posited better improvement in managerial competency till 2020, while miserably failing in 2021.

On the other hand, several banks' scale efficiency outperformed pure technical efficiency. Bank Asia showed progressive managerial competency in recent years, while it exhibited an inefficient managerial level compared to optimal usage of resources. On

the other hand, BRAC Bank posited a significant managerial competency in the years 2016 and 2021, while unable to optimally utilise resources from 2017 to 2020. City Bank unveiled inconsistent causes of inefficiency levels in the study period. It showed mixed inefficiency scores in the period. Similarly, Dhaka Bank showed incompetent management in most years, while on average, scale efficiency outperformed pure technical efficiency. DBBL was comparably competent in management in 2016, 2019, 2020, and 2021, and on average better in scale efficiency. Similarly, Eastern Bank showed higher SE in 2016, 2019, 2020, and 2021 with a higher average of SE than PTE. Although IFIC performed better in terms of SE, PTE was also considerably better on average. Jamuna, Mercantile, Midland, and MTB are observed to have higher SE. Jamuna Bank's SE outperformed PTE in 2016, 2017, 2019, and 2021, while Mercantile Bank's SE was higher in 2016, 2019, and 2020. Both Midland and MTB had higher SE than PTE in 2017, 2018, 2019, and 2020. NRB, One Bank, Premier, Trust, Uttara, AIBL, SIBL, Union, Shahjalal, Standard, Sonali, and HSBC bank demonstrated higher scale efficiency than pure technical efficiency on average and also in most years. Sonali Bank showed poor management competency from 2016 to 2019 and 2021, while showing significant progress in 2020. Nevertheless, Sonali Bank reported the lowest PTE, which demonstrates very poor managerial competency. Based on the average VRS score, it is indeed confirmed that scale efficiency was better from 2017 to 2020, while a little bit lower in 2016 and equal in 2021. As a result, it can be concluded that lower efficiency scores of commercial banks are mostly derived from incompetent managerial actions, underutilisation of inputs, and inefficient workforces that reflect economies of scale in output.

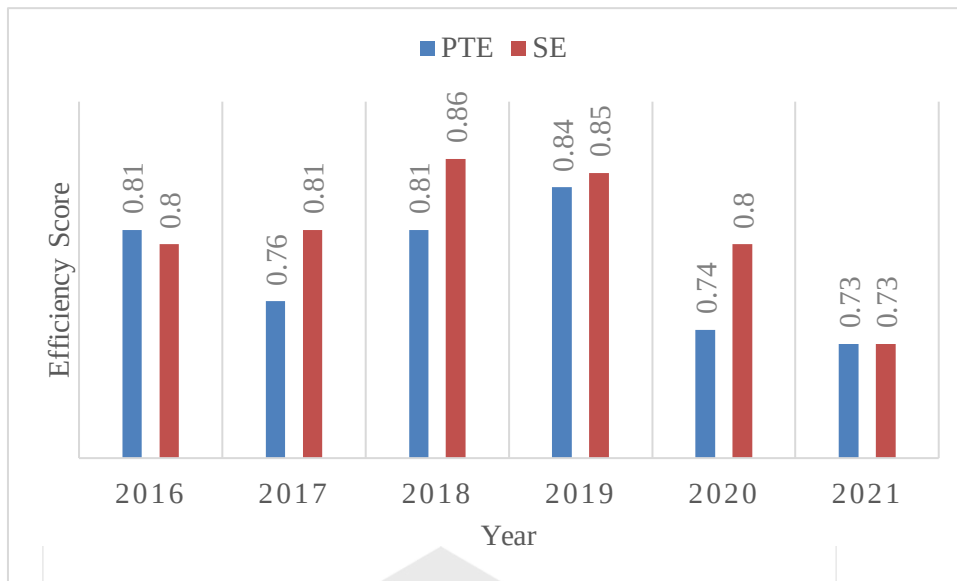


Figure 4.7 PTE and SE score under the intermediation approach

Figure 4.7 represents the pure technical efficiency and scale efficiency scores under the intermediation approach for the commercial banks for the period of 2016 to 2021. According to the results, the inefficiency scores of commercial banks were attributed mostly to inadequate usage of resources in 2016. In other words, commercial banks were not able to optimally use the resources to produce the desired output. Subsequently, banks managed to improve the optimal usage of resources in 2017, while management incompetence led to technical inefficiency. Similarly, management incompetence contributed to the inefficiency of commercial banks in 2018, 2019, and 2020, while banks comparatively improved their optimal usage of resources to attain output in those years. Hence, in 2021, management incompetence and optimal usage of resources contributed equally to the inefficiency. Therefore, commercial banks comparatively managed to utilise resources optimally, although not with full efficiency.

4.3.3.2 Production Approach

Table 4.7 exhibits the pure technical and scale efficiency scores for individual banks based on the production approach for the period of 2016 to 2021. According to the results, all commercial banks combinedly showed a lower pure technical efficiency score throughout the study period. For example, pure technical efficiency (PTE), which depicts

managerial competency, outperforms scale efficiency (SE), which represents the optimal utilisation of resources. As a consequence, commercial banks displayed an inefficiency level, which was mostly incurred due to managerial incompetence throughout the study period.

However, several banks have demonstrated better managerial competency over scale efficiency. For instance, NRB, NBL, Prime, Pubali, IBBL, FSIB, Janata, Sonali, and SBI banks have demonstrated better managerial competency than optimal utilisation of resources. Although the FSIB bank had a higher pure technical efficiency score than scale efficiency, the bank showed significant efficiency close to one. Similarly, NBL bank showed only a 1 per cent deviation between pure technical efficiency and scale efficiency. Janata Bank demonstrated a significant deviation between scale efficiency and pure technical efficiency by 13 per cent. It refers to better managerial competency compared to the optimal usage of resources to produce better output. In fact, Janata Bank unveiled a 100 per cent competency in managerial competency in 2021, while showing 72 per cent scale efficiency in the same year.

On the other hand, AB Bank, BCB, Bank Asia, BRAC, City, Dhaka, DBBL, Eastern, IFIC, Jamuna, Mercantile, Midland, MTB, One, Premier, Southeast, Trust, UCB, Uttara, AIBL, SIBL, Union, Shahjalal Islami, EXIM, Standard, Rupali, Agrani, and HSBC bank have posited the lower PTE than SE. It means that managerial competency is way more effective than scale-optimal usage of resources. In other words, these banks' inefficiency is mostly caused by managerial incompetence. Among these banks, BRAC and BCB bank showed a significant deviation of 23 per cent between PTE and SE which implies that these banks were not managerially competent to achieve full efficiency level. BRAC acknowledged the poor managerial ability in their operations at an earlier period of the study period. Similarly, BCB has demonstrated devastating managerial inability throughout the study period, except in 2018 and 2021, in which it showed a better managerial capability to produce output by utilising input. Meanwhile, several other banks have also demonstrated crucial deviation between PTE and SE, such as IFIC at 21 per cent, DBBL at 18 per cent, SIBL at 15 per cent, HSBC and Eastern Bank at 13 per cent, Dhaka, Uttara, and Premier Bank at 12 per cent, One and Jamuna Bank at 10 per cent between PTE and SE.

Table 4.7 VRS score for Banks - Production approach

Bank	2016		2017		2018		2019		2020		2021		Avg	
	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE
AB Bank	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.96	0.49	0.90	0.87	0.69	0.89	0.92
BCB	0.26	0.95	0.27	0.08	1.00	1.00	0.09	0.29	0.18	0.95	1.00	0.90	0.47	0.70
Bank Asia	0.86	0.92	0.94	0.62	0.60	0.79	0.59	0.83	0.98	0.94	0.75	0.77	0.79	0.81
BRAC	0.33	0.72	0.42	0.80	0.66	0.89	0.96	0.92	0.51	0.80	0.63	0.76	0.59	0.82
City	0.83	0.94	0.43	0.79	0.80	0.74	1.00	1.00	0.78	0.64	0.70	0.52	0.76	0.77
Dhaka	0.92	0.92	1.00	1.00	0.64	0.91	1.00	1.00	1.00	0.95	0.43	0.91	0.83	0.95
DBBL	0.51	0.77	0.30	0.91	0.78	0.98	0.84	0.72	0.99	0.90	0.49	0.67	0.65	0.83
Eastern	0.42	1.00	0.73	0.57	1.00	0.94	0.74	0.82	0.80	0.86	0.47	0.70	0.69	0.82
IFIC	0.46	0.88	0.67	0.94	0.66	0.88	1.00	1.00	1.00	1.00	0.53	0.89	0.72	0.93
Jamuna	1.00	0.87	0.70	0.66	0.74	0.84	0.49	0.71	0.62	0.97	0.54	0.61	0.68	0.78
Mercantile	0.77	0.88	1.00	0.98	1.00	1.00	1.00	0.96	0.76	0.80	0.54	0.73	0.85	0.89
Midland	0.80	0.97	0.05	0.78	0.55	0.41	1.00	1.00	0.75	0.57	0.27	0.21	0.57	0.66
MTB	0.52	0.90	1.00	1.00	1.00	0.91	1.00	1.00	0.64	0.80	0.87	0.75	0.84	0.89
NBL	1.00	0.67	1.00	1.00	1.00	0.82	0.88	0.76	0.53	0.77	0.65	0.95	0.84	0.83
NRB	1.00	1.00	0.15	0.07	0.62	0.24	1.00	1.00	1.00	1.00	1.00	1.00	0.80	0.72
One	1.00	0.97	0.67	0.90	0.90	0.94	1.00	1.00	0.48	0.97	0.94	0.82	0.83	0.93
Premier	1.00	0.72	0.63	1.00	0.80	0.66	0.65	0.83	1.00	1.00	0.27	0.89	0.73	0.85
Prime	1.00	1.00	0.97	0.56	1.00	1.00	0.70	0.52	0.36	0.73	0.83	0.54	0.81	0.73
Pubali	0.52	0.71	0.59	0.81	1.00	0.92	0.72	0.50	0.86	0.52	0.93	0.49	0.77	0.66
Southeast	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.86	0.75	0.33	0.84	0.87	0.92
Trust	1.00	1.00	1.00	1.00	1.00	0.74	0.68	0.91	0.71	0.78	0.69	1.00	0.85	0.91
UCB	1.00	0.92	0.63	0.83	0.46	0.82	0.51	0.52	1.00	0.98	1.00	1.00	0.77	0.85
Uttara	1.00	0.99	0.33	0.80	0.26	0.93	0.94	0.72	0.89	0.69	1.00	1.00	0.74	0.86
IBBL	1.00	1.00	1.00	1.00	1.00	0.75	0.95	0.76	1.00	1.00	1.00	1.00	0.99	0.92
AIBL	0.61	0.77	0.79	0.90	0.56	0.73	0.76	0.87	1.00	1.00	0.88	0.57	0.77	0.81
SIBL	0.62	0.90	0.98	0.99	0.64	0.78	0.75	0.67	0.88	0.89	0.31	0.84	0.70	0.85
FSIB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	1.00	1.00	1.00	0.99
Union	0.10	0.60	1.00	0.33	1.00	1.00	1.00	1.00	0.43	0.93	1.00	1.00	0.76	0.81
Shahjalal Islami	1.00	0.98	0.48	0.76	1.00	0.85	0.65	0.85	0.45	0.91	1.00	1.00	0.76	0.89
EXIM	1.00	1.00	0.99	0.90	0.78	0.79	1.00	0.83	0.49	0.75	0.53	1.00	0.80	0.88
Standard	1.00	1.00	0.76	1.00	0.68	0.98	0.99	0.99	0.58	0.72	1.00	1.00	0.84	0.95
Janata	0.95	0.71	0.79	0.74	1.00	0.96	0.85	0.61	0.87	0.95	1.00	0.72	0.91	0.78
Rupali	0.70	0.90	0.95	0.92	0.62	0.95	1.00	1.00	1.00	1.00	0.94	0.87	0.87	0.94
Sonali	1.00	1.00	1.00	0.72	0.70	0.94	0.76	0.69	1.00	1.00	1.00	0.49	0.91	0.81
Agrani	0.78	0.71	0.62	0.64	1.00	1.00	0.62	0.91	1.00	0.92	1.00	1.00	0.84	0.86
SBI Bank	0.80	0.90	1.00	0.51	0.96	0.44	1.00	1.00	0.81	0.96	0.15	0.72	0.79	0.76
Al Falah	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1
HSBC	0.58	0.82	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.19	0.74	0.80	0.93
Mean-PTE	0.80		0.76		0.83		0.84		0.78		0.73		0.79	
Mean-SE		0.89		0.80		0.86		0.84		0.88		0.81		0.85

Figure 4.8 shows the pure technical efficiency and scale efficiency under the production approach for the commercial banks for the period of 2016 to 2021. The results posited that the inefficiency of commercial banks was aided by management incompetency throughout the study period. In other words, the management of commercial banks was not effective in operating the banking activities in order to attain full efficiency score. Hence, the banks were also unable to fully utilise the resources throughout the study period. In 2019, both management incompetency and inefficient allocation of resources equally led to inefficiency for commercial banks.

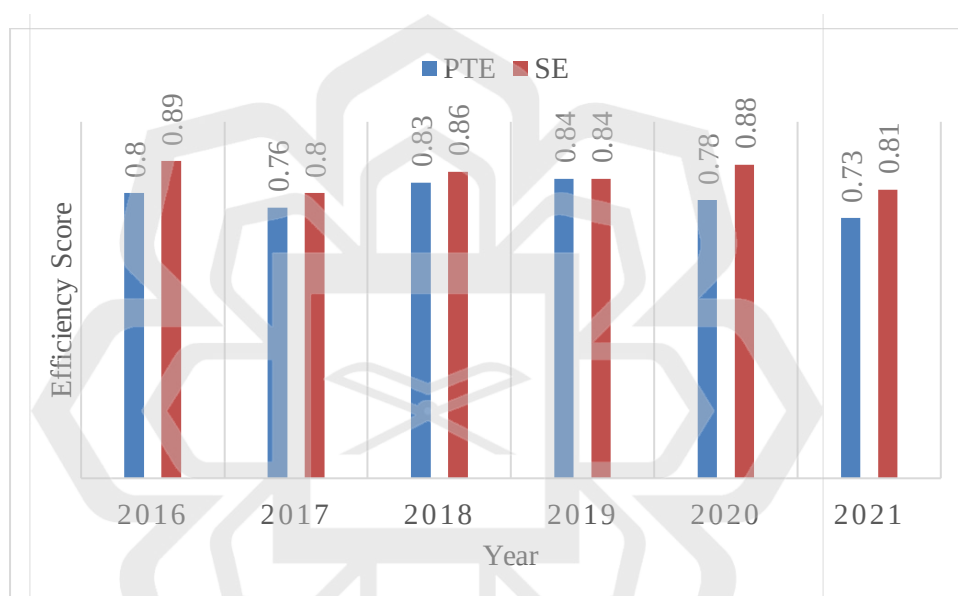


Figure 4.8 PTE and SE score of Commercial Banks under the Production Approach

4.3.3.3 Profitability Approach

Table 4.8 exhibits the pure technical and scale efficiency scores for individual banks based on the profitability approach for the period of 2016 to 2021. According to the measurement of VRS efficiency, banks have shown inconsistent trends in the causes of inefficiency. For example, AB Bank showed managerially competent in its early years but drastically dropped in the year 2021 where scale efficiency outperformed managerial competency. On average, it showed a managerial inability to produce sufficient output by using input. Hence, BCB in most years showed efficiency in both managerial competency and optimal usage of resources except in 2018 where PTE outperformed SE, nevertheless,

it showed a better competency in both PTE and SE on average. Bank Asia showed progressive managerial competency in recent years while they exhibited an inefficient managerial level compared to optimal usage of resources. On the other hand, BRAC Bank posited a significant managerial competency in the years 2016 and 2021 while unable to optimally utilise resources from 2017-2020. City Bank unveiled an inconsistent cause of inefficiency level in the study period. It showed mixed inefficiency scores in the period though on average, its managerial ability is observed poor. Dhaka Bank, DBBL, Eastern, IFIC, Jamuna, Mercantile, MTB, One, Premier, Prime, Pubali, Southeast, Trust, UCB, Uttara, IBBL, AIBL, SIBL, FSIB, Union, Shahjalal Islami, EXIM, Standard, Janata, and Agrani bank posited lower PTE than SE. This means these banks were unable to produce noteworthy output from the input used by management. HSBC Bank has managed to show a better efficiency level in both management and optimal usage of resources.

Table 4.8 VRS score for Banks - Profitability approach

Bank	2016		2017		2018		2019		2020		2021		Avg		
	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	
AB Bank	1.00	0.65	1.00	0.84	1.00	1.00	0.79	0.98	0.74	0.52	0.07	0.98	0.77	0.83	
BCB	1.00	1.00	1.00	1.00	1.00	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	
Bank Asia	0.38	0.78	0.73	1.00	1.00	1.00	0.29	0.80	0.66	1.00	0.90	0.86	0.66	0.91	
BRAC	0.37	0.93	1.00	0.68	0.69	0.85	1.00	1.00	1.00	0.69	0.64	0.82	0.78	0.83	
City	1.00	1.00	0.27	1.00	0.85	0.79	0.27	0.86	0.34	0.96	0.27	0.95	0.50	0.93	
Dhaka	0.81	0.82	0.19	0.77	0.22	0.95	1.00	0.49	0.62	0.87	0.50	0.67	0.56	0.76	
DBBL	0.18	0.51	0.83	0.95	1.00	1.00	1.00	1.00	0.31	1.00	0.78	0.93	0.68	0.90	
Eastern	1.00	1.00	0.13	0.92	0.49	0.99	1.00	1.00	0.94	0.70	0.21	0.88	0.63	0.92	
IFIC	1.00	1.00	0.87	0.99	0.57	0.83	0.60	0.79	0.57	0.67	0.09	0.89	0.62	0.86	
Jamuna	0.51	0.83	0.86	0.87	0.24	0.93	1.00	0.72	1.00	0.69	1.00	0.78	0.77	0.80	
Mercantile	0.64	0.86	0.53	0.58	0.45	0.80	0.52	1.00	0.51	0.66	0.21	0.65	0.48	0.76	
Midland	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
MTB	0.17	0.84	1.00	0.60	0.72	0.99	0.27	0.97	1.00	0.83	0.98	1.00	0.69	0.87	
NBL	0.67	0.65	1.00	1.00	0.96	0.55	0.95	0.72	0.13	0.60	0.93	0.72	0.77	0.71	
NRB	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.20	1.00	0.87	
One	0.35	0.69	1.00	1.00	0.80	0.74	1.00	1.00	1.00	1.00	1.00	1.00	0.86	0.91	
Premier	0.35	0.77	0.86	0.89	0.16	0.77	0.35	0.94	1.00	0.78	0.71	0.51	0.57	0.78	
Prime	0.73	0.79	0.90	0.80	0.29	0.79	0.05	0.99	0.13	0.92	0.26	0.91	0.39	0.87	
Pubali	0.30	0.91	0.72	0.80	0.27	0.85	0.91	0.96	0.35	0.92	1.00	1.00	0.59	0.91	
Southeast	0.74	0.65	0.88	0.64	1.00	1.00	0.24	0.91	0.04	0.82	1.00	0.97	0.65	0.83	
Trust	1.00	0.91	1.00	0.98	0.96	0.76	0.18	1.00	0.34	0.86	1.00	0.68	0.75	0.87	
UCB	0.19	0.84	0.79	0.63	0.51	0.90	0.20	0.97	0.38	0.79	0.36	0.71	0.41	0.81	
Uttara	1.00	0.62	0.58	0.92	0.92	1.00	1.00	1.00	0.68	0.99	1.00	0.73	0.86	0.88	
IBBL	0.95	0.46	0.71	0.54	0.28	0.96	0.11	0.75	0.25	0.40	0.68	0.76	0.50	0.65	

Bank	2016		2017		2018		2019		2020		2021		Avg	
	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE
AIBL	0.73	0.79	0.59	0.95	0.15	0.99	0.12	0.96	0.95	0.91	0.69	0.63	0.54	0.87
SIBL	0.46	0.77	0.98	0.84	0.21	0.97	0.40	0.55	0.57	0.62	0.60	0.43	0.54	0.70
FSIB	1.00	0.43	1.00	0.91	0.19	0.88	1.00	1.00	0.16	0.51	0.85	0.99	0.70	0.79
Union	1.00	1.00	1.00	0.95	0.18	0.97	0.38	0.96	0.42	0.78	0.68	0.45	0.61	0.85
Shahjalal Islami	0.79	0.96	1.00	0.88	0.65	0.74	1.00	1.00	1.00	0.91	1.00	1.00	0.91	0.92
EXIM	0.76	0.63	1.00	0.88	0.12	0.92	0.67	0.72	0.25	0.64	0.07	0.74	0.48	0.76
Standard	0.77	0.96	1.00	1.00	0.13	0.97	0.98	0.97	1.00	1.00	0.84	0.70	0.79	0.93
Janata	0.54	0.40	0.04	0.98	0.67	0.90	0.61	0.76	0.30	0.61	0.48	0.36	0.44	0.67
Rupali	0.19	0.66	0.99	0.60	0.67	0.75	0.83	0.63	1.00	0.60	0.74	0.57	0.74	0.64
Sonali	0.33	0.67	1.00	0.38	0.80	0.59	0.93	0.62	1.00	0.18	1.00	0.62	0.84	0.51
Agrani	0.22	0.65	1.00	1.00	0.43	0.80	0.21	0.82	0.06	0.47	0.12	0.48	0.34	0.70
Sbi Bank	1.00	1.00	1.00	0.88	1.00	1.00	1.00	0.83	1.00	0.93	1.00	1.00	1.00	0.94
Al Falah	1.00	1.00	0.55	0.69	1.00	1.00	1.00	1.00	0.74	0.22	0.37	0.48	0.78	0.73
HSBC	1.00	1.00	1.00	1.00	0.91	0.99	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00
Mean-PTE	0.69		0.82		0.62		0.68		0.64		0.69		0.69	
Mean-SE		0.80		0.85		0.89		0.89		0.77		0.76		0.83

Figure 4.8 displays the PTE and SE score for aggregate commercial banks for the period of 2016 to 2021 under the profitability approach. Based on the average level of PTE and SE for all commercial banks, it can be articulated that the majority of the commercial banks posited an inefficiency level due to the inability of management to utilize input in producing sufficient output. In other words, management incompetency mostly aided the inefficiency level of commercial banks throughout the study period.

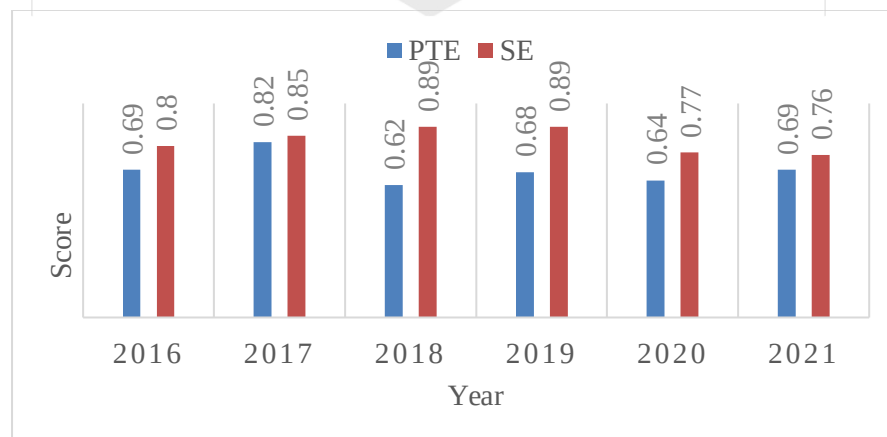


Figure 4.9 PTE and SE score for commercial banks under the profitability approach

4.3.4 PTE and SE under Three Banking Approaches

Table 4.9 displays the average PTE and SE scores for all commercial banks under three banking approaches. These results indicate in which areas banks performed well and also need to emphasise particular areas to improve efficiency levels. AB Bank showed considerably better PTE and SE scores under the intermediation and production approaches compared to the profitability approach. By managing and focusing on customer-driven services, this bank can accelerate its profitability and efficiency levels. On the other hand, BCB and Midland banks can be considered as examples that showed the best managerial competency level and optimal usage of resources to achieve the best efficiency level under the profitability approach. However, this bank is required to accelerate its managerial competency in utilising inputs and also enhance workforce capabilities to improve its intermediation and production levels in order to improve its overall performance. Bank Asia, City Bank, Dhaka Bank, DBBL, Eastern Bank, Mercantile Bank, and IFIC Bank have performed well in terms of efficiency score under intermediary and production approaches, while underperforming in terms of efficiency level under the profitability approach. Under the profitability approach, they scored a poor PTE level, which demonstrates their managerial incompetence regarding the utilisation of input and the inefficient workforce.

BRAC Bank, MTB, One, Premier, Trust, Uttara, AIBL, SIBL, Union, Shahjalal, Standard, Jamuna, and HSBC Bank demonstrated better efficiency levels in regard to SE score, while considerably poor in PTE. These results suggest that the management of these banks has yet to utilise its input and workforce efficiently to improve its overall efficiency score in all approaches. On the other hand, SBI and NBL banks posited better PTE scores than SE scores in all approaches, which indicates better managerial competency. Bank Al Falah demonstrated the best efficiency level under the production approach, where the management had taken advantage of economies of scale. However, this bank failed to perform well in the other two approaches due to the low optimal scale of resources. Based on the VRS scores, it can be concluded that commercial banks were mostly showing low scores in PTE, which suggests improving their managerial capabilities in utilising inputs to produce maximum output as well as effectively utilising the workforce. Besides, several banks showed better competency in particular

approaches, with competent management in taking advantage of the economies of scale, but exhibiting poor performance in other approaches.

Table 4.9 Average PTE and SE scores under three approaches

Bank	Intermediation		Production		Profitability	
	PTE	SE	PTE	SE	PTE	SE
AB Bank	0.91	0.87	0.89	0.92	0.77	0.83
BCB	0.51	0.50	0.47	0.70	1.00	0.99
Bank Asia	0.84	0.85	0.79	0.81	0.66	0.91
BRAC	0.70	0.74	0.59	0.82	0.78	0.83
City	0.73	0.80	0.76	0.77	0.50	0.93
Dhaka	0.71	0.90	0.83	0.95	0.56	0.76
DBBL	0.81	0.88	0.65	0.83	0.68	0.90
Eastern	0.70	0.82	0.69	0.82	0.63	0.92
IFIC	0.93	0.96	0.72	0.93	0.62	0.86
Jamuna	0.76	0.79	0.68	0.78	0.77	0.80
Mercantile	0.74	0.88	0.85	0.89	0.48	0.76
Midland	0.57	0.67	0.57	0.66	1.00	1.00
MTB	0.67	0.86	0.84	0.89	0.69	0.87
NBL	0.92	0.82	0.84	0.83	0.77	0.71
NRB	0.61	0.69	0.80	0.72	1.00	0.87
One	0.80	0.92	0.83	0.93	0.86	0.91
Premier	0.98	1.00	0.73	0.85	0.57	0.78
Prime	0.73	0.67	0.81	0.73	0.39	0.87
Pubali	0.88	0.75	0.77	0.66	0.59	0.91
Southeast	1.00	0.97	0.87	0.92	0.65	0.83
Trust	0.80	0.95	0.85	0.91	0.75	0.87
UCB	0.85	0.69	0.77	0.85	0.41	0.81
Uttara	0.66	0.74	0.74	0.86	0.86	0.88
IBBL	0.78	0.64	0.99	0.92	0.50	0.65
AIBL	0.86	0.91	0.77	0.81	0.54	0.87
SIBL	0.85	0.95	0.70	0.85	0.54	0.70
First Security Islami Bank	0.92	0.83	1.00	0.99	0.70	0.79
Union Bank	0.75	0.84	0.76	0.81	0.61	0.85
Shahjalal Islami Bank	0.75	0.88	0.76	0.89	0.91	0.92

Bank	Intermediation		Production		Profitability	
	PTE	SE	PTE	SE	PTE	SE
Exim Bank	0.94	0.87	0.80	0.88	0.48	0.76
Standard Bank	0.86	0.98	0.84	0.95	0.79	0.93
Janata Bank	0.82	0.72	0.91	0.78	0.44	0.67
Rupali Bank	0.99	0.84	0.87	0.94	0.74	0.64
Sonali Bank	0.25	0.57	0.91	0.81	0.84	0.51
Agrani Bank	0.81	0.62	0.84	0.86	0.34	0.70
SBI Bank	0.85	0.78	0.79	0.76	1.00	0.94
Bank Al Falah	0.80	0.68	1.00	1	0.78	0.73
HSBC Bank	0.66	0.92	0.80	0.93	0.99	1.00
Mean	0.78	0.81	0.79	0.85	0.69	0.83

4.4 EFFICIENCY SCORE FOR PUBLIC BANKS AND PRIVATE BANKS

The results of the earlier DEA assessments are further analysed according to bank ownership, either public or private. Based on the research objectives, this research next analysed the efficiency scores according to public and private banks. The efficiency scores were also categorised into groups to gauge the trends in banks under different ownership.

4.4.1 Constant Returns to Scale (CRS): Technical Efficiency

Table 4.10 displays the technical efficiency (TE) score for four public banks, namely Janata, Rupali, Sonali, and Agrani Bank, as well as 34 private commercial banks, for the period of 2016 to 2021. Under the intermediation approach (Figure 4.9), the public banks demonstrated an average efficiency score of 55 per cent for the study period. The public banks attained more than 50 per cent efficiency until 2020, but only 17 per cent in 2021. Unpredictably, private banks showed a better efficiency score in 2021 while public banks collapsed in efficiency score in the same year. Although both public and private banks depicted lower efficiency levels throughout the study period, they comparatively improved efficiency scores from 2017 to 2019; however, they started to decrease in 2020.

In the study period, private banks outperformed public banks in the aggregate level of efficiency.

Table 4.10 Average TE for Public and Private Banks

Approach	Bank	2016	2017	2018	2019	2020	2021	Avg.
Intermediation	Public banks (average)	0.63	0.56	0.60	0.64	0.69	0.17	0.55
	Private banks (average)	0.69	0.65	0.71	0.75	0.59	0.62	0.67
Production	Public banks (average)	0.71	0.64	0.80	0.65	0.94	0.76	0.75
	Private banks (average)	0.73	0.64	0.71	0.75	0.67	0.59	0.68
Profitability	Public banks (average)	0.17	0.50	0.48	0.43	0.25	0.32	0.36
	Private banks (average)	0.61	0.72	0.56	0.63	0.54	0.56	0.60

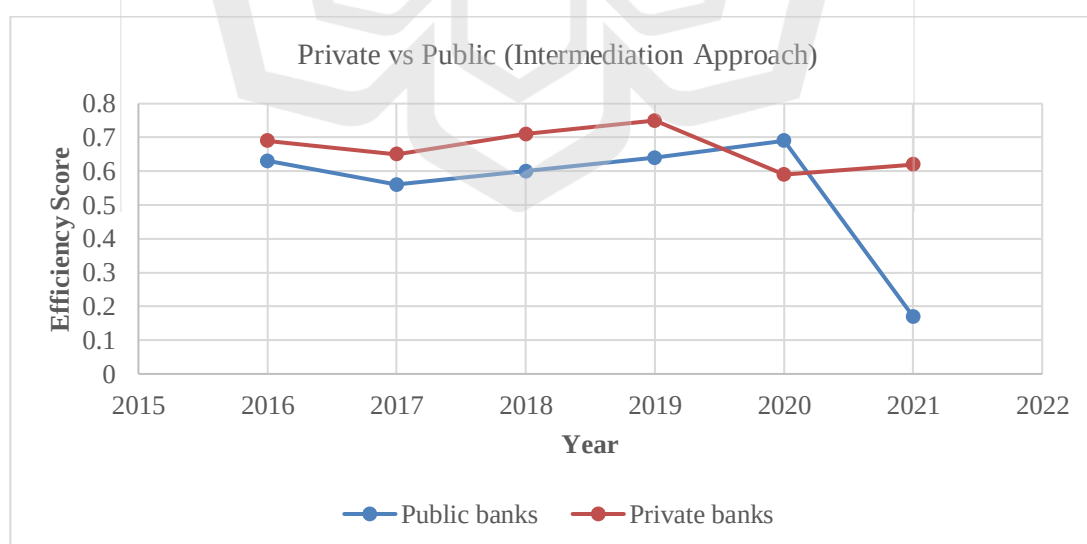


Figure 4.10 Average technical efficiency score between private and public banks

Under the production approach (Figure 4.10), private banks demonstrated a decline from 2019 to 2021 at a slower pace, while public banks exhibited a highly volatile efficiency level throughout the period. However, in terms of average efficiency score, public banks (75 per cent) outperformed private banks (68 per cent) in this approach, which demonstrates a better performance by public banks. Public banks attained a 94 per cent efficiency level in the year 2020, and the lowest score was in 2016, while private banks attained the lowest in 2021 and the highest 75 per cent efficiency level in 2019.

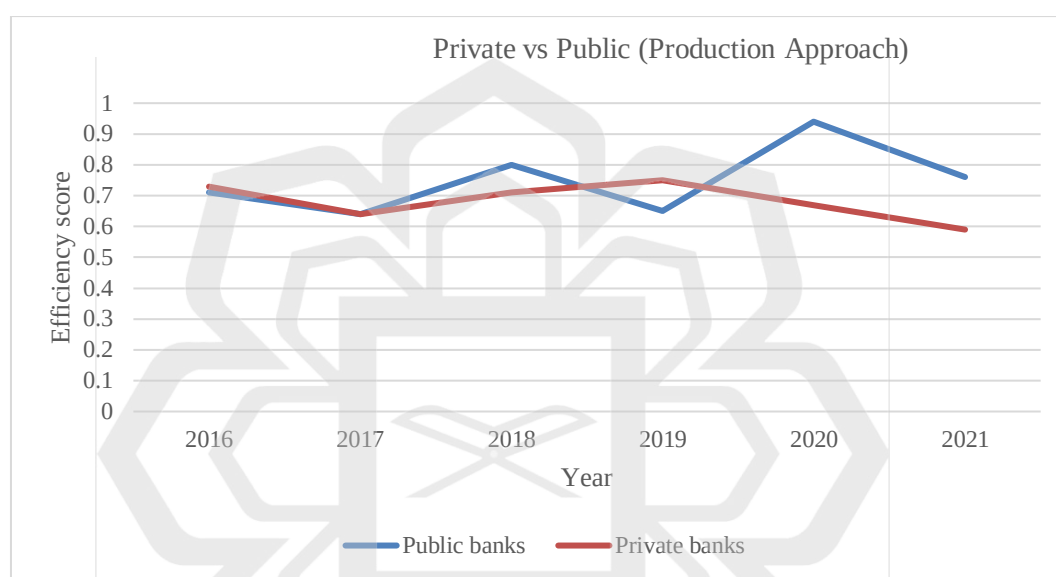


Figure 4.11 Average technical efficiency score between private and public banks (Production Approach)

Figure 4.11 presents the trend of efficiency scores of public and private banks under the profitability approach from 2016 to 2021. In this approach, private banks remained at the top and performed better than the public banks in terms of efficiency throughout the study period. It refers to the better efficiency level in the study period compared to public banks. According to the results, public banks demonstrated only a 36 per cent efficiency level while private banks achieved a 60 per cent efficiency level on average. However, the efficiency score is not considered better for each type of bank. Yet, private banks showed far better performance than public banks in this approach. public banks showed the lowest score in 2016 and improved in 2017, then gradually fell from 2018 to 2020, then slightly improved in 2021. On the other hand, private banks

maintained above 50 per cent throughout the study period and attained the highest score in 2017.

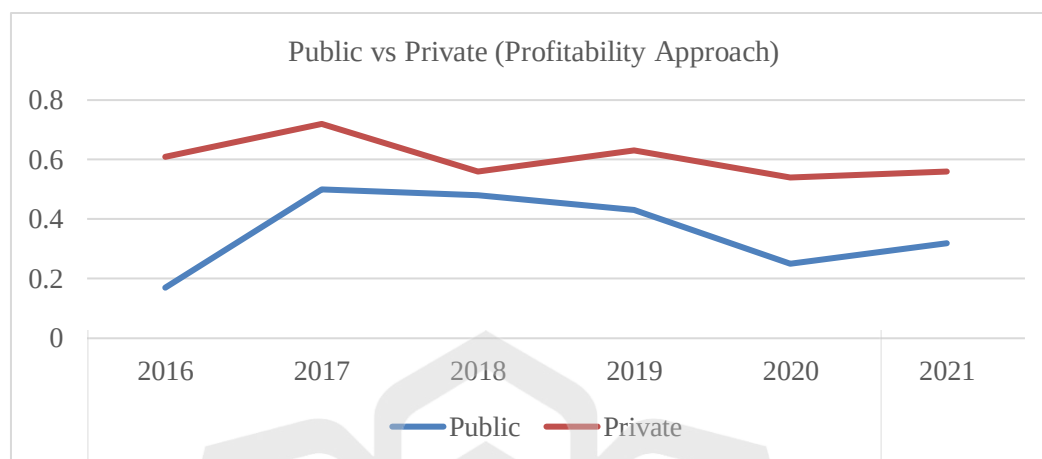


Figure 4.12 Average technical efficiency score between private and public banks (Profitability Approach)

4.4.2 Variable Returns to Scale (VRS): Pure Technical and Scale Efficiency

Table 4.11 and Figure 4.12 represent the pure technical efficiency (PTE) and scale efficiency (SE) scores for the public and private banks based on three approaches from 2016 to 2021. Under the intermediation approach, public banks showed lower PTE and SE than private banks. Between 2017 and 2020, public banks' PTE underperformed SE, while private banks showed the opposite direction, indicating SE outperformed PTE. Hence, public banks improved PTE significantly in 2021, while private banks slightly fell in 2021. On average, public banks were better in managerial competency, while private banks were in optimal usage of resources.

Table 4.11 Average PTE and SE for Public and Private Banks

App.	Bank	2016		2017		2018		2019		2020		2021		Avg.	
		PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE
Int.	Public	0.76	0.76	0.72	0.78	0.78	0.77	0.79	0.70	0.97	0.70	0.28	0.41	0.72	0.69
	Private	0.82	0.81	0.76	0.82	0.81	0.87	0.85	0.86	0.72	0.81	0.78	0.77	0.79	0.82
Prod.	Public	0.85	0.83	0.84	0.75	0.83	0.96	0.80	0.80	0.97	0.97	0.99	0.77	0.88	0.85
	Private	0.79	0.9	0.75	0.81	0.83	0.84	0.85	0.85	0.76	0.87	0.7	0.81	0.78	0.85
Profit	Public	0.32	0.59	0.76	0.74	0.64	0.76	0.65	0.71	0.59	0.46	0.58	0.51	0.59	0.63
	Private	0.73	0.82	0.82	0.86	0.62	0.91	0.68	0.91	0.65	0.8	0.7	0.79	0.70	0.85

Under the production approach, public banks are observed to have better PTE than private banks while demonstrating the same SE score. Public banks unveiled a gradual decline in PTE until 2019 but showed substantial improvement in 2020 and 2021 while positing a volatile SE score throughout the study period. On the other hand, private banks depicted volatile PTE and SE scores throughout the study period. Similar to the intermediation approach, public banks demonstrated better management decisions, while private banks in the utilisation of resources. Under the profitability approach, public banks unveiled better managerial competency than private banks throughout the study period except in 2018. Likewise, the scale efficiency score for private banks was higher than for private banks throughout the study period. However, both private and public banks showed better optimal usage of resources than managerial competencies under the profitability approach.

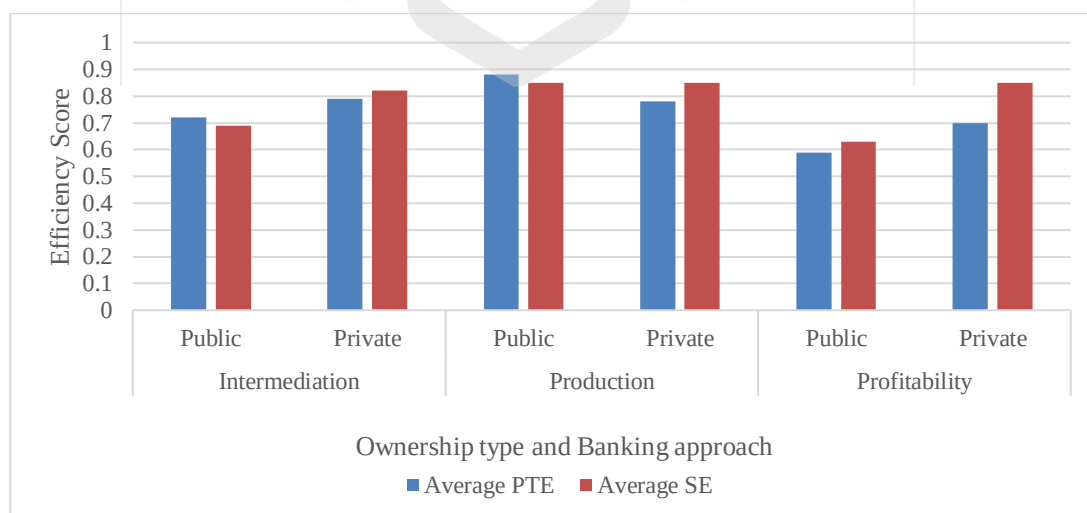


Figure 4.13 Average PTE and SE scores for Public vs Private bank

4.5 EFFICIENCY SCORE FOR ISLAMIC AND CONVENTIONAL BANKS

The efficiency scores of the earlier DEA assessments are further grouped according to the bank structure, either conventional or Islamic. Based on the research objectives, this research has grouped the efficiency scores for conventional and Islamic banks.

4.5.1 Constant Returns to Scale (CRS): Technical Efficiency

Table 4.12 presents the average technical efficiency score for Islamic and conventional banks according to the three banking approaches. The average for each categorised bank was calculated for the periods considered in the study. It refers to the average technical efficiency by bank category for the period of 2016-2021, aggregately.

Table 4.12 Average TE for Islamic and Conventional Banks

Approach	Bank	2016	2017	2018	2019	2020	2021	Avg.
Intermediation	Islamic banks	0.72	0.75	0.79	0.85	0.66	0.63	0.73
	Conventional banks	0.67	0.6	0.67	0.7	0.58	0.55	0.63
Production	Islamic banks	0.81	0.8	0.78	0.81	0.68	0.79	0.78
	Conventional banks	0.7	0.58	0.7	0.71	0.7	0.54	0.66
Profitability	Islamic banks	0.64	0.76	0.37	0.6	0.43	0.42	0.54
	Conventional banks	0.54	0.67	0.62	0.61	0.53	0.58	0.59

Under the intermediation approach (Figure 4.13), conventional banks demonstrated a better efficiency score in each period than Islamic banks. In 2019, both banks acknowledged the highest technical efficiency, whereas Islamic banks performed better than conventional banks by 15 per cent. Consequently, on average, Islamic banks attained 10 per cent higher efficiency scores than conventional banks.

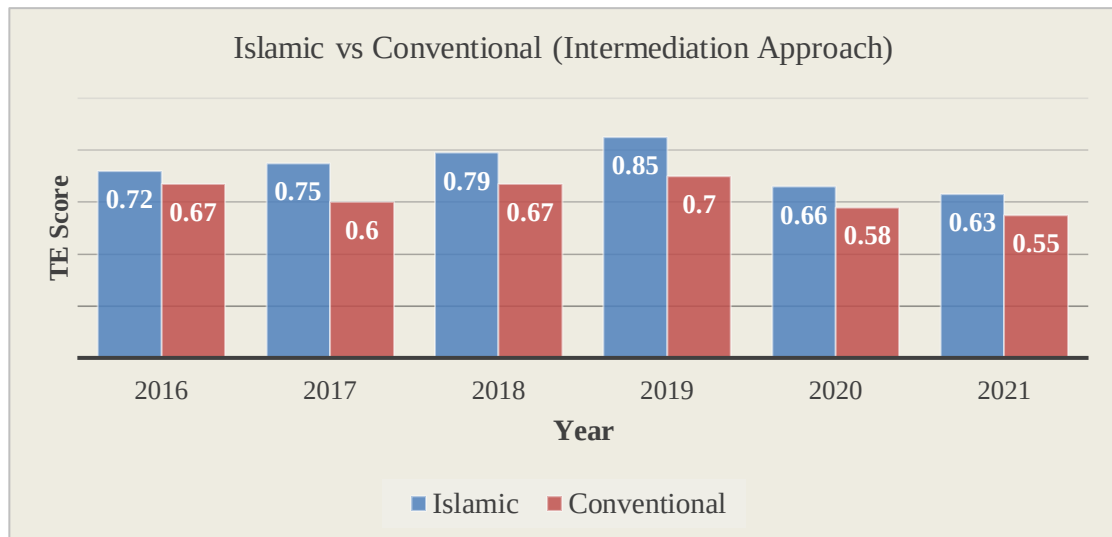


Figure 4.14 TE score of Islamic vs Conventional (Intermediation)

Likewise, under the production approach (Figure 4.14), Islamic banks demonstrated better technical efficiency compared to conventional banks throughout the study period, except in 2020. Surprisingly, Islamic banks improved in 2021 while conventional banks showed a significant decline in 2021. Overall, Islamic banks outperformed conventional banks by 12 per cent.

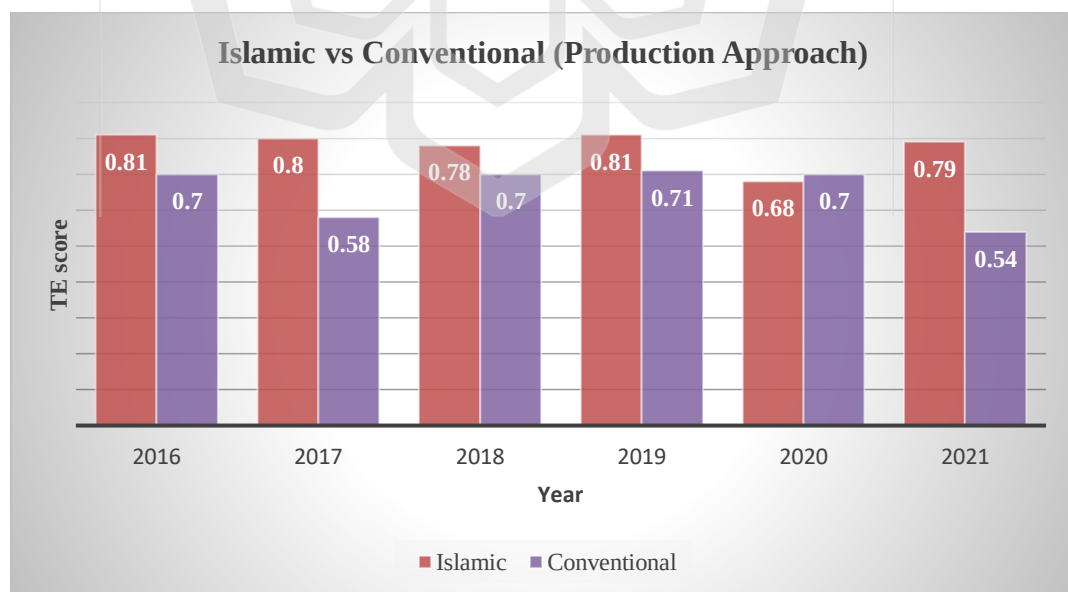


Figure 4.15 TE score of Islamic vs Conventional (Production)

Figure 4.15 exhibits the trend of technical efficiency scores of Islamic and conventional banks under the profitability approach from 2016 to 2021. In this approach, conventional banks performed better than Islamic banks by 5 per cent. Despite the tiny difference in average technical efficiency for the study period, Islamic banks outperformed conventional banks in 2016 and 2017, while conventional banks outperformed Islamic banks from 2018 to 2021.

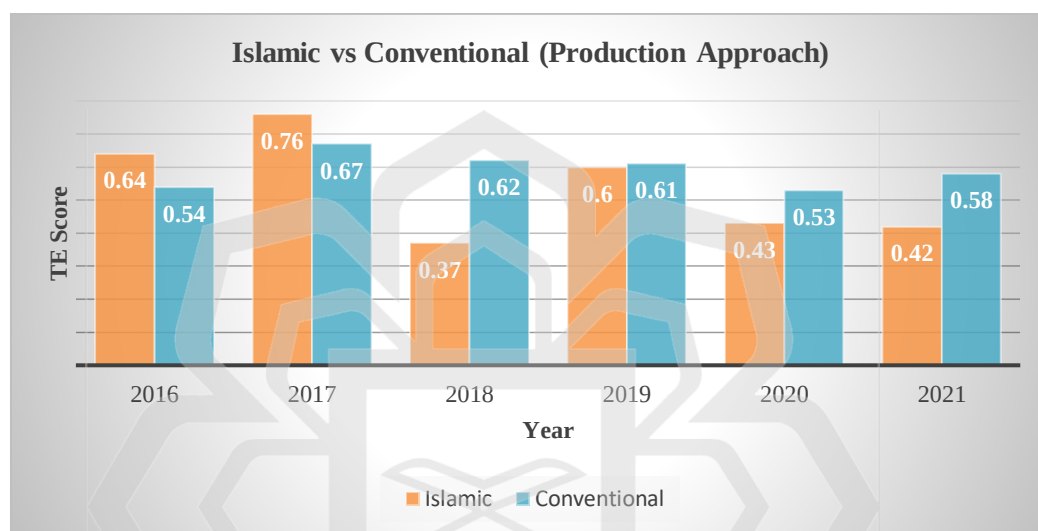


Figure 4.16 TE score of Islamic vs Conventional (Profitability)

4.5.2 Variable Returns to Scale (VRS): Pure Technical and Scale Efficiency

Pure technical efficiency and scale efficiency scores are presented in Table 4.13. The comparison between the causes of inefficiency of Islamic and conventional banks was made based on aggregate average scores for each period as well as for the overall study period. The results included both PTE and SE scores under three different approaches. Under the intermediation approach, Islamic banks showed higher PTE and SE than conventional banks. Conventional banks' scale efficiency outperformed pure technical efficiency throughout the period, while Islamic banks posited a mixed result that refers to volatile inefficiency causes. However, Islamic banks exhibited the same average score of PTE and SE, while managerial competency caused higher inefficiency for conventional banks.

Table 4.13 PTE & SE for Islamic and Conventional Banks

App.	Bank	2016		2017		2018		2019		2020		2021		Avg	
		PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE
Int.	Islamic	0.87	0.81	0.80	0.86	0.89	0.87	0.96	0.89	0.74	0.86	0.78	0.77	0.84	0.84
	Conventional	0.79	0.80	0.74	0.80	0.78	0.85	0.80	0.83	0.75	0.78	0.71	0.72	0.76	0.80
Prod.	Islamic	0.83	0.92	0.90	0.89	0.86	0.89	0.91	0.89	0.73	0.91	0.86	0.91	0.85	.83
	Conventional	0.79	0.88	0.71	0.77	0.81	0.84	0.82	0.83	0.80	0.86	0.68	0.77	0.77	.90
Profit	Islamic	0.85	0.76	0.88	0.85	0.39	0.94	0.64	0.89	0.61	0.65	0.58	0.71	0.66	0.80
	Conventional	0.63	0.81	0.79	0.85	0.70	0.87	0.69	0.88	0.66	0.81	0.72	0.78	0.70	0.83

Unlike the intermediation approach, Islamic banks demonstrated lower SE but higher PTE than conventional banks in the production approach. In this approach, it refers to the better managerial competency of Islamic banks compared to conventional banks. Hence, Islamic banks showed incompetence in management between 2020 and 2021, while conventional banks demonstrated better optimal usage of resources compared to their management competencies. On average, the suboptimal usage of resources contributed to the inefficiency of Islamic banks, while management incompetence is the major contributor to the inefficiency of conventional banks. Unlikely, in the profitability approach, conventional banks demonstrated better management competency, thus scale efficiency is the major contributor to inefficiency. Islamic banks managed to improve in the utilisation of resources under this approach, while managerial inadequacy contributed to the inefficiency of Islamic banks.

4.6 CHAPTER SUMMARY

This chapter has presented a comprehensive analysis of the research findings, leveraging Data Envelopment Analysis (DEA) to evaluate the efficiency of commercial banks in Bangladesh. It opened with a detailed descriptive overview of the dataset to establish context. The chapter then examined technical efficiency (TE) levels across three banking approaches, intermediation, profitability, and production, while also assessing pure technical efficiency (PTE) and scale efficiency (SE). These metrics were further compared across key subgroups, including public versus private banks and Islamic versus conventional banks. Collectively, the results offer a nuanced understanding of efficiency patterns within the sector and provide critical insights that will inform the subsequent discussion and interpretation of findings in the next chapter.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

5.1 INTRODUCTION

Building on the data analysis and interpretation outlined in the previous chapter, this concluding chapter discusses and synthesises the key findings of the study. It evaluates the efficiency of commercial banks, public and private banks, as well as Islamic and conventional banks, across three banking approaches: intermediation, production, and profitability. The chapter distils the research outcomes in relation to the established objectives, drawing connections to relevant past studies. In addition, it highlights the contributions of this study to the field, outlines practical and theoretical implications, acknowledges research limitations, and offers recommendations for future inquiry, ultimately providing a structured and insightful conclusion to the study.

5.2 OVERVIEW OF THE RESEARCH

This thesis reviewed the banking and efficiency literature and discussed the different approaches to banking operations and their mechanisms. Efficiency was explained by the calculation of input over output under an output-oriented approach, while the banking industry aims to maximise its output by utilising inputs (Chowdhury et al., 2022). This thesis emanates from the prevailing literature that implicitly considers banks as intermediary institutions and mostly ignores the multiple objectives of banks, thus acting as a full financial corporation (Casu et al., 2022). It was thus argued that the banking institutions incorporate their operations in terms of intermediation, production, and profitability, leading to the banking system being termed as ‘multi-objective’ or ‘universal bank’ in this thesis. This thesis accordingly discussed the three main approaches for stipulating input and output variables of the banks.

The data was extracted from annual reports of the individual banks over the study period. The data was pooled from a total of 38 banks for each of the 6 years (2016-2021) to carry out the analysis. Henceforth, the efficiency scores were measured using the Data

Envelopment Analysis (DEA) due to its aptitude to handle multiple inputs and outputs as well as being devoid of the necessity to specify particular functional forms. Both constant returns to scale (CRS) and variable returns to scale (VRS), the DEA models were applied to estimate the output-oriented efficiency of Bangladeshi banks. The comparison of the models aided in determining the best model in the context of the Bangladeshi commercial banks. Finally, the results from the DEA analysis enabled the researcher to answer the research questions, thus achieving the research objectives.

Over the past few decades, the global banking industry has faced significant financial disruption, resulting in the collapse of several major banks, which challenges the concept of ‘too large to fail’ (Fonseka & Farooque, 2024; Gržeta et al., 2023). The occurrence of these bank failures highlights the global significance of bank efficiency, considering the significant risks connected with banking operations, including various forms of ownership. The global consequences of banking efficiency outcomes can have substantial impacts on many stakeholders and the broader financial system. Amidst financial instability and vulnerabilities, two specific measures are identified to mitigate future risks in the banking sector and enhance the business environment (Fonseka & Farooque, 2024). Firstly, implementing a robust legal framework and rigorous regulations for banks, which generally focus on governments and bank regulators, such as the Central Bank Act and BASEL Accords. Secondly, promoting greater liberalisation in financial and banking markets is connected to the effects of globalisation, which enables the entry of more private and foreign banks into domestic banking markets, as well as the competition between Islamic banking and conventional banking operations. Both goals strive to enhance the efficiency of banks by reducing volatility and systemic vulnerabilities in the banking industry, which lead to significant costs to the global economy (Fonseka & Farooque, 2024). Banks that are efficient are proven to be more capable of enduring economic shocks and financial crises (Ferreira, 2018; Yusifzada & Mammadova, 2015). The efficiency levels of Bangladeshi commercial banks present a crucial role in the global financial system through signalling the stability and resilience of the financial system. As an emerging economy, the efficiency of the banking sector is crucial for attracting global investors and organisations. The results indicated that the Bangladeshi banking system has not performed efficiently; however, several commercial banks showed consistently improving performance throughout the study period. These

banks can attract and receive the trust of foreign investors to make investments in Bangladesh.

Bangladesh is an emerging nation, and the efficiency level of Bangladesh's banking sector is crucial to both policymakers and stakeholders (Akhter, 2018; Masum et al., 2015). The insight of efficiency evaluations has a significant impact on the regulatory assessments and oversight of banks. The efficiency scores should prompt regulators to monitor the performance and operational capabilities of certain banks, which necessitates further monitoring. The banks that attained high levels of efficiency indicate robust management practices, good potential for profitability, and reduced operational risks, consequently enhancing investor confidence and attracting investment money. Besides, those banks have the ability to handle risks and keep sufficient capital reserves properly, hence improving overall financial stability and also being more competitive within the market. Those efficient banks are crucial for economic progress as they effectively allocate resources to productive sectors. It implies that efficient banks are the backbone of the financial system in the country. Therefore, they promote investment, entrepreneurship, and consumption, all of which foster economic development as a whole within the regional as well as global economy. Efficiency results aid the identification of effective techniques and practices that can be promoted and adopted throughout the banking sector (McKinsey & Company, 2023). The current findings facilitated the identification of the most useful banking practices employed by individual banks in Bangladesh. This includes operational practices, risk management methodologies, and customer service improvements that promote overall efficiency (Akdeniz et al., 2024). Besides, efficiency results offer insights into how banks adjust to new rules, ensuring compliance while preserving operational efficiency (McKinsey & Company, 2023). On the other hand, less efficient banks demonstrate a challenging operational environment to improve their efficiency levels (Shah et al., 2023). Less efficient banks usually demonstrate diminished profitability caused by higher expenses and suboptimal resource utilisation (McKinsey & Company, 2023). This may restrict their capacity to invest in innovative technologies and services, thereby diminishing their competitiveness. Regulators emphasise micro-prudential monetary systems to improve their performance before it has a spill-over effect on the entire financial system. Bank managers and directors of those banks with low efficiency levels should strengthen their operational strategies to improve performance. Further, the pure technical efficiency and scale

efficiency scores enable them to identify their weak strategies (Abel & Bara, 2017; S. Kumar & Gulati, 2008). As a result, these results allow them to revise their strategies to accelerate their efficiency levels.

5.3 DISCUSSION OF MAJOR FINDINGS

This research employed the DEA technique to establish efficiency scores of Bangladeshi banks under multiple banking approaches, namely intermediation, production, and profitability. However, it is recognised that DEA, being a non-parametric method, does not comprehensively elucidate the causes, impacts, or factors that influence efficiency deviations. These efficiency scores provide empirical proof to demonstrate the highlighted research gaps, specifically the absence of coherent evaluations employing multiple banking approaches within the context of the Bangladeshi banking sector, comprising Islamic banks, conventional banks, and diverse ownership models, namely state-owned versus private-owned banks. The research gap is highlighted not exclusively by a lack of DEA investigations, but also by the deficiency of multifaceted (diverse operational approaches), comparative, and comprehensive assessments. The research findings present bank-level efficiency levels across three operational paradigms (intermediation, production, and profitability), thereby encompassing several functional characteristics of banking and addressing the research gaps. A bank may excel in the intermediation strategy through effectiveness in mobilising and transferring funds while performing poorly in the profitability approach, indicating regulatory restrictions or structural inefficiencies that impact income despite robust operational performance.

Moreover, by differentiating the efficiency scores based on ownership (state-owned vs private) and business concentration (Islamic vs conventional), this research addresses research questions regarding the comparative efficiency of various categories of banks. The comparative dimension of DEA facilitates performance benchmarking, offering an empirical basis to determine whether a particular bank model or governance structure is intrinsically more efficient, or if inefficiencies stem from operational inflexibilities (managerial or optimisation of resources). The following sub-sections explain the achievement of the definite research objectives. As mentioned, this study seeks to answer four objectives, discussed and deliberated sequentially, one after another, connected with

the findings in Chapter Four, and supported by the reviewed works of literature in Chapter Two.

5.3.1 First Objective: Measuring Efficiency of Commercial Banks

The first objective is “*To Measure the Efficiency Level of Commercial Banks in Bangladesh.*” The efficiency score was calculated using Data Envelopment Analysis (DEA) based on different banking approaches, covering the data from 2016 to 2021, during which Bangladesh’s economy has been showing tremendous growth. The findings from the calculation demonstrated inconsistent efficiency scores for all commercial banks.

Aggregately, commercial banks measured at an average of 65 per cent efficiency level, affected by the recent epidemic that led to a decline in the efficiency score under the intermediation approach. Yet, the efficiency score before the pandemic for the commercial banks is not significantly better. This is supported by Uddin et al. (2022), who acknowledged only a 56 per cent efficiency level for conventional banks in Bangladesh using DEA. Using Stochastic Frontier Analysis (SFA), Sun and Chang (2011) found that general banking efficiency for Asian emerging countries is approximately 60 per cent which is supported by the findings of this study. On the other hand, Azad et al. (2020) unveiled a 95 per cent efficiency level for Bangladeshi banks by using the DEA technique, which is significantly greater than the current findings. The analysis results provide a detailed explanation of the possible explanations for the empirical findings, which mainly concern the bank’s development strategy and the economic environment (Shi et al., 2023). Based on the empirical results, it is clear that commercial banks’ average overall efficiency fluctuated between 2016 and 2019, with an increasing trend before declining beyond that year. The impact of COVID-19 in 2020 is primarily accountable for the decline in these banks’ average overall efficiency between 2019 and 2021. A portion of the economy as a whole was negatively impacted by the pandemic, and this had an effect on the banking industry either directly or indirectly. This finding is in line with Shi et al. (2023), who stated COVID-19’s effect on the decline of commercial banks’ efficiency. Financial services revised their operations in various ways in response to the pandemic crisis. All things taken into account, commercial banks

sought to lower their operational expenses and, more importantly, the amount of credit they extended. Consequently, they had to deal with a significant amount of non-performing loans while simultaneously experiencing a decrease in the volume of loans they made and their interest income. As a result, they depended more on revenue from sources other than interest.

These inefficiencies are caused mostly by managerial incompetence that failed to operate the banking activities adequately. The performance and success of commercial banks are significantly influenced by the effectiveness of their management (Shi et al., 2023). It pertains to bank managers' capacity to allocate resources prudently and efficiently in order to meet the objectives of the bank. Modern banks compete vigorously in the market (Casu et al., 2022), with profit margins frequently being narrow. One of the fundamental things that distinguishes successful banks from competitors is management efficiency. Several factors are considered in regard to the effectiveness of management, such as asset quality, innovation, customer service, cost management, and risk management, which lead to bank efficiency. For commercial banks, risk management is yet another essential component of effective management. Banks are subject to a number of risks, such as operational, liquidity, market, and credit risks. A resilient strategy, technique, and risk management framework enable an organisation to identify, evaluate, and mitigate these risks in order to carry out effective risk management. In addition to reducing the potential of losses, effective management ensures sufficient capital reserves for weathering any unexpected shocks. The findings demonstrated a sharp decline in the recent period, which may be due to the pandemic. Therefore, it can be assumed that the management of Bangladeshi commercial banks failed to reserve sufficient capital, resulting in ineffective management competency, which led to poor banking efficiency throughout the period.

Likewise, commercial banks showed an average efficiency level of 69 per cent under the production approach, which was also affected by pandemic events in recent years. However, commercial banks performed slightly better in this approach than in the intermediation approach. Similar to the intermediation approach, the incapability of management in banking operations caused the operational inefficiency. One of the most important aspects of effective management is cost control. Generally, the cost of operation is an important factor for effective management that allows the organisation to

make a better profit (Koh et al., 2016). Accordingly, banks have to make an effort to keep operating costs as low as possible without jeopardising the quality of their products and services. Finding strategies for reducing expenses on overhead, increasing employee productivity, and putting forth effective procedures and technologies are all critical to effective cost management. Banks can increase their profitability and strengthen their position as market leaders by controlling costs. Perhaps, due to technological advancements, banks incurred substantial expenses for the adoption and adaptation of financial technologies, security measures for online threats, and human capital for maintenance, which caused the lower efficiency score (Fonseka & Farooque, 2024; Proença et al., 2023; Shi et al., 2023). This might be due to the novice level of offering financial services to its customers, such as financial technology and expenses. Asset quality is a critical determinant of managerial effectiveness in commercial banks, especially under the intermediation and production approach (Koh et al., 2016). Banks must closely evaluate each borrower's creditworthiness and keep a lid on the performance of their current loans in order to maintain a high-quality loan portfolio (Shi et al., 2023). Usually, banks can lower the frequency of loan defaults, non-performing loans, and related allegations by managing credit risk effectively. Notably, Bangladeshi commercial banks unveiled a proportion of 10.1 per cent non-performing loans by June 2023 (Bangladesh Bank, 2023a), which signifies an ineffective managerial competency in the selection of borrowers and their creditworthiness. A significant portion of non-performing loans is in the commercial banking sector.

Meanwhile, commercial banks are yet to perform better via the framework of the profitability approach. Under this approach, commercial banks had the worst efficiency score compared to the other two approaches. A similar finding was unveiled by Achi (2021), who showed a worse efficiency score under the profitability approach than the production approach for Algerian commercial banks. As usual, management incompetence is the major contributor to inefficiency. In commercial banks, providing excellent customer service is essential to managerial effectiveness. Banks should concentrate on fostering long-term relationships with customers by offering personalised and efficient services (Supriyanto et al., 2021). This involves providing an extensive range of financial products and services, assuring accurate and prompt transaction processing, and offering superior customer service. By placing the needs of their customers first, banks may increase retention of customers, draw in new business, and

distinguish themselves apart from competitors. Consequently, innovation is crucial to the managerial effectiveness of commercial banks. Banks have to innovate and adapt in the contemporary, rapidly evolving banking landscape in order to remain viable and competitive (Hadid et al., 2020). This can be accomplished in a number of ways, including by increasing decision-making skills, optimising administrative responsibilities, and providing better customer service (Koh et al., 2016). This transformation involves adopting advanced technologies such as artificial intelligence, data analytics, mobile banking, and comprehensive digital banking platforms to enhance customer experience and operational efficiency and create new revenue streams (Bhutto et al., 2023). Through the effective integration of such innovations, banks will position themselves as leaders within the sector, gaining a competitive advantage. Additionally, by designing more user-friendly and accessible products, banks can increase customer engagement and revenue growth. However, the digital banking landscape in Bangladesh remains in an initial stage, with commercial banks facing substantial costs, particularly due to reliance on third-party service providers. Despite these challenges, recent progress in Bangladesh's banking sector highlights robust investments in digital infrastructure and growing adoption of fintech solutions. However, barriers such as cybersecurity risks, digital literacy gaps, and infrastructural limitations continue to pose significant obstacles to full-scale digital transformation.

The findings have also demonstrated that the pandemic caused a noteworthy decline in efficiency levels under all approaches (Boubaker et al., 2023b; Istaiteyeh et al., 2024; Shi et al., 2023). It means the pandemic has affected the overall operations and performance of commercial banks (Istaiteyeh et al., 2024). However, the result shows that listed commercial banks are, on average, comparatively technically inefficient in both situations. While the banking system in Bangladesh is improving, the current efficiency level is insufficient to draw that conclusion. As a result, it is fair to mention that the management of Bangladeshi commercial banks was inadequate. Thus, they are not aiding the economic growth, pointedly. Since the banking industry is becoming more competitive, banks may meet the ever-evolving requirements of their customers, embrace opportunities, and manage barriers by consistently working to increase their managerial efficiency (Boubaker et al., 2023b; Istaiteyeh et al., 2024; Shi et al., 2023). The productive operations of banks are based primarily on the effectiveness of their management. It entails rigorous attention to detail in a number of areas, such as risk mitigation, personnel

optimisation, regulatory compliance, and technological integration. Banks can provide resilient and sustainable growth despite changing market conditions through a comprehensive approach to these factors.

The findings, especially related to the efficiency scores of commercial banks, closely align with the intermediation theory of banking (Benston & Smith, 1976; Konstantakopoulou, 2023), which asserts that banks generate value by effectively directing surplus funds to deficit units. The findings on the superior intermediation efficiency and profitability of conventional private banks corroborate the theory, founded on conventional risk-taking and financing models, which are inherently compatible with effective financial intermediation. Likewise, the production approach, which highlights banks as entities converting inputs (capital, labour) into outputs (deposits, financing), is evident in the enhanced performance of Islamic banks, consistent with Berger and Humphrey's (1997) cost-efficiency hypothesis.

5.3.2 Second Objective: Measuring Efficiency using Intermediation, Production and Profitability Approaches

The second objective of this study is *“To Determine an Appropriate Banking Approach for Assessing the Efficiency of Bangladeshi Commercial Banks.”* The efficiency scores using intermediation, production and profitability banking approaches were calculated to achieve the objective before a recommendation on the most appropriate banking model for Bangladesh was suggested. It is unmanageable to overemphasise the importance of commercial banks in any economy; they are one of the main foundations supporting contemporary economies (Alam et al., 2021; Fonseka & Farooque, 2024). These financial institutions provide a range of services, including lending, savings mobilisation, payment systems, and foreign exchange operations, and play a crucial part in promoting an economy's growth, development, and stability. Contemporary banks are regarded as universal banking, providing all types of financial services to their customers, transforming an array of products and services beyond their traditional intermediary role (Antunes et al., 2024). This research evaluates and compares commercial banks' performances using three banking approaches discussed in the literature, namely, intermediation, production, and profitability approaches. Besides, it is also aimed at

learning the most appropriate approach for commercial banks from the Bangladeshi perspective, whereby the banking sector is criticised with several issues such as bad loans and poor services (Hasan, 2023; Rob, 2023). Based on the findings, commercial banks unveiled different efficiency scores in different approaches. Certain banks performed well in the intermediation approach, while others showed better efficiency levels in the production and profitability approaches.

Premier, Southeast, and IFIC banks nearly attained the full efficiency score (90-98 per cent) under the intermediation approach in the study period. This means that these banks have been placing more emphasis on the intermediary role of banking institutions. In other words, these banks are better at collecting deposits and converting those deposits into loans and investments. Besides, Social Islami Bank (SIBL), Al Arafah Islami Bank (AIBL), and EXIM Bank demonstrated an 80 per cent efficiency level under the intermediation approach. Therefore, it can be stated that these banks performed well when they focused on the collection of deposits and converting them into loans and investments (Chowdhury et al., 2022). In other words, these banks have utilised their workforce and deposits to effectively manage loans and investments. Thus, these banks achieve higher efficiency levels by focusing on the intermediary business model and operating accordingly. On the other hand, Sonali Bank and Bangladesh Commercial Bank performed poorly in relation to the intermediary role. This finding posits the inadequacy of management capacities to effectively utilise deposits and workforce to profoundly manage loans and investments in order to generate more profits. However, these banks are capable of capitalising their employees and assets to collect more deposits.

Bank Al Falah attained full efficiency, whilst Islami Bank and First Security Islami Bank have achieved close to full efficiency levels (91 per cent and 99 per cent, respectively) under the production framework. It indicates that these banks effectively utilised their workforce and assets to attract depositors. Besides, AB Bank and Dhaka Bank also performed comparably better in this model, which suggests that if they can focus on utilising workforce and assets more, they can successfully improve their deposit collection. Conversely, Midland, Bangladesh Commercial, HSBC, and SBI Bank have relatively underperformed in the deposit-generating strategy, but these banks demonstrated superior efficiency in the profitability strategy. This indicates that these banks were effectively integrating technological innovations and providing customer-

oriented products and services. Nonetheless, these banks achieved nearly 100 per cent efficiency under the profitability framework, whereas the other two approaches resulted in significantly lower average efficiency scores. Consequently, they are proficient in addressing customer-driven or current demands to an optimal degree.

NRB Bank, Shahjalal Islami Bank, and One Bank should operate using this banking model, as they have also shown better efficiency scores using the profitability approach. By optimal utilisation of resources and effective management, they can improve the efficiency level in the forthcoming year. In contrast, United Commercial, Mercantile, Islamic Bank, Social Islamic, Janata, Agrani, and EXIM Bank exhibited poor performance under the profitability approach, while these banks showed better performance in the other two approaches. This implies that these banks have implemented competent strategies to collect deposits and manage them to convert them into profitable investments and loans (Achi, 2021). In detail, these banks have the ability to create deposits with their labour and fixed assets, but they still need to improve how they use the funds they gather to generate additional revenue (Antunes et al., 2024). Subsequently, the findings demonstrated that several commercial banks, which performed better in the intermediation and production approach, performed worse in the profitability approach. Drawing from these findings, it can be inferred that these banks have employed effective strategies to collect funds using their workforce and assets and convert them to profitable loans and investments. However, these banks do not focus on other non-banking services to generate profits.

It can be inferred that commercial banks in Bangladesh are comparably better in both production and intermediation approaches. By improving their current strategies, the management can train their workforce on how to utilise inputs effectively as well as reduce wasted resources, and by incorporating customer-driven services and technological advancements, commercial banks have the potential to accelerate their current efficiency level. Based on the outcome of the efficiency scores, this research suggests Bangladeshi banks have the potential to collect deposits utilising an efficient workforce and bank assets since the financial market is still underdeveloped.

Which banking approach is recommended to measure the efficiency of commercial banks in Bangladesh? While different banks exhibited varying efficiency

levels across these approaches, the production approach, which generally delivered higher average efficiency scores, is recommended for Islamic and publicly owned banks. This recommendation is grounded in quantitative findings and the contextual realities of Bangladesh's banking sector and national policy environment. The production approach, focusing on effective management of operational inputs and excluding interest expenses and revenues (Camanho & Dyson, 1999), resonates with the operational challenges faced by Bangladeshi banks and aligns with the government's emphasis on financial inclusion and efficient resource allocation. Bangladesh's recent development plans (World Bank, 2023) emphasise sustainable growth through productive sectors such as textiles, agriculture, and information technology, which require efficient banking support underpinned by prudent cost control and operational efficiency. Further, the government's goals for deepening credit flow to priority sectors and strengthening banking system resilience complement the focus of the production approach. Given that many public and Islamic banks operate under regulatory frameworks prioritising operational prudence over interest income maximisation (IMF, 2023), the production approach aptly reflects their governance and functional realities. It measures management competency in resource utilisation, a critical factor for sustaining effective banking operations in Bangladesh's evolving economic landscape. Therefore, this study recommends that managers of Islamic and public-owned banks prioritise strategies that enhance operational efficiency consistent with the production approach. By doing so, they can better contribute to national development objectives while improving institutional performance and sustainability.

Meanwhile, banks that achieved higher efficiency levels in the intermediation approach are mostly private-owned conventional banks, which prioritise interest spreads and profit generation through efficient credit disbursement (Sealey & Lindley, 1977). These banks excel in resource utilisation to maximise outputs, but improving the management of non-performing loans remains critical to further boosting their efficiency (IMF, 2023). The intermediation approach aligns closely with Bangladesh's evolving financial sector and government policies aiming to strengthen private sector banking to fuel economic growth (World Bank, 2023). By efficiently channelling resources into productive sectors such as manufacturing and services, private banks support national priorities of entrepreneurship and industrial development as outlined in Bangladesh's Monetary Policy Review (Bangladesh Bank, 2023). Empirical studies affirm that

improved intermediation efficiency drives financial sector development and economic expansion in Bangladesh (Das & Ghosh, 2006; Panah et al., 2014). Consequently, private conventional banks adopting this approach are well-positioned to advance Bangladesh's economic agenda. Furthermore, banks showing high profitability efficiency demonstrate capabilities in cost control and revenue maximisation, suggesting the profitability approach suits banks targeting long-term sustainability in competitive markets (Drake et al., 2006; Panah et al., 2014). Thus, this research recommends that private conventional banks concentrate on the intermediation approach, improving credit risk management and resource allocation to align with Bangladesh's economic policies. Banks with strong profitability efficiency should continue enhancing cost minimisation and revenue optimisation strategies. Ultimately, banks should adopt the approach best aligned with their structure and strategic goals to maximise performance and contribute to Bangladesh's economic prosperity.

5.3.3 Third Objective: Comparative Performance of Public and Private Banks

The third objective of this research is “*To Compare the Efficiency Scores between Public and Private Commercial Banks in Bangladesh.*” The findings from the DEA analysis were grouped according to the nature of the banks and discussed based on the mean efficiency scores. Despite the fact that both public and private banking sectors make significant contributions to national economies, efficiency levels are affected by their different ownership strategies (Shi et al., 2023). Profits and innovation are given priority by private banks, which improves operational efficiencies but exposes them to greater risk (Boubaker et al., 2023b; Fonseka & Farooque, 2024). Public banks, on the other hand, place more emphasis on social welfare objectives and service delivery, although they may face challenges with bureaucratic issues and inadequate assessment systems. Therefore, achieving maximum efficiency across all banking segments continues to depend on striking a balance between profitability and societal advantages.

Based on the findings, private banks outperformed state-owned banks in terms of efficiency level. These findings reflect the Structure-conduct-performance (SCP) theory, which posits that banks in more competitive settings with superior governance structures are likely to exhibit higher efficiency. The low efficiency of state-controlled banks, often

marked by bureaucratic inefficiency and political interference, corresponds with global findings indicating that state-held banks are usually less efficient owing to diminished profit incentives and weakened accountability (La Porta et al., 2002). The empirical findings substantiate these theoretical frameworks by demonstrating consistent patterns of inefficiency in state-owned banks and profit-oriented practices in private banks. The current findings are consistent with previous research (Sufian & Kamarudin, 2014), such as that private banks in South and Southeast Asia surpass state-owned banks in terms of cost and profit efficiency. However, the current finding contradicts the study conducted by Sharma and Rawat (2023), who found that state-owned banks are more efficient than private banks in India, although Bangladesh shares similar types of economic and cultural practices. In addition, Fonseka and Farooque (2024) unveiled a better efficiency level of state-owned commercial banks than privately owned banks in Pakistan. However, Le et al. (2022) estimated a better efficiency level for privately-owned banks in Vietnam, while Bangladesh was recently deemed to be a competitor of Vietnam in terms of RMG exports. Generally, private banks operate under business entities that are privately held by investors or shareholders. Their primary concentration is on generating profits, as opposed to public banks that frequently serve larger societal goals. Since market forces primarily determine private banks, they typically have more flexibility when it comes to lending practices and interest rates. However, these institutions are also more vulnerable to risk as a result of this flexibility. As an example, private banks may incur large losses when borrowers default on loans during economic downturns. The findings of this research provided an expected outcome whereby private banks are better in efficiency level than public banks, under intermediation and profitability approaches. According to Davydov (2018), state ownership of commercial banks is unproductive due to political influence, poorer managerial incentives compared to privately owned banks, and government monitoring activities.

Political influence undermines commercial banks' unwavering goals of profit maximisation, which has a negative impact on their financial performance. Previous empirical research has shown that state-owned banks had poorer financial performance, which is linked to poorer corporate governance and extremely high-risk levels (Cornett et al., 2010; C.-H. Shen & Lin, 2012). Nevertheless, public banks are supported by the government and pursue priorities other than merely generating revenue. These involve promoting equitable growth, supporting regional development, and ensuring that those

with limited resources have access to financing (Gökgöz et al., 2023). Despite typically being less competitive, public banks receive significant advantages from the economies of scale obtained by government subsidies. They frequently target industries with low-profit margins, such as housing, infrastructure, and agriculture, and offer wider credit facilities and cheaper interest rates. Nevertheless, public-owned banks may experience problems with organisational efficiency because of political interference and bureaucratic bottlenecks. Besides, due to the issues of non-performing loans and fraud cases, perhaps among Bangladeshi public-owned banks, there has been a lower efficiency level. This finding is consistent with Liu et al. (2019), Dong et al. (2014), and Ehsan and Javid (2018), who revealed that government-owned banks are prone to increasing their credit risk. They explained that the political connection with public-owned banks increases the credit risk and channelling societal development objectives, relevant loans might enhance the non-performing loans ratio, thereby reducing the efficiency level of public-owned banks. The findings of this research explained that public-owned banks are more prone to taking credit risk, which reduces banking efficiency. In contrast, private-owned banks tend to be more careful regarding their credit practices, which is also supported by Boateng et al. (2019).

Hence, private banks are often more efficient in their operations than state-owned ones because of competition among them, which drives them to adopt cost-saving strategies like automation and process simplification. This is evident even though there may be associated risks. Besides, public banks are condemned to use traditional procedures. It means that the advanced technologies, adequate services, and qualified manpower, the unavailability of ATM and internet banking services might cause a lower efficiency. On the other hand, private banks are known for better services, friendly customer service, and better internet banking facilities that improve their efficiency. This is also supported by a prior study conducted by Kirimi et al. (2022), who showed a negative association between state ownership of banks and their net interest margin. Surprisingly, public banks showed better efficiency under the production approach, whereby they even performed well during the pandemic crisis. This can be supported by a study conducted by Boateng et al. (2015), who found that Chinese state-owned banks are more profitable than other banks. As suggested by Jiang et al. (2013) and Le et al. (2022), the government should privatise the banking sector to boost its revenue income and efficiency. Hence, both public and private banks underperformed during the

pandemic period, which lessened their overall efficiency score in the study period. Besides, public-owned banks engage in harmful loan activity, deposit-taking, and non-interest spending, affecting their efficiency. In line with the theory that the better banks were first privatised in developed economies, the banks still to be privatised in developing countries like Bangladesh are therefore less effective. The assumption that public-owned banks are too tiny to be effective by global standards has led many developed countries to implement bank consolidation plans.

5.3.4 Fourth Objective: Comparative Performance of Islamic and Conventional Banks

The fourth objective is “*To Evaluate and Compare the Efficiency Level between Islamic and Conventional Commercial Banks in Bangladesh.*” An essential component of the economic system is the banking industry, which acts as an intermediary between those in need of financial assistance and individuals or businesses eager to invest their funds. Globally, several types of banks have been established over time, each with a unique set of fundamental values and procedures. For instance, the distinctions between Islamic and conventional banks, two institutions that provide distinct financial strategies based on religious convictions (Beck et al., 2013; Fakhrunnas, Nahda, et al., 2023; Mai et al., 2023). In order to gauge the difference in efficiency level of such distinction, the DEA results were grouped by categorising the Islamic and commercial banks from the understudied commercial banks. The average efficiency scores for both categorised banks were compared to determine the performance of Islamic and conventional banks. The findings from the intermediation approach demonstrated a noteworthy difference between the efficiency level of Islamic and conventional banks, where Islamic banks performed better. This finding is similar to several studies that showed better efficiency levels of Islamic banks compared to their counterparts (Azad et al., 2021; Mirzaei et al., 2022). For instance, this finding is consistent with a past study conducted by Nabi et al. (2019), who unveiled better efficiency levels of Islamic banks compared to conventional banks in Bangladesh. Similarly, Banna et al. (2023) also revealed an improved efficiency level of Islamic banks in Bangladesh. Their findings revealed the contribution of managerial competency to higher technical efficiency, while conventional banks demonstrated better optimal usage of resources. Another study carried out by Kassim and Islam (2015) and

Mai et al. (2023) found better operational efficiency of Islamic banks in dealing with operating expenses and deposits to produce revenue income and other income-generating assets. On the other hand, Haque and Sohel (2019) found lower efficiency for Bangladeshi Islamic banks compared to conventional banks, which contradicts the findings of this study. The current finding also contradicts the prior study conducted by Wei et al. (2020), who evaluated the price, revenue, and cost efficiency between conventional and Islamic banks in 18 countries. They have shown no significant deviation in efficiency levels between conventional and Islamic banks in 18 countries, including Bangladesh. Nevertheless, the findings from Asmild et al. (2019) supported the current findings, whereas Islamic banks outperformed conventional banks in terms of overall efficiency.

Similarly, Islamic banks performed better than conventional banks under the production approach. It can be elucidated that Islamic banks usually uphold an enhanced level of capital and liquidity, fostering a sense of confidence in depositors, who can be assured that the bank is adequately equipped to address financial issues (Schoon, 2013). Besides, Islamic banks' depositors, the compatibility of Islamic banking operations with their religious convictions and communal values is a crucial determinant in selecting Islamic banks for their deposits (Qian & Velayutham, 2017). The findings are consistent with previous research (Sufian & Kamarudin, 2014), which indicated that private banks in South and Southeast Asia surpass state-owned banks in terms of cost and profit efficiency. In a similar vein, research conducted by Mobarek and Kalonov (2014) indicated that Islamic banks exhibit greater efficiency in deposit mobilisation, although they demonstrate diminished profitability attributable to restricted product offers and regulatory limitations. Islamic banks often demonstrate superior asset stability and quality because of their compliance with Shariah principles, which limit high-risk investments (Schoon, 2013). In addition, Islamic banks demonstrate greater cost-effectiveness compared to conventional banks (Beck et al., 2010, 2013). Nevertheless, this may fluctuate based on the region and market dynamics (Beck et al., 2010). Since the majority of the population is Muslim in Bangladesh, Islamic banks may have found an additional advantage in an increase in deposits. Research often reveals no substantial disparities in overall efficiency between Islamic and conventional banks, while both categories of banks efficiently utilise their resources; however, they may vary in their operational capacity to generate income and profit (Akdeniz et al., 2024; Beck et al., 2013; T. Hassan et al., 2009b; Jubilee et al., 2021). The competence and integrity of the employees

operating under an Islamic or conventional umbrella are the primary determinants of their efficiency, rather than the orientation of banking ownership.

Meanwhile, conventional banks posited a better efficiency score in the profitability approach than Islamic banks. This finding refers to the adaptability of market structure and incorporating product and service design based on customers' current preferences, in which conventional outperformed Islamic. This finding is supported by the previous finding of Uddin et al. (2022), who posited better profitability efficiency of conventional banks than Islamic banks in Bangladesh. In addition, compared to conventional banks, the deposit and investment growth for Islamic banks in Bangladesh is significant (Rashid et al., 2019). As usual, both types of banks went through a critical situation during the pandemic, acknowledging a sharp decline during the period. Likewise, the operational issue has been the crucial reason for inefficiencies for both conventional and Islamic banks, although Islamic banks showed slightly better management competency under the production approach. Due to competent manpower and holistic business operations, Islamic banks are operating and utilising resources in a manner where customer are gathering reliability and compatibility with their services. Islamic banks rigorously handle the banking crises and aid in keeping these crises from flourishing into the real economy and also from abolishing societal happiness (Polyzos et al., 2023; Saâdaoui & Khalfi, 2022). While the banking policies of conventional and Islamic banks are considerably different, neither has a distinct advantage over the other in terms of overall efficiency. Thus, Islamic banks are more competent in acquiring deposits using their operational competency. The findings explained that the choice between these two systems comes from individual preferences that are shaped by ethical, religious, cultural, and personal beliefs. However, Islamic banks are still required to attain full efficiency in order to expand their market value in the economy. Islamic banks are governed by Shariah principles that mandate the adoption of asset security and risk sharing, as well as the prohibition of interest-based transactions (*riba*). This could potentially result in more conservative lending and investment decisions, which could affect their risk management practices.

Based on the findings, it is elucidated that due to a large portion of the population being Muslim and a small number of Islamic banks in Bangladesh, Islamic banks are able to collect more deposits than Conventional banks. So, lending activities comprehensively

may not be able to make banks more profitable or efficient. These suggest that other banking activities, such as investment, financing, and other financial services, are equally important in order to be efficient because bank lending does not substantially contribute to the banks' efficiency in the contemporary financial world.

5.4 SUMMARY OF THE FINDINGS

According to the findings, there was a notable variation in the efficiency scores of 38 commercial banks from 2016 to 2021 across the three banking approaches. The evidence suggests that private commercial banks continuously surpass state-owned banks, especially in production and profitability banking approaches. Likewise, Islamic banks exhibit superior efficiency through the intermediation strategy, indicative of their robust asset-based financing and deposit mobilisation techniques, which are consistent with their shariah-compliant practices.

Table 5.1: Summary of the Key Findings

Bank Category	Efficiency Level	Key Feature	Notable Findings
Private Commercial	High	Capital adequateness, innovation, diversified services	Efficient in the Intermediation approach
State-owned	Low	Bureaucratic management, high NPLs, and political influence	Less efficient in all three approaches
Conventional	High	Better management competency, digital and technology-oriented	Efficient in Intermediation and Profitability approach
Islamic	High	High deposit intermediation, lower leverage ratios	Efficient in Production approach

Table 5.1 demonstrates the bank type and tiers of their efficiency level to extract substantial insights. Banks are classified into three categories: high-efficiency, medium-efficiency, and low-efficiency clusters based on their efficiency levels, considering the number of high-efficiency banks. Comparative analysis indicates that high-efficiency banks typically exhibit several features, including enhanced capitalisation, diversified services, managerial competencies, investment in technology, and utilisation of fast-growth digital banking services, which likely enhance their performance. In contrast, low-efficiency banks, typically state-owned banks or newly established ones, have high NPL rates, inferior governance frameworks, political influence, and restricted product diversification. The empirical findings also support the notion that Islamic banks perform better in a particular approach, namely ‘production’. This result suggests that Islamic banks are robust in deposit collection and utilisation through a risk-sharing operating approach.

5.5 RECOMMENDATIONS

Drawing the findings from overall efficiency scores for commercial banks, this research identifies several suggestions for commercial banks in Bangladesh. Most commercial banks performed comparably better in the production approach, leading to optimal utilisation of their input resources to collect funds. Further, several banks posited better efficiency in allocating deposits into productive loans and investments. Due to the business model of Islamic banks, they are more profound in the production approach. As their depositors believe in their Islamic investment and financing, they manage to collect funds in Bangladesh, where the majority of the population is Muslim. However, Islamic banks should not only focus on collecting funds but also effectively allocate those funds into productive investments, financing and designing contemporary services complying with Islamic principles. Therefore, Islamic banks should expand their products and services to encompass digitised Islamic microfinance, sukuk-based investment products, and shariah-compliant solutions tailored for SMEs, thereby improving overall performance. Conventional banks have been performing better at mediating the funds from surplus to deficit. However, by increasing financial inclusion, including remote areas, these banks can boost their efficiency level in all approaches. They can accelerate

their efficiency by availing themselves of their products and services, including online banking in remote areas.

State-owned commercial banks mostly demonstrated better efficiency levels in the intermediary role, which indicates their traditional banking practices. State-owned banks should improve their current operational strategies by incorporating modern financial services, such as technological advancements in designing, operating, and providing services. Then, they can effectively manage their funds into productive investments and improve profitability (Antunes et al., 2024). State-owned banks should enhance retail digital banking platforms, automate operations, and diversify into fee-based services such as mobile banking and trade finance. Private banks can enhance their operations by investing in AI-driven risk assessment tools, cross-selling wealth management services, and offering green banking products to meet the demand of ESG-conscious customers and investors. These product-level changes correspond to improving operational and financial performance, offering banks efficiencies in both scale and breadth.

5.5.1 Proposed Strategies

This research used three banking approaches to measure efficiency levels in order to find the appropriate performance measurement and monitoring model for commercial banks. The production approach is ideal for Islamic and public-owned banks in Bangladesh, as it focuses on the efficient management of operational inputs while excluding interest expenses and revenues (Camanho & Dyson, 1999). This approach aligns well with the sector's regulatory environment and operational challenges, whereby many public and Islamic banks prioritise cost control and financial inclusion over interest income maximisation (IMF, 2023; World Bank, 2023). Bangladesh's national development plans emphasise sustainable growth through sectors like textiles and ICT, which require banks to efficiently allocate resources and underpin financial stability (World Bank, 2023). Hence, Islamic and public banks should adopt strategies that enhance operational efficiency consistent with the production approach, supporting both institutional sustainability and national economic goals.

The intermediation approach suits private conventional banks that focus on profitability through interest margin maximisation and efficient credit disbursement (Sealey & Lindley, 1977). These banks are crucial to Bangladesh's economic growth by channelling resources into productive sectors such as manufacturing and services, thus supporting entrepreneurship and industrial development (Bangladesh Bank, 2023; World Bank, 2023). Despite strong resource utilisation, managing non-performing loans remains essential to boost efficiency under this model (IMF, 2023). Therefore, private banks are advised to improve credit risk management and resource allocation aligned with national economic policies. Banks excelling in profitability and efficiency should also optimise cost control and revenue growth strategies to sustain competitiveness and contribute to Bangladesh's long-term economic prosperity.

5.5.2 Proposed Peers

Based on the efficiency scores, this research suggests that the banking sector in Bangladesh should strengthen managerial competencies to enhance workforce efficiency and optimise input utilisation, ultimately maximising output. Improved managerial capacity enables banks to achieve optimal resource use at economies of scale. Banks underperforming in certain efficiency approaches can learn from those with superior performance. Table 5.2 highlights the commercial banks achieving considerably high technical efficiency (above 90 per cent) under the three approaches, providing benchmarks for best practices.

Table 5.2 List of efficient (close to full efficiency level) banks under three different approaches

Rank	Bank	Intermediation		
		TE	PTE	SE
Efficient	Premier Bank	0.98	0.98	1.00
	Southeast Bank	0.97	1.00	0.97
	IFIC	0.90	0.93	0.96
Less efficient	Sonali Bank	0.11	0.25	0.57
	BCB	0.28	0.51	0.50

	Midland Bank	0.37	0.57	0.67
Production Approach				
Efficient	Bank Al Falah	1.00	1.00	1.00
	First Security Islami Bank	0.99	1.00	0.99
	IBBL	0.91	0.99	0.92
Less Efficient	BCB	0.39	0.47	0.70
	Midland	0.42	0.57	0.66
	BRAC	0.49	0.59	0.82
Profitability Approach				
Efficient	Midland	1.00	1.00	1.00
	BCB	0.99	1.00	0.99
	HSBC Bank	0.98	0.99	1.00
	SBI Bank	0.94	1.00	0.94
Less Efficient	Janata Bank	0.28	0.44	0.57
	Agrani Bank	0.29	0.34	0.70
	IBBL	0.30	0.50	0.65
	UCB	0.31	0.41	0.81

In terms of the intermediary role, Premier Bank demonstrated near-full efficiency with a score of 98 per cent, indicating a highly competent management team. Southeast Bank also performed strongly with a 97 per cent efficiency level, further reflecting effective management among private conventional banks. IFIC Bank recorded a 90 per cent efficiency score, with inefficiencies primarily attributable to managerial shortcomings and scale inefficiency, the former contributing slightly more. Collectively, these three private conventional banks outperformed their peers in the intermediary function. Conversely, Sonali Bank, BCB, and Midland Bank exhibited significantly lower efficiency levels in this area. These underperforming banks could benefit from benchmarking against more efficient counterparts to enhance their operational effectiveness.

Meanwhile, only three banks demonstrated notable efficiency under the production approach. Bank Al Falah, an Islamic bank, achieved full efficiency, indicating optimal resource utilisation and a highly competent management team. First Security Islami Bank followed closely with 99 per cent efficiency, with a marginal 1 per cent inefficiency attributed to scale inefficiencies, suggesting near-optimal resource use. Islami Bank Bangladesh Limited (IBBL) also showed strong resource utilisation, with its primary inefficiency stemming from management competency, accounting for a 9 per cent shortfall. Notably, these three Islamic banks outperformed others significantly under this approach. Conversely, banks like BCB, Midland, and BRAC could benefit by adopting practices from these Islamic banks, particularly in channelling investments and financing towards productive ventures and managing operations more effectively to enhance their efficiency.

Under the profitability approach, four banks achieved more than 90 per cent efficiency level. Midland Bank demonstrated full efficiency throughout the study period, reflecting a capable management team and optimal resource utilisation. BCB Bank also performed admirably with a 99 per cent efficiency score, evidencing strong managerial competence. HSBC Bank followed closely with 98 per cent efficiency, successfully utilising its resources, while SBI Bank achieved 94 per cent, with its 6 per cent inefficiency primarily due to suboptimal resource utilisation despite competent management. Notably, none of the public-owned banks surpassed the 90 per cent efficiency threshold under this approach during the study period. Public banks such as Janata and Agrani, alongside Islamic bank IBBL and UCB, struggled to meet profitability demands, as reflected in lower efficiency scores. These banks may face challenges in offering customer-centric services within a competitive market. Adopting best practices from more efficient banks could enable these institutions to enhance their operational and promotional efforts, thereby improving overall performance.

Overall, Table 5.2 highlights the diversity in efficiency across banks and approaches, suggesting that benchmarking against best performers can guide underperforming banks toward adopting more effective operational practices.

5.5.3 Proposed Improvement Strategies

Enhancing efficiency is crucial for commercial banks to strengthen profitability, competitiveness, and overall operational efficiency. Several strategies can be taken by banks to improve their efficiency, for instance, embracing technology to optimise operations and deploy digital banking solutions, streamlining repetitive operations such as account initiation and transactions, and optimising online banking platforms to promote customer satisfaction and operational effectiveness. Besides, banks may perform periodic evaluations of resource distribution among various departments and functions. Bank managers may improve the utilisation of resources and efficiency of the workforce by determining occurrences of excessive staffing or inefficient use of resources and redistributing staff and resources to areas of greater importance or growing prospects. Another strategy is recommended to establish resilient risk assessment protocols and employ sophisticated analytics for risk modelling to enhance risk management frameworks to effectively minimise credit, operational, and compliance risks. Besides, banks streamline and standardise operational procedures to eliminate duplications and inefficiencies. Banks may enforce cost-control strategies to decrease unnecessary expenditures. Finally, banks can develop explicit Key Performance Indicators (KPIs) and performance measures to oversee enhancements in efficiency. Consistently evaluate performance in comparison to established standards, analyse the underlying causes for any discrepancies, and take appropriate measures to promote ongoing enhancement. By implementing these strategies, banks may boost their efficiency levels and thus performance.

5.6 CONTRIBUTIONS

Several important aspects of this research have been discussed, for example, statement of problems, research questions, research objectives, research significance, relevant literature reviews, research gaps, research methodology, data sources and collection methods, analysis approaches, results of the analysis, and discussion on significant findings. All these discussions address the question of “how this research contributed to the body of knowledge?”. Undoubtedly, the current research has made valuable

contributions: empirical, practical, and methodological contributions. Specific contributions are further discussed as follows.

5.6.1 Empirical Contributions

From a theoretical standpoint, this research deals with existing banking models and methods of DEA that can be applied to the analysis of banking efficiency, which have different mechanisms and operational objectives for profit maximisation and consumer trust and preferences. An intriguing finding is that efficiency seems to decline nonlinearly with the pandemic crisis in all commercial banks. Furthermore, the different models provided different efficiency results. This is due to the practices of full financial firms by banks. Three main approaches are predominant in the banking sector, integrated with the universal financial services undertaken by banking institutions. The findings contributed to the literature on studying elements of banking activities in the modern banking system. More so, another theoretical contribution is the study of three different banking models utilised in the research to evaluate the average efficiency as well as types of inefficiencies within and between banking groups that are diverse in specialisation and ownership. A further contribution is made to the expansion of banking efficiency literature to Bangladesh since most of the prior studies focus on developed economies. Thus, this research also showed efficiency scores under three diverse models in Bangladeshi banking studies. This research advances knowledge about how diversification of banking approaches affects bank performance. The contribution made to the literature through the assessment of three different banking approaches, especially the profitability and production approach, is scarce in the literature. The findings of this research further aid researchers seeking to understand the different banking approaches and their effectiveness on bank performance in Bangladesh.

This research further contributes to the knowledge relevant to banks that differ by ownership. Prior studies have demonstrated a significant gap in banking performance under the ownership strategy. The findings of this research showed a poor efficiency level of government-owned banks. This evidence can be a source of further studies, especially in low-developing countries. Further, it also aids in literature that shows the necessity of the privatisation of commercial banks. Besides, the majority of the literature confirmed

the better efficiency of Islamic banks globally. The findings of this study may enrich the threads of evidence. Moreover, the findings demonstrated that throughout the most recent crisis, Islamic banks performed better than conventional banks due to their better asset quality and management competency.

5.6.2 Practical Contributions

This research presents implications for the banking sector in Bangladesh by delivering a thorough, empirically based methodology for evaluating and comparing efficiency among different types of banks. The amalgamation of intermediation, production, and profitability approaches enables banks to assess their operational strengths and weaknesses comprehensively. This helps banks uncover opportunities for digital innovation, optimisation of resources, and portfolio diversification, especially state-owned and Islamic banks. Moreover, the comparative analysis of Islamic and conventional banks informs product and service tactics within a highly competitive financial sector. The results imply that managers can use efficiency measurement to benchmark a bank's overall performance. Competent management in banks facilitates cost-effective decision-making and boosts efficiency when it comes to the output-to-input ratio. Banks and other institutions may be able to better control operating costs, lower capital costs, increase capital effectiveness, and develop synergies across different banking strategies with improved resource utilisation. Better operational and strategic choices can result from managers who manage resources more effectively. So, while allocating resources, the management of an inefficient bank should keep technical efficiency in mind. Moreover, financial institutions can boost their efficiency by implementing new management strategies, products, and services. The banking sector in Bangladesh has not yet prioritised the improvement of efficiency through the proper management of deposits, loans, and investments at the optimal level of operations. This research may be used by policymakers to strengthen their oversight and regulation of the banking sector in Bangladesh, thereby boosting the country's economic growth. Another implication of this research is that it offers new evidence of the linkage between efficiency and bank ownership and specialisation in Bangladesh's dual-operation banking sector. The diverse banking models and operations emerged due to the current practices of banking institutions as universal banks providing all sorts of financial services to their

customers. Thus, bank managers and policy-makers may take note of the findings of this research to emphasise banking operations and regulations in order to stabilise banking efficiency. A key factor in bank performance is the effective use of human resources. Employees with the necessary skills and knowledge make a major contribution to efficient operations. Consequently, hiring competent staff and funding training initiatives are essential to reaching high managerial efficiency. Fostering departmental collaboration also guarantees smooth coordination, which adds even more to the overall performance of the organisation.

More specifically, bank managers and the board of directors may strengthen their operations and strategies to improve efficiency levels under all banking models in the competitive market. As intermediaries for savers and borrowers, banks manage deposits as well as make lending decisions based on risk assessment. In addition, it is crucial to keep in mind that challenges still exist in spite of developments in strategic planning and technology. The regulations governing financial services around the world are constantly changing, making regulatory compliance critical. A bank's reputation could be tarnished, and severe consequences could result from breaching regulations. Managing risks related to credit disbursing is another challenge, as credit defaults have the potential to bankrupt the bank if they are not managed carefully. Thus, a key component of any bank's strategy should include effective risk management procedures. The stability of the financial markets depends on their capacity to effectively manage these operations. Policymakers may implement new regulations or rectify the current regulations and guidelines for banking institutions to boost their efficiency to sustain economic growth. Particularly, strengthen the regulations, operations, and banking strategies of public-owned commercial banks to make them more productive and efficient. On the other hand, Islamic banks are comparatively more efficient than conventional banks; managers should focus more on them to improve their operational competency to make them close to full efficiency. In this regard, policymakers may introduce independent and robust Shariah guidelines to protect consumers' beliefs and integrity in Islamic financial institutions. In concluding remarks, at both managerial and empirical levels, this research made a contribution by creating a framework integrating different approaches in which a single technique can be applied to measure both average efficiency and comparative scores between banking groups that are diverse in ownership and specialisation for effective managerial decisions and policy recommendations. Thus, it bridges the mislaid

connection between theory and application. Besides, the significance of human capital development in terms of banking activity diversification is unavoidable. Therefore, regulators and legislators must take the initiative to allow banks to invest in human capital in order to develop effective banking systems and long-term benefits.

Despite the differences in ownership structure and business approaches, all banks use a variety of strategies to make substantial contributions to maintaining strong and stable national economies. Public sector banks assist in bridging socioeconomic disparities and ensuring equitable access to financial resources across all societal segments, whereas private banks encourage competition and promote technical developments, supporting entrepreneurship and employment creation. The assumption that public-owned banks are far away from being effective by global standards has led many developing economies to implement bank consolidation plans. The findings pointed to the need for more prudence in government-mandated bank consolidation. Meanwhile, Islamic banks focus on Islamic-compliant financial services and products that draw religious people's attention to the financial system. Therefore, the coexistence of all banks with different structures assures a stable and effective banking system that can satisfy the diverse needs of the contemporary global economy. Policymakers in a diverse economy should promote all types of banking institutions in order to enhance financial inclusion, thus promoting financial activities on a broader range. The research addresses performance discrepancies among bank categories, hence contributing to larger financial inclusion in Bangladesh. By reducing transaction costs, banks can aid in more access to finance for marginalised groups (such as rural communities, small and medium enterprises, and women-led firms), and improve customer service responsiveness, thus improving efficiency levels. The results can assist banks in developing inclusive financial products, such as low-income savings accounts or community microfinance instruments, that bolster national initiatives in poverty alleviation and equitable development. Moreover, efficient banking fosters durable economic stability and resilience by minimising systemic inefficiencies and encouraging financial innovation. Furthermore, the restriction of speculation and debt-driven expansion in Islamic banking fosters a sustainability-focused financial system. This underscores the capacity of Shariah-compliant institutions to promote ethical, sustainable, and socially responsible finance, exemplified as green sukuk or waqf-based development funding.

5.6.3 Methodological Contributions

From the methodological viewpoint, using DEA to estimate the efficiency scores of Bangladeshi banking organisations undoubtedly provided further insights into the differences across banking groups and specialisations, strengthening the outputs of frontier analysis, particularly technical efficiency results. In other words, the DEA technique is treated as the most effective method for articulating or estimating the efficiency measures for all kinds of business models, either for financial institutions or manufacturing sectors. Another contribution is the positioning of the favourability and unfavourability inefficiencies caused across banking subgroups over the study period. The method applied in a particular application is to decompose the efficiency scores into three components to estimate the overall efficiency as well as the inefficiency caused across banks. Another methodological contribution is the development of a single framework with three different approaches, which is assessed by a single technique (DEA) between different groups of banks that are diverse in terms of ownership and specialisation. Uses of different inputs and outputs, whereas deposits have been used as intermediaries between production and the intermediation approach during the assessment of the efficiency level. In other words, deposits have been treated as input and output from different perspectives using the same mathematical technique to evaluate the performance of the banking sector in Bangladesh. According to the findings, government-owned banks seem to be less efficient than privately held banks. Therefore, the Bangladesh government should impose more limits on bank lending practices.

5.7 LIMITATIONS OF THE STUDY

Several limitations can be articulated in this research, which are common and generally accepted within the scope of PhD studies that seek to explore complex topics in a manageable and focused manner. First, the study focuses exclusively on commercial banks operating in Bangladesh, which limits the ability to generalise findings to other economies. The application of Data Envelopment Analysis (DEA) is restricted to the envelopment formulation without incorporating the multiplier formulation or other efficiency measures such as cost or profit efficiency. Although DEA is a widely accepted method, alternative techniques like Stochastic Frontier Analysis (SFA) are also

commonly used, but were not applied here. The sample size includes only 38 of approximately 58 commercial banks, potentially affecting representativeness, while the analysis covers six years, limiting insight into longer-term efficiency trends. Additionally, the research does not use Malmquist Index analysis, which could have provided a better understanding of technological progress and productivity changes over time. Finally, comparisons are limited to private versus public and Islamic versus conventional banks, excluding domestic versus foreign ownership distinctions.

5.8 RECOMMENDATIONS FOR FURTHER STUDY

Several extensions could be made to this study to compensate for its limitations. It is suggested that risk exposure factors be included in any future research on the development and performance of Bangladeshi commercial banks. The factors that expose an organisation to risk should be evaluated in terms of their impact on efficiency and output. Production and operational strategies for efficiency and productivity change analysis, as well as the use of parametric methods for assessing overall efficiency, may be the subject of future research. It would also be prudent to use a machine learning approach and an agent-based financial model relevant to banking efficiency in further work to produce a parallel computation process with enhanced characteristics, particularly concerning convergence. Some works, including Polyzos et al. (2023), have previously attempted to explore these directions in the literature.

Since there is still much work to be done, the analysis and discussions in this research will encourage greater research in this area. To begin with, disaggregated data on certain products and business lines are required to have a deeper understanding of the distinctions in the provision of financial services between Islamic and conventional banks. This would enable the readers to incorporate Islamic windows, that is, traditional banks that provide products complying with Sharia law, into future research. Subsequent research endeavours may also evaluate the influence of Islamic bank expansion on the banking system's growth and, eventually, the ability of companies and enterprises to obtain and utilise banking products. A few notable variations in banking models are indicated by empirical assessments. Nonetheless, this research discovered that Islamic banks have superior efficiency compared to conventional banks, which indicates better

management competency and asset quality. Additionally, this research discovered that Islamic banks outperform conventional banks in terms of intermediation and production approaches. Further investigation is necessary to fully understand the significant variances that exist between different countries and sizes of Islamic banks.

Remarkably, there are very limited studies considering various banking models evaluating the efficiency levels, and comparing the most effective models for commercial banks in certain countries. Since there are not many studies on efficiency evaluation using various approaches, more studies are deemed important to minimise the global research gaps relevant to diverse banking models' efficiency levels. Additionally, the study proved that the intermediary function is not substantial anymore in regard to most banking institutions, and thus cannot be a standalone contributor to economic growth. Therefore, further studies should be carried out to examine the connection between commercial banks' efficiency from diverse models and economic growth.

It is important to note that the use of annual data may prove to be a limitation of this research, since high-frequency data analysis may not provide the relevant effect factors when combined with annual data (Angori et al., 2019). The number of years is another drawback of this research. A panel data analysis will provide a clearer picture if the years are expanded, since specific analyses indicate that particular series may be stationary at the individual level. This can be enhanced further by including more years. Future studies may also conduct cross-border studies to evaluate efficiency and productivity. By including similar economies, further study may provide robust findings across borders that share similar economic endeavours and their banking efficiency levels, which will help regulators to acknowledge. The sample size can be extended in future studies to cover all commercial banks to observe the complete picture of the efficiency of Bangladeshi commercial banks. Even though this research contributed significantly to understanding how ownership structure, ownership concentration, and their interactions affect credit risk, further investigation is necessary. Future investigations should carry out a cross-country (e.g., SAARC, India, or other emerging countries) study to compare these associations. Further studies can be considered, including the Malmquist index to observe the changes in performance between years and further decompose efficiency due to technological and operational factors.

5.9 CONCLUSIONS

This research makes a meaningful contribution to the literature on bank efficiency in developing economies by employing a comprehensive, multi-dimensional framework that incorporates production, intermediation, and profitability approaches to evaluate the performance of Bangladeshi commercial banks from 2016 to 2021. By applying the Data Envelopment Analysis (DEA) technique, the study offers nuanced insights into various bank types, including Islamic and conventional, as well as state-owned and private institutions, across multiple efficiency metrics such as technical, purely technical, and scale efficiencies. While previous studies have primarily focused on the intermediation approach, very few have simultaneously considered all three approaches to gauge efficiency. Consequently, prior research has seldom revealed which operational model most effectively drives bank efficiency or explored efficiency differences between private and public banks. The integration of these three approaches in this study provides a previously undisclosed perspective on bank performance and highlights the distinctive strengths of individual institutions. These findings are especially notable in identifying high-performing banks and clarifying which methodological approach best showcases their competencies within the sector. Although DEA alone possesses limited explanatory capacity, its strategic amalgamation with comparative analysis, sub-group assessments, and second-stage regression modelling renders it a significant and focused methodology to tackle the complex research gaps identified in the literature and the objectives of this research. The findings demonstrated a weaker overall efficiency score for all commercial banks. The efficiency score under the production approach was comparatively efficient compared to the intermediation and profitability approaches. State-owned banks posited higher efficiency scores under the production approach, while private banks showed better efficiency in the other two approaches. Islamic banks outperformed conventional banks under the production and intermediation approach, except for the profitability approach, in terms of overall efficiency.

The findings provide the banking sector with a pragmatic benchmarking instrument to pinpoint internal inefficiencies and replicate the strategic attributes of high-performing counterparts. Financial institutions can leverage this information to recalibrate resource distribution, invest in operational innovations, enhance governance frameworks, and diversify service offerings. Islamic banks can enhance profitability by

diversifying into digital shariah-compliant investment products, whereas state-owned banks must rectify governance deficiencies and operational inflexibilities. In addition, as banks strive to improve efficiency, customers may gain from reduced transaction costs, enhanced digital platforms, and more customised financial solutions, especially for underrepresented groups like SMEs and rural clients. Systemic resilience offers insights into crisis-response tactics. The findings further provide a comprehensive assessment of bank performance in Bangladesh and serve as a framework for future changes aligned with the nation's financial inclusion and economic development goals.



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APPENDIX I

PAST STUDIES ON EFFICIENCY

Authors/ Year	Country	Objective	Input	Output	Approach
(Asmild et al., 2022)	Bangladesh	differentiate inefficiency of family vs non-family-owned banks	salary cost, other costs	non-interest revenue, net interest revenue	profitability
(Boubaker et al., 2022)	10 Countries	the efficiency of Islamic banks	operating expenses, total deposits	operating incomes, other earning assets	Intermediation
(Mirzaei et al., 2022)	48 countries	efficiency of Islamic vs conventional banks	staff cost, fixed cost, total deposits, impaired loans	total customer loans, other earning assets, non-interest income	Intermediation
(V. P. Kumar & Kar, 2023)	India	Efficiency of private vs public bank	intermediation: fixed assets, operating costs profitability: deposits	intermediation: deposits operating: interest income, other income	Intermediation, profitability
(Safiullah & Shamsuddin, 2022)	28 Countries	Efficiency of Islamic vs conventional banks	total deposits, physical capital, labour	total loans, other earning assets, non-interest income	Intermediation
(Milenković et al., 2022)	Western Balkans countries	sustainability of intermediate functions of banks	deposits, labour costs, capital	loans, investments	Intermediation
(Algeri et al., 2022)	Italy	Operation efficiency of small banks	total funds, staff expenses, fixed assets, loan loss provision	total loans, other earning assets	Intermediation
(Akin Aksoy & Kandil Goker, 2022)	Turkey	Efficiency of commercial banks	production: fixed assets, employee expenses, profitability: investments,	production: investments, performing loans, car profitability: interest income, non-	Production, profitability

Authors/ Year	Country	Objective	Input	Output	Approach
			performing loans, car	interest income	
(Azad et al., 2021)	Malaysia	Efficiency of Islamic vs conventional	production: capital, deposits intermediation: earning assets, interest expenses profitability: loans, non- interest expenses	production: non-earning assets intermediation: liquid assets profitability: net income, loan loss provision	Intermediation, production, profitability
(Banna et al., 2020)	MENA, Asian	Efficiency of Islamic banks	short-term funding, deposits, staff expenses, fixed assets	other earning assets, loans	Intermediation
(An et al., 2019)	China	Resource plan for banks	operation cost, interest expense, labour, deposit	interest income, non- interest income, non- performing loan balance	Intermediation
(Anouze & Bou-Hamad, 2019)	MENA	Banks' performance	personal expenses with fixed assets, deposits, equity	loans, net income, off- balance-sheet liquid assets	Intermediation
(Tamatam et al., 2019)	India	Efficiency of public vs private commercial banks	total assets, total deposits	advances, interest income, total income, operating profit	Intermediation
(Kamarudin et al., 2019)	Malaysia	Revenue efficiency of local vs foreign Islamic banks	deposit, labour	loans, total income	Intermediation
(Phan et al., 2018)	Hong Kong	Cost efficiency	deposits, total physical capital, labour	total securities and other investments, total loans	Intermediation
(Ouenniche & Carrales, 2018)	UK	Commercial banks' efficiency	labour, capital,	gross loans, total customer deposits	Intermediation

Authors/ Year	Country	Objective	Input	Output	Approach
			interest expenses	total income	
(H. Jiang & He, 2018)	China	Banking efficiency	fixed assets, salaries, operating costs	operating income, net profit	Intermediation
(Banya & Biekpe, 2018)	African Countries	Banking efficiency	deposits, labour	total assets	Intermediation
(Grmanová & Ivanová, 2018)	Slovakia	Banking efficiency	liabilities, operating cost	loans and advances, non-interest income	Intermediation
(Henriques et al., 2018)	Brazil	Banking efficiency	fixed assets, deposits, personal expenses	total loans	Intermediation

APPENDIX II

STUDIES ON THE EFFICIENCY OF BANGLADESHI BANKS

Author	Purpose	Period/Method	Findings
(Alvi et al., 2021)	explores the transmission role of efficiency in the relationship between bank competition and stability	2012-2018 GMM	efficiency plays a transmission role in the relationship between bank competition and stability
(Zheng et al., 2020)	Discover the influence of industry-specific and macroeconomic determinants of NPLs in the entire banking system	1979-2018 ARDL & VEC	Bank loan growth, Net operating profit, and deposit rates negatively impact NPLs, while bank liquidity and lending rates have a positive impact
(Dutta & Saha, 2021)	explore the impact of competition and efficiency on the financial stability of Bangladeshi banks	2009-2017 GMM	a nonlinear competition–stability relationship, and though efficiency contributes to stability, the impact is moderated in the presence of competition.
(Gupta et al., 2021)	examines the concurrent effects of bank risk, efficiency and cost of financial intermediation of Bangladeshi commercial banks	2000-2016 GMM	Efficiency gains cost the spread of banks' financial intermediation and risk-taking negatively affects the return. Cost-efficient banks are taking more credit risk; however, more efficiency gains reduce banks' risk substantially.
(S. M. K. Rahman et al., 2021)	Investigated the impact of bank competition and efficiency on the financial stability of the banking sector	2011-2018 GMM	higher bank competition results in higher bank stability. It is also seen that higher cost efficiency results in higher bank stability
(Moudud-Ul-Huq et al., 2020)	examined the impact of ownership structure on a bank's risk and efficiency	2000-2014 Regression	institutional ownership has positive effect on the overall efficiency of the banks
(Amin et al., 2021)	Examined the relationship between macroeconomic and	2008-2019 Regression	return on assets and inflation negatively influence NPL, but GDP growth has a favourable impact.

Author	Purpose	Period/Method	Findings
	firm-specific factors, and NPLs		
(Nurul Kabir et al., 2020)	investigates the determinants of the credit risk of Islamic and conventional banks	2001-2018 GMM	among the macroeconomic variables, GDP growth decreases credit risk, whereas real interest rate and inflation increase credit risk. Bank-specific variables prove that both clusters of banks suffer from adverse selection and moral hazard problems.
(M. M. Rahman et al., 2020)	examines simultaneous relationships between regulatory capital, risk, and ct-inefficiency	2006-2018 GMM	there is a negative and significant relationship between capital regulation, credit, and overall risk. The capital adequacy ratio is positively and significantly related to default risk and liquidity risk
(Suzuki et al., 2020)	identify the incentives in the conversion strategy into Islamic banks	2004,2008	the higher reserve requirement for conventional banks provides the incentive for the conversion into Islamic banks, given that less reserve requirement
(A. Akter, 2020)	Measured the operation efficiency of foreign branches of public-owned banks	2012-2017 DEA	Foreign branches of banks are performing efficiently over the years as an intermediary financial agent between savers and borrowers
(Fatema et al., 2019)	Investigated the productivity	2013-2017 DEA	Listed commercial banks are technically inefficient
(G. Nabi et al., 2019)	Estimated and compared the performance of public-owned, private and Islamic commercial banks	2009-2014 DEA	Islamic banks (4.42%) are less inefficient than public-owned (14.08%) and conventional commercial (5.81%) banks
(Samad, 2019)	Estimated the efficiency of Islamic banks	2008-2012 DEA, TOBIT	Islamic banks are efficient in managerial as PTE dominates TE, also overall, they are quite efficient
(T. Khan, 2018)	Estimated the deposit performance of both types of banks	2007-2016 Comparison and graphical	In terms of growth and productivity, Islamic banks are better than conventional

Author	Purpose	Period/Method	Findings
			whereas conventional banks are better in the overall measurement
(M. Z. Rahman & Islam, 2018)	Assessed and compared the performance of the banking sector	2010-2016 CAMEL	The banking sector is better in terms of performance and overall capital adequacy than the approximate rate set by the central bank.
(Sarker et al., 2017)	Investigated the performance of Islamic banking, only one bank	2010-2014 Ratio Analysis	The banking ability, efficiency and product diversity are increasing gradually.
(Banna et al., 2017)	Investigated the effect of the global financial crisis and the efficiency of commercial banks	2000-2013 DEA, Regression	Efficiency level was low during 2010 while was the highest in 2001
(Robin et al., 2017)	Assessed the cost efficiency of the commercial banks	1983-2012 SFA, DEA	The cost of banking institutions has fallen due to financial deregulation

APPENDIX III

LIST OF BANKS IN BANGLADESH

There are five types of Banks in Bangladesh. These are:

- A) Central Bank
- B) Public-owned commercial banks
- C) Private commercial banks
- D) Foreign commercial banks
- E) Specialised development banks

A) Central Bank:

- Bangladesh Bank

B) Public-owned commercial banks:

1. Sonali Bank Limited
2. Rupali Bank Limited
3. Agroni Bank Limited
4. Janota Bank Limited

C) Private commercial banks:

1. United Commercial Bank Limited
2. Mutual Trust Bank Limited
3. BRAC Bank Limited
4. Eastern Bank Limited
5. Dutch Bangla Bank Limited
6. Dhaka Bank limited
7. Islami Bank Bangladesh Limited
8. Uttara Bank Limited
9. Pubali Bank Limited
10. IFIC Bank Limited
11. National Bank Limited
12. The City Bank Limited

13. NCC Bank Limited
14. Prime Bank Limited
15. Southeast Bank Limited
16. Al-Arafah Islami Bank Limited
17. Social Islami Bank Limited
18. Standard Bank Limited
19. One Bank Limited
20. Exim Bank Limited
21. Bangladesh Commerce Bank Limited
22. First Security Islami Bank Limited
23. The Premier Bank Limited
24. Bank Asia Limited
25. Trust Bank Limited
26. Shahjalal Islami Bank Limited
27. Jamuna Bank Limited
28. ICB Islami Bank
29. AB Bank
30. Mercantile Bank Limited

D) Foreign commercial banks:

1. Citibank
2. HSBC
3. Standard Chartered Bank
4. Commercial Bank of Ceylon
5. State Bank of India
6. Habib Bank Limited
7. National Bank of Pakistan
8. Woori Bank
9. Bank Alfalah
10. ICICI Bank

E) Specialised development banks:

1. Bangladeshi Krishi Bank
2. Rajshahi Krishi Unnayan Bank

3. Progoti Co-operative Land Mortgage Bank Limited
4. Grameen Bank
5. The Dhaka Mercantile Co-operative Bank Limited (DMCBL)
6. Bangladesh Development Bank Limited
7. Bangladesh Somobay Bank Limited (Cooperative Bank)
8. Ansar VDP Unnyan Bank
9. Basic Bank Limited
10. Karmasangstan Bank

