FinTech Adoption and Its Impact on Bank Profitability: A Study of Bangladeshi Commercial Banks

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Abstract

This study aims to clarify the impact of FinTech (Financial Technology) determinants such as the number of automated teller machines (ATMs), agent banking outlets, cash recycling machines (CRMs), and software development on the profitability of commercial banks of Bangladesh in the tenure of 2019 to 2023. Panel data is used in which a random effect model has been applied to analyze the data. The findings of the study show that numbers of ATMs, CRMs, and agent banking have a statistically significant negative relationship with banks' profitability, and software development has a statistically significant positive influence on banks' profitability. This indicates that the influence of FinTech has mixed evidence on the profitability of banks. The high operating expenses of agent banking, CRMs, and ATMs are perhaps the reason behind their negative effects. On the other hand, software development boosts profitability through process automation, staff reduction, increased productivity, and improved customer experience, all of which result in lower costs and more revenue. These findings will help the competent authorities of Bangladesh create regulatory frameworks that promote effective FinTech implementation, emphasizing digital innovation to boost overall banking performance. For commercial bank management, prioritizing software development over expensive ATMs, CRMs, and agent banking can improve operational efficiency and profitability while alleviating the resource strain associated with maintaining physical infrastructure.

Keywords: FinTech, ATM, CRM, Agent Banking, Software Development, Commercial Banks, Bangladesh.

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1.0 Introduction

FinTech enhances operational efficiency, reduces costs, and expands access to financial services, thereby significantly boosting the profitability of commercial banks. Technological developments have caused a significant upheaval in the banking sector in recent years (Chowdhury & Hussain, 2022). FinTech is the result of the convergence of finance and technology that indicates the creative application of technology to provide financial services and goods in ways that are quicker, more effective, and frequently easier to access than conventional approaches (Merton, 1992). The developed financial technologies have become an important element in the financial industry. These technologies are contributing significantly to the banking industry (Cruz-García et al., 2021).

The term 'FinTech' has been used since 1972 which includes a broad range of applications in banking, insurance, investment management, payments, and lending, among other areas of the financial business (Schueffel, 2016). Peer-to-peer lending platforms, robo-advisors, mobile banking apps, and blockchain-based cryptocurrencies are considered just a few examples of how FinTech innovations are provided, used, and perceived to changing the way financial services (Sharif Abu Karsh, 2020). The introduction of more economical and effective operating models that improve the proper utilization of resources falls under the third category (Ross, 1976; Vasiljeva et al., 2016). Due to FinTech, financial inclusion has increased significantly, and time and costs have also been reduced due to increased efficiency and productivity (Mahmud et al., 2023).

Bangladesh has been making tremendous progress in the technological sector for the last few decades meanwhile this progress continues to cope with the digital revolution. The banking industry is also moving forward with this digital revolution(Tushar, 2021). The banking industry in Bangladesh uses several types of FinTech devices and facilities to render financial services (Kabir, Huda, & Faruq, 2021). According to Ahmed, & Enamul (2022), top management of several financial institutions in Bangladesh thinks that a strategic alliance of banks FinTech, and mobile financial services might provide better and more affordable services. In this regard, a question has been determined: Does FinTech enhance bank profitability in Bangladesh?

In this study, the FinTech determinants include ATMs (Automated Teller Machines) (Ullah, 2023), Agent Banking (Hossain et al., 2021), Cash Recycle Machines (CRMs) (Fyaz, 2023), and Software Development (Islam et al., 2021) since these technical advancements are crucial in accelerating the financial services industry's advancement. These components demonstrate how financial institutions use technology to boost productivity, elevate client satisfaction, and broaden financial inclusion (Vives, 2019). The study intends to clarify how FinTech determinants such as the number of ATMs, agent banking outlets, cash recycling machines (CRMs), and software development affect the profitability of commercial banks in Bangladesh. Through expanding access to financial services, cutting transaction costs, and boosting industry efficiency, FinTech has a major positive impact on Bangladesh's GDP growth (Taher & Tsuji, 2022). Increased investment, entrepreneurship, and the creation of jobs are all possible outcomes of this, and they can all support economic expansion.

2.0 Literature Review

FinTech has fundamentally transformed the financial industry by upending long-standing organizational structures and changing the way financial services are offered and consumed (Deng, Huang, & Cheng, 2019). The emergence of peer-to-peer lending, online payment systems, and internet banking in the late 20th and early 21st centuries marked the beginning of the current FinTech scene (Baporikar, 2023). FinTech firms are upending traditional financial services with more user-friendly, economical, and efficient alternatives but it also comes with dangers and obstacles (Murinde et al., 2022). These include risks to cybersecurity, problems with following regulations, worries about data privacy, and moral conundrums (Gimpel et al., 2018). According to Chen(2016), the rise of FinTech ecosystems and cooperative alliances between established companies and startups is erasing preconceived notions and opening up fresh possibilities for cooperation and co-creation.

Banks often play a dominant role in the financial system where according to the notion of financial intermediation, banks are essential to the mobilization and redistribution of social capital (Tang et al., 2024). FinTech is positively and significantly correlated with bank profitability, which indicates that bank profitability is associated with levels of digital engagement (Singh et al., 2021). By using a variety of metrics, such as a FinTech development index and patents, research has been conducted to employ patent data to quantify FinTech innovation. To assess the diverse implications on bank performance and fragility, the heterogeneity of FinTech and banks is significantly considered (Singh et al., 2020; Zhao et al., 2022).

FinTech is creating new facilities and opportunities every day, but without proper planning regarding installation and setup costs, digital machinery costs, and software development costs, it will create a huge burden for the company (Salam et al., 2023). Financial Technology has made financial services easier for people, and they can access them 24/7 through the internet and with smart devices. Since peer-to-peer lending is one of the alternatives that FinTech start-ups provide, they all adhere to the same customer-centric strategy, and the financial sector benefits greatly from FinTech, which lowers costs while delivering better services and raising consumer satisfaction (Tang et al., 2024; Wang et al., 2015).

Day by day, the use of technology is increasing, and people are more and more attracted to technology (Mahmud et al., 2023). Nowadays, people prefer to do their tasks via mobile phones and the internet (Hassan et al., 2022). Davis (1989) has developed the technology acceptance model, which states that a technology's perceived ease of use and usefulness influence a user's intention to embrace it. In the 21st century, banks and FinTech are walking hand in hand and banks financial activities cannot be imagined without financial technology. With the assistance of FinTech, Banks provide different types of facilities to their customers such as CRMs (Cash Recycling Machines), ATMs (Automated Teller Machines), Agent Banking, and updated software development.

Furthermore, researchers (Cho & Chen, 2021; Kou et al., 2021; Mustapha, 2018; Scott et al., 2017; Tunay et al., 2015; Wang et al., 2021; Zhang & Yang, 2019) have shown that investment in FinTech has a favorable impact on profitability. Banks are constantly coming up with new services using FinTech, and certainly, these services and facilities are reducing the time and costs of banks and increasing efficiency. However, a research conducting on Japanese banks from 2004 to 2018 shows that even in developed countries, financial inclusion is critical but branch closures reduce Japanese bank profitability and in addition, the number of loan accounts and ATMs does not affect bank profitability (Kumar et al., 2022). According to Vives (2019) it has been discovered that there is a growth in the quantity of ATMs and branches, indicating an increase in operations and customers. They also found that commercial banks were open to growing their operations into areas and locations for unbanked people. The bank's incentives to take a chance and increase its efficiency and profitability could have altered in reaction to FinTech developments. Moreover, FinTech has improved the performance of international banks, whereas the number of electronic financial services that banks provide to their clients increases in direct proportion to the quality and performance of the banks (Almashhadani et al., 2023).

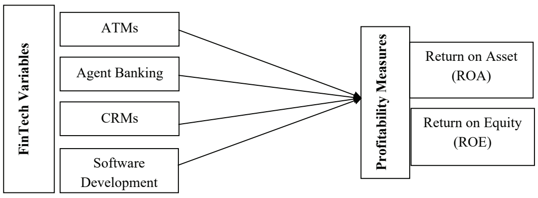
Additionally, Gržeta et al. (2023) opined that in contrast to big and medium-sized banks, small banks are adversely affected by the global regulatory framework in terms of profitability and relative efficiency. The relationship between digital investments and profitability is influenced by the size of the bank (Chhaidar et al., 2022). A bank's resources, agility, risk tolerance, and strategic priorities are all impacted by its size, which has an impact on how well it adapts to FinTech. Firm Size is also a fundamental element in determining the profitability of banks. Banks that are large may indicate credit-worthiness and financial sound in their business, and they can make more investments which brings them high profit (Hermuningsih et al., 2023).

Return on Assets (ROA) and Return on Equity (ROE) are critical metrics for evaluating bank profitability, offering insights into asset utilization and shareholder returns. ROA measures how effectively banks convert assets into profits, while ROE reflects profitability in relation to shareholders' equity. Higher values in both metrics indicate effective management and operational efficiency, which are vital for attracting investors and sustaining competitive advantages (Naceur & Omran, 2021). Furthermore, Rahman (2023) emphasizes that ROA is significantly influenced by operational efficiency through business intelligence, allowing banks to provide superior services at lower costs than their competitors. Caiado, Nascimento, Quelhas, Tortorella, Rangel (2018) found that FinTech positively impacts ROE and net investment profits (NIP), while its effect on ROA is positive but insignificant. Despite being accounting measures, these metrics are significant in banking because they represent two key perspectives of profitability: asset efficiency (ROA) and shareholder value creation (ROE), offering a holistic view of a bank's financial health.

Previous research in Bangladesh has looked at how individual FinTech elements—like software development, ATMs, cash recycling machines (CRMs), and agent banking—affect bank profitability. However, there hasn't been any thorough study that combines all four factors to evaluate their overall impact. Specifically, Uz-Zaman et al. (2023) investigated agent banking; Fyaz (2023) investigated CRMs; Moon et al. (2022) and Ullah (2023) investigated ATMs; and Uz-Zaman et al. (2023) investigated software development. Therefore, this study uniquely combines the effects of four FinTech variables—ATMs, CRMs, agent banking, and software development—together for the first time in the context of Bangladesh, aiming to enhance understanding of their collective impact on bank profitability utilizing ROA and ROE measures. In addition, this study also uses firm size as a control variable, which helps to isolate its effect on profitability while identifying the effect of FinTech on bank profitability.

The Technology Acceptance Model (TAM) provides a theoretical framework to understand the adoption of FinTech solutions, such as ATMs, CRM systems, software development, and agent banking, in enhancing bank profitability. Perceived usefulness and ease of use, key TAM variables, play crucial roles in the acceptance of these technologies (Davis, 1989). For instance, ATMs and CRM systems streamline customer interactions and reduce operational costs, leading to higher efficiency and customer satisfaction (Venkatesh & Davis, 2000). Software development enables banks to offer innovative financial products, improving user experiences and increasing customer retention (Chuang & Hu, 2011). Agent banking extends services to underserved areas, boosting financial inclusion and revenue streams (Sarma & Pais, 2011). As banks embrace these FinTech advancements, the resulting improved operational efficiency and service accessibility directly contribute to increased profitability. Hence, the TAM framework effectively explains how banks' adoption of FinTech positively impacts their financial performance. Based on the above discussions, the following conceptual framework has been developed for this study:

Figure 1: Relationship Between FinTechs and Bank Profitability:



Notes: The above figure shows the expected relationship between FinTech variables and profitability measures.

3.0 Methods and Hypothesis Development

3.1 Sample Selection and Data Source

For this study, a sample of 30 commercial banks is selected and data is for the period of 2019 to 2023. Although 62 scheduled banks operate under the full supervision of Bangladesh Bank, only 30 commercial banks were listed on the Dhaka Stock Exchange (DSE) as of December 2019. The selection of the 2019–2023 study period was motivated by the notable technological developments and FinTech investments that have revolutionized Bangladesh's banking industry. This period maximizes the sample size by enabling a thorough examination of all 30 commercial banks listed on the Dhaka Stock Exchange. A focus on these years enhances data reliability, as earlier periods would yield fewer banks with complete information, thereby providing a more robust understanding of the relationship between FinTech and bank profitability.

3.2 Variable Description

Previously authors (Tushar, 2021; Zheng et al., 2023; Singh et al. 2021; Ullah, 2023; Ashraf, 2023) incorporated profitability measures through a proxy variable like return on asset (ROA) and further some of them (Fyaz, 2023; Rachman & Hendayani, 2023; Ahmed et al., 2017; Mustapha, 2018; Chhaidar et al., 2023; and Mwambuli & Richard, 2024) also used the return of equity (ROE) to evaluate the bank profitability. This study utilized both ROA and ROE as the proxy of profitability measures following previous studies like Andreou et al. (2016), Hasan, Tawfiq, Hasan, & Islam (2024), Cheema and Din (2013). Consequently, automated teller machines (ATMs), agent banking, cash recycling machines (CRMs), and investment in software development are used as FinTech variables and firm size is considered as a company-specific variable which is used as a control variable. A brief illustration of the variables is shown in Table 1.

Table 1: Variable Measurement

Serial No.	Variable Name	Variable Definition	Sources
Performance Measure(Dependent Variables)			
1	Return on Asset (ROA)	A financial indicator called return on assets (ROA) shows how well a business uses its assets to make a profit. It calculates a company's profitability based on all of its assets.	Zheng et al. (2023);
2	Return on Equity (ROE)	A company's profitability is determined by its return on equity (ROE), which is the ratio of equity owned by shareholders to earnings. It demonstrates how well the business is making money off of the capital that shareholders have made.	Singh et al. (2021); Ahmed et al. (2017)
FinTech Determinants (Independent Variables)			
3	Automated Teller Machines (ATMs)	An automated teller machine (ATM) is a computerized device that eliminates the need for a human teller to assist bank customers with their financial operations. Cash withdrawals, deposits, transfers, and balance enquiries are examples of transactions.	Ullah (2023);
4	Agent Banking	The term "agent banking" describes a banking model in which financial institutions use approved third-party agents or individuals to deliver banking services. These representatives, who work for local companies or retail establishments, represent banks in providing a variety of banking services, including account opening, deposits, withdrawals, money transfers, and bill payment.	Ashraf (2023); Hossain et al. (2021)

5	Cash Recycle Machines (CRMs)	Recycled cash machines, or CRMs, are sophisticated banking devices that both accept and disburse currency. Customers' deposited cash can be recycled by them, allowing for withdrawals of the same sum. CRMs assist in controlling the machine's cash flow and lowering the need for frequent cash replenishments.	Fyaz (2023); Rachman & Hendayani (2023)
6	Software Developments	The process of creating, coding, testing, and maintaining systems or applications is referred to as software development. It includes every step of the process from gathering requirements to implementing and supporting software.	Chhaidar et al., 2023); Islam et al. (2021); Panova (2021)
Company Specific Factor(Control Variable)			
7	Firm Size	The term "firm size" describes the scope or size of an organization, which is frequently determined by indicators like market capitalization, total assets, revenue, and number of people. It can be categorized as small, medium, or large based on the type of business and the area.	Mwambuli & Richard (2024); Arner Et al. (2015)

3.3 Hypotheses Development

3.3.1 ATM and Bank Profitability

Banks in Bangladesh have significantly reduced operational expenses in order to enhance profitability due to the installation of Automated Teller Machines (ATMs), which eliminate the need for physical branches and staffing (Bangladesh Bank, 2023). The financial performance of banks can be improved by implementing additional ATM banking activity (Degerli, 2019; Ullah, 2023). Clients eventually come to rely on and trust the ATM since it makes managing their financial requirements so simple but unexpectedly, there are drawbacks to security and misuse of ATMs (Moon et al., 2022).In this regard, the world is working to lessen abuse while also attempting to increase comfort and safety (Janakiraman; Nicoletti et al., 2017). The availability of a huge number of ATMs might contribute to the banks' profitability and notifies policymakers to the need to enhance the information technology system to support the most efficient use of online banking in Bangladesh. (Ullah, 2023; Moudud-Ul-Huq, & Hossain, 2020). Thus, the following hypothesis is made-

H_A: *There is a significant relationship between the number of ATMs and bank profitability.*

3.3.2 Cash Recycling Machine and Banks Profitability

On modern ATMs, referred to as recycle ATMs that are now recognized as cash recycling machines (CRM), a single cassette is utilized for both cash withdrawal and deposits (Batı & Gözüpek, 2017). A one-stop banking solution that can help clients with their financial transaction activities is a CRM. This includes depositing and withdrawing money without going through a bank teller. The CRMs have improved cash management and helped banks increase their profit margins by lowering the cost and error of processing cash (Rachman & Hendayani, 2023). Moreover, with CRM reaching previously underserved rural areas, banks have been able to increase customer bases, mobilize deposits, and drive profitability through lower operating costs. CRM has become popular all over the world, as well as in Bangladesh (Fyaz, 2023). Following the above discussion, the below hypothesis is proposed-

H_B: *There is a significant relationship between CRMs and bank profitability.*

3.3.3 Agent Banking and Bank Profitability

Profitability is positively and statistically significantly connected with the number of deposit accounts and agent banking outlets (Chamboko et al., 2021). As rural people have to be brought into the system to improve their living conditions, economic conditions, and agent banking can be extremely helpful in making that possible (Hossain et al., 2021). Further, just before and after the coronavirus pandemic, Bangladesh's agent banking industry had a very consistent growth rate (Ashraf, 2023). Agent Banking is the practice of offering limited banking services to members of the under-privileged class of society by using agents chosen by lawful agreement in place of tellers or cashiers, according to Bangladesh Bank (Hossain et al., 2021). The following hypothesis is made regarding the relationship between agent banking and the profitability of bank-

> H_C: *There is a significant relationship between the numbers of agent banking and bank profitability.*

3.3.4 Investment in Software Development and Bank Profitability

The emergence of FinTech software in Bangladesh, namely in the domain of digital payments, has facilitated the provision of novel and inventive services by financial institutions. This has resulted in heightened client engagement and loyalty, ultimately leading to increased profit margins (Amin, Taghizadeh-Hesary, & Khan, 2022). Software development is another essential and inevitable element of FinTech (Islam et al., 2021). Development and installation of modern software have been played an imperative role in banks financial achievement (Panova, 2021). Investing in IT services from outside providers seems to have a positive effect on accounting profits and profit efficiency, even though buying hardware and software typically lowers banks' performance (Grant & Yeo, 2018). Thus, the below hypothesis is proposed-

> H_D: *There is a significant relationship between investment in software development and bank profitability.*

3.4 Data Analysis Methods

The random effects model of panel data analysis is utilized for this study following the results of the Hausman test and Breusch and Pagan Lagrangian multiplier test (Greene, 2003). Before choosing the random effect model, relevant diagnostic tests such as the multi-collinearity test, autocorrelation test, and normality test also have been conducted (Woolridge, 2004). The following two regression equations are developed for this study-

$$ROA_{i,t} = \beta_0 + \beta_1 ATM_{i,t} + \beta_2 CRM_{i,t} + \beta_3 Agtbank_{i,t} + \beta_4 Softdevelop_{i,t} + \beta_5 Fsize_{i,t} + \varepsilon_{i,t} \text{------------(i) and}$$

$$ROE_{i,t} = \beta_0 + \beta_1 ATM_{i,t} + \beta_2 CRM_{i,t} + \beta_3 Agtbank_{i,t} + \beta_4 Softdevelop_{i,t} + \beta_5 Fsize_{i,t} + \varepsilon_{i,t} \text{------------(ii)}$$

Where, ROA and ROE stand for return on assets and return on equity, respectively. ATM stands for automated teller machines; CRM represents cash recycling machines; Agtbank stands for agent banking outlets; and softdevelop stands for investment in software development. Fsize stands for firm size, which is used as a control variable asit has a direct influence on an organization's capacity to adopt FinTech, firm size is sometimes seen as a critical element in analyses of the variables influencing that capacity (Mwambuli & Richard, 2024). Moreover, i stands for banks, and t stands for time (year) and finally, ε is the error term.

4.0 Data Analysis and Discussion

4.1 Descriptive Statistics

Table 2 shows the results of the descriptive statistics of the examined variable, where data is employed from 30 commercial banks in Bangladesh from 2019 to 2023. Here, the mean, standard deviation, median, minimum, maximum, skewness and kurtosis are shown for all the variables used in this study. The mean ROA and ROE are 0.0748 and 0.1080, respectively, whereas standard deviations are 0.0273 and 0.0317, respectively. The average number of ATMs, agent banking outlets and CRMs are 5.36, 5.11 and 0.8182, respectively. This indicates that the number of CRMs is lower than ATMs in the banking sector of Bangladesh. Furthermore, the logarithmic value of annual average investment in software development is 2.2576 million and the firm size considering its assets amount is 12.73 million. This is mentioned here that natural logarithmic data is used for software development and firm size to improve the normality.

Table 2: Descriptive Statistics

Variables	Obs.	Mean	Std. Dev	Median	Min.	Max.	Skewness	Kurtosis
ROA (%)	150	0.0748	0.0273	0.6700	0.0370	0.1200	0.4067	1.8802
ROE (%)	150	0.1080	0.0317	0.1000	0.0700	0.1600	0.4787	1.7727
ATM (number)	150	5.3642	0.7691	5.5500	4.0800	6.4400	-0.3764	2.0173
Agent Banking (Number)	150	5.1158	1.5037	4.8100	3.2300	7.8900	0.6512	2.3526
Cash Recycling Machines (Numbers)	150	0.8182	0.3893	1.0000	0.0000	1.0000	-1.6499	3.7222
Software Development (million BDT)	150	2.2576	0.9278	2.7268	0.0943	3.2668	-1.1347	2.9441
Firm Size (million BDT)	150	12.7255	0.2858	12.7200	12.3300	13.2500	0.3715	2.1367

Notes: The table shows the mean, standard deviation, minimum, median, skewness, and kurtosis of the return on asset (ROA), return on equity (ROE), automated teller machines (ATMs), agent banking, cash recycling machines (CRMs), software development, and firm size for 30 commercial banks using the data of 2019-2023. Here, natural logarithmic data is used for software development and firm size to improve the normality. This is also mentioned here that firm size is measured by the total assets of the respective financial institutions.

4.2 Correlation Analysis

The presence of collinearity between the variables of explanation and the analysis of the linear connection between the variables is identified using the correlation matrix. Here, both ROA and ROE show a negative correlation with ATMs which was supported by the researchers, Moudud-Ul-Huq & Hossain (2020). In addition, CRMs and agent banking both also show a negative correlation with ROA and ROE. However, the results of a positive correlation between software development and profitability, as measured by ROA and ROE, were aligned with the results of Uz-Zaman et al. (2023). Additionally, firm size exhibits a negative correlation with both ROA and ROE (Table 3). Table 3 also shows that there is no multicollinearity problem, as there is no correlation coefficient between the variables below 0.80. Furthermore, the variance inflation factors (VIF) test shows the mean value of VIF is 3.92 which also justifies that there is little chance of multicollinearity issue among the variables as VIF above 10 indicates a multicollinearity problem (Kutner, Nachtsheim & Neter, 2004; Farag, Meng, & Mallin, 2015; O'brien, 2007).

Table 3: Correlation Matrix

Variables	**ROA**	**ROE**	**ATMs**	**AB**	**CRM**	**SD**	**FS**	**VIF Factor**
Return on Asset (ROA)	1.000							-
Return on Equity (ROE)	0.7389**	1.000						-
Automated Teller Machines (ATMs)	-0.1342**	-0.1194**	1.000					7.13
Agent Banking (AB)	-0.3298**	-0.1665**	0.2225**	1.000				1.74
Cash Recycling Machines (CRM)	-0.4036*	-0.0390**	0.2830**	-0.1725**	1.000			1.31
Software Development (SD)	0.6012**	0.5060*	-0.3012*	-0.1086**	-0.2971**	1.000		1.51
Firm Size (FS)	-0.4283***	-0.3158**	0.5460**	0.5042 **	0.0174**	0.2782*	1.000	7.91

Statistically Significant *p<0.10, **p<0.05, *** p<0.01; t statistics are enclosed in parentheses.

Notes: The table shows the results of Pearson's pairwise correlation coefficients between the examined variables. Data from 30 commercial banks in Bangladesh between 2019and 2023 is utilized. Moreover, the variance inflation factors (VIF)mean is 3.92.

4.3 Results of Regression Analysis

To determine the impact of FinTech on bank profitability, random effects panel regression analysis is used. Moreover, the pooled OLS model was also solicited along with the above-mentioned analysis. In this case, software development, agent banking, automated teller machines (ATMs), and return on assets (ROA) are the independent factors, while return on equity (ROE) and return on assets (ROA) are the dependent variables. In addition, firm size has been considered as a control variable.

The diagnostic tests (normality, multi-colinearity, heteroscedasticity, autocorrelation, and serial correlation) related to panel data analysis have been performed and found that there is no issue with normality, multi-colinearity, autocorrelation, and serial correlation except the heteroscedasticity problem for both regression equations i and ii. Thus, the 'robust standard error'method for both the random effects model (Model I) and the pooled OLS model (Model II) has been applied to element the effects of heteroscedasticity issue following (Mia, 2022). The results of both panel data analysis models are shown in Table 4 below:

Table 4: Influence of FinTech on commercial bank profitability

Variables	Model -I Random Effect Model		Model -II Pooled OLS Model	
	ROA (T-stat)	ROE (T-stat)	ROA (T-stat)	ROE (T-stat)
Automated Teller Machines (ATMs)	-0.0037***	-0.0582*	-0.0050***	-0.0660*
	(-2.55)	(-3.13)	(-4.16)	(-4.98)
Agent Banking (AB)	-0.0001***	-0.0010***	-0.0062***	-0.0075***
	(-0.08)	(-0.13)	(-3.39)	(-2.55)
Cash Recycling Machines (CRM)	-0.0018***	-0.0229**	-0.003***	-0.035**
	(-1.73)	(-1.94)	(-2.59)	(-2.36)
Software Development(SD)	0.0029***	0.0010***	0.0030**	0.0045**
	(2.85)	(2.73)	(1.94)	(2.35)
Firm Size(FS)	-0.0482**	-0.0472**	-0.0681*	-0.0783*
	(1.14)	(2.71)	(2.75)	(4.22)
Constant	0.0277***	0.3997***	0.041***	0.49***
	(4.61)	(5.18)	(6.45)	(7.33)
F-Stat	0.0010***	0.0001***	0.0400***	0.0450***
	(20.05)	(19.08)	23.05)	(21.31)
Adj-R2	0.592	0.512	0.648	0.565
No. of Observations	150	150	150	150

*Statistically Significant *p<0.10, **p<0.05, *** p<0.01; t statistics are enclosed in parentheses*

Notes: The table shows the results of FinTech's influence on the profitability of commercial banks in Bangladesh using 30 commercial banks' data from 2019 to 2023.Model-I shows the results of the random effects model and Model- II shows the results from the Pooled OLS model. Here, the Pooled OLS model is applied to check the robustness of the results of the random effect model. Additionally, the 'robust standard error' method is applied to both tests as the data suffers from heteroscedasticity problems.

The regression analysis demonstrates a significant negative impact of ATMs on both return on equity (ROE) and return on assets (ROA) which indicates ATMs have a significant relationship with bank profitability, supporting the hypothesis H_A .The ATMs' coefficients in Model I (Random Effects) are -0.0037 (t = -2.55, p <0.01) for ROA and -0.0582 (t = -3.13, p < 0.10) for ROE. These findings suggest that ATMs may not be as profitable in the short run because of the costs involved, including installation, maintenance, and operating charges. Similar to this, Model II (Pooled OLS) shows that the results of the random effect are credible with coefficients of -0.0660 ($t = -4.98$, $p < 0.10$) for ROE and -0.0050 ($t = -4.16$, $p < 0.01$) for ROA. Additionally, Jegede (2014) and Singh et al. (2021) discovered a negative correlation between ATM usage and bank profitability. ATM deployments must be in line with long-term profitability objectives through a well-balanced investment strategy that takes potential revenue, operational expenses, and user demand into account.

The regression results show that Cash Recycling Machines (CRMs) have a significant negative influence on both return on equity (ROE) and return on assets (ROA), which supports the hypothesis H_B that there is a strong association between CRMs and bank profitability. The coefficient for CRMs in Model I (Random Effects) is -0.0229 ($t = -1.94$, $p < 0.05$) for ROE and -0.0018 ($t = -1.73$, $p < 0.10$) for ROA. The findings of Hasan (2019) corroborate these results, which indicate that the expenditures of CRMs, including installation and maintenance, may outweigh their immediate financial benefits and negatively affect profitability. The comparable conclusions are also confirmed in Model II (Pooled OLS). This suggests that although CRMs can lower cash handling expenses and improve operational efficiency, their financial impact needs to be carefully considered. Banks ought to think about making the most of their current CRMs and assess whether making more purchases of these devices would be financially prudent. It is crucial to weigh these expenses against possible operational savings to match CRM installations with overarching profitability targets.

The hypothesis H_C, which suggests a significant relationship between the number of agent banking outlets and bank profitability, is supported by the regression analysis, showing a notable negative impact of agent banking on both Return on Assets (ROA) and Return on Equity (ROE). In Model I (Random Effects), the coefficient for agent banking is -0.0001 ($t = -0.08$, $p < 0.01$) for ROA and -0.0010 ($t = -0.13$, $p < 0.01$) for ROE. These findings suggest that the costs connected with expanding agent banking services may outweigh the immediate financial benefits, leading to reduced profitability in the short term. Similarly, Model II (Pooled OLS) also confirms these findings. This highlights the need for banks to critically evaluate the cost-effectiveness of expanding their agent banking networks. Agent banking can increase service reach and financial inclusion, but its effect on profitability needs to be carefully considered. Banks should concentrate on streamlining current agent banking operations and making sure that the possible gains in income and client engagement exceed the expenses of growth.

The regression analysis demonstrates a favorable influence of software development on both Return on Assets (ROA) and Return on Equity (ROE), supporting the hypothesis H_D , which suggests a substantial association between software development investment and bank profitability. The coefficients for software development in Model I (Random Effects) are 0.0029 ($t = 2.85$, $p < 0.01$) for ROA and 0.0010 ($t = 2.73$, $p < 0.01$) for ROE. Siska (2022) supports these findings, which show a positive correlation between software development investments and increased profitability. These investments may also improve customer service, operational effectiveness, and overall financial performance. The same results are also conveyed by the pooled OLS model. This result emphasizes how important it is to spend money on cutting-edge software solutions if you want to increase bank profitability. Banks can accomplish increased efficiency and effectiveness, which can result in higher returns, by enhancing their systems for handling transactions, managing data, and interacting with customers. As a result, investing in software development lowers costs while increasing operational efficiency, which enhances profitability.

Overall, the results of the regression study demonstrate that the profitability of banks is adversely affected by FinTech factors (ATMs, CRMs, and Agent banking). This finding indicates that initial investment costs in ATMs, CRMs, and agent banking have not coped with their revenue generation which leads to the bank's profitability. However, software development has positively influenced the bank's profitability because investment in software helps to reduce operating costs.

5.0 Conclusion

The purpose of this study is to provide insights into the adaptation of FinTech and its influence on commercial banks' profitability in Bangladesh. To assess their effects on the profitability of commercial banks, factors such the quantity of ATMs, agent banking services, cash recycling machines (CRMs), and software development have been used. For the study, the random effects model of panel data analysis is applied wherein data was collected from 30 commercial banks listed in the Dhaka Stock Exchange (DSE) in Bangladesh. After analysis, it has been found that software development has a statistically significant positive impact on bank profitability, while the number of ATMs, CRMs, and agent banking has a statistically significant negative association with banks' profitability. Therefore, the scheduled commercial banks in Bangladesh should examine the current state of the market regarding the number of automated teller machines (ATMs), agent banking facilities, cash recycling machines (CRMs), and software development as these technologies have huge fixed and operating costs; and inefficient investment in FinTech may lessen their banks' profitability.

This research was conducted under certain limitations, which opened up new avenues for future research opportunities. Future studies could include more scheduled commercial banks, beyond those listed on the Dhaka Stock Exchange (DSE), to provide a more comprehensive analysis. Additionally, expanding the scope to investigate other FinTech factors such as mobile financial services, digital wallets, and blockchain technology would offer deeper insights into their impact on bank profitability. Extending the time frame beyond 2019 to 2023, and conducting cross-country comparisons, could further enhance the understanding of how FinTech affects financial institutions across different contexts.

References

Abu Taher, S., & Tsuji, M., (2022). An Overview of FinTech in Bangladesh. In Advances in Finance, Accounting, and Economics, pp. 82–95. https://doi.org/10.4018/978-1-7998-8447-7.

Ahmad, A. H., Green, C., & Jiang, F., (2020). Mobile Money, Financial Inclusion And Development: A Review with Reference To African Experience. Journal of Economic Surveys, Vol. 34 (4), pp. 753–792. https://doi.org/10.1111/joes.12372.

Ahmed, A., & Enamul Hasan, Md. (2021). Bangladesh toward Digital Financial Inclusion: FinTech Experience. Journal of Entrepreneurship and Business Innovation, Vol. 8 (2), pp. 33-49. https://doi.org/10.5296/jebi.v8i2.19115.

Almashhadani, Mohammed and Hasan., (2023). The Impact of Financial Technology on Banking Performance: A Study on Foreign Banks in UAE. International Journal of Scientific and Management Research, vol. 06, pp. 1-21. https://doi.org/10.37502/IJSMR.2023.6101.

Amber A. Smith, David P. Synowka and Alan D. Smith, (2014). E-Commerce Quality and Adoptive Elements of e-Ticketing for Entertainment and Sporting Events. International Journal of Business Information Systems, vol. 15(4), pp. 450-487. https://doi.org/10.1504/IJBIS.2014.060397.

Andreou, P. C., Antoniou, C., Horton, J., & Louca, C. (2016). Corporate governance and firm-specific stock price crashes. European Financial Management, 22(5), 916-956. https://doi.org/10.1111/eufm.12084

Arner, D. W., Barberis, J., and Buckley, R. P., (2015). The Evolution of Fintech: A New Post-Crisis Paradigm? Georgetown Journal of International Law, vol.47, pp. 1271–319, https://doi.org/10.2139/ssrn.2676553.

Ashik-Uz-Zaman, Hossain, M. S., & Abedin, M. T., (2023). Route to financial sustainability: Implications in a mixed method framework [Special issue]. Corporate Ownership & Control, vol.20(3), pp. 386–407. https://doi.org/10.22495/cocv20i3siart13.

Ashraf and Mohammad Ali, (2023). Comprehending the Intention to Use Branchless Banking by Rural People during the Corona Pandemic: Evidence from Bangladesh. Journal of Financial Services Marketing, vol.28(1), pp. 99–116. https://doi.org/10.1057/s41264-021-00136-7.

Babu, K. E. K., (2021). Artificial intelligence in Bangladesh, its applications in different sectors and relevant challenges for the government: an analysis. International Journal of Public Law and Policy. vol.7(4), pp. 319-.333 https://doi.org/10.1504/ijplap.2021.118891.

Baltagi, B. H., (2014). Panel Data and Difference-in-Differences Estimation. Elsevier Piublishhing, pp. 425–33. https://doi.org/10.1016/B978-0-12-375678-7.00720-3.

Bangladesh Bank, (2023). Prudential guidelines for agent banking operation in Bangladesh. https://www.bb.org.bd/en/index.php/about/guidelist.

Bangladesh Bank, (2023). Prudential guidelines for National Financial Inclusion Strategy. https://www.bb.org.bd/en/index.php/about/guidelist.

Baporikar, N. (2023). Fintech Influence on Banking Services. International Journal of Banking, Risk & Insurance, vol. 11(2), pp. 40-49.

Batı, Şeyma, and Didem Gözüpek, (2019). Joint Optimization of Cash Management and Routing for New-Generation Automated Teller Machine Networks. IEEE Transactions on Systems, Man, and Cybernetics: Systems, vol.49(12), pp. 2724–2738. https://doi.org/10.1109/TSMC.2017.2710359.

Ben Naceur, S., & Omran, M. (2008, January). The effects of bank regulations, competition and financial reforms on MENA banks' profitability. Economic Research Forum, 1-33.

Bin Amin, S., Taghizadeh-Hesary, F., & Khan, F., (2022). Facilitating Green Digital Finance in Bangladesh: Importance, Prospects, and Implications for Meeting the SDGs. In Economics, Law, and Institutions in Asia Pacific, pp.143–165. https://doi.

org/10.1007/978-981-19-2662-4_7.

Caiado R, Nascimento D, Quelhas O, Tortorella G, Rangel L (2018). Towards sustainability through green, lean and six sigma integration at service industry: review and framework. Technol Econ Dev Econ, vol. 24(4), pp. 1659–1678. https://doi.org/10.3846/tede.2018.3119.

Chamboko, R., Cull, R., Giné, X., Heitmann, S., Reitzug, F., & Westhuizen, M. V. D., (2021). The role of gender in agent banking: Evidence from the Democratic Republic of Congo. In World Development, vol. 146, pp- 105551-105572. Elsevier BV. https://doi.org/10.1016/j.worlddev.2021.105551.

Cheema, K. U. R., & Din, M. S. (2013). Impact of corporate governance on performance of firms: A case study of cement industry in Pakistan. Journal of Business and Management Sciences, vol. 4(1), pp. 44-46. https://ideas.repec. org/p/pra/mprapa/53202.html.

Chen, Long, (2016). From Fintech to Finlife: The Case of Fintech Development in China. China Economic Journal, vol. 9(3), pp. 225–39. https://doi.org/10.1080/17538963.2016.1215057.

Chhaidar, A., Abdelhedi, M. and Abdelkafi, I, (2023). The Effect of Financial Technology Investment Level on European Banks' Profitability. Journal of the Knowledge Economy, vol. 14(3), pp. 2959–81. https://doi.org/10.1007/s13132-022-00992-1.

Chowdhury, N. H., & Hussain, N., (2022). Using technology acceptance model for acceptance of FinTech in Bangladesh. International Journal of Internet Technology and Secured Transactions, vol. 12(3), pp. 250-269. https://doi.org/10.1504/ijitst.2022.122104.

Chuang, L.M. and Hu, F.C., (2011). An empirical study of customers' perceptions of security and trust in e-payment systems. Electronic Commerce Research and Applications, vol. 10(6), pp.783-791. https://doi.org/10.1016/j.elerap.2011.03.003.

Chuen, D. L. K., & Deng, R. H. (2017). Handbook of blockchain, digital finance, and inclusion, volume 2: ChinaTech, mobile security, and distributed ledger. Academic Press.

Davis, F.D., (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, vol. 13(3), pp. 319-340. https://doi.org/10.2307/249008.

Degerli, Kazim, (2019). Regulatory Challenges and Solutions for Fintech in Turkey. Procedia Computer Science, vol.158, pp. 929–37. https://doi.org/10.1016/j.procs.2019.09.133.

Deng, X., Huang, Z., & Cheng, X., (2019). FinTech and Sustainable Development: Evidence from China Based on P2P Data. In Sustainability MDPI AG, vol. 11 (22), pp. 6434-6453. https://doi.org/10.3390/su11226434.

Farag, H., Meng, Q., & Mallin, C. (2015). The social, environmental and ethical performance of Chinese companies: Evidence from the Shanghai Stock Exchange. In International Review of Financial Analysis, Elsevier BV, vol. 42, pp. 53–63. https://doi.org/10.1016/j.irfa.2014.12.002.

Fyaz, A. S., (2023). The impact of Alternative Delivery Channels (ADC) toward cashless banking: in the light of Islami Bank Bangladesh Ltd. Brac University. http://hdl.handle.net/10361/23653.

Gimpel, H., Rau, D. and Röglinger, M., (2018). Understanding FinTech Start-Ups – A Taxonomy of Consumer-Oriented Service Offerings. Electronic Markets, vol.28(3), pp. 245–64. https://doi.org/10.1007/s12525-017-0275-0.

Gomber, P., Kauffman, R. J., Parker, C., & Weber, B. W. (2018). On the Fintech Revolution: Interpreting the Forces of Innovation, Disruption, and Transformation in Financial Services. Journal of Management Information Systems, vol. 35 (1), pp. 220–265. https://doi.org/10.1080/07421222.2018.1440766.

Greene, W. H. (2003). Econometric analysis. Prentice Hall google schola, 3, 116-125.

Gržeta, I., Žiković, S. and Tomas Žiković, I., (2023). Size Matters: Analyzing Bank Profitability and Efficiency under the Basel III Framework. Financial Innovation, vol.9(1), pp. 1-28. https://doi.org/10.1186/s40854-022-00412.

Hasan, S., M., Tawfiq, T. T., Hasan, M. M., & Islam, K. A. (2024). Corporate governance dynamics in financial institution performance: A panel data analysis. Investment Management & Financial Innovations, vol. 21(3), pp. 292-303. http://dx.doi.org/10.21511/imfi.21(3).2024.24

Hassan, M. S., Islam, M. A., Sobhani, F. A., Hassan, M. M., and Hassan, M. A., (2022). Patients' intention to adopt fintech services: a study on Bangladesh healthcare sector. International Journal of Environmental Research and Public Health, vol. 19(22), pp. 1-19. http://doi: 10.4018/IJABIM.20210701.oa30.

Hassan, Md. S., Islam, Md. A., Sobhani, F. A., Nasir, H., Mahmud, I., & Zahra, F. T., (2022). Drivers Influencing the Adoption Intention towards Mobile Fintech Services: A Study on the Emerging Bangladesh Market. MDPI AG. vol. 13 (7), pp. 349-365. https://doi.org/10.3390/info13070349.

Hermuningsih, S., Sari, P. P., and Rahmawati, A. D., (2022). The moderating role of bank size: influence of fintech, liquidity on financial performance. JournalSiasat Bisnis, vol.27(1), pp. 106–117. https://doi.org/10.20885/jsb.vol27.iss1.art8.

Hossain, Md. Imran, Al-Amin, Md. and Toha, Md Abu, (2021). Are Commercial Agent Banking Services Worthwhile For Financial Inclusion?. Business Management and Strategy, vol.12(2), pp. 206-227. https://doi.org/10.5296/bms.v12i2.19070.

Jakšič, Marko, and Matej Marinč, 2019. Relationship Banking and Information Technology: The Role of Artificial Intelligence and FinTech. Risk Management,vol.21(1), pp. 1–18. https://doi.org/10.1057/s41283-018-0039.

Jegede, C. A., (2014). Effects of Automated Teller Machine on the Performance of Nigerian Banks. American Journal of Applied Mathematics and Statistics, vol. 2(1), pp. 40–46, https://www.academia.edu/download/56056332/ajams-2-1-7.

Jen-Her Wu and Shu-Ching Wang, (2005). What Drives Mobile Commerce?: An Empirical Evaluation of the Revised Technology Acceptance Model. Information & Management, vol. 42(5), pp. 719–729. https://doi.org/10.1016/j.im.2004.07.001.

Jinsong Zhao, Xinghao Li, Chin-Hsien Yu, Shi Chen and Chi-Chuan Lee, (2022). Riding the FinTech Innovation Wave: FinTech, Patents and Bank Performance. Journal of International Money and Finance, vol.122, pp. 102552-67. https://doi.org/10.1016/j.jimonfin.2021.102552.

Joel F. Houston, Chen Lin, Ping Lin and Yue Ma, (2010). Creditor Rights, Information Sharing, and Bank Risk Taking. Journal of Financial Economics, vol. 96(3), pp. 485–512. https://doi.org/10.1016/j.jfineco.2010.02.008.

K. Batu Tunay, Necla Tunay and İlyas Akhisar, (2015). Interaction Between Internet Banking and Bank Performance: The Case of Europe. Procedia - Social and Behavioral Sciences, vol. 195, pp. 363–368. https://doi.org/10.1016/j.sbspro.2015.06.335.

Kabir, Md. H., Huda, S. S. M. S., & Faruq, O. (2021). Mobile Financial Services In The Context of Bangladesh. In Copernican Journal of Finance & Accounting, vol. 9 (3), pp. 83-98. https://doi.org/10.12775/cjfa.2020.013.

Kabir, S., & Sayem, S., (2022). FinTech Services and Network Economics: Mediating Effect of FinTech Adoption. International Journal of Advance Research and Innovative Ideas In Education, vol. 8(5), pp. 314-326.

Karsh, Sharif Abu, and Yusuf Abufara, (2020). The New Era of Financial Technology in Banking Industry. Journal of Southwest Jiaotong University, vol. 55(4), pp. 1-13. https://doi.org/10.35741/issn.0258-2724.55.4.54.

Keliuotytė-Staniulėnienė, Greta, and Gintarė Smolskytė, (2019). Possibilities for Financial Technology Sector Development and Its Impact on Banking Sector Profitability in Lithuania. Economics and Culture, vol. 16(1), pp. 12–23. https://doi.org/10.2478/jec-2019-0002.

Kutner, M. H., Nachtsheim, C. J., & Neter, J. (2004). Simultaneous inferences and other topics in regression analysis. Applied linear regression models. 4th ed. McGraw-Hill Irwin, New York, NY, pp.168-170.

Liu, Y., Saleem, S., Shabbir, R., Shabbir,M.,S., Irshad, A., and Khan, S., (2021). The Relationship between Corporate Social Responsibility and Financial Performance: A Moderate Role of Fintech Technology. Environmental Science and Pollution Research, vol. 28(16), pp. 20174–87. https://doi.org/10.1007/s11356-020-11822-9.

Mahmud, K., Joarder, M. M. A., and Sakib, K., (2023). Customer Fintech Readiness (CFR): Assessing customer readiness for fintech in Bangladesh. Journal of Open Innovation: Technology, Market, and Complexity, vol.9(2), pp.1-21. https://doi.org/ 10.1016/ j.joitmc.2023. 100032.

Menicucci, Elisa, and Guido Paolucci, (2016). The Determinants of Bank Profitability: Empirical Evidence from European Banking Sector. Journal of Financial Reporting and Accounting, vol.14(1) pp. 86–115. https://doi.org/10.1108/JFRA-05-2015-0060.

Merton, R. C., (1992). Financial Innovation and Economic Performance. Journal of Applied Corporate Finance, vol.4(4), pp. 12–22. https://doi.org/10.1111/j.1745-6622.1992.tb00214.

Meyer, D., and Adela S., (2017). The Impact of Remittances on Economic Growth: An Econometric Model. Economia, vol.18(2), pp. 147–55. https://doi.org/10.1016/j.econ.2016.06.001.

Mia, M. A., (2022). Innovations and the Financial Performance of Microfinance Institutions: A Global Evidence. In Social Purpose, Commercialization, and Innovations in Microfinance: A Global Perspective, Springer Publication, Singapur, pp. 121-145. https://doi.org/10.1007/978-981-19-0217-8_6.

Moon, I. T., Shamsuzzaman, M., Mridha, M. M. R., & Rahaman, A. S. Md. M.(2022). Towards the Advancement of Cashless Transaction: A Security Analysis of Electronic Payment Systems. Journal of Computer and Communications. vol. 10(07), pp. 103–129.https://doi.org/10.4236/jcc.2022.107007.

Moudud-Ul-Huq, S., & Hossain, S. A. (2020). Impact of cashless policy on bank's profitability: Evidence from a developing economy. In International Journal of Financial Engineering, vol.07 (03), pp. 2050034-49. https://doi.org/10.1142/s2424786320500346

Murinde, V., Rizopoulos, E., & Zachariadis, M., (2022). The impact of the FinTech revolution on the future of banking: Opportunities and risks. In International Review of Financial Analysis, vol. 81, pp. 102103-130. https://doi.org/10.1016/j.irfa.2022.102103.

Mustapha, S. A., (2018). E-Payment Technology Effect on Bank Performance in Emerging Economies–Evidence from Nigeria. Journal of Open Innovation: Technology, Market, and Complexity, vol. 4 (4), pp. 43-56. https://doi.org/10.3390/joitmc4040043.

Mwambuli, E. L., & Richard, P., (2024). What Determines Financial Performance? An Insight of Market and Firm level attributes in Tanzania. African Development Finance Journal, vol.7(6), pp.70-94. http://journals.uonbi.ac.ke/index.php/adfj

Nicoletti, Bernardo, (2017). The Future of FinTech. Springer International Publishing. https://doi. org/10.1007/978-3-319-51415-4.

Niina Mallat, Matti Rossi, Virpi Kristiina Tuunainen and Anssi Öörni, (2009). The Impact of Use Context on Mobile Services Acceptance: The Case of Mobile Ticketing. Information & Management, vol.46(3), pp. 190–95. https://doi.org/10.1016/j.im.2008.11.008.

O'brien, R. M. (2007). A Caution Regarding Rules of Thumb for Variance Inflation Factors. In Quality & Quantity, Springer Science and Business Media LLC, Vol. 41 (5), pp.673–690. https://doi.org/10.1007/s11135-006-9018-6.

Panova, G., (2020). Digital Platforms and Banks. In Lecture Notes in Networks and Systems, pp. 463–472., https://doi.org/10.1007/978-3-030-47458-4_55.

Paula Cruz-García, Juan Fernández de Guevara and Joaquín Maudos, (2021). Bank Competition and Multimarket Contact Intensity. Journal of InternationalMoney and Finance, vol.113, pp. 102338. https://doi.org/10.1016/j.jimonfin.2020.102338.

Perwej, Dr. Y., Qamar Abbas, S., Pratap Dixit, J., Akhtar, Dr. N., & Kumar Jaiswal, A. (2021). A Systematic Literature Review on the Cyber Security. International Journal of Scientific Research and Management.vol. 9 (12), pp. 669–710. https://doi.org/10.18535/ijsrm/v9i12.ec04

Rachman, Nurida Dhatin Afiza, and Ratih Hendayani, (2023). THE

Effect of E-sercvice Quality on Customer Satisfaction of Cash Recycling ATM Users With Technological Optimal as a Moderating Variables. International Journal of Economics, Business and Accounting Research (IJEBAR), vol. 7(2), pp.1-15. https://doi.org/10.29040/ijebar.v7i2.8898.

Rahman, M. M. (2023). The effect of business intelligence on bank operational efficiency and perceptions of profitability. FinTech, vol. 2(1), pp. 99-119. https://doi.org/10.3390/fintech2010008

Sarma, M. and Pais, J., (2011). Financial inclusion and development. Journal of International Development, vol. 23(5), pp. 613-628. https://doi.org/10.1002/jid.1698.

Schueffel, Patrick, (2016). Taming the Beast: A Scientific Definition of Fintech. Journal of Innovation Management, vol.4(4), pp. 32–54. https://doi.org/10.24840/2183-0606_004.004_0004.

Scott, V. S., John Van Reenen and Markos Zachariadis, (2017). The Long-Term Effect of Digital Innovation on Bank Performance: An Empirical Study of SWIFT Adoption in Financial Services. Research Policy, vol.46(5), pp. 984–1004. https://doi.org/10.1016/j.respol.2017.03.010.

Singh, R., Malik, G., & Jain, V., (2021). FinTech effect: measuring impact of FinTech adoption on banks' profitability. International Journal of Management Practice, vol. 14 (4), pp. 411-31. https://doi.org/10.1504/ijmp.2021.116587.

Singh, S., Sahni, M.M. and Kovid, R.K., (2020). What Drives FinTech Adoption? A Multi-Method Evaluation Using an Adapted Technology Acceptance Model. Management Decision, vol.58(8), pp. 1675–97. https://doi.org/10.1108/MD-09-2019-1318.

Siska, E., (2022). Financial Technology (FinTech) and its impact on financial performance of Islamic banking. ARBITRASE: Journal of Economics and Accounting, vol. 2(3), pp.102-108. Doi: https://doi.org/10.47065/arbitrase.v2i3.338.

Tang, M., Hu, Y., Corbet, S., Hou, Y. (Greg), & Oxley, L., (2024). Fintech, bank diversification and liquidity: Evidence from China. Research in International Business and Finance, vol. 67, pp. 102082-96. https://doi.org/10.1016/j.ribaf.2023.102082.

Tushar Ismail Hossain, (2021). Industry revolution 4.0 and digital transformation - it's implementation, opportunity and challenges in Bangladesh textile industry. Brac University. http://hdl.handle.net/10361/18720.

Ullah, F. A. A., (2023). Electronic Banking and Its Impact on the Financial Performance of Commercial Banks in Bangladesh: A Descriptive Analysis. Research Journal of Finance and Accounting, vol. 14 (7), pp. 6-12. https://doi: 10.7176/RJFA/14-7-02.

Varma, P., & Nijjer, S., (2022). Examining the role of fintech in the future of retail banking. ECS Transactions, The Electrochemical Society, vol. 107(1), pp. 9855-9878. https://doi10.1149/10701.9855.

Vasiljeva, Tatjana, and Kristina Lukanova, (2016). Commercial Banks and Fintech Companies in the Digital Transformation: Challenges for the Future. Journal of Business Management, vol. 11, pp. 25-33. https://journals.riseba.eu/index.php/jbm/article/view/91.

Venkatesh, V. and Davis, F.D., (2000). A theoretical extension of the Technology Acceptance Model: Four longitudinal field studies. Management Science, vol. 46(2), pp. 186-204. https://doi.org/10.1287/mnsc.46.2.186.11926.

Vijay, K., Sujani T. and Sanjeev, A., (2022). Financial Inclusion and Bank Profitability: Evidence from a Developed Market. Global Finance Journal, vol.53, pp. 1-12. https://doi.org/10.1016/j.gfj.2021.100609.

Vives, X., (2019). Digital Disruption in Banking. In Annual Review of Financial Economics vol. 11 (1), pp. 243–272. https://doi.org/10.1146/annurev-financial-100719-120854.

Wang, P., Zheng, H., Chen, D. and Ding, L., (2015). Exploring the critical factors influencing online lending intentions. Financial Innovation, vol.1, pp.1-11.https://doi.org/10.1186/s40854-015-0010-9.

Yang, W., Sui, X. and Qi, Z., (2021). Can Fintech Improve the Efficiency of Commercial Banks? An Analysis Based on Big Data. Research in International Business and Finance, vol. 55, pp. 1-12. https://doi.org/10.1016/j.ribaf.2020.101338.

Zhang, Miao, and Juanjuan Yang, (2019). Research on Financial Technology and Inclusive Finance Development. Atlantis Press, pp. 66–71. https://doi.org/10.2991/ieesasm-18.2019.14.

Zheng, C., Rahman, M. A., Hossain, S., & Moudud-Ul-Huq, S., (2023). Does Fintech-Driven Inclusive Finance Induce Bank Profitability? Empirical Evidence from Developing Countries. Journal of Risk and Financial Management, vol. 16(10), pp. 457-485.https://doi.org/10.3390/jrfm16100457.