

Research Article

Effect of E-Banking Service on Financial Performance of Commercial Banks: A Case of Selected Private Commercial Banks in Ethiopia

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Abstract

This study examines the impact of e-banking services on the financial performance of selected private commercial banks in Ethiopia. It focuses on the roles of ATM, POS, Internet Banking (IB), Debit Card (DC), and Mobile Banking (MB) services. Financial performance is evaluated using Return on Assets (ROA) and Return on Equity (ROE) as key indicators. A panel dataset was collected from six purposely selected private commercial banks: Awash Bank S.C., Bank of Abyssinia, Dashen Bank, Cooperative Bank of Oromia, United Bank, and Zemen Bank S.C., covering the period from 2018 to 2023. Utilizing a quantitative approach and employing both descriptive and explanatory research designs, the study applies fixed and random effects regression models estimated with E-Views 13. The findings indicate that POS terminals have a significant negative effect on both ROA and ROE, suggesting that investments in POS infrastructure may not be generating the expected financial returns. In contrast, ATMs, debit cards, and internet banking services exhibit a significant positive impact on both profitability measures, highlighting their effectiveness in enhancing bank performance. Interestingly, mobile banking shows a mixed effect; it positively influences ROA but negatively and significantly affects ROE, indicating potential inefficiencies or cost challenges in mobile banking deployment. This study contributes original insights to the existing literature by providing context-specific findings from Ethiopia, particularly regarding the differing effects of mobile and POS banking services compared to previous research. It enriches the discussion on the strategic role of digital banking technologies in shaping the financial outcomes of banks operating in emerging markets.

Keywords

E-banking, Private Banks, ROA, ROE, Ethiopia

1. Introduction

E-banking provides bankers, customers, and other stakeholders with online access to their bank accounts, allowing them to perform transactions and obtain information about financial products and services [60]. As a result, e-banking enables customers to carry out various banking activities,

such as accessing their accounts, transferring funds, withdrawing cash, and making payments without the need to visit a physical bank branch. The banking sector in Ethiopia has become very competitive in recent years, with the players in the industry taking keen interest in its financial performance.

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the report by [49]. There were twenty eight private commercial banks operating in Ethiopia that are registered in EATS (Ethiopia Automated Transfer System).

Research shows a strong connection between e-banking services and financial performance. In Rwanda, the introduction of e-banking resulted in an increase in return on assets (ROA) from 0.94% in 2020 to 2.98% in 2022 [31, 53]. In a similar vein, e-banking accounted for 64.3% of the variation in financial performance in Kenya [15, 23, 52]. Studies on e-banking services positively impact performance, some studies report negative effects, such as ATMs and e-money showing insignificant impacts on banking performance in Indonesia [44]. The effectiveness of e-banking can vary significantly based on regional factors and the specific banking environment, suggesting that not all banks may experience the same level of benefit from e-banking services [5]. Recent studies have consistently shown that the adoption of e-banking positively impacts the financial performance of commercial banks. In Ghana, e-banking services such as ATMs, mobile banking, and electronic funds transfers have significantly increased bank profitability [7]. Similarly, banks in Tanzania saw improved profitability through various e-banking products, including ATMs, agency banking, and online banking in Tanzania [41]. In Pakistan, banks reported higher profitability and enhanced customer retention as a result of e-banking adoption [61]. However, a study on Bangladeshi state-owned banks indicated a short-term negative impact on profitability metrics during the year of adoption, followed by a positive effect on return on assets in the subsequent year [28]. These findings suggest that while e-banking generally enhances bank performance, the impact may vary across different contexts and timeframes.

However, there is a lack of comprehensive research on this topic, which creates a gap in understanding the actual impact of e-banking on the financial health of commercial banks. This gap impedes informed decision-making by bank managers, policymakers, and investors. Consequently, this study aims to investigate the effect of various e-banking services such as ATM, Point of Sale (POS), Internet Banking (IB), Debit Cards (DC), and Mobile Banking (MB) on the financial performance, specifically Return on Assets (ROA) and Return on Equity (ROE), of private commercial banks in Ethiopia.

2. Literature Review

2.1. Theoretical Framework

Technology Acceptance Model (TAM): developed by Davis in 1989, suggests that the adoption of new technologies such as e-banking is influenced by their perceived usefulness and ease of use. In developing countries, the uptake of e-banking services can enhance the financial performance of commercial banks by reducing operational costs, increasing transaction volumes, and improving customer satisfaction [3].

Resource-Based View Theory (RBVT): This theory posits

that a firm's competitive advantage stems from its unique resources and capabilities. For commercial banks, e-banking services represent a strategic resource that can enhance efficiency, reduce costs, and expand customer reach. Banks that successfully leverage e-banking technologies are likely to experience improved financial performance [8, 39, 42].

Financial Inclusion Theory (FIT): This theory emphasizes the significance of providing affordable and accessible financial services to underserved populations. E-banking services play a crucial role in promoting financial inclusion in developing countries by facilitating access to banking services for rural and low-income communities. This, in turn, can lead to increased deposits, loan disbursements, and overall profitability for commercial banks [18].

Innovation Diffusion Theory (IDT): This theory explains how new technologies spread within a society. The adoption of e-banking services by commercial banks in developing countries can be viewed as an innovation that enhances their financial performance by attracting tech-savvy customers, reducing transaction times, and improving service delivery [36, 57].

Theory of Planned Behavior (TPB): was proposed by Ajzen (1983) and was used to predict human behavior. This theory suggests that intention to engage in a behavior determines an individual's behavior. If one intends to use electronic banking the degree to which the person may favor or unfavor the use of e-banking is the attitude in consideration of the outcomes of its use. Subjective norm is another contributing factor that may affect people's intention towards using electronic banking [2].

Automated Teller Machine (ATM): is a self-service electronic device that allows bank customers to perform basic banking transactions, such as withdrawing cash, depositing funds, checking account balances, and transferring money between accounts, without the need for a human teller [19, 59]. ATMs are typically located in convenient public areas and are accessible 24/7, providing customers with increased flexibility and convenience [35].

Point of Sale (POS): is a technology that enables merchants to process card payments at retail locations. POS terminals allow customers to make payments using debit or credit cards, reducing the need for cash transactions [36].

Debit Cards (DC): are payment cards that allow customers to access funds directly from their bank accounts to make purchases or withdraw cash. Unlike credit cards, debit cards do not involve borrowing money; instead, they deduct funds directly from the user's account [18, 68].

Internet Banking (IB): also known as online banking or e-banking) is a service that allows customers to access their bank accounts and conduct financial transactions over the internet, using a computer or other internet-enabled device [22]. Common internet banking services include viewing account balances, transferring funds, paying bills, applying for loans, and managing investments [6].

Mobile Banking (MB): is a service that allows customers

to access their bank accounts and conduct financial transactions using a mobile device, such as a Smartphone or tablet [24]. Mobile banking applications (apps) typically offer features similar to internet banking, including viewing account balances, transferring funds, paying bills, and locating ATMs [47].

2.2. Hypothesis

Studies indicate a strong relationship between e-banking services and financial performance. For instance, in Rwanda, the implementation of e-banking led to an increase in return on assets from 0.94% in 2020 to 2.98% in 2022 [31]. Similarly, in Kenya, e-banking accounted for 64.3% of the variation in financial performance [15, 23, 52].

The effect of Automated teller machines (ATM) on the financial performance.

The impact of Automated Teller Machines (ATMs) on bank profitability shows mixed results across different studies. In Rwanda, a significant positive relationship was found between ATMs and bank profitability measures (ROA, ROE, and net margin [26]. Similarly, in Kenya, ATMs positively and significantly influenced banks' return on assets from 2007 to 2016 [48]. However, a study in Botswana revealed that ATMs were statistically insignificant in affecting ROA and ROE [40]. ATM has an insignificant impact on the profitability (ROA and ROE) of Nepalese commercial banks [66].

H₁: Automated teller machines (ATM) have a significant positive effect on the financial performance of private commercial banks in Ethiopia.

2.2.1. The Effect of Point of Sales (POS) on the Financial Performance

A study of Iranian banks found weak positive relationships between POS and both return on assets (ROA) and ROE [65]. The study found that Point of Sale (POS) systems have a negative significant effect on Return on Equity [20]. POS terminal services have a positive influence on the financial performance of small and medium-sized enterprises in Nigeria [54]. However, the sustained use of cloud-based POS during the COVID-19 pandemic showed mixed results, with a positive impact on non-financial performance but a negative effect on financial performance in Indonesia [55].

H₂: Point of sales (POS) has a significant positive effect on the financial performance of private commercial banks in Ethiopia.

2.2.2. The Effect of Debit Cards (DC) on the Financial Performance

In Pakistan, increased usage of debit cards was found to enhance bank profitability, as measured by Return on Assets (ROA), from 2004 to 2013 [56]. Similarly, in Kenya, the use of debit cards at ATMs showed a significant positive relationship with ROA [14]. Additionally, the SACCO link debit

card services offered by Kenyan Deposit-Taking SACCOs demonstrated a positive effect on financial performance [45]. However, a study of Nepalese commercial banks revealed that debit cards had an insignificant impact on both ROA and Return on Equity (ROE) from 2016 to 2021 [66].

H₃: Debit cards (DC) have a significant positive effect on the financial performance of private commercial banks in Ethiopia.

2.2.3. The Effect of Internet Banking (IB) on the Financial Performance

In India, IB services significantly improved banks' Return on Assets (ROA) and Return on Equity (ROE) [32]. Similarly, in Pakistan, IB transactions had a positive long-term effect on ROE and ROA [56]. A study of Asian countries revealed that IB contributes to banks' ROE after a three-year lag, although a negative impact was observed in the first year [58]. Research on Indonesian banks found no significant effect of IB implementation on ROA, ROE [29].

H₄: Internet banking (IB) has a significant positive effect on the financial performance of private commercial banks in Ethiopia.

2.2.4. The Effect of Mobile Banking (MB) on the Financial Performance

According to [37] found that mobile banking had a negative but insignificant effect on profit growth. Similarly, [30] reported a negative and significant impact of mobile banking on both Return on Assets (ROA) and Return on Equity (ROE) for Islamic banks in Indonesia. Conversely, [62] observed that mobile banking had no significant effect on either ROA or ROE. In contrast, [67] found that mobile banking products positively contributed to the financial performance of Equity Bank, reporting an ROE of 26.1% and an ROA of 3.5% in 2022.

H₅: Mobile banking (MB) has a significant positive effect on the financial performance of private commercial banks in Ethiopia.

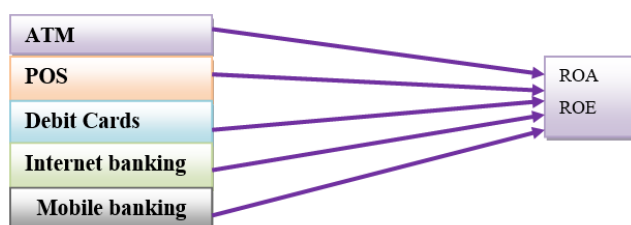
2.3. Research Gap

Several studies have explored the impact of e-banking services on financial performance in Africa; there is a lack of comprehensive research focusing on Ethiopia. Most studies have examined individual e-banking services in isolation, with limited attention to their combined effect on ROA and ROE. While foreign literature has explored the effect of electronic banking systems in African and Asian countries, local studies are limited [9, 10, 38, 63, 64]. This study aims to fill this gap by analyzing the impact of multiple e-banking services on the financial performance of Ethiopian commercial banks using panel data from 2018 to 2023.

2.4. Conceptual Framework

The study's conceptual framework illustrates the relationship between the dependent variable (the financial performance of Ethiopia's commercial banks) and the independent variable (e-banking) depicted as follow;

- 1) Independent Variable Dependent Variable
- 2) Electronic Banking Banks Financial Performance



Source: Reviewed from Literature by Author, 2024

Figure 1. Conceptual Framework.

3. Method

The study used a quantitative research approach with an explanatory study design [17] to analyze the correlation between Ethiopia's private commercial banks' profitability and the effects of electronic banking factors. The study analyzed six senior commercial banks such as Awash Bank S.C., Bank of Abyssinia, Dashen Bank, Cooperative Bank of Oromia, United Bank, and Zemen Bank S.C. established before 2015. The study used panel data from selected banks and the National Bank of Ethiopia from 2018 to 2023 using purposive sampling.

The Hausman test is used to select panel regression models, with the hypothesis being either a fixed effects model or a random effects model.

In general panel data regression model can be described as follows

$$Y_{it} = \alpha + \beta x_{it} + u_{it}$$

In this case, u_{it} is the i th observation of the stochastic error term, $\beta_1 \dots \beta_k$ are the regression coefficients, Y_i is the i th observation of the dependent variable, and $X_{1i} \dots X_{ki}$ are the i th observations of the independent variables.

$$ROA_{it} = \alpha + \beta_1 (ATM)_{it} + \beta_2 (POS)_{it} + \beta_3 (MBAN)_{it} + \beta_4 (IBAN)_{it} + \beta_5 (DC)_{it} + U_{it}$$

$$ROE_{it} = \alpha + \beta_1 (ATM)_{it} + \beta_2 (POS)_{it} + \beta_3 (MBAN)_{it} + \beta_4 (IBAN)_{it} + \beta_5 (DC)_{it} + U_{it}$$

Where:

ROA: Return on asset of the i^{th} bank at time t

ROE: Return on equity of the i th bank at time t

ATM_{it} ; is number of ATM terminals of the i^{th} bank at time t

POS_{it} ; is number of POS terminals of the i^{th} bank at time t

MB_{it} ; is number of mobile banking users of the i^{th} banking at time t

$IBAN_{it}$: number of internet banking users of i^{th} bank at a time t

DC_{it} : number of Debit card users i^{th} bank at time t

α : Constant term

$\beta_1 \dots \beta_5$ are parameters estimated

U_{it} is the error component for i at a time t assumed to have mean zero $E[U_{it}] = 0$

i = Commercial banks $i = 1 \dots 6$; and

t = the index of time period and $t = 1-6$

As cited by [11, 27] emphasize the importance of validity and reliability in research instruments. The researcher utilized

secondary data sources from financial organizations' annual reports for cross-checking and ensuring consistent results.

The study utilized Pearson correlation and multiple regression analysis to analyze financial performance relationships, employing the fixed and random effect model using E-View software.

4. Result and Discussion

4.1. Correlation Analysis Results

According to [12], if two variables, y and x , are correlated, it does not imply a causal relationship between them. Instead, it indicates that there is evidence of a linear relationship between the variables, and changes in one variable are associated with changes in the other variable to some degree, as quantified by the correlation coefficient.

Table 1. Correlation Matrix.

	ROA	ROE	NPOS	NMBU	NIBU	NDC	NATM
ROA	1						
ROE	0.428832	1					

	ROA	ROE	NPOS	NMBU	NIBU	NDC	NATM
NPOS	-0.54101	-0.007601	1				
NMBU	0.75602	0.46913	0.364228	1			
NIBU	0.76461	0.08421	0.445812	0.687668	1		
NDC	0.49494	0.079264	0.725748	0.471925	0.436164	1	
NATM	0.270649	0.28717	-0.22466	0.14373	0.23706	0.1553	1

Significant at the 0.05 Level (2-tailed)

Source E-Views Output 2024 version 13

Table 1 shows the summary of correlation results; accordingly, there is a positive correlation (0.27) between ROA and number of ATMs, indicating as the number of ATMs increases return on assets (ROA) increases. Likewise, there is a strong positive correlation (0.756) between ROA and the number of mobile banking users, indicating that a higher number of mobile banking users are associated with higher profitability (ROA). There is also a strong positive correlation (0.76) between the number of internet banking users and ROA, implying that the higher the number of internet is banking users, the higher the ROA. There is a positive correlation (0.49) between ROA and number of debit card users, implying that the higher the number of debit card users, the higher the return on assets (ROA). Finally, the number of POS machines and

ROA have a substantial negative association (-0.54), which suggests that as POS machine count rises, ROA falls. On the other hand, ROE was positively correlated with the number of ATMs; users of mobile banking, debit cards, and internet banking increase ROE with a different correlation coefficient. However, the number of POS terminals has a negative relationship.

4.2. Regression Analysis Results

All diagnostic tests, including multicollinearity, heteroskedasticity, normality and autocorrelation were tested and satisfied.

Table 2. Regression Results for ROA.

Dependent variable: ROA

Method: Panel Least Squares

Date: 04/10/24 Time: 01:43

Sample: 2018 2023

Period included: 6

Cross –section included:6

Total panel (unbalanced) observation: 34

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NPOS	-0.000613	0.000224	-2.731940	0.0106
NMBU	-5.69E-07	1.49E-07	-3.819742	0.0007
NIBU	1.07E-05	4.40E-06	-2.424458	0.0021
NDC	6.73E-07	3.08E-07	2.186509	0.0030
NATM	3.02E-05	3.19E-05	0.943761	0.0041
C	2.897705	0.067826	42.72235	0.0000
R-squared	0.763459	Mean dependent var		2.575714
Adjusted R-squared	0.722676	S.D. dependent var		0.390439
S.E. of regression	0.205612	Akaike info criterion		-0.170851

Sum squared resid	1.226008	Schwarz criterion	0.095780
Log likelihood	8.989886	Hannan-Quinn criter.	-0.078810
F-statistic	18.72002	Durbin-Watson stat	1.511516
Prob (F-statistic)	0.000000		

Source: E-views output (2024) version 13

$$ROA_{it} = \beta_0 + \beta_1 NATM_{it} + \beta_2 NPOS_{it} + \beta_3 NDC_{it} + \beta_4 NMB_{it} + \beta_5 NIB_{it} + \varepsilon_{it} \dots \quad (1)$$

$$= 2.89 + 3.02 - 0.000613 + 6.73 + 5.69 + 1.07 + 0.068$$

As shown in Table 2, the values of R square and adjusted R square are 76.43% and 72.97%, respectively. This result shows how the variance in the dependent variable (ROA) is

explained by the explanatory variable in the model. Therefore, 72.97% of the variation in the ROA is explained by the number of ATM terminals, number of POS terminals, number of mobile banking users, number of internet banking users, and number of debit cards. Nonetheless, extraneous factors not accounted for in the model account for the remaining 27.03% of the variation in return on assets of private commercial banks in Ethiopia.

Table 3. Regression Results for ROE.

Dependent Variable: ROE

Method: Panel Least Squares

Date: 04/10/24 Time: 01:35

Sample: 2018 2023

Periods included: 6

Cross-sections included: 6

Total panel (unbalanced) observations: 34

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NPOS	-0.005460	0.001156	-4.723233	0.0001
NMBU	5.69E-06	7.68E-07	-7.411044	0.0000
NIBU	7.67E-05	2.25E-05	3.412162	0.0020
NDC	8.54E-06	1.58E-06	5.395431	0.0000
NATM	0.000662	0.000182	-3.638050	0.0011
C	20.60182	0.370425	55.61678	0.0000
R-squared	0.717275	Mean dependent var		19.81324
Adjusted R-squared	0.666789	S.D. dependent var		1.818045
S.E. of regression	1.049457	Akaike info criterion		3.093207
Sum squared resid	30.83806	Schwarz criterion		3.362565
Log likelihood	-46.58453	Hannan-Quinn criter.		3.185066
F-statistic	14.20726	Durbin-Watson stat		2.261957
Prob (F-statistic)	0.000001			

Source: E-views output (2024) version 13

$$ROE_{it} = \beta_0 + \beta_1 NATMT_{it} + \beta_2 NPOS_{it} + \beta_3 NDC_{it} + \beta_4 NMB_{it} + \beta_5 NIB_{it} + \varepsilon_{it} \quad (2)$$

$$= 20.60182 + 0.000662 - 0.0054566 + 8.54 + 5.69$$

As shown in Table 3, the values of R square and adjusted R square are 71.72% and 66.67%, respectively. The number of ATMs, POS terminals, mobile banking users, internet banking users, and debit card users accounts for 66.67% of the variation in the ROE. This result illustrates how the explanatory variable in the model explains the variance in the dependent variable (ROE). However, other factors not included in the model account for the remaining 33.33% of the variation in return on assets of Ethiopian private commercial banks.

5. Discussion

ATM and Return on Asset: From table 2 above, it shows that the number of ATM terminals had a coefficient of 3.02 and a P value of 0.004. This indicates that, while keeping other variables constant, the sampled Ethiopian private commercial banks' return on assets (ROA) increased by 3.02 and the number of ATMs increased by one unit. Due to the fact that the number of ATM terminals' p value is statistically significant at the 5% significance level. The results are consistent with those of studies conducted by [13] in their journal of online banking and commerce. According to [10] related study on financial institutions in Ethiopia, which also found a significant impact of ATMs on bank performance. However, the bank's profitability was positively and marginally impacted by the ATMs [46, 63, 64]. In contrast, [10] found that the number of ATMs in Ethiopia has a negligible negative impact on return on asset (ROA) for private commercial banks.

ATM and return on equity: As indicated from table 3, the number of ATM terminals had a coefficient of 0.000662. Moreover, the P value was 0.0011. This indicates that if all other explanatory variables were constant and the data were statistically significant at the 5% level of significance, the number of ATMs would have increased by one unit and the return on equity (ROE) of the sampled Ethiopian private commercial banks would have increased by 0.000662 units. The study's conclusion is consistent with [9, 38] in that the quantity of ATMs had a favourable and significant impact on bank profitability, contrary to the large negative impact of ATMs on the profitability of Ethiopia's private commercial banks. According to [46, 64] ATMs lower transaction costs, which would explain the positive correlation between them and ROA. Higher profit follows lower costs, and higher profit leads to higher ROA. Furthermore, clients may use additional services, opening doors for cross-selling and potential revenue growth. In addition, banks usually charge non-customers for using their ATMs. These fees increase the bank's revenue, which improves its financial performance.

POS and Return on Asset: from the table 2, the POS ter-

minal's P value was 0.0106 and its coefficient of number was -0.00613. This indicates that, assuming all other explanatory factors remain constant and are statistically significant at the 5% level of significance, an increase of one unit in point of sale (POS) would result in a drop of -0.00613 units in return on asset (ROA) of the studied Ethiopian private commercial banks. In the case of ROA, there is therefore insufficient data to rule out the null hypotheses. The study disagrees with [9, 38], who found that the number of ATM terminals had a positive and significant effect on bank profitability. The study's findings are consistent with a significant negative effect of POS terminals on the profitability of private commercial banks in Ethiopia [63, 64].

POS and Return on Equity: from table 3 illustrates that the number of POS terminals has a coefficient of -0.005460 and a P value of 0.0001. This indicates that if all other explanatory variables remained constant and the sample of Ethiopian private commercial banks' return on equity (ROE) was statistically significant at the 5% level of significance, the number of point of sale (POS) would have increased by one unit. Therefore, there is no sufficient evidence to reject the null hypotheses. The finding of the study agrees with a negative and significant effect of the number of POS terminals on the profitability of private commercial banks in Ethiopia [63, 64], and the finding of the study is inconsistent with [9, 38], where the where the number of ATM terminals had a positive and significant effect on the profitability of the bank. Overall, while having POS terminals can be beneficial for commercial banks in terms of increasing transaction volume and revenue, having an excessive number of terminals without corresponding demand could potentially have a negative impact on their financial performance. Banks should carefully assess the market demand and ensure that the number of POS terminals is aligned with actual transaction volumes to maximize profitability.

Debit card and Return on Asset: from table 2 indicates that the number of debit cards has a 6.73 coefficient and a P value of 0.0030. Assuming the other explanatory variables remain constant and are statistically significant at the 5% level of significance, this implies that the number of debit cards grew by one unit and the return on assets (ROA) of the sampled Ethiopian private commercial banks increased by 6.73 units. Consequently, in the instance of ROA, the null hypotheses were disproved. According to [38, 64], the study's findings support the idea that the quantity of debit cards has a positive impact on the profitability of private commercial banks in Ethiopia. However, [9] discovered that the quantity of debit cards significantly reduces return on assets.

Debit card and Return on Equity: from Table 3 illustrates that the number of debit cards has an 8.54 coefficient, with a P value of 0.0000. This indicates that if all other explanatory variables remained constant and the sample of Ethiopian private commercial banks' return on equity (ROE) was statistically significant at the 5% level of significance, the number of debit cards would have increased by one unit. Thus, in the

instance of ROE, there is enough data to rule out the null hypothesis. The financial performance of commercial banks has been greatly enhanced by debit cards in a number of ways, including increased transaction volume, lower costs associated with handling cash, and opportunities for cross-selling. Overall, debit cards have proven to be a valuable tool for commercial banks to enhance their financial performance by increasing transaction volume, reducing costs, attracting and retaining customers, creating cross-selling opportunities, and leveraging data analytics for personalized services. As electronic payment methods continue to grow in popularity, debit cards are expected to play an even more significant role in driving the profitability of banks in the future.

Internet banking and Return on Asset: from Table 2 illustrates that the number of internet banking has a coefficient of 1.07 and a P value of 0.0021. This indicates that if all other explanatory factors were constant and were statistically significant at the 5% level of significance, the number of internet banking users would increase by one unit and the sample of Ethiopian private commercial banks' return on asset (ROA) would increase by 1.07 units. As a result, there is enough data to rule out the null hypothesis. The study's conclusion is in line with [10, 46] in that the number of internet banking users significantly lowers the profitability of Ethiopia's private commercial banks, while [16] found that NIB in Kenya has a positive impact on bank profitability.

Internet banking and Return on Equity: from Table 3 indicates that the number of internet banking accounts has a coefficient of 7.67 and a P value of 0.0020. This indicates that, assuming all other explanatory factors remain constant and are statistically significant at the 5% level of significance, there would be an increase of one unit in the number of internet banks and an increase of 8.7.67 units in the return on equity (ROE) of the sampled Ethiopian private commercial banks. As a result, in the case of ROE, the null hypotheses were rejected. According to research conducted by [33, 34, 43], the number of private commercial banks' internet banking users has a favourable and significant impact on their return on equity. The bank's profitability was positively impacted by the number of internet banking accounts because it resulted in cheaper charge fees, improved commission income, staffing levels, and decreased bank costs. This is useful for addressing consumer satisfaction and ease of use, but it has little to no positive impact on commercial banks' financial success.

Mobile banking and Return on Asset: from table 2 shows that the coefficient of the number of mobile banking users was -5.69, with a P value of 0.0007. Keeping all explanatory variables constant and statistically significant at the 5% level of significance, this indicates that the number of mobile banking users increased by one unit and the return on assets (ROA) of sampled Ethiopian private commercial banks decreased by 5.69 units. Therefore, there is sufficient evidence to reject the null hypotheses. This result is also consistent with the findings of [21, 25], whose research showed a significant and adverse correlation between financial performance and mobile banking. That differed, nevertheless, from [13] findings. This suggests that the financial performance of Ethiopia's private commercial banks was significantly impacted negatively by mobile banking due to inadequate skills, network failure, low internet penetration, and security concerns that seriously jeopardize the confidentiality and integrity of bank data, which are among the obstacles impeding the use of mobile banking [51].

Mobile banking and return on equity: from table 3 shows that the number of mobile banking users had a coefficient of 5.67 and a P value of 0.0001. This indicates that, assuming all other explanatory factors remain constant and are statistically significant at the 5% level of significance, there would be a one unit increase in the number of mobile banking users and a 5.67 unit rise in the return on equity (ROE) of the sampled Ethiopian private commercial banks. As a result, there is enough data to rule out the null hypothesis. The findings of the study disagree with the significant negative effect of the number of mobile banking users on the profitability of private commercial banks in Ethiopia. [63] and the findings of the study consistent [38, 46] had a positive and significant effect on the profitability of the bank. Based on the above result, it can be concluded that mobile banking offers financial institutions several opportunities for increasing revenues.

6. Summary of Hypothesis Testing

The hypothesis was evaluated and the impact of each explanatory variable was examined in light of the regression output concerning the first indicator of bank financial performance, which is determined by ROA and ROE.

Table 4. Summary of hypothesis testing when Financial performance measured by ROA.

Independent variable	Expected relationship with ROA	Actual result	Significance Level	Decision
Number of ATM	+ve/significance	+ve/insignificance	0.0041	Don't reject
Number of POS	+ve/significance	-ve/significance	0.0106	Reject
Number of Debit Card	+ve/significance	+ve/significance	0.0030	Don't reject
Number of internet banking	+ve/significance	+ve/significance	0.0021	Don't reject

Independent variable	Expected relationship with ROA	Actual result	Significance Level	Decision
users				
Number of mobile	+ve/significance	-ve/significance	0.0007	Reject

Table 5. Summary of hypothesis testing when Financial performance measured by ROE.

Independent variable	Expected relationship with ROA	Actual result	Significance Level	Decision
Number of ATM	+ve/significance	+ve/insignificance	0.0011	Don't reject
Number of POS	+ve/significance	-ve/significance	0.0001	Reject
Number of debit card	+ve/significance	+ve/significance	0.0000	Don't reject
Number of internet banking users	+ve/significance	+ve/significance	0.0020	Don't reject
Number of mobile	+ve/significance	+ve/significance	0.0000	Don't reject

7. Conclusion

The study examined the effect of e-banking services on the financial performance of selected private commercial banks in Ethiopia from 2018 to 2023. The findings revealed that the number of ATMs, debit cards, and internet banking users positively and significantly impacted both return on assets (ROA) and return on equity (ROE). However, the number of point-of-sale (POS) terminals had a negative and significant effect on both ROA and ROE. Mobile banking showed a mixed impact, negatively affecting ROA but positively influencing ROE. These results suggest that while certain e-banking services enhance profitability, others may not be as effective, depending on the specific financial performance metric being measured.

The study concludes that private commercial banks in Ethiopia should strategically invest in e-banking services that positively impact financial performance, such as ATMs, debit cards, and internet banking. However, the negative impact of POS terminals and mobile banking on financial performance in the Ethiopian context can be attributed to a combination of factors related to costs, adoption rates, infrastructure limitations, and security concerns. They should also carefully evaluate the deployment of POS terminals and mobile banking to ensure that these services align with market demand and do not adversely affect profitability.

8. Implication

Banks should strategically place ATMs in high-traffic areas, such as supermarkets, open-air markets, hospitals, and shopping centers, to maximize their usage and profitability. They

should continue to invest in online and mobile banking platforms to enhance the customer experience and improve operational efficiency. However, they must also address any security and network issues that could impact mobile banking usage. Banks should actively promote the issuance and use of debit cards to increase transaction volume and reduce reliance on cash, thereby boosting profitability. Finally, banks should carefully assess market demand and ensure that the number of POS terminals aligns with actual transaction volumes to maximize profitability.

9. Contribution

The study also addresses a gap in the literature by focusing on the Ethiopian context, where limited research has been conducted on the relationship between e-banking and financial performance. Conflicting results regarding mobile and POS terminals the study provides evidence contradictory to earlier research and contributes new insights specific to the Ethiopian banking context. It also offers valuable insights for both academics and practitioners and contributes to the broader discourse on the role of technology in enhancing financial performance in emerging markets.

10. Limitations

The study focuses on six private commercial banks in Ethiopia. As a result, the findings may not be applicable to the entire banking sector, including public banks, and they may not apply to other countries as well. Additionally, the reliance on secondary data may limit the depth and breadth of the analysis. The study spans the period from 2018 to 2023, and the results may not be relevant to other time periods due to

changes in the economic environment, technology, or regulations. While the model explains a significant portion of the variance in Return on Assets (ROA) and Return on Equity (ROE), there remains a degree of unexplained variance. This unexplained variance could be attributed to macroeconomic conditions, regulatory changes, or specific management strategies employed by the banks.

11. Future Research Directions

The study focuses on Ethiopia's private commercial banks, examining the impact of e-banking on financial performance metrics like ROA and ROE. It also explores non-financial outcomes like customer satisfaction and service caliber, allowing for the identification of unexplored variables for future research.

Abbreviations

ROA	Return on Asset
ROE	Return on Equity
NPOS	Number of Point of Sales
NMBU	Number of Mobile Banking Users
NIBU	Number of Internet Banking Users
NDC	Number of Debit Card
NATM	Number of Automated Teller Machine

Author Contributions

Abebe Tilahun Kassaye: Data curation, Project administration, Resources, Supervision, Validation

Anteneh Mengist Alamirew: Conceptualization, Funding acquisition, Investigation, Methodology, Validation, Writing – original draft

Conflicts of Interest

The authors declare no conflicts of interest.

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