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BETTIOUI Nesrine, Associate Prof., University Professor
Finance, Laboratory (LMELSPM)
University of Ain Temouchent Belhadj Boucheib
11, Chemin Doudou Mokhtar, Ben Aknoun, 46000, Algeria
e-mail: nesrine.bettioui@univ-temouchent.edu.dz
ORCID: https://orcid.org/0009-0004-5520-2942
ALI DAHMANE Mohammed, Associate Prof., University Professor
Public finance management, Laboratory (LMELSPM)
University of Ain Temouchent Belhadj Boucheib
11, Chemin Doudou Mokhtar, Ben Aknoun, 46000, Algeria
e-mail: ali.dahmane@univ-temouchent.edu.dz
ORCID: https://orcid.org/0000-0003-4965-4454

THE IMPACT OF ELECTRONIC BANKING SERVICES ON THE FINANCIAL PERFORMANCE OF COMMERCIAL BANKS IN ALGERIA

This study seeks to highlight the impact of electronic banking services on the financial performance of commercial banks in Algeria during the period 2004—2023, using the ARDL model. Accordingly, the most important results are as follows: the existence of a positive relationship between Automated Teller Machines (ATM) and commercial bank branches (BRN), as well as the indicator of loans granted by the bank (CRD) online with the financial performance indicator (ROA).

***Keywords**: financial performance; electronic banking services; ATMs; commercial bank.*

The banking sector has witnessed significant developments due to financial technology, as electronic banking services such as digital transfers, electronic payments, and artificial intelligence in banking transactions now directly affect the financial performance of commercial banks.

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Therefore, the global digital transformation has led to increased efficiency in banking operations, as financial technology has helped reduce operational costs and increase profits by providing faster and more secure services to customers. Digital banking solutions have also contributed to expanding the customer base by enabling access to financial services in remote areas, which has enhanced financial inclusion rates.

In this regard, the Algerian banking sector has undergone gradual transformations toward adopting digital banking services, as commercial banks have expanded their provision of electronic payment services and online banking to improve the quality of financial performance. However, there are still challenges facing this transformation, such as weak digital infrastructure, low financial awareness among customers, and banking regulations that may limit the speed of digital expansion. Despite these challenges, the increasing reliance on financial technology contributes to improving the operational efficiency of banks, reducing financial risks, and increasing profitability by offering more advanced services that meet customer needs.

Accordingly, the relationship between electronic banking services and the financial performance of commercial banks reflects the extent of the impact of financial innovations and banking technology on the efficiency of financial institutions, as digital transformation has become one of the fundamental factors determining the stability and growth of the banking sector in Algeria and the world as a whole.

Problem Statement. Considering that the provision of electronic banking services has become an inevitable necessity for banks to keep pace with technological developments in the banking industry in order to achieve their various objectives and strengthen their financial position, the research problem emerges and revolves around the following core question:

To what extent did electronic banking services affect the financial performance of commercial banks in Algeria during the period 2004—2023? To answer the general research problem, we will present a set of subsidiary problems as follows:

• What are the most important indicators that improve the financial performance of commercial banks in Algeria?

• Is there an impact of electronic banking services on the financial performance of commercial banks in Algeria during the study period?

Study Hypotheses. As a logical framework for the study and in an attempt to answer the sub-questions, we propose the following hypotheses:

• the indicators that improve the financial performance of commercial banks in Algeria include automated teller machines (ATMs), branches of commercial banks, and loans granted through the internet;

• there is a positive impact between ATMs, commercial bank branches, and loans granted through the internet and the financial performance of commercial banks in Algeria in both the short and long term during the study period.

Study Objectives:

• to identify the types of electronic banking services provided by commercial banks;

• to identify the main indicators for measuring the financial performance of commercial banks;

• to highlight the current state of electronic banking services provided by commercial banks in Algeria;

• to highlight the nature of the relationship between electronic banking services and the financial performance of commercial banks in Algeria.

Study Methodology. To answer the research problem, the study relies on the descriptive analytical method by analyzing various indicators related to electronic banking services and the financial performance of the Algerian banking sector, in order to assess their development during the period from 2004 to 2023. To highlight the impact of the efficiency of electronic banking services on the financial performance of commercial banks in Algeria in the short and long term, the ARDL model was used, employing the statistical software Eviews12.

This study was supported by several previous studies in African, Asian, and European countries, most notably: Tilahun (2016), Bethlehem (2018), Tegenu (2020), and Yosef (2017).

PREVIOUS STUDIES

The study by O. Hannington (2013) seeks to determine whether there is a relationship between the dependent variable, which is performance measured by profit after tax, and the independent variables that include the number of ATMS, the number of debit and credit cards issued to customers, the number of electronic points of sale, and electronic funds transfers, as components of electronic banking services in Kenya, based on the SPSS model.

The results showed that electronic banking services have a strong and significant impact on the profitability of commercial banks in the Kenyan banking industry. Accordingly, there is a positive relationship between electronic banking services and bank performance. The results also revealed that banking innovations affect profitability Mean while.

This study, presented by K. Batu & N. Tunay (2015), aims to examine the extent of the impact of banks' profitability performance on electronic banking services. The effects of both Return on Assets (ROA) and Return on Equity (ROE) were analyzed using data from electronic banking services in 23 developed and developing countries during the period from 2005 to 2013, through dynamic panel data methods. Due to the innovative nature of electronic banking services, they have a significant impact on banks' performance. Both the analytical method employed and the inclusion of banking data from developed and developing countries are among the most notable features that distinguish this study from similar studies in the literature. The results showed that the profitability of banks in developed and developing countries is significantly affected by the ratio of the number of branches to the number of ATMs, and that electronic banking services are statistically significant. The results also revealed that some variables were contrary to the expected negative relationship, due to the disparity in the

level of development among countries, socio-cultural structures, and electronic banking infrastructure.

This study by S. Yang & L. Zeyun (2018) investigated the performance of Chinese banks following the full adoption of *e*-banking system, particularly in profitability and cost efficiency performance. The study became more important with the development of *e*-banking and internet because of increased penetration of *e*-banking which has redefined the banking operations in China and in globe. Secondary method was adopted in this study. The report and data of five banks in China were used for sample analysis. The bank performance was measured in terms of return on assets (ROA), return on equity (ROE), operating margin (OM), net interest margin (NIM) and efficiency ratio. With the data collected, the different performance means between development stage and developed stage of *e*-banking in China were compared. The study revealed that *e*-banking could improve the Chinese bank performance in terms of ROA, ROE, and OM. On the contrary, *e*-banking has a slight impact on Chinese bank performance with respect to NIM and efficiency ratio. The findings of this study are to provide banks with suggestions for *e*-banking adoption for banking operations.

The study by H. Imran (2021) examines the relationship between *e*-banking adoption and the financial performance of state-owned commercial banks in Bangladesh. The pooled ordinary least square (OLS) estimate was applied to analyze the panel data of the sample banks. The empirical findings reveal that *e*-banking adoption and implementation has a significant negative impact on banks' profitability in terms of return on assets, return on equity, and net interest margin in the year of adoption. However, the result also shows that *e*-banking has a significant positive impact on return on assets in the year following adoption.

The study by H. Melikaoui & N. Hamadi (2022) aims to clarify the impact of minimizing the risks of electronic transactions on improving the financial performance of the Algerian banking during the period 2011—2018 for 28 public and private banks, by testing a multiple regression model between electronic banking risk as independent variables and financial performance as a dependent variable. The study model showed that there is a positive direct relationship between risk reduction and financial performance improvement at the 5% error level.

The study by J. Moses (2022) aims to determine the effects of electronic banking services on the performance of banks in Kenya. The study specifically focused on the effects of mobile banking services, electronic funds transfers (EFT), point-of-sale banking services, and ATMs during the period 2015—2019. Both inferential and descriptive statistics were used to analyze the collected data. The statistical software package (SPSS) was adopted. The study concluded with the following key findings: bank performance is positively affected by the increase in electronic transfer services. The results also indicated that bank profitability increases with the rise in electronic banking services

The study by A. Nshimyimana & P. Nkurunziza (2023) seeks to examine the impact of electronic banking services on the performance and profitability of commercial banks in Rwanda. The specific objectives were to analyze the use of electronic banking services in cog Banque PLC during the period from 2018 to

2021 using the ARDL model. Various electronic banking system tools were used, such as ATMs, direct payments, mobile banking, debit/Visa card payments, and electronic cheque payments. The study reached the following key results: electronic banking services play an important role in the financial performance of banks in Rwanda as they increase profitability, return on equity, loans, improve the quality of bank management, increase their assets, and enhance their growth and expansion. The study also concluded that electronic banking services contribute to improving company performance despite the challenges faced, such as network failures, lack of skills, and security issues, which pose a major threat to the confidentiality and integrity of banking information.

The study by N. ElBaraka & B. Abed (2024) aims to identify the impact of electronic banking services in improving the financial performance of banks through an econometric study on Algerian commercial banks for the period (2004—2018), using the ARDL model and EViews software. The results of the study found a statistically significant positive impact of electronic banking services on improving the financial performance of Algerian commercial banks. The results also showed that bank financial performance is negatively affected by the number of bank branches and loans.

The study by M. Anteneh & T. Abebe (2025) aims to highlight the impact of electronic banking services on the financial performance of commercial banks in Ethiopia during the period 2018—2024 using the PANEL model and EViews software. The study's results showed a statistically significant positive impact of electronic banking services, ATMs, and debit cards on the financial performance of commercial banks (ROA and ROE) in Ethiopia, while the number of the bank's point-of-sale devices had a negative impact on the financial performance of commercial banks during the study period.

The study by A. Saadaoui & A. Slimani (2024), aimed to demonstrate the mechanism of the impact of electronic banking services on enhancing the financial performance of commercial banks in Algeria, by presenting and analyzing the factors supported through these services, which enhance the bank's financial performance. The study found that this type of service has an indirect impact on enhancing financial performance, as it contributes to increasing the volume of services provided; Attracting new customers, which leads to higher revenues, on the one hand, and on the other, contributing to lower risks and lower losses, thereby improving the results of measuring financial performance.

COMMERCIAL BANK PERFORMANCE INDICATORS

To measure the performance and profitability of commercial banks, there are three main indicators, most notably: Return on Assets (ROA), Return on Equity (ROE), and Net Interest Margin (NIM).

Return on Assets (ROA). ROA is the return on investment rate used to measure the efficiency and performance of commercial banks. It measures the bank's management efficiency in using its total assets to generate income.

Through this indicator, the net income per monetary unit of the average assets held during this period can be measured. It is calculated using the following formula (Wijaya, 2019):

$$\text{ROA} = \frac{Net\ Income}{Total\ Asset} \times 100.$$

Return on Equity (ROE). ROE can be measured by dividing net income by shareholders' equity. The higher this return, the better, as it means the bank can distribute more profits to shareholders. It can be calculated as follows (Ashok, Kushal, 2021, p. 132):

$$\text{ROE} = \frac{Net\ Income}{Total\ Equity} \times 100.$$

Types of Electronic Banking Services. Electronic banking services have many types, the most important of which are the following (Abaenewe, Ogbulu, 2013):

- Automated Teller Machines (ATM).
- Electronic Point-of-Sale Devices (POS).
- Internet Banking (IB).
- Mobile Banking (MB).

ANALYTICAL STUDY OF THE DEVELOPMENT OF ELECTRONIC BANKING INDICATORS AND THE PERFORMANCE OF COMMERCIAL BANKS IN ALGERIA DURING THE PERIOD (2004—2023)

Within the framework of analyzing the relationship between the development of electronic banking and the improvement of the performance of commercial banks in Algeria, we studied five key indicators representing: the Return on Assets (ROA) index, the number of ATMs index, the commercial bank borrowers index, the ratio of non-performing loans to total loans (%), and the commercial bank branches index. Reliable data were adopted from world bank WDI sources for the period between 2004 and 2023, and they were converted into graphical formats to read their developments more accurately and objectively.

The following Fig. 1 shows the development of the Return on Assets index in Algeria during the period from 2004 to 2023. During the period 2004—2018, ROA in Algeria recorded continuous improvement, rising from 0.23% in 2004 to 1.745% in 2018. This growth clearly reflects an improvement in banks' performance in utilizing their assets to generate profits, indicating internal management efficiency and diversification of income sources, driven by relative economic stability and the gradual growth of the banking sector. However, this upward trend did not continue, as the index began to decline starting from 2019 until the end of 2023. This deterioration can be linked to multiple factors, most notably: the negative impact of the COVID-19 pandemic, the rise in non-performing loans, and the slowdown in economic activity, which reduced banks' ability to generate profits. It is evident that banks' profitability improved sustainably over 15 years but experienced a sharp collapse during the last three years, highlighting the need to reassess banking policies and profit sources in times of crisis.

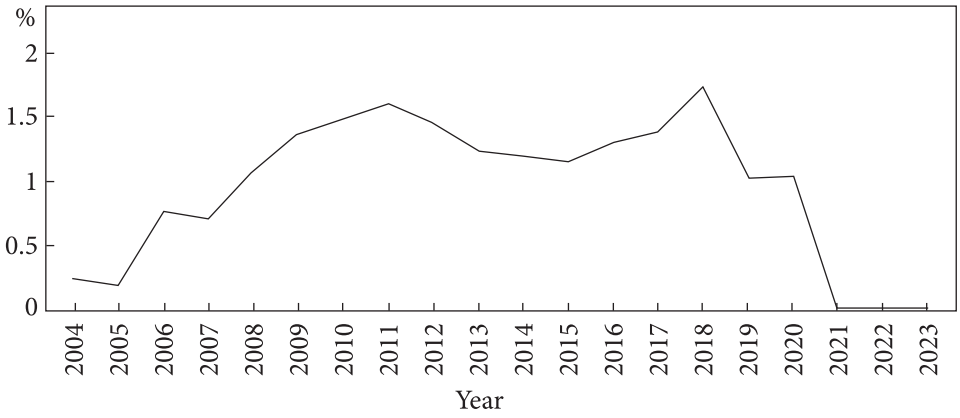

Fig. 1. Development of the return on assets ratio in Algerian commercial banks, %
Source: prepared by the authors based on: *FRED*. URL: https://fred.stlouisfed.org/series/DDEI05DZA156NWDB

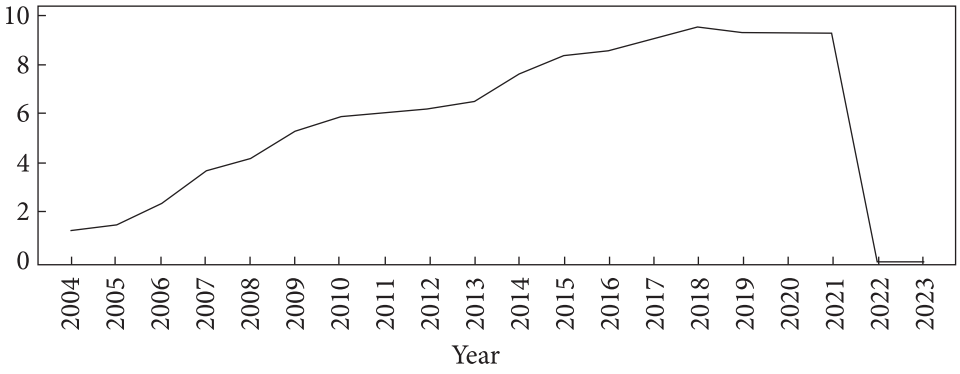

Fig. 2. Development of the Automated Teller Machines (ATMs) indicator per 100,000 adults in Algerian commercial banks
Source: prepared by the authors based on: *The World Bank*. URL: https://data.albankaldawli.org/indicator/FB.ATM.TOTL.P5?end=2024&locations=DZ&start=2000&view=chart

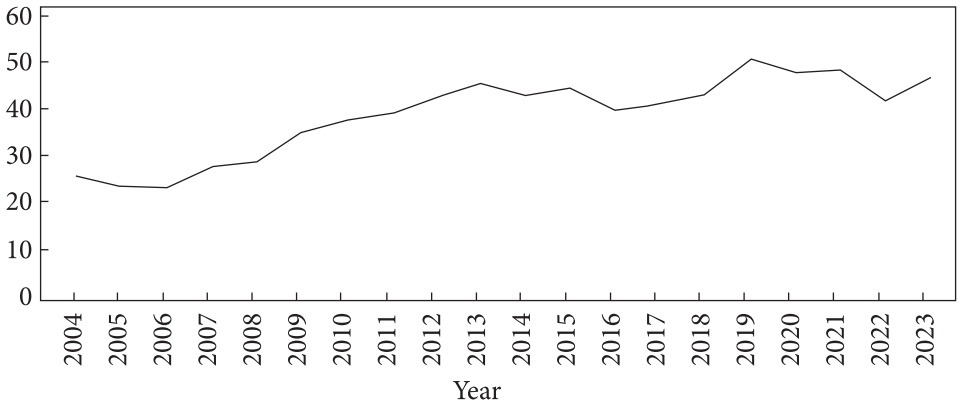

Fig. 3. Development of the online borrowers index (CRD) in Algerian commercial banks
Source: prepared by the authors based on: *The World Bank*. URL: https://data.albankaldawli.org/indicator/FB.CBK.BRWR.P3?end=2024&locations=DZ&start=2000&view=chart

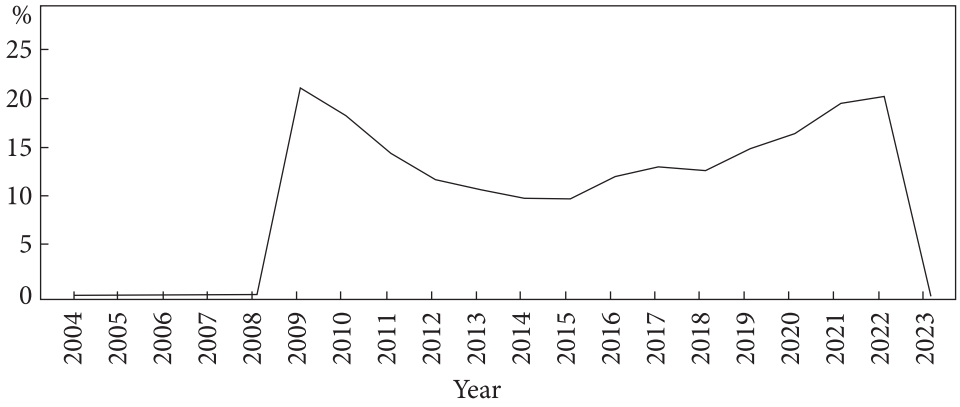

Fig. 4. Development of the non-performing loans to total loans ratio in Algerian commercial banks, %
Source: prepared by the authors based on: *The World Bank*. URL: https://data.albankaldawli.org/indicator/FB.AST.NPER.ZS?end=2024&locations=DZ&start=2000&view=chart

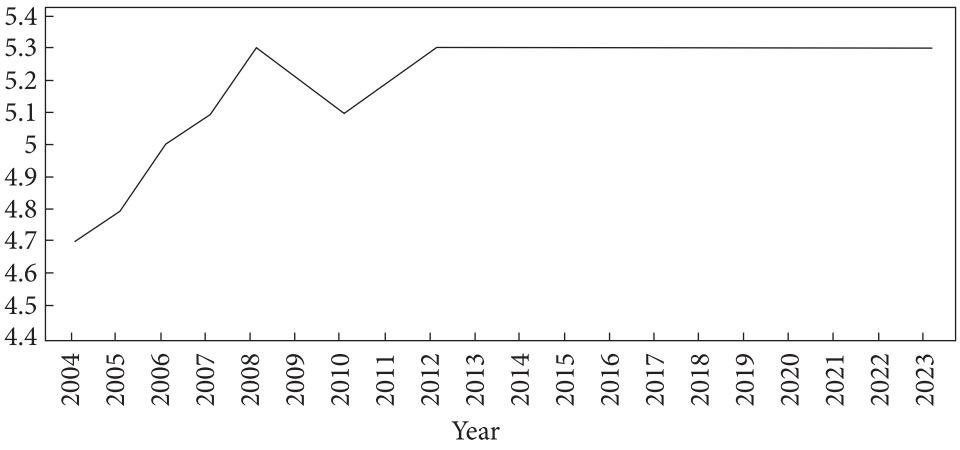

Fig. 5. Development of the the commercial bank branch index (BRN), per 1,000 adults in Algeria
Source: prepared by the authors based on: *The World Bank*. URL: https://data.albankaldawli.org/indicator/FB.CBK.BRCH.P5?end=2024&locations=DZ&start=2000&view=chart

The following Fig. 2 highlights the development of the ATM machines index in Algeria during the period from 2004 to 2023, where this indicator witnessed a noticeable development during the studied period, increasing from only 1.27 machines in 2004 to 9.54 machines in 2018. This reflects a significant effort by banks to expand the coverage of electronic banking services and facilitate withdrawals outside working hours. However, this indicator recorded stagnation in the number of machines during the study period, which indicates a relative halt in technological expansion. Accordingly, it became evident that Algerian commercial banks are moving toward improving digital coverage through ATMs, especially since the COVID-19 pandemic, during which electronic payments continuously developed.

The following Fig. 3 shows the development of the online borrowers index (CRD) in Algeria during the period from 2004 to 2023. This indicator reflects the extent to which citizens access bank financing and, consequently, the extent of financial inclusion in Algeria. We observed a gradual increase from 26 borrowers in 2004 to 50.6 in 2019, indicating a significant improvement in the relationship between citizens and banking institutions and an increase in trust in the financial sector. On the other hand, a decline was recorded to 41.9 in 2022, amid difficult economic and social conditions, indicating reduced demand for loans or stricter lending conditions by banks. Then the index saw a slight recovery in 2023, estimated at 46.9. Therefore, despite the general increase in the number of borrowers, the economic crisis affected citizens' borrowing capacity and prompted banks to be cautious in granting loans, calling for actions to support balanced financial inclusion in Algeria.

The following Fig. 4 shows the development of the ratio of non-performing loans to total loans (%) — i.e., the non-performing loans index — which is among the indicators that serve as early warnings about the condition of banks. This index did not record any values until 2008. Starting from 2009, data began to appear showing high percentages of non-performing loans, gradually increasing to reach their peak in 2022 at 20.3%, a very high rate, indicating weak customer file assessments or economic conditions that affected their repayment capacity.

Accordingly, we conclude that Algerian commercial banks face a real challenge in reducing credit risks, as the increase in the rate of unpaid loans to such a level requires a comprehensive review of lending and collection policies. This negatively reflects on the performance of the banking sector in Algeria during the study period.

The following Fig. 5 shows the development of the commercial bank branches index through the number of online point-of-sale devices in Algeria, where the number of commercial bank branches reached 4.7 per 1000 adults in 2004, slightly rising to 5.3 in 2008. Notably, it remained stable at this level without change until 2023, despite population growth and market needs.

This stability shows that Algerian banks no longer rely on horizontal expansion (opening new branches), but have begun transitioning toward digital banking, which explains the greater focus on ATMs and electronic services instead of investing in costly traditional infrastructure, especially in remote or rural areas. Accordingly, we conclude that banks' reliance on digitization instead of expanding the traditional banking network may be a strategic option to reduce costs and achieve rapid access, but this direction should be accompanied by actual expansion of electronic services.

Thus, we conclude that through our analysis of the graphs, it is clear that Algerian public and private commercial banks have made significant progress in improving their performance and profitability during the early years of the studied period, supported by the development of banking technology and increased citizen interaction with financial institutions. However, the negative developments recorded since 2019 — whether in terms of profits, non-performing loans, or even the slowdown in digital expansion — call for:

• the need to evaluate the real state of banking digitization, not just its superficial form;

• enhancing banks' capabilities in risk management;

• working to restore confidence in the banking system through transparency and continuous improvement of services.

ECONOMETRIC STUDY OF THE IMPACT OF ELECTRONIC BANKING SERVICES ON THE FINANCIAL PERFORMANCE OF COMMERCIAL BANKS IN ALGERIA

Through the econometric and analytical study, we will examine the extent to which financial technology services impact the performance of the Algerian banking sector in order to address the research problem and hypotheses. This will be achieved by estimating the multiple linear regression equation of the study variables and conducting econometric tests to verify the quality of the estimated multiple linear regression model.

The following equation illustrates the model of the study as follows:

$$ROA_{it} = \beta_0 + \beta_1 ATM_{it} + \beta_2 BRN_{it} + \beta_3 CRD_{it} + \beta_4 RISK_{it} + \varepsilon_t,$$

where *Dependent Variable*: ROA — represents the performance of the banking sector in Algeria measured by return on assets, obtained from the Freed database; *Independent Variables*: ATM — represents the ATM index per 100,000 adults, obtained from the World Bank database; BRN — the number of commercial bank branch per 1,000 adults, obtained from the World Bank database; CRD — represents the online borrowers per 1,000 adults via the internet, obtained from the World Bank database; RISK — represents the index of non-performing bank loans to total loans (%), obtained from the World Bank database; β_0, ..., β_4 — model parameters; ε_t — random error; i — commercial banks; t — the index of time period.

PRESENTATION OF THE STUDY RESULTS

In the following section, we will address all the tests related to the ARDL model, starting with the unit root test, bounds cointegration test, diagnostic tests for the model, lag length test, and parameter estimation for the short and long run.

Stationarity Test of the Study Variables. As a first step, we conduct a stationarity test of the time series, which is a condition for the ARDL model. Unit root tests are the most important method for determining the stationarity of time series. This helps analyze the model's properties and avoid the problem of spurious regression in the case of the presence of a unit root. This is done using ADF (Augmented Dickey-Fuller) and PP (Phillips-Perron) tests. The results are in the Table 1, where H0 — presence of a unit root, i.e., the series is non-stationary; H1— absence of a unit root, i.e., the series is stationary.

The following Table 1 displays based on the stationarity test results using the ADF and PP tests, the study revealed that all study variables are integrated of the

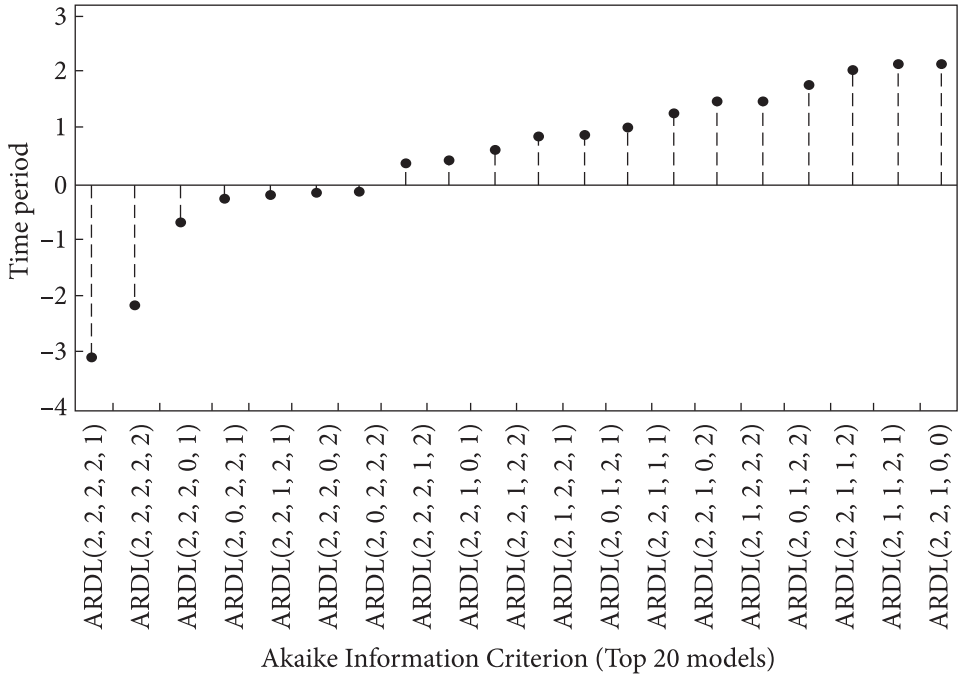

Fig. 6. Test of the optimal lag length for the model
Source: compiled by the authors using Eviews12 outputs.

Table 1. **Unit Root Test (Stationarity Test)**

ADF		PP		Variable
I0	I1	I0	I1	
−2.111 (0.241)ns	−1.944 (0.03)**	−1.474 (0.524)ns	−4.306 (0.004)*	ROA
−1.372 (0.573)ns	−3.794 (0.011)*	−1.493 (0.515)ns	−3.794 (0.014)*	ATM
−4.035 (0.065)ns	−3.061 (0.048)**	−11.920 (0.000)*	/	BRN
−1.324 (0.595)ns	−2.921 (0.053)**	−1.318 (0.598)ns	−4.689 (0.001)*	CRD
−2.262 (0.192)ns	−3.119 (0.043)**	−2.215 (0.207)ns	−2.995 (0.054)**	RISK

* Stationary at 1%; ** Stationary at 5%; ns — non-stationary.
Source: compiled by the authors using Eviews12 outputs.

first order. Accordingly, we accept the alternative hypothesis H1, which means that there are no unit roots in the time series. This allows us to proceed with the estimation process using the ARDL model.

Cointegration Test Using the ARDL Bounds Approach. This test is used to detect the presence of cointegration between the variables in both the long and short term so that we can estimate these relationships simultaneously using the

Autoregressive Distributed Lag (ARDL) model. However, we must first determine the optimal lag length, based on several criteria (LOGL, SC, AIC, BIC), by selecting the lowest value. The results are in the Fig. 6 below.

Bounds test for cointegration. The model's quality will be tested before it is adopted, by relying on the Bounds Test, as shown in the following Table 2 below.

The following Table 2 shows the results of the Bounds Test. We observe that the calculated *F*-statistic value falls outside the critical value bounds I0 and I1 at the 1%, 5%, and 10% significance levels. This indicates the rejection of the null hypothesis, which states that there is no long-term equilibrium relationship. Thus, we accept the alternative hypothesis, confirming the existence of cointegration between the study variables, i.e., the existence of a long-run equilibrium relationship.

DIAGNOSTIC TESTS OF THE ARDL MODEL

Heteroskedasticity Test. We will address the test for heteroskedasticity based on the Breusch-Pagan-Godfrey test and the ARCH test, as shown in the following Table 3 and Table 4.

Table. 2. **Results of the Bounds Test for Cointegration**

Test Statistic	Value	*k*
F-statistic	7.985166	4
	Critical Value Bounds	
Significance, %	I0 Bound	I1 Bound
10	2.45	3.52
5	2.86	4.01
2.5	3.25	4.49
1	3.74	5.06

Source: compiled by the authors using Eviews12 outputs.

Table 3. **Results of the Breusch-Pagan-Godfrey Test for Heteroskedasticity**

F-statistic	Prob. *F*(13,4)	Obs**R*-squared	Prob. Chi-Square (13)	Scaled explained *SS*	Prob. Chi-Square (13)
0.6357	0.7602	12.12949	0.5171	0.4673	0.1050

* Observed.
Source: compiled by the authors using Eviews12 outputs.

Table 4. **Results of the ARCH Test for Heteroskedasticity**

F-statistic	Prob. *F*(1,15)	Obs**R*-squared	Prob. Chi-Square (1)
2.6616	0.1236	2.5619	0.1095

* Observed.
Source: compiled by the authors using Eviews12 outputs.

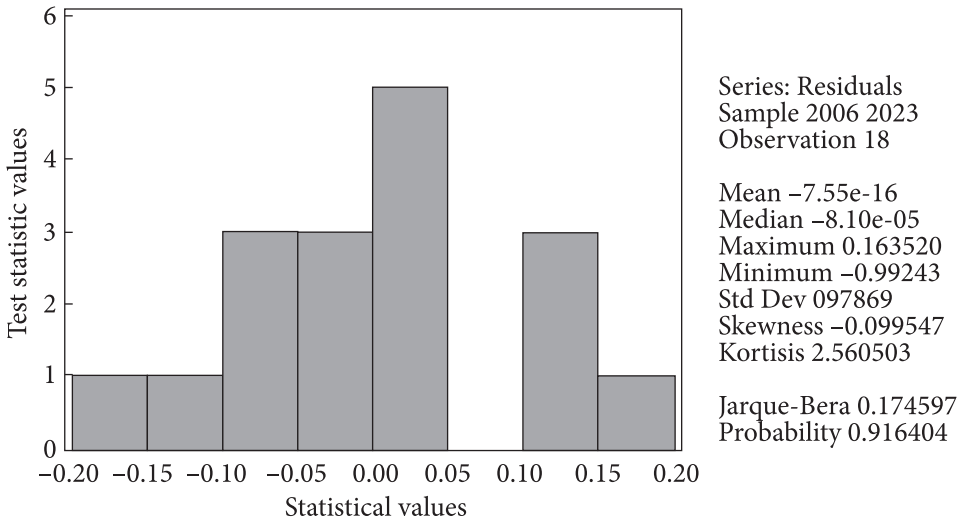

Fig. 7. Results of the Normality Test
Source: compiled by the authors using Eviews12 outputs.

Table 5. **Results of the Lagrange Multiplier Test for Serial Correlation of Residuals**

F-statistic	Prob. *F*(1,3)	Obs**R*-squared	Prob. Chi-Square (1)
1.1879	0.3555	5.1058	0.0238

* Observed.
Source: compiled by the authors using Eviews12 outputs.

The results of the Breusch-Pagan-Godfrey heteroskedasticity test and the ARCH test, as presented in Table 3 and Table 4, the probability values for both tests were 0.7602 and 0.1236, respectively — both greater than the 5% significance level. Accordingly, we accept the null hypothesis H_0, and conclude that there is no heteroskedasticity problem.

Lagrange Multiplier Test for Autocorrelation of Residuals. We now address the autocorrelation test of residuals using the Breusch-Godfrey Serial Correlation LM, as shown in the following Table 5.

Table 5 above presents the results of the autocorrelation test of residuals indicate that the probability corresponding to the LM statistic was 0.3555, which is greater than the 5% significance level. Therefore, we accept the null hypothesis, which indicates that there is no autocorrelation among the residuals.

Normality Test (Jarque-Bera). We now proceed to the normality test based on the Jarque-Bera test.

The results of the normality test as illustrated in Fig. 7 above show that the probability corresponding to the Jarque-Bera statistic was 0.9164, which is greater than the 5% significance level. Therefore, we accept the null hypothesis, which indicates that the residuals follow a normal distribution.

ESTIMATION OF THE SHORT- AND LONG-RUN MODEL USING THE ARDL MODEL

In this section, we present the estimation of the relationship between banking performance and electronic banking indicators in Algeria during the period 2004—2023, in both the short and long run, using the ARDL model.

Estimation of the Short-Run Model Parameters Using the ARDL Model. To estimate the parameters in the short run, the Error Correction Model (ECM) is used, as shown in Table 6.

From the Table 6 above, we observe that most of the model's parameters are statistically significant, and the error correction coefficient (ECM) was estimated at –0.613, which is negative and significant at the 5% level. This confirms the validity and existence of a long-run equilibrium relationship between banking performance and electronic banking indicators.

Table 6. **Results of the Error Correction Model (ECM) estimation test for the ARDL model**

Cointegrating Form				
Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
D(ROA(–1))	–1.540289	0.376772	–4.088122	0.0150
D(ATM)	0.408450	0.066975	0.723409	0.0495
D(ATM(–1))	0.164996	0.101738	–1.621767	0.0502
D(BRN)	0.044685	1.991968	–2.010417	0.0147
D(BRN(–1))	1.927234	1.367673	–1.409134	0.0316
D(RISK)	–0.025499	0.018510	–1.377581	0.0404
D(RISK(–1))	–0.033883	0.024056	–1.408462	0.0318
D(CRD)	0.303907	0.032704	–2.259907	0.0267
CointEq(–1)	–0.613890	0.435678	1.409044	0.0316

Source: compiled by the authors using Eviews12 outputs.

Table 7. **Results of the Long-Run Coefficients Estimation Test for the ARDL Model**

Long Run Coefficients				
Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
ATM	0.223660	0.196588	–1.137708	0.0188
BRN	1.328081	2.520323	–0.526949	0.0261
RISK	–0.088631	0.051441	0.172288	0.0516
CRD	0.274028	0.209073	1.310677	0.2602
C	–1.889188	8.944144	–0.211221	0.8430
Cointeq = ROA – (–0.2237ATM – 1.3281BRN + 0.0089RISK – 0.2740CRD – 1.8892)				

Source: compiled by the authors using Eviews12 outputs.

Estimation of Long-Run Model Parameters. To estimate the long-run parameters, the Bounds Test is used, as follows.

From the Table 7 above, we note that most of the model's parameters are statistically significant, which indicates the impact of all independent variables — ATM machines, commercial bank branches, non-performing loans — except for the borrowers from commercial banks (CRD) on the dependent variable, banking performance (Return on Assets) of the Algerian banking sector during the study period. This finding is consistent with many studies, most notably (Elbaraka, Abed, 2024).

The limited impact of internet banking services on the financial performance of commercial banks in Algeria (only in the short term) can be explained by the contrast with traditional banking services. This is largely due to the low level of trust in internet banking services (digital services). On the other hand, the internet banking services provided by Algerian commercial banks have not yet reached the desired quality level.

Discussion of the Study Results. The study results in the short run showed that the model is statistically significant, as indicated by the *f*-Statistic = 0.00, meaning that the overall significance of the estimated equation is statistically acceptable at a significance level below 5%. The adjusted determination coefficient R^2 showed an explanatory power of 0.86, meaning that the independent variables explain approximately 86% of the dependent variable, and the remaining 14% is explained by other variables not included in the model, which is due to the random error.

The results also showed a positive relationship between ATMs (ATM) and the Return on Assets (ROA) at a 5% significance level. That is, if the number of ATMs increases by one unit, the bank's performance increases by 40%. This indicates that the increase in both the number of ATMs and the number of issued payment cards in Algeria during the study period positively reflected the performance and profitability of the banking sector. This finding is consistent with many studies, most notably: A. Nshimyimana & P. Nkurunziza (2020), M. Anteneh & T. Abebe (2025), D. Tilahun (2016), G. Tegenu (2020), B. Bethlehem (2018).

This relationship can be explained by the fact that any increase in the number of ATMs during the study period has contributed to improving financial inclusion by expanding and facilitating access to banking services, particularly in areas with lower network coverage. Consequently, the increased volume of banking transactions attracts new customers to banks, which has positively impacted the volume of deposits and loans — considered main sources of income and profitability for commercial banks in Algeria.

The indicator of number commercial bank branches (BRN) — representing the number of point-of-sale devices via the internet — also showed a positive relationship with the financial performance of commercial banks in Algeria (ROA), statistically significant at the 1% level. During the study period, Algeria experienced an increase in the number of commercial bank branches (BRN), which made it easier for customers to access financial services and led to a growth in the number of clients, deposits, and transactions. This expansion generated additional income for banks through

commissions and fees on electronic payments and transfers without a significant rise in costs. These results are contrary to the findings of N. El Baraka & B. Abed (2024).

Although the BRN indicator positively affected the financial performance (ROA) of commercial banks, the improvement was limited: each additional branch increased performance by only 4%, indicating slow banking intermediation and insufficient agency coverage, especially in remote municipalities. Consequently, financial inclusion in Algeria remains. Among the studies supporting this relationship (Moses, 2022).

In contrast, the non-performing loans index (RISK) showed a negative relationship with the banking performance index in Algeria, statistically significant at the 5% level. That is, when non-performing loans increase by one unit, the performance of commercial banks decreases by 2%. This indicates that Algerian commercial banks are still unable to adequately manage and monitor their loans, as evidenced by the significant rise in the volume of non-performing loans. These loans are often granted in an effort to boost profitability without conducting proper studies to assess and follow up with clients at the time of loan disbursement, which leads to increased credit risk in addition to direct financial losses for these banks. Consequently, banks are required to allocate high levels of loan loss provisions, which reduce net profits. Moreover, non-performing loans undermine the confidence of investors and clients in the banking sector, thereby weakening the bank's ability to attract new capital and finance productive and investment activities. Ultimately, this negatively impacts the bank's financial performance indicators and threatens its stability. These results are consistent with the findings of N. El Baraka & B. Abed (2024).

Finally, the number of online borrower's index (CRD) with the Return on Assets (ROA), statistically significant at the 5% level. That is, if the number of users of online banking services increases by one unit, the performance of commercial banks increases by 30%. This indicates an increased provision and design of modern and advanced financial products and services online by Algerian commercial banks to meet the needs of individuals, considering that these digital operations have contributed to reducing operational costs and accelerating the loan approval process, enabling banks to achieve greater profits for the same level of existing assets. This finding aligns with many previous studies, notably: M. Anteneh & T. Abebe (2024), O. Hannington (2013), A. Nshimyimana & P. Nkurunziza (2020).

The Error Correction Model (ECM) parameter was estimated at –0.613, which is negative and significant at the 5% level, confirming the validity of the long-run equilibrium relationship between the performance of commercial banks and electronic banking indicators in Algeria during the study period.

The long-run results showed that the study variables maintained the same positive relationship between ATMs and the number of internet-enabled point-of-sale devices with bank performance, statistically significant at 1% and 5% respectively. This indicates the increasing reliance of Algerian commercial banks on financial technology to provide innovative financial services via smartphones, magnetic cards, etc., which save individuals time, effort, and cost — enhancing their performance in both the short and long term. The negative relationship between

non-performing loans and the financial performance of commercial banks is also statistically significant at the 5% level.

However, the online borrower's index (CRD) was found not statistically significant and had no impact on the performance of commercial banks in Algeria during the study period in the long run.

CONCLUSION

At the conclusion of this study, it can be stated that electronic banking services represent a fundamental factor in improving the financial performance of banks, not only in Algeria but also globally. The research results showed that digital transformation in the banking sector contributes to increasing operational efficiency, improving profitability, and expanding the scope of financial services to include new categories of clients, which enhances financial inclusion and helps reduce banking risks.

Accordingly, this study aims to highlight the impact of electronic banking services on the performance of commercial banks in Algeria during the period from 2004 to 2023. The study adopted a descriptive analytical approach to first highlight the reality of electronic banking in Algeria. Second, an econometric study was conducted to clarify the nature of the relationship between electronic banking indicators and the financial performance of commercial banks in Algeria in both the short and long-term using the ARDL model. The study led to the following key results:

- the analytical study highlighted that there are three key indicators that improve the financial performance of commercial banks in Algeria through electronic banking services: automated teller machines (ATM), commercial bank branches (BRN), and borrowers from commercial banks (CRD). Accordingly, the first hypothesis of the study is accepted;
- the results showed a positive relationship between ATMs (ATM) and the Return on Assets (ROA) at a 5% significance level, indicating that the increase in ATMs enhances the performance and profitability of the banking sector in Algeria during the period 2003—2024;
- the indicator of the commercial bank branch index (BRN) also showed a positive relationship with the financial performance of commercial banks in Algeria (ROA), statistically significant at the 1% level, but with a weak percentage, which indicates a slowdown in banking intermediation provided by the banking sector, especially in municipalities distant from the province;
- the online borrower's index (CRD), through loans granted online, showed a positive relationship with the financial performance indicator (ROA), statistically significant at the 5% level. This indicates the increased offering and design of modern and advanced financial products and services by Algerian commercial banks, which is an essential element for improving and developing their performance and profitability. Accordingly, the third hypothesis of the study is accepted;
- finally, the non-performing loans index (RISK) showed a negative relationship with the financial performance of commercial banks in Algeria (ROA), statistically significant at the 5% level. This indicates that commercial banks do not rely

on technology in predicting, managing, and mitigating financial risks, which has negatively affected the performance of commercial banks in Algeria;

• the long-term study results showed that the study variables maintained the same positive relationship between ATMs and bank branches with the performance of commercial banks, statistically significant in both the short and long term, as well as the negative relationship between non-performing loans and bank performance. However, the internet banking indicator through borrowers from commercial banks via the internet was found not statistically significant in the long term. The second hypothesis of the study is accepted.

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Несрін Беттіуї, доцент, професор університету (фінанси)
Лабораторія з проблем ринків, робочих місць,
законодавства та моделювання в країнах Магрибу
Університет імені Бельхаджа Бучаїба в Айн-Темушенті
шосе Дуду Мохтар, 11, Бен-Акнун, 46000, Алжир
Мохаммед Алі Дахман, доцент, професор університету
(управління державними фінансами)
Лабораторія з проблем ринків, робочих місць,
законодавства та моделювання в країнах Магрибу
Університет імені Бельхаджа Бучаїба в Айн-Темушенті
шосе Дуду Мохтар, 11, Бен-Акнун, 46000, Алжир

ВПЛИВ ЕЛЕКТРОННИХ БАНКІВСЬКИХ ПОСЛУГ НА ФІНАНСОВІ ПОКАЗНИКИ КОМЕРЦІЙНИХ БАНКІВ В АЛЖИРІ

Висвітлено вплив електронних банківських послуг на показники діяльності комерційних банків в Алжирі в період з 2004 по 2023 р. Використано описовий аналітичний підхід, щоб, по-перше, з'ясувати реалії електронного банкінгу в Алжирі за допомогою аналізу різних показників, пов'язаних з електронними банківськими послугами, і фінансових показників алжирського банківського сектору з метою визначення рівня їх розвитку в період з 2004 по 2023 р. По-друге, проведено економетричний аналіз для уточнення характеру зв'язку між показниками електронного банкінгу і фінансовими показниками комерційних банків в Алжирі як у коротко-, так і в довгостроковій перспективі з використанням моделі ARDL. За підсум-

ками дослідження зроблено такі ключові висновки: існує позитивний зв'язок між показниками, що стосуються банкоматів, індексом відділень комерційних банків (BRN), індексом онлайн-позичальників (CRD) та індексом фінансової діяльності банків (ROA). Однак є обернена залежність між ними та індексом непрацюючих кредитів (RISK) як у коротко-, так і в довгостроковій перспективі. Відповідно, цифрова трансформація в алжирському банківському секторі сприяє зростанню операційної ефективності, підвищенню прибутковості й активнішому охопленню фінансовими послугами нових груп клієнтів. У результаті це посилює фінансову інклюзію і допомагає пом'якшити банківські ризики.

***Ключові слова**: фінансові показники; електронні банківські послуги; банкомати; комерційний банк.*

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