

Evaluation of Profitability Factors of Digital Banks in the UK From 2018 to 2023 , PANEL data analysis

ARROUF AFIFA

Constantine 2 University

Algeria

afifa.arrouf@univ-constantine2.dz

Reçu le : 26/09/2024

Accepté le : 27/12/2024

Publié le : 31/12/2024

Abstract:

International banks are increasingly establishing digital banks, a trend that has been accelerated by the COVID-19 crisis, during which digital transformation has surged across many sectors.

Our study aims to evaluate the factors affecting the profitability of digital banks in five banks in the U.K from 2018 to 2023 measuring with profitability metrics, using the multiple regression with panel data and analyzing data with EVIEWS program.

The study reveals that non-interest income ratio negatively affects both ROA (Return on Assets) and ROE (Return on Equity), asset size significantly influence the profitability of digital banks. Additionally, customer growth negatively impacts ROE, and technology costs do not significantly affect ROA or ROE but affect negatively the net profit margin.

Despite their modernity, these banks have managed to capture market share and attract many customers. To improve profitability, banks should focus on managing costs by investing in cost-effective technology solutions that enhance operational efficiency and optimize assets by entering new markets.

Keywords: digital banks; Profitability; factors; U.K; Panel data

Jel Classification Codes : G21 ; G23; C33;L25

ملخص:

تتجه البنوك العالمية، نحو إنشاء بنوك رقمية، وهذا الاتجاه أكدته أزمة كورونا التي نما فيها التحول الرقمي في العديد من المجالات.

تهدف الدراسة الى تقييم العوامل التي تؤثر على ربحية البنوك الرقمية في خمسة بنوك رقمية في المملكة المتحدة من سنة 2018 إلى سنة 2023 من خلال اعتماد مؤشرات قياس ربحية البنوك باستخدام الانحدار المتعدد مع بيانات بانل وتحليل البيانات بواسطة برنامج EVIEWS

توصلت الدراسة الى وجود تأثير سلبي لنسبة الدخل من غير الفوائد على كل من العائد على الاصول والعائد على حقوق الملكية. وتأثير إيجابي لحجم الأصول على ربحية البنوك الرقمية اما نمو العملاء فيؤثر سلبا على العائد على حقوق الملكية فقط ، بينما لا تؤثر تكاليف التكنولوجيا على العائد على الأصول والعائد على حقوق الملكية ولكنها تؤثر سلبا على صافي هامش الربح .

على الرغم من حداثة، تمكنت هذه البنوك من تحقيق حصص في السوق، وجذب العديد من العملاء من اجل تحسين ربحيتها يجب على البنوك إدارة تكاليفها بكفاءة من خلال الاستثمار في حلول تكنولوجية فعالة تعزز الكفاءة التشغيلية وتعزيز أصولها من خلال دخول أسواق جديدة.

الكلمات المفتاح : بنوك رقمية ؛ ربحية ؛ عوامل ؛ مملكة متحدة ؛ بيانات بانل.

تصنيف JEL : G21 ; G23; C33; L25

I. Introduction:

In recent years, financial technology has developed rapidly, further accelerated by the COVID-19 pandemic. It has significantly enhanced the delivery of banking services to various segments of society and regions through both traditional channels and electronic platforms, such as cards, websites, and mobile applications. This progress has also contributed to achieving financial inclusion, with some countries realizing high rates of access to financial services. Many are now transitioning from digital services to fully digital banks that offer banking solutions without physical branches and minimal human intervention, relying solely on mobile applications.

The digital transformation affecting various sectors has imposed radical changes on the banking industry to keep pace with development, competition, and customer expectations. In this context, digital banks have emerged as the latest and most innovative banking models, actively seeking to expand their market share and improve their performance.

Facing the growing wave of artificial intelligence, countries are increasingly establishing digital banks that target customers and provide digital financial services in competition with traditional banks.

I .1. The problem of the study:

Considering their modernity, do digital banks in the U.K achieve acceptable profitability over the period 2018 - 2023 and what are the factors that impact their profitability?

I .2.Hypothesis:

1. Customer growth positively impacts the profitability of digital banks in the U.K.
2. Cost to income ratio or efficiency ratio positively impacts the profitability of digital banks in the U.K.
3. A higher investment in technology positively impacts the profitability of digital banks in the U.K.
4. Total assets positively impacts the profitability of digital banks in the U.K.
5. A higher non-interest income ratio positively impacts the profitability of digital banks in the U.K.

I .3. The importance of the study:

The importance of the subject is evident as it addresses a modern issue with limited existing research, focusing on the new trend in banking, where institutions are transitioning from providing traditional digital services to establishing fully digital banks managed remotely. The importance of the study is also evident from the importance of banks in the economy, as they are the beating heart of it by pumping money so that the economy can perform its functions.

The development of the banking system is a mirror of the development of the economy, and it is certain that any development or positive impact on banks will have a positive impact on economic development.

I .4. Research objectives:

1. This study aims to answer the problem raised, based on the following set of objectives:
2. Identifying global digital banks and their development.
3. Identifying their types and classification.
4. Analyzing the factors affecting the profitability of digital banks with a case study.

5. Provide recommendations to improve the profitability of digital banks.
6. Provide recommendations based on the experience of these banks to establish Algerian digital banks.

II. Methods and Materials:

To address the problem raised, this study utilized two methods. The first is the descriptive method, which presents the facts and provides a clear picture of the current state of digital banks worldwide through an analysis of previous studies. The second method is analytical, aimed at diagnosing and analyzing financial reports and statistical tables related to digital banks in UK and their financial performance using multiple regression with panel data. This approach analyzes observations on multiple banks over multiple time period. The statistical significance level of the study is 05%.

III. Literature Review:

The most important eras of the development of banks can be highlighted as follows (Restiana Ie Tjoe Linggadjaya, 2023):

- Bank 1.0 (**1472-1980**), the traditional bank, was established in 1472 as a place to accept deposits and grant loans, with a physical meeting required between the bank and the customer. Mainframe computers were used but not for direct contact with customers.
- Bank 2.0 (**1980-2007**) The bank began to adopt ATMs, which enabled customers to conduct transactions without physically confronting them in the bank. Thus, the era of self-service banking began, and this era was marked by the emergence of the Internet in 1995.
- Bank 3.0 (**2007-2017**) is referred to as the generation of online and mobile banking, which allows customers to perform banking activities from anywhere. This began with the emergence of smartphones in 2007 and made mobile payments possible.
- Bank 4.0 (**2017-present**), where banks began to abandon the concept of "face-to-face", branch office services, Technological resources, including artificial intelligence, big data and blockchain technology, are the most important features of the pillars of Bank 4.0.

Banks that offer exclusively digital banking services have a variety of "names", including neobanks, challenger banks, digital banks, green banks, fintech banks and many others. The following definitions can be provided for them:

- Digital banks are depository institutions that provide banking services primarily through electronic channels rather than physical branches. This means that the digital bank's business model relies heavily on technology, which distinguishes it from traditional banks (BIS, 2020).
- There are many terms in English for digital banks such as online-only banks, digital-only banks and neobanks, virtual bank, smart bank. Online-only banking is defined as providing banking services to customers entirely through the Internet, usually either by mobile phone or personal computer, with ATM withdrawals and transfers.

An online-only bank does not need to establish physical branches, but a physical head office is established to communicate face-to-face with users to help deal with various issues. Internet-only banking refers to a business model that provides most banking services through electronic media such as ATMs and websites, without the need to go to branches or agencies (Chen, 2021).

It is Important to note the difference between electronic and digital banks. Electronic banks provide some electronic services to the customer, while digital banks are banks whose services are all digital via the Internet and phone applications and do not have real branches.

Digital banks are divided into two types: some have a license from the Central Bank and initially operate independently of their own brand, and others directly as a branch of the traditional bank and with a license from it (Shermukhamedov, 2021) In the next element, we will deal with the most detailed types and classifications of digital banks.

III .1. Typology of digital banks:

The following table illustrate the typology of Digital Banks made by Giacomo Büchi and Luca Fasolo 2019, the comparison between Neo banks and challenger banks shows that the two banks are initially financial startups, the main difference between the two banks is that neo banks are not licensed bank they use the partner license while the challengers banks have their own license .

Table 1. Typology of digital banks

Type Dimension	Beta banks	Neo banks	Challengers Banks	Retail Banks	Big Tech Banks
Bank's License	Full license of the parent bank	Not licensed use the licenses of partner banks	Licensed	Licensed or partially licensed	Licensed or partially licensed
Initial position	Incumbent	Fintech	Fintech	Retail	Big Tech
Strategy	Defensive	Collaborative	Challenger	Challenger	Challenger
Experience	Practiced	New market entrants	New market entrants	New market entrants	New market entrants
Business industry	Banking first	The core business is the banking sector	The core business is the banking sector	The core business is not the banking sector	The core business is not the banking sector

Source: Author using Giacomo Büchi , Luca Fasolo, New Banks in th 4th Industrial Revolution: A Review and Typology. 22nd International Conference Thessaloniki (Greece). 2019

III .2. Digital banks in the world:

We are going to begin our world tour of digital banks with analyzing laws and regulations prevalent in different jurisdictions.

According to Sameer Gahlo and Stuti Gosh , India is in process framing regulation for organization of the activity of digital only banks , Hong Kong monetary authority has also made guidelines for licensing digital banks in its jurisdiction specifying certain condition that a locally company need to fulfil to be able to function as a digital bank , these guidelines allows both financial and non-financial locally company to apply for digital bank license catering primely to retail business though a virtual bank operates digitally , its required to establish a branch office in Hong Kong for interacting with regulatory authority, and to redress customer

grievance a digital bank is treated at par with a traditional bank and required to respect all the applicable regulation like capital requirement and risks norm and carve out a way to maintain a balance between protection of public deposit and technological innovation .

The central bank of Malaysia has also issued a licensing framework for digital banks containing provisions ranging from applicability to eligible business activities (Ghosh, 2023) . AEON Bank recently launched as the country's first Islamic digital bank on May 26, 2024. AEON Bank offers a range of digital banking products that adhere to Shariah principles, such as Savings Account-i and Visa Debit Card-i (aeonbank, 2024).

In the United Kingdom there exists no separate licensing framework which is applicable to digital banks as these banks are also required to abide with the provision laid down in the financial services and market act 2000 (Ghosh, 2023).

In Africa, Nigeria and South Africa have a very developed banking system, according to Daniel 2020, The influence of the new Generation **Y, born** between the early 1980s and the mid-1990s, in the South African banking market is increasing, banks need to make changes and develop new technologies to satisfy their needs, challenger banks began their activities in the South African market in 2019. The most popular digital bank in South Africa is Bank Zero. Challenger banks have customer-oriented strategy they maintain the customer relationship even with their low-cost digital business models (Daniel, 2020).

In Nigeria, digital banks are regulated by the Banks and Other Financial Institutions Act of 2020. According to (Ngwoke,2024) the advantages of challenger banks are first, the lower costs and fees compared to traditional banks, the best example is Kuda bank, which is a Nigerien digital bank offering free products and services to customers. Secondly the operational costs that are lower than those of traditional banks, in the absence of premises and offices and a reduced number of workers. Finally, digitalization not only reduces costs but also allows time saving by reducing the time of information processing and documents study and eliminates queues in branches. Moreover, customers can now access digital bank banking services every day at any time and from any location.

Digital banks are threatened by cyberattacks, customer information can be stolen or used fraudulently this requires implementing high digital security, network outages and internet outages are also inconveniences of digital banks (Ngwoke, 2024).

IV - Profitability analysis of a sample of digital banks in the U.K:

For this study, we selected five digital banks which are among the most popular digital banks in UK and at the same time, data relating of these banks are available and collected from annual reports in the web site of the banks. The choice was also made to correspond to the study period from 2018 to 2023 The banks chosen are the first digital banks to be installed, i.e. before 2018 today the majority of existing digital banks in UK are banks created only after 2019. The table below shows the characteristics of the digital banks of our study:

Table 2. the characteristics of the digital banks of our study

Bank	CATEGORIE	FOUNDED YEAR	LICENSED YEAR	Market concentration
ATOM BANK	NEO BANK	2013	2015	UK
MONZO	NEO BANK	2015	2017	UK and USA
REVOLUT	NEO BANK	2014	2021	UK and 30 countries.
OAKNORTH BANK	NEO BANK	2013	2015	UK and USA in 2024
TANDEM BANK	NEO BANK	2014	2018	UK

Source: Author

IV.1. Presentation of measurement variables:

Table 3. descriptive statistics of variables

Million GBP and %

	ROA	ROE	PROFIT MAR	ASSETS	TECH	CIR	CUST_GROW	NON_INTR
Mean	-0.012467	-0.239767	-0.726247	4444.050	19.93903	-0.505767	1.525433	0.317491
Median	-0.018500	-0.190000	-0.440000	2984.500	11.55000	0.830000	0.435000	0.062000
Maximum	0.028100	0.220000	0.500000	17361.00	122.3000	6.650000	22.80000	1.000000
Minimum	-0.070000	-1.240000	-4.270000	457.7000	3.600000	-31.44000	-0.017000	0.000000
Std. Dev.	0.025645	0.370926	1.094856	4137.055	26.79761	6.690684	4.110311	0.382440
Skewness	-0.215972	-1.059385	-1.212215	1.674782	2.592166	-3.477470	4.852807	0.759918
Kurtosis	2.345364	3.669997	4.603766	5.304937	9.313089	16.50514	25.61389	1.916120
Jarque-Bera	0.768904	6.172598	10.56241	20.66540	83.41548	288.4501	756.9835	4.355873
Probability	0.680824	0.045671	0.005086	0.000033	0.000000	0.000000	0.000000	0.113275
Sum	-0.374010	-7.193000	-21.78740	133321.5	598.1710	-15.17300	45.76300	9.524740
Sum Sq. Dev.	0.019073	3.990001	34.76255	4.96E+08	20825.24	1298.192	489.9451	4.241554
Observations	30	30	30	30	30	30	30	30

Source: Eviews

Profitability: In this article we refer to three profitability measures: ROA, ROE, Net profit margin For all the banks studied, the (ROA) is in average equals -1,2 %, with a minimum of -07% and a maximum value of 2,8%

For all the banks studied, the (ROE) is in average equals -24 %, with a minimum of -124%and a maximum value of 22%

For all the banks studied, the (Net profit margin) is in average equals -72%, with a minimum of -427%and a maximum value of 50%

In average profitability ratios are negatives because the digital banks under study achieved losses during the period ; due to their modernity, as digital banks are newly established and their period of activity is a few years, and at this stage the costs are greater than the returns achieved, as their revenues covered all the costs associated with the establishment and provision of financial services and products, but these incomes do not cover all other operating expenses such as marketing and technology, and for this reason banks made losses during the study period.

The profitability Metrix used are negatives throughout the period but in continuous improvement from year to year. Revolut and Monzo have achieved their first-year profit in 2023.

Total Assets: reflect the sizes of the banks, a higher total asset can indicate a larger market reach, as it often reflects the bank's ability to attract large individuals and manage a significant amount of deposits and investments. Revolut made the largest assets volume of 17.361 million GBP in 2023.

Technology cost: For Atom bank, Tandem Bank, Monzo and OAKNORTH¹, we use IT cost as a proxy for technology cost, for Revolut data concerning IT cost is not available in the annual reports so, we use research and development cost as proxy for technology cost, Revolut group undertake R&D for enhancing technology platform.

¹ For 2018 and 2019 the technology cost of aknorth bank was taken from the website (prove.com)
Analyse des coûts technologiques de certaines banques britanniques (Challenger Banks) dans le cadre des dépenses opérationnelles

Cost to income ratio: this ratio is calculated as the total operating cost divided by total operating income, the smaller this percentage, the better the bank will manage its costs this ratio can be acceptable at the initial years of operations only. the cost to income ratio was negative in some banks because the operating income was also negative, but it improved at the end of the study period, as it began to gradually and significantly decline. Monzo had the highest cost to income ratio (CIR) among banks in 2018, at 665 % in 2023 the ratio has declined to became 96%.

Non-Interest Income to Total Revenue Ratio: the growth rate of non-interest income indicates the effectiveness of revenue diversification strategies, and the proportion of revenue derived from non-interest sources it's also reflects the bank's ability to diversify its revenue. The mean of the ratio is around 31 % with the maximum and minimum values of 100 % and 0 % respectively.

Comparing the five digital banks shows us that each bank has a special strategy through which each bank tries to excel, achieve returns and attract new customers that differ from others, as Atom Bank focuses on banking intermediation and achieving returns from loan interests, other banks like MONZO and Revolut focus on diversification and achieving returns outside the traditional banking activity.

Revolut is initially a fintech and obtained its license as a bank in 2021, Revolut still generate its revenue from contracts with customers such as cards , revenues from cryptocurrency of the group , Commission from the sale of insurance products, ,Monthly or annual subscription fees charged to retail and business customers, the non interest income ratio of Revolut was 70% in 2023 this ratio decreased compared to 2020 when it reached 100% . (Revolut BANK, 2021)

MONZO bank has divided its revenue model to three groups: customer card payments, banking services and subscription products, and loan interest.

ATOM BANK Interest income has always delivered the lion's share of bank revenues, but the residential mortgage portfolio is diversified, between mortgage and business.

Customer Growth: For all the banks studied, the customer growth is in average equals 151%, Aoknorth bank achieved the lowest rate estimated - 1,7 % in 2021, while other banks achieved a jump in the growth rate and then increased in 2023 at a rate of 31% for Monzo and 45 % for REVOLUT. Word of mouth is still fulling the customer growth of Monzo in 2021.

IV .2. Characteristics of time series; the stationarity test:

To test the stationary nature of the time series, we use the Phillips-Perron test.

- **Null hypothesis:** The time series has a unit root, which means that it is not stationary.
- **Alternative hypothesis:** The time series is stationary.

the p value is less than 05% the null hypothesis is rejected, and we conclude that the series is stationary **in the first difference**.

Null Hypothesis: Unit root (individual unit root process)
Series: D(ROE)
Date: 09/06/24 Time: 18:04
Sample: 2018 2023
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett ke...
Total (balanced) observations: 20
Cross-sections included: 5

Method	Statistic	Prob.**
PP - Fisher Chi-square	38.1801	0.0000
PP - Choi Z-stat	-4.18214	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Null Hypothesis: Unit root (individual unit root process)
Series: D(ROA)
Date: 09/06/24 Time: 17:50
Sample: 2018 2023
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett ke...
Total (balanced) observations: 20
Cross-sections included: 5

Method	Statistic	Prob.**
PP - Fisher Chi-square	25.0300	0.0053
PP - Choi Z-stat	-2.97145	0.0015

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results D(ROA)

Cross section	Prob.	Bandwidth	Obs
ATOM	0.0241	3.0	4
MONZO	0.2606	0.0	4
REV	0.0569	3.0	4
OAK	0.2233	0.0	4
TANDEM	0.0461	3.0	4

Null Hypothesis: Unit root (individual unit root process)
Series: D(PROFIT MAR)
Date: 09/19/24 Time: 14:06
Sample: 2018 2023
Exogenous variables: None
Newey-West automatic bandwidth selection and Bartlett ke...
Total (balanced) observations: 20
Cross-sections included: 5

Method	Statistic	Prob.**
PP - Fisher Chi-square	26.8893	0.0027
PP - Choi Z-stat	-3.21857	0.0006

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results D(PROFIT_MAR)

Cross section	Prob.	Bandwidth	Obs
ATOM	0.0176	2.0	4
MONZO	0.1660	1.0	4
REV	0.0378	0.0	4
OAK	0.0635	0.0	4
TANDEM	0.2068	0.0	4

Source: Author calculations under Eviews

IV.3. Model Estimation, Multiple Regression with panel data from 2018 to 2023:

The results of our estimate are illustrated in the following tables.

Dependent Variable: ROA
Method: Panel Least Squares
Date: 09/06/24 Time: 14:06
Sample: 2018 2023
Periods included: 6
Cross-sections included: 5
Total panel (balanced) observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.021012	0.007455	-2.818685	0.0095
CIR	8.56E-05	0.000580	0.147686	0.8838
TECH	-0.000485	0.000381	-1.271403	0.2158
CUST_GROW	-0.000645	0.000965	-0.668974	0.5099
ASSETS	6.45E-06	2.35E-06	2.743282	0.0113
NON_INTR	-0.029739	0.011762	-2.528442	0.0184
R-squared	0.500415	Mean dependent var	-0.012467	
Adjusted R-squared	0.396335	S.D. dependent var	0.025645	
S.E. of regression	0.019925	Akaike info criterion	-4.816803	
Sum squared resid	0.009528	Schwarz criterion	-4.536564	
Log likelihood	78.25205	Hannan-Quinn criter.	-4.727152	
F-statistic	4.807978	Durbin-Watson stat	0.553320	
Prob(F-statistic)	0.003473			

For the Profitability measured by the ROA and ROE Pearson correlation coefficient (R²), obtained in the regression, shows that bank profitability is explained at 50% and 58% by the explanatory variables used.

For ROA The coefficient associated with the explanatory variable Noninterest margin and total assets is significative.

- Non-interest ratio: The coefficient associated with this variable means that, for digital banks, an increase in the share of non-interest income is associated with a decrease in profitability

(ROA). In other words, when digital banks increase their share of non-interest income, it seems to negatively affect their ability to generate profits relative to their assets.

- **Total assets:** The coefficient associated with this variable is significant, indicating that asset size has an impact on the profitability of digital banks.
- **Technology costs, cost-to-income ratio, customer growth:** These variables are not statistically significant, meaning they do not have a measurable or reliable impact on ROA in the model used

Dependent Variable: ROE
Method: Panel Least Squares
Date: 09/06/24 Time: 14:11
Sample: 2018 2023
Periods included: 6
Cross-sections included: 5
Total panel (balanced) observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.259363	0.098059	-2.644978	0.0142
CIR	0.010588	0.007623	1.388924	0.1776
TECH	-0.003206	0.005014	-0.639451	0.5286
ASSETS	6.32E-05	3.09E-05	2.043694	0.0521
CUST_GROW	-0.040000	0.012691	-3.151823	0.0043
NON_INTR	-0.413024	0.154719	-2.669509	0.0134
R-squared	0.586784	Mean dependent var	-0.239767	
Adjusted R-squared	0.500698	S.D. dependent var	0.370926	
S.E. of regression	0.262101	Akaike info criterion	0.336685	
Sum squared resid	1.648731	Schwarz criterion	0.616925	
Log likelihood	0.949719	Hannan-Quinn criter.	0.426336	
F-statistic	6.816213	Durbin-Watson stat	1.507517	
Prob(F-statistic)	0.000438			

For ROE The coefficient associated with the explanatory variable Noninterest margin customer growth and total assets is significative.

- **Customer growth:** The significant coefficient suggests that customer growth has a measurable but negative impact on ROE.
- **Total assets:** As with ROA, total assets have a significant impact on ROE. This shows that asset size is important for the return on equity of digital banks.
- **Non-interest ratio:** The negative coefficient indicates that, for digital banks, an increase in this

margin is associated with a decrease in ROE. This suggests that non-interest income does not contribute positively to return on equity. This confirms the study of Phan et al (2022) entitled; The Impact of Non-Interest Income on the Performance of Commercial Banks in the ASEAN Region through ROA, ROE, the results show that when banks depend more on non-interest income, the performance of these banks decreases.

Dependent Variable: PROFIT MAR
Method: Panel Least Squares
Date: 09/06/24 Time: 14:13
Sample: 2018 2023
Periods included: 6
Cross-sections included: 5
Total panel (balanced) observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.501205	0.362487	-4.141400	0.0006
CIR	0.019814	0.028180	0.703144	0.4887
CUST_GROW	0.009893	0.046914	0.210872	0.8348
ASSETS	0.000336	0.000114	2.935134	0.0072
TECH	-0.037306	0.018533	-2.012936	0.0454
NON_INTR	0.068564	0.571939	0.119879	0.9055
R-squared	0.351887	Mean dependent var	-0.726246	
Adjusted R-squared	0.216864	S.D. dependent var	1.094856	
S.E. of regression	0.968892	Akaike info criterion	2.951530	
Sum squared resid	22.53006	Schwarz criterion	3.231770	
Log likelihood	-38.27295	Hannan-Quinn criter.	3.041181	
F-statistic	2.606117	Durbin-Watson stat	0.575274	
Prob(F-statistic)	0.050970			

For the net profit margin, the coefficient associated with the explanatory variable technology and total assets is significant: (prob below the 5% threshold). the coefficient of technology cost is negative which mean that technology cost is inversely related to profitability of digital banks.

According to the tables below, the estimate of the multiple regression of banks' profitability measured by ROA, ROE and net profit margin is as follows.

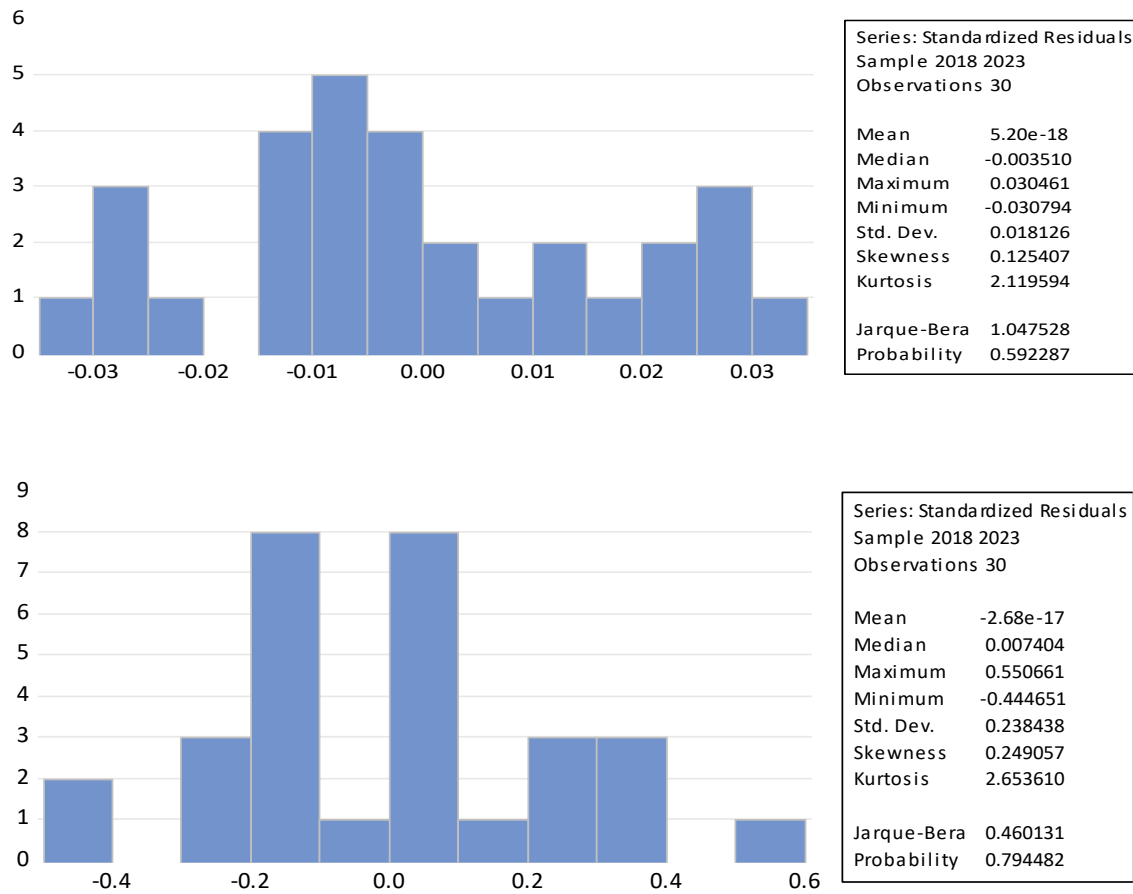
ROA= -0,0004 Technology cost +0,00000645 Total Assets + 0,0000852 CIR- 0,029Non-Interest ratio - 0,0006Customer Growth - 0,02

ROE = - 0,00032 Technology cost +0,00000632 Total Assets + 0,010 CIR- 0,041Non-Interest ratio - 0,04Customer Growth - 0,06

Net profit margin= - 0,0037 Technology cost +0,0000336 Total Assets + 0,019 CIR+ 0,07non-interest ratio + 0,0098Customer Growth - 1,50

Model validation refers to various statistical tests. The results of these different tests are illustrated below:

IV .3.1. Normality test:



Source: Author calculations under Eviews

According to the results of this test, the probability associated with the Jarque-Bera statistic (0.59) (0.79) is greater than 0.05. The hypothesis of normality of the residues is therefore verified.

IV .3.2. Heteroscedasticity test :

Heteroskedasticity Test

F-statistic	1.014767	Prob. F(3,12)	0.4202
Obs*R-squared	3.237691	Prob. Chi-Square(3)	0.3564
Scaled explained SS	1.810908	Prob. Chi-Square(3)	0.6126

The test indicates that the probability of accepting H0 is greater than 5%, so we rejected the null hypothesis of homoscedasticity, the Heteroscedasticity hypothesis is verified.

V.Results :

1. Digital banks are in the start-up phase of activity which requires a lot of investment and costs. incomes do not cover all other operating expenses such as marketing and technology, and for this reason 04banks on five made losses during the study period. return on equity (ROE), return on assets (ROA), and profit margin are negatives throughout the period but in continuous improvement from year to year.
2. For digital banks A higher non-interest ratio is associated with a decrease in ROA and ROE Banks should carefully assess how they generate and manage non-interest income to ensure that this income contributes positively to their overall return. The costs associated with these revenues and the strategy for their generation must be optimized to avoid negative impacts on ROE and ROA
3. Asset size has a positive impact on the profitability of digital banks. Measured by ROA ROE and net profit margin. Larger banks, with more assets, can benefit from economies of scale, reducing the average cost per unit of asset and potentially improving profitability. Large banks can also afford to launch diversified financial products and explore new markets.
4. Customer growth has a measurable but negative impact on ROE. This suggests that increasing the number of customers might reduce the return on equity. New customers often take time to generate meaningful revenue. If upfront costs are high because rapid growth can strain resources, more customers may require additional infrastructure, support staff, and technology, leading to higher operational costs that can dilute profitability.
5. Technology cost is inversely related to profitability of digital banks Measured by net profit margin.

VI. Recommendations:

To improve the performance of digital banks, we propose the following recommendations:

- Expanding market share geographically, especially in Europe.
- Creating reasonable and thoughtful ratios for non-interest income in digital banks can help enhance profitability.
- It's crucial for digital banks to manage technology investments costs efficiently to minimize their impact on net profitability.
- Manage cost by invest in cost-effective technology solutions that enhance operational efficiency.
- As for the recommendations concerning Algeria to move towards the digitization of the banking sector and the creation of digital banks we propose the following points,
- Reform of the banking system through Popularization of the use of electronic cards in payment.
- Investing in startups in the field of artificial intelligence specialized in financial technology and digital security.
- Algerian Central banks must establish special laws and regulation for digital banks
- Partnership and investment with digital security companies to protect customer information and data Digital Security.

VII. Bibliography:

1. aeonbank. (2024). Retrieved from <https://www.bing.com/ck/a?!&&p=4e02f7a4e81f5632JmltdHM9MTcyNDk3NjAwMCZpZ3VpZD0yMWY1YzA4Ny02MDliLTYwZDctMTFmOS1kMjVjNjFmMDYxZjImaW5zaWQ9NTE5Ng&p=3&ver=2&hsh=3&fclid=21f5c087-609b-60d7-11f9-d25c61f061f2&psq=ISLAMIC+DIGITAL+BANKS++ARABIC+BANK+in+sangapour+>
2. Aoknorth bank 2023 , 2022, 2021,2020,2019,2018 annual reports
3. Atom banks 2023 , 2022, 2021,2020,2019,2018 annual reports
4. BIS. (2020). *Policy responses to fintech*.
5. Buchi, G., Cugno, M., & Castagnoli, R. (2019). New Banks in th 4th Industrial Revolution: A Review and Typology. *22nd International Conference Thessaloniki (Greece)*.
6. Chen, Y.-L. W.-H. (2021). Exploring the Determinants of Customer Loyalty to Internet-Only Bank Services. *AMCIS 2021 Proceedings*. 12. .
7. Daniel, R. S. (2020). Developing a framework for future business models in the South African banking industry. North-West University (South Africa).
8. Ghosh, C. S. (2023). Emerging Opportunities and Challenges in FinTech Industry – A Comparative Study of India With Other Jurisdictions. In R. K. Misra, *Technology, Management and Business*.
9. Monzo Bank 2023,2022,2021,2020,2019,2018,annual reports
10. Ngwoke, R. (2024). AN APPRAISAL OF THE REGULATION OF DIGITAL BANKS IN NIGERIA. *Agora International Journal of Juridical Sciences* , Vol. 18 No. 1: .
11. Revolut bank 2023 ,2022,2021 ,2020,2019,2018 annual reports
12. Restiana Ie Tjoe Linggadja, B. S. (2023). Digital Transformation of PT Bank Jago Tbk from Conventional Bank to Digital Bank. *International Journal of Digital Entrepreneurship and Business (IDEB)*.
13. Shermukhamedov, B. (2021). INNOVATIONS IN BANKING: DIGITAL BANKING. *Theoretical & Applied Science* .
14. Tandam bank 2023 , 2022, 2021,2020,2019,2018 annual reports