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The reality of financial technology and its role in enhancing financial inclusion: A case study of the banking sector in Algeria during the period (2010-2018)

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Abstract---The global and Arab banking sectors have become in need of financial technology to ensure their continuity. This need arises from the banking sectors' inclination towards further development, innovation, speed, and inclusivity. This study aims to examine the impact of implementing financial technology, represented by the development of ATMs and interbank payment cards, on financial inclusion, measured by the number of borrowers from commercial banks in Algeria. The study analyzes annual data from 2010 to 2018 using a multiple linear regression model. Prior to this, a statistical study was conducted on the application of financial technology services in Algeria during the period from 2016 to 2021. Among the key findings is the significant positive impact of using interbank electronic payment cards on financial inclusion. However, there was no significant impact of the development of ATMs on financial inclusion in Algeria during the study period.

Keywords---Financial technology, financial inclusion, electronic payment cards, Debit cards, ATMs.

Introduction

Global interest in financial inclusion has grown significantly in the past two decades due to its importance, particularly in the context of financial systems globalization. Following the global financial crisis of 2008, international attention towards achieving financial inclusion has increased, leading to broad commitments from governmental entities to achieve this goal. This has resulted in the implementation of policies aimed at enhancing and facilitating access to and usage of financial services and products for all segments of society, enabling them to utilize these services effectively. Additionally, there has been a focus on providing diverse and innovative financial services at low costs through service providers in this sector.

In the face of increasing competition, the global and Arab banking sectors, including the Algerian sector specifically, have recognized the need for financial technology (Fintech) to ensure their continuity and inclusivity. According to the report ⁱ"Fintech in the Middle East and North Africa" released by the Wamda Research Lab in collaboration with Payfort, Fintech has gained strong momentum in many Arab countries since 2012. The number of fintech startups providing financial services increased from 30 companies to 105 startups by 2015, including two companies in Algeria. The digital transformation, which was one of Algeria's key developmental objectives prior to the outbreak of the COVID-19 pandemic in 2019ⁱⁱ, has been manifested through the state's efforts to establish an efficient electronic payment system to modernize its banking system.

In this context, Algeria has made progress in enhancing financial technology innovations by developing digital financial services that have the ability to reduce costs, increase speed, enhance security, transparency, and enable safer financial services. Increased access to digital payments serves as a gateway to digital financial services, particularly for Algerians who have limited familiarity with the financial sector. This highlights the strong relationship between the roles that financial technology sectors and services can play in achieving financial inclusion objectives.

1- Research Problem: Based on the above, the research problem revolves around the following:

What is the current status of financial technology implementation in Algeria? And what is the impact of financial technology on enhancing financial inclusion in the banking sector during the period 2010-2018?

2- Research Hypotheses: To study and analyze this topic, we have formulated the following main hypothesis:

- There is a significant impact of financial technology on enhancing financial inclusion in the Algerian banking sector during the study period.

3- Research Objectives: Among the objectives of this study are the research and analysis of the current implementation of financial technology services in Algeria, along with investigating their impact on enhancing financial inclusion in the Algerian banking sector. This will be achieved by utilizing the advancements in banking, finance, and financial technology, specifically focusing on the

development of ATMs and interbank payment cards (Debit cards) during the period from 2010 to 2018.

4- Study Data and Sources: Due to the nature of the applied study, which was divided into two parts, the first being a statistical study and the second a regression analysis study, the data for the first part of the applied study (related to the statistical study of the state of financial technology in Algeria) consisted of the volume (number, value) of the following: online payment services, cash withdrawal services from ATMs, and electronic payment terminal activity. The annual data for the period from 2016 to 2021 was obtained from the website of the Algerian Cash Collection Association (GIE MONETIQUE). As for the data for the second part of the applied study, which involved a regression analysis study, and given the nature of the study, which aimed to determine the impact of financial technology on enhancing financial inclusion in the banking sector in Algeria, the study variables were divided into two sections.

- The dependent variable: It represents the financial inclusion index, expressed as the number of borrowers from commercial banks in Algeria per 1000 adults.
- The independent variables: They consist of two financial technology indicators:
- The development of the number of ATMs between banks in Algeria.
- The number of interbank payment cards (Debit cards) in Algeria.

Annual observations of the study variables (dependent and independent) were taken during the study period from 2010 to 2018, resulting in approximately 9 observations from various sourcesⁱⁱⁱ.

5- The Methodology and Statistical Tools Used in the Research: In order to study and analyze the topic and achieve the desired objectives, we adopted the methodology commonly used in economic and financial studies. The descriptive method was employed in the theoretical aspect of this study. As for the practical aspect, the descriptive method was used for the study variables, along with a case study approach. Excel was used for data visualization, while Eviews9 was utilized for conducting statistical and regression analysis. The Multiple Linear Regression model was employed due to the small sample size of the study, which consisted of only nine (09) observations for each study variable. To ensure the quality of the estimated model, a set of diagnostic tests was conducted. Based on the above, the applied model in this study takes the following form:

$$FI = C + \alpha_1(ATMS) + \alpha_2(CIB)$$

Where:

FI: Financial Inclusion index, represented by the number of borrowers from commercial banks in Algeria per 1000 adults.

C: Constant term.

ATMS: Development of the number of ATMs during the study period.

CIB: Natural logarithm of the number of interbank payment cards (Debit cards).

6- The Time and Spatial Framework of the Research:

- Spatial Boundaries: The study focused on the banking sector in Algeria.
- Time Boundaries: The study covered a time period of nine complete years from 2010 to 2018.

7-Previous Studies on the Topic:

The study conducted by Jouani Sonia and Meriem Adila^{iv} (2021) aimed to clarify the role of financial technology in enhancing financial inclusion in the Arab world. The study followed a descriptive methodology and analytical approach, drawing on the experience of the Kingdom of Bahrain. The study found that the Kingdom of Bahrain has achieved financial and economic advancement in promoting the strategy of financial inclusion through information technology, communication technology, and digital technology. Bahrain ranked second in the Arab world in the Financial Inclusion Index issued by the World Bank, with a financial inclusion rate of 82%.

Meanwhile, the study conducted by Ibtisam Ali Hussein et al. (2021)^v aimed to clarify the opportunities and challenges of financial technology, particularly regarding security, trust, ease of use, and effectiveness. It also aimed to assess the response of bank customers to financial technology tools and identify the measures that banks can take to expand their usage and contribute to enhancing financial inclusion in Iraq. The research concluded that expanding the provision of electronic financial services enhances financial inclusion by reaching all segments of society through increased credit availability, cost reduction, risk assessment, and stimulation of companies and business activities to increase production, achieve economic growth, and create job opportunities. The study recommended that financial technology should be incorporated into a national strategy for financial and digital transformation and education, encouraging knowledge exchange among stakeholders in the public and private sectors and civil society to enhance financial awareness and knowledge for all individuals in the society.

In addition, the study conducted by Wafa Hamdouch et al. (2021)^{vi} examined the role of financial technology as a mechanism to enhance the performance of the Algerian banking sector by identifying the motivations and challenges of adopting digital financial technologies in this sector. The study found a low level of performance in the Algerian banking sector in terms of expanding financial inclusion, which serves as a key driver for the adoption of financial technology. However, the adoption is contingent upon successfully overcoming several obstacles. The study recommends the importance of leveraging the experiences of Arab countries in establishing regulatory sandboxes for testing digital services, encouraging the uptake of electronic payment tools, and establishing a legal framework that allows for partnerships between financial technology companies and Algerian banks.

A study conducted by Nahla Abu Al-Az (2021)^{vii} examined the impact of implementing financial digitization technologies, such as ATMs, credit cards, electronic debts, and mobile money, on financial inclusion in several African countries during the period 2014-2018. The study included a sample of 15 African countries using the Panel Data analysis technique. The study found a statistically significant positive effect of using ATMs and mobile money on financial inclusion. On the other hand, the study found that the use of electronic debts and credit cards had no statistically significant impact on financial inclusion. Additionally, the study incorporated several macroeconomic variables into the model, such as inflation rate, population growth rate, and remittances.

The results indicated the same positive effect of using ATMs and mobile money on financial inclusion, and the inflation rate also showed a statistically significant positive impact on financial inclusion. However, the study revealed a statistically significant negative impact of remittances on financial inclusion.

The study conducted by Rafik Ben Ayechouba et al. (2021)^{viii} aimed to identify the impact of the COVID-19 pandemic on the financial technology industry. The study found several important results, including the crucial role played by financial technology in mitigating the risks associated with cash exchange during the COVID-19 outbreak and supporting financial inclusion during and after the global pandemic. Additionally, the study highlighted that cybersecurity has become a concerning challenge in the field of financial technology.

The study conducted by Abdulwahab Sakhr and Samia Ben Ali (2021)^{ix} characterized the state of financial technology in the Middle East and North Africa region as an emerging alternative to traditional financial services. The study identified the main obstacles and challenges faced by countries in the region, as well as highlighting the potential of financial technology and the possible opportunities to be exploited. The study concluded that financial technology has been experiencing continuous growth internationally. However, in the Middle East and North Africa, there has been variation and divergence due to the absence of regulatory and legal frameworks and the lack of government support in some countries for this sector.

The study conducted by Ayman Bouzana and Wafa Hamdoush (2021)^x aimed to evaluate the level of key financial inclusion indicators in the Algerian banking sector during the period 2011-2018 in order to assess the level of banking intermediation provided to different segments of the Algerian society. The study concluded that the contribution of the banking sector in enhancing the level of financial inclusion for different segments of the Algerian society is modest. This is attributed to the slow progress of banking intermediation provided by the banking sector and its failure to adapt to the developments in the banking industry. Additionally, the levels of financial inclusion indicators were found to be limited, which explains the shortcomings of the efforts made by monetary authorities to deepen financial inclusion for various segments of society.

The study conducted by Dahbia Latarech and Samia Harraq (2020)^{xi} explored the state of financial technology, which has experienced rapid growth in investments in recent years, in line with the developments of the Fourth Industrial Revolution, artificial intelligence, and the digital economy. It highlighted the potential of financial technology to revolutionize the field of financial services and enhance financial inclusion in Arab countries, particularly for SMEs and individuals. However, the study concluded that despite the growth in investment in financial technology in Arab countries, its role remains limited and weak in reducing the financial inclusion gap. This is attributed to several obstacles, including the absence of laws and regulations related to licensing, insufficient risk capital, a lack of digital financial literacy, and an unfavorable business environment for the launch of these companies.

While the study by Florentina Kurniasari and the authors (2021)^{xii} aimed to analyze the impact of digital technology factors' growth on customer decisions in selecting financial technology services using customer knowledge as an internal variable, the growth of digital technology was measured using social networks, regulatory services, and financial services facility variables. The sample of this research focused on a small segment of customers located in Java Island, and the statistical data were analyzed using the PLS algorithm. The results demonstrate that the customer's decision in choosing financial technology services strongly influences their knowledge. Additionally, customer knowledge is formed from information collected from social networks, based on official sources from the government, financial services facilities, and financial inclusion. This study recommends the need for education, promotion, and provision of sufficient information to increase literacy rates in reading and writing regarding financial technology. The study also suggests the implementation of clear and urgent government regulations to protect consumer and factory interests.

Based on our knowledge, it can be said that most studies have relied on descriptive analysis of the relationship between financial inclusion and financial technology, with only a few adopting statistical and measurement methods to study the impact of the relationship between financial technology and financial inclusion.

Therefore, our research contribution lies in combining analysis in a statistical study of the implementation of financial technology services in Algeria during the period (2016-2021) with conducting a standard statistical study to test the impact of financial technology implementation, represented by the evolution of the number of ATMs and payment cards between banks, on financial inclusion measured by the number of borrowers from commercial banks in Algeria during the period (2010-2018).

Firstly, The Theoretical Framework for the Role of Financial Technology in Enhancing Financial Inclusion

The increased focus on the role of financial technology in enhancing financial inclusion has brought a digital dimension to the concept of financial inclusion, making the two terms closely associated with each other. Several international bodies have defined financial inclusion, including the definition provided by the G20 and the Alliance for Financial Inclusion (AFI)^{xiii}. According to AFI, financial inclusion is defined as "the measures taken by regulatory bodies to enhance access to and usage of financial services and products for all segments of society, including marginalized groups. These services and products should be tailored to their needs, provided in a fair and transparent manner, and at reasonable costs. The Financial Stability Board^{xiv} defines financial technology as "technologically enabled financial innovations that can result in new business models, applications, processes, or products, with an associated material effect on financial markets and institutions and the provision of financial services. Financial innovations can be found in various areas of finance, such as retail and wholesale payments, financial market infrastructure, investment management, and insurance."

From the above, it is evident that financial technology (Fintech) has the real potential to disrupt the structure of financial services, making them faster, cheaper, more secure, transparent, and accessible, surpassing the limitations of traditional methods. On the other hand, the rapid evolution of financial technology services and emerging companies offering innovative solutions for various financial activities and services mimic what traditional banking sectors offer but in a simpler and more advanced way. Financial technology encompasses several sub-sectors, including^{xv}:

- ✓ Payment and Transfer Operations: Replace traditional payment systems or money transfers.
- ✓ Lending: Connect lenders with customers in need of financing (direct lending platforms and crowdfunding).
- ✓ Personal/Corporate Finance: Combine the previous services by providing banking services on digital platforms.
- ✓ Investor Banking/Capital Markets: Services typically provided by investment banks.
- ✓ Insurance Technology: Offer insurance products to customers or more efficient risk assessment solutions for insurance companies.
- ✓ Wealth Management: Provide wealth management solutions to clients with the support of machine learning.
- ✓ Regulatory Compliance Technology: Assist companies in complying with regulations.
- ✓ Blockchain: A decentralized digital ledger where transactions in cryptocurrencies are recorded. It is a new decentralized technology for encrypting digital transaction systems. The list includes all continuously added new elements, and the value of transactions within it is expected to reach \$9 trillion per year.

Based on the theoretical framework and previous studies, it can be inferred that the requirements of recent years, especially during the COVID-19 crisis, have strengthened the need to increase digital financial inclusion. This is because digital financial inclusion involves the use of cost-effective digital means to reach financially excluded populations who currently lack sufficient services tailored to their needs. These services are responsibly provided at an affordable cost to clients and sustainable for service providers. Financial technology (fintech) has played a crucial role in reducing the risks associated with cash exchange during the COVID-19 pandemic, supporting financial inclusion during and after the global health crisis, and expanding the scope of electronic financial services. This enhances financial inclusion for all segments of society by increasing access to credit and reducing costs. Additionally, fintech helps assess risks and encourages companies and business activities to increase production, achieve economic growth, and create employment opportunities.

Despite the increasing investment in financial technologies in Arab countries, their role in reducing the financial inclusion gap remains mostly limited and weak. This can be attributed to several accumulated obstacles, including the absence of laws and regulations related to licensing, inadequate risk capital, lack of digital financial literacy, and an unsuitable business environment for the growth of these companies.

However, the weak performance of the banking sector in terms of financial inclusion in Algeria is primarily due to the modest contribution of the banking sector in enhancing the level of financial inclusion for Algerian society. This is evident in the slow pace of banking intermediation provided by the banking sector, its failure to keep up with the developments in the banking industry, and the limited levels of financial inclusion indicators. These factors explain the shortcomings of the efforts made by monetary authorities to deepen financial inclusion for different segments of society.

Secondly, The reality of financial technology (fintech) services in Algeria for the period of 2016-2021

The reality of financial technology services in Algeria for the period (2016-2021) is primarily limited to the initial wave of financial technology services. These services mainly consist of payment solutions that facilitate and expedite the purchasing process, as well as online and mobile payment services for bills and purchases. These services can be divided into three main types, which we will examine through a statistical study for the period (2016-2021), as follows:

1- Online payment services in Algeria for the period (2016-2021)^{xvi}: According to the Monetic Economic Interest Group (GIE Monétique), there are currently 231 online merchants enrolled in the electronic payment system, known as "e-Payments". Since the launch of online payments, approximately 16,276,508 transactions have been conducted, distributed across the study years as shown in

Table 01 and Figure 01 below.

The data presented in Table 01 and Figure 01 indicate a remarkable qualitative leap in the volume of online transactions in terms of both value and quantity during the past two study years (2020 and 2021), compared to the preceding years. The number of online transactions has experienced a growth rate of over 70% from 2020 to 2021, accompanied by a growth rate in value estimated at around 106.1%. This signifies the increasing adoption and utilization of online payment services in Algeria.

Table No. (01): Size of the Online Payment Sector in Algeria during the Period (2016-2021)

Year	Number of Total Transactions	Total Amount of Transactions (DZD)
2016	7 366	15 009 842,02
2017	107 844	26 799 423,40
2018	176 982	332 592 583,28
2019	202 480	503 870 361,61
2020	4 593 960	5 423 727 074,80
2021	7 821 346	11 176 475 535,68

Source: Prepared by the authors based on the data of the GIE Monétique, Link: <https://giemonetique.dz/ar/qui-sommes-nous/activite-paiement-sur-internet/>

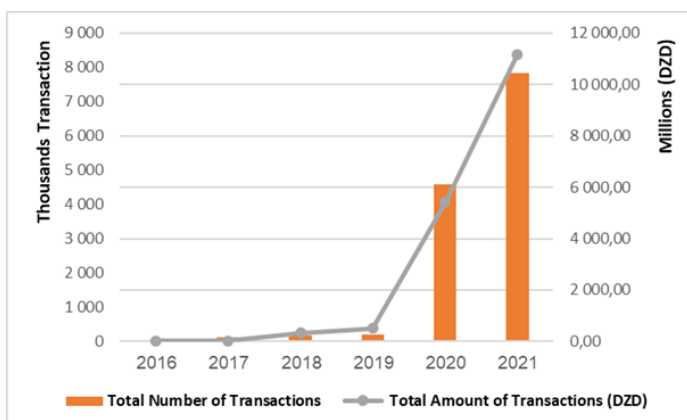


Figure No. 1: Size of the Online Payment Sector in Algeria during the Period (2016-2021)

Source: prepared by the researchers according to data from the Table No. (01)

This increase in the volume of online transactions can be attributed to several factors. Firstly, there has been a rise in the number of bank-issued payment cards equipped with online payment services. This has led to a shift in consumer behavior, particularly among the youth population, towards preferring online payments for various services and purchases.

In addition, the COVID-19 pandemic has played a significant role in driving the surge in online transactions since the launch of these services. The table (Table 02) and figure (Figure 02) below provide details on the total number of online payment transactions according to activity type during the period (2016-2021).

Table (02): Total Number of Online Payment Transactions by Type of Activity in Algeria for the Period (2016-2021)

	2016	2017	2018	2019	2020	2021
Telephone / Contacts	6 536	87 286	138 495	141 552	4 210 284	6 993 135
transport	388	5 677	871	6 292	11 350	72 164
insurance	51	2 467	6 439	842	4 845	8 372
Electricity/Water	391	12 414	29 722	38 806	85 676	120 841
Administrative Service	0	0	1 455	2 432	68 395	155 640
Other Services	0	0	0	5 056	213 175	457 726
Sale of goods	0	0	0	0	235	13 468

Source: Prepared by the authors based on the data of the GIE Monétique, Link: <https://giemonetique.dz/ar/qui-sommes-nous/activite-paiement-sur-internet/>

From the above table (Table 02) and figure (Figure 02), it is evident that online payment services in Algeria are primarily concentrated in service-oriented economic activities. These activities include telecommunications, electricity, water, transportation, administration, insurance, as well as other services such as tourism, aviation, training, visa services, parcel delivery, and the sale of electronic tickets for sports events. The sale of goods, especially in the past three

years of the study, has also witnessed significant growth. However, it is important to note that not all sectors have been included in the analysis yet.

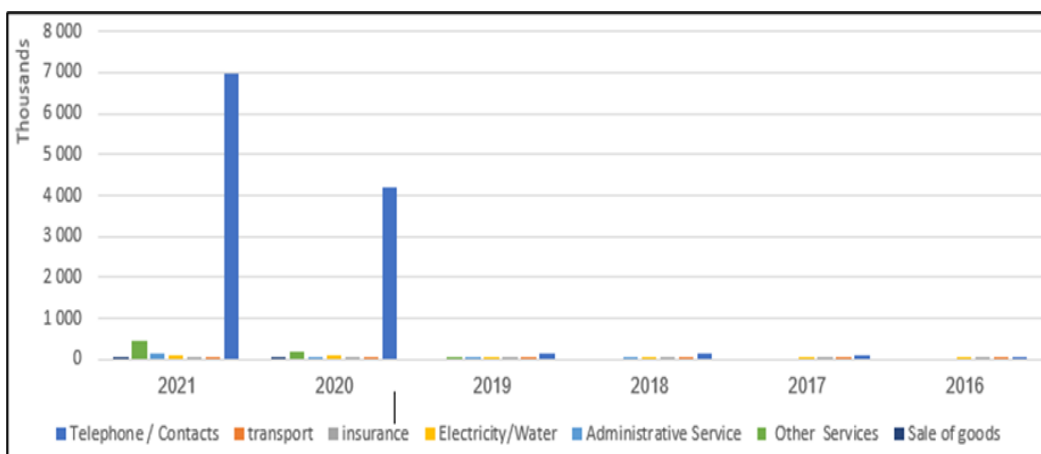


Figure (02): Total number of online payment transactions by type of activity in Algeria for the period (2016-2021)

Source: prepared by the researchers according to data from the Table (02)

According to the statistics, online payment transactions in Algeria have primarily focused on telephone and communication bill payments, such as internet bills and mobile credit top-ups. These transactions constitute the majority of the total number of online transactions according to activity type. This trend is particularly evident during the COVID-19 pandemic period in the years 2020 and 2021.

2. Cash withdrawal activity in Algeria during the period (2016-2021):

Tables 03 and 04, as well as Figures 03 and 04 below, illustrate the cash withdrawal activity in terms of transaction volume (count and value) and the number of operational ATMs (Automated Teller Machines) in Algeria during the period (2016-2021). Table 03 and Figure 03 below show the total number of ATMs operated by banks in Algeria during the period (2016-2021).

Table No. (03): Total Number of Inter-Bank ATMs Operating in Algeria for the Period (2016 - 2021)

Years	The Total Number of Operating Inter-Bank ATMs
2016	1370
2017	1443
2018	1441
2019	1621
2020	3030
2021	3053

Source: Prepared by the authors based on the data of the GIE Monétique, Link: <https://giemonetique.dz/ar/activite-retrait-sur-atm/>

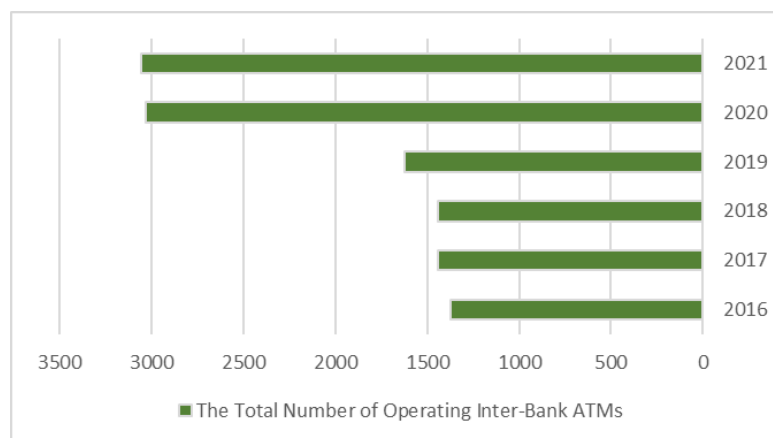


Figure No. (03): Total Number of Inter-Bank ATMs Operating in Algeria for the Period (2016 - 2021)

Source: prepared by the researchers according to data from the Table No. (03)

As shown in Table 03 and Figure 03 above, there has been a continuous but modest growth in the number of operational ATMs in Algeria during the years 2017, 2018, and 2019, with the highest growth rate reaching only 13% between 2018 and 2019. However, in 2020, there was a significant surge in growth, reaching approximately 87% in the number of ATMs compared to 2019, mainly due to the expansion of the National ATM Network. Subsequently, there was a near stagnation with a growth rate of only 0.80% in 2021. Meanwhile, Table 04 and Figure 04 below provide information on the volume of cash withdrawal transactions in terms of count and value during the period (2016-2021).

Table No. (04): Volume of cash withdrawal activity through ATMs in Algeria during the period (2016-2021)

Year	Total number of withdrawal transactions	Total amount of withdrawal transactions (thousand dinars)
2016	6 868 031	98 822 525,00
2017	8 310 170	126 398 291,00
2018	8 833 913	136 233 452,00
2019	9 929 652	164 116 233,00
2020	58 428 933	1 073 004 953,00
2021	87 722 789	1 728 937 064,00

Source: Prepared by the authors based on the data of the GIE Monétique Link:

<https://giemonetique.dz/ar/activite-retrait-sur-atm/>

As indicated in the above Table 04 and Figure 04, there has been a continuous and relatively stable growth in the volume (value and count) of cash withdrawals through ATMs in Algeria during the period (2016-2019). However, this activity witnessed a significant leap in 2020, with the total number of withdrawal transactions experiencing a growth rate of over 488% and the value of transactions growing by nearly 584% compared to 2019. This growth continued in 2021, although at a much slower pace than before. The number of transactions

completed through ATMs increased by 50.13%, while the value of transactions grew by over 61% compared to the previous year. Despite the stagnation recorded in the number of ATMs in 2021 compared to 2020 (3,053 ATMs in 2021 compared to 3,030 in 2020), the growth in transaction volume and value persisted.

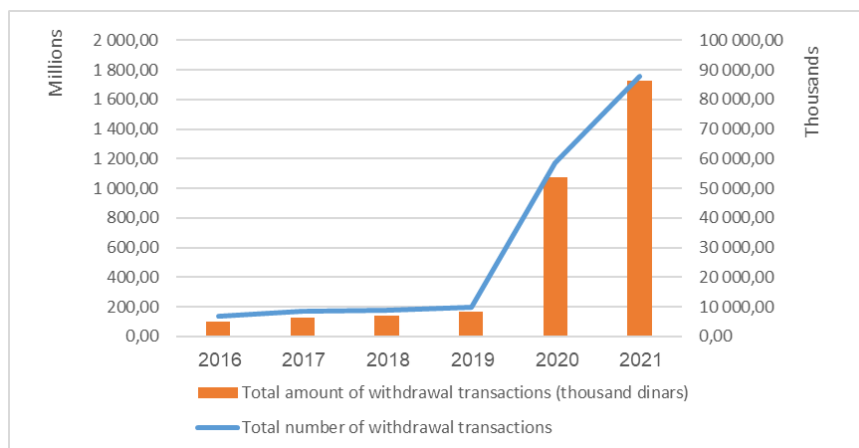


Figure No 04: Volume of cash withdrawal activity through ATMs in Algeria during the period (2016-2021)

Source: Prepared by the authors based on the data of Table No. (04)

The increase in the volume of cash withdrawal activity through ATMs can be attributed to a shift in behavior among Algerian cardholders, who have started to prefer withdrawing cash from interbank ATMs rather than relying on post office windows or bank tellers due to the COVID-19 pandemic.

3. Electronic Payment Service via Electronic Payment Terminals (TPE) in Algeria for the period (2016-2021):

Table 05 and Figure 05 below demonstrate the activity of the electronic payment service through Terminal de Paiement Électronique (TPE) devices, widely recognized among merchants and users. The table and figure illustrate the development in the number of TPE devices deployed in stores and businesses in Algeria during the study period, indicating a continuous and increasing growth.

Table No. (05): Total Number of Operating Electronic Payment Terminals (TPE) during the period (2016-2021)

	Total Number of TPE
2021	37561
2020	33945
2019	23762
2018	15397
2017	11985
2016	5049

Source: Prepared by the authors based on the data of the GIE Monétique Link: <https://giemonetique.dz/ar/activite-paiement-sur-tpe/>

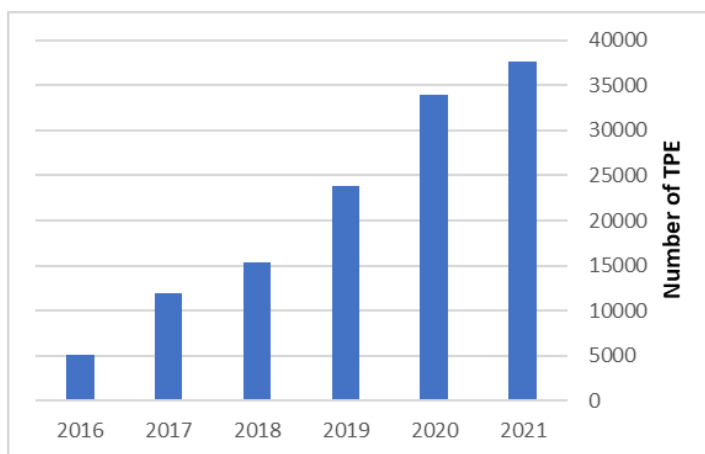


Figure No. (05): Total Number of Operating Electronic Payment Terminals (TPE) during the period (2016-2021)

Source: Prepared by the authors based on the data of Table No. (05).

The highest growth rate in the number of operational TPE devices in Algeria was recorded in 2017, reaching approximately 138%. This growth can be attributed to the launch of a project to promote the use of electronic payment devices among merchants in 2017, with the aim of implementing the project by 2019. However, this project faced several years of delay, which experts attribute to the limited and insufficient quantity of TPE devices^{xvii}. Additionally, merchants faced challenges due to poor internet connectivity, which hindered the implementation process and led to a state of stagnation and ambiguity. The lack of awareness and support also contributed to the delays. The deadline for mandating merchants to possess TPE devices was set for December 31, 2022.

Table 06 and Figure 06 below illustrate the volume (number and value) of transactions through operational TPE devices in Algeria for the period (2016-2021). These transactions experienced continuous growth during the study period. However, the years 2020 and 2021, which coincided with the COVID-19 pandemic, witnessed a surge in the growth of transactions through TPE devices in terms of both number and value.

The growth rate in the number of transactions reached approximately 160% in 2020 and over 202% in 2021. Similarly, the growth rate in the value of transactions through TPE devices reached 147% in 2020 and exceeded 220% in 2021. Despite the low increase in the number of TPE devices in those years, primarily attributed to severe liquidity shortages in Algeria during that period, cardholders were compelled to search for stores, shops, pharmacies, and other establishments offering this service as a suitable solution to their liquidity problems. As a result, this service witnessed the highest growth rate, maintaining the same momentum during the pandemic compared to other available fintech services in Algeria.

Table No. (06): Volume of transactions by Electronic Payment Terminals (TPE) during the period (2016-2021)

Years	Number of Payment Transactions	Total Amount of Payment Transactions (DZD)
2016	65 501	444 508 902,40
2017	122 694	861 775 368,90
2018	190 898	1 335 334 130,76
2019	274 624	1 916 994 721,11
2020	711 777	4 733 820 043,01
2021	2 150 529	15 113 249 499,92

Source: Prepared by the authors based on the data of the GIE Monétique. Link: <https://giemonetique.dz/ar/activite-paiement-sur-tpe/>

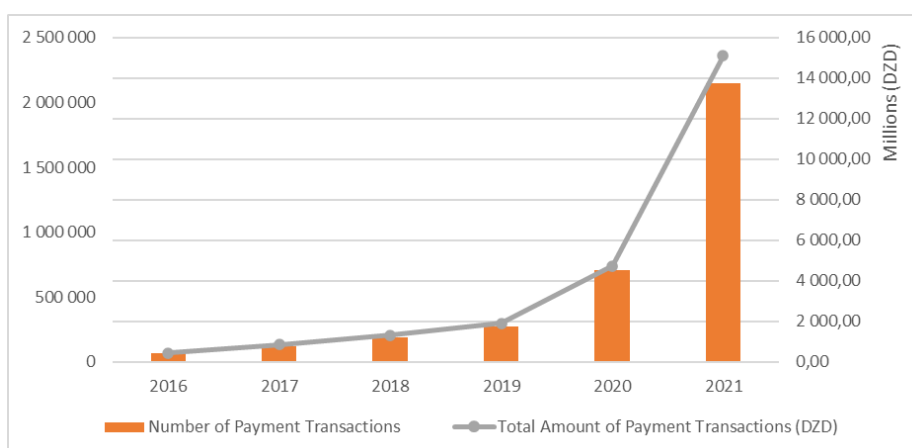


Figure No. (06): Volume of transactions by Electronic Payment Terminals (TPE) during the period (2016-2021)

Source: Prepared by the authors based on the data of Table No. (06)

Despite this significant growth in the volume of transactions through operational TPE devices in Algeria during the study period, they remain below the required level, which is considered "very low," compared to the actual market needs in terms of the number of authorized merchants and the majority of citizens holding debit cards. The relevant authorities^{xviii} attribute this low percentage to the merchants' lack of ownership of TPE devices, as they try to evade transaction monitoring, considering the cost and expenses of acquiring and maintaining these devices to be high. In addition, there is a shortage of professionals skilled in device installation and maintenance.

Fourthly, a statistical study will be conducted to measure the impact of financial technology on promoting financial inclusion in the banking sector in Algeria for the period (2010-2018). Through this axis, we aim to uncover the effect of implementing financial technology, represented by the development of Automated Teller Machines (ATMs) and interbank payment cards (CIB), as independent variables, on financial inclusion (FI) represented by the number of borrowers in

commercial banks per 1,000 adults as a dependent variable during the period (2010-2018).

To address the second part of the study problem and test the study hypothesis stating that there is an impact of financial technology on enhancing financial inclusion (FI) in the banking sector in Algeria during the study period, a statistical analysis will be conducted following three main steps:

1 - Descriptive statistics study of study variables: Table (07) below shows a summary of the most important descriptive statistics for the study variables, using the measure of central tendency.

Table (07): Summary of the most important results of descriptive statistics for the study variables during the study period

	FI	CIB	ATMS
Mean	5.205633	5.788505	587.2222
Median	5.222900	5.816623	595.0000
Maximum	5.257200	6.057187	648.0000
Minimum	5.057000	5.328380	475.0000
Observations	9	9	9

Source: Prepared by the researchers, relying on the outputs of the statistical software EViews 9

In general, the table above indicates that the study was based on a total of 9 observations. The dependent variable, Financial Inclusion (FI), shows a positive mean that exceeds 5 borrowers from commercial banks in Algeria per 1000 adults. This indicates the growth of the Financial Inclusion variable during the study period. The minimum value recorded was approximately 0.5 borrowers from commercial banks in Algeria per 1000 adults, which was observed in 2010. The maximum value exceeds 5.20 borrowers recorded in 2015. This confirms the positive development of the Financial Inclusion indicator in Algeria when compared to the beginning of the study period. As for the independent variables represented by the commonly used Financial Technology indicators in the Algerian banking sector during the study period (2010-2018), it is observed that the mean number of interbank ATMs in Algeria reached 587 ATMs. This indicates an increasing number of ATMs during the study period. The minimum value approached 475 ATMs in 2013, a period characterized by a recession and limited use of electronic payment cards and ATMs in Algeria.

While subsequent years witnessed a continuous increase in their number, which is among the priorities of the Algerian public authorities to promote automated cash through the widespread use of electronic payment methods, as part of modernizing the banking system, such as remote compensation systems and collective payment methods. The maximum growth in the number of ATMs exceeded 648 ATMs recorded in 2017. However, the total number of operational ATMs in Algeria remains relatively small compared to global indicators. On the other hand, the second independent variable, represented by the number of interbank payment cards (CIB cards), had an average of 878,406 cards, reflecting positive growth in the number of cards during the study period. The minimum

value recorded was 213,000 cards at the beginning of the study period in 2010, while the maximum value was recorded at the end of the study period in 2018, with a total of approximately 1,140,741 CIB payment cards. This confirms the continuous increase in the number of CIB payment cards during the study period.

Based on previous studies and global reports, the banking sector in Algeria suffers from a weak and limited presence of ATMs and a low ownership of payment cards. This indicates relatively poor performance in terms of reaching a larger number of individuals and institutions with financial and banking products and services. This may suggest a weak contribution of the banking sector in Algeria through financial technology services in enhancing financial inclusion for different segments of society.

2. Estimation and testing of the multiple linear regression equation for the study variables:

We will attempt to estimate the multiple linear regression equation for the study variables and conduct diagnostic tests to assess the adequacy of the estimated equation (model).

2-1. Estimation of the linear regression equation for the study variables: As a reminder, the estimated multiple regression equation for the dependent variable is found as follows:

$$FI = C + \alpha_1(ATMS) + \alpha_2(CIB)$$

Where:

FI: Financial Inclusion index, represented by the number of borrowers from commercial banks in Algeria per 1000 adults.

C: Constant term.

ATMS: Evolution of the number of Automated Teller Machines (ATMs).

CIB: Natural logarithm of the number of interbank payment cards (Debit cards).

Table (08): Results of estimating the multiple regression equation during the study period

Dependent Variable: FI				
Method: Least Squares				
Date: 06/05/22 Time: 16:55				
Sample: 2010 2018				
Included observations: 9				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CIB	0.237420	0.058414	4.064442	0.0066
ATMS	-0.000240	0.000200	-1.195899	0.2768
C	3.972026	0.370683	10.71542	0.0000
R-squared	0.762991	Mean dependent var		5.205633
Adjusted R-squared	0.683988	S.D. dependent var		0.060057
S.E. of regression	0.033761	Akaike info criterion		-3.677826
Sum squared resid	0.006839	Schwarz criterion		-3.612085
Log likelihood	19.55022	Hannan-Quinn criter.		-3.819696
F-statistic	9.657760	Durbin-Watson stat		1.596761
Prob(F-statistic)	0.013314			

Source: Prepared by the researchers, based on the outputs of the statistical software EViews 9

The table above (Table 08) displays the results of estimating the multiple regression equation for the dependent variable (number of borrowers from commercial banks in Algeria per 1000 adults) as a measure of financial inclusion (FI) during the period (2010-2018). Generally, from the estimated multiple regression equation, we observe the following key points:

There is variation in the statistical significance of the estimated regression equation coefficients. The independent variable (CIB), represented by the number of interbank payment cards, is statistically significant at a significance level of 5%. This is because its p-value (Prob) is less than 0.05 according to the t-test. Therefore, we accept the alternative hypothesis (H1) and reject the null hypothesis (H0), indicating that the estimated coefficient for the independent variable is statistically different from zero (not equal to zero). In other words, the coefficient of the financial technology index, represented by interbank payment cards in Algeria (CIB), is statistically significant at a 5% significance level, with a value of 0.0066 (Prob).

As for the second independent variable, the evolution of the number of Automated Teller Machines (ATMS), it was not statistically significant even at a significance level of 10%. The statistical probability for it is estimated to be 0.2768 (Prob), which is greater than the 5% and 10% significance levels. Therefore, we accept the null hypothesis (H0) and reject the alternative hypothesis (H1). This means that the estimated coefficient for the independent variable (ATMS) does not differ significantly from zero (or equal to zero). In other words, the evolution of the number of ATMs, as one of the indicators of financial technology, does not have a significant impact on enhancing financial inclusion in the banking sector in Algeria during the study period (2010-2018).

As indicated by the F-statistic test, the overall significance of the estimated equation is statistically acceptable at a significance level below 0.05. The F-statistic probability is calculated to be 0.013. This means that the independent variable (CIB), as one of the financial technology indicators used in our study, has an impact on financial inclusion (FI) in Algeria during the study period. On the other hand, the second independent variable (ATMS) does not have a significant impact on financial inclusion during the study period.

The estimation results of the multiple regression equation for the study variables also revealed the following key points:

- The coefficient of determination (R-squared) was 76.29%, indicating that the independent variables explain approximately 76% of the variation in the dependent variable (FI), while the remaining 24% is attributed to random error.
- The coefficient for the variable (CIB), representing the number of payment cards, was 0.23. This means that a 1% increase in the number of interbank payment cards (CIB) in Algeria during the study period leads to a potential increase of 23.74% in the financial inclusion index (FI). This suggests a potential increase in the number of borrowers from commercial banks in Algeria. However, the second variable (ATMS) did not have any significant impact on the financial inclusion index during the study period.

Note: The Durbin-Watson statistic (DW statistic) is considered a measure of autocorrelation in the residuals of a regression model. It is commonly used when the sample size is less than 30 observations. Therefore, we will perform a set of standard tests on the estimated linear regression equation for the dependent variable to ensure the quality of the estimated equation. The following tests will be conducted:

2-2. Standard Tests for the Estimated Multiple Linear Regression Equation:

Specifically, the diagnostic tests for the residuals of the estimated equation are conducted within the framework of estimation using the Ordinary Least Squares (OLS) method. These tests assume that the errors (residuals) of the estimated multiple regression equation follow a normal distribution, are unbiased, and exhibit homoscedasticity. In other words, the conditional variance of the equation's residuals should be constant. To ensure the validity of the estimated multiple linear regression equation, the following diagnostic tests are typically conducted:

A. Residual Plot: Plotting the residuals against the observed values is important because it can indicate potential issues with the estimated regression equation. If the residuals repeatedly deviate from the dashed lines, it suggests the presence of serial autocorrelation in the estimated multiple regression equation.

Residual plots are important as they may indicate problems in the estimated regression equation. If the points of the residuals deviate from the dashed lines, it indicates the presence of serial autocorrelation in the estimated multiple regression equation.

From Figure 07 below, we can observe that the calculated residuals mostly fall within the dashed lines, indicating that they are not significantly different from zero, except for a few outliers. However, relying solely on visual inspection for

analyzing these tests can be imprecise. Therefore, we will resort to other tests to ensure the quality of the estimated model.

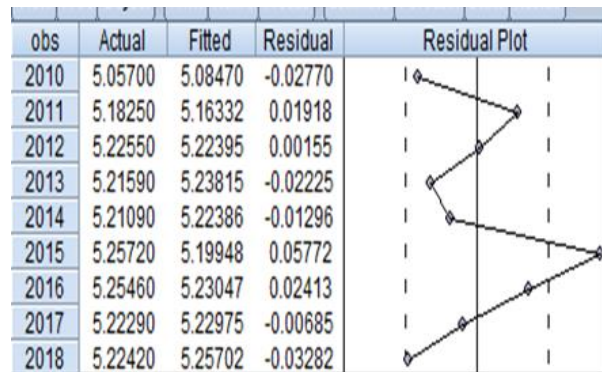


Figure (07): Results of plotting the residuals for the estimated multiple linear regression equation

Source: Prepared by the researchers, relying on the outputs of the statistical software EViews 9

B. Normality Test for Residuals: Among the standard tests to verify that the residuals of the estimated equation follow a normal distribution, we find the Jarque-Bera (JB) test. This test examines the null hypothesis (H_0) that the residuals of the multiple linear regression equation are normally distributed.

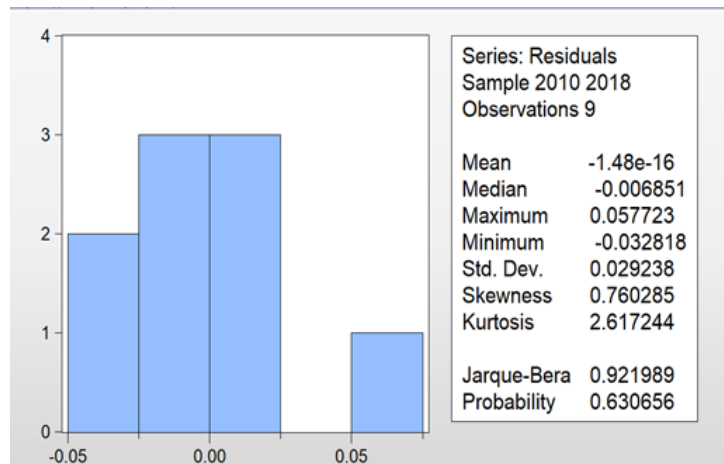


Figure (08): Results of testing the normal distribution of residuals for the estimated multiple linear regression equation.

Source: Prepared by the researchers, relying on the outputs of the statistical software EViews 9

B. From the above figure, it appears that the p-value corresponding to the Jarque-Bera (JB) statistic (0.630656) is greater than the 5% significance level. This indicates that the residuals are normally distributed with respect to the estimated multiple regression model. Therefore, we accept the null hypothesis

(H0) and conclude that the residuals are normally distributed for the estimated multiple linear regression equation of the dependent variable.

C. Autocorrelation LM Test:

Table (09): presents the results of the autocorrelation LM test for the residuals of the estimated multiple linear regression equation

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.029507	Prob. F(1,5)	0.8703
Obs*R-squared	0.052801	Prob. Chi-Square(1)	0.8183

Source: Prepared by the researchers, relying on the outputs of the statistical software EViews 9.

From Table 09 above, we observe two tests, the F-test and the Chi-squared test, both of which show statistically significant values greater than 0.05. This indicates the acceptance of the null hypothesis (H0), implying that the model is free from the issue of autocorrelation.

D. Homoscedasticity Test:

Table (10): presents the results of the homoscedasticity test for the residuals of the estimated multiple linear regression equation

Heteroskedasticity Test: White

F-statistic	0.030274	Prob. F(2,6)	0.9703
Obs*R-squared	0.089916	Prob. Chi-Square(2)	0.9560
Scaled explained SS	0.032315	Prob. Chi-Square(2)	0.9840

Source: Prepared by the researchers, relying on the outputs of the statistical software EViews 9

We observe from Table 10 above that both the F-test and the Chi-squared test show statistically significant values greater than 5%, specifically 0.9703 for the F-test and 0.9560 for the Chi-squared test. This indicates the acceptance of the null hypothesis (H0), which means that the residuals possess the property of homoscedasticity, indicating constant variance.

H. Variance Inflation Factors (VIF) Test: This test aims to detect multicollinearity among the residuals in the estimated multiple linear regression equation. If the VIF value falls between 5 and 10, it indicates the presence of multicollinearity issue in the residuals of the multiple linear regression equation. This test is considered one of the most important diagnostic tests to ensure the quality of the estimated models. The results of this test are illustrated in the following table:

Table (11): Results of the multicollinearity detection test for the residuals of the estimated multiple linear regression equation

Variance Inflation Factors
Date: 06/05/22 Time: 16:59
Sample: 2010 2018
Included observations: 9

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
CIB	0.003412	903.7897	1.013273
ATMS	4.01E-08	110.3109	1.013273
C	0.137406	1084.978	NA

Source: Prepared by the researchers, relying on the outputs of the statistical software EViews 9.

The results from Table 11 above indicate that the VIF value is 1.013273 for both variables (ATMS and CIB). This suggests that the model (equation) is free from multicollinearity issues. Thus, the null hypothesis (H0) is accepted, and the alternative hypothesis (H1) stating the presence of multicollinearity is rejected.

Fifthly, Analysis of Results:

After our attempt to analyze the implementation of financial technology services in the banking sector in Algeria and conducting a statistical analysis through a set of standard diagnostic tests, in addition to the theoretical aspects discussed in the study and in comparison with previous research findings, we will now discuss and interpret the results, testing their hypotheses based on the statistical and standard statistical results of the estimated equation (model). The study hypothesis states that there is an impact of financial technology application on enhancing financial inclusion in Algeria during the study period. In terms of the results of the multiple linear regression estimation, this hypothesis was tested, and we found variation in the parameters of the financial technology indicators used in the study in terms of statistical significance. The most important findings of the study can be summarized as follows:

- ✓ There are concerted efforts by the public authorities in Algeria towards developing the banking sector. This is manifested in the creation of institutions that support its modernization, such as the remote compensation system for collective payment methods. An example of this is the establishment of the Monetic Cash Group (GIE monétique) in June 2014, which aims to enhance the state's strategic approach in implementing an efficient electronic payment system.
- ✓ The results of the statistical study on the implementation of financial technology services in the banking sector in Algeria during the study period indicate significant and continuous growth in the volume of transactions and the use of available financial technology services in Algeria, particularly in recent years. This can be attributed to changes in individuals' behavior towards using electronic payment tools, especially since the launch of the service and the emergence of the COVID-19 pandemic. However, this growth remains below the means employed by the relevant authorities and falls short compared to the real market needs of the country. It also remains far behind

global rates in terms of accessibility and utilization of various sectors of financial technology and their services. This aligns with the opinions of many experts and specialists.

- ✓ There is a limitation in the availability of financial technology services provided by the banking sector in Algeria, which is mainly focused on payment solutions. These services primarily include electronic payment services for bill payments, purchases, and domestic fund transfers (sending money to the recipient within the country). These services are categorized into three main types: online payments, interbank cash withdrawal and payment, and payment through electronic payment terminals (TPE). These services represent the initial wave of financial technology.
- ✓ The results of the statistical analysis of the study, using the multiple linear regression model estimation, showed a statistically significant positive relationship between the number of interbank electronic payment cards (CIB) in Algeria and financial inclusion, represented by the number of borrowers from commercial banks per 1000 adults (FI) during the study period. This may be attributed to the state's policy towards the use of financial technology and structural reforms to promote the adoption of digital financial transactions and expand electronic services in the banking sector, especially in recent years. There has been a relative response to individuals' behavior towards using these services since their launch, further reinforced by the emergence of the COVID-19 pandemic.
- ✓ - Furthermore, the results of the statistical analysis showed no statistically significant relationship between the development of automated teller machines (ATMs) and financial inclusion (FI). This can be attributed to the stagnation in the availability of ATMs in Algeria, especially in the past two years, despite an increase in the number of interbank payment cards (debit cards) in circulation. In addition, there is a lack of awareness among citizens regarding the utilization of ATMs, even though they possess debit cards. Instead, they tend to rely on traditional bank checks rather than using ATMs.

Based on the findings, it can be stated that technology has a relative impact on enhancing financial inclusion in Algeria during the study period. Therefore, the study hypothesis is partially accepted, which aligns with the study conducted by Nahla Abu Al-Az (2021), as well as the study by Johani Sonia and Maryam Adila (2021), and also the study by Bouzana Ayman, Hamdouch Wafa (2021). However, the results of the study differ to some extent from the study by Wafa Hamdouch, Lamiaa Ammani, and Samia (2020), as well as the study by Zahabiya Latarch and Samia Harraq (2020).

Conclusion

In conclusion, this study analyzed the implementation of financial technology services in the banking sector in Algeria and examined the impact of financial technology application represented by the development of ATMs and interbank payment cards on financial inclusion, measured by the number of borrowers from commercial banks in Algeria. The study utilized annual data for the period 2010-2018 to address the main research problem: What is the current state of financial technology application in Algeria and its effect on enhancing financial inclusion in the banking sector during the period 2010-2018?

To address this research problem and test the study hypothesis, we employed a multiple linear regression model and conducted statistical analysis on the state of financial technology services in Algeria during the period 2016-2021. The results revealed variations in the parameters of the financial technology indicators used in the study in terms of statistical significance. The key findings of the study can be summarized as follows:

- ✓ The public authorities in Algeria are supporting the modernization of the banking system and the development of the banking sector in order to enhance the strategic approach of the state in establishing an efficient electronic payment system.
- ✓ There has been significant and continuous growth in the volume of transactions and the use of available financial technology services in Algeria in recent years. This can be attributed to a change in individuals' behavior towards using electronic payment tools. However, this growth remains below the level required to meet the actual market needs of the country.
- ✓ The financial technology services offered by the banking sector in Algeria are limited, mainly focusing on payment solutions, such as electronic bill payment, purchases, and local fund transfers. These services are limited to the early wave of financial technology solutions.
- ✓ - There is a statistically significant positive relationship between the number of interbank electronic payment cards (CIB) in Algeria and financial inclusion, represented by the number of borrowers from commercial banks per 1000 adults (FI) during the study period.
- ✓ - There is no statistically significant relationship between the development of ATMs (Automated Teller Machines) and financial inclusion (FI), despite an increase in the number of circulating interbank payment cards. Additionally, there is a lack of awareness among citizens regarding the utilization of ATMs, even though they possess bank payment cards. Instead, they tend to opt for using bank checks rather than ATMs.

Suggestions and Recommendations

Based on the preceding analysis, the study provides several recommendations and prospects to enhance the growth and development of financial inclusion in Algeria:

- ✓ Adopting a digital economy approach and improving the technological and regulatory business environment to facilitate the establishment of financial technology companies in Algeria and streamline the licensing process.
- ✓ Undertaking more comprehensive and profound reforms by Algerian authorities, including upgrading infrastructure and improving the quality of financial services provided.
- ✓ Enhancing the legal and legislative frameworks related to money protection, combating cybercrime, and information security to safeguard the rights of all parties involved in the field of financial technology.
- ✓ Providing the appropriate financial and banking infrastructure to facilitate access to official financial and banking services for all segments of Algerian society and regions, by increasing the spread rate of ATMs in various locations where citizens are present. This will enhance the demand for bank cards and their use in financial transactions, as well as expanding mobile phone services within the banking industry.

- ✓ Benefiting from global experiences in using and embracing financial technology, such as Gulf Cooperation Council countries like the UAE. Conducting field research and studies to identify the weaknesses experienced by Algeria and dedicating efforts to providing modern technological support and programs.
- ✓ Focusing on open spaces, awareness campaigns, conferences, and scientific seminars to further educate individuals about the advantages and benefits of financial technology, with the aim of increasing awareness and trust among users in digital services, and minimizing reliance on poor traditional products.
- ✓ The necessity of expediting the implementation of the 2018 Financial Law, particularly regarding the ownership and use of electronic payment terminals (TPE) by merchants. This is intended to enable citizens to use these devices in various commercial establishments and points of sale, while providing tax privileges to the merchant and their businesses during the initial years of owning the device.

Footnotes

ⁱ Financial Technology and Its Impact on the Banking Sector and Customers in the Arab Region, Arab Banks Union, February 2018, p. 04

ⁱⁱ Based on: Dorothy Delour and Isabelle Popar, How Digital Financial Services Can Provide a Path Toward Economic Recovery in Algeria, World Bank Blogs, article available at: [link](<https://blogs.worldbank.org/ar/arabvoices/how-digital-financial-services-can-provide-path-toward-economic-recovery-algeria>), access date: June 28, 2022.

ⁱⁱⁱ These sources are represented as follows: World Bank database, available at: [link] (<https://donnees.banquemondiale.org/indicateur/> and

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^{vi} Wafaa Hamdoush and Others, The Role of Financial Technology in Enhancing the Performance of the Algerian Banking Sector: Motivations and Challenges, Published Article, New Economy Journal, Volume 12, Issue 04, 2021.

^{vii} Nahla Abu Al-Azz, The Impact of Financial Digitization Technology on Financial Inclusion in the Banking Sector in African Countries, Published Article, College of Policy and Economics Journal, Issue 10, April 2021.

^{viii} Ben Ayshouba Rafika and Others, Financial Technology and Enhancing Financial Inclusion in the Context of the Coronavirus Pandemic, Published Article, Economy and Environment Journal, Volume 04, Issue 01, April 2021.

^{ix} Abdulwahab Sakri, Samia Ben Ali, Analysis of the Reality of Financial Technology in the Middle East and North Africa Region: A Reading of Challenges and Potentials, Published Article, Journal of Financial and Accounting Sciences Research, Volume 06, Issue 01, 2021.

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- ^x Bouzana Ayman, Hamdoush Wafaa, Evaluation of the Degree of Financial Inclusion in the Algerian Banking Sector during the Period 2011-2018, Published Article, Journal of Financial and Accounting Sciences Research, Volume 06, Issue 01, 2021.
- ^{xi} Goldie Lattarsh, Samia Haraq (2020), The Reality of Financial Technology in Arab Countries and Its Importance in Enhancing Financial Inclusion in Small and Medium Enterprises, Published Article, Advanced Economic Research Journal, Volume 05, Issue 02, 2020.
- ^{xii} Florentina Kurniasari, et al., The Role of Financial Technology in Increasing Financial Inclusion in Indonesia, International Journal of Data and Network Science, Volume 5, (2021).
- ^{xiii} Juani Sonya, Mariam Adila, Reference previously mentioned, p. 275.
- ^{xiv} Financial Technology and Its Impact on the Banking Sector and Customers in the Arab Region, Arab Banks Union, February 2018, p. 09.
- ^{xv} Goldie Lattarsh, Samia Haraq, Reference previously mentioned, p. 95.
- ^{xvi} Based on the Algerian Interbank Cash Group, available at: [link](<https://giemonetique.dz/ar/qui-sommes-nous/activite-paiement-sur-internet/>) .
- ^{xvii} Based on statements by Mr. Issam Bedrisi, Director of the Union of Algerian Merchants and Craftsmen to the online newspaper El Chourouk, in an article titled: "Algeria ranks second in the Maghreb in electronic payment dissemination by 26 percent, according to a recent report by the World Bank", by Belkacem Houam, published on: 20/03/2022, available at: [link](<https://www.echoroukonline.com/>).
- ^{xviii} Based on statements by the "Algerian Interbank Cash Group" to the Algerian news agency, in an article titled: "Electronic Payment: A 20 percent increase in the number of interbank cards in circulation during 2021", published on: Saturday, February 5, 2022, at 15:11, available at: [link](<https://www.aps.dz/ar/economie/120796-20-2021>).

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