The effect of the electronic government indices on strengthening the financial inclusion in Algeria: econometric study during 2005-2022

Zouaouid lazhari [1]♦, Benchaa oualid [2]

[1] University of Ghardaia (Algeria), zouaouid.lazhari@univ-ghardaia.dz
[2] University of Ghardaia (Algeria), benchaa.oualid@univ-ghardaia.dz

Abstract:

This study aims at showing the effect of the electronic government indices on strengthening the financial inclusion. In so doing, we study the effect of the independent variable (electronic government) with its dimensions (the online service OSI, the telecommunication infrastructure index TII, and the human capital index HCI) on the independent variable (the financial inclusion) with its variables (the growth of the commercial banks branches GrCBB and the growth of the automatic teller machines GrATMs) during 2005-20222. The study uses the analytical descriptive method and ARDL model according to Eviews 10 to test the hypotheses.

Findings of the statistical analysis and of hypotheses testing show a positive significant effect for the TII and HCI on GrCBB, and no significant effect for OSI during the study period. Besides, TII and HCI have a positive significant effect on GrATMs. Moreover, there is a negative significant effect for OSI on GrATMs during the study period. In the end, the study recommends boosting the use of the online services, encouraging the private companies to develop innovative digital financial services and applications, and facilitating partnerships between the government and technological companies to support the technical development.

Keywords: Electronic government, Financial inclusion, Online service, Telecommunications infrastructure, ATMs.

JEL Classification: L86, F65, E42.

♦ Corresponding author

I. Introduction:

Amid the giant development in the era of the modern technology, the electronic government got a vital role in improving the electronic services and strengthening the interaction between the citizens and the governmental departments because the current measure of development takes into consideration the development of the government services and the adoption of the internet. The latter is the optimal tool to achieve growth in various fields, including the financial sector that is a paramount index of the financial and banking safety. This safety covers the access, use, and quality of the financial services that affect the social strata, including the vulnerable. Based on what was said, the research on the effect of the electronic government indices on strengthening the financial inclusion is very important. It relies on analyzing how technology is adopted to provide better and more inclusive financial services. In this regard, this study investigates the effect of developing the electronic government in Algeria through investing in the governmental technological innovation to strengthen the financial inclusion and improve the living standards.

Problematic of the study:

This study sheds light on the potential effect of the adoption of the electronic government on strengthening the financial inclusion in Algeria. In the light of the important transformations in the technology and the adoption of the electronic governments to enhance the governmental services and facilitate access to them, it is necessary to study the potential effect of adopting the electronic government on the financial inclusion FI that targets empowering the individuals, mainly the vulnerable and poor, to have full access to the financial services. In this regard, the study raises the following question:

-Is there a statistically significant effect for the indices of the electronic government development on strengthening FI in Algeria during 2005-2022?

The sub-questions:

-Is there a statistically significant effect for OSI, TII, and HCI on GrCBB in Algeria during 2005-2022?

-Is there a statistically significant effect for OSI, TII, and HCI on GrATMs in Algeria during 2005-2022?

The hypotheses of the study:

-There is a statistically significant effect for OSI, TII, and HCI on GrCBB in Algeria during 2005-2022.

-There is a statistically significant effect for OSI, TII, and HCI on GrATMs in Algeria during 2005-2022.

Importance of the study:

The importance of this study lies within analyzing the relation between, and showing the effect of, the electronic government development EGD and the financial inclusion FI, mainly in the light of the emerging challenges and prospects. In this regard, improving FI is one of the main objectives to achieve the sustainable development thanks to the role of the financial services in the economic development and the living standards.

The aims of the study:

This study aims at:

- Showing the main international indices of measuring EGD.
- Analyzing the effect of these indices on FI in Algeria during the study period.
- Providing efficient recommendations to strengthen the role of the electronic governmental transformation in enhancing FI and strengthening the economic sustainability in Algeria.

Embodying these goals shall efficiently contribute to providing clear visions about the complementarity of the technology in the governmental structure, which may contribute to the achievement of FI and increase the economic opportunities of the vulnerable categories in Algeria.

Method of the study:

To reach the aims and test the hypotheses, we used the analytical descriptive method. In this context, we shall analyze and study the effect of the electronic government indices on FI in Algeria using Eviews V.10 and ARDL.

Study limitations:

The study took place from 2005 to 2020 in Algeria.

Data collection sources:

Due to the nature of the study, we relied on the official reports on the topic, issued by the UN and the Algerian Central Bank, and on some scientific studies and papers.

Literature review:

In our endeavor to find literature that helps bridge the research gap of our study, we chose 04 studies that are related to our study and have common variables and indices to show the added value our study aims at introducing.

1. The study of Amekrane & Bouthelja (2023): It is a Master dissertation entitled "the role of the digital transformation in strengthening the level of the financial inclusion: comparative study between Algeria and UAE during 2011-2021". It aimed at shedding light on the role of the digital transformation in reinforcing FI and used the descriptive method to explain the concepts related to the digital transformation and FI. Besides, it analyzed and presented FI indices in the context of the digital transformation to better understand the effect of the digital transformation on FI. Then, it compared Algeria to UAE to draw the variances between the two states. Findings showed big differences between the two states, as UAE shows high excellence in the digital transformation and FI thanks to the efforts and investments. Thus, Algeria needs more work to bridge the gap compared to the advanced states.

2. The study of Salam (2022): It is a paper entitled "measuring the median role of the digital transformation in the relation between the financial inclusion and the sustainable development: empirical study on private service organizations". It aimed at examining the correlation between FI and the sustainable development, and the role of the digital transformation as a median in this context. It used the analytical descriptive method and relied on the questionnaire for data collection. The authors administered 320 questionnaires and recovered 295. Findings showed a statistical relation between FI and the sustainable development, and between FI and the digital transformation. Besides, there was a statistical

relation between the digital transformation and the sustainable development. In the end, it recommended focusing on developing the infrastructure of the digital transformation through complementary systems including devices, operational systems, storage tools, and software that suit the technological environments and information centers to exploit all the assets efficiently. Furthermore, it recommended adopting FI policies by the organizational and control institutions and developing mechanisms for efficient data collection.

3. The study of al Haddad (2022): It is a paper entitled "the effect of applying the digital transformation on the internal audit and the achievement of the financial inclusion: field study in the Egyptian banks". It aimed at discovering the effect of applying the digital transformation technology in the banking companies, with focus on evaluating the effect of the application on specific aspects, namely the internal audit and FI inside the Egyptian commercial banks. Moreover, it presented the effect of this application on the goals of the sustainable development according to the vision of Egypt 2030. The study used the desk method and analyzed the literature and the views of the experts. Besides, it included a field study for data collection. Then, it statistically analyzed the data coming from a survey on 150 informants from different fields, including the internal audit directors, the external auditors, the information technology employees in the Egyptian commercial banks, and the university teachers. Findings showed a strong effect for the application of the digital transformation mechanisms in the banks on the development of the internal audit measures, the important role of the information technology in improving the banking transactions, and the beneficial use of the modern techniques to achieve FI in the Egyptian commercial banks and the sustainable development.

d. The study of Radif, Ghaffar, & Ben Ayad (2021): It is a paper entitled "the digital transformation as a mechanism to strengthen the financial inclusion in Algeria". It shed light on the main conditions to achieve FI in Algeria, thanks to its importance in widening the target audience. The study mainly focused on the role of the digital transformation in reinforcing the FI and its goals through the vulgarization of the digital financial services. The study used the analytical descriptive method and found out that the digital financial transformation contributes to FI dimensions, including the penetration, access, and use. Besides, it allows many advantages, which reduce the financial costs of the financial and non-financial services providers, provide fast secure financial services, and improve the quality of the services to the citizens and customers.

What characterizes our study is that it focuses on the indices of EGD and analyses and measures its indices on FI in Algeria. It agrees with some previous studies regarding the use of the analytical descriptive method because it is the most suitable to answer its problematic. In addition, our study differs than the other studies in the fact that it is the first econometric study, to the best of our knowledge, which studies and relates a set of indices of the independent variable (the electronic government) with a set of indices of the independent variable (FI). Thus, the findings shall rely on measuring and analyzing the effect between these indices during 2005-2022 in Algeria.

II. The theoretical chapter:

1. Conceptual introduction to the electronic government:

1.1 Definition of the electronic government:

OCED defined it in 2000 as the use of the information technology, mainly the internet, to achieve better governments (Kafi, 2011, p. 263). Besides, the UN defined it in 2002 as the use of the internet to send information and government services to the citizens (al Salibi, 2014). Then, in 2014, the UN redefined it as the use of the information technology and its applications in the public administration to simplify and complement the administration work, manage the information and data more efficiently, provide public services, and widen the communication channels to integrate and empower people (the Economic and Social Issues Administration, 2018, p. 222). In addition, the World Bank defined the electronic government as the use of the information and communication technology ICTs, such as internet and computers to change the relation between the government, the citizens, the businesses, and the other governmental bodies. This technology may achieve many goals, such as enhancing the citizens' services, strengthening the interaction with the businesses and industries, empowering the citizens through access to the information, and improving the efficiency of the governmental administration (ESCWA, 2014, p. 12). Based on what was said, we can say that the electronic government is that governmental administrative system that basically relies on ICTs to provide the government services and efficiently manage the public issues. It requires the integration of ICTs with the traditional governments to improve the services, facilitate the communication between the citizens and the government, and improve the administrative work.

1.2 The developmental effect of the electronic government:

After the collapse of dot-com bubble, it turned clear that the justification of the electronic government initiatives requires more than providing the government services through internet, as was the case in the last decade. The OCED proved that the modern electronic governments' initiatives must contribute to the main goals of the government. Therefore, it is necessary to adopt study models that resemble those used in the efficiency studies to evaluate the electronic government projects, including the cost analysis and the analysis of the risks and potentials about the economic return, be it for the government or the citizen. We can show the developmental effect of the electronic government in table 01:

Table 01: the developmental effect of the electronic government

| Advantages/ Benefitting side	Government	Citizen
The direct costs and the direct return (financial effect)	Reducing the costs and identifying the necessary resources to develop and innovate goods and services to increase their value and improve the equivalence.	Reducing the administrative burdens, improving the quality and speed of the services, and achieving an economic efficiency in the financial and temporal use.
The direct costs and the direct return (non-financial effect)	Achieving the full benefit from the investment, strengthening the complementarity between	Achieving the citizen satisfaction through providing continuous high quality services during the

	the various channels of service providing, and strengthening data and services sharing to empower the government to provide its services proactively and promote for them through the most suitable cannels for the citizen.	week, guaranteeing better access and equality, handling the privacy and security issues, increasing transparency, and providing the citizens with choices.
Indirect cost and return for the good rule through the purchases	Strengthening the legitimacy through supporting the security and building general trust, updating and developing the governmental structure, guaranteeing the equality, and reinforcing the efficient response, consolidating accountancy, and encouraging participation.	Strengthening the growth through improving the businesses, establishing an advanced digital society, and developing the infrastructure to execute the procedures securely.

Source: (Schonberger & Lazar, 2007)

The table shows the electronic government projects that take into consideration the cost and return model according to the benefitting party.

1.3 The critical factors of the electronic government success:

We can classify the critical factors of the electronic government success in 05 sets, as shown in figure 01:
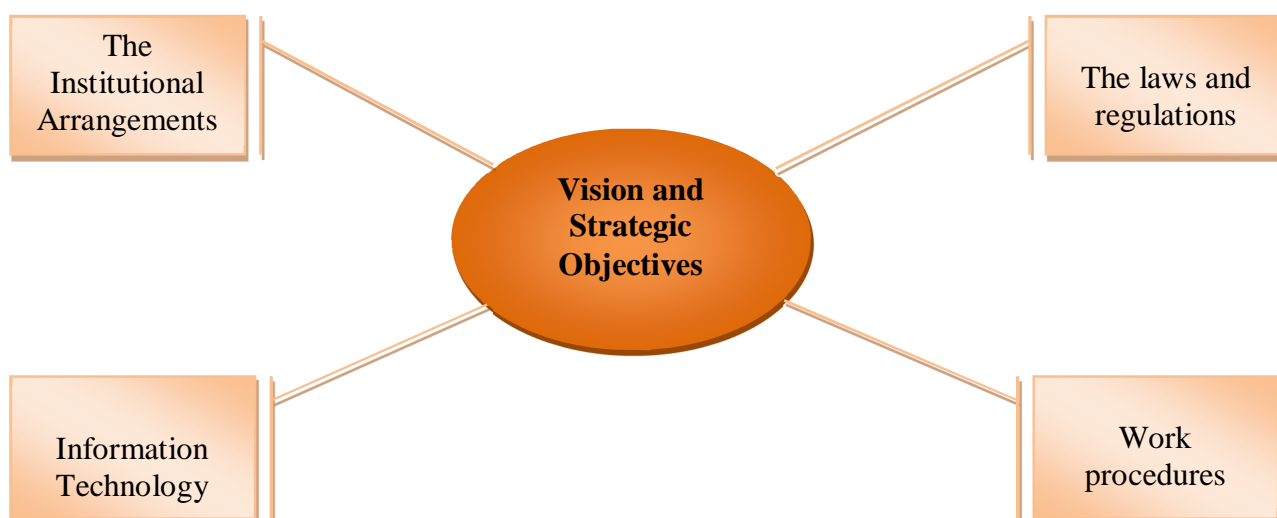
Source: Soh Bong Yu, p. 25

To guarantee the success of the electronic government, it is necessary to set a long-term plan based on a thoughtful vision. The success is based on the good sustainable measures. The primary focus on the government strategic vision (vision from top to bottom) is the optimal way and helps understand the general objectives of the government and execute small tasks with primarily clear priorities (vision from bottom to top). The application of the

electronic government requires dealing with legal and legislative issues to avoid the complexity of the paper environment. Thus, the current laws must be updated to deal with the electronic transactions.

The institutional measures are a set of prerogatives and collaboration mechanisms that manage the behavior of the individuals and institutions within a given field to guarantee collaboration inside the government, allow the efficient participation of the private sector, and accelerate the execution of the actions. In this regard, the electronic government requires a change in the working methods and coordination of the various projects. The real change to the electronic government embodies the improvement of the work procedures, as the services change into electronic after developing the administrative measures and getting rid of the unnecessary steps. Moreover, the reengineering of the procedures increases the work efficiency and removes the low efficiency steps.

1.4 E-Government Development Index (EGDI):

It estimates the readiness and competency of the national administrations in using ICTs to provide the public services. It needs the evaluation of the internet availability, which gives access to the services and information. It is a compound index that relies on the weighted mean of three econometric indices. Its branches are regularly updated in each edition to guarantee exactness. These indices are (Araar & Khelifi, 2021, p. 58):

1.4.1 Telecommunication Infrastructure Index (TII):

It relies on the data of the International Union for Telecommunications and evaluates the efficiency of the telecommunication infrastructure. It has 04 secondary components, namely the rate of internet users, the phone subscription per 100 inhabitants, the subscriptions of mobile-broadband per 100 inhabitants, and the subscriptions of the fixed-broadband per 100 inhabitants. The analysis of 2020 excluded the subscriptions of the fixed-broadband due to the decrease of the subscription in some states, reflecting the exact estimation of the infrastructure.

1.4.2 Human Capital Index (HCI):

It is based on the data provided by UNESCO and the UN Development Program. It aims at measuring the ability of the human resources to strengthen and use ICTs. It has 04 components, namely the adults' literacy, the school enrollment, the expected education years, and the education yeas average. The two last components had been added since 2014.

1.4.3 Online Service Index (OSI):

It is based on the data of the UN Social and Economic Issues Administration and aims at evaluating the national presence via internet. It measures the availability of the services and content via internet in the member states.

The value of EGDI is either very high (more than 0.75), high (from 0.5 to 0.75), average (from 0.25 to 0.5), or low (less than 0.25).

2. A conceptual introduction to financial inclusion (FI):

2.1 Definition of FI:

The World Bank defines it as the opportunity for individuals and companies to sustainably and responsibly access financial services and products at logical costs to meet their needs (Nguyen, 2021, p. 78). Besides, OCED and the International Net for Financial Education define it as the process that aims at reinforcing the access to a wide set of official

financial services and products that are subject to control at reasonable prices in a way that satisfies the needs of various social categories. This shall be met through the adoption of innovative methods that cover the financial education to increase the financial welfare and reinforce the socioeconomic complementarity (Chenbi& Ben Lakhder, 2019, pp. 106-107).

Moreover, FI is defined as the wide access to the financial services in the absence of tariff and non-tariff obstacles that hinder the use of the financial services (Haabazoka, Mweeta, & Mwanaumo, 2021, p. 1074). Besides, it is the process that allows the full access to the official financial services and their use comprehensively with low obstacles. Furthermore, it includes reducing the potential obstacles to allow the individuals at the work age to access a complementary set of high quality financial services at a low cost (Tuesta, Sorensen, Haring, & Camara, 2015, p. 03).

Thus, FI can be procedurally defined as empowering the poor categories to access the basic financial services, such as insurance and loans from the official service providers in a flexible way (Adalessossi & Kaya, 2015, p. 25). In addition, it refers to efforts that provide suitable financial services and products for the low-income people at low costs and in a fair and transparent manner (Ozili, 2020, p. 458).

2.2 The dimensions of FI:

FI is evaluated and measured through 03 scales recommended by G20, namely the ability to access the financial services (the outreach dimension), the efficiency of using the financial services (the use dimension), and the quality of goods and services (quality dimension) (Odhiambo, Nyasha, Zerihun, & Tipoy, 2019, p. 38)

2.2.1 The outreach dimension:

It is about the financial side that deals with the individuals' ability to access the financial services. It is measured using indices that show the geographic spread of these services, namely (Bakhouche, 2022, p. 57)

- The number of the commercial banks per 1000 km^2.
- The number of ATMs per 1000 km^2.

Besides, other indices show the demographic spread, namely:

- The number of the commercial banks per 100000 adults.
- The number of ATMs per 100000 adults.

The current researches show that the density of the branches and ATMs, regarding the geography and demography, confirm the increase of the access to the financial services by the individuals and the companies. The lack of the physical points of the financial services shows the necessity of taking urgent measures. In the light of the banking services without branches, the index of the number of the commercial banks branches is misleading. Thus, the finical technology provides financial services via the phone to consolidate the access in the regions that have no banks branches or ATMs.

2.2.2 The use dimension:

It measures the spread and use of these services by the citizens. It is measured by:

- The rate of the adults who have an account in at least one official financial institution: the spread of the accounts of the official financial institutions among the adults is measured.
- The number of the banking accounts per 1000 adults: it expresses the banking density in the society.
- The number of deposit accounts per 1000 adults: it shows the spread of the savings services.
- The number of credit accounts per 1000 adults: it shows the possibility of access to funding.
- The number of borrowers per 1000 adults: it shows the spread of the credit services among the adults.
- The number of depositors per 1000 adults: it measures the spread of the deposit services among the adults.

We notice that despite people have banking accounts, it does not necessarily mean they use other financial services. Therefore, the focus in some cases is on the two main services, the loans and the deposits. Their indices are used as a rate of the GDP to estimate the use dimension. Besides, the index of the transferable money accounts and the value of the financial transactions via phone are used to determine the extent of using the technology in the financial services.

2.2.3 The quality of the financial services dimension:

It is measured by providing the financial services to the consumers. It includes indices that express the illiteracy, the disclosure requirements, the conflict settlement efficiency, the property cost, etc (Bakhouche, 2022, p. 58). The following table summarizes the indices of FI according to each dimension.

Table 02: The indices of measuring the dimensions of FI

The indices of the access dimension	
Number of banks branches per 100 adults	Number of commercial banks branches per 1000 Km^2
Number of ATMs per 100000 adults	Number of ATMs per 1000 Km^2
Number of credit cards per 1000 adults	Number of Points of Sale POS per 100000 adults
The indices of the use dimension	
Rate of adults and companies who have financial accounts at the official financial institutions	
Number of depositors per 1000 adults or the number of deposit accounts per 1000 adults	Number of lenders per 1000 adults or the number of loans per 1000 adults
The indices of the quality dimension	
The financial knowledge (financial education) The overall correct answers by the adults about the basic financial concepts, such as the inflation, the interest rate, the compound interest, the monetary allusion, the main goal of the insurance, the diversity of the risks, etc.	
The cost of use * The cost of opening a bank account.	

* The average cost of the credit transfers. *The average cost of maintaining a bank account (the annual costs)
The transparency requirements * The total payout rate compared to the credit (the basic costs and the commission, taxes, insurance, and fees). * The disclosure of the information in an easy language. * Banning the hidden conditions. * The existence of a model for describing the provided financial services

Source: (Al-Khazraji & Al-Araji, 2019: 328)

2.3 The factors that help the success of FI:

The G20 adopted a set of principles to boost FI and develop the policies of establishing an environment that facilitates access to the innovative financial services for all the social categories, including the low income people. These principles are (Al Sanjeri & al Naimi, p. 142):

The diversity: It increases the competition in the financial market to improve the access to the financial services at low costs in the fields of insurance, loans, payments, transfers, etc. Besides, the service providers must consider the customers' needs, provide innovative services, and reduce the costs of the services.

The innovation: It improves and expands the financial services. It includes extensive efforts to develop the financial infrastructure, which plays a vital role in the comprehensive financial system and facilitates the access to the various financial services (OngoNkoa, & Song, 2020, p. 04).

III. The practical chapter (Methodology of the econometric study):

The effect of EGD with its dimensions (OSI, TII, and HCI) on FI with its dimensions (GrCBB and GrATMs) in Algeria during 2005-2022 is measured according to ARDL using Eviews 10. This study follows the time-series data to know the relation of the cointegration of the effect of the variables of the independent variable (electronic government) on the two dimensions of the dependent variable (FI). Moreover, the study uses the annual data, turned into quarterly data to increase the size of the sample. Thus, we have 72 quarterly views during Q12005-Q42022, in the Algerian economy. The choice of the analysis period was based on the data availability. In this regard, we used the quadratic match sum method, which proved efficiency in integrating the adjustments of the seasonal deviations when turning the data from the low frequency to the high one, and removing the data deviations from one point to another.

a. The study variable (The study model):

The following figure shows the study variables and dimensions:
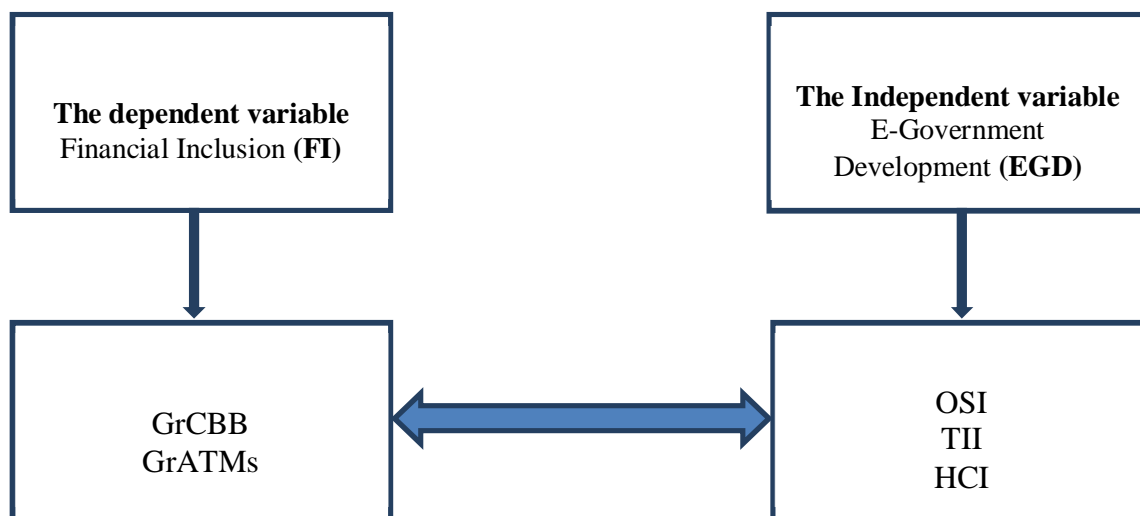
The Independent variable (EGD):

It has 03 dimensions:
1. OSI (Online Service Index)
2. TII (Telecommunication Infrastructure Index)
3. HCI (Human Capital Index)

We obtained the data of this variable from the UN Social and Economic Issues Administration reports, which are issued each two years. These reports are about the electronic government in the 193 member states. To make the econometric study and get uninterrupted time series, we referred to the experts of econometrics to handle the issue of the lack of annual data. Thus, it was suggested that we reuse the frequency of value of the previous year in the current year (E.g. The frequency of 2005 is reused in the following year 2006, which does not exist, and the value of 2007 is reused in 2008, which does not exist, etc). The second suggestion was that we take the average of the total values of the year N and the year N+2 to get the value of the year N+1. This is what we used in this study because the values of the independent variable dimensions were almost convergent. It is worth mentioning that the value of each dimension of the EGDI is between 0 and 1, as shown in the theoretical chapter.

The dependent variable (FI):

It has 02 dimensions:
1. GrCBB (Growth rate of commercial bank branches)
2. GrATMs (rowth rate of Automated Teller Machines)

We obtained the data from the reports of the Algerian Central Bank and the statistical statements published on its website during the study period. We found the growth rate of the two dimensions by subtracting the value of the comparison year from the value of the basic year. The value of the basic year during the study period was divided.

b. Testing the stationarity of the time-series:

The results are shown the table:

Table 03: the results of the stationarity of the time-series of the study variables

VARIABLE	Levels			1st Differences		
	ADF	1% level	Prob	ADF	1% level	Probability
OSI	-1.40309	-3.052169	0.5679	-6.59153	-3.052169	0.0000
TII	-1.19146	-3.639410	0.6671	-6.89021	-3.639410	0.0000
HCI	-1.52067	-3.661660	0.5101	-4.48928	-3.661660	0.0012
GrCBB	-2.57544	-3.052169	0.1075	-5.50939	-3.052169	0.0001
GrATMs	-1.98301	-3.632900	0.2926	-5.65702	-3.632900	0.0000

Source: by the authors based on the outputs of Eviews 10

After testing the stationarity of the 04 time series, we found out that they are all stationed at the level one, i.e., they have the same integration degree, showing a long-term relation.

c. Testing the model quality:

Before adopting ARDL model to estimate the short and long-term effects, we must examine its quality using the following tests:

- The residuals natural distribution test:

To check the natural distribution, we use Jacque-Bera test. Thus, we find that the result is insignificant (a>0.05) and confirm that the residuals are naturally distributed. Besides, from the value of J-B that is less than $\chi^2=5.99$, we confirm the natural distribution of the model, as shown in figure 03.

Figure 03: The results of the residuals natural distribution test
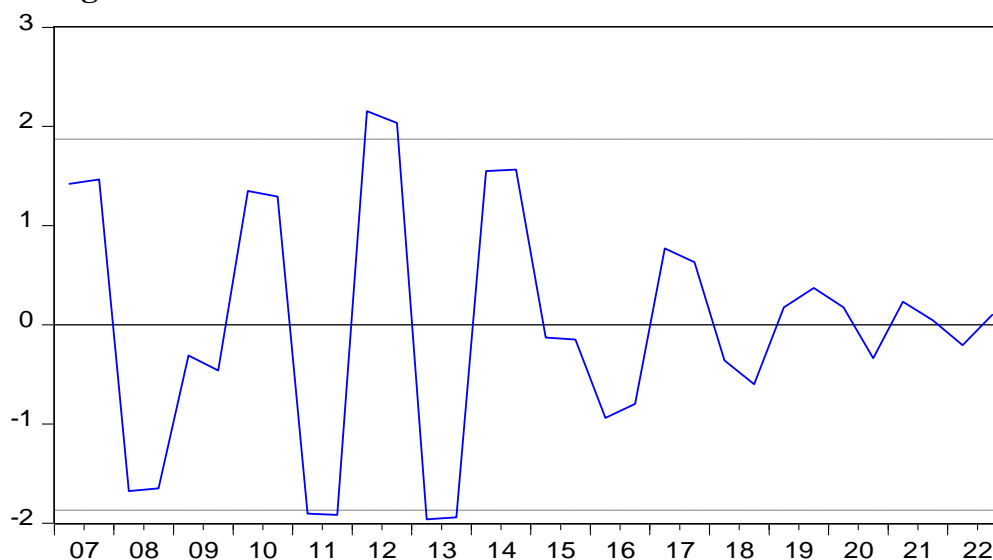
Source: by the authors based on the outputs of Eviews 10

The heteroskedasticity test:

We use ARCH test. We have obs*R-squared = 1.576 >5% $\chi^1=3.839$. Therefore, we accept the null hypotheses that there is no heteroskedasticity in the error term. This is supported by the P-value 0.1968 that is more than 5%.

Table 04: The results of the heteroskedasticity

0.3123	Prob.F (1,31)	1.65278	f-statistic
0.1968	Prob.Chi-square	1.57647	Obs*R-squared

Source: by the authors based on the outputs of Eviews 10

Breusch-Godfrey serial LM test:

Obs R-squared =9.320 >5% χ^2 =5.99 is less than 5% and indicates a problem in the model, as shown in table 05.

Table 05: results of Breusch-Godfrey serial LM test

0.0625	Prob.F (2,11)	3.34212	f-statistic
0.0019	Prob.Chi-square	9.32057	Obs*R-squared

Source: by the authors based on the outputs of Eviews 10

The statistical analysis of the study tool:

According to the value of R-squared and the significance of F-statistics, we can accept the model. We made Durbin stat Watson test and found a value of 1.723; it is between 00 and 03. Thus, the model does not have a problem of autocorrelation of the error term. Hence, we accept the null hypothesis, as shown in table 06.

Tale 06: The results of estimating ARDL model for the effect of EGD indices on strengthening FI in Algeria during 2005-2022

Variable	(GrCBB)				(GrATMs)			
	Coefficient	Std. Error	t-Statistic	Prob.*	Coefficient	Std. Error	t-Statistic	Prob.*
GrCBB (-1)	0.329092	0.185385	1.775181	0.0949	-	-	-	-
GrCBB (-2)	-0.736242	0.206267	-3.569369	0.0026	-	-	-	-
GrCBB (-3)	0.381248	0.278834	1.367291	0.1904	-	-	-	-
GrCBB (-4)	0.773820	0.311283	2.485909	0.0244	-	-	-	-
GrATMS (-1)	-	-	-	-	0.275499	0.198976	1.384582	0.1914
GrATMS (-2)	-	-	-	-	0.078187	0.425478	0.183762	0.8573
GrATMS (-3)	-	-	-	-	0.081214	0.350789	0.231519	0.8208
GrATMS (-4)	-	-	-	-	-0.649422	0.390493	-1.663082	0.1222
HCI	-5.220387	3.572810	-1.461143	0.1633	236.7641	63.83286	3.709126	0.0030
HCI (-1)	0.861981	2.674982	0.322238	0.7514	1.920670	33.84229	0.056754	0.9557
HCI (-2)	26.66885	4.300584	6.201217	0.0000	-69.57371	45.52680	-1.528192	0.1524
HCI (-3)	-6.941065	4.961829	-1.398892	0.1809	-10.52546	34.50321	-0.305057	0.7655
HCI (-4)	-15.07664	6.073562	-2.482339	0.0245	161.1792	56.38785	2.858403	0.0144
OSI	-2.015860	3.463827	-0.581975	0.5687	-321.8992	129.7429	-2.481053	0.0289
TII	-4.564261	2.108478	-2.164718	0.0459	8.216072	67.90637	0.120991	0.9057
TII (-1)	1.626360	1.820461	0.893378	0.3849	79.27084	92.73927	0.854771	0.4094

TII (-2)	5.773572	1.858487	3.106598	0.0068	37.02386	57.73810	0.641238	0.5334
TII (-3)	-0.995900	1.796707	-0.554292	0.5870	114.3418	76.49967	1.494670	0.1608
TII (-4)	-4.396442	2.433747	-1.806450	0.0897	191.7177	82.29055	2.329766	0.0381
C	2.159518	1.515095	1.425335	0.1733	-7.204586	58.89445	-0.122330	0.9047

R-squared	0.995714		Meandependent var	16.88375
Adjusted R-squared	0.989780		S.D. dependent var	18.50838
S.E. of regression	1.871071		Akaike info criterion	4.377613
Sumsquaredresid	45.51179		Schwarz criterion	5.247893
Log likelihood	-51.04180		Hannan-Quinn criter.	4.666086
F-statistic	167.7954		Durbin-Watson stat	1.723612
Prob (F-statistic)	0.000000			

Source: by the authors based on the outputs of Eviews 10

In statistics modeling, the exact estimation of the model is vital. One of the widely used measures is the determination coefficient(R-squared). In the last analyses, the value of R-squared of the model was 0.995714. Therefore, there is a high rate of interrogation in the variable interpreted by the model.

To improve the evaluation, the adjusted R-squared reaches 0.989780. This modification takes into consideration the number of the predictors, which provides a more reliable measure to generalize the model. As for the weighted mean of the dependent variable that reached 16.88375, it provides a central referential point of the values, while the standard deviation of the variable that reached 18.50838 reflects the dispersion of the values around the mean.

Regarding the standard error of regression 1.871071, it is a crucial index of the exactness of the model. In this regard, F coefficient that measures the importance of the model in general shows a value of 167.7954 with a very low probability of 0.000000. Thus, it statistically supports the power of the model.

By discovering the criteria of the GoF, AIC and Schwartz criteria are 4.377613 and 5.247893, respectively. The low values show that the model is economic and balanced. The values of the log likelihood and Hannan-Quinn criteria are -51.04180 and 4.666086, respectively, and provide additional views about the model. To evaluate the potential variance in the residual, Durbin-Watson statistics shows a value of 1.723612. It is near the expected range 2, and reflects a minimum limit of the auto variance, which strengthens the reliability of the model.

- Testing and discussion of the hypotheses:

Hypothesis 01: There is a statistically significant effect for OSI, TII, and HCI on GrCBB in Algeria during 2005-2022.

The regression coefficients of GrCBB show that GrCBB (-2) has a statistically significant negative effect with a value of -0.736242 and significant probability of 0.0026. In the same context, TII (-2) shows a positive effect as its coefficient value is 5.773572 and significant probability is 0.0068. This shows a statistical positive relation between TII and GrCBB during the study period. In other words, the positive effect shows that the increase in the value of TII is statistically related to GrCBB. Thus, the improvements in the telecommunications infrastructure, such as developing the internet and its infrastructure, contributes to the growth and expansion of the commercial banks. This may be due to the

improvements in the communication between the branches, the better banking services, and the expansion of the local and regional markets.

On the other hand, the coefficient of HCI (-2) indicates a positive effect of 26.66885 and significant probability of 0.0000. In return, the variable of OSI has an insignificant effect on GrCBB. Since there is a statistically significant positive effect, the increase in HCI coincides with GrCBB. In other words, the investment in the human skills may have a positive effect on the growth of the banking sector (number of branches) during the study period. Besides, the last result shows the absence of a strong or remarkable effect for OSI on GrCBB. In other words, the change in the internet quality according to OSI does not lead to big statistical changes in the number of the commercial banks branches. The results provide important details about the effect of different indices on GrCBB. Thus, we relatively accept the first hypothesis because one of the dimensions (OSI) did not have an effect. This analysis allows taking decisions that are more detailed in the Algerian banking sector.

Hypothesis 02: There is a statistically significant effect for OSI, TII, and HCI on GrATMs in Algeria during 2005-2022.

The regression coefficients of GrATMs show that GrATMs (-4) has a statistically significant negative effect with a coefficient of -0.649422 and significant probability of 0.1222. On the other hand, HCI shows a positive effect as its coefficient is 236.7641 and significant probability is 0.0030. The results of TII are various. In this regard, TII (-4) shows a statistically significant positive effect of 191.7177 and significant probability of 0.0381. On the other hand, OSI shows a statistically significant negative effect as its coefficient is -321.8992 and significant probability is 0.0289.The statistical analysis shows a strong statistical relation between TII and GrATMS. Thus, there is a positive correlation between the quality of the telecommunication infrastructure and GrATMs. In general, this effect may be positive because the improvement of the telecommunication infrastructure improves the ATMs services and makes it accessible to the users; thus, the number of ATMs increases.

The statistically significant positive effect of HCI on GrATMs during the study period shows that the increase of the indices coincides with the growth of ATMs. In other words, the better quality of the human resources increases ATMs. Moreover, the statistically significant negative effect of OSI on GrATMs can be interpreted saying that the deterioration of internet services negatively affects the number of ATMs, or there is a problem in the stability of internet telecommunications that affects the performance of ATMs. Furthermore, there may be a negative effect linked to the reliance on the digital technology in this context. These findings shed light on the effect of given indices on GrATMs in Algeria. Thus, we accept the second hypothesis. This analysis gives strong signals to the decision makers about how to develop the banking infrastructure efficiently in the light of the technological development and the changes in the financial services.

d. Estimating the short and long-term effects using ARDL:

The bounds test confirms the cointegration between EGD and FI. The results confirm the alternative hypothesis about the existence of a cointegration, as confirmed by the calculated value of that reached 170.379, which is more than the tabulated value of the maximum bound of the parameter estimated at 4.37 and more than the minimum bound 3.49

at significant levels 1%, 2.5%, 5%, and 10%. The economic interpretation means the existence of cointegration that corresponds to the economic vision.

Table 06: The results of the bounds test

F-Bounds test			Null Hypothesis: No levels relationship	
Test Statistic	Value	sig	I(0)	I(1)
f-statistc	170.3785	10%	3.09	2.2
	2	5%	3.49	2.56
		1%	4.37	3.29

Source: by the authors based on the outputs of Eviews 10

VI- Conclusions:

Upon this study, our findings show that:

- The electronic government indices play an important role in strengthening FI by making the financial services more accessible.
- The governments may use the technology to provide the financial services via internet for the geographically isolated people.
- The electronic government techniques may help make the financial transfers and funding more secure and efficient and, thus, increase the citizens' trust in the financial services.
- There is a positive effect of TII and HCI on GrCBB during the study period.
- There is no statistically significant effect for OSI
- There is a statistically significant effect for TII and HCI on GrCBB in Algeria during 2005-2022, while OSI has no effect.
- There is a statistically significant effect for TII and HCI on GrATMs in Algeria during 2005-2022.
- There is a statistically significant negative effect for OSI on GrATMs in Algeria during 2005-2022.
- There is a statistically significant effect for OSI, TII, and HCI on GrATMs in Algeria during 2005-2022.

V- Suggestions:

Based on these findings, we shall recommend some points that strengthen FI in Algeria through EGD, as follows:

- Developing the telecommunications infrastructure: through investment in telecommunications nets, widening the internet coverage through satellites and optic fibers, and strengthening the wireless nets infrastructure to pave the way for fast and easy internet access in rural and urban areas.
- Developing the human capital: through training on technology, internet, and the digital skills, and encouraging the high studies in technology and software.
- Motivating the use of online services: through the adoption of the electronic governmental services, such as electronic registration, electronic application, and the electronic payment of taxes, and encouraging the companies to provide online services to improve the digital commercial environment.

- Securing the information: through high privacy measures for the financial transactions online, and through awareness campaigns about the digital security to guarantee the citizen's understanding of the fraud risks and how to avoid them.

- Increasing collaboration with the private sector: by encouraging the private companies to develop innovative applications and financial services, and facilitating the partnership between the government and the technological companies.

- Improving the policies orientation: through setting a legal and political frame to motivate the technological development, encouraging investment in innovation, and improving the transparency and accountability in managing the technological projects to guarantee the efficient use of funds.

IV- Bibliography:

- Adalessossi, K., & Kaya, N. (2015). The Measure of the Financial Inclusion in the African Countries. *Advances in Management & Applied Economics, 05* (05), pp. 23-32.

- Asma al-Sanjari& Zahar al Naimi. (2022). measuring the effect of the financial depth on the financial inclusion by application on Iraq and Egypt, *Mesopotamia development journal*, 41 (135), pp. 134-160.

- Economic and Social Issues Administration. (2018). study of the electronic government, New York, UN.

- Haabazoka, L., Mweetwa, C., & Mwanaumo, E. (2021). The Relationship Between Financial Inclusion and Economic Development in the New Digital Era for Developing Countries. A Case of Zambia. *Paper presented at the Modern Global Economic System: Evolutional Development vs. Revolutionary Leap 11* (pp. 1072-1090). Springer International Publishing.

- Khaoula Amekrane & Saliha Bouthelja. (2023). the role of the digital transformation in strengthening the financial inclusion: comparative study between Algeria and UAE during 2011-2011, *Magister thesis*, Algeria: the University Center Abd al Hafidh Boussouf of Mila.

- Lynda Bakhouche. (2022). the effect of developing the financial system on the economic growth in Algeria: case study of Algeria, *journal of intellectual excellence for the human and social sciences*, 03 (03), pp. 53-67.

- Mostafa Radif, Faycel Ghaffar, & Samir Ben Ayad. (2021). the digital transformation as a mechanism to strengthen the financial inclusion in Algeria, *Middle East journal for human and cultural sciences*, 01 (05), pp. 258-301.

- Mostefa Kafi (2011). the electronic administration, Syria: Raslan house and company.

- Nguyen, T. T. (2021). Measuring financial inclusion: a composite FI index for the developing countries. *23* (01), pp. 77-99.

- Odhiambo, N. M., Nyasha, S., Zerihun, M. F., & Tipoy, C. (2019). Financial Development in Africa: Is It Demand-Following or Supply-Leading? *Extending Financial Inclusion in Africa* , pp. 37-60.

- Ongo Nkoa, B. E., & Song, J. S. (2020). Does institutional quality affect financial inclusion in Africa? A panel data analysis. *Economic Systems, 44* (04).

- Oussama Salam. (2022). measuring the effect of the median role of the digital transformation in the relation between the financial independence and the sustainable development: empirical study on private service companies, *scientific journal for the commercial and financial studies and researches*, 03 (01), pp. 1039-1082.
- Ozili, P. K. (2020). Financial inclusion research around the world: A review. *Forum for Social Economics, 50* (04), pp. 457-479.
- Rasha al Haddad. (2022). the effect of applying the digital transformation on the internal audit and the achievement of the financial inclusion- field study in the Egyptian banks, *Journal of Alexandria for accounting researches*, 06 (03), pp. 653-702.
- Schonberger, V. M., & Lazar, D. (2007). *Governance and information Technology: From Electronic Government to Information Government.* U.S.A: The MIT Press.
- Soh Bong Yu, .. *e-Government of Korea: How we have been working with it.* Korea: kado presentation.
- Sourya Chanabi & al Said Ben Lakhder. (2019). the importance of the financial inclusion in achieving the development: strengthening the financial inclusion in the Arab Egyptian Republic, *journal of researches in accounting and financial sciences*, 04 (01), pp. 104-129.
- Thouraya al- Khazraji & Sabyan al-Aaradji. (2019). the economic measurement of the effect of the financial inclusion on the banking stability in Iraq, *Journal of economic and administrative sciences*, 26 (119), pp. 323-344.
- Tuesta, D., Sorensen, G., Haring, A., & Cámara, N. (2015). Financial inclusion and its determinants: - -the case of Argentina. *Working Paper, No. 15/03* (pp. 1-28). Madrid: BBVA Research.
- ESCWA. (2014). the electronic government: policies, strategies, and applications, Beirut, UN.
- - Nayla al Saybi (2014). from the electronic government to the smart government, URL: https://2u.pw/87KsiMS, accessed on 25/12/2023.