

The effect of making financial services accessible to everyone on the steadiness of banks in Algeria - a statistical analysis employing the ARDL framework

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Abstract:

This paper aims to examine and comprehend the connection between financial inclusion and banking stability in Algeria by utilizing financial data that facilitates the development of the three dimensions of financial inclusion: access, usage, and availability. In addition, it includes the calculation of a unified index of banking stability in Algeria. The study covers the period from 2004 to 2022, which is the latest date for which these data were approved. The study, utilizing limit tests of the distributed autoregressive model (ARDL) through the EViews procedure, concludes that a long-term equilibrium relationship exists between the dimensions of financial inclusion and banking stability in Algeria throughout the duration of the study.

Key Words: *Financial inclusion, financial stability, Financial exclusion, Banking Stability, ARDL.*

JEL Classification: *G00 ,O16 ,G20 ,G21 ,G2, C33.*

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1. Introduction

Financial inclusion, along with its underlying principles and foundations, has emerged as a vital component within numerous financial and economic systems globally. The ability of individuals to access and utilize financial services is now fundamental to revitalizing the financial and banking sectors. Therefore, it has become imperative for different countries to develop a national plan and strategy to promote financial inclusion. In this regard, Algeria is no exception. The Bank of Algeria is striving diligently to enhance and support financial inclusion in the country (Abbad Hayet, Touati Karima, 2022, p. 476). According to the Global Findex Database published periodically by the World Bank, Algeria is classified among the countries with a medium level of financial inclusion. The percentage of account ownership in Algeria increased from 42.78% in 2017 to 44.1% in 2021 (Sania Ansar et al, 2022). The gender gap in account ownership has also seen a noticeable reduction in recent statistics compared to 2014. Additionally, the indicator for owning a bank card in Algeria reached its highest level in 2021, with 23.82% of adults owning a bank card compared to 20.74% in 2017. All these indicators reflect the progress in the Algerian financial and banking sector.

Regarding banking stability, various studies and research have concluded that the Algerian banking system, despite its underdevelopment and the dominance of public banks, enjoys a certain level of financial stability. This is also due to the efforts made by the monetary authorities in this regard, reaching its highest level in recent years. Does financial inclusion contribute to achieving banking stability? This is what we aim to explore in our study by addressing the following main question:

How does financial inclusion affect banking stability in Algeria?

1.1 Research Goals:

- To understand the principles of financial inclusion and the steadiness of banking institutions;
- To explore the elements of financial inclusion and the steadiness of the banking sector in Algeria;
- To investigate how the various aspects of financial inclusion affect the stability of the banking industry in Algeria.

1.2 Methodology:

In order to provide a robust response to the research question, we adopted an inductive approach and employed the bounds test within an autoregressive distributed lag (ARDL) model, focusing on the period from 2004 to 2022.

1.3 Previous Studies:

The study by Merniz Rahma , Bendjelloul Khaled. titled 'The impact of financial inclusion on bank's stability in Algeria- an econometric study'published on: 11/06/2024.

The study was designed to evaluate how financial inclusion affects the steadiness of the banking sector in Algeria. To achieve this endeavour, the authors used the ARDL approach, which combines various quantitative indicators of financial inclusion in Algeria as exogenous variables. Then, its impact on banking stability in the country is evaluated. An overall index of banking stability was adopted, based on a different set of indicators representing the macroeconomics and microeconomics. According to the results reached by the authors, although there is a positive impact on financial access indicators, this impact is largely related

to the oversight function exercised over the financial system, which is mainly related to ensuring the quality of loans granted.

The study by Abbad Hayet and Touati Karima . titled 'Impact of Financial Inclusion on Banking Stability in Algeria: Empirical Approach'published on: 31/10/2022.

This article aims to elucidate the relationship between financial inclusion and banking stability in Algeria. The assessment of financial inclusion is conducted through the total capacity of banks (IAASB), utilizing a multivariate regression model that analyzes annual data from 2004 to 2020. The findings indicate that financial inclusion in Algeria adversely affects financial stability, as demonstrated by the loans provided by banks to emerging financial entities within the sector. Additionally, the research examines the index's responsiveness to fluctuations in oil prices and the positive correlation observed among the variables.

The study by M. Mostak Ahamed and Sushanta K. Mallick, titled 'Is Financial Inclusion Good for Bank Stability? International Evidence,'January 2019

The aim of this study is to find out whether financial inclusion is conducive to banking stability. For this purpose, a sample of 2,635 banks from 86 countries over a period of 9 years from 2004 to 2012 was used. It employed banking and financial information to explore how financial inclusion impacts the financial steadiness of banks. In this research, the Z-score is considered the main independent variable, while the key independent variables include the financial inclusion index along with its various components, specifically the dimensions of awareness and financial utilization. This was achieved by conducting a basic regression analysis. Finally, the research findings indicated that increased financial inclusion may contribute to greater stability within the banking sector., especially for banks that have larger deposit shares and those operating in countries with high institutional quality. Ultimately, the research indicates that improving financial inclusion is not merely a developmental objective for the government, but also a critical priority for banks to ensure and uphold their stability.

For our study, it differs from previous studies in that it consists of two main parts that may play a significant role in changing the results obtained. We have enhanced the accuracy of the financial inclusion sub-indices by utilizing more suitable data and adhering to the methodologies established in the foundational studies that focused on the calculation of the financial inclusion index. The Sarma Mandira study conducted in 2012 serves as the most exemplary model for reference in this context. Additionally, in calculating the banking stability index, we relied on purely banking indicators and isolated all external influences to capture the true relationship between the study variables. We also undertook all procedures to make the data more stable and clear, such as working on differences instead of original data to avoid stability issues and some other measurement problems. Moreover, our study covered a longer and more recent period, and on this basis, there will be a tangible addition to the results and recommendations.

2. Theoretical Framework

2.1 Comprehending the Concept of Financial Inclusion

2.1.1 Financial inclusion

The World Bank Group asserts that financial inclusion is essential for eradicating poverty and promoting broad-based prosperity. It defines this concept as the ability of individuals and

businesses to access financial products and services that are not only beneficial but also affordable, customized to meet their specific needs. (such as transactions, payments, savings options, credit facilities, loans, and insurance services), all while being provided responsibly and sustainably." (Harish Natarajan, 2024)

For the Algerian central bank, there are three essential elements to financial inclusion: the presence, utilization, and reach of financial services, particularly for disadvantaged and economically excluded individuals. The concept also highlights the importance of incorporating these individuals into the official financial framework and safeguarding them from the exploitation that exists within informal network. (Benyoub fatma,boufelfel sihem, 2023, p. 273)

As per the International Monetary Fund (IMF), financial inclusion refers to the capacity of individuals and companies to obtain and utilize financial services. It is frequently seen as a crucial instrument for reaching sustainable development objectives by: (Ndoye, A. & Barajas, A, 2022, p. 103)

- Improving the living standards of individuals;
- Eradicating poverty;
- Promoting inclusive economic development.

Financial inclusion is the process by which all economic actors ensure easy access, availability and use of services provided by the formal financial system. (Sarma, 2012)

Based on the previous definitions, it can be concluded that financial inclusion comprises multiple aspects, signifying the extent to which financial services are available, the level of their utilization, and the accessibility of these services.

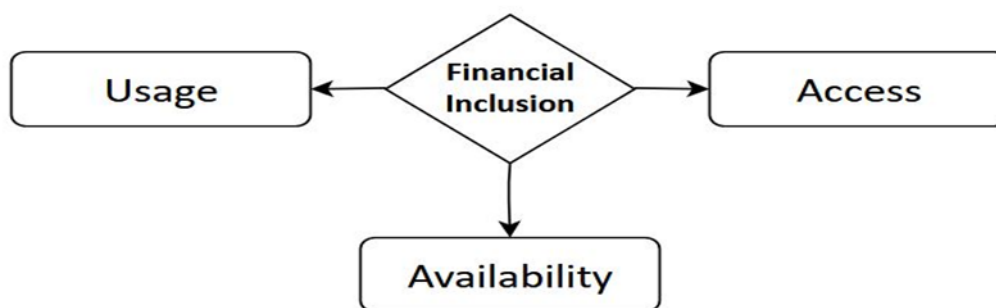
2.1.2 Financial Exclusion

Financial exclusion stands in stark contrast to financial inclusion, typically describing a scenario where numerous individuals face challenges in accessing or utilizing standard financial products and services that cater to their requirements, thereby hindering their ability to lead a seamless and conventional social life within their community. Prior research on this subject has identified five distinct forms of financial exclusion, which are outlined below: (Sarma, Index of Financial Inclusion – A measure of financial sector inclusiveness 1, 2012, p. 02)

- Access Exclusion: This occurs when a large segment of the population is excluded from benefiting from the financial services that are provided within the formal financial system for various reasons, including major issues including geographical difficulties such as distance, or risks associated with the financial services provided;
- Condition Exclusion: This typically occurs when diverse segments of society are excluded due to unsuitable conditions for accessing available financial services;
- Marketing Exclusion: The goal of marketing is often to target specific groups to increase sales, but this can lead to the exclusion of other groups from benefiting from the financial services and products offered. This exclusion occurs when certain groups are left out of the marketing process, making them feel that they are not the intended audience.

2.1.3 Dimensions of Financial Inclusion

Figure 01: The Main Dimensions of Financial Inclusion



Source: By Authors based on (Shah, Shahid Manzoor and Ali, Amjad, 2023, p. 04).

Financial inclusion has three main dimensions that encompass all aspects of its concept: the Access dimension, which generally signifies the ability of individuals and institutions to acquire formal financial services and products, the Usage dimension, which illustrates the degree to which individuals and institutions derive benefits from these financial services and the frequency of their utilization; and lastly, the Availability or Penetration dimension, which signifies the extent to which financial services are accessible and reach all segments of society. These dimensions are assessed and combined into a singular indicator to create a comprehensive financial inclusion index for a specific community.. (Shah, Shahid Manzoor and Ali, Amjad, 2023, p. 04)

2.1.4 Financial Inclusion Indicators

Financial inclusion has numerous sub-indicators that can be used to calculate the financial inclusion index. However, given that these indicators are not available for all countries, it is possible to highlight the most important indicators under each dimension of financial inclusion as follows: (Sarma, 2008, p. 08)

- The distribution of bank branches is measured per: One thousand (1,000) square kilometres; One hundred thousand (100,000) individuals.
- The availability of bank ATMs is assessed per: One thousand (1,000) square kilometers; One hundred thousand (100,000) individuals.
- The number of loans is calculated per: One thousand individuals (1,000).
- The number of deposits is determined per: One thousand individuals (1,000).
- The mean ratio of loans to Gross Domestic Product (GDP) and deposits to Gross Domestic Product (GDP).
- The ratio of bank accounts compared to the overall population.
- The volume of credit represented as a percentage of Gross Domestic Product (GDP).
- The deposit volume expressed as a percentage of Gross Domestic Product (GDP).

2.1.5 Importance of Financial Inclusion

Financial inclusion enables people to manage money efficiently and facilitates financial transactions. It also provides them with better opportunities to grow their businesses and improve their financial and living standards. In addition, it helps them to better handle financial issues, protects them from short-term fluctuations, and enables them to take advantage of available opportunities to achieve a comfortable financial situation, thereby fully improving their living standards. (Josiah Aduda, Elizabeth Kalunda, 2012, p. 103)

Financial inclusion offers financial service providers the chance to engage with a broader segment of society, thereby facilitating the expansion of their businesses and enhancing their investment prospects. This engagement will, in turn, invigorate economic activity by fostering a financial landscape rich in robust financing opportunities, ultimately contributing to local sustainable development and elevating the quality of life for residents.

2.2 The Principle of Banking stability

2.2.1 Banking stability

The concept of banking stability is fundamentally linked to the financial robustness of the banking sector. It is defined by a condition of financial equilibrium that banks experience. This indicates that the financial well-being of individual institutions serves as the cornerstone for the overall stability of the banking industry. Thus, the emphasis is placed on the financial health of the banking industry. In essence, the stability of banks is directly linked to their financial health.

Figure 02: Components of Financial Stability



Source: By Authors based on (Mr. Garry J. Schinasi, 2004, pp. 04-08)

When considering the different dimensions of financial stability, we found that there are four main risks that can be used as indicators to measure the resilience of financial institutions, especially banks. First, credit risk is prominent, including potential defaults of customers and the resulting impact on the strength of financial intermediaries. In addition, market risks arise from market factors or market volatility and disruptions in cross-border financial markets, which may exacerbate financial instability (Mr. Garry J. Schinasi, 2004, pp. 04-08). At the same time, operational risks highlight cumulative weaknesses in business processes, underscoring the need for robust risk management. Finally, the fourth pillar of financial risk refers to the importance of maintaining the required and basic levels of liquidity or liquid assets to confront unexpected shocks; otherwise, the lack of funds will lead to a series of undesirable events. The Bank of Korea defines financial stability as a state in which the financial system remains free from instability., meaning that the components of the financial system do not face any issues that would lead to a state of instability, as follows: (Bank of Korea, 2024)

- **Financial and Banking Institutions:** These institutions are in a state of financial stability when they are capable of performing their role in financial intermediation without any hindrance and without the intervention of any external party, whether governmental or non-governmental, to assist them in carrying out their tasks.
- **Stability of the Financial Markets:** The financial market is described as stable when it does not suffer from any problems or difficulties that hinder the performance of its basic

tasks. Market transactions take place smoothly, while maintaining the stability of asset prices in a manner consistent with economic realities. Which supports confidence in the financial market and its performance and its participants.

- **Stability of the Financial System Infrastructure:** This indicates that the financial system maintains market discipline, guarantees the security of transaction settlements, and features payment systems that function efficiently and seamlessly.

2.2.2 The importance of financial stability

By examining instances of financial instability, one can grasp the significance of maintaining financial stability. When there's a deficiency in financial stability, the financial system faces difficulty in effectively allocating resources, in addition to the difficulty of assessing and managing financial risks, including the inability to maintain acceptable levels of operation. The absence of financial stability often leads to increased volatility of asset prices, which inevitably leads to a state of monetary and economic instability. On the other hand, financial instability negatively affects investor confidence and discourages investment in the local market, due to the system's inability to address internal disturbances. Hence, investing in such a market becomes risky, which may cost investors not only returns but also their capital which is their only wealth. Therefore, financial stability is critical to maintaining broader economic and social stability. (World Bank, 2024)

2.3 Describe the intricate connection between financial stability and financial inclusion.

Upon reviewing the relevant studies and research on the topic, it is evident that many academics and experts in the fields of finance and banking concur that participation in the financial sector is associated with its overall stability. The objective of financial inclusion is to ensure that marginalized groups within the population have access to formal financial services at reasonable costs. (Elsayed, 2020, pp. 04-05) . It is also challenging to achieve financial stability while a certain proportion of the community still experiences financial exclusion, such as residents of rural areas and vulnerable poor groups. This suggests a significant connection among financial inclusion, the accessibility of financial services, and overall financial stability.. (Merniz Rahma, Bendjelloul Khaled, 2024, p. 90)

Financial inclusion promotes financial stability by diversifying banks' portfolios and assets. This is accomplished by expanding the volume of loans provided to small and medium-sized enterprises, thereby decreasing the percentage of borrowers within the overall portfolio. This diversification inherently provides better protection against counterparty risks due to the implemented diversification policy. Financial inclusion creates the conditions necessary for this policy by engaging more individuals and small businesses willing to borrow. (Boulenfad Abir , Hacini Ishaq, 2021, p. 741)

A significant correlation exists between financial inclusion and financial stability, with each factor impacting the other in various manners. However, the consensus in numerous studies suggests that financial inclusion predominantly influences financial stability. By facilitating access to financial services for individuals and businesses alike, financial inclusion can bolster financial stability through improvements in economic conditions and living standards, a reduction in income disparity, and a decrease in systemic risks. Whereas, Increased access to formal financial services reduces the likelihood of individuals turning to potentially hazardous informal financial avenues. This, in turn, contributes to the mitigation of vulnerabilities and

risks faced by the overall financial system. Financial stability is also considered crucial to achieving sustainable development goals, especially sustainable financial inclusion. (Arora, Rashmi, 2019, pp. 05-06) A robust financial system fosters and bolsters confidence, motivating both individuals and businesses to participate in formal financial activities. This initiative aims to expand and enrich financial services, thereby fostering greater financial inclusion that ultimately benefits society at large.

3 Methodology

3.1 Types and Source of data

The study utilizes annual data, carefully selecting the most pertinent indicators to effectively represent each variable. We ensured that the data characteristics were balanced and free of missing values. In our study, we relied on an extended time period from 2004 to 2022, which provides a sufficient period from which the underlying relationships between the study variables can be extracted. The main source of our data was the World Bank Group, with additional information obtained from the annual reports of the Bank of Algeria to rectify any gaps. This study utilized various software tools, including Microsoft Excel and the statistical software Eviews13. It is worth mentioning that when calculating any composite index, the data must first be standardized and normalized to ensure they have the same unit of measurement. Therefore, we will utilize the normalization technique to compute the variables pertinent to the study, specifically the Dimensions of Financial Inclusion and the Banking Stability Index. The process of normalizing and standardizing the variables guarantees that all indicator values are restricted to a uniform range of [0, 1]. the weakest indicator value represents The minimum value, while the strongest value indicates the maximum value. Values approaching 0 suggest potential instability (or stress), whereas values approaching 1 indicate stability in the financial system (Tuduetso .P. M, Lekgathamang. L. S , Lesego .S, 2023, p. 741). The normalization formula is defined as follows:

$$nX_{it} = \frac{X_{it} - \min X_i}{[\max(X_i) - \min(X_i)]}$$

In this context:

- nX_{it} : the normalized value of the indicator (i) at time (t);
- X_{it} : the original measurement of the indicator at time (t);
- $\max(X_i)$: the highest value recorded for each indicator throughout the study duration;
- $\min(X_i)$: the lowest value recorded for each indicator during the study period.

3.2 Financial inclusion index in Algeria

To examine the scope of financial inclusion within Algeria and its impact on the stability of the nation's banking system, we employed various sub-indicators that meet the necessary reliability criteria, drawing information from the World Bank and the International Monetary Fund. The data provided are thorough and devoid of any omissions. These sub-indicators were categorized into different aspects of financial inclusion, drawing from prior research, with Mandira Sarma's work being the most influential. Regarding the ratios and weights assigned to

these categories, they were allocated equal proportions. The subsequent table presents this information:

Table 01: Dimensions of Financial Inclusion

Dimensions	Indices	Average
Access	Density of ATMs per 1,000 square kilometers	25%
	Density of ATMs per 100,000 adult individuals	25%
	Density of commercial bank branches per 1,000 square kilometers	25%
	Density of commercial bank branches per 100,000 adult individuals	25%
Usage	Number of individuals borrowing from commercial banks per 1,000 adults	33.33%
	Number of deposit accounts held with commercial banks per 1,000 adults	33.33%
	Number of loan accounts with commercial banks per 1,000 adults	33.33%
Availability	Total outstanding deposits with commercial banks as a percentage of GDP	50%
	Total outstanding loans from commercial banks as a percentage of GDP	50%

Source: By Authors based on both (Sarma, 2008) & (Benaini, R. & Metair, S, 2022, p. 46)

3.3 Financial Stability index in Algeria

During the study period, a detailed combined score for the stability of the banking sector in Algeria will be calculated, using a precisely selected set of sub-indices that effectively capture the state of the Algerian banking sector. The following table outlines the main metrics used in the computation of the banking stability score in this study. We chose to assign equal importance to each metric, recognizing their equal significance in evaluating the condition of the banking sector from our perspective.

Table 02: Indices of Banking Stability

Unified Index	Indices	Average
AFSI	ROA	20%
	ROE	20%
	Capital Adequacy Ratio - CAR	20%
	Non-Performing Loans - NPLs	20%
	Z-SCORE	20%

Source: By Authors based on (Goran Karanovic, Bisera Karanovic, 2015, p. 07)

Therefore, the financial stability equation for Algeria can be formulated as follows:

$$\text{Algerian Banking Stability Index} = w1*ROA + w2*ROE + w3*CAR + w4*NPLs + w5*Z\text{-SCORE}$$

where: w1, w2, w3, w4, w5 are the weights assigned to each indicator. Since we have given them the same weight of 20%, these weights are equal.

3.4 Specification of the Model

In order to evaluate how the different aspects of financial inclusion effects on the stability of Algeria's banking industry, we employed the autoregressive distributed lag (ARDL) model, adopting a bounds testing methodology. This model was selected due to its suitability and alignment with the study's goals, which include understanding and examining how financial inclusion, across its various facets, influences the stability of Algeria's banking sector, over both immediate and extended periods. As a result, the basic equation of the model has been formulated as follows:

$$AFSI = f(AC + US + AV)$$

where:

- AFSI denotes the dependent variable, specifically referring to financial (banking) stability.
- The independent variables consist of three dimensions that characterize financial inclusion: access, usage, and availability, as detailed below:
 - AC: the first independent variable, representing the access dimension;
 - US: the second independent variable, representing the usage dimension;
 - AV: the third independent variable, representing the availability dimension;

In this study, the model will be estimated utilizing the ARDL framework, as introduced by Pesaran and Shin in 1998. We will then conduct the Bound test to test the hypothesis of a long-term relationship (Pesaran, Shin et al., 2001). Thus, the final form of the model to be estimated is as follows:

$$AFSI = B0 + B1(AC) + B2(US) + B3(AV) + Ui$$

Where:

- The constant term, denoted as B0, signifies the value of the financial stability index when all other variables are held at zero;
- The regression coefficient associated with the dimension of access to financial services (AC) is denoted as B1;
- The coefficient for the dimension of use of financial services (US) is represented by B2;
- The coefficient for the dimension of availability (AV) is indicated as B3;
- The random error term (residuals) is represented by Ui.

4 Result and Analysis

4.1 Estimating Model

Prior to estimating the model, it is important to note that the annual data series were transformed into semi-annual series. This adjustment was made to optimize the number of observations for the model and to enhance the precision of the outcomes. Consequently, we now possess 38 observations rather than 19, which represents a significantly acceptable quantity of data points that facilitates a more precise estimation of the relationship's nature.

4.1.1 Examination of Time Series Stability (Stationarity Assessments)

Before implementing the Autoregressive Distributed Lag (ARDL) model, it is essential to conduct a stationarity assessment on the time series data utilized. A variety of Unit Root Tests have been established by several researchers and economists, including but not limited to:

- The Phillips and Perron test (Phillips and Perron - 1988);
- The Augmented Dickey-Fuller test (ADF - 1981);
- The Simple Dickey-Fuller test (Dickey Fuller - 1979).

In this study, we will apply the most widely recognized unit root test, namely the Augmented Dickey-Fuller (ADF) test, to examine the variables ASFI, AC, US and AV both at their initial level and after performing the first difference.

Table 03: ADF UNIT ROOT TEST

Null Hypothesis: the variable has a unit root					
<u>At Level</u>					
With Constant		AFSI	AC	US	AV
	t-Statistic	-2.2813	-2.5620	-1.5920	-1.2938
	Prob.	0.1831	0.1099	0.4766	0.6222
With Constant & Trend	Result	n0	n0	n0	n0
	t-Statistic	-2.0824	3.7423	-2.1572	-2.4787
	Prob	0.5382	1.0000	0.4983	0.3361
Without Constant & Trend	Result	n0	n0	n0	n0
	t-Statistic	-0.0453	1.5529	-0.0608	-0.2064
	Prob	0.6612	0.9681	0.6560	0.6051
	Result	n0	n0	n0	n0
	<u>At First Difference</u>				
		d(AFSI)	d(AC)	d(US)	d(AV)
With Constant	t-Statistic	-5.8886	-7.6177	-5.8583	-5.8863
	Prob	0.0000	0.0000	0.0000	0.0000
	Result	***	***	***	***
With Constant & Trend	t-Statistic	-5.9490	-9.8695	-5.8060	-5.8065
	Prob	0.0001	0.0000	0.0002	0.0002
	Result	***	***	***	***
Without Constant & Trend	t-Statistic	-5.9161	-1.6998	-5.9161	-5.9161
	Prob	0.0000	0.0841	0.0000	0.0000
	Result	***	*	***	***

Source: By Authors based on EViews13 outputs

The data collected reveal the following significance levels:

- (*) corresponds to significance at 10%;
- (**) at 5%;
- (***) at 1%;
- (no) indicates non-significance.

As detailed in Table 03:

- At level (I0), all variables exhibit non-stationarity.
- Considering the First Difference, all variables demonstrate stationarity at all significance levels. This suggests that accepting the alternative hypothesis (and rejecting H0) regarding the existence of a unit root confirms that all variables become stationary after applying the First Difference.

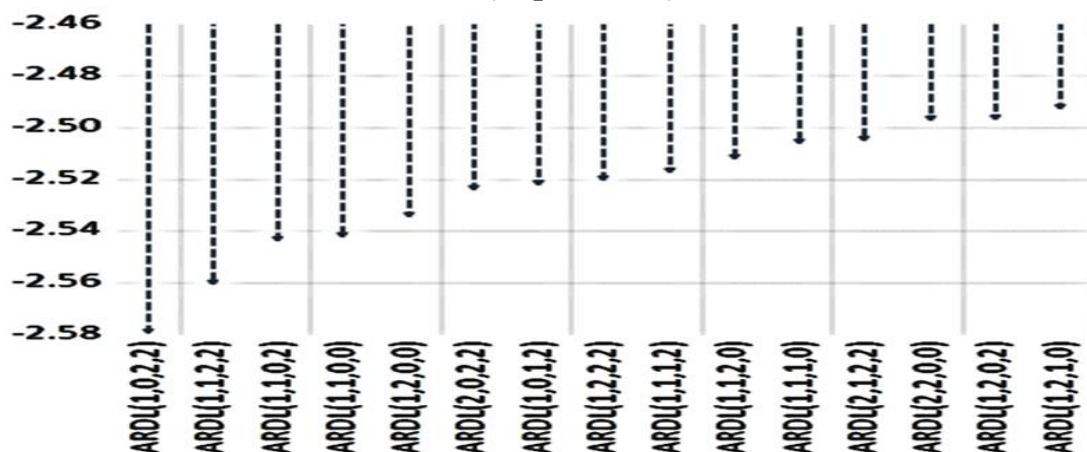
As observed, all-time series variables were stationary after taking the first difference. Additionally, there are variables that are stationary at level, specifically the access dimension at 5% and the banking stability (dependent variable) at 10%, which makes the application of the ARDL bounds test feasible.

4.1.2 Evaluating Ideal Lag Lengths to the ARDL Model

By selecting the lowest value of the Akaike Information Criterion (AIC) we will have cared the evaluation of the optimal lag lengths to the ARDL model of our study.

AIC is among the most commonly utilized criteria in this field, alongside the Bayesian Information Criterion (BIC) and the Hannan-Quinn Criterion (HQ), as detailed below:

Figure 03: AKaike Information Criteria (Top Models)



Source: By Authors based on EViews13 outputs.

Therefore, the best model is ARDL (1,0,2,2), where the dependent variable (AFSI) has a lag of one, (AC) The first independent variable has no lag, while the second and third independent variables (US, AV) each have two lags.

4.1.3 Co-integration Analysis

Before estimating the long-term and short-term effects, we apply the bounds test to understand whether there is actually a cointegration relationship between the study variables and how strong that relationship is, if any. The statistic calculations F and T provide this information. The table displays the results after the test execution.

Table 04: Bounds Critical Values

Significance levels	10%		5%		1%	
Sample Size	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
F-Statistic						
35	2.958	4.100	3.615	4.913	5.198	6.845
40	2.933	4.020	3.548	4.803	5.018	6.610
Asymptotic	2.720	3.770	3.230	4.350	4.290	5.610
t-Statistic						
Asymptotic	-2.570	-3.460	-2.860	-3.780	-3.430	-4.370

Source: By Authors based on EViews13 outputs.

The F-Statistic value of 11.140671 exceeds all critical values across different significance levels, as indicated in Table 04. Therefore, we can reject the null hypothesis that there is no joint integration at these levels, which means that we accept the alternative hypothesis that there is a relationship at these levels, as the calculated T-Bound test value is -5.578116, which

is less than all critical values within different limits, and therefore we can reject the null hypothesis that there is no joint integration relationship between the different aspects of financial inclusion and financial stability of the Algerian banking sector.

4.1.4 Estimating Long & Short-term Relationships

To continue exploring and in order to prove the existence of long and short-term relationships between variables. We proceed to apply the error correction model as follows:

Table 05: Conditional error correction

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AFSI(-1)	-0.634870	0.113814	-5.578116	0.0000
AC	0.963011	0.177443	5.427164	0.0000
US(-1)	-0.873794	0.158435	-5.515166	0.0000
AV(-1)	-0.400112	0.114431	-3.496541	0.0016
D(US)	-0.577426	0.168424	-3.428415	0.0020
D(US(-1))	0.343174	0.152083	2.256493	0.0323
D(AV)	-0.199947	0.123133	-1.623830	0.1160
D(AV(-1))	0.176692	0.098455	1.794656	0.0839
C	0.348539	0.056367	6.183376	0.0000

Source: By Authors based on EViews13 outputs.

- According to the results shown in the table, the one-period lagged dependent variable has a significant negative effect on its current value. This effect is highly statistically significant with a probability of 0.000 and a very high t-Statistic, indicating strong statistical significance. Consequently, a rise of one unit in the dependent variable during the preceding period results in a reduction of roughly 63% in its value in the current period.
- The access dimension (without a period lag, AC) is positively and significantly associated with banking stability, with a strong effect of 96%. This indicates that a one-unit rise in access to financial services results in a corresponding increase of 0.96 units in the degree of banking stability. This effect is statistically very significant, with a very low probability of p-value = 0.000, and a high t-Statistic, indicating strong statistical significance.
- There is a negative effect of the one-period lagged usage dimension (US) on banking stability. This effect is statistically significant (p-value = 0.0000). This indicates that a rise of one unit in the financial services usage index from the previous period results in a decline in banking stability in the current period by as much as 87.38%.
- There is a negative effect of the one-period lagged availability dimension (AV) on banking stability. This effect is very statistically significant (p-value = 0.0016). This suggests that a one-unit rise in the availability dimension (AV) during the preceding period results in a 40.01% decline in banking stability in the current period.

This pertains to the long-term effects. We will now examine the short-run relationships, as detailed below, between the independent variables, which represent different aspects of financial inclusion, and the dependent variable, which we have chosen, which is banking stability.

- The change in the usage index (US) has a negative effect on banking stability. This effect is highly statistically significant (p-value = 0.0020). This indicates that an increase of one unit in the change in the US leads to a 57.74% decrease in banking stability.

- The alteration in the one-period lagged US variable exerts a positive influence on the dependent variable. This positive influence is statistically significant (p-value = 0.0323), indicating that a one-unit increase in the change of the one-period lagged US variable results in a 34.32% enhancement in banking stability.

- In contrast, there is no statistically significant for the effect of the change in the availability index (AV) on the dependent variable, as indicated by a p-value of 0.1160.

Overall, the effect of a change in the one-period lagged AV variable shows limited statistical significance (P = 0.0839). This small effect indicates that a one-unit increase in the one-period lagged AV variable leads to a 17.67% improvement in bank stability. However, from a statistical perspective, the availability index does not significantly affect bank stability in the short run.

4.1.5 Error Correction Term (COINTEQ)

The error correction term obtained from the results of the error correction model is both negative and statistically significant. This indicates that the model does not present any significant problems, as demonstrated by the following table.

Table 06: The error correction term

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ	-0.634870	0.090224	-7.036625	0.0000

Source: By Authors based on EViews13 outputs.

The negative error correction term of -0.634870, which is statistically significant (p-value: 0.0000), suggests that financial stability is progressing towards a long-term equilibrium at an approximate rate of 63% per period. This implies that the adjustment process spans roughly 9 months and 5 days, with 63% of the correction realized within the initial 6 months, and the remaining 36% occurring over the subsequent 3 months and 5 days.

Of course, this assumes that the correction rate is constant over time, which is economically unlikely. Therefore, we calculate the half-life as follows:

$$Half - Life = \frac{\ln(2)}{|\gamma|}$$

In this context:

γ represents the error correction term,

$\ln(2)$ denotes the natural logarithm of 2.

Upon substitution, we arrive at:

$$Half - Life = \frac{\ln(2)}{0.634870} \approx 1.092$$

Thus, the system takes approximately 1.092 periods, or about a six months, to return half of the deviation to the long-term equilibrium after a short-term shock.

4.2 Model Quality Test:

In order to verify the accuracy and performance standards of the model, a sequence of tests is carried out as outlined below.:

4.2.1 Ensure the adequacy of the residuals

In order to verify the sufficiency of the residuals, we will conduct a series of established tests:

1. Normality Test: We will use the Jarque-Bera statistic, where the null hypothesis (H_0) states that the residuals follow a normal distribution.

2. Heteroscedasticity Test: We will check for heteroskedasticity (non-constant variance) using the ARCH test, which is particularly suitable for the ARDL model.

3. Autocorrelation Test: We will address the issue of autocorrelation using the Breusch-Godfrey test.

Table 07: Model Quality Tests

Test	Normality Test (Jarque-Bera)	Heteroscedasticity Test (F-statistic)	Autocorrelation Test (F-statistic)
Inference Value	1.80	0.49	2.37
Probability	0.40	0.48	0.11

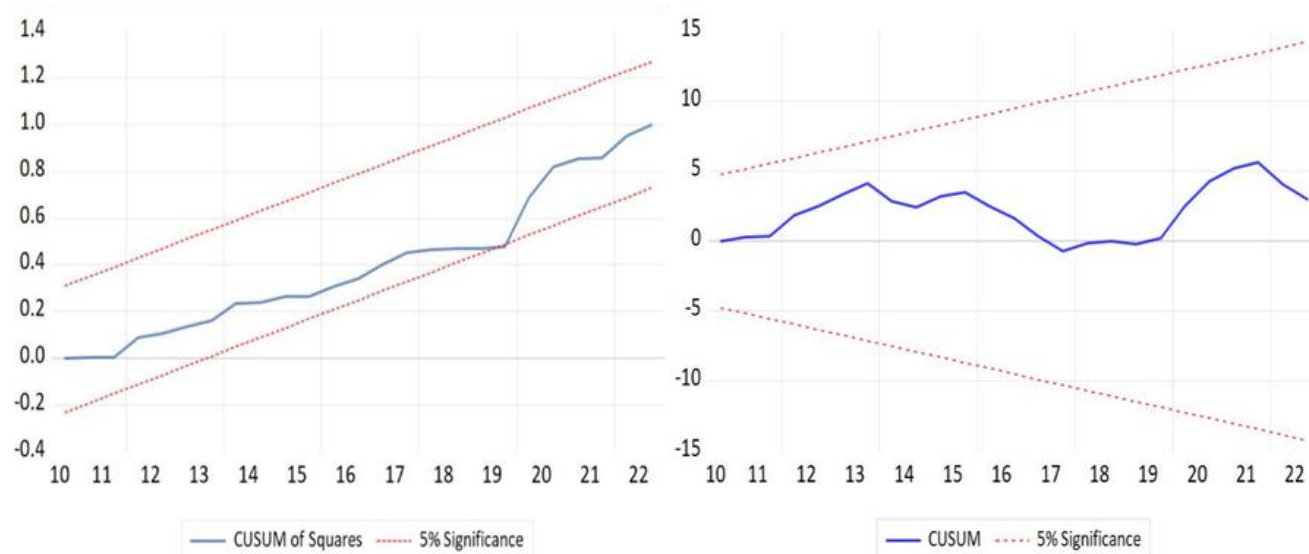
Source: By Authors based on EViews13 outputs

As indicated in Table (05), The probability is greater than 0.05 (prob = 0.40), which prompts us to reject the null hypothesis and accept the alternative hypothesis, indicating that the residuals follow a normal distribution. In terms of heteroskedasticity, the Fisher F-statistic reveals a Prob.F of 0.49, equating to 0.48 (Prob.F (0.49) = 0.48), which is also above 0.05, This enables us to accept the null hypothesis indicating the absence of heteroskedasticity. Additionally, in evaluating the autocorrelation of errors, we also accept the null hypothesis (H_0) of no autocorrelation, as evidenced by the F-statistic, which has a Prob(F-statistic) value of 0.11, exceeding the significance level of 0.05.

4.2.2 Examining the structural stability of the model and its parameters:

In order to evaluate the structural stability of the model and the stability of its parameters, we will use the CUSUM and CUSUM Squares tests, and the results were very positive, as shown in the following figure.

Figure 04: CUSUM and CUSUM of squares tests



Source: By Authors based on EViews13 outputs

As illustrated in Figure 04, The graph stays within the defined confidence limits, encompassing both the upper and lower bounds, at the 5% significance level. This indicates that the model's parameters demonstrate long-term stability, and there is a consistent variance in the errors of the model.

5. CONCLUSION

5.1 Conclusions

This study uses Ardl bound test to analyze the relationship between the financial inclusion index, which was measured in different well-known dimensions, and the presence of stability within the Algerian banking sector. These results indicate the existence of a relationship between the variables in the short and long term, while emphasizing that the direction of the relationship varies depending on the independent variable and the timing of the observed change.

Overall, our study reached several conclusions, which can be summarized as follows:

- The error correction coefficient indicates a long-term equilibrium relationship between the variables, characterized by a rapid adjustment and return to equilibrium among the study variables;
- There is a negative effect of the usage dimension (US) on banking stability in Algeria, however, the dependent variable is positively affected by the change in the US variable from the previous period.
- The access dimension is positively and significantly associated with Algerian banking stability, with a strong effect of 96%;
- There is a negative effect of the one-period lagged availability dimension (AV) on banking stability by 40.01% in the current period, the availability index does not significantly affect banking stability in the short term in Algeria.
- The presence of a negative and statistically significant error correction coefficient suggests that a robust and swiftly adjusting long-term equilibrium relationship exists between the variables.

5.2 Recommendations

- Collaborative efforts must be consolidated to elevate the levels of financial inclusion in Algeria in a systematic and suitable manner, which certainly enhances the degree of stability within the country's banking sector.
- Financial awareness and literacy among the Algerian community should be promoted, with efforts to eradicate financial illiteracy, especially among those suffering from financial exclusion and deprivation.
- Financial services should be provided more stringently to limit easy access and usage, thereby preventing financial problems for banks that could affect their stability;
- A balance in the financial sector should be achieved by supporting and developing the dimensions of access and availability, ensuring equal opportunities for benefiting from financial services. This can be done by expanding the network of banks, especially those in the private sector, and providing as many ATMs as possible to facilitate financial transactions for citizens and reduce the risks associated with cash handling;
- The network of financial services offered by banks should be expanded to include many segments of the Algerian society that suffer from financial exclusion, especially since most financial services, particularly financing, are aimed at segments that do not consider interest (usury) as an obstacle, given that the Algerian society is predominantly Muslim and conservative.

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7. Appendices

Appendice 1: The original data used to calculate the banking stability index (Primary data)

YEAR	ROA	ROE	NPLs	Z-Score	CAR
2004	0,37	6,8	0,374	0,0963	10,04
2005	0,26	5,18	0,192	0,0852	12,3
2006	1,15	24,28	0,175	0,0949	15,2
2007	1	20,13	0,221	0,1002	12,9
2008	1,42	24,7	0,157	0,1296	16,54
2009	1,89	24,55	0,145	0,1772	22,11
2010	1,96	21,09	0,149	0,1923	23,31
2011	2,07	21,08	0,1123	0,199	20,9
2012	1,93	18,88	0,1173	0,2049	23,62
2013	1,67	15,76	0,1056	0,2054	21,5
2014	1,54	15,06	0,0921	0,1882	15,98
2015	1,55	15,5	0,098	0,1996	18,39
2016	1,74	15,8	0,0188	0,2213	18,9
2017	1,86	15,73	0,1296	0,2312	19,56
2018	2,34	19,12	0,127	0,2428	19,05
2019	1,38	11,34	0,1476	0,2243	17,99
2020	1,35	10,73	0,1636	0,2482	19,17
2021	1,7	14,35	0,1964	-	21,6
2022	1,38	13,47	0,1986	-	21,53
min	0,26	5,18	0,0188	0,0852	10,04
max	2,34	24,7	0,374	0,2482	23,62
max-min	2,08	19,52	0,3552	0,163	13,58

Source: IMF & World Bank, Bank of Algeria

Appendice 2: The data we used to calculate the banking stability index

YEAR	ROA	ROE	NPLs	Z-Score	CAR	AFSI
2004	0,05288	0,08299	1	0,08466	0	0,24411
2005	0	0	0,48761	0,01656	0,16642	0,13412
2006	0,42788	0,97848	0,43975	0,07607	0,37997	0,46043
2007	0,35577	0,76588	0,56926	0,10859	0,2106	0,40202
2008	0,55769	1	0,38908	0,28896	0,47865	0,54287
2009	0,78365	0,99232	0,35529	0,58098	0,88881	0,72021
2010	0,81731	0,81506	0,36655	0,67362	0,97717	0,72994
2011	0,87019	0,81455	0,26323	0,71472	0,79971	0,69248
2012	0,80288	0,70184	0,27731	0,75092	1	0,70659
2013	0,67788	0,54201	0,24437	0,75399	0,84389	0,61243
2014	0,61538	0,50615	0,20636	0,64847	0,43741	0,48275
2015	0,62019	0,52869	0,22297	0,7184	0,61487	0,54103
2016	0,71154	0,54406	0	0,85153	0,65243	0,55191
2017	0,76923	0,54047	0,31194	0,91227	0,70103	0,64699
2018	1	0,71414	0,30462	0,98344	0,66348	0,73313
2019	0,53846	0,31557	0,36261	0,86994	0,58542	0,5344
2020	0,52404	0,28432	0,40766	1,01656	0,67231	0,58098
2021	0,69231	0,46977	0,5	-	0,85125	0,62833
2022	0,53846	0,42469	0,50619		0,8461	0,57886

Source: Prepared by researchers based on Appendice No1.

Appendice 3: The original data used to calculate the Financial Inclusion index (Primary data)

YEAR	Number of ATMs per 1,000 km2	Number of ATMs per 100,000 adults	Number of borrowers from commercial banks per 1,000 adults	Number of commercial bank branches per 1,000 km2	Number of commercial bank branches per 100,000 adults	Number of deposit accounts with commercial banks per 1,000 adults	Number of loan accounts with commercial banks per 1,000 adults	Outstanding deposits with commercial banks (% of GDP)	Outstanding loans from commercial banks (% of GDP)
2004	0,12	1,27	26,00	0,45	4,75	627,30	-	44,00	24,95
2005	0,15	1,51	23,28	0,47	4,75	639,26	24,45	39,15	23,52
2006	0,24	2,41	23,37	0,50	4,99	672,54	24,34	41,36	22,40
2007	0,38	3,75	27,83	0,52	5,10	717,09	28,78	46,21	23,56
2008	0,44	4,23	28,98	0,55	5,28	714,67	30,65	44,71	23,67
2009	0,57	5,37	35,00	0,56	5,21	436,56	41,23	47,47	30,95
2010	0,65	5,97	34,86	0,56	5,09	505,72	43,51	44,99	27,24
2011	0,68	6,13	39,29	0,58	5,21	519,75	50,33	43,07	25,53
2012	0,70	6,24	42,81	0,59	5,25	550,21	53,66	41,27	26,44
2013	0,75	6,56	45,34	0,60	5,25	563,02	56,98	43,42	30,96
2014	0,89	7,67	42,90	0,61	5,26	579,14	48,20	49,44	37,74
2015	0,99	8,42	44,63	0,63	5,30	565,88	54,35	49,87	43,53
2016	1,03	8,65	39,56	0,63	5,30	550,58	51,40	46,48	45,15
2017	1,12	9,21	41,01	0,64	5,27	528,48	47,81	48,78	47,03
2018	1,18	9,62	43,25	0,66	5,34	515,62	58,47	49,59	48,91
2019	1,17	9,39	50,62	0,67	5,35	572,25	60,03	48,02	52,95
2020	1,19	9,38	48,13	0,67	5,30	517,92	54,04	53,67	60,51
2021	1,20	9,37	48,64	0,68	5,31	517,98	53,78	52,90	44,35
2022	1,06	8,13	41,92	0,69	5,29	531,29	50,18	50,65	37,11
min	0,12	1,27	23,28	0,45	4,75	436,56	24,34	39,15	22,40
max	1,20	9,62	50,62	0,69	5,35	717,09	60,03	53,67	60,51
max-min	1,08	8,34	27,34	0,24	0,60	280,53	35,69	14,52	38,11

Source: IMF & World Bank