

The impact of financial inclusion on financial stability in middle-income countries in Africa “Econometric study for the period 2011-2021”

أثر الشمول المالي على الاستقرار المالي في الدول متوسطة الدخل في إفريقيا دراسة قياسية للفترة 2011-2021

Barkat Mourad¹. Mazouzi fadila². Hammami Raid imade Eddine³

¹ Research Laboratory MIM, University center of el bayadh. (Algeria), Barkat.ryadh@gmail.com

² Economic Science and Management Science Laboratory, University of laghouat (Algeria),
fd.mazouzi@lagh-univ.dz

³ Quantitative and qualitative applications laboratory for economic, social, and environmental advancement in Algerian institutions, University of ghardaia (Algeria), hammami.raid@univ-ghardaia.dz

Received: 12/03/2023;

Accepted: 30/06/2023;

Published: 30/06/2023;

Abstract:

The study aimed to demonstrate the impact of financial inclusion in its various dimensions, especially those related to the use and access to various financial services, on financial stability, which is the beating nerve and artery of the economy, through an econometric study on some middle-income African countries during the period 2011-2021, depending on Sectional time series data by estimating the three models for the data of the panel, and the study found the absence of the effect of financial inclusion in its dimension related to the use of financial services, whether positively or negatively, while the effect of financial inclusion in its dimension related to access to services was positive on the variable of financial stability in countries middle income in Africa.

Keywords: financial inclusion, financial stability, panel data, middle-income countries in Africa.

JEL Classification : C33, C54, F43, O11, P52

الملخص:

هدفت الدراسة إلى تبيان أثر الشمول المالي في أبعاده المختلفة خاصة منها المتعلقة باستخدام و الوصول إلى الخدمات المالية المختلفة على الاستقرار المالي الذي يعد العصب النابض و شريان الاقتصاد، وذلك من خلال دراسة قياسية على بعض الدول الإفريقية متوسطة الدخل خلال الفترة 2011- 2021 بالاعتماد على بيانات السلاسل الزمنية المقطعية من خلال تقدير النماذج الثلاث لمعطيات البانل، و قد توصلت الدراسة إلى غياب تأثير الشمول المالي في بعده المتعلق باستخدام الخدمات المالية سواء بالإيجاب أو بالسلب، في حين كان لأثر الشمول المالي في بعده المتعلق بالوصول إلى الخدمات إيجابي على متغير الاستقرار المالي في الدول متوسطة الدخل في إفريقيا.

الكلمات المفتاحية: الشمول المالي ، الاستقرار المالي ، بيانات البانل ، الدول متوسطة الدخل في إفريقيا .

* Hammami Raid imade Eddine, Hammami.raid@univ-ghardaia.dz

Introduction:

Since the early 2000s, the concept of financial inclusion has attracted the attention of governments and central banks around the world for its contribution to achieving the goal of economic and financial development, as it helps greater access to formal financial services by households and companies in both developing and developed countries as well as Reducing poverty and improving economic conditions, meanwhile in the aftermath of the 2007-2009 global financial crisis, the issue of financial stability has emerged and gained the attention of researchers and policymakers around the world to mitigate systemic financial risks and enhance financial stability as well as a sustainable development strategy for all countries. This raises the question of whether inclusive finance and financial stability are complementary, particularly whether financial inclusion stimulates or endangers financial stability .

According to a review of previous studies, the inconsistent view of the effects of financial inclusion on financial stability, as we will seek through this study to fill this literature gap as one of the main objectives of this study, moreover, while there has been a wide range of research on the relationship that can In which financial inclusion affects financial stability, many empirical types of research cannot investigate such a relationship in African countries, especially middle-income ones, so this research will add new evidence to existing studies to previous studies, and the results of the research can also provide financial institutions and governments With important information that they can benefit from, which helps them obtain an appropriate financial development strategy, improve the regulatory framework and thus enhance the financial stability of the entire system, and in light of the above, the following problem can be raised:

“ion impactHow does financial inclus financial stability in middle-income countries in Africa?”

Based on the main question, the following sub-questions arise:

- What are the most important financial inclusion and stability concepts?
- What is the dialectical relationship between financial inclusion and financial stability?
- Do indicators of financial inclusion have a statistical significance in affecting the financial stability index in middle-income countries in Africa?

From the above, the following hypotheses can be put forward:

- Indicators of financial inclusion in its dimension of access to and use of financial services may positively improve the level of financial stability in middle-income countries in Africa.
- Improving levels of access to financial services in middle-income countries in Africa is a priority in achieving financial inclusion and thus contributing to good levels of financial stability.
- The use of financial services in middle-income countries in Africa is at very weak levels due to fear and the absence of a financial culture that would expand the use of various financial services, which is what weakens the rate of expansion of financial inclusion, and thus the possibility of an absence of impact on financial stability.

Objectives of the study:

Through our study, we aim to highlight the impact of indicators of financial inclusion in its dimensions related to access and use of financial services on financial stability in middle-income countries in Africa, based on annual data for the period from 2011 to 2021, by estimating the three models of panel data and selecting the optimal model from that. It allows us to test the problem of the study and reach specific results.

Study Approach:

Given the nature of the subject and to achieve the objectives of this research and to understand its various aspects, we will rely on the descriptive approach and theoretical analysis of previous studies and experiences, and we will also use the standard approach by following the necessary standard and statistical methods to study the impact of financial inclusion on financial stability in the study sample countries.

I - Conceptual framework for financial inclusion and financial stability:

1. Financial stability:

Although there are many definitions of financial stability, most definitions consider the term. From a common point of view, as defined by the European Central Bank (ECB, 2012), financial stability is the state in which a financial system, made up of financial intermediaries and financial markets, can withstand related market infrastructures, shocks, therefore, may reduce the likelihood of disruptions to the operations of financial intermediation, which are severe enough to significantly lower the financial system. According to (Ahmad, 2018, pp. 47-54). A stable financial system can efficiently allocate resources, manage financial risks related to the financial system, and eliminate unwanted price movements of real or financial assets that will affect monetary flexibility. Financial imbalances that appear internally or due to unexpected events are also eliminated in a stable financial system. Shocks will be absorbed by the system through self-correcting mechanisms that prevent negative impacts on the real economy and other financial systems to achieve sustainable economic growth. Financial stability is essential to the policy because most economic transactions occur through the financial system.

2. Financial inclusion

Financial inclusion is defined diversely based on their goals and their measurements of goals, where (Hannig & Jansen, 2010) and (García, 2016) agree that financial inclusion aims to attract the “unbanked” population into the formal financial system, where they can access financial services including credit, savings, payment, insurance, etc. In terms of metrics, financial inclusion can be categorized by the following groups: access (ability to access and use financial services/products of formal institutions), quality (involvement of financial services/products available to requirements customers, including customer choices, understanding of the customer, and attitude of the customer), usage (permanence and depth of services/products used in the financial system) and impact (efficiency of financial services/products that contribute to improving the lives of consumers) (World Bank, 2014) and (Park & Mercado, 2018).

3. The dialectic of the relationship between financial inclusion and financial stability

Empirical studies on the potential effects of financial inclusion on financial stability are new and relatively few, providing contrasting aspects of how these concepts are theoretically related.

According to (Khan, 2011) some basic ways show the positive effects of financial inclusion on financial stability.

First: Financial inclusion promotes widespread savings intermediation and facilitates structural changes in the financial system because it allows more opportunities for financial institutions to operate in newly established businesses or expanded markets. When the balance sheet of the entire sector increases with the diversity and wider participation of economic agents, it contributes to greater flexibility in economic potential.

Second: Financial inclusion provides a more solid base for retail financing for private financial institutions for banks. Retail deposits act as a reserve for borrowed funds to increase the stability of the sector because it appears that low incomes show consistent financial behaviors in the cycle of boom and bust about keeping deposits and repaying loans, so during periods of financial distress, The deposits of these customers become a continuous source of funding, especially when banks run out of other sources of credit.

Third, financial inclusion constrains the fact that a large informal sector can weaken the effectiveness of monetary policy transmission, as it facilitates more formal participation of financially excluded agents of the economy such as households and small firms, who typically make financial decisions independent of and uninfluenced by supervised monetary agencies. (Prasad, 2010) Also, insufficient access to credit for small and medium-sized enterprises and micro-entrepreneurs results in undesirable effects on overall unemployment because these firms are labor-intensive and financially intensive in their operations. By including them in the financial sector, these funded firms can expand their operations and produce more products for the economy.

Using PANEL data for countries over the period 2005-2011, with a dynamic GMM estimate, (Morgan & Pontines, 2014) proxy financial inclusion with the share of SME credit in total commercial bank credit and the ratio of SME borrowers to total commercial bank borrowers, financial stability is also measured through non-performing loans to banks and Z-index scores for banks. The authors found that a higher proportion of lending to SMEs was associated with lower non-performing loans and a lower probability of default for financial institutions. Similar results were also found with a greater number of small business borrowers. On the other hand, (Han & Melecky, 2013) researched the relationship between financial inclusion and stability in 95 countries by applying World Bank data and the sectional regression method. Financial inclusion is measured as access to and use of deposits before the 2008 crisis, and the percentage of individuals who used bank deposits in 2011, the dependent variable is the maximum decline in bank deposit growth in 2006-2010. The conclusion was that: broadening access to and use of bank deposits can significantly mitigate withdrawals during periods of crisis, enhance the stable funding ratio of banks and lead to a reduction in total bank deposit volatility in times of economic downturn.

In addition, the estimated coefficients of the variables indicate that a 10% increase in the percentage of individuals with access to deposits would reduce deposits by up to 8%, which means strengthening financial stability in both the banking system and the financial sector, also a study (Tran & Nguyen, 2020) show that the impact of financial development on Z-Score is significantly positive, while its impact on non-performing loans is significantly negative, thus reducing the risk to the bank.

In contrast to the positive relationships, some empirical studies support the negative impact of financial inclusion on financial stability, using panel data for countries with a regression method, as (Sahay, Cihak, Barajas, & Gao, 2015) studied the overall impact of financial development, which combines Among a multidimensional measure including depth, reach, and efficiency, of economic

growth and financial stability among 200 observations, researchers found a significant negative effect on financial stability and argued that in countries with low bank supervision and compliance with the Basel principles of effective banking supervision, access to credit is associated with Positively associated with a decline in bank reserves, and this trend is much greater when the decline in financial collateral is faster in countries with weaker supervision, while access to and use of other financial services besides credit does not negatively affect financial stability because the effects are still inconclusive.

The World Bank (2012) in the Global Financial Development Report also provided evidence of the negative relationship between inclusiveness and financial stability using the Financial Access Survey data. Financial access is represented by the number of loan accounts in commercial banks per 1000 adults, and financial stability is represented by non-performing loans to banks. There is a similar negative finding: increased loan penetration is associated with lower capital in banks, meaning that high-income countries with high levels of financial access face related factors that impose greater instability, such as lower capital requirements, moreover it revealed The data from the research also show that countries with higher competition in the banking sector have higher deposit spread and higher financial stability.

In the same context, some previous studies present views that when financial inclusion is associated with rapid or ineffective comprehensive expansion from unregulated parts of the financial sector, systemic risks will increase, as (Mehrotra & Yetman, 2015) argued that one of the methods to increase financial inclusion is Stimulating banks through strong credit expansion to poor and creditworthy households who do not pay enough attention to repaying loans. As a result, the credit standards in the banking system can be compromised and deteriorate, and the screening capacity before disbursement may decrease, which leads banks to absorb customers with low credit quality. (Igan & Pinheiro, 2011), (Khan, 2011) suggested that improvements in financial inclusion may lead to the growth of non-financial sector-regulated institutions.

II- Econometric analysis of the impact of financial inclusion on financial stability in the study sample countries

1. Sources and variables of the study:

In this study, we use high-reliability data sources, mainly from the Global Financial Development Database (GFDD) of the World Bank, for the Z-Score indicator of banking stability and safety as an indicator expressing financial stability, whose high value reflects the ability of the banking system to remain in a state of stability and avoidance. about the possibility of falling into financial failure, which is thus one of the common and important measures that have been used in many studies to express financial stability, including studies (Morgan & Pontines, 2014) and (Han & Melecky, 2013) where GFDD represents a comprehensive data set consisting of From time series data for countries, classified according to the variables of the characteristics of the financial system that are characterized by financial depth, financial access, financial efficiency and financial stability from 203 countries, and accordingly in our study 11 African countries were selected from the segment of middle-income countries based on the availability of relevant data on financial stability variables during The period 2011-2021.

The International Monetary Fund database was also used to express financial inclusion, based on a study (Cihak, 2016), where the comprehensive financial system must be classified into two dimensions: the use of financial services and access to them, as the use of financial services, ranges from deposit accounts, credit cards, and payment services, as well as Access to the financial system measures the extent to which individuals can access financial services, and accordingly, the

variables will be focused on the banking system for two reasons: first, the banking sector represents the largest part of financial intermediation in the majority of financial systems in countries, second: it is easier to obtain statistical data for the banking sector compared to non-bank service providers.

1-1- Indicators of the use of financial services

Credit: We will rely on available variables related to comprehensive credit services, including the number of credit cards (CRE) and the number of commercial bank borrowers (BOR).

Account: We use the indicator of the number of deposit accounts with commercial banks, DAB, in the model to express the desire to establish bank accounts and deposits.

1-2- Indicators of access to financial services:

Penetration: Penetration dimensions measure the level of financial access at the level of the banking sector. The number of ATMs per 100,000 adults (ATM1) as well as the number of ATMs per 1,000 km² (ATM2) are the most relevant indicators because they capture the demographic spread of the banking sector.

Availability: The Availability dimension focuses on the broad geographical scope of the financial sector since the physical distance to financial service providers is considered a barrier to financial inclusion,

The variable number of bank branches per 100,000 adults (BRAN1) and the variable number of commercial bank branches per 1,000 km² (BRAN2) are the most relevant. Therefore, the independent variables expressing financial inclusion and their expected impact on financial stability can be summarized according to the following table:

Table 1 Description of the independent variables and their predicted effect

The reason	Expected effect	Data sources	Code	Independent variables	Hypothesis
(+): Increased credit can facilitate expanded operations of the financial sector, thus increasing economic flexibility (-): The expansion of credit to low-rated individuals can worsen the level of bank lending, increase non-performing loans	-/+	IMF DATA	CRE	The number of credit cards	H1
	-/+	IMF DATA	BOR	The number of borrowers from commercial banks	

and, accordingly, reduce financial stability.					
Deposits provide a more robust base for financing financial institutions, thus increasing stability, as well as helping to facilitate other financial services and enhancing the effectiveness of monetary policies.	+	IMF DATA	DAB	The number of deposit accounts with commercial banks	H2
(+) Saving and deposits' geographical and demographic reach is good for institutional capital bases. (-) The geographical and demographic reach of credit may increase the risk of default.	-/+	IMF DATA	ATM1	ATMs per 100,000 adults	H3
		IMF DATA	ATM2	ATMs per 1000 km ²	
	-/+	IMF DATA	BRAN1	The number of bank branches per 100,000 adults	H4
		IMF DATA	BRAN2	The number of bank branches per 1000 km ²	

Source: Prepared by researchers based on the theoretical review of previous studies

2. Study methodology and model:

Through the econometric study, we seek to know the impact of financial inclusion variables on financial stability in 11 middle-income countries in Africa, represented in Algeria, Tunisia, Egypt, Morocco, Senegal, Ghana, South Africa, Angola, Cameroon, Cote d'Ivoire, Nigeria, using this. The methodology of the panel data during the period from 2011 to the year 2021, given that the estimate according to this data has important advantages and gives more accurate results because it takes into account the information with a time dimension in the time series as well as the sectional dimension in the different units, so it can be said that the panel data It has a double dimension, a time dimension, and an individual dimension. This is what made its study more effective and active in

econometrics, and therefore it is of great importance that we can summarize in the following points: (Badraoui, 2015, pp. 201-202)

- This type of data allows the researcher to study the differences and differences in behavior between individuals, so that the double dimension that the panel data enjoys can be translated as a double dimension of the available information, more than that of the sectional or temporal ones.
- Panel data is distinguished from others by a greater number of degrees of freedom as well as better efficiency, which positively affects the accuracy of the estimators.
- The use of the panel data will allow us to mitigate the problem of multilinearity.
- The ability to identify some economic phenomena such as technical progress and economies of scale, thus addressing the problem of the inability to divide economies of scale and the technical progress in the analysis of production functions.
- Longitudinal data gives better efficiency and an increase in degrees of freedom as well, less multiplicity between variables, and more informational content. If cross-sectional or temporal data from periods are used, then the T model of cross-sectional views is measured in N so that we have longitudinal data defined by the following formula:

$$Y_{it} = \alpha_i + \beta'x_{it} + \varepsilon_{it},$$

whereas:

- $N=1,2,\dots,i$ represents the individual units.
- $T=1,2,\dots,t$ represents periods.
- Y_{it} is a vertical vector representing the dependent variable.
- X_{it} matrix ($NT \times K$) represents the independent variables.
- B ($K \times 1$) is a vertical vector of the parameters to be estimated where the model assumes that there are K parameters in x_{it} without the hard limit.
- ε_{it} is a random error limit for unit i and period T .

3. Basic models for analyzing panel data:

3-1 - Pooled Regression Model (PME)

This model is considered one of the simplest longitudinal data models, in which all coefficients are constant for all periods, ignoring any effect of time. By rewriting the model in the equation below, we obtain the aggregate regression model in the following form: (Jamal, 2012).

$$Y_{it} = B_{0(1)} + \sum_{j=1}^k B_j X_{j(it)} + \varepsilon_{it}$$

$$J=1, 2, 3, \dots, n \quad t=1, 2, 3, \dots, N$$

Where: $E(\varepsilon_{it}) = 0$ and $\text{var}(\varepsilon_{it}) = \sigma$ the ordinary least squares method is used to estimate the model parameters in the above equation with the size of observations ($N \times T$).

3-2- Fixed Effects Model (FEM)

The use of the fixed effects model takes into account the change of slope and section from one unit to another for the cross-section observations within the studied sample so that it will be assumed that the parameters change constantly, and on this basis, they are called fixed effects models, so they represent both the individual and temporal dimension of the panel model so we can estimate the model by comparing individuals against time (Badrawy, 2015, p. 209)

In the fixed effects model, the goal is to know the behavior of each cross-sectional data set separately by making the cut-off parameter β_0 vary from one set to another with the slope coefficients β_j remaining constant for each cross-sectional data set (i.e., we will deal with the case of heterogeneity in the variance between the aggregates). The fixed effects model is in the following form (Muhammad R., 2014).

$$Y_{it} = \beta_{0(i)} + \sum_{j=1}^k \beta_j X_{j(it)} + \varepsilon_{it}$$

$$j=1, 2, 3, \dots, n \quad t=1, 2, 3, \dots, N$$

Where $E(\varepsilon_{it}) = 0$ and $(\varepsilon_{it}) = \sigma \text{ var}$ The term fixed effects means that the parameter β_0 for each cross-sectional data set does not change during time, but the change is only in the cross-sectional data groups to estimate the model parameters in the above equation and allow the cut-off parameter β_0 to change between Sectional aggregates usually use dummy variables as much as $N-1$ to avoid complete linear multiplicity, then use the usual least squares method, and the fixed effects model is called the least squares model for dummy variables after adding the dummy variables D in the above equation, the final form of the model becomes as follows:

$$Y_{it} = \sum_{d=2}^N \alpha_d D_d + \sum_{j=1}^k \beta_j X_{j(it)} + \varepsilon_{it}$$

$$j=1, 2, 3, \dots, n \quad t=1, 2, 3, \dots, N$$

3-3- Random Effects Model (REM)

The random effect model is represented in the fact that the constant changes randomly, and if the random effect is found in both the individual and the temporal factor, we call this model the u-composite model, the appropriate estimation method in this type of model is the generalized least squares method GLS or by Through a method that links the appreciation between individuals and the appreciation within individuals, as it takes the following form:

$$Y_{it} = u + \sum_{j=1}^k \beta_j X_{j(it)} + \varepsilon_{it}$$

$$j=1, 2, 3, \dots, n \quad t=1, 2, 3, \dots, N$$

3-4- How to choose the appropriate model:

We use the (Test Hausman) test to choose between the fixed and random effect methods based on the null hypothesis that all the estimation coefficients through the random effect have the same efficiency as those estimated through the fixed effect, rejecting the null hypothesis makes the estimation coefficients through the random effect more accurate This does not mean that the estimation coefficients resulting from the fixed effect model are ineffective, as the hypotheses of the model are as follows:

H0: The random effects model is the appropriate autocorrelation between the variables).

H1: fixed effects model is the appropriate model (there is an autocorrelation between the variables (Ratia Mohamed, 2014, pp. 155-156)

Whereas, the "Hausman" test is given by the following relation: (Hausman, 1981).

$$H = X^2(K - 1) = [b - B^{\wedge}] / \psi^{\wedge} - 1 [b - B^{\wedge}]$$

Where:

$$= \text{Var}[b] - [B^{\wedge}] \psi^{\wedge} = \text{Var} [b - B^{\wedge}]$$

Each of the variance and covariance matrices of regression features b obtained from the LSDV method represents the constant, and the variance and covariance matrix of the random effect model $B^{\wedge}$ without the constant; Accordingly, under the null hypothesis, the best model is the random effect model, which means that the individual effect is not associated with other variables. In the opposite case, the best model is the fixed effect model.

4. Study form assessment results:

After addressing the most important aspects of the subject in the theoretical framework of the study, as well as the most important indicators expressing the dimensions of financial inclusion, as well as the variable of financial stability, with the presentation of the study hypotheses about the possible possibilities of the effects of financial inclusion on the financial stability variable, in addition to the methodology used for the panel data and its various models, we will present the study model in different Its variables are as follows:

$$BZS_{it} = \alpha + \beta_1 * CRE_{it} + \beta_2 * BOR_{it} + \beta_3 * DAB_{it} + \beta_4 * ATM1_{it} + \beta_5 * ATM2_{it} + \beta_6 * BRAN1_{it} + \beta_7 * BRAN2_{it} + \epsilon_{it}$$

where:

The dependent variable: is BZS, which represents the Z-Score index of banking stability and safety as an indicator expressing financial stability, while the independent or explanatory variables are represented by CRE: the number of credit cards, BOR: the number of borrowers from commercial banks, DAB: the number of deposit accounts with commercial banks, ATM1: ATMs per 100,000 adults, ATM2: ATMs per 1,000 km², BRAN1: number of bank branches per 100,000 adults, BRAN2: number of bank branches per 1,000 km², ϵ_{it} : represents the random error limit, α : represents the constant or categorical.

5. Estimating the models according to the panel data:

According to the analysis of the panel results, the data models were estimated, which are the regression pooled model (PRM), the fixed effects model (FEM), and the random effects model (REM).

Table No. (1) shows the results of the assessment included in Appendices No. 1, 2, and 3, using the Eviews 12 program, as follows:

Table 1: Basic model estimation of panel data

Estimating models			
Model (REM)	Model (FEM)	Model (PRM)	Explanatory variables
1.01 (0.35)	1.12 (0.33)	1.68 (0.00)	CRE
1.75 (0.14)	1.71 (0.17)	-1.72 (0.00)	BOR
-2.78 (0.08)	-3.04 (0.07)	4.28 (0.00)	DAB
-0.43 (0.05)	-0.52 (0.03)	4.43- (0.00)	ATM1
0.35 (0.00)	0.45 (0.00)	1.38 (0.00)	ATM2
2.59 (0.00)	2.96 (0.00)	7.73 (0.00)	BRAN1
-1.94 (0.00)	-2.53 (0.00)	-1.98 (0.00)	BRAN2
20.76 (0.00)	23.35 (0.00)	/	Constant
0.29	0.98	0.05	R ²
121	121	121	Obs
6.88 (0.00)	299.32 (0.00)	7.58 (0.00)	F

The values in parentheses represent the probability value of the parameters of the variables.

Source: Prepared by researchers based on the outputs of Eviews 12

The data shown in Table 1 indicate the results of the panel data estimation of the effect of the explanatory variables represented by CRE: number of credit cards, BOR: number of borrowers from commercial banks, DAB: number of deposit accounts with commercial banks, ATM1: ATMs per 100,000 adults, ATM2: ATMs Automated teller machines per 1,000 km², BRAN1: the number of bank branches per 100,000 adults, BRAN2: the number of bank branches per 1,000 km², on the dependent variable represented by BZS for the Z-Score of stability and banking safety as an indicator expressing financial stability in eleven countries Average income in Africa during the period from 2011 to 2021, and this is according to three main models, where the table shows the value of the coefficients as well as the probability value of the estimation results, as it becomes clear that the probability value of Fisher's statistic is less than 0.05 in the three models, which indicates the suitability of the three models Statistically, in order to choose the appropriate model, we had to perform the Hausman test.

5-1-Hausman test:

Table 2 shows the results of the Hausman test based on the test results shown in Appendix 4:

Table 2 Hausman test results

p-value	Chi-Statistic	Test type
0.0001	30.68	Hausman test

Source: Prepared by the researchers based on the outputs of the 12 Eviews program

Through the results of the Hausman test shown in Table 2, it is clear that its statistical value was estimated at 30.68, with a probability value estimated at 0.0001 less than the significance level of 0.05. Accordingly, according to these results, the null hypothesis is rejected and the alternative hypothesis is accepted, which assumes that there is a correlation between the effects of countries, so the effects model is used. The fixed effects model (FEM) is the appropriate model, and to reach clear results, we had to re-estimate the fixed effects model and its results are shown in Table 3 according to the program outputs in Appendix 2 as follows:

Table 3 Results of Fixed Effects Model (FEM) Estimation

(FEM) fixed effects model	Explanatory variables
1.12 (0.33)	CRE
1.71 (0.17)	BOR
-3.04 (0.07)	DAB
-0.52 (0.03)	ATM1
0.45 (0.00)	ATM2
2.96 (0.00)	BRAN1
-2.53 (0.00)	BRAN2
23.35 (0.00)	Constant
0.98	R ²
121	Obs
299.32 (0.00)	F

Source: Prepared by the researchers based on the outputs of the 12 Eviews program

The results of estimating the fixed effects model shown in Table 3 indicate that the value of Fisher's statistic was estimated at 299.32, while the probability value was estimated at 0.00, which is smaller

than the significance level of 0.05. The explanatory variables explain the dependent variable by 98%, which is an acceptable value. The results also indicate that the value of the parameter of the number of credit cards variable is equal to 1.12, while the probability value is equal to 0.33, which is a value greater than the significance level of 0.05, meaning that the variable of the number of credit cards has no statistical significance. As for the statistical value of the parameter of the BOR variable, the number of borrowers from commercial banks, it is equal to 1.71, with a probability value equal to 0.17, which is less than the level of significance 0.05, meaning that the variable has no statistical significance. As for the statistical value of the parameter DAB, the variable of the number of deposit accounts in commercial banks, it is equal to -3.4 With a probability value of 0.07, that is, the variable has no statistical significance, and the statistical value of the ATM1 variable parameter ATMs per 100,000 adults is equal to -0.52 with a probability value less than 0.05 That is, this variable has a statistical significance. As for the statistical value of the ATM2 variable: ATMs per 1,000 km², it is equal to 0.45 with a probability value less than 0.05, meaning that the variable has statistical significance. For the BRAN1 variable: the number of bank branches per 100,000 adults, its value the statistic is equal to 2.96, with a probability value less than 0.05, meaning that the variable has a statistical significance, while the statistical value of the BRAN2 variable: the number of bank branches per 1000 km² is equal to -2.53, while its probability value is less than the significance level, meaning that the variable has a statistical significance. The statistical value of the constant C parameter is equal to 23.35, with a probability value equal to 0.00, which is less than 0.05, meaning that the constant has statistical significance.

6. The economic interpretation of the results of the analysis:

In the light of the previous analysis of the statistical results from the estimation of the fixed effect model, it is clear that the variables expressing the first dimension of financial inclusion represented in the indicators of the use of financial services represented by each of the CRE, BOR and DAB variables have no statistical significance in the effect, whether positively or negatively, on the financial stability variable in Middle-income countries in Africa, which is explained by the weakness of financial inclusion indicators in their dimension expressing the use of financial services in affecting the financial stability of these countries, while the indicators of financial inclusion in their dimension related to access to financial services had an impact on financial stability, where we find that ATM1 variable: ATMs per 100,000 adults has an inverse relationship with the financial stability index, meaning that if one unit of the number of ATMs per 100,000 adults increases, the level of financial stability in the study sample countries will decrease by 0.52 percent, but the value of The effect is very weak, While the ATM2 index, ATMs per 1,000 km², had a positive effect, that is, if the number of ATMs per 1,000 km² increased, it would improve the financial stability index by 0.45 percent, which is explained by the nature of the services used by individuals. This positively affects financial stability, because of the strategies of these countries to expand the spread of these devices while promoting an effective financial culture of how to use them, that is, despite their large spread and cost, they had an effective impact in ending financial isolation and enhancing financial stability, not to mention reducing the impact of parallel markets in countries On the other hand, we find that the BRAN1 variable: the number of bank branches per 100,000 adults has a positive effect on the level of financial stability, as in the case of an increase of one unit of the number of branches Commercial banks per 100,000 adults will increase the level of financial stability by 2.96 percent. As for the BRAN2 indicator: the number of bank branches per 1,000 km² has a negative and weak impact, that is, if the number of bank branches per 1,000 km² increases, it will decrease. The financial stability decreased by 2.53 percent, and this is explained by the fact that the spread and expansion of banks in middle-income countries in Africa has a positive

impact on increasing the financial stability rate for these countries. Credit and they seek to cooperate only with reliable banks, which increases the competitiveness and spread of commercial banks and their branches, which raises the level of financial stability in the study sample countries, and one of the main tasks of the commercial bank is to convince potential customers of its reliability and financial stability.

In general, and according to the results reached, as well as the results of the previous analysis, it can be said that the indicators of financial inclusion in its dimension related to the use of financial services do not affect financial stability in the study sample countries. As for the indicators of financial inclusion in its dimension related to access to financial services, it had a positive impact on Financial stability in the study sample countries showing that the axis of enhancing financial inclusion aims to enhance the ability of individuals and institutions to access financial services and financing provided by banks and financial institutions, in particular digital services. This explains the positive impact of financial inclusion in its dimension related to access to Financial Services on Financial stability.

Conclusion:

By studying and determining the impact of financial inclusion on financial stability using a sample of 12 middle-income countries in Africa during the period from 2011 to 2021 using the panel cross-sectional time series data, and when estimating the three-panel models and conducting the Hausmann test, the impact model was determined The constant as an appropriate model for the study, where the results of the application of the fixed effect model came, which confirmed the absence of the impact of financial inclusion in its dimension related to the use of financial services, whether positively or negatively, on the variable of financial stability in middle-income countries in Africa, and this is due to the weak degree of financial inclusion in the study sample countries When using financial services, the main reason may be the low levels of technology or mechanisms and tools that contribute to increasing the use of financial services and expanding them in a larger scale. On the other hand, indicators of financial inclusion in their dimension related to access to financial services had a positive impact on financial stability in the study sample countries. This is due to the strategies of these countries in expanding the spread of these ATMs, as well as the number of commercial banks while promoting a culture of This means that despite its large spread and cost, it had an effective impact in ending financial isolation and enhancing financial stability, not to mention reducing the impact of parallel markets in middle-income countries in Africa, which is considered one of the most important obstacles that prevent improving levels of financial stability. Banks and their expansion in middle-income countries in Africa helped in the geographical and demographic reach of savings and deposits, which is good for the capital bases of these commercial banks, and depositors are more attentive to choosing a credit institution and seek cooperation only with reliable banks, which increases the competitiveness and spread of banks. Commercial bank and their branches raise the level of financial stability in the study sample countries, and one of the main tasks of the commercial bank is to convince potential customers of its reliability and financial stability.

Sources and references:

1. Ahmad, D. (2018). Financial inclusion and financial stability: Survey of Nigeria's financial system. *International Journal of Research in Finance and Management*, 1(2), 47-54.
2. Badraoui Shahinaz 2015, *The Impact of Exchange Regimes on Economic Growth*, a thesis submitted for a Ph.D., Faculty of Economic Sciences, University of Tlemcen, 2014-2015, pp. 201-202.
3. Cihak, M., Mare, D., & Melecky, M. (2016). *The Nexus of Financial Inclusion and Financial Stability A Study of Tradeoffs and Synergies*. World Bank Policy Research Working Paper Series 7722.
4. ECB (2012). *Financial Stability Review. What is financial stability?* Frankfurt: European Central Bank.
5. García, C. (2016). Can financial inclusion and financial stability go hand in hand? *Economic Issues Journal Articles*, *Economic Issues*, 21(2), 81-103.
6. Hannig, A., & Jansen, S. (2010). *Financial Inclusion and Financial Stability: Current Policy Issues*. Finance Working Papers 23124, East Asian Bureau of Economic Research.
7. Han, R. & Melecky, M. (2013). *Financial Inclusion for Stability: Access to Bank Deposits and the Deposit Growth during the Global Financial Crisis*. World Bank Policy Research Working Paper Series 6577.
8. Igan, D. & Pinheiro, M. (2011). *Credit Growth and Bank Soundness: Fast and Furious?* IMF Working Papers 11/278, International Monetary Fund.
9. Khan, S. (2011). H R Khan: Financial inclusion and financial stability: Are they two sides of the same coin? Address at BANCON, organized by the Indian Bankers Association and Indian Overseas Bank, Chennai.
10. Morgan, P. & Pontines, V. (2014). *Financial Stability and Financial Inclusion*. Finance Working Papers 24278, East Asian Bureau of Economic Research.
11. Mehrotra, A., & Yetman, J. (2015). *Financial inclusion - issues for central banks*. BIS Quarterly Review. Bank for International Settlements.
12. Mohamed Rataia, (2015), *Using Panel Data Models to Estimate the Economic Growth Function in Arab Countries.*, Algerian Journal of Economics and Finance, Issue 2, Algeria, pp. 155-156.
13. Park, C. & Mercado, R. (2018). *Financial Inclusion: New Measurement and Cross-Country Impact Assessment*. Working Papers wp29, South East Asian Central Banks (SEACEN) Research and Training Centre.
14. Prasad, E. (2010). *Financial Sector Regulation and Reforms in Emerging Markets: An Overview*. NBER Working Papers 16428, National Bureau of Economic Research, Inc
15. Sahay, R., Cihak, M., Barajas, A. & Gao, Y. (2015). *Rethinking Financial Deepening: Stability and Growth in Emerging Markets*. IMF Staff Discussion Notes 15/08, International Monetary Fund.
16. Tran, S.H., & Nguyen, L.T. (2020). *Financial Development, Business Cycle and Bank Risk in Southeast Asian Countries*. *Journal of Asian Finance, Economics, and Business*, 7(3), 127- 135. <https://doi.org/10.13106/jafeb.2020.vol7.no3.127>
17. World Bank (2014). *Global Financial Development Report 2014: Financial Inclusion*. Washington, D.C.
18. Zakariya Yahya Nuri Al-Jamal 2012 *Testing the Model in Data Models in Fixed and Random Longitudinal Data Models*, Iraqi Journal of Statistical Sciences, Volume 12, Issue 21, University of Mosul, College of Accounting and Mathematics Sciences, pp. 266-285.

Appendices

Appendix 1: Results of the summative effect model test

Dependent Variable: BZS?
Method: Pooled Least Squares
Date: 10/07/22 Time: 14:02
Sample: 2011 2021
Included observations: 11
Cross-sections included: 11
Total pool (balanced) observations: 121

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CRE?	1.68E-06	2.79E-07	5.998626	0.0000
BOR?	-1.72E-06	4.02E-07	-4.286298	0.0000
DAB?	4.28E-07	7.17E-08	5.976356	0.0000
ATM1?	-4.437854	0.856370	-5.182166	0.0000
ATM2?	1.389941	0.309703	4.487984	0.0000
BRAN1?	7.737681	1.553690	4.980198	0.0000
BRAN2?	-1.988039	0.706117	-2.815451	0.0057
Root MSE	9.785643	R-squared		0.059892
Mean dependent var	18.24425	Adjusted R-squared		0.010413
S.D. dependent var	10.13451	S.E. of regression		10.08160
Akaike info criterion	7.515412	Sum squared resid		11586.82
Schwarz criterion	7.677152	Log likelihood		-447.6824
Hannan-Quinn criter.	7.581101	Durbin-Watson stat		0.187865

Appendix 2: Fixed effect model test results

Dependent Variable: BZS?
Method: Pooled Least Squares
Date: 10/07/22 Time: 14:06
Sample: 2011 2021
Included observations: 11
Cross-sections included: 11
Total pool (balanced) observations: 121

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23.35535	1.941628	12.02875	0.0000
CRE?	1.12E-07	1.16E-07	0.962811	0.3379
BOR?	1.71E-07	1.27E-07	1.352548	0.1792
DAB?	-3.04E-08	1.70E-08	-1.795031	0.0756
ATM1?	-0.523764	0.241820	-2.165927	0.0326
ATM2?	0.452658	0.124793	3.627280	0.0004
BRAN1?	2.968000	0.597288	4.969127	0.0000
BRAN2?	-2.539201	0.456052	-5.567794	0.0000
Fixed Effects (Cross)				
_1-C	7.136117			
_2-C	-13.61567			
_3-C	-6.968096			
_4-C	5.018838			
_5-C	22.85220			
_6-C	18.75988			
_7-C	-4.856572			
_8-C	0.521379			
_9-C	-10.59401			
_10-C	-11.10604			
_11-C	-7.148033			
Effects Specification				
Cross-section fixed (dummy variables)				
Root MSE	1.421583	R-squared		0.980160
Mean dependent var	18.24425	Adjusted R-squared		0.976885
S.D. dependent var	10.13451	S.E. of regression		1.540800
Akaike info criterion	3.838940	Sum squared resid		244.5286
Schwarz criterion	4.254842	Log likelihood		-214.2558
Hannan-Quinn criter.	4.007854	F-statistic		299.3243
Durbin-Watson stat	1.537399	Prob(F-statistic)		0.000000

Appendix 3: Random effect model test results

Dependent Variable: BZS?
 Method: Pooled EGLS (Cross-section random effects)
 Date: 10/07/22 Time: 14:13
 Sample: 2011 2021
 Included observations: 11
 Cross-sections included: 11
 Total pool (balanced) observations: 121
 Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	20.76731	2.431951	8.539364	0.0000
CRE?	1.01E-07	1.09E-07	0.931594	0.3535
BOR?	1.75E-07	1.19E-07	1.475344	0.1429
DAB?	-2.78E-08	1.62E-08	-1.720677	0.0880
ATM1?	-0.434602	0.221194	-1.964794	0.0519
ATM2?	0.352011	0.109346	3.219250	0.0017
BRAN1?	2.590810	0.539851	4.799120	0.0000
BRAN2?	-1.944475	0.391234	-4.970112	0.0000
Random Effects (Cross)				
_1-C	7.502397			
_2-C	-12.06167			
_3-C	-4.700946			
_4-C	1.222998			
_5-C	17.57352			
_6-C	19.41801			
_7-C	-4.082143			
_8-C	-0.501477			
_9-C	-9.567217			
_10-C	-9.139360			
_11-C	-5.664120			
Effects Specification				
		S.D.	Rho	
Cross-section random		6.177421	0.9414	
Idiosyncratic random		1.540800	0.0586	
Weighted Statistics				
Root MSE	1.637624	R-squared	0.298961	
Mean dependent var	1.368183	Adjusted R-squared	0.255534	
S.D. dependent var	1.964017	S.E. of regression	1.694602	
Sum squared resid	324.4993	F-statistic	6.884201	
Durbin-Watson stat	1.156400	Prob(F-statistic)	0.000001	
Unweighted Statistics				
R-squared	-0.045318	Mean dependent var	18.24425	
Sum squared resid	12883.53	Durbin-Watson stat	0.029126	

Appendix 4: Hausmann test results

Correlated Random Effects - Hausman Test
 Pool: CHOMOL
 Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	30.685115	7	0.0001