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Financial inclusion in Morocco: The impact of financial development, financial innovation and economic growth

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Abstract: The relationship between financial inclusion, social development, particularly poverty reduction, financial innovation and economic growth has been endorsed by a number of studies. Indeed, the development policies pursued by countries such as Morocco often define financial inclusion, growth, financial development, financial innovation, monetary policy and investment as fields of action for economic and social development. The aim of this study is to assess this choice by examining the short- and long-term relationship between financial inclusion, financial development, financial innovation, growth, inflation and the interest rate. Using the ARDL (AutoRegressive Distributed Lag) model and the Granger causality test, the results show the positive short- and long-term effect of financial development and financial innovation on financial inclusion, and the positive short- and negative long-term effect of economic growth on financial inclusion. The inflation and the interest rate that represents monetary policy influence financial inclusion in the short and long term positively and negatively respectively. In terms of causality, the granger test shows that economic growth has an effect on inclusion in only one direction and that financial inclusion has an effect on financial development in only one direction. On the other hand, innovation, inflation and the interest rate have a bidirectional relationship with financial inclusion.

Keywords: *ARDL, Financial inclusion, Financial development, Financial innovation, Growth.*

1. Introduction

The slowdown in growth and the changing needs of the population, as well as Morocco's ambition to play a strategic role in the Europe-Africa relationship, have prompted the government to review its development model from 2021. This model, which has shown its limitations in generating growth and economic development, has been called into question, giving rise to a new development model designed on the basis of a series of consultations which have made it possible to define the new values of society, identify the strengths and weaknesses as well as the opportunities of the country, and define social and economic objectives for public policies for the 2030 horizon.

On the economic level, the main objective is to significantly improve the Gross Domestic Product per inhabitant. To achieve this, the model has defined a series of priority areas such as digital transformation, financial development, encouraging private investment, sustained economic growth, financial inclusion and the development of society by encouraging entrepreneurial freedom.

The World Bank (2012) defines financial inclusion as the proportion of individuals and businesses that use financial services. As such, as an action, it represents all of the mechanisms put in place to offer all financial products and services to segments of society, whether businesses or individuals, in particular the population in difficulty and excluded from traditional services, at an appropriate price that meets their needs. For the United Nations (UNCTAD, 2014), financial inclusion is defined through

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three dimensions, namely access to a wide range of financial services at an affordable price, responsible institutions with good internal governance, and diversity of financial service offerings.

Financial inclusion is often the task assigned to specialized organizations that can take charge of the provision in a responsible and sustainable way, in accordance with a regulatory framework that defines the remit of each party, such as credit institutions, insurance companies etc.

Financial inclusion can be a guarantee of sound management of funds and deposits against unhealthy practices. Indeed, as part of the fight against informality, notably in terms of the demand for money, security and protection of deposits, financial inclusion makes it possible to better monitor financial flows and direct them towards the most promising economic sectors.

On a social level, financial inclusion is considered by international organizations, such as the World Bank, the UN and the alliance for financial inclusion, as one of the major challenges for social and economic development, particularly through its contribution to economic growth and its role in combating social disparities.

The aim of this paper is to assess the short- and long-term impact on financial inclusion of three factors, namely financial development, economic growth and financial innovation, and to evaluate the causal relationships between the above variables, using the ARDL model and causality in the sense of Granger.

This study will make it possible to determine the factors influencing financial inclusion, which is considered to be a driving force behind social development and the fight against poverty, with a view to assessing the factors on which the new model recommends that the government focus its actions to achieve development objectives.

For this reason, the rest of this document consists of a review of the literature in the second section, the methodology in the third section, the empirical results in the fourth section and, finally, the discussion and conclusion.

2. Literature Review

Financial inclusion is considered to be an important element of financial stability and a tool for social development. The definition of this concept, and its importance for economic, financial and social development, has attracted a great deal of research interest.

In this context, Claessens (2006) defines financial inclusion as the ability of a financial system to provide services at a reasonable cost. Sarma (2008) develops this definition by incorporating the diversification of the status of the beneficiaries of these services as well as innovation in the approaches to creating and generalizing these services.

For Barajas et al (2020), financial inclusion refers to the percentage of the population with access to a basic financial product (bank account, electronic banking card, credit account, savings account, insurance, etc). For Sahay et al. (2015), financial inclusion combines access to and efficient use of services, while Jahan et al. (2019) adds the quality of products and services as an indicator of financial inclusion.

In addition, several factors can influence financial inclusion, such as economic growth, financial development, financial innovation, financial stability, the demand for money, financial education, information technology, etc. The relationship between these factors and financial inclusion has been the subject of various studies in the economic literature. The study therefore presents a restricted review of the literature concerning the factors studied, i.e. financial development, financial innovation and growth, as well as the indexes used to measure these factors.

2.1. The Relationship Between Financial Development, Financial Inclusion and Economic Aggregates

The World Economic Forum defined financial development in its 2011 Financial Development Report as the factors, policies and institutions that lead to efficient financial intermediation and markets, and broad and deep access to capital and financial services. Islam & al (2021) and Aluko & Opoku (2022) consider that financial development (FD) includes improvements in the operations of the financial system, such as pooling deposits, allocating money to productive projects, monitoring these investments, diversifying risks and exchanging goods and services.

According to Jeanneney & Kpodar (2006), financial development is associated with four factors : the accumulation of financial assets, the expansion of the market for financial instruments, efficiency and free competition in the financial sector and free access by the population to financial services. The nature of these factors reveals a certain correlation with the development of financial inclusion.

This finding is shared by several researchers, such as Lenka (2021), who considers that the development of the financial sector can be evaluated by reference to two indicators : financial development and financial inclusion.

According to Voghouei et al (2011), several factors affecting financial development, such as legal tradition, institutions, financial liberalization, openness policy, political economy factors, etc. As a result, the effect of financial development on the various economic and financial aggregates has been examined by various studies, such as Rubio & Carrasco-Gallego (2016), who studied the effect on monetary policy and concluded that the efficiency of monetary policy depends on the extent of financial market development.

The relationship with economic growth has been analyzed by several studies such as McKinnon (1973) and Gurley and Shaw (1955) who argue that financial institutions and markets stimulate economic growth through the efficient allocation of financial resources to the most productive investments. Similarly, Calderon & Liu (2003) and Levine (2005) consider that financial institutions and markets can promote economic growth through several channels.

Regarding the relationship with monetary policy, Basa et al (2019), examining the relationship. The results reveal that financial development has a significant negative effect on monetary policy, production and inflation, indicating that a more developed financial system has hampered the effectiveness of monetary policy.

In summary, these studies show that there is a significant correlation between financial development, monetary policy and economic development, and may even encourage economic growth, despite the lack of consensus on this point. However, in terms of financial inclusion, financial development can, through the mechanisms of innovation and competitiveness, provide permanent solutions enabling the integration of different economic and social layers.

2.2. Economic Growth and Financial Inclusion

Economic growth can be measured by the increase in the percentage of gross domestic product (GDP) after adjusting for the inflation rate. It represents the quantity of goods and services produced. According to Naoklao (2015) and Recep (2012), the combination of financial development and economic growth generates economic development and promotes the development of human capital, contributing to the reduction of poverty, inequality, disparities and improved income.

For inclusion, the relationship with economic growth has been examined by several studies such as Ghosn (2011) who studied the effect of inclusion on economic growth in India and concluded the positive effect of access to and use of financial services on economic growth. Sarma (2016) investigated the causal relationship between the dimensions of financial inclusion and economic growth and concluded the existence of a bi-directional causal relationship. This positive effect was also concluded by Pradhan et al. (2016), Raza et al. (2019).

Similarly, Thanh & Ha (2019) who studied the effect of financial inclusion indicators on economic development and concluded that there is a correlation between these indicators and economic development. Kusuma (2020), examining the impact of financial inclusion on economic growth, poverty, income inequality and financial stability in Asia, concluded that the existence of a partial impact of inclusion on these factors.

According to Ozili et al. (2023), based on a literature review of this relationship with economic growth, the topic has emerged significantly since 2016 and mainly concerns developing countries and regions of Asia and Africa. Also, they concluded that most studies report a positive impact of financial inclusion on economic growth, while very few studies show a negative impact and that the most active channel of financial inclusion to boost economic growth is access to financial products and services developed by financial institutions.

Ifediora et al. (2022), examined this relationship in sub-Saharan Africa using panel data from 22 sub-Saharan African countries (SSAs) during the periods from 2012 to 2018 and concluded that bank branches and ATMs have a positive and significant impact on economic growth, deposit accounts and outstanding loans promote economic growth but not significantly, while outstanding deposits have a negative impact on economic growth.

Biswas (2023) studied this relationship for South Asian countries and concluded that financial inclusion positively impacts economic growth in these countries. However, the magnitude of the impact varies depending on the different measures of inclusion used. Mostafa et al. (2023), examined the countries of North Africa and the Middle East and concluded that the development of financial inclusion leads to economic development in this region.

In summary, the causal relationship between financial inclusion and economic growth has been supported by much of the research conducted on the topic. As a result, an effective financial inclusion policy can encourage the integration of different strata in economic development, particularly by fighting against the informal sector, which can have a positive impact on wealth and poverty.

2.3. Financial Innovation and Financial Inclusion

Financial innovation is defined by several researchers, such as Ignazio (2007), who associates financial innovation with the development of new financial products, new approaches to deploying existing financial services or new processes with new products. For Noyer (2007), it is the creation of new products on the market.

For Lerner and Tufano (2011), financial innovation refers to the development of new financial instruments and their dissemination, and to financial technology and infrastructure, whereas Khan et al. (2021) consider that innovation is the result of a process of transforming old products and processes into new, more efficient ones.

Solans (2005) considers that financial innovation refers both to technological advances that facilitate access to information, exchanges and means of payment, and to the emergence of new financial instruments and services, new forms of organization and more developed and complete financial markets".

The relationship between financial inclusion and financial innovation has been the subject of several studies, such as Mgbada et al (2024), who studied the effect of bank branches and mobile services on financial inclusion and concluded that these innovation factors had a positive effect on financial inclusion. Emmanuel (2020), studying this relationship in Cameroon, concluded that the positive impact of the mobile product and microfinance institutions on financial inclusion.

2.4. Measuring Financial Development, Financial Innovation, Financial Inclusion and Growth

To measure the "financial inclusion" and "financial development" variables, several components have been integrated, be it by the literature or by international organizations such as the World Bank. Indeed, according to Outreville (1999), the measurement of financial development is based on a set of economic aggregates, the choice of which is often dictated by the availability of data.

In this context, the financial development index used by the International Monetary Fund, created in 2008, is made up of two indicators: the financial institutions index and the financial markets index. The first index (FI) measures the development of the activity of financial institutions by referring to three indicators: the financial depth index, the financial institution access index and the financial institution efficiency index.

The financial market index is made up of three indicators: the financial market depth index, the financial market access index and the financial market efficiency index, which includes the stock turnover ratio.

On the other hand, several studies have proposed other indices to measure financial development, such as Heng et al (2016), who adjusted the previous index by integrating other components, such as household deposits as a percentage of GDP in the indicator of the depth of financial institutions, the bank concentration rate in the indicator of the efficiency of financial institutions, etc.

Financial innovation also has a significant impact on monetary aggregates, particularly M_2. Innovations in savings products and financial investments, such as online savings accounts, certificates of deposit and investments in money market funds, can influence the composition of M_2.

In this framework, several researches have associated financial innovation with the $\frac{M_2}{M_1}$ ratio such as Bara & Mudzingiri (2016) who studied the causal relationship between financial innovation and economic growth in Zimbabwe, Qamruzzaman & Jianguo (2017) who studied the effect of financial innovation on economic growth and Rizwan & al.(2021) who studied the causal relationship between financial innovation and economic growth in China, India and Pakistan during the period from 1970 to 2016.

Consequently, this study uses the financial development index to measure the variable « financial development » and the $\frac{M_2}{M_1}$ ratio to measure the variable « financial innovation ». For financial inclusion, the measurement index will be presented in the methodology.

3. Methodology

To assess the effect of the factors "financial innovation", "economic growth" and "financial development" on financial inclusion in the short and long term, this study uses the autoregressive distributed lag model (ARDL) and the error correction model (ECM) as well as the Granger causality test.

3.1. Presentation of the Autoregressive Distributed Lag Model (ARDL)

According to Kripfganz and Schneider (2018), the ARDL (Autoregressive Distributed Lag Model) plays a key role when it comes to making a vital economic decision based on past data. This is referred to as distributed change over future periods. It is a model containing the lagged values of the dependent variable and the current and lagged values of the explanatory variables as explanatory variables.

Indeed, the ARDL model can be specified if the variables are integrated at different orders. According to Nkoro & Uko (2016), it is a model used when there is a combination of variables with $I(0)$ and $I(1)$, i.e. stationary variables at level $I(0)$ and $I(1)$ (at level zero and 1st difference).

To study the cointegration of the variables, the ARDL model is estimated using the bounds testing cointegration method proposed by Pesaran, et al. (2001). The general $ARDL\ (p, q)$ model is defined by equation 1.

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots + \beta_p Y_{t-p} + \delta_0 X_t + \delta_1 X_{t-1} + \delta_2 X_{t-2} + \cdots + \delta_p X_{t-q} + \epsilon_t \qquad (1)$$

With $\epsilon_t\ i.i.d \sim N(0,1)$

β_i are the coefficients of the short-term dynamics of the model, while, δ_j are coefficients that show the long-term relationship. If there are several variables X_l, X_{t-j} will be replaced by $X_{l,t-2}$ and δ_j will be replaced by δ_{lj} respecting the number of lags for each variable X_l

This formulation can be expressed in a reduced form by equation 2.

$$Y_t = \beta_0 + \sum_{i=1}^{p} \beta_i Y_{t-i} + \sum_{j=0}^{q} \delta_j X_{t-j} + \epsilon_t \qquad (2)$$

To study the relationship between the variable Y_t and the explanatory variables X_t, it is necessary to satisfy the stationarity condition for these variables. For this reason, the study uses the Augmented Dickey-Fuller test and the Phillips-Perron test. These tests consist of estimating the three models:

$$[1] : X_t - X_{t-1} = D(X_t) = (\varphi_1 - 1) X_{t-1}$$

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[2] : $X_t - X_{t-1} = D(X_t) = (\varphi_1 - 1)X_{t-1} + c$
[3] : $X_t - X_{t-1} = D(X_t) = (\varphi_1 - 1)X_{t-1} + c + bt$

Furthermore, the use of the cointegration approach by ARDL model in the study of the effect on financial inclusion of the variables "financial innovation", "financial development" and "economic growth" can be a powerful tool for effectively forecasting the future evolution of financial inclusion in order to readjust government policies. Indeed, the estimation steps of the ARDL and ECM model are as follows:

Step 1: The long-term relationship between the variables

To assess the presence of a long-term relationship between the variables, the approach consists of using the critical values proposed by Pesaran, et al (2001). These critical values consist of a lower limit, assuming that all the variables are $I(0)$, and an upper limit, assuming that all the variables are $I(1)$. If the calculated F-statistic value exceeds the upper critical value, the null hypothesis (H_0: no cointegration) is rejected in favor of the alternative hypothesis, indicating the existence of cointegration between the variables. Otherwise, the H_0 hypothesis is not rejected.

In fact, the definition of the model ARDL (p, q_1, q_2...... q_i) and the H_0 hypothesis is formulated by the equations 3, 4 and 5.

$$\Delta Y_t = \mu + \sum_{i=1}^{n} \beta_i \Delta Y_{t-i} + \sum_{i=1}^{n} \varphi_i \Delta X_{t-i} + \alpha_1 Y_{t-1} + \alpha_1 X(1)_{t-1} + \alpha_2 X(2)_{t-1} + \cdots + \alpha_p X(p)_{t-1} + \varepsilon_t \quad (3)$$

With :

$$\sum_{i=1}^{n} \varphi_i \Delta X_{t-i} = \sum_{i=1}^{n} \gamma_{1i} \Delta X(1)_{t-i} + \sum_{i=1}^{n} \gamma_{2i} \Delta X(2)_{t-i} \sum_{i=1}^{n} \gamma_{3i} \Delta X(3)_{t-i} + \cdots + \sum_{i=1}^{n} \gamma_{Pi} \Delta X(p)_{t-i} \quad (4)$$

$$H_0: \alpha_0 = \alpha_1 = \alpha_2 = \cdots = \alpha_p = 0 \quad (5)$$

n is the maximum lag order of the ARDL model, chosen by the user.

Step 2: Choosing the appropriate lag length for the ARDL model.

In order to select the appropriate model of the long-term equation, it is necessary to determine the optimal lag length (k) using appropriate model order selection criteria such as the Akaike Information Criterion (AIC), the Bayesian Schwarz Criterion (SBC) or the Hannan-Quinn Criterion (HQC). Therefore, this study uses the AIC criteria

Step 3 : Model validation test.

To validate the ARDL model, the empirical study uses diagnostic tests such as the white noise test, the autocorrelation test, the Breusch-Godfrey LM serial correlation test, the heteroskedasticity test, the Jarque-Bera test and stability tests using the CUSUM of squares test.

Step 4: Transformation of the ARDL model into an error-correction model

The error correction model is defined by equation 6.

$$\Delta Y_t = \mu + \sum_{i=1}^{n} \beta_i \Delta Y_{t-i} + \sum_{i=1}^{n} \varphi_i \Delta X_{t-i} - \rho V_{t-1} + \varepsilon_t \quad (6)$$

With

$V_{t-1} = Y_{t-1} - \alpha_1 X(1)_{t-1} - \alpha_2 X(2)_{t-1} - \alpha_3 X(3)_{t-1} - \cdots - \alpha_p X(p)_{t-1} - cte$

If X_{t-i} is composed of p variables $X(i)$.

3.2. Granger Causality Test

Let X and Y be two variables, X causes Y in the Granger sense if the past values of X have explanatory power over the current values of Y.

For the error correction model, which is written as:

$$\Delta Y_t = \mu + \sum_{i=1}^{n} \beta_i \Delta Y_{t-i} + \sum_{i=1}^{n} \varphi_i \Delta X_{t-i} - \rho V_{t-1} + \varepsilon_t$$

The Past values of X appear in the terms $\sum_{i=1}^{n} \varphi_i \Delta X_{t-i}$. This implies that the null hypothesis of the Granger test is defined as follows:

H_0: $\varphi_i = \rho = 0$ (X does not Granger Cause)

To test this hypothesis, the test statistic is a Fisher where the values are compared with the tabulated values. The hypothesis is rejected if the p-value is below the critical threshold of 0.05.

4. Empirical Results

The empirical study of the effect of financial development, financial innovation and economic growth on financial inclusion makes it possible to determine the effect of each variable as well as the causal links between its variables. Indeed, this paragraph is dedicated to the definition of the measurement elements of the different variables as well as the empirical results of the estimation of the ARDL model and the MCE model.

4.1. Definition of Variables

In the previous paragraph, growth is quantified by the change in gross domestic product (GDP), financial innovation is quantified by the $\frac{M_2}{M_1}$ ratio and financial development is quantified by the financial development index.

For financial inclusion, we have constructed a financial inclusion index based on three factors:

- X_1 : Bank loans as a percentage of GDP ($\%GDP$) based on Bank Al Maghreb databases.
- X_2 : Domestic credit provided to the private sector by banks as a percentage of GDP (% of GDP), for which the data used come from the International Monetary Fund (IMF) databases.
- X_3 : Gross savings as a percentage of GDP (% of GDP) using data from the International Monetary Fund (IMF) databases.

To calculate the financial inclusion index (FII), as an indicator of financial inclusion, we will use the approach of Sarma and Pais (2008) and Sarma (2012) for the construction of the financial inclusion index. The index consists of three basic dimensions associated with the factors (X_1), (X_2) and (X_3). The dimension index for the l-th factor, F_l , is calculated by equation N° 7.

$$F_l = \omega_l \frac{X_l - m_l}{M_l - m_l} \quad (7)$$

with

F_l is the dimension index for the l-th factor; ω_l is the weight attached to the factor l, $0 \leq \omega_l \leq 1$; X_l is the real value of the factor l ; M_l is the upper limit of the value of the factor l; m_l is the lower limit of the value of the factor l.

Equation (7) ensures that $0 \leq F_l \leq 1$. The higher the value of F_l the better the country performs in terms of factor l. Each factor is assumed to have a function of equal importance, so the weight attached to each dimension is $\omega_l = 1$.

The first step is to calculate Y_{i1} and Y_{i2}. The values of Y_{i1} and Y_{i2} are calculated by the following equations (8) and (9):

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$$Y_{i1} = \frac{\sqrt{F_{i1}^2+F_{i2}^2+F_{i3}^2}}{\sqrt{\omega_1^2+\omega_2^2+\omega_3^2}} = \frac{\sqrt{F_1^2+F_2^2+F_3^2}}{\sqrt{3}} \quad (8)$$

$$Y_{i2} = \frac{\sqrt{(\omega_1-F_{i1})^2+(\omega_2-F_{i2})^2+(\omega_3-F_{i3})^2}}{\sqrt{\omega_1^2+\omega_2^2+\omega_3^2}} = \frac{\sqrt{(1-F_{i1})^2+(1-F_{i2})^2+(1-F_{i3})^2}}{\sqrt{3}} \quad (9)$$

To calculate the financial inclusion index for each year i (IIF_i), we take the simple average of Y_{i1} and Y_{i2} calculated by the following equation (10):

$$IIF_i = \frac{1}{2}[Y_{i1} + Y_{i2}] \quad (10)$$

4.2. Presentation of the ARDL Model

To examine the problematic of this study, financial inclusion will be considered as a production function of the elements of the index constructed previously, namely bank credit, domestic credit and deposits. Consequently, the Cobb Douglas function is used to model the relationship between financial inclusion (IFI) and the five variables chosen financial development (FD), economic growth (GDP), financial innovation (IVF), inflation (Inf) and the monetary interest rate (R).

The Cobb Douglas function is defined by equation (11).

$$IFI = \alpha_0 PIB^{\alpha_1} FD^{\alpha_2} IVF^{\alpha_3} INF^{\alpha_4} R^{\alpha_5} \quad (11)$$

Using the logarithmic function, we will transform this relationship into a log-linear relationship defined by equation (12).

$$Ln(IFI) = \ln(\alpha_0) + \alpha_1 \ln(PIB) + \alpha_2 \ln(FD) + \alpha_3 \ln(IVF) + \alpha_4 \ln(INF) + \alpha_5 \ln(R) \quad (12)$$

Consequently, we can formulate the ARDL model as follows:

$$\Delta lnIFI_{,t} = \mu + \sum_{i=1}^{n} \beta_i \Delta lnIFI_{,t-i} + \sum_{i=1}^{q} \varphi_i \Delta \ln(PIB)_{t-i} + \sum_{i=1}^{p} \theta_i \Delta \ln(FD)_{t-i} + \sum_{i=1}^{r} \gamma_i \Delta \ln(IVF)_{t-i} + \sum_{i=1}^{l} \pi_i \Delta \ln(INF)_{t-i} + \sum_{i=1}^{m} \omega_i \Delta \ln(R)_{t-i} + c_0 lnIFI_{,t-1} + \alpha_1 \ln(PIB)_{t-1} + \alpha_2 \ln(FD)_{t-1} + \alpha_3 \ln(IVF)_{t-1} + \alpha_4 \ln(INF)_{t-1} + \alpha_5 \ln(R)_{t-1} + \varepsilon_t$$

The error correction model is defined by equation (13).

$$\Delta lnIFI_t = \mu + \mu + \sum_{i=1}^{n} \beta_i \Delta lnIFI_{t-i} + \sum_{i=1}^{q} \varphi_i \Delta \ln(PIB)_{t-i} + \sum_{i=1}^{p} \theta_i \Delta \ln(FD)_{t-i} + \sum_{i=1}^{r} \gamma_i \Delta \ln(IVF)_{t-i} + \sum_{i=1}^{l} \pi_i \Delta \ln(INF)_{t-i} + \sum_{i=1}^{m} \omega_i \Delta \ln(R)_{t-i} - \rho V_{t-1} + \varepsilon_t \quad (13)$$

with

$$V_{t-1} = lnIFI_{t-1} + \tau_1 \ln(PIB)_{t-1} + \tau_2 \ln(FD)_{t-1} + \tau_3 \ln(IVF)_{t-1} + \tau_4 \ln(INF)_{t-1} + \tau_5 \ln(R)_{t-1} - cte$$

4.3. Descriptive Analysis

The database used is made up of 33 observations of each variable concerning annual data covering the period from 1990 to 2022. For descriptive statistics, Table 1 summarizes the characteristics of each series:

Table 1.
Descriptive analysis.

Series	Mean	Median	Standard deviation	Kurtosis	Skewness
$Ln(IFI)$	-0.0026	-0.0020	0.0015	2.0065	-0.4733
$Ln(BIP)$	27,18012	27,2260	0,5202	1,7462	-0,2403
$Ln(FD)$	-1.3348	-1.2560	0.3030	2.2852	-0.8124
$Ln(IVF)$	0.1620	0.1660	0.0152	3.0234	-0.6301
$Ln(INF)$	0.5878	0.4910	0.8557	2.1758	0.0591
$Ln(R)$	1.3152	1.1720	0.5612	2.4515	0.6096

The time series graphs are shown in Figure 1.

Figure 1.
Series plot of exogenous and endogenous variables.

To determine the order of integration of each series we will use the level and first difference collegrams. Indeed, the results presented in Fig.2A, concerning $ln(IFI)$, $Ln(BIP)$, $Ln(FD)$, $Ln(IVF)$

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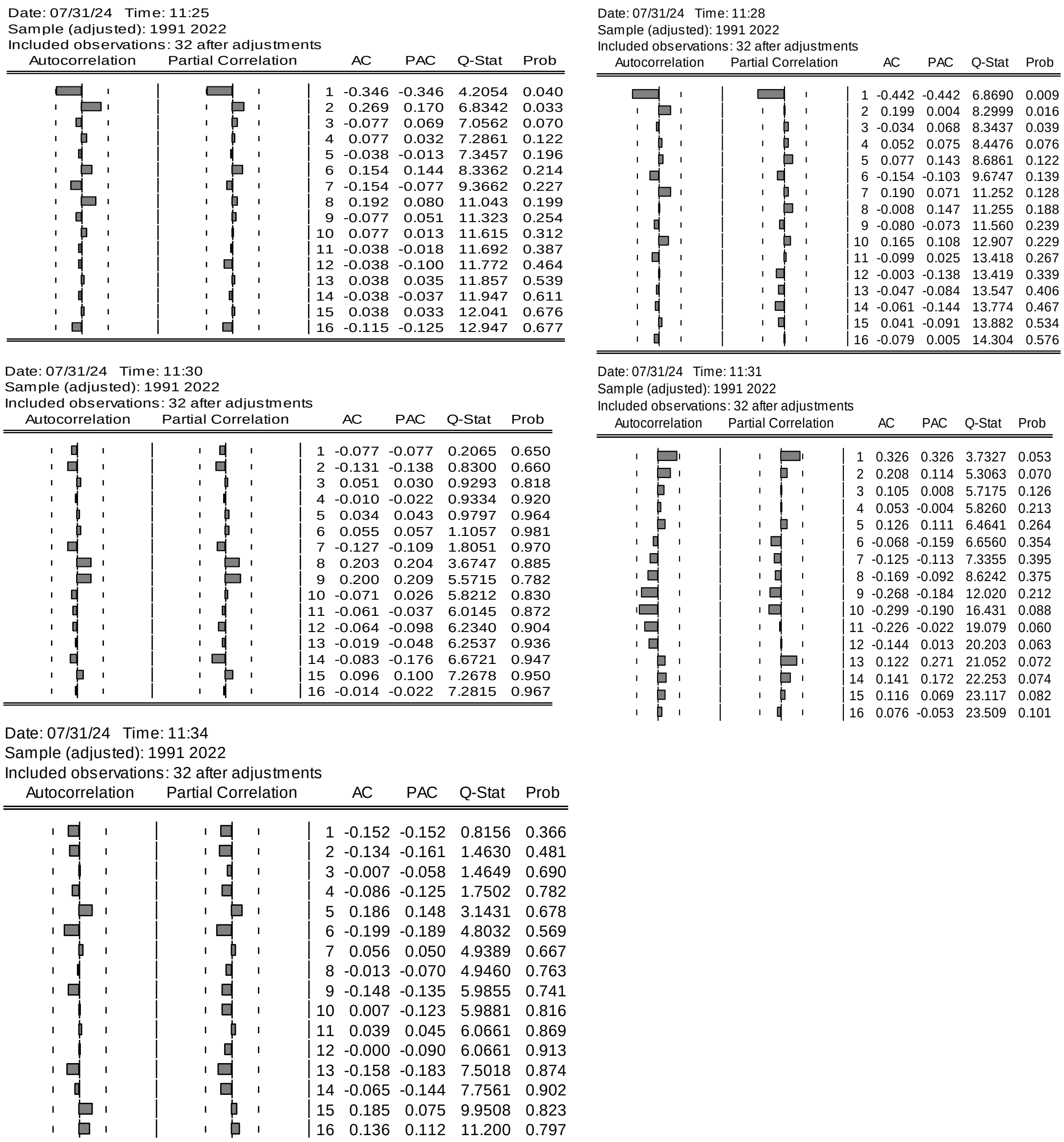
and $Ln(R)$ show that the first autocorrelation is significant, which means that they are of the order of $I(1)$.



Date: 07/31/24 Time: 11:25
Sample (adjusted): 1991 2022
Included observations: 32 after adjustments

	AC	PAC	Q-Stat	Prob
1	-0.346	-0.346	4.2054	0.040
2	0.269	0.170	6.8342	0.033
3	-0.077	0.069	7.0562	0.070
4	0.077	0.032	7.2861	0.122
5	-0.038	-0.013	7.3457	0.196
6	0.154	0.144	8.3362	0.214
7	-0.154	-0.077	9.3662	0.227
8	0.192	0.080	11.043	0.199
9	-0.077	0.051	11.323	0.254
10	0.077	0.013	11.615	0.312
11	-0.038	-0.018	11.692	0.387
12	-0.038	-0.100	11.772	0.464
13	0.038	0.035	11.857	0.539
14	-0.038	-0.037	11.947	0.611
15	0.038	0.033	12.041	0.676
16	-0.115	-0.125	12.947	0.677

Date: 07/31/24 Time: 11:28
Sample (adjusted): 1991 2022
Included observations: 32 after adjustments

	AC	PAC	Q-Stat	Prob
1	-0.442	-0.442	6.8690	0.009
2	0.199	0.004	8.2999	0.016
3	-0.034	0.068	8.3437	0.039
4	0.052	0.075	8.4476	0.076
5	0.077	0.143	8.6861	0.122
6	-0.154	-0.103	9.6747	0.139
7	0.190	0.071	11.252	0.128
8	-0.008	0.147	11.255	0.188
9	-0.080	-0.073	11.560	0.239
10	0.165	0.108	12.907	0.229
11	-0.099	0.025	13.418	0.267
12	-0.003	-0.138	13.419	0.339
13	-0.047	-0.084	13.547	0.406
14	-0.061	-0.144	13.774	0.467
15	0.041	-0.091	13.882	0.534
16	-0.079	0.005	14.304	0.576

Date: 07/31/24 Time: 11:30
Sample (adjusted): 1991 2022
Included observations: 32 after adjustments

	AC	PAC	Q-Stat	Prob
1	-0.077	-0.077	0.2065	0.650
2	-0.131	-0.138	0.8300	0.660
3	0.051	0.030	0.9293	0.818
4	-0.010	-0.022	0.9334	0.920
5	0.034	0.043	0.9797	0.964
6	0.055	0.057	1.1057	0.981
7	-0.127	-0.109	1.8051	0.970
8	0.203	0.204	3.6747	0.885
9	0.200	0.209	5.5715	0.782
10	-0.071	0.026	5.8212	0.830
11	-0.061	-0.037	6.0145	0.872
12	-0.064	-0.098	6.2340	0.904
13	-0.019	-0.048	6.2537	0.936
14	-0.083	-0.176	6.6721	0.947
15	0.096	0.100	7.2678	0.950
16	-0.014	-0.022	7.2815	0.967

Date: 07/31/24 Time: 11:31
Sample (adjusted): 1991 2022
Included observations: 32 after adjustments

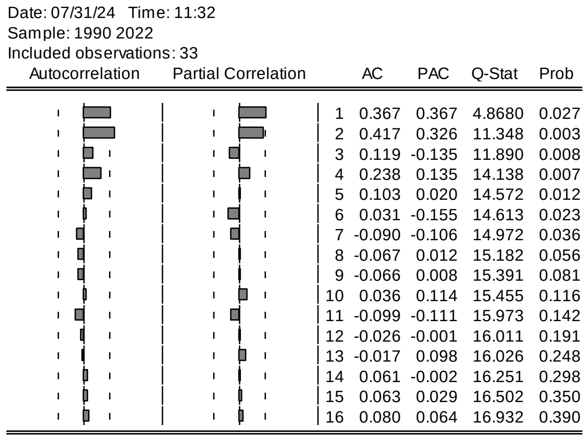
	AC	PAC	Q-Stat	Prob
1	0.326	0.326	3.7327	0.053
2	0.208	0.114	5.3063	0.070
3	0.105	0.008	5.7175	0.126
4	0.053	-0.004	5.8260	0.213
5	0.126	0.111	6.4641	0.264
6	-0.068	-0.159	6.6560	0.354
7	-0.125	-0.113	7.3355	0.395
8	-0.169	-0.092	8.6242	0.375
9	-0.268	-0.184	12.020	0.212
10	-0.299	-0.190	16.431	0.088
11	-0.226	-0.022	19.079	0.060
12	-0.144	0.013	20.203	0.063
13	0.122	0.271	21.052	0.072
14	0.141	0.172	22.253	0.074
15	0.116	0.069	23.117	0.082
16	0.076	-0.053	23.509	0.101

Date: 07/31/24 Time: 11:34
Sample (adjusted): 1991 2022
Included observations: 32 after adjustments

	AC	PAC	Q-Stat	Prob
1	-0.152	-0.152	0.8156	0.366
2	-0.134	-0.161	1.4630	0.481
3	-0.007	-0.058	1.4649	0.690
4	-0.086	-0.125	1.7502	0.782
5	0.186	0.148	3.1431	0.678
6	-0.199	-0.189	4.8032	0.569
7	0.056	0.050	4.9389	0.667
8	-0.013	-0.070	4.9460	0.763
9	-0.148	-0.135	5.9855	0.741
10	0.007	-0.123	5.9881	0.816
11	0.039	0.045	6.0661	0.869
12	-0.000	-0.090	6.0661	0.913
13	-0.158	-0.183	7.5018	0.874
14	-0.065	-0.144	7.7561	0.902
15	0.185	0.075	9.9508	0.823
16	0.136	0.112	11.200	0.797

Figure 2A.
Collegrams

For the variable $L(INF)$, no autocorrelation is significant which means that it is integrated of order $I(0)$. The results are shown in Figure 2B.



Date: 07/31/24 Time: 11:32
Sample: 1990 2022
Included observations: 33

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.367	0.367	4.8680	0.027
		2	0.417	0.326	11.348	0.003
		3	0.119	-0.135	11.890	0.008
		4	0.238	0.135	14.138	0.007
		5	0.103	0.020	14.572	0.012
		6	0.031	-0.155	14.613	0.023
		7	-0.090	-0.106	14.972	0.036
		8	-0.067	0.012	15.182	0.056
		9	-0.066	0.008	15.391	0.081
		10	0.036	0.114	15.455	0.116
		11	-0.099	-0.111	15.973	0.142
		12	-0.026	-0.001	16.011	0.191
		13	-0.017	0.098	16.026	0.248
		14	0.061	-0.002	16.251	0.298
		15	0.063	0.029	16.502	0.350
		16	0.080	0.064	16.932	0.390

Figure 2B.
Collegrams du $Ln(Inf)$.

4.3. Stationarity Tests for Series

The results of the stationarity tests according to the three models defined above, for each series, are detailed below.

For the $Ln(IFI)$ series, the T-statistics of the Dickey Fuller test at the first difference for the three models are respectively (-8.599102), (-8.455550), (-9.002514) which correspond to a p-value of (0.0000) and the T-statistics of the Phillips-Perron test are (-8.630235), (-8.525221), (-9.002514) which correspond to a p-value of (0.0000). These results show that the p-values of the three models are less than 5%, so the series is stationary at first difference. Analysis of the Phillips-Perron test shows the same results. Consequently, the series ln (IFI) is integrated of order $I(1)$.

For the $Ln(GDP)$ series, the T-statistics of the Dickey Fuller test for at the first difference the three models are (-0.810281) which corresponds to a p-value of (0.3562) greater than 5% for the first model and respectively (-9.094314), (-9.729962) for the last two models which correspond to a p-value of (0.0000). Similarly, the T-statistics of the Phillips-Perron test are (-4.284683) which corresponds to a p-value of (0.0001) greater than 5% for the first model and respectively (-8.975558), (-11.15328) for the last two models which correspond to a p-value of (0.0000). The results show that for the first model we cannot reject the H_0, hypothesis, which means that the series is not stationary. On the other hand, the p-value of models 2 and 3 are less than 5%, so the series is stationary at the first difference with constant. Analysis of the Phillips-Perron test allows us to accept stationarity for all three models. Consequently, according to Dickey Fuller, the $ln(GDP)$ series is integrated of order $I(1)$.

For the $Ln(FD)$ series, the T-statistics of the Dickey Fuller test for the three models are respectively (-5.067849), (-5.842465), (-4.515374) which correspond to a p-value of (0.0000) for the first two models and a p-value of (0.0073) for the third model. The T-statistics of the Phillips-Perron test are (-5.070490), (-5.863540), (-5.842465) which correspond to a p-value of (0.0000). The results of the two tests (Dickey Fuller and Phillips-Perron) show that the p-values of the three models are less than 5%, so the series is stationary at first difference. Consequently, the $ln(FD)$ series is integrated of order $I(1)$.

For the $Ln(IVF)$ series, the T-statistics of the Dickey Fuller test for the three models are respectively (-4.303972), (-4.165840), (-4.450721) which correspond respectively to p-values of (0. 0001), (0.0028), (0.0067) and the T-statistics of the Phillips-Perron test are (-4.319977), (-4.186593), (-4.485071) which correspond respectively to p-values of (0.0001), (0.0027), (0.0062). The results of the two tests show that the p-values of the three models are less than 5%, so the series is stationary at first difference. Consequently, the $ln(IVF)$ series is integrated of order $I(1)$.

For the $Ln(INF)$ series, the stationarity test showed stationarity at the zero level. The T-statistics of the Dickey Fuller test for the three models are (-2.876550), (-3.613831) and (-4.058946) respectively,

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corresponding to p-values of (0.0054), (0.0110) and (0.0165). The T-statistics of the Phillips-Perron test are (-2.689102), (-3.568474), (-4.136338) which correspond respectively to p-values of (0.0088), (0.0123), (0.0138). The results of the two tests show that the p-values of the three models are less than 5%, so the series is stationary at the (0) level. Consequently, the $ln(Inf)$ series is integrated of order $I(0)$.

Finally, for the Ln(R) series, the T-statistics of the Dickey Fuller test for the three models are respectively (-5.769268), (-6.037527), (-6.022211) which correspond respectively to p-values of (0. 0000), (0.0000), (0.0001) respectively and the T-statistics of the Phillips-Perron test are (-5.768639), (-6.047517), (-6.176665) which correspond to p-values of (0.0000), (0.0000), (0.0001) respectively.

The results of the two tests show that the p-values of the three models are less than 5%, so the series is stationary at first difference. Consequently, the $ln(R)$ series is integrated of order $I(I)$.

In summary, the series used are either integrated of order $I(1)$ or of order $I(0)$. The Table N° 2 summarises the results.

Table 2.
Level of series integration.

Series	Integration level
$Ln(BIP)$	I(1)
$Ln(FD)$	I(1)
$Ln(IVF)$	I(1)
$Ln(IFI)$	I(1)
$Ln(INF)$	I(0)
$Ln(R)$	I(1)

4.4. Optimal ARDL Model and Estimation of the Chosen Model

In this step, we will identify the optimal ARDL model. The Akaike Information Criterion (AIC) will be used to select the model. Figure 3 presents the results.

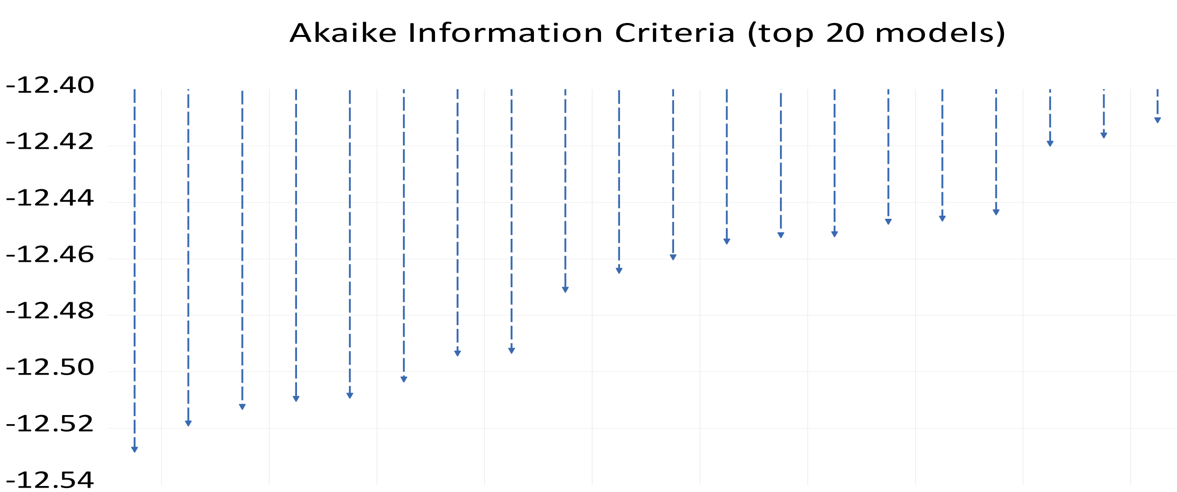

Figure 3.
Optimal ARDL model

Figure 3 shows that the optimal ARDL model is the ARDL (3,3,1,2,3,3) model which minimizes the AIC criterion. Therefore, this is the model that will be retained for the remainder of this study as it provides statistically significant results with the minimum of parameters.

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The parameters of the models are estimated using Eviews. The estimation results are summarized in equation 14.

$$\begin{aligned} LNIFI = \; & 0.0859 * LNIFI(-1) + 0.4886 * LNIFI(-2) - 0.3431 * LNIFI(-3) \\ & + 0.0010 * LNPIB + 0.0020 * LNPIB(-1) - 0.0043 * LNPIB(-2) \\ & -0.0044 * LNPIB(-3) + 0.0023 * LNFD + 0.0017 * LNFD(-1) \\ & +0.0188 * LNIVF - 0.0233 * LNIVF(-1) + 0.0298 * LNIVF(-2) \\ & + 0.0005 * LNINF - 0.0001 * LNINF(-1) - 0.0005 * LNINF(-2) \\ & +0.0005 * LNINF(-3) - 0.0004 * LNR + 0.0006 * LNR(-1) \\ & -0.0008 * LNR(-2) - 0.0016 * LNR(-3) + 0.1566 \end{aligned} \quad (14)$$

The cointegration equation is defined by the equation (15).

$$\begin{aligned} D(LNIFI) = \; & -0.7686 * (LNIFI(-1) - (-0.0074 * LNPIB(-1) + 0.0052 * LNFD(-1) \\ & + 0.0329 * LNIVF(-1) + 0.0005 * LNINF(-1) - 0.0030 \\ & * LNR(-1) \; 0.2037)) \end{aligned} \quad (15)$$

Diagnostic Tests

Diagnostic tests include Residual White Noise Test, Residual Autocorrelation Test, Heteroscedasticity Test, Residual Normality Test and Model Stability Test.

The white noise test verifies that the model's residuals form white noise. The hypothesis H_0 : "no autocorrelation of the residuals up to order k" is tested against H_1 : "autocorrelation of the residuals to order k", using the Q-statistic test of Ljung-Box.

In terms of decision-making, the test uses the sum of autocorrelations in the series, which is distributed according to a chi-square distribution. If the associated probability is less than 0.05, we reject hypothesis H_0 : "no autocorrelation" and accept hypothesis H_1: "autocorrelation of residuals to order k". The results of the test are shown in Figure 4.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	-0.096	-0.096	0.3033	0.582
		2	-0.109	-0.119	0.7124	0.700
		3	-0.033	-0.057	0.7506	0.861
		4	0.038	0.015	0.8028	0.938
		5	-0.312	-0.325	4.5333	0.475
		6	-0.051	-0.133	4.6357	0.591
		7	0.091	-0.011	4.9781	0.663
		8	-0.031	-0.098	5.0201	0.755
		9	0.124	0.128	5.7185	0.768
		10	-0.179	-0.305	7.2523	0.701
		11	0.121	0.051	7.9871	0.714
		12	0.005	-0.003	7.9884	0.786
		13	0.023	-0.029	8.0192	0.842
		14	-0.089	0.014	8.4903	0.862
		15	0.064	-0.112	8.7522	0.890
		16	-0.065	-0.070	9.0386	0.912

Figure 4.
White noise test

Analysis of the correlogram shows that the probabilities of all orders are greater than 5%, which means that we cannot reject the hypothesis H_0 : "no autocorrelation", and consequently the residuals of the model behave like white noise.

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To test autocorrelation, the Breusch-Godfrey LM serial correlation test shows that there is no serial correlation in the model. The F-statistic of the test is equal to 0.346150, i.e. a p-value of 0.7189 greater than 5%, so the residuals are not autocorrelated.

To test for heteroscedasticity, we will use the Breusch-Pagan-Godfrey test. In fact, the F statistic is equal to 0.583764 with a p-value equal to 0.8486 greater than 5%, which means that the hypothesis H_0: "heteroscedasticity of errors" cannot be rejected.

The Jarque-Bera test is used to test the normality of series. The hypothesis H_0: "normality of observations" is rejected if the p-value is less than 5%. For the residuals of the model, the H_0 cannot be rejected because the p-value is equal to 0.057113, above the critical value of 0.05.

3.7. Model Stability Test

The stability of the model is verified by the CUSUM of squares test. This test is based on the cumulative sum of the square of the recursive residuals with the hypothesis H_0: " stability of the relationship, between two lines representing the limits of the interval". Applying these tests to Eviews, the results are shown in Figure 5.

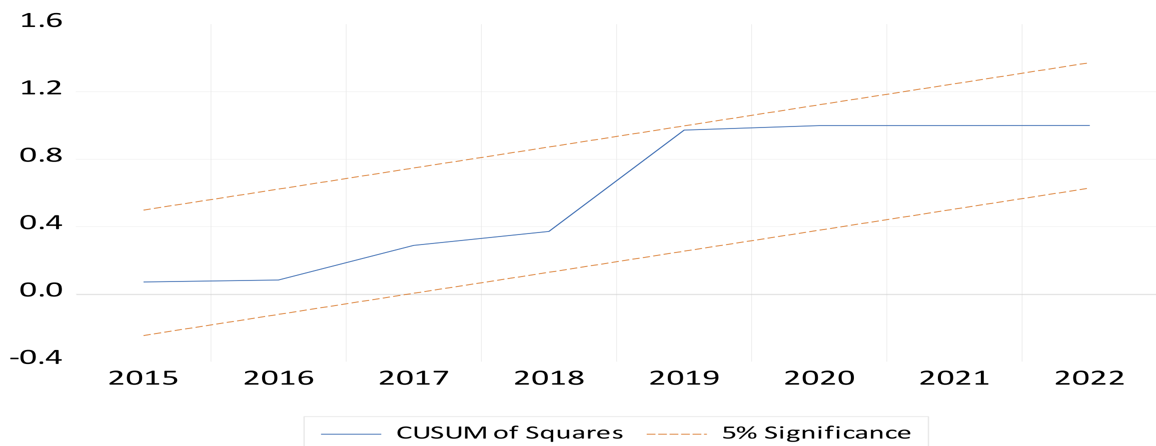

Figure 5.
CUSUM of squares test.

Figure 5 shows that the curve does not leave the dotted corridor, so at the 5% level the model coefficients are stable over time.

In summary, all the diagnostic tests applied led to the validation of our estimated $ARDL$ (3,3,1,2,3,3) model, which is characterised by the reliability of the estimates observed in terms of the absence of autocorrelation, homoscedasticity, normality of the residuals and stability of the coefficients.

4. Cointegration Test at the Bounds

The test results are presented in Table 3. These results show that the value of the F-statistic (F= 3.715253) is greater than the value of the upper bung for the 5% and 10% thresholds. We therefore conclude that there is cointegration between the variables in the model at the 5% threshold. As a result, the short-term and long-term relationship can be estimated.

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Table 3.
Cointegration test at the bounds.

F-bounds test		Null hypothesis: No levels relationship		
Test statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
F-statistic	3.715253	10%	2.08	3
k	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

5. Short-Term Relationship

The error correction model associated with the model ARDL (3,3,1,2,3,3) was estimated to determine the short-term relationship. Table 4 shows the results.

Table 4.
Short-term relationship.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$D(LNIFI(-1))$	-0.145447	0.115529	-1.258967	0.2397
$D(LNIFI(-2))$	0.343198	0.115029	2.983574	0.0154
$D(LNPIB)$	0.001031	0.001988	0.518354	0.6167
$D(LNPIB(-1))$	0.008742	0.001967	4.444335	0.0016
$D(LNPIB(-2))$	0.004424	0.001918	2.306847	0.0465
$D(LNFD)$	0.002327	0.001443	1.613098	0.1412
$D(LNIVF)$	0.018883	0.012493	1.511476	0.1650
$D(LNIVF(-1))$	-0.029831	0.015275	-1.952888	0.0826
$D(LNINF)$	0.000575	0.000154	3.740464	0.0046
$D(LNINF(-1))$	3.58E-06	0.000206	0.017353	0.9865
$D(LNINF(-2))$	-0.000540	0.000142	-3.790970	0.0043
$D(LNR)$	-0.000489	0.000415	-1.176305	0.2696
$D(LNR(-1))$	0.002504	0.000507	4.937452	0.0008
$D(LNR(-2))$	0.001606	0.000532	3.015953	0.0146
$CointEq(-1)*$	-0.768604	0.116744	-6.583663	0.0001
R-squared	0.898138	Mean dependent var		-0.000100
Adjusted R-squared	0.803066	S.D. dependent var		0.000845
S.E. of regression	0.000375	Akaike info criterion		-12.63283
Sum squared resid	2.11E-06	Schwarz criterion		-11.93223
Log likelihood	204.4924	Hannan-Quinn criter.		-12.40870
Durbin-Watson stat	2.152692			

Table 4 shows that the predictive capacity of the model measured by R-squared is fairly high, with a coefficient of 89.8%, which means a correlation coefficient of 94.76%.

The above findings are based on the results of the estimation of the short-term relationship, which shows a negative (-0.768604) and significant (P=0.0001) error correction coefficient. This value means that the adjustment towards long-term equilibrium is 76.86% per year.

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6. Long-Term Relationship

The long-term relationship between financial inclusion and the variables $Ln(BIP)$, $Ln(FD)$, $Ln(IVF)$, $Ln(Inf)$ and $Ln(R)$ is defined in Table 5.

Table 5.
long-term relationship.

Variable	Coefficient	Std. error	t-Statistic	Prob.
$LNPIB$	-0.007425	0.001716	-4.326734	0.0019
$LNFD$	0.005285	0.003618	1.460689	0.1781
$LNIVF$	0.032975	0.040413	0.815933	0.4356
$LNINF$	0.000501	0.000983	0.509477	0.6227
LNR	-0.003009	0.001213	-2.480219	0.0350
C	0.203773	0.052893	3.852525	0.0039

$$EEC = LNIFI - (-0.0074 * LNPIB + 0.0053 * LNFD + 0.0330 * LNIVF + 0.0005 * LNINF - 0.0030 * LNR + 0.2038)$$

The results of the estimation of the long-term relationship show that the coefficients of economic growth and the interbank interest rate ($Ln(PIB)$, $n(R)$) are negative and significant. On the other hand, the coefficients of the other variables $Ln(FD)$, $Ln(IVF)$, $Ln(INF)$ are positive and significant.

7. Granger Causality Test

The results of the Granger causality test are shown in Table N° 6.

Table 6.
Granger causality test.

Null hypothesis	F-Statistic	Prob.
LNPIB does not granger cause LNIFI	5.85156	0.0080
LNIFI does not granger cause LNPIB	0.62570	0.5428
LNFD does not granger cause LNIFI	5.18814	0.0127
LNIFI does not granger cause LNFD	0.37815	0.6888
LNIVF does not granger cause LNIFI	0.04368	0.9573
LNIFI does not granger cause LNIVF	1.40950	0.2623
LNINF does not granger cause LNIFI	0.75447	0.4803
LNIFI does not granger cause LNINF	0.28220	0.7564
LNR does not granger cause LNIFI	2.06112	0.1476
LNIFI does not granger cause LNR	0.21935	0.8045

The results of the Granger causality test show that there is bidirectional causality between financial inclusion ($Ln(IFI)$) and the variables "financial innovation ($Ln(IVF)$)", "inflation ($Ln(INF)$)" and "interest rate ($Ln(R)$)", since the probability is greater than 5%. On the other hand, the test shows that there is a causal relationship in one direction only between financial inclusion and "Economic growth ($Ln(PIB)$)" in that the hypothesis "$Ln(PIB)$ does not Granger Cause $Ln(IFI)$" was rejected with a p-value of 0.008 less than 5%, whereas the hypothesis "$Ln(IFI)$ does not Granger Cause $Ln(PIB)$" cannot be rejected.

Similarly for financial development, the test shows that there is a causality in one direction only between financial inclusion ($Ln(IFI)$) and "financial development ($Ln(FD)$)" because the hypothesis "$Ln(FD)$ does not Granger Cause $Ln(IFI)$" was rejected with a p-value of 0.0127 less than 5%, whereas the hypothesis "$Ln(IFI)$ does not Granger Cause $Ln(FD)$" cannot be rejected.

8. Discussion

The previous results of the ARDL model showed the short- and long-term relationship between "financial inclusion" and "financial development", "financial innovation", "economic growth", "inflation" and "interest rate". This relationship was confirmed by the Granger causality test for the variables "financial innovation", "inflation " and "interest rate" in both directions, whereas it was only one direction for "economic growth" and "financial development".

For the relationship between the variables "financial inclusion" and "economic growth", the results show that there is a positive effect of growth in the long term, whereas it is negative in the short term. The existence of a positive effect has also been noted by other studies, such as Rantnawati (2020), who studied Asian countries, and Sene et al. (2023), who studied the case of Senegal using the ARDL model and found a negative effect in the short term and a positive effect in the long term, and Diaw and Fall (2022), who made the same finding concerning the effect of a single direction, the positive effect in the long term and the negative effect in the short term, by studying the countries of the West African Economic and Monetary Union (UEMOA).

With regard to the relationship between the variables "financial inclusion" and "financial development", the results show a positive effect in the short and long term. Several studies share this observation, including Mathew and Sivaraman (2021), who studied the relationship between the development of the financial sector and the inclusion of life insurance in India, and Qamruzzaman (2023), who studied the case of Arab countries.

As for the positive effect of financial innovation in the short and long term, this result is shared by other researchers such as Qamruzzaman (2023).

With regard to inflation, the results show a positive effect in the short and long term. On the other hand, some studies have shown a negative correlation, such as Oanh and Van (2023). For the interest rate, the results show a negative effect in the short and long term.

9. Conclusion

Based on the empirical results of the ARDL model presented above, we can confirm the positive short- and long-term effect of financial development and financial innovation on financial inclusion in Morocco. As a result, investment in these two areas can promote financial inclusion in the short and long term, thereby helping to reduce poverty and disparities, which are two of the major thrusts of Morocco's new development model.

Furthermore, the study of causality in Granger's sense shows that financial development and financial innovation have a causal relationship in both directions with financial inclusion, while the latter causes economic growth. This shows that investment in financial inclusion can improve growth in Morocco, which is a crucial objective for the new model.

We also found that inflation and the interest rate, which are two instruments of monetary policy, have a positive and a negative effect respectively in the short and long term. This means that monetary stability is a factor to be considered in financial inclusion development policies.

Furthermore, it should be pointed out that this study suffers from certain difficulties, particularly in terms of the availability of data concerning certain dimensions of financial inclusion, such as the number of branches per 100,000 adults and the number of ATMs per 100,000 adults. However, the elements used for the inclusion index are significant in that they represent two key activities in the Moroccan financial market: loans and deposits.

Also, we are convinced that this study could be improved by integrating the impact of foreign investment on financial inclusion. In fact, this factor was not included in the study due to the lack of data, given that Morocco has adopted a new investment charter to encourage foreign investment.

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