

# THE IMPACT OF BANK LOANS ON INFLATION IN ALGERIA ECONOMETRIC STUDY FOR THE PERIOD (2007-2022)

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## ABSTRACT:

This study investigates the impact of bank loans, both short and long term, on the inflation rate in Algeria during the period (2007-2022). The study employs measurement and analytical modelling using the Nonlinear Autoregressive Distributed Lag (NARDL) model, concluding that both short and long-term bank loans have a long-term equilibrium relationship with the inflation rate in Algeria. There is asymmetry in the effects of positive and negative shocks of short-term bank loans in the long run, indicating that negative shocks in the Algerian economy have a different and opposite effect compared to positive shocks in the short term. Additionally, there is no symmetry in the impact, and we accept the alternative hypothesis that there is no long-term symmetry, meaning that negative shocks in the Algerian economy have a different and opposite effect compared to positive shocks in the long term.

**Keywords:** Short-term loans, long-term loans, inflation, NARDL.

## Introduction:

Commercial banks play a crucial role as financial intermediaries in the economy by mobilizing savings from surplus units in the form of deposits and then reallocating these surpluses in the economy through various types of bank loans to deficit economic agents. These loans vary in terms of their amount or duration; some are short-term, often used for consumption or working capital purposes, while others are long-term, typically aimed at financing investment projects. Loans are considered one of the most important forms of money deployment in banks and represent a classical function of banks. Lending functions play an effective role for banks in terms of profitability and for the economy in supporting economic activity. During economic cycles, when investors' returns are delayed and there is a gap between resource collection and expenditure time, there is a need to resort to borrowing to stimulate or expand production, or even when establishing new investments and projects. Despite the potential of bank loan growth to stimulate investment and support economic activity, there is another aspect to bank loans: they represent an injection of additional cash into the economy by the banking system. Excessive growth in the issuance of various types of bank loans contributes to increasing precautionary risks at both the partial and overall levels, resulting in higher costs, which in turn lead to an increase in the general price level. Therefore, although the primary and fundamental objective of monetary policy is to contain and target inflation, banks' neutrality towards systematic policy and the desire for profit through

deploying as much money as possible can lead to inflation. Hence, the main problem of this study arises: **to what extent is the inflation rate in Algeria influenced by the granting of bank loans?**

**Study Hypotheses:** Based on the aforementioned problem, the study adopts a set of hypotheses, the essence of which is that bank loans granted by the banking system are not closely linked to inflation and therefore do not contribute significantly to increasing inflation.

**Study Objectives:** The study encompasses a range of objectives, the most prominent of which include:

- Identifying the extent of penetration of the banking system into the Algerian economy through the volume of bank loans granted.
- Shedding light on the responsiveness of the growing volume of loans granted in Algeria to the evolution of inflation rates.
- Determining the direction of the relationship between bank loans and inflation rate in Algeria.
- Measuring and analyzing the impact exerted by bank loans on the inflation rate in Algeria during the period (2007-2022).

**Significance of the Study:** The significance of the study lies in its investigation into the direction of the relationship between bank loans as a channel of monetary policy and an indicator of overall economic stability, namely inflation, its measurement, and analysis. The study aims to understand the impact of this relationship on the general price level in Algeria. This understanding can lead to the identification of the most suitable and successful size and duration of bank loans granted to the economy, aiming for optimal targeting of the inflation rate.

**Study Methodology:** The study adopted two methodologies. Firstly, it employed the descriptive-analytical approach to study the theoretical literature concerning both bank loans granted by the banking system and inflation rates in Algeria, and to analyze the trend of study variables. Secondly, it utilized statistical methodology with its standard analytical tools to measure the problem statement posed by the study.

#### **Firstly: The Theoretical Background of Bank Loans and Inflation:**

##### **1- Previous Studies:**

- **Study by Radhe Shyam Pradhan, Neelam Timsina Dhungana:** The Impact of Bank Lending on Inflation in Nepal<sup>i</sup>. This study aims to evaluate the effects of bank lending on inflation and suggests ways to improve bank lending to achieve price stability in Nepal. The study conducted correlation and regression analysis using panel models for twenty-four commercial banks during the period from (1996-2015). The empirical results showed that bank lending has a positive impact on inflation in Nepal. The study concluded that there is a positive reflection of bank lending on inflation in Nepal. However, the interest rate has a negative impact on inflation. Therefore, it is recommended that if the central bank wants to contain inflation, it should reduce excessive unproductive lending by commercial banks and attempt to resize the speculative sector.
- **Study by Serhat Yüksel and Mustafa Özşarı:** The Impact of Consumer Loans on Inflation and Current Account Deficit: Toda-Yamamoto Causality Test for Turkey<sup>ii</sup>. This study aims to investigate whether consumer loans are determinants of inflation and current account deficit in Turkey for the period 1994-2015. The study concluded that despite the significant growth of consumer loans during the study period, they are not the cause of high inflation. The quantitative changes in the volume of consumer loans do not lead to monetary inflation or an increase in the

general price level. Similarly, regarding the current account deficit, the Toda-Yamamoto causality test showed that consumer loans granted to individuals in various forms in Turkey do not cause a current account deficit. This means that the problems of inflation and the current account deficit in Turkey are caused by factors other than consumer loans, indicating that reducing consumer loans, as pursued by banking authorities in Turkey, is not the solution to inflation and the current account deficit.

- **Study by BRENDA MIDECHA IMBUGA:** Evaluating the Impact of Inflation on Loan Repayment among Commercial Banks in Kenya<sup>iii</sup>. The main objective of this study is to determine the effects of inflation as one of the macroeconomic variables on loan repayment in commercial banks within the banking sector in Kenya. Delinquent loans were used as the dependent variable, with inflation as the independent variable. The study targeted 10 commercial banks listed on the Nairobi Securities Exchange (NSE) over a period of five years (2008-2012). The study relied on the Kenya National Bureau of Statistics to obtain inflation rates for the study periods. The study utilized the Ordinary Least Squares (OLS) method to estimate the regression equation and test values at a significance level of 5%. The study concluded that an increase in inflation rates affects loan repayment. As inflation rates rise, this affects the interest imposed on loans, leading to increased interest payments by borrowers, which in turn leads to defaults on loan repayment and subsequently an increase in the volume of delinquent loans. Additionally, the study found that inflation has a significant positive relationship in explaining credit risk in commercial banks in Kenya. The study recommended that managers of commercial banks employ flexible approaches to deal with macroeconomic factors, such as inflation, and increase loan loss provisions in times of high inflation and decrease loan loss provisions during periods of low inflation.

## 2- The theoretical literature on banking loans and economic growth:

### 2-1: The theoretical foundation of banking loans:

**2-1-1: The definition of banking loans:** The lending process is defined as the provision of money in exchange for deferring cash payment to a specified future time<sup>iv</sup>. It is also known as "salf" (loan) and facilities provided by banks to their clients<sup>v</sup>. It is considered an important source of financing relied upon by projects for short-term financing operations<sup>vi</sup>. It is a form of investment of clients' funds by achieving their interests, whether they are suppliers or borrowers alike<sup>vii</sup>. It is sought to finance various purposes: consumptive, commercial, investment, and others, according to the credit applicant's need<sup>viii</sup>.

**2-1-2: Types of banking loans:** There are several considerations through which banking loans are classified, and among the most important criteria are: the purpose of the credit and the term criterion, and we will focus on the term criterion as it is the subject of study. Loans are divided according to this criterion into:

- **Short-term loans:** These are loans with a duration usually of one year or less, used to finance regular and ongoing production costs<sup>ix</sup>. Their duration is usually one year and does not exceed two years at most. They mostly take the form of credit facilities such as overdrafts, revolving credits, and others<sup>x</sup>.
- **Medium-term loans:** These loans are aimed at financing investments that exceed one year and do not exceed seven years, such as loans for financing equipment and tools<sup>xi</sup>.

- **Long-term loans:** These are loans with a duration exceeding seven years and can extend up to twenty years. They are directed towards financing permanent investments, such as acquiring real estate, land, buildings, and others<sup>xii</sup>.

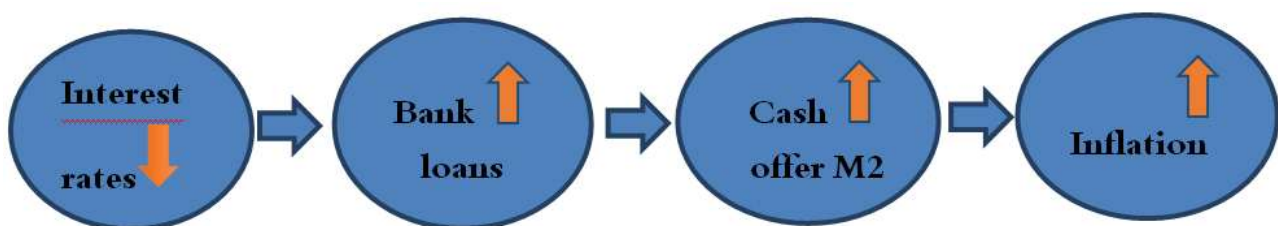
## 2-2: The theoretical foundation of inflation:

**2-2-1: Definition of Inflation:** The term inflation refers to consecutive increases in the overall level of prices that persist for a certain period<sup>xiii</sup>. Inflation can be defined as any increase in effective total demand exceeding the total supply of goods and products over a specific period, leading to an increase in the overall level of prices. In other words, inflation represents pressure of total demand on goods and services, surpassing the total available supply of output from these goods and services. In such a scenario, the increase in total demand translates into an increase in the overall level of prices<sup>xiv</sup>.

Inflation is the continuous rise in the general level of prices or a decrease in the value of money over a specific period. Some economists often attribute inflation to an increase in the quantity of circulating money<sup>xv</sup>.

**2-2-2: Causes of Inflation:** <sup>xvi</sup>If we want to eliminate inflation, we must first understand what causes it. Among the causes of inflation are government overspending, monopolies, greedy labour unions, military expenditures, budget deficits, as well as anything that slows down the economic growth rate will increase the inflation rate. Increased government regulation may slow down the rate of technological change in growth and thus cause inflation. However, the expansion of the money supply is the main cause of inflation.

**3- The Relationship between Banking Loans and Inflation:** Banks pay interest rates on savings to attract depositors' funds. They also earn returns from the interest rate against the money they lend from their deposits. When interest rates are low, individuals and companies tend to seek more loans. Each bank loan injects an additional cash flow into the market, increasing the money supply in the economy. According to the quantity theory of money, an increasing money supply leads to inflation. Therefore, low interest rates tend to increase banking loans and consequently increase inflation. High interest rates tend to decrease the volume of banking loans granted, thus reducing inflation. So, theoretically, banking loans have a positive relationship with inflation.



**Secondly: Measuring the impact of bank loans on inflation using the NARDL model:**

### 1- Methodology and Tools:

**1-1: Study Variables:** The selection of study variables was based on economic theory and previous studies. The following study variables were chosen:

- **Inflation (INF):** It is defined as a continuous rise in the general level of prices, leading to a decrease in the purchasing power of money over a certain period. It is caused by two real factors: changes in demand and supply<sup>xvii</sup>, as a dependent variable.

- **Short-Term Bank Loans (STL):** These represent amounts granted to individuals and institutions, usually with a duration of no more than a year, primarily used to finance business activities of establishments<sup>xviii</sup>. It is considered an explanatory variable.
- **Medium and Long-Term Bank Loans (LTL):** These loans are aimed at financing certain capital-intensive operations undertaken by projects, such as making modifications to improve production for expansion purposes, as well as financing large projects. The duration of these loans ranges from 5 to 7 years. It is also considered an explanatory variable.

Data for the study variables were collected from accredited sources, with the World Bank database being used for inflation data, and the Algerian Bank website for short and long-term loan data.

**1-2- Model Specifications:** In order to determine the relationship between the dependent variable and the explanatory variables and to monitor the magnitude of the effects between them, it is necessary to specify a model that defines this. It is expected that the general form of the study model will take the following equation:

$$INF_t = f(STL_t, LTL_t) \dots\dots\dots (01)$$

The EViews 12 econometric software was used to estimate the model and extract the results.

**1-3- Methodology Used:** In order to obtain results for describing and analyzing the study, several statistical tests should be conducted to achieve the best and most accurate results in order to provide the correct interpretation of the studied phenomenon. Among these methods and tests used are the following:

**1-3-1 Unit Root Test for the Stability of Time Series:** Unit root tests not only detect the general trend component but also help identify the appropriate method to make the series stable. Among these tests is the Augmented Dickey-Fuller (ADF) test. ADF tests are based on the hypothesis H1:  $|\phi| < 1$  and on the estimation using the least squares method according to the following formula<sup>xix</sup>:

$$\partial y_t = \rho y_{t-1} - \sum_{j=2}^p \phi_j \partial y_{t-j} + c + bt + \varepsilon_t \dots\dots\dots (02)$$

$$\partial y_t = \rho y_{t-1} - \sum_{j=2}^p \phi_j \partial y_{t-j} + c + \varepsilon_t \dots\dots\dots (03)$$

$$\partial y_t = \rho y_{t-1} - \sum_{j=2}^p \phi_j \partial y_{t-j} + \varepsilon_t \dots\dots\dots (04)$$

The hypothesis H1 mentioned above is tested through a statistical comparison (T) of the estimated parameter ( $\phi$ ) with the table values of the Augmented Dickey-Fuller (ADF) test as well using Mackinnon's (1991) method. If the absolute value of the estimated statistical (T) exceeds the absolute value of (ADF), it is statistically significant, and thus we reject the null hypothesis of the presence of a unit root<sup>xx</sup>, indicating that the time series is stable. If it is less than the critical value, we cannot reject the unit root, indicating that the time series is unstable. Consequently, we test the stability of the first differences of the series. If the series is stable in its first differences, then it is integrated of order one; if not, we repeat the test for differences of higher orders<sup>xxi</sup>.

**1-3-2 Nonlinear Autoregressive Distributed Lag (NARDL) Model Test:**

The NARDL model is a nonlinear extension of the ARDL model developed by Nimmo Greenwood - Yu Shin in 2014. The NARDL model allows us to test nonlinear relationships in both the short and long run simultaneously and analyze positive and negative shocks<sup>xxii</sup>. It takes into account data asymmetry, meaning that when disaggregating the variables, we find an asymmetric effect of positive and negative shocks of the independent variables on the dependent variable. Thus,

economic deviations or shocks that occur to the variables may have different rates of adjustment to reach equilibrium or potential paths<sup>xxiii</sup>.

The NARDL model has several advantages, including<sup>xxiv</sup>:

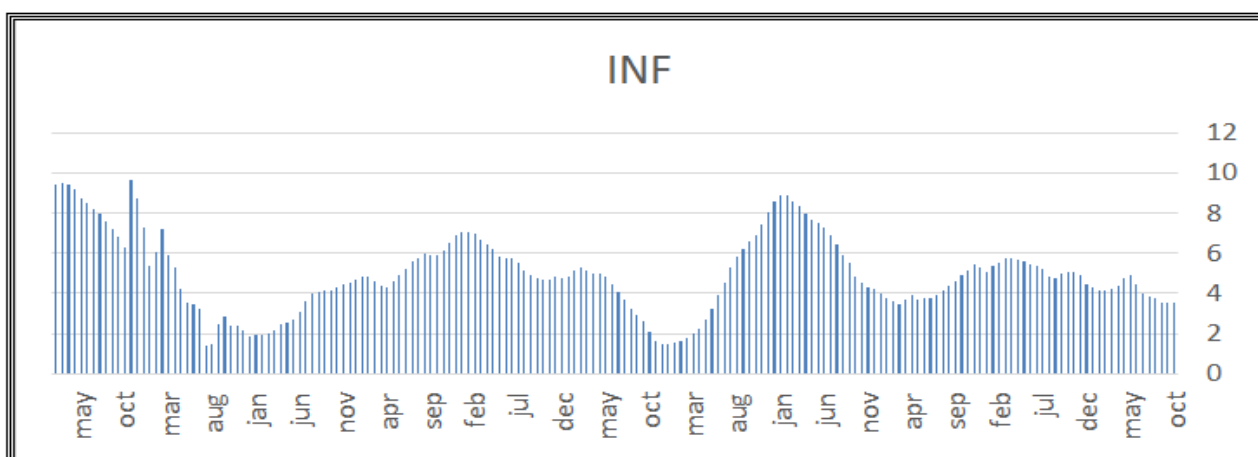
- It can be applied when time series are stationary at both levels and first differences.
- It allows measuring asymmetry in both short and long-term horizons.
- In addition to measuring asymmetry, it is also used to detect hidden common integration.
- It is used in large samples.

The NARDL technique involves several steps<sup>xxv</sup>: Estimating the equation through ordinary least squares (OLS) regression, then testing the relationship of common integration between model variables. In the third step, testing for asymmetry in short and long terms, and finally, deriving positive and negative multipliers.

## 2- Analysis of the Evolution of Study Variables:

**2-1- Analysis of the Evolution of Inflation Rates in Algeria:** Inflation rates in Algeria have witnessed significant variations from one period to another.

**Figure (01): Evolution of Inflation Rates in Algeria during the Period (2007-2022)**



**Source:** Compiled by the researchers using EViews 12 software.

- During this period, various economic stimulus programs were implemented, such as the Economic Recovery Support Program, the Supplementary Program for Growth Support, and the Five-Year Development Program. The implementation of these programs resulted in the injection of liquidity resulting from increased spending, leading to rising inflation rates. This increase, in addition to the programs, was also due to successive wage increases during the period from 2008 to 2012, as well as an increase in government spending directed towards investment during the period from 2009 to 2010. As for the rise in inflation for the years 2016 and 2022, the reason can be attributed to borrowing and the authorities resorting to non-traditional financing in 2022. The decrease in the inflation rate in the years 2005 and 2006 can be attributed to the general price level moving at a slow pace during this period, and the economy being in a contraction phase, while inflation continued to rise with the onset of the COVID-19 crisis in 2020.

**2-2- Evolution of Bank Loans:** Through Appendix 01 and the subsequent figure, it is observed that short-term loans experienced significant fluctuations during the period from 2007 to 2022, with noticeable increases also during the period from 2001 to 2022. However, this evolution in growth rates was not at the same pace.

**Figure 02: Evolution of Bank Loans in Algeria during the Period (2007-2022)**

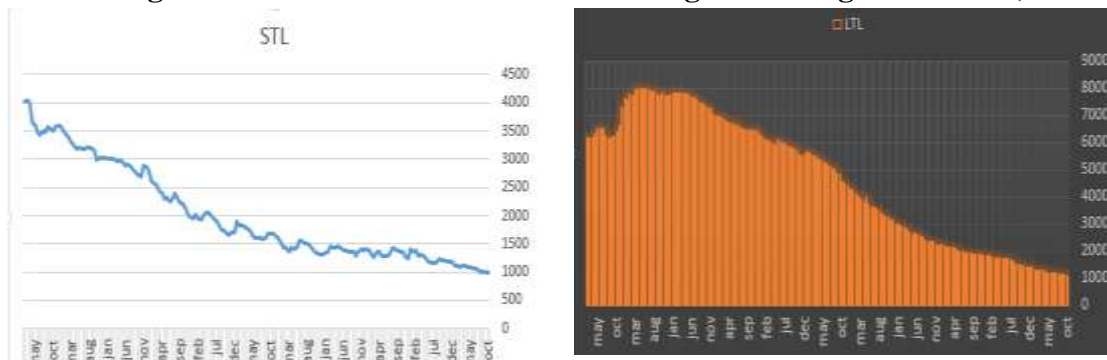


Figure 02-01: Evolution of Bank Loans by Type

**Source:** Compiled by the researchers using Excel

**The period of 2007 to 2022:** since the year 2000, bank loans, in all their types, have witnessed significant improvement due to Algeria's surpassing of that stage and the rescheduling of its debts through the support received from the International Monetary Fund aimed at improving economic efficiency to address the imbalances hindering long-term growth. Additionally, this increase is explained by the security and political stability in Algeria, accompanied by the significant increase in oil prices, from which Algeria benefited and used to support economic activity, small and medium-sized projects, various development programs, and the implementation of economic recovery programs witnessed at the beginning of this period. This reflected in the increase in long-term loans throughout the period, and even after the decline in oil prices, bank loans continued to rise due to the necessity of completing projects and the state resorting to non-traditional financing. Subsequently, Algeria entered into austerity policies, and then in 2020, the lending policy was affected by prevailing conditions, especially the COVID-19 crisis.

### 3 - Results and Their Discussion:

**3-1 Time Series Stability Study:** Economic measurement literature calls for monitoring the reactions of a phenomenon and determining the direction of the relationship between variables of this economic phenomenon through a time series stability study to select the most appropriate model based on economic theory and the degree of integration of time series.

For the time series stability study, the Augmented Dickey-Fuller (ADF) test was employed to test whether the time series under study is stable or not, as well as to determine its degree of integration. The following table shows the results of the ADF test analysis:

Table 01: Results of the Unit Root Test for Study Variables Using Augmented Dickey-Fuller (ADF)

Variable name	At the level			At the first difference		
	Constant	Constant and intercept	Constant and trend intercept	Constant	Constant and intercept	Constant and trend intercept
INF	0.0247	0.0943	0.7821	0.0071	0.0264	0.0005
LTL	0.5060	0.9999	0.9414	0.0000	0.0000	0.0000
STL	0.9998	0.9712	1.000	0.0000	0.0000	0.0000

Source: Compiled by the researchers using EViews 12 software.

**3-1 The NARDL methodology relies on several relationships:** Estimating the relationship of asymmetry<sup>xxvi</sup> parameters in the long term according to the following equation:

$$y = \beta^+ x^+ + \beta^- x^- + u_t$$

Where  $x$  is a variable divided into  $x^-$  and  $x^+$ , representing the partial sum of negative and positive values, respectively, as follows: <sup>xxvii</sup>

$$x_t^+ = \sum_{j=1}^t \Delta x_j^+ = \sum_{j=1}^t \max(\Delta x_j, 0) \dots \dots \dots (1)$$

$$x_t^- = \sum_{j=1}^t \Delta x_j^- = \sum_{j=1}^t \min(\Delta x_j, 0) \dots \dots \dots$$

Shin, Yu, and Greenwood Nimmo (2014) integrated the first relationship into the ARDL model by Pesaran and Shin<sup>xxviii</sup> (1999), Pesaran et al. (2001), and thus obtained the NARDL model according to the following equation:

$$\Delta y_t = \alpha_0 + \rho y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \sum_{i=1}^{p-1} \varphi_i \Delta y_{t-i} + \sum_{i=0}^q (\pi_i^+ \Delta x_{t-i}^+ + \pi_i^- \Delta x_{t-i}^-) + e_t$$

Where:  $\rho, \theta^-, \theta^+$  represent the long-term parameters,  $\pi^+, \pi^-, \varphi_t$  represent the short-term parameters.

**Estimation of the model using the NARDL approach:** According to the results of the stationary test of time series, where the dependent variable is stable at the first difference and the independent variables are a mixture of integrated of order I(0) and I(1), in this case, we can use the NARDL model to test for asymmetry between positive and negative shocks of bank loans granted by the banking sector in both short and long terms. This model provides better parameter estimates in the long run. Additionally, it allows for separating short-term effects from long-term effects, thus enabling the determination of the integrated relationship between short and long terms.

The NARDL model derives dynamic asymmetric effects, graphically illustrating the distinction between short and long ranges<sup>xxix</sup>. The methodology of NARDL can be summarized in the following steps:

- Estimation of the NARDL model
- Testing for common integration using the Wald test
- Estimation of the long-term model
- Testing for asymmetry
- Diagnostic tests for model quality

**1- Estimation of the NARDL Model:** After separating the negative and positive values of bank loans, the NARDL model was estimated, and the following results were obtained.

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-2420.267	454.7441	-5.322261	0.0002
INF(-1)	-1.835719	0.238286	-7.703833	0.0000
LST_P(-1)	14.26360	4.562752	3.126097	0.0088
LST_N(-1)	-21.30877	4.244699	-5.020088	0.0003
LTL_P(-1)	-23.96983	3.875315	-6.185261	0.0000
LTL_N(-1)	12.65455	5.479640	2.309377	0.0395
LST_P(-2)	-8.523392	3.295416	-2.586439	0.0238
DINF(-1)	0.279593	0.142944	1.955965	0.0742
LST_P	8.257244	5.620399	1.469156	0.1675
LTL_N(-2)	-10.34927	4.459220	-2.320871	0.0387
LST_N(-2)	15.16538	2.948916	5.142696	0.0002
LTL_N	-4.438011	4.383368	-1.012466	0.3313
R-squared	0.948198	Mean dependent var	0.938942	
Adjusted R-squared	0.900713	S.D. dependent var	372.5095	
S.E. of regression	117.3769	Akaike info criterion	12.67551	
Sum squared resid	165328.0	Schwarz criterion	13.26454	
Log likelihood	-140.1061	Hannan-Quinn criter.	12.83178	
F-statistic	19.96843	Durbin-Watson stat	2.325969	
Prob(F-statistic)	0.000005			

**In the short term:** It is observed that positive changes in short-term loans are inversely related to inflation, where a positive shock in short-term loans has a positive effect on inflation. This aligns with economic theory, as injecting short-term loans is considered the injection of new cash reserves. Given that short-term bank loans are mostly for consumption, directed towards purchasing goods and services, they contribute to inflation.

As for long-term bank loans, the NARDL model indicates that negative shocks in long-term loans are inversely related to inflation. This aligns with monetary theories, especially the classical ones, where a decrease in long-term loans implies a decrease in M2, especially considering the large amounts associated with long-term loans, consequently leading to a reduction in inflation

**2 - Common Integration Test:** To ensure the existence of a long-term relationship in the study model, we will conduct a common integration test using the Wald test, which tests the hypothesis

$$\begin{cases} H_0: \varphi_1 = \varphi_2 = \varphi_3 = 0 \\ H_1: \varphi_1 \neq \varphi_2 \neq \varphi_3 \neq 0 \end{cases}$$

By comparing the calculated F with the tabulated F and comparing it to the critical values established by Pesaran (2001), if the calculated F-value exceeds the upper critical value, we reject the null hypothesis of no long-term equilibrium relationship and accept the alternative hypothesis of common integration among the study variables. Conversely, if the calculated F-value is less than the lower critical value, we reject the alternative hypothesis and accept the null hypothesis, indicating the absence of a long-term equilibrium relationship. The obtained results are as follows:

**Table (02): Results of the Common Integration Test Using the Bonds Test**

Calculated F value	Critical Values	Significance Level			
		1%	2,5 %	5%	10%
20.29322	Minimum I (0)	4.13	3.55	3.1	2.63
	Maximum I(1)	5	4.38	3.87	3.35

**The source:** Compiled by researchers based on data from EViews 12 software.

Through the above table and appendix number (), it is evident that the calculated F, which amounted to (20.29322), exceeds the upper critical value determined by (Pesaran). This implies the rejection of the null hypothesis and the acceptance of the alternative hypothesis, meaning that there exists a long-term equilibrium relationship trending from the explanatory variables towards the dependent variable. In other words, there is a co-integrating relationship in both positive and negative rates of short and long-term loans at a significance level of 1%.

**3- Estimating the long-term model:** The NARDL approach entails deriving the long-range coefficients according to the method adopted by Matthew Greenwood-Nimmo<sup>xxx</sup>, and modeling the non-symmetric cointegration and dynamic effects. To compute the long-term coefficients, the negative coefficients of the independent variables, whether positive or negative, are divided by the coefficient of the dependent variable. Based on Appendix number (), we obtain the following results:

- LST\_P(-1)/ DINF(-1)= 7.770036
- LST\_N (-1)/ DINF(-1)=-11.60786
- LTL\_P(-1)/ DINF(-1)=-13.05746
- LTL\_N(-1)/ DINF(-1)=6.893512

And thus, the long-term equation becomes as follows:

$$INF = 7.770036 LST\_P - 11.60786 LST\_N - 13.05746 LTL\_P + 6.893512 LTL\_N + U_t$$

The equation above indicates that positive changes in short-term bank loans and inflation are positively related, while negative shocks to short-term bank loans are inversely related to inflation. This aligns with quantitative theory logic, where an increase in short-term bank loans results in an additional cash supply in the market, leading to a rise in the overall price level. Short-term bank loans are typically directed towards boosting consumption and stimulating spending, thus naturally contributing to inflation.

Regarding long-term loans, positive shocks to long-term bank loans and inflation are inversely related, while negative changes in long-term bank loans are positively related to inflation. This implies that long-term bank loans in Algeria tend towards the investment sector and increasing productivity without contributing to inflation. Positive changes are negatively related, while negative changes are positively related to inflation. This result allows us to conclude that long-term loans provided by the banking sector in Algeria are aimed at supporting investment and increasing productivity.

**4- Non-linearity test:** The NARDL approach distinguishes itself from the ARDL model by an additional test, which is the non-linearity test in the long term, using the Wald test. This test examines the hypothesis that:

$$\left[ \begin{array}{l} H_0: (\beta^+ = -\frac{\theta^+}{\rho}) = (\beta^- = -\frac{\theta^-}{\rho}) \\ H_1: (\beta^+ = -\frac{\theta^+}{\rho}) \neq (\beta^- = -\frac{\theta^-}{\rho}) \end{array} \right.$$

This test reveals whether positive and negative changes in the independent variable have an equal effect on the dependent variable. It does so by comparing the calculated F-value with the tabulated F-value. If the probability of F is less than 0.05, we reject the null hypothesis, which suggests the absence of non-linearity, and accept the alternative hypothesis, which suggests non-linearity. However, if the probability of F is greater than 0.05, we accept the null hypothesis, which suggests non-non-linearity, and accept the alternative hypothesis. The obtained results are as follows:

- **Testing non-linearity for short-term loans:** Using the Wald test to detect non-linearity between positive and negative rates of short-term bank loans, the following results were obtained:

Test	Value	Probability
<b>t-statistic</b>	4.767190	0.0005
<b>F-statistique</b>	22.72610	0.0005
<b>Chi-Square</b>	22.72610	0.0000

From the table above, we notice that the probability value of the F-statistic, which is (0.0005), is less than the significance level of 5%. Based on this result, we reject the null hypothesis, which suggests the absence of non-linearity, and accept the alternative hypothesis, which suggests non-linearity. According to the Wald test, there is non-linearity in the effects of positive and negative shocks of short-term bank loans in the long run.

- **Testing non-linearity for long-term loans:** To detect non-linearity between negative and positive values of long-term bank loans, the Wald test was utilized. This test yielded the following results:

Test	Value	Probability
<b>t-statistic</b>	2.617969	0.0225
<b>F-statistique</b>	6.853763	0.0225
<b>Chi-Square</b>	6.853763	0.0088

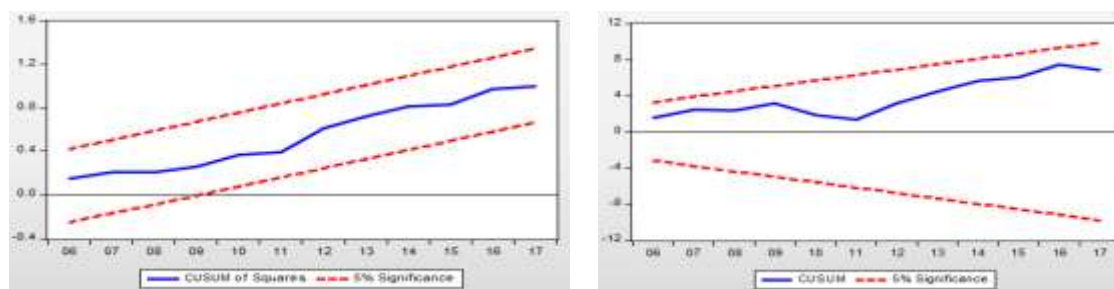
From the probability value of the F-statistic, which is (0.0005), we observe that it is smaller than the significance level of 5%. Based on this result, we reject the null hypothesis, which suggests the absence of non-linearity in the effect, and accept the alternative hypothesis, which suggests non-linearity.

**5- Results of the Structural Stability Test for the NARDL Model:**

In this test, we will assess the structural stability of the short and long-term coefficients, or in other words, the absence of any structural changes in the data used in this study over time. To determine this, the following two tests are required: the Cumulative Sum of Residuals (CUSUM) test and the Cumulative Sum of Square Recursive Residuals (CUSUMSQ) test. It is worth noting that structural stability in the NARDL model is achieved if the graphical representation of both CUSUM and

CUSUMSQ statistics remains within critical bounds at a significance level. The following figure illustrates the results of the structural stability test for the estimated ARDL model:

**Figure (03): Illustrates the results of the Structural Stability Test.**



**The Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ)      The Cumulative Sum of Residuals (CUSUM)**

**The source:** Compiled by researchers using EViews 12 software.

It is evident from both figures that the estimated coefficients for the NARDL model used are stable. We observe that both the Cumulative Sum of Residuals (CUSUM) and the Cumulative Sum of Squares of Residuals (CUSUMSQ) are represented by roughly straight lines that fall within the critical region boundaries, indicating structural stability of the NARDL model at a significance level of 5%.

Regarding the CUSUMSQ test, it confirms the stability of the parameters at a significance level of 5%, indicating consistency in the model between the results of short and long-run error correction. The graphical representation of both tests for this model falls within the critical boundaries at a significance level of 5%, confirming stability and consistency among the study variables in the model.

**6- Tests for diagnosing model quality:**

To ensure the quality of the model used in the analysis and its freedom from statistical issues, a series of tests were conducted, including:

- Serial Correlation Test for Residuals: Taste Breusch-Godfrey Serial Correlation LM
- Heteroskedasticity Test: ARCH
- Normality Test for Random Errors: Jack-Bera

The results of these tests are presented in the following table.

**Table (08): Results of Diagnostic Tests for the NARDL Model**

Serial Correlation Test for Residuals	Prob Chi-Square	Obs*R-squared	Prob F	F-statistique
	0.2461	1.345127	0.4361	0.653122
Heteroskedasticity Test	Prob Chi-Square	Obs*R-squared	Prob F	F-statistique
	0.1182	2.441544	0.1292	2.493982
Normality Test	Jarque-Bera			Prob

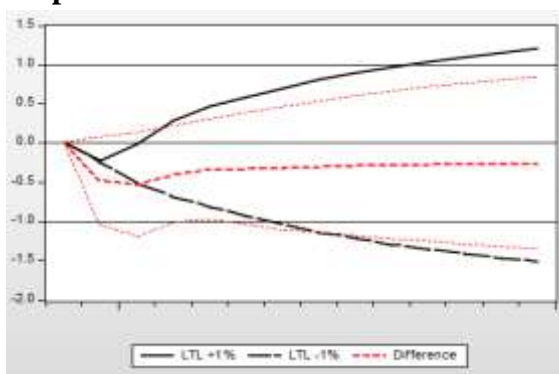
<b>for Random Errors</b>	<b>0.106013</b>	<b>0.948374</b>
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The source: Compiled by researchers using EViews 12 software.

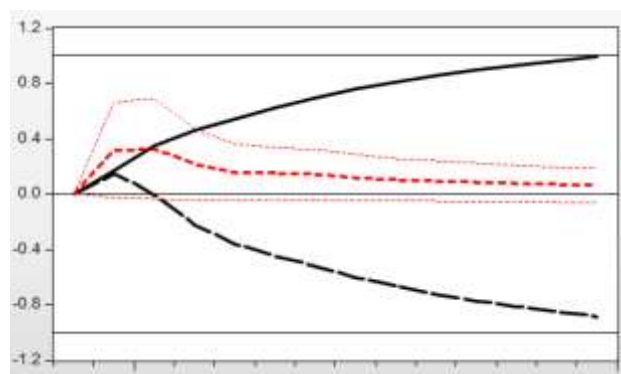
- **Taste Breusch-Godfrey Serial Correlation LM Test:** This test checks for the presence of serial correlation among the residuals. The null hypothesis states no serial correlation, while the alternative hypothesis suggests the presence of serial correlation. The non-significant F-statistic in the Breusch-Godfrey Serial Correlation LM Test indicates the absence of serial correlation in the residuals. The probability value of Fisher is 0.4361, which is greater than the significance level of 5%, leading us to accept the null hypothesis, concluding that there is no serial correlation problem in the residuals.
- **Heteroskedasticity Test ARCH:** The Heteroskedasticity Test assesses whether the variance of the error term is constant. The Fisher probability value of 0.1292 is greater than the significance level of 5%, indicating acceptance of the null hypothesis, which suggests constant variance of the error term in the estimated model.
- **Normality Test Jack-Bera:** This test assesses if the residuals follow a normal distribution. The Jack-Bera probability value of 0.106 is greater than the significance level of 5%, leading to the acceptance of the null hypothesis, indicating that the residuals are normally distributed.

In summary, based on the diagnostic tests conducted, we can conclude that the model is sound, free from statistical issues, and statistically significant. This confirms the validity of the estimated model and its suitability for interpreting the studied phenomenon.

**7- The non-symmetric dynamic multiplier test allows for tracking patterns of asymmetric adaptation.**



Source: Prepared by researchers using EViews 12 software.



Source: Prepared by researchers using EViews 12 software.

This curve illustrates the calculation of the impact of cumulative dynamic multipliers obtained according to the equation, where inflation returns to its new equilibrium after a positive or negative uniform shock in the volume of bank loans granted. Dynamic multipliers are estimated based on the most ready-to-use NARDL model selected by applying a general-to-specific approach. The positive (solid black line) and negative (dashed black line) change in curves describe the adjustment of inflation rates to positive and negative shocks of bank loans granted over a period of ten years. Additionally, it shows upper and lower confidence bands (dashed red lines) representing 95% confidence intervals to provide a measure of statistical significance. If the zero line lies between the lower and upper bands, then asymmetric effects are not significant at the 5% significance level.

Many interesting results emerge from the analysis of dynamic multipliers, as the figures in the chart confirm the existence of an inverse relationship between bank loans granted and inflation in the long-term equilibrium. We can observe that negative shocks of bank loans over ten years have a positive effect, and vice versa for positive shocks of bank loans granted.

### Conclusion:

The aim of this study was to demonstrate the measurement and analysis of the impact exerted by bank loans on the inflation rate in Algeria during the period 2008-2022 by testing the non-linear relationship in both short and long terms simultaneously and analyzing positive and negative shocks through the NRDL model. The results led to several key findings:

- There is asymmetry in the effects of positive and negative shocks of short-term bank loans in the long term, meaning that negative shocks in the Algerian economy have a dissimilar and opposite effect to positive shocks in the short term.
- There is no symmetry in the impact, and we accept the alternative hypothesis that there is no long-term symmetry, meaning that negative shocks in the Algerian economy have a dissimilar and opposite effect to positive shocks in the long term.

Additionally, many interesting results from dynamic multiplier analysis emerge, confirming the inverse relationship between granted bank loans and long-term equilibrium inflation. We can observe that negative shocks from bank loans for ten years have a positive effect, and vice versa for positive shocks from granted loans.

Thus, it can be said that short-term bank loans positively impact inflation in both the long and short terms, whether through positive or negative shocks significantly, linked to the effectiveness of banking sectors in financing investment projects, feasibility studies of projects, control over monetary aggregates, and the ratio of loan returns to bank deposits, which reflect on the economy. As for long-term bank loans, they positively affect inflation in both short and long terms, whether through positive or negative shocks, contributing less to inflation compared to the impact exerted by short-term bank loans in the long term.

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