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DETERMINANTS OF INFLATION IN ALGERIA DURING THE PERIOD FIRST QUARTER OF 2000 TO THE FOURTH QUARTER OF 2022 APPLICATION OF THE ARDL MODEL

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Astract: This paper examines the determinants of inflation in Algeria during the period first quarter of 2000 to the fourth quarter of 2022 using an autoregressive distributed lag model (ARDL) to capture the long and short run relationship between inflation rate and other economic variables using quarterly data we find that the determinants of inflation in Algeria are :money supply the import price index, nominal effective exchange rate .

Key words: inflation, money supply, import price index long-term relationship, ARDL.

I INTRODUCTION

Inflation is a continuous and sustained increase in the price level in an economy. It is an economic phenomenon that greatly affects the daily lives of individuals, companies, and governments,

. Since 2020, the world has witnessed large rates of inflation, amid severe economic fluctuations and geopolitical instability unprecedented for decades, and it rose sharply in 2022 due to the rise in energy and food prices.

Inflation is a challenge that has far-reaching impacts on all aspects of life, especially the economy. For this reason, it is incumbent upon the government to ensure that its plans and daily programs are not unduly impacted by the unpredictable and fluctuating prices of goods and services. It is essential for every organization to have a stable macro-economic environment that is free from persistent and unrepentant price changes, which would allow for reliable and confident future predictions and forecasting, thus enabling quality planning. This is equally true for individuals, as proper planning enables one to thrive in the unsteady economy that is currently being experienced in Algeria. All of these factors highlight the growing need to undertake a comprehensive study of inflation, with a view to developing a time-independent and reliable model. Although the word "inflation" is widely known and used, very few individuals have attempted to study it in conjunction with macroeconomic studies, focusing on its determinants and effects on a developing economy.

Comparable to the directives of most central banks, the Central Bank of Algeria has consistently prioritized the attainment of stability in prices of goods and services. The impetus behind the burgeoning focus on price stability stems from the need to preserve overall macroeconomic equilibrium, and the recognition that price stability engenders investment, productivity, and employment. However, despite the implementation of numerous governmental policies and programs, Algeria's economy has experienced persistent inflation, which has had negative consequences for the most vulnerable members of society. Inflation is considered one of the main problems that the economies of countries suffer from, and it is also one of the most important goals of macroeconomic policy. Inflation rates began to rise after the Corona pandemic, and according to World Bank statistics, rates reached 3.5% and 8.3% during the years 2021 and 2022, respectively. This rise constitutes a real threat in the long term, whether to the individual or society. Economic policies, through their tools, especially monetary and fiscal ones, contribute to curbing part of this inflation. However, studying and understanding the determinants of inflation is crucial because it helps central banks conduct an effective monetary policy to ensure price stability. The relative importance of each determinant varies from country to country.

The main objective of this study is to explain the determinants of long-term inflation in Algeria over the period from first quarter of 2000 to the fourth quarter of 2022. Throughout this paper, we will attempt to answer the following question:

Problematic

What are the long-term determinants of inflation in Algeria over the period from 1970 to 2022?

Study hypotheses

The determinants of inflation are the money supply, exchange rate, import price index, and interest rates

research methodology

In order to answer this question, the first part of this paper is devoted to the theoretical framework of inflation and an analysis of the inflation rate in Algeria over the period in question. The second part consists of an empirical review of the state of the art, which will present the main works that have dealt with the subject. The third part is devoted to the ARDL modelling of the consumer price index as the main indicator of inflation during the period in question, using several determination factors

II INFLATION IN ECONOMIC THEORIES

Economic theories about inflation have always aroused particular interest among economists because of its negative economic and social consequences. Inflation primarily affects the measure of value and the money reserve functions, which has led to several analyzes on the relationship between inflation and money supply. Three major currents stand out in this question: the Critical Current, the Keynesians and the New Classics (Nyangezi, 2013, pp. 3-5).

The monetary approach considers inflation to be a purely monetary phenomenon. Monetarists rely on the quantitative equation of money, which expresses the relationship between transactions and money supply. This relationship is expressed by the equation $MV = PY$, where M represents the quantity of money, V the velocity of money circulation, Y the total number of transactions or output over a given period, and P the general price level. According to this approach, the nominal value of output (PY) is determined by the money supply, and the price level (P) is the ratio between the nominal value of output and the general level of output (Y). Many empirical studies have confirmed this theory, showing a positive correlation between the growth of the money supply and the level of inflation (Fridman, 1996).

John Maynard Keynes (1883 – 1946) and his followers espoused the belief that the augmentation of the aggregate demand serves as the impetus for demand pull inflation. Demand pull inflation occurs when the overall demand for goods and services surpasses the aggregate supply and provisions of goods and services within the economy. The aggregate demand, in this context, encompasses consumption, investment, and government expenditure. Totonchi (2011) asserts that a policy that induces a decline in each component of the total demand is effective in alleviating the pressure on demand and subsequently curbing inflation. Essentially, this entails reducing government expenditures, augmenting taxes, and exercising control over the volume of money.

The Keynesian a pproach criticizes this restrictive management of funds. According to Keynesians and New Keynesians, money can be used to stimulate production. In the case of underemployment, an increase in the money supply can stimulate the economy through demand. Although this may lead to inflation, it helps combat unemployment by encouraging the resumption of economic activity. The Phillips curve illustrates this relationship, showing that a higher level of inflation is associated with a lower unemployment rate. From this perspective, inflation is not seen as a danger, but as a necessary evil, a balance must be found between the level of inflation and unemployment. These policies were successful in the years after World War II until the late 1970s, but the onset of stagflation (inflation combined with unemployment) challenged this approach.

The cost-push theory of inflation gained significant prominence during the 1950s and 1970s, when it became commonly referred to as "New inflation". This phenomenon is closely associated with an escalation in production costs, primarily stemming from wage hikes or increases in input prices. As Totonchi (2011) asserts, when labor unions demand higher wages from employers, the latter respond by raising the prices of their goods. Consequently, this leads to cost-push inflation. It is worth noting that the resulting price surge has the potential to impact other businesses that utilize these goods, thereby driving up their own prices. This cycle may extend on a national level and persist over a considerable period of time.

New Classics takes a different perspective. Unlike the Keynesians, they believe that money has no effect on the real sphere, even in the short term, contrary to what the monetarists say. Therefore, they call for a long-term strict monetary

policy to effectively combat inflation. According to the new classics, an increase in money supply disproportionate to wealth formation is the cause of inflation, due to the bad expectations it creates. In their analysis, expectations play a central role in inflation. However, debate exists as to whether expectations are adaptive or rational.

According to the adaptive expectations hypothesis advocated by Friedman, individuals form their price expectations based on recently observed values. So there is inertia in inflation, because expectations of future inflation, based on past inflation, affect prices expected by economic factors. This means that inflation can only change slowly from year to year depending on the degree of credibility of fiscal and monetary policies.

For authors such as Lucas and Sargent (1982), adaptive expectations are too simplistic to apply to all circumstances. Under the premise of their rational expectations, economic agents make optimal use of all available information, including information about current and future policies, to forecast prices. The inertia of inflation is only obvious: in fact, it is inadequate fiscal and monetary policies that maintain inflationary dynamics. If these policies come to an end, this dynamic will stop on its own and agents will make correct expectations.

The novel neoclassical synthesis of inflation: According to Totonchi (2011), the novel neoclassical synthesis perceives monetary and demand factors as fundamental determinants of business cycles. In addition, Totonchi asserts that this synthesis regards expectations as crucial to the inflation process, but suggests that expectations can be regulated through the implementation of monetary policy rules. The new version of the IS-LM-PC (Phillips curve) in the new neoclassical synthesis endows the price level with an endogenous quality, thereby allowing both the Keynesian and real business cycle mechanisms to operate through distinct channels (Totonchi, 2011).

Neo political macroeconomics of inflation: Unlike other theories of inflation that predominantly focus on economic factors as determinants, the new political economy offers fresh perspectives on the relationship between the timing of elections, the performance of policymakers, political instability, policy credibility and reputation, and the inflation process itself (Totonchi, 2011). It posits that the occurrence of sustained government deficits as a potential cause of inflation may be partially or fully mitigated when considering the political process as well as potential lobbying activities influencing government budgets.

Economic history teaches us the plausibility of these two hypotheses. Thus, in empirical studies, econometrics propose models that incorporate both rational expectations and adaptive expectations. Validation of these assumptions depends on the baseline values of the model parameters.

III PREVIOUS ECONOMETRICS STUDIESES

There are many standard studies dealing with the determinants of inflation. Here are some notable studies in this field:

The Determinants of Inflation: A Survey" by Robert J. Barro (1996): This study provides an overview and analysis of the determinants of inflation in the economic literature. The study addresses several potential factors such as money supply, demand, production costs, technology, employment, and government policies, and analyzes their impact on inflation.

Inflation Dynamics: A Structural Econometric Analysis" by Martin S. Eichenbaum and Jonas D. M. Fisher (2003): This study presents a structural economic model for analyzing the dynamics of inflation. The study is based on building an economic model that simulates the interaction of many variables such as money supply and demand, production costs and monetary policies to clarify their impact on inflation.

Inflation Dynamics and the Great Recession" by Michael T. Kiley (2014): This study explores the relationship of inflation to the Great Recession. The study analyzes the dynamics of inflation during the recession and tries to explain its changes. The study indicates the importance of monetary and economic factors in shaping inflation during periods of economic recession.

(Papi and Lim (1997) examined the determinants of inflation in Turkey. To investigate the results of the study, a time series data set from 1970 to 1995 was used. The Johansen cointegration technique was applied to investigate the correlations between exchange rate, money supply, export prices, wages, import prices, and inflation. The results of the study revealed that there is a statistically significant positive relationship between wages, money supply, export prices, import prices, and inflation in Turkey, while the exchange rate had a negative impact on inflation.

Liu, O. and O.S. Adedeji (2000) highlighted some of the major determinants of inflation in the Islamic Republic of Iran by using the Johansen cointegration technique using Using quarterly data over the period 1989:Q2–1999:Q4,. The analysis find a strong impact of monetary factors on inflation, while the exchange rate effect is weak and transient

(Adayleh, 2018) assesses the determinants of inflation in the Jordanian economy during the period 2000:1 to 2017:4. The results show the money supply, credit to the economy and the price of oil have a positive and significant impact on inflation, while the interest rate and the output gap have a negative and significant effect on inflation. 'inflation. Impulse response functions and analysis of variance decomposition test were used. Both tests showed that inflation in the Jordanian economy was mainly driven by the long-term oil price, which indicated that the supply side was persistent inflation in the Jordanian economy.

(Musa & Yousif, 2018) modeled the determinants of inflation in Sudan with the GMM method over the period 2000-2017. Their results show that increasing the money supply and reducing the exchange rate lead to a high rate of inflation. Conversely, the growth of GDP and that of public expenditure lead to a drop in the inflation rate in Sudan.

(Osman et al., 2019) analyzed the causes of inflation in Saudi Arabia during the period 1980-2018, using an ARDL model to examine the short and long-term relationships between inflation, money supply , the stock market index, real GDP, the price of oil and the global inflation rate. The results reveal that inflation is positively determined by the broad money supply, the price of oil and the price of real GDP in the short and long term. The global inflation rate has a positive effect only in the long term, without having a short-term effect.

term causal relationship between the import price and the money supply.

Study (Touer, A., & Abdeljabar, M. (2021)This paper aimed to find out the extent of the impact of interest rates on inflation in Algeria during the period 1980-2018, and this study has divided into two aspects a theoretical aspect that includes some theoretical basics for both interest rates and inflation rates. Ardl, using eviews.10, and after studying the stability of both variables, the results showed a long-term equilibrium relationship between interest rates and inflation rates in Algeria, and the study also found that interest rates affect inflation adversely in Algeria, in the long and short term, i.e. The lower the interest rates, the higher the inflation rate in Algeria

Study (*Saad Mohammed Alnefaee(2018)*

, this paper investigated the short- and long-run determinants of inflation in Saudi Arabia during the period 1987-2017. To achieve this object, the Johansen-Julius cointegration process and the error correction model (VECM) were relied upon to examine the existence of short- and long-term relationships between inflation, money supply, domestic demand, exchange rate, and oil prices. The results revealed that long-term inflation is positively affected by money supply, domestic demand, and oil prices, and negatively affected by the exchange rate. Inflation is greatly affected by short-run domestic factors (money supply and domestic demand). Granger causality results also indicated the existence of a two-way causal relationship between money supply and inflation. Unidirectional causality also moves from domestic demand and oil prices to the price level. The impulsive response analysis also showed that shocks related to money supply, domestic demand, and oil prices have a positive impact on inflation.

Study (Si Mohammed & Benhabib, 2016), this study investigated the most important determinants of inflation in Algeria using the ARDL model during the period 1980-2012. This paper focuses on the main sources to explain the trend of inflation in Algeria (import prices, oil prices and money stocks, government spending, nominal and actual exchange rates). The study found that there is a stable long-term relationship between inflation and its determinants. External factors (import price, oil price and actual and nominal exchange rates) affect inflation in Algeria. It was concluded with regard to the effect on inflation that fiscal and monetary policy in and of themselves cannot be statistically significant.

Study (Dakhisi and Labiq, 2017) This study aims to study the impact of some macroeconomic variables related to the goods and services market and the money market on the development of the inflation rate in Algeria during the period 1990-2016. The results indicated the existence of causal relationships in the short term linking each of the supplies Monetary exchange rate and the consumer price index, but the results for imports, which express the expansionary fiscal policy and increased demand for foreign products, were insignificant. The study also showed that there is a long-term causal

relationship between the three explanatory variables and the consumer price index, as short-term imbalances are corrected by 76.34% annually, and in the event of any shock, the consumer price index takes about 1,309 years to reach equilibrium.

In summary, these empirical studies clearly indicate that the money supply, import prices, and the exchange rate are the main drivers of inflation. We will use these results to select an appropriate set of data to include in our model later.

IV DATA AND APPLIED STUDY

The data used in this study covers the period from the first quarter of 2000 to the fourth quarter of 2022, using the International Monetary Fund database.

The dependent variable represents inflation, which we express as the consumer price index(CPI)

The independents variables were determined based on previous studies as follows:

- The money supply(MS) represented by the monetary mass, where the money supply (monetary factors): The amount of money in circulation is often considered an important factor in determining inflation. An increase in the money supply can lead to higher inflation. (Friedman. (1969)
- Exchange rate (XR): Changes in exchange rates can affect the prices of imported goods and services. Currency depreciation can lead to higher prices for imports and thus to inflation (Dornbusch. (1976)
- .Import price index (IPIND) The increase in import prices leads to an increase in production costs and, consequently, to an increase in the prices of domestic commodities
- Interest rate (INR) Monetary policies pursued by governments, such as lowering interest rates, can contribute to inflationary pressures. Romer (2012)

Fig1 : Evolution of the consumer price index, money supply, exchange rate and interest rates

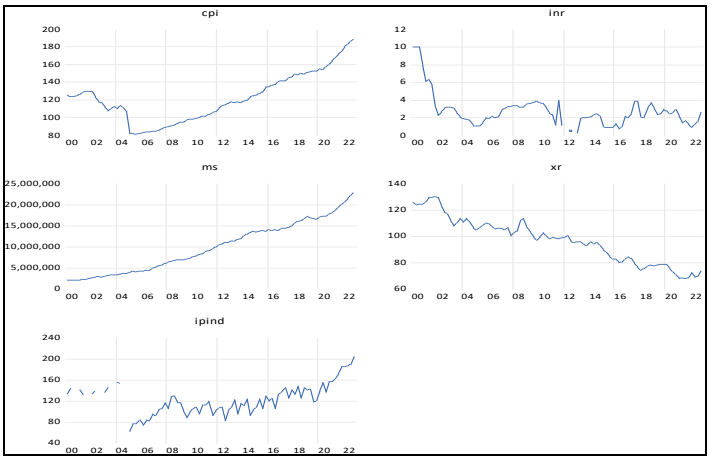


Fig.1 Graphic Representation

Source : eviews 13 outputs using IMF data

Through the graphs, we notice that the period 2000-2012a was characterized by the stability of inflation rates, which represents the rate of growth in the price index, and this is due to the implementation of the structural adjustment program in cooperation with the International Monetary Fund, which aimed to stabilize prices at a level similar to what it is in The trading partners In Figure 1, we notice that inflation rates have declined significantly from 2000 to 2005.

Where inflation fell in the first quarter of the year 2005 to its lowest rate, then it rose again in the second quarter of the same year, and the rise continued until it reached its highest rate in the fourth quarter of the year 2012 at a rate of 9.8%. It was adopted by the government, for which a total amount of about 62 billion US dollars was allocated until the year 2009.

Then it declined in the years that followed this period until it rose again in 2016. This is due to the recorded increase in fuel prices, which rose by more than 50%. After the decline in the period 2017-2019, inflation rose again due to the Corona pandemic, as well as the rise in food and energy prices as a result of fluctuations. political.

With regard to the exchange rate, we notice a continued deterioration in the value of the dinar throughout the studied period, as its largest value was recorded in the first quarter of the year 2001and the lowest value of the dinar in the first quarter of the year 2021

With regard to the money supply, we note the continued increase in the money supply, and this is evidence of the expansionary monetary policy adopted by the government

Regarding import prices, there is a fluctuation over previous years, but this index has not stopped increasing since 2020 as a result of the covid19 pandemic and the increase in hydrocarbon prices.

V-1 Study of the stability of time series

The validity of the analysis of time series data depends on the important first step consisting of checking the stability of the time series under study.

Tab1 : unit root test results

Null Hypothesis: the variable has a unit root

		LOG(CPI)	LOG(IPIND)	LOG(MS)	LOG(INR)	LOG(XR)
At Level						
With Constant	t-Statistic	0.8509	-0.8352	-2.3287	-4.8629	-0.8357
	Prob.	*0.9944*	*0.8023*	*0.1653*	*0.0001*	*0.8039*
		n0	n0	n0	***	n0
With Constant & Trend	t-Statistic	-1.4965	-2.5943	-0.9119	-4.9282	-3.8828
	Prob.	*0.8239*	*0.2843*	*0.9496*	*0.0006*	*0.0167*
		n0	n0	n0	***	**
Without Constant & Trend	t-Statistic	1.0633	1.4581	3.6906	-2.1853	-2.0931
	Prob.	*0.9239*	*0.9630*	*0.9999*	*0.0286*	*0.0355*
		n0	n0	n0	**	**
At First Difference						
		d(LOG(CPI))	d(LOG(IPIND))	d(LOG(MS))	d(LOG(INR))	d(LOG(XR))
With Constant	t-Statistic	-7.1686	-3.6961	-4.7186	-11.5219	-7.3581
	Prob.	*0.0000*	*0.0063*	*0.0002*	*0.0001*	*0.0000*
		***	***	***	***	***
With Constant & Trend	t-Statistic	-7.6732	-3.6805	-4.9914	-11.5633	-7.3085
	Prob.	*0.0000*	*0.0306*	*0.0005*	*0.0000*	*0.0000*
		***	**	***	***	***
Without Constant & Trend	t-Statistic	-7.0874	-3.3466	-2.5438	-11.5848	-7.1553
	Prob.	*0.0000*	*0.0011*	*0.0114*	*0.0000*	*0.0000*
		***	***	**	***	***

Notes:
b: Lag Length based on SIC
c: Probability based on MacKinnon (1996) one-sided p-values.

Source : eviews 13 outputs using IMF data

The standard recommendation is to use unit root tests and additional stability tests to evaluate the random properties of the variables used to estimate the model.

The developed Dickie Fuller test (ADF) was carried out, and the results of the tests showed through Table 01 that the interest rate variable is stable at level I(0) and the rest of the variables are integrated of the first degree I(1), and this is what makes the integration test The participant using the limits test is feasible (Pesaran 2001)

V-3 The correlation analysis

The correlation matrix provides a numerical measure of the strength and direction of the linear relationship between pairs of variables. In this analysis, we assess the correlation coefficients between different pairs of variables to understand their degree of association.

Tab2 : table of correlation

	CPI	INR	IPIND	MS	XR
CPI	1.000000	-0.103727	0.815191	0.854126	-0.755466
INR	-0.103727	1.000000	0.069992	-0.388377	0.449873
IPIND	0.815191	0.069992	1.000000	0.570341	-0.466017
MS	0.854126	-0.388377	0.570341	1.000000	-0.952689
XR	-0.755466	0.449873	-0.466017	-0.952689	1.000000

The table below shows. An initial examination of the correlation coefficients between the dependent variable (CPI) and the other independent variables (MS, XR, IPIND, INR). We notice a strong and direct relationship between it and the import price index and the monetary mass. We also notice a strong inverse relationship between the price index and the exchange rate, and a weak inverse relationship between the price index and the interest rate

V-2 study of causality between variables

Through the (Granger) test, we note that the variables that cause inflation are: the exchange rate and the money supply, while the import price index .

affects the consumer price index indirectly through its effect on the money supply

Tab3 : Granger test

Pairwise Granger Causality Tests
Date: 06/19/23 Time: 16:42
Sample: 2000Q1 2022Q4
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
LOG(INR) does not Granger Cause LOG(CPI)	84	0.80677	0.4499
LOG(CPI) does not Granger Cause LOG(INR)		0.27994	0.7566
LOG(IPIND) does not Granger Cause LOG(CPI)	70	1.86428	0.1632
LOG(CPI) does not Granger Cause LOG(IPIND)		3.57612	0.0336
LOG(MS) does not Granger Cause LOG(CPI)	90	3.76055	0.0272
LOG(CPI) does not Granger Cause LOG(MS)		1.26250	0.2882
LOG(XR) does not Granger Cause LOG(CPI)	90	3.78566	0.0266
LOG(CPI) does not Granger Cause LOG(XR)		1.12367	0.3299
LOG(IPIND) does not Granger Cause LOG(INR)	64	0.05814	0.9436
LOG(INR) does not Granger Cause LOG(IPIND)		0.13868	0.8708
LOG(MS) does not Granger Cause LOG(INR)	84	0.67663	0.5113
LOG(INR) does not Granger Cause LOG(MS)		0.14850	0.8622
LOG(XR) does not Granger Cause LOG(INR)	84	0.52061	0.5962
LOG(INR) does not Granger Cause LOG(XR)		0.17147	0.8427
LOG(MS) does not Granger Cause LOG(IPIND)	70	4.73546	0.0120
LOG(IPIND) does not Granger Cause LOG(MS)		2.24080	0.1145
LOG(XR) does not Granger Cause LOG(IPIND)	70	7.11994	0.0016
LOG(IPIND) does not Granger Cause LOG(XR)		1.87047	0.1622
LOG(XR) does not Granger Cause LOG(MS)	90	0.10896	0.8969
LOG(MS) does not Granger Cause LOG(XR)		3.31389	0.0411

Source : eviews 13 outputs using IMF data

V-4 Estimation of the determinants of inflation through the ARDL technique

- Introducing ARDL Technology Autoregressive distributed Lag model (ARDL)

The joint integration developed by (Shin and Pesaran) in 1997 and 2001 is tested on the basis of merging Autoregressive Models and DistributedLag Models. In this methodology, the time series is a function of slowing down its values and the values of The current explanatory variables and their slowing down by a period of time or more.

V-5 ARDL model properties

This model has the following characteristics:

It can be used regardless of the degree of integration between variables, whether they are integrals of order I(0), integrals of I(1), or integrals of different degrees (i.e. the order of integration is not uniform for all variables.(

The results of its application are good if the sample size (number of observations) is small, and this is in contrast to the traditional cointegration tests that require the sample size to be large in order for the results to be more efficient.

The ARDL model enables us to estimate the components (relationships) of the long and short term together in one equation.

The ARDL model takes a sufficient number of time lags to obtain the best set of data from the general framework model.

Stages of applying the ARDL methodology

V-6 The Bounds test or cointegration test approach of Pesaran

Cointegration between series assumes the existence of one or more long-term equilibrium relations between them, which relations can be combined with the short-term dynamics of these series in an error correction model (vector) which takes the following form:[1]

$$\Delta Yt = AYt - 1 + \sum_{i=1}^{p} Bi\Delta Yt - i + Ut \dots\dots (1)$$

With:

- ΔYt = vector of stationary variables under study (whose dynamics are explained);
- Bi= matrix whose elements are parameters associated with (ΔYt -i);
- A = matrix of the same dimension as ΔYt (where r (A) = number of cointegrations relations);
- Δ= difference operator 1.

The ARDL / Bounds Testing methodology of Pesaran and Shin (1999) and Pesaran et al. (2001) has a number of features that many researchers feel give it some advantages over conventional cointegration testing. For instance:

- It can be used with a mixture of I (0) and I (1) data.
- It involves just a single-equation set-up, making it simple to implement and interpret.
- Different variables can be assigned different lag-lengths as they enter the model.

The model that serves as the basis for the cointegration test with the distributed lag (Pesaran et al. (2001) test) is the following cointegrated ARDL specification (taking the form of an error correction model or VECM) when studying the dynamics between two series "Yt (log(CPI)) and Xt (XR IPIND TNR MS).

$$\Delta\log(\mathrm{CPI})_t = \gamma_1\log(\mathrm{CPI}_{t-1}) + \gamma_2\log(\mathrm{XR})_{t-1} + \gamma_3\log(IPIND) + \gamma_4\log(\mathrm{TNR})_{t-1}\gamma_5\log(\mathrm{MS})_{t-1} + \sum_{i=1}^{p} a_i\,\Delta\log(\mathrm{CPI})_{t-1} + \sum_{j=0}^{q-1} b_j\Delta\log(\mathrm{XR})_{t-j} + \sum_{j=0}^{q-1} c_j\Delta\log(\mathrm{IPIND})_{t-j} + \sum_{j=0}^{q-1} d_j\Delta\log(TNR)_{t-j} + +M_0 + M_1 + \varepsilon_t \quad \dots\dots (2)$$

.

The relationship (2) can also be written as follows:

[1] Jonas Kibala Kuma. Modélisation ARDL, Test de cointégration aux bornes et Approche de Toda-Yamamoto: éléments de théorie et pratiques sur logiciels. Licence. Congo-Kinshasa. 2018. P8.

$$\Delta\log(\mathrm{CPI})_t = M_0 + M_1 + \sum_{i=1}^{p} a_i\,\Delta\log(\mathrm{CPI})_{t_{t-1}} + \sum_{i=1}^{p} a_i\,\Delta\log(\mathrm{CPI})_{t-1} + \sum_{j=0}^{q-1} b_j\Delta\log(\mathrm{XR})_{t-j} + \sum_{j=0}^{q-1} c_j\Delta\log(\mathrm{IPIND})_{t-j} + \sum_{j=0}^{q-1} d_j\Delta\log(TNR)_{t-j} + \theta\mu_{t-1} + \varepsilon_t \dots (3)$$

Where θ is the error correction term (adjustment coefficient, or speed of adjustment). Based on the relationship (3), after estimation, we will conclude the existence of a cointegration relationship between Yt and Xt if and only if: $0 < |\tilde{\theta}| < 1; \tilde{\theta} < 0$ And we reject "$H_0: \tilde{\theta} = 0$ " ($\tilde{\theta}$ is statistically significant)

The testing procedure involves comparing the Fisher values obtained with the simulated critical values (bounds) for different cases and various thresholds, as proposed by Pesaran et al.

If Fisher > upper bound: Cointegration exists.

If Fisher > lower bound: Cointegration does not exist.

If lower bound < Fisher < upper bound: No conclusion can be drawn.

V-7 Estimated Results of the ARDL model and Discussion

1. Lag Length Test for the Model

In order to determine the lag periods, which the model will estimate based on the Autoregressive Distributed Lag (ARDL) methodology, lag periods are selected according to the Akaike Information Criterion (AIC). The estimation results indicate that the optimal lag periods, corresponding to the lowest AIC value, are (2,0,4,0,0). This means that there are two lagged periods for the dependent variable, the Consumer Price Index (CPI), and no lag for the independent variable, the Money Supply (MS), Exchange Rate, and Interest Rate. Additionally, there are four lagged periods for the independent variable, Import Price Index.(IPIND)

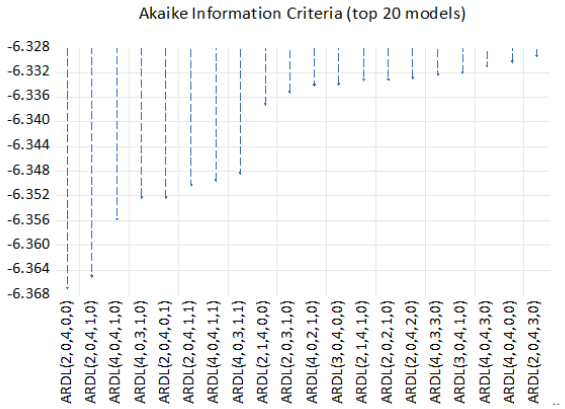


Fig.2 Akaike Information criteria

2. Bound Test

Tab4 :Bound test

Long-Term Relationship Estimation
Bound Test

Test Statistic	Value	K
F-statistic	9.224567	3

Significance level	I(0)	I(1)
10%	2.323	3.273
5%	2.743	3.792
1%	3.71	4.965

Source : eviews 13 outputs using IMF data

long-term relationship estimation based on outputs (Eviews13)

The results of the bound test are presented in Table 10 below and show that the Fisher test statistic (F = 9.224567) significantly exceeds the upper limits of the critical values. In this case, we can reject the null hypothesis of no long-term relationship and conclude that a long-term relationship exists between the variables in the model

3. Estimation of short-run and the long-run coefficient

After confirming the existence of a stable long-term relationship using the bound test approach, it is now necessary to obtain the long and short-term relationship for the parameters of the estimated model and the error correction parameter (ECM).

Tab4 : Estimation results for short-run coefficients

Dependent Variable: DLOG(CPI)
Number of models evaluated: 2500
Selected model: ARDL(2,0,4,0,0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(CPI(-1))*	**-0.110801**	0.043628	-2.539702	0.0140
LOG(INR)**	-0.005647	0.002635	-2.142874	0.0366
LOG(IPIND(-1))	0.037217	0.014343	2.594869	0.0122
LOG(XR)**	-0.076549	0.033797	-2.264962	0.0276
LOG(MS)**	0.021948	0.015036	1.459695	0.1502
C	0.358766	0.222477	1.612601	0.1127
DLOG(CPI(-1))	-0.225590	0.125623	-1.795760	0.0781
DLOG(IPIND)	0.008046	0.013411	0.599931	0.5511
DLOG(IPIND(-1))	-0.025863	0.015878	-1.628897	0.1092
DLOG(IPIND(-2))	-0.006040	0.014613	-0.413332	0.6810
DLOG(IPIND(-3))	0.018505	0.013472	1.373572	0.1753

R-squared	0.281753	Mean dependent var	0.011642
Adjusted R-squared	0.148744	S.D. dependent var	0.010276
S.E. of regression	0.009481	Akaike info criterion	-6.326070
Sum squared resid	0.004854	Schwarz criterion	-5.958097
Log likelihood	216.5973	Hannan-Quinn criter.	-6.180881
F-statistic	2.118305	Prob(F-statistic)	0.038577

* p-values are incompatible with t-bounds distribution.
** Zero-lag variable.

Source : eviews 13 outputs using IMF data

We observe that the error correction coefficient is negative and statistically significant (-0.11). This indicates the presence of long-term adjustments for short-term errors. The imbalances in the consumer prices produced will be corrected by 11% within one unit of time (quarter) since the study's data is quarterly. This means that it takes approximately 10 quarters, or about two and a half years, for inflation to return to its equilibrium level.

Tab5 : Estimation results for long-run coefficients

Deterministics: Rest. constant (Case 2)

CE = LOG(CPI(-1)) - (-0.690869*LOG(XR) + 0.335890*LOG(IPIND(-1)) - 0.050968*LOG(INR) + 0.198085*LOG(MS) + 3.237925)

Variable *	Coefficient	Std. Error	t-Statistic	Prob.
LOG(XR)	-0.690869	0.193437	-3.571537	0.0007
LOG(IPIND(-1))	0.335890	0.157537	2.132137	0.0371
LOG(INR)	-0.050968	0.030979	-1.645243	0.1051
LOG(MS)	0.198085	0.079363	2.495934	0.0153
C	3.237925	1.839325	1.760388	0.0834

Note: * Coefficients derived from the CEC regression.

Source : eviews 13 outputs using IMF data

Based on the results, we find that the exchange rate is the dominant factor affecting price index changes. A 1% depreciation of the currency leads to a 0.69% increase in the price index.

Furthermore, based on the results, it appears that imported inflation is the second dominant factor after the exchange rate in the long run, accounting for 33% of the variation. For example, a 1% increase in the import price index results in a 0.33% increase in the consumer price index. This can be attributed to Algeria's significant dependence on imports.

In the third position, we find that the money supply has an impact of 0.2% on the consumer price index for every 1% increase. This aligns with the quantity theory of money.

Lastly, the interest rate shows a minimal contribution, where a 1% increase in interest rates leads to a 0.05% decrease in the consumer price index.

Residual and Stability diagnostic

In order to ensure the reliability of the results and avoid any biased estimation, it is necessary to test the econometric robustness of the estimated model by conducting validation tests on the model's residuals. We will assess the robustness of our estimates by performing the usual tests, namely an autocorrelation test (Breusch-Godfrey), a, and a heteroscedasticity test (Breusch-Pagan-Godfrey).

Serial correlation LM test

We are going to test the following hypothesis:

H0: there is no serial correlation;

H1: there is a serial correlation.

This test concerning the errors which are unknown, the econometrics use the residuals instead of the errors since the residuals represent a good approximation than the errors, to detect this characteristic. We use the Breusch-Pagan-Godfrey test which is more general and without any application conditions with a null hypothesis to correspond to the absence of correlation.

The table shows that the Prob. Chi-Square value is greater than 0.05, indicating that we cannot reject the null hypothesis. Therefore, there is no evidence of serial correlation. The absence of correlation is a crucial assumption for the application of the least squares estimation method. This assumption requires that the error terms are not correlated with each other, allowing the least squares estimator to be effective.

Table 5: Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.103294	Prob. F(2,52)	0.9020
Obs*R-squared	0.257213	Prob. Chi-Square(2)	0.8793

➢ **Heteroskedasticity test**

Wearegoingtotestthefollowinghypothesis:
H0: Residuals are homoscedastic (constant variance).
H1: Residuals are heteroscedastic (varying variance).

Source : eviews 13 outputs using IMF data

The results indicate that the probability value associated with the test (0.35) is greater than the significance level (0.05). This leads us to accept the null hypothesis that the residuals are homoscedastic and reject the alternative hypothesis.

Table 6: Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	1.132406	Prob. F(10,54)	0.3562
Obs*R-squared	11.26788	Prob. Chi-Square(10)	0.3370
Scaled explained SS	11.59988	Prob. Chi-Square(10)	0.3127

Source : eviews 13 outputs using IMF data

Based on the results obtained above, where the three conditions of normality of residual distribution, serial independence of residuals, and homoscedasticity are met, we can confirm the validation of our econometric model and the reliability of its results.

Stability test of estimated model

After estimating the error correction format for the (ARDL) model, it is necessary to test the structural stability of the short-term and long-term coefficients for the inflation model to ensure that the data does not contain structural changes. Two tests are used for this purpose: the Cumulative Sum (CUSUM) test and the Cumulative Sum of Squares (CUSUM SQ) test, as shown in the following figure.The parameters of the model are stable as the graph falls within the interval of critical values at a 5% significance level. Thus, we can confirm the robustness of our econometric model and the reliability of its results.

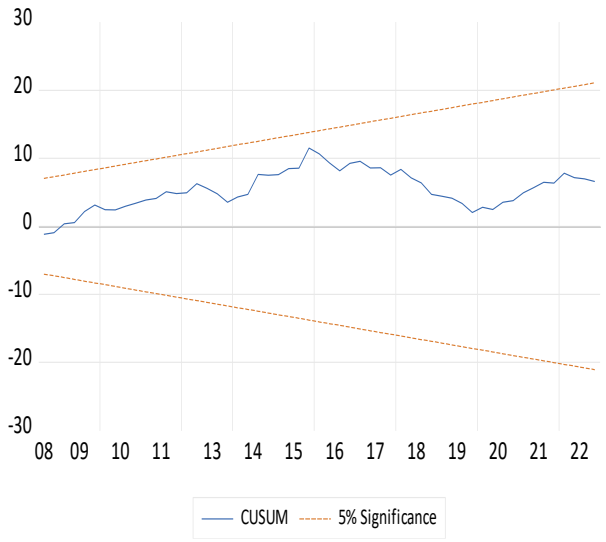


Fig 3 : CUSUM test results

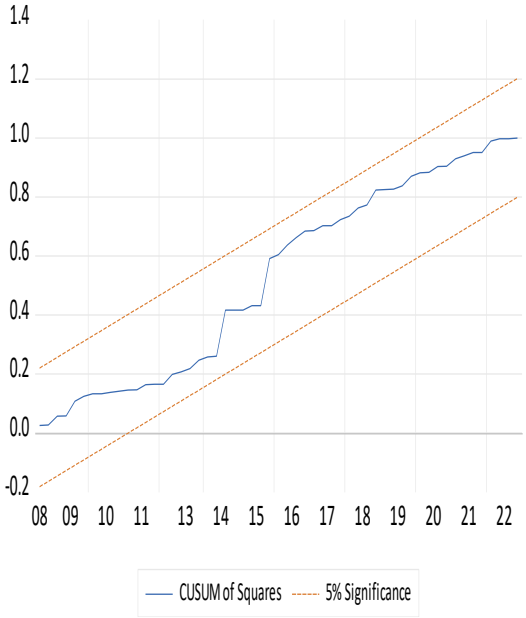


Fig 4 : CUSUM of squares test results

V CONCLUSIONS

Since the 1990s, one of the objectives of monetary policy led by the Bank of Algeria has been to maintain inflation at a relatively low and stable level. For this reason, monetary authorities have employed a set of tools such as liquidity control, interest rates, and the exchange rate. It is a prerequisite for any sound monetary policy to control inflation by understanding its determinants.

The topic of inflation in the economy is a multifaceted and extensively debated subject. Inflation is impacted by a multitude of factors including monetary shocks, demand-side factors, supply-side shocks, structural and political factors, and institutional influences Totonchi. (2011)

In conclusion, the theory of inflation in the economy is intricate and influenced by a multitude of factors, necessitating a comprehensive understanding of macroeconomic dynamics.

This research paper attempted to identify the main determinants of inflation in Algeria through the analysis of quarterly data from 2000 to 2022. To this end, we used the ARDL technique, and the empirical study yielded the following results:

There exists a long-run cointegrating relationship between inflation, money supply, official nominal exchange rate, and import price index which confirms our hypothesis

Our main conclusion is that the import price index and exchange rate appear to be major determinants of inflation, confirming the fact that Algeria's weak production and lack of competitiveness in domestic products make it vulnerable to global price fluctuations and expose it to risk by relying on imported inputs, intermediates, and even final goods. Therefore, efforts should focus on accelerating the process of diversifying the national economy, improving the business environment, attracting foreign direct investment, and enhancing means of integration into the global economy. This would undoubtedly reduce long-term inflationary pressures arising from dependence on imports.

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