The impact of monetary policy in supporting the goal of food security in Algeria during the period (1990–2024)

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Received: 02/04/2026 **Accepted: 30/09/2026** **Published: 20/11/2026**

Abstract:

Food security is a strategic challenge for oil-dependent economies facing high exposure to market volatility and fluctuating rentier revenues. This study measures the contribution of monetary instruments to Algerian food security (1990–2024) using the ARDL model. Empirical results show that activating bank credit and expansionary measures (reducing the discount rate), alongside inflation control and flexible exchange rate management complemented by increased agricultural public spending cumulatively improved food security indicators by 0.03336, 0.0515, 0.1287, 0.2663, and 0.001875 units, respectively. These findings underscore the necessity of integrating monetary and fiscal policies to transform financial resources into productive agricultural investments supporting self-sufficiency.

Keywords: Food Security; Monetary Policy ; Agricultural Sector; Fiscal Policy; ARDL Model.
Jel Classification Codes: Q18, E52, E62, F31, C22

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1. Introduction :

In recent decades, food security has become a critical priority on the agenda of economic policymakers, reflecting the growing challenges faced by national and global food systems. This heightened attention is largely driven by accelerating population growth, which has substantially increased food demand, alongside rising income levels that have reshaped consumption patterns and intensified pressure on agricultural resources. Moreover, persistent volatility and upward trends in international food prices have amplified concerns regarding the sustainability and resilience of food supply, particularly in developing economies that remain vulnerable to external shocks.

Against this backdrop, Algeria has undertaken, since the early 1990s, a series of economic reforms aimed at reinforcing its agricultural sector as a strategic foundation for achieving food security. These reforms have focused on enhancing agricultural productivity, promoting efficient resource allocation, and fostering an enabling environment for both public and private investment. Within this policy framework, monetary policy has emerged as a key instrument, playing a pivotal role in regulating liquidity, ensuring price stability, and facilitating access to credit. Through these channels, monetary policy contributes indirectly yet significantly to strengthening agricultural output and supporting the long-term objective of sustainable food security.

In light of the preceding analysis, this study is primarily concerned with addressing the following central question: **how effective is monetary policy in advancing and strengthening food security objectives in Algeria over the period 1990–2024 ?**

Based on the central research question, the study's problem can be further specified through the following analytical sub-questions:

-What is meant by food security?;

-What are the most important tools of monetary policy?;

-What is the relationship between monetary policy tools and food security in Algeria?;

To address the main research question, the following hypotheses have been formulated:

-The policy of regulating loans directed to the agricultural sector contributes to stimulating productive investment, thereby enhancing food security in Algeria ;

- Controlling inflation levels leads to the stabilization of food prices, which positively impacts the food security index in Algeria ;

-Reducing the discount rate lowers the cost of bank borrowing, thereby encouraging investment in agricultural and productive projects, which in turn positively contributes to enhancing food security levels in Algeria ;

-Fiscal policy, through expanding public spending aimed at supporting production inputs and agricultural activities, contributes to enhancing food security levels in Algeria ;

- An increase in the exchange rate of the dollar against the dinar stimulates domestic production of food commodities as a substitute for imports, contributing to higher exports, reduced imports, and consequently supporting food security;

Significance of the Study : The significance of this research lies in the vital role played by monetary policy tools in directing financing toward strategic sectors, foremost among them the agricultural sector. This is achieved through the provision of credit facilities and incentive-based financing for productive and investment projects. These mechanisms aim to increase food production rates and achieve self-sufficiency, which serves as a fundamental pillar for enhancing sustainable food security in Algeria.

Research Objectives: This study primarily aims to analyze and evaluate the impact of monetary policy on strengthening food security in Algeria. To achieve scientifically rigorous results, the research employs the Auto-Regressive Distributed Lag ARDL model to investigate the dynamic relationship and quantify the long-term and short-term effects of monetary variables on national food sustainability."

Research Scope: Based on the central question and the formulated hypotheses, and in line with the study's objectives and significance, the temporal scope is defined by the period from 1990 to 2024. Regarding the spatial scope, the study is limited to examining the relationship between monetary policy and food security within the Algerian context.

Research Methodology: In accordance with the analytical requirements of the study, an inductive approach was adopted in its empirical dimension. This was implemented by utilizing statistical analysis and econometric tools to model and examine the nature of the correlation between monetary variables and food security indicators within the Algerian context.

2. Conceptual Framework for Food Security and Its Strategic Dimensions

This section is dedicated to providing an in-depth analytical review of the conceptual definition of food security by exploring its fundamental pillars and core components. It further aims to establish a solid knowledge base that enables the researcher to grasp the complex interconnections between food availability and accessibility. Moreover, this framework serves as a foundation for a deeper understanding of how policies and strategies are formulated to ensure the achievement of sustainable food security.

2.1. Definition of Food Security

According to the World Bank, food security refers to a situation where every person can reliably obtain enough food, at any given time, to maintain proper health and daily activity. A country is considered food secure when its economic, commercial, and distribution systems are able to ensure a steady and sufficient food supply for all citizens, even in the face of emergencies, reduced national production, or instability in global markets

(bourzama & Benomar, 2018, p. 33) , From the perspective of the World Health Organization, food security encompasses the full set of conditions and standards required throughout the stages of food production, processing, storage, distribution, and preparation, in order to ensure that food is safe, reliable, and suitable for consumption. It is no longer sufficient for food to be merely available in adequate quantities or to meet basic nutritional needs; it must also be harmless to consumers' health and produced in ways that do not damage the environment or contribute to increased pollution (bennourine & ouddane, 2021, p. 208) , The World Organization for Agricultural Development defines food security as the continuous provision of food in sufficient quantity and quality to support health and daily activity for all members of a nation. This relies primarily on domestic production and on each country's comparative advantage in food commodities, while ensuring that food is made accessible to citizens at prices compatible with their income and financial capacity (benchehida, 2023, p. 99), Regarding the position of the Algerian legislator, food security is defined in Article 3 of Law No. 08/16 on Agricultural Guidance as the ability of every individual to easily and regularly access safe and sufficient food that enables them to lead an active life.

Based on the definitions mentioned above, it can be stated that food security means ensuring that every citizen has access to their essential nutritional needs throughout the year, without deprivation at any time, whether through domestic production or imports. In other words, food security is the ability of a society to provide adequate and appropriate food to its population, both in the short and long term, in terms of quantity and quality, at prices compatible with their income levels and purchasing power (barkati, 2022, p. 483) .

2.2 Dimensions of Food Security

Food security is achieved when everyone, at all times, has the financial, social, and economic means to access safe and nutritious food in sufficient quantities to meet their dietary needs and preferences, allowing them to lead a healthy and active life. Based on this perspective, four dimensions of food security can be identified, which include (Makid & Ben Ayad, 2017, p. 2) :

-Food Availability **:** Availability is a crucial dimension of food security. Supplying sufficient food to the population is necessary but not sufficient on its own. It is a prerequisite for ensuring adequate access to food for individuals, meaning that food must be both sufficient in quantity and appropriate in quality. This dimension encompasses not only the amount of food but also its quality and diversity. Indicators used to assess availability include the adequacy of dietary energy supply, the proportion of calories derived from cereals, roots, and tubers, average protein supply, average protein supply from animal sources, and the average value of food production.

- Food Access: This dimension refers to the regular and adequate availability of food resources to individuals, allowing them to obtain a proper diet. Access to food depends primarily on income, food prices, and households' or individuals' ability to receive social support. It is also heavily influenced by social factors, such as the physical

accessibility of food, which depends on the availability of transportation infrastructure like railways and roads, and the economic accessibility, represented by local food price indices and the prevalence of undernutrition.

- Stability: Stability concerns the ability to obtain sufficient food at all times without facing the risk of losing this ability due to shocks such as economic crises, environmental disasters, or seasonal cycles. For households or individuals to achieve food security, they must have reliable access to adequate food at all times. There should be no risk of losing access due to shocks (economic or climatic) or recurring events (such as seasonal food insecurity). Therefore, the concept of stability encompasses both the availability and access dimensions of food security.

- Utilization : Food utilization refers to the way individuals make use of food, which depends on food quality, preparation, and storage. This dimension is divided into two groups. The first includes variables determining the ability to utilize food, such as access to adequate household facilities, safe water, and sanitation. The second focuses on the outcomes of food utilization, particularly nutritional deficiencies among children under five, including stunting, wasting, and underweight. Additionally, the 2013 edition of the State of Food Insecurity in the World report introduced four indicators of micronutrient deficiencies: the prevalence of anemia and vitamin A deficiency among children under five, and the prevalence of iodine deficiency and anemia among pregnant women.

2.3 National Policies for Achieving Food Security in Developing Countries

Ensuring food security in developing nations calls for the implementation of a comprehensive framework built upon a range of coordinated national policies, presented as follows (Nasser, 2010, pp. 48-51):

-Economic Development Policy: This policy focuses on leveraging a country's specific advantages. In cases where a developing nation has strengths in producing certain food items, economic development emphasizes agricultural advancement. When such advantages are absent, the country prioritizes generating enough foreign currency to fund food imports, mainly through industrial growth.

-Food Production Expansion Policy: This approach directs government efforts toward enhancing the agricultural sector by enlarging land allocated for food cultivation and by developing livestock and fisheries. The ultimate goal is to reach self-sufficiency in food supply.

-Pricing Policy: Through this policy, the government ensures that essential food products remain accessible throughout the year, especially for low-income populations. It does so by influencing prices or providing subsidies, including the establishment of fixed prices to guarantee a stable food flow. Additionally, food price stability is supported through a strategic reserve system, increasing stock levels during surpluses and decreasing them during shortages. Determining the optimal reserve size is a key component of this approach.

-Food Rationing and Consumption Management Policy: This policy regulates consumption according to available resources and nutritional needs suited to societal conditions, following international standards. Measures include adjusting consumption patterns by discouraging wasteful habits, targeting subsidies to essential foods only, limiting imports to essential items unavailable locally in sufficient quantity and quality, promoting public awareness campaigns to guide consumption behavior, and reducing excessive consumption among high-income groups through taxation on luxury food products.

3. The role of indirect monetary policy instruments in supporting food security.

Monetary policy constitutes a fundamental pillar through which economic authorities maintain macroeconomic stability and promote development, particularly in strengthening food security. Through both its direct and indirect instruments, it influences economic conditions and resource allocation. Moreover, it acts as a stabilizing mechanism that mitigates economic fluctuations, thereby ensuring the continuous availability and stability of food supplies in markets.

3.1 Definition of Monetary Policy

Monetary policy refers to the set of measures and tools employed by the state through the monetary authority to control the money supply, aiming to achieve monetary stability in particular, and economic stability in general. In other words, monetary policy encompasses all actions taken by the monetary authority to ensure the stability of money and the full and synchronized performance of its economic and social functions (Hussein, 2021, p. 4).

3.2 Monetary Policy Instruments:

Monetary policy instruments consist of the following :

3.2.1 Direct instruments: Qualitative tools of monetary policy primarily aim at guiding how credit is utilized rather than influencing its total volume, which is the focus of quantitative tools. Therefore, qualitative control targets bank credit itself instead of the monetary reserves upon which lending is based. Quantitative instruments include the following (Hadji, 2016, pp. 85-87) :

-Credit Framing Policy: This approach seeks to legally manage the expansion of the primary mechanism for money creation, namely loans issued by banks and financial institutions. It is sometimes referred to as credit allocation. Historically, the Bank of England employed this strategy in the late 18th century as a means to exercise control over the credit system.

-Selective Credit Policy: Under this policy, lending institutions allocate loans based on specific criteria, such as expected profitability and risk assessment, including the borrower's solvency and the adequacy of collateral. Nonetheless, such allocations may not always correspond with the long-term requirements for sustainable economic growth.

-Moral Persuasion: This technique involves the central bank encouraging commercial banks to adopt certain practices without formal mandates or directives. The success of this method relies heavily on the central bank's persuasive capacity and the commercial banks' trust in, and willingness to comply with, its guidance.

.3.22 Indirect Instruments: Also known as quantitative credit control tools, indirect instruments are generally classified into three main types:

-Rediscount Policy: The rediscount rate refers to the interest rate charged by the central bank to commercial banks when providing them with loans or when rediscounting the bills of exchange and bonds they present. The primary objective of this rate is to influence the volume of discounted loans, which in turn affects the borrowed monetary base (Bouchneb, 2010, p. 86) .

Open Market Policy: This policy involves the central bank intervening in the money market to either decrease or increase liquidity by selling or purchasing securities such as stocks and bonds. It is considered the most commonly used and widely adopted tool, particularly in developed countries (Bouhson, 2021, p. 13) .

Statutory Reserve Requirement Policy: This refers to the percentage of each deposit that a commercial bank is required to hold in the form of liquidity, which is then deposited with the central bank as a legal reserve. No interest is earned on these reserves (Hadji, 2016, p. 83).

4. Literature Review

Food security is a critical issue that directly influences societal well-being and the sustainability of livelihoods. Monetary policy plays a pivotal role in strengthening food security through its impact on macroeconomic stability, individuals' access to food, and the stimulation of domestic production. A substantial body of literature has examined the relationship between monetary policy and food security, highlighting the mechanisms through which monetary tools can be oriented to stabilize food markets and enhance access to basic needs.

Inflation, particularly food price inflation, is considered one of the main factors negatively affecting food security (Gahamanyi & G´erard, 2025, pp. 1-15), as it leads to rising food prices and erodes individuals' purchasing power, especially among low-income groups. Empirical evidence indicates that food-insecure individuals are more vulnerable to increases in food inflation, with price becoming the primary determinant of their consumption choices (Haydaroğlu & Bilgiçb, 2024, pp. 597-608), Moreover, food price volatility resulting from inflationary pressures and macroeconomic factors contributes to greater instability in food security, particularly in developing economies (Ullah, Sohag, Mariev, & Zada, 2026, pp. 1-18).

Recent studies further confirm that higher inflation rates are directly associated with increased food prices and reduced accessibility, thereby exacerbating food insecurity (Olufemi-Phillips, Abbey, Onyeka, & Louis, 2026, pp. 102-128), Effective monetary policy aimed at controlling inflation can directly reduce food price volatility,

facilitating access to food, especially in developing countries where inflation represents a major challenge to food security.

In addition, monetary policy contributes to the provision of credit to farmers and food processors, thereby enhancing domestic production (Hossam, 2024, pp. 85-128). This, in turn, increases food production levels and ensures the availability of stable local food supplies.

security challenges. Achieving positive outcomes requires a balance between monetary policy and other policies, such as fiscal, structural, and developmental policies, to ensure an integrated approach to food security.

5. Quantifying the Impact of Monetary Policy Instruments on Food Security Indicators in Algeria

Advanced econometric models allow for the exploration of the nature of dynamic interactions and causal links between the monetary mechanisms adopted by the Bank of Algeria and food security requirements over the time series (1990–2024). This empirical section aims to quantify the impact of monetary variables, such as agricultural credit and discount rates, on enhancing food availability and thereby achieving food security according to the following methodological sequence:

5.1 Study Variables and Econometric Methodology

The empirical component of this study relies on econometric tools to construct and estimate an optimal mathematical model that captures the nature of the relationships between variables. The model aims to analyze and test the quantitative impact of monetary policy indicators as independent variables, and their role in driving food security levels as the dependent variable. The study variables are defined as follows:

Table N°1: Model Variables

symbol	index	variables	Explanation
dependent variable			
y	Food Production	Urban Food Security	Food production is defined as a series of integrated processes aimed at transforming natural resources and raw materials (whether plant-based or animal-based) into products suitable for human consumption. It constitutes the fundamental pillar of food security, Food production has been utilized as a proxy for food security (Ramzi & Al-Nefaie, 2026, pp. 1-10)
independent variables			
x_1	Total Credit Outflow Allocated to the Agricultural Sector	Monetary Policy	Selective credit control functions as a pivotal direct monetary policy instrument designed to optimize resource allocation toward priority sectors. By incentivizing commercial banks to provide preferential credit facilities to the agricultural sector, this tool plays a crucial role in enhancing food security. It facilitates the scaling of agricultural productivity, supports agri-business sustainability, and ensures the continuous flow of specialized financing, thereby mitigating food supply chain vulnerabilities

			and fostering national food sovereignty.
x_2	Inflation Rate	Ultimate Objective of Monetary Policy	This goal serves as a catalyst for increasing food security due to the direct relationship between the quantity of production and its price. Additionally, expansionary monetary policy contributes to supporting agricultural production, thereby ensuring food supply, by lowering interest rates and raising appropriate price levels.
x_3	Discount Rate	Monetary Policy	A decrease in the discount rate is considered an indicator of improved food security indicators, as it reduces the cost of bank borrowing, which helps stimulate investment in productive sectors. This approach enhances the national economy's ability to provide local food and reduce reliance on imports, thereby contributing to the improvement of long-term food stability.
x_4	Agricultural Subsidy	Fiscal Policy	An increase in this indicator signifies enhanced food security, as it reflects greater stability in food availability and accessibility, thereby strengthening the resilience of the food system.
x_4	Exchange Rate	-	The improvement in this indicator has contributed to enhancing food security indicators, as it helps reduce food import costs and strengthens the ability to provide locally produced food at reasonable prices

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

5. 2 Model Estimation

Econometric investigations utilizing Ordinary Least Squares (OLS) are frequently impeded by structural estimation challenges, predominantly the 'Spurious Regression' phenomenon. This distortion stems from the presence of non-stationary stochastic components within time series, which disrupt the underlying data-generating process and yield misleading statistical inferences. To ensure robust estimation and eliminate analytical bias, the following methodological protocol is adopted:

5.2.1 Time Series Stationarity Analysis

The stationarity analysis of time series constitutes a fundamental methodological step to avoid the problem of spurious regression and to ensure the consistency and reliability of econometric results. Based on the graphical characterization of the time paths of the study variables, it appears that their statistical behavior is non-stationary, as the series exhibit general trends and fluctuations that prevent the stability of both the mean and variance over time. To statistically confirm these properties, the data were subjected to the Augmented Dickey Fuller (ADF) and Phillips Perron (PP) tests, given their strong ability to address issues of autocorrelation and heteroskedasticity, thereby allowing for an accurate determination of the order of integration of the variables prior to proceeding with econometric estimation.

Fig N° 1: Graphical Representation of Time Series



Source: Prepared by the researchers based on the outputs of EViews 12.

Driven by the initial diagnostic insights from the visual data inspection, which indicated potential stochastic trends, the variables underwent rigorous unit root examination to validate their stationarity properties. Specifically, the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) frameworks were implemented to ascertain the precise integration order of the underlying processes. The subsequent table delineates the synthesized outcomes of these diagnostic tests, providing a robust basis for the selection of the appropriate econometric model.

Table N°2: Unit Root Test

At level										
time series	ADF test					PP test				
	With Constant & Trend		With Constant		Without Constant & Trend	With Constant & Trend		With Constant		Without Constant & Trend
	b=0	λ=0	c=0	λ=0	λ=0	b=0	λ=0	c=0	λ=0	λ=0
y	0.0478	0.4399	0.1726	0.6940	0.9962	0.0478	0.4637	0.1726	0.6910	0.9993
x_1	0.3753	0.8994	0.1089	0.7927	0.8545	0.3753	0.8522	0.1089	0.7820	0.8067
x_2	0.5052	0.2190	0.0349	0.080	0.1120	0.5052	0.2479	0.0349	0.1009	0.1120
x_3	0.0009	0.0027	0.9276	0.8690	0.0557	0.1885	0.5164	0.9276	0.7532	0.2306
x_4	0.0364	0.4039	0.1483	0.8064	0.8343	0.0364	0.3750	0.1483	0.8064	0.8396
x_5	0.0135	0.2967	0.0000	0.0000	0.9937	0.0063	0.0001	0.0000	0.0000	0.9661
At First Difference										

y	0.7421	0.0000	0.0147	0.0000	0.0000	0.7421	0.0000	0.0147	0.0000	0.0000
x_1	0.6307	0.0005	0.1451	0.0001	0.000	0.6307	0.0005	0.1451	0.0001	0.000
x_2	0.4578	0.0000	0.6520	0.0000	0.0000	0.4578	0.0000	0.6520	0.0000	0.0000
x_3	0.0607	0.0068	0.1907	0.0033	0.0002	0.2980	0.0248	0.1745	0.0048	0.0005
x_4	0.8553	0.0002	0.1838	0.0000	0.0000	0.8553	0.0002	0.1838	0.0000	0.0000
x_5	0.1704	0.0000	0.0621	0.0000	0.0000	0.1704	0.0000	0.0621	0.0000	0.0000

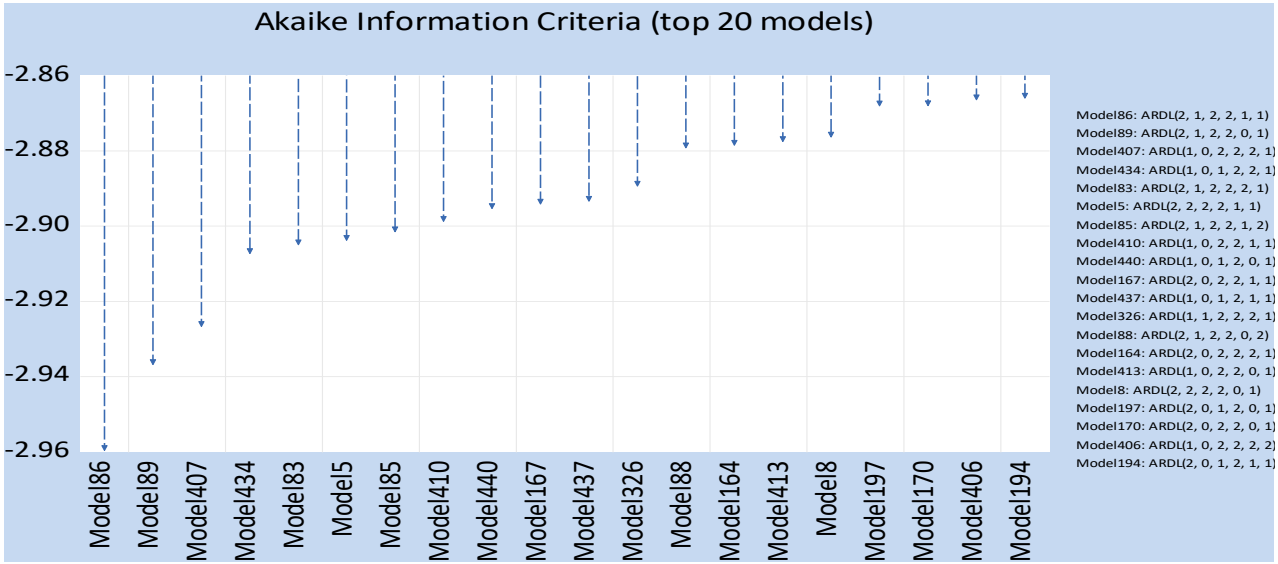
Source: Prepared by the researchers based on the outputs of EViews 12.

Analytical readings derived from the empirical results presented in the table above, utilizing the Augmented Dickey-Fuller (ADF) framework to examine stationarity properties, indicate that all variables under study possess a unit root at their levels. However, it is explicitly demonstrated that these time series achieve statistical stationarity after the first differencing process, thereby confirming they are integrated of order one, denoted as I(1). This finding establishes a robust methodological basis for exploring long-term equilibrium relationships.

.5.22 Cointegration Test

properties required for this framework, a systematic methodological sequence is implemented to evaluate long-run co-movement dynamics. This analytical procedure commences with the identification of the optimal lag structure for the first-differenced variables within the Unrestricted Error Correction Model (UECM). The selection process is strictly governed by the minimization of the Akaike Information Criterion (AIC) and the Schwarz Criterion (SC) , Consequently, various model specifications were estimated across different lag lengths using EViews 12, allowing for a comparative assessment of the information criteria to determine the most parsimonious model, as evidenced by the subsequent graphical diagnostic outputs.

Fig N° 2: Graphical Representation of Time Series



Source: Prepared by the researchers based on the outputs of EViews 12.

It is clear from the figure that the minimum value of the Akaike criterion corresponds to the column lengths (since the values are negative), which intersects with the ARDL model (2,1,2,2,1,1). The model shown in the equation was estimated using the Ordinary Least Squares (OLS) method, and then the existence of cointegration was verified using the Wald test. After conducting this test on the specified model, the following results were obtained:.

Table N°3: Wald Test Results for Validating Long-run Cointegration Dynamics

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	5.522485	10%	2.08	3
k	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

Source: Prepared by the researchers based on the outputs of EViews 12.

A systematic comparison between the calculated F-statistic and the corresponding critical values reveals that the computed test statistic significantly exceeds the upper bound threshold across all conventional significance levels. Consequently, the null hypothesis of no cointegration is rejected, confirming a synchronized long-run equilibrium relationship among the variables. This statistical evidence justifies the subsequent estimation of the Error Correction Model (ECM) based on the [Your Technique, e.g., ARDL] approach.

5.2.3 Estimation of Long-Term Parameters and Error Correction Model After confirming the existence of a cointegration relationship between the time series under study, we can estimate the long-term and short-term parameters, as well as the error correction or adjustment coefficient, as follows:

A- Estimation of Long-Term Parameters: The results of the parameter estimation can be summarized in the following table:

Table N°4 : Results of Estimating Long-Term Parameters

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1	0.036669	0.009067	4.044438	0.0008
X2	0.128758	0.037335	3.448757	0.0029
X3	-0.051526	0.018139	-2.840626	0.0108
X4	0.001875	0.000800	2.342578	0.0308
X5	0.266389	0.071372	3.732408	0.0015
C	2.789340	0.255925	10.89907	0.0000

EC = Y - (0.0367*X1 + 0.1288*X2 -0.0515*X3 + 0.0019*X4 + 0.2664*X5 + 2.7893)

Source: Prepared by the researchers based on the outputs of EViews 12.

B-Short-Run Dynamics and Error Correction Model (ECM) Estimation:

Error Correction Models are implemented to identify the 'Speed of Adjustment' coefficient, which quantifies the capacity of the system to revert to its long-run equilibrium trajectory following short-term stochastic shocks or imbalances. The empirical outcomes presented in the following table delineate the estimated short-run parameters and the convergence properties toward equilibrium:

Table N°5: Empirical Results of Short-Run Parameter Estimates

ARDL Error Correction Regression
Dependent Variable: D(Y)
Selected Model: ARDL(2, 1, 2, 2, 1, 1)
Case 2: Restricted Constant and No Trend
Date: 03/30/26 Time: 12:49
Sample: 1990 2024
Included observations: 33

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob
D(Y(-1))	0.250856	0.108439	2.313330	0.03
D(X1)	0.009936	0.008648	1.148939	0.26
D(X2)	0.043850	0.010344	4.239199	0.00
D(X2(-1))	-0.034269	0.013872	-2.470422	0.02
D(X3)	-0.101263	0.013667	-7.409377	0.00
D(X3(-1))	0.043473	0.010227	4.250909	0.00
D(X4)	0.002622	0.000526	4.982646	0.00
D(X5)	0.635494	0.087555	7.258223	0.00
CointEq(-1)*	-0.809676	0.112778	-7.179359	0.00

Source: Prepared by the researchers based on the outputs of EViews 12.

The findings reported in Table (4) indicate that the error correction term is statistically significant, with a negative coefficient estimated at -0.809676. This reflects the presence of a strong self-adjusting mechanism in the proposed model, whereby short-run imbalances are gradually corrected, allowing the system to return to its long-run equilibrium path within a period of approximately nine months and twenty-one days following the initial disturbance.

5.3 Diagnostic Tests for the Estimated Model: These tests serve as a fundamental tool for evaluating the robustness and efficiency of the estimated model. They are used to rigorously verify the model's compliance with classical assumptions and to ensure it is free from potential standard issues. Passing these tests is a crucial prerequisite for relying on the model for scientific analysis, interpretation, or generating reliable forecasts. In this context, a set of important tests is available, with the most significant outlined below:

-Autocorrelation Test of Residuals : The Breusch-Godfrey test is widely recognized as one of the most reliable methods for detecting the presence of autocorrelation in the model's residuals. The results of this test are summarized in the following table:

Table N°6: Diagnostic Test Results for Residual Autocorrelation

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

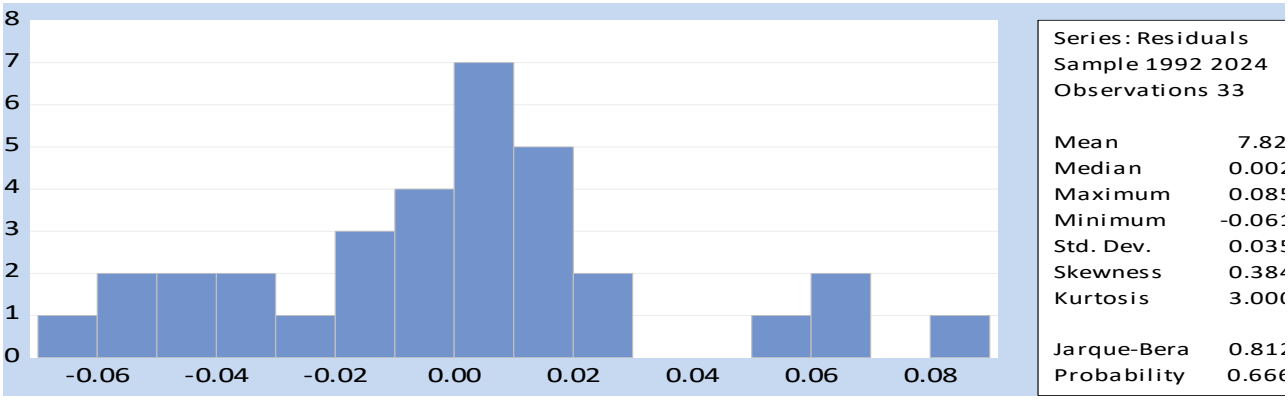
F-statistic	0.222497	Prob. F(2,16)	0.8030
Obs*R-squared	0.892963	Prob. Chi-Square(2)	0.6399

Source: Prepared by the researchers based on the outputs of EViews 12.

The results presented in the table indicate that the calculated value of the F-test (F-statistic = 0.22) exceeds the 5% significance level, justifying the acceptance of the null hypothesis. This confirms the absence of autocorrelation among the model's residuals, thereby reinforcing the model's reliability in accurately representing the data.

-**Testing the Distribution of Model Residuals:** The Jarque-Bera test was employed to examine whether the model's residuals conform to a normal distribution, with the null hypothesis assuming that the residuals follow a normal pattern. The results presented in the following figure illustrate the extent to which the residuals meet this assumption, thereby reinforcing the reliability and efficiency of the model in statistical analysis.

Fig N° 3: Jarque-Bera Normality Test Results for Estimated Residuals



Source: Prepared by the researchers based on the outputs of EViews 12.

The figure illustrates that the histogram of the model's residuals closely resembles the bell-shaped curve characteristic of a normal distribution. Additionally, the Jarque-Bera test yields a p-value of 0.812690, exceeding the 5% significance threshold, which supports the acceptance of the null hypothesis and confirms that the residuals follow a normal distribution, thereby reinforcing the model's reliability and analytical validity.

-Testing the Homoscedasticity Assumption of Residual Variance: To validate the assumption of constant error variance and ensure the absence of heteroscedasticity within the estimated model, the Breusch-Pagan-Godfrey test was performed. This diagnostic procedure is essential for maintaining the efficiency of the OLS estimators. The empirical outcomes of this test are documented in Table (6) as follows:

Table N°7: Breusch-Pagan-Godfrey Test Results for Heteroscedasticity

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

F-statistic	0.978241	Prob. F(14,18)	0.5087
Obs*R-squared	14.25910	Prob. Chi-Square(14)	0.4306
Scaled explained SS	4.242794	Prob. Chi-Square(14)	0.9938

Source: Prepared by the researchers based on the outputs of EViews 12.

Since the calculated value of the F-test exceeds the 5% significance level, the null hypothesis is accepted, indicating that the variance of the error term in the estimated model is constant and homogeneous. This supports the validity of the model's statistical assumptions and reinforces its reliability for analysis and forecasting.

-**Ramsey RESET Test for Functional Form Misspecification**: The Ramsey RESET test is employed as a rigorous diagnostic tool to evaluate the adequacy of the model's functional specification. It ensures that the mathematical formulation accurately captures the underlying economic relationships among the variables, confirming the absence of specification biases such as omitted variables or incorrect functional forms. The empirical results of this diagnostic procedure are summarized as follows:

Table 8: Ramsey RESET Test Results for Functional Form Specification

Ramsey RESET Test
Equation: UNTITLED
Omitted Variables: Squares of fitted values
Specification: Y Y(-1) Y(-2) X1 X1(-1) X2 X2(-1) X2(-2) X3 X3(-1) X3(-2) X4 X4(-1) X5 X5(-1) C

	Value	df	Probability
t-statistic	1.456157	17	0.1636
F-statistic	2.120394	(1, 17)	0.1636
Likelihood ratio	3.878891	1	0.0789

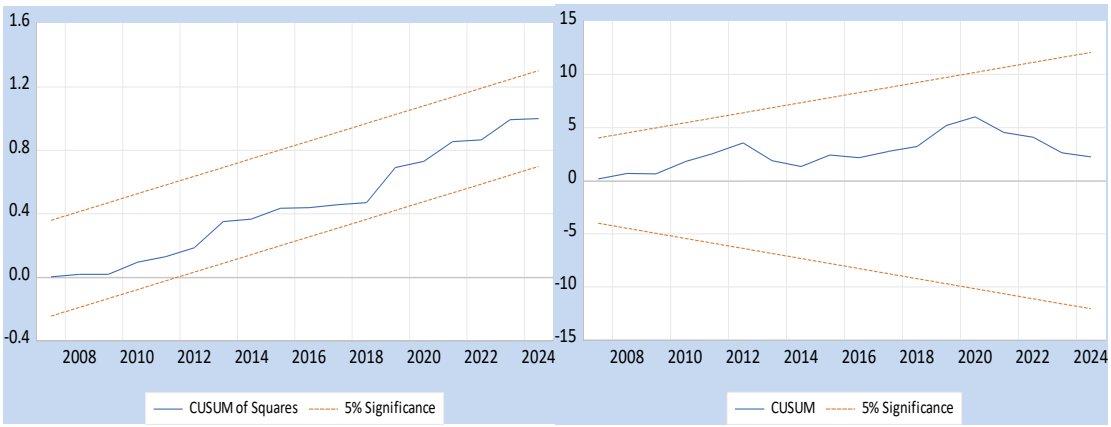
Source: Prepared by the researchers based on the outputs of EViews 12.

Given that the p-value associated with the F-statistic exceeds the 5% significance threshold, the null hypothesis of correct functional specification cannot be rejected. This empirical evidence validates the adequacy of the proposed functional form in capturing the economic dynamics between the variables under investigation, ensuring the robustness of the model against specification bias.

5.4. Parameter Stability and Structural Stability Test of the Estimated ARDL Model

This approach is used to assess whether the dataset exhibits any structural shifts over time. It relies on two primary methods: the CUSUM test for cumulative residuals and the CUSUM of Squares test for cumulative squared residuals , As shown in Figure (4), the coefficients estimated for the ARDL model demonstrate structural stability across the entire study period,

Fig N° 4: CUSUM and CUSUM-squared Statistics for Parameter Stability



Source: Prepared by the researchers based on the outputs of EViews 12.

This indicates that the relationships among the variables remain consistent, with the model showing coherent adjustment patterns in both the short and long term. Moreover, the statistics from both tests remain within the critical thresholds at a 5% significance level, confirming the model's reliability and robustness for analysis and forecasting.

6. Results and discussion

Drawing from the long-run estimation results reported in Table (3), the steady-state equilibrium equation is formulated as follows:

$$Y = 2.789340 + 0.036669X_1 + 0.128758X_2 - 0.051526X_3 + 0.650785X_3 + 0.001875X_4 + 0.266389X_5$$

-The statistical results are consistent with the first research hypothesis, as the estimated parameters indicate that a one-unit increase in the regulation of the volume of loans directed to the agricultural sector considered an important tool of monetary policy contributes to enhancing the food security index by 0.036669 units. This can be attributed to the vital role these loans play in financing agricultural activities by improving farmers' productive capacity, facilitating access to modern inputs, and promoting the adoption of advanced agricultural technologies, which positively affects both the volume and stability of production. Moreover, such financing helps reduce the food gap and strengthen self-sufficiency, thereby supporting the stability of food supplies and improving the level of food security in the medium and long term.

-The regression equation indicates the acceptance of the second hypothesis, as the results show that a one-unit increase in inflation rates contributes to enhancing the food security index by 0.128758 units. This can be explained by the fact that controlling inflation through effective monetary policy tools can create a moderate and appropriate inflationary environment, reflected in higher prices that incentivize agricultural producers to increase production and improve their productivity. This, in turn, leads to higher agricultural revenues, which ultimately contributes to strengthening food security.

-The results of the regression equation confirmed the third hypothesis, which states that reducing the discount rate leads to lower bank borrowing costs, thereby providing a strong incentive for investment in agricultural and productive projects. The results indicate that a one-unit decrease in the discount rate contributes to an increase in the food security index by 0.051526 units, reflecting the positive impact of monetary policy on the agricultural sector. This effect can be attributed to the fact that lower financing costs enable farmers and investors to access financial resources more easily, encouraging them to expand production, adopt modern agricultural technologies, and improve resource management. Such expansion, in turn, enhances agricultural revenues and increases the capacity to meet local food demand, thereby improving the level and stability of food security in the medium and long term. In other words, monetary policies aimed at reducing the discount rate serve as an

effective mechanism to support agricultural production, stimulate economic growth in the agricultural sector, and strengthen the national capacity to achieve food self-sufficiency.

-The results of the regression equation allowed us to confirm the fourth hypothesis, which states that the implementation of fiscal policy through the expansion of public spending aimed at supporting production inputs and agricultural activities contributes to enhancing food security. The results indicate that a one-unit increase in public spending allocated to the agricultural sector contributes to raising the food security index by 0.001875 units. This effect can be attributed to the fact that increased public spending provides farmers with the necessary resources to secure essential inputs, such as high-quality seeds and fertilizers, and enables them to invest in improving agricultural infrastructure and adopting modern technologies. Moreover, this financial support enhances farmers' capacity to increase production volume and improve its quality, which positively impacts agricultural revenues and stabilizes food supplies, ultimately strengthening food security levels in the medium and long term.

-The statistical results confirm the acceptance of the fourth hypothesis, as the estimated parameters reveal a statistically significant positive relationship between the USD/Dinar exchange rate and the food security index. The findings indicate that a one-unit increase in the exchange rate contributes to an improvement in the food security index by 0.266389 units. This positive impact is attributed to the activation of the 'automatic price protection' mechanism for domestic products; the depreciation of the local currency raises the relative cost of food imports, thereby reducing their price competitiveness against local agricultural outputs. This structural shift incentivizes domestic producers to expand their production base and intensify agricultural investment to meet the rising demand for national alternatives. Consequently, this leads to a reduction in foreign food dependency, an improvement in the agricultural trade balance, and ultimately, the strengthening of national food security pillars in the long term.

7. Conclusion:

The analytical and econometric study investigating the impact of monetary policy on supporting food security in Algeria during the period (1990-2024) has yielded a set of fundamental results that reflect the nature of the relationship between monetary variables and food security, as follows:

- The credit policy of Algerian banks demonstrates significant effectiveness in directing credit toward financing agricultural and farming projects, as well as initiatives related to the food supply chain, thereby ensuring supply stability and enhancing the state's ability to meet citizens' food needs in a sustainable manner.

-Monetary policy in Algeria demonstrates acceptable effectiveness, as it is able to control the growth levels of prices in a balanced manner, contributing to market stability and enhancing the state's ability to provide food in

sufficient and safe quantities. This price stability contributes significantly to supporting food security indicators by protecting citizens' purchasing power and ensuring the sustainable availability of essential goods.

- Adopting an expansionary monetary policy in Algeria, through reducing discount rates, helps stimulate lending and investment in vital sectors, including the agricultural sector, thereby contributing to increased food production, ensuring the stability of supplies, and ultimately enhancing food security in a sustainable manner.

- Fiscal policy demonstrates acceptable efficiency in directing financial resources allocated to support agricultural production and ensure the stability of food supplies, thereby contributing effectively to the enhancement of food security.

-The appreciation of the USD exchange rate against the DZD contributes to improving food security in Algeria through its role in price protection. As food imports become more expensive, local producers are incentivized to increase investment in national agriculture as a substitute for imports (import substitution). This shift reduces foreign dependency and enhances food availability from sustainable local sources.

Based on the statistical and analytical findings of the study, which demonstrated the pivotal role of the integration between monetary and fiscal policy tools and the exchange rate in improving food security indicators, and relying on the success of these tools in stimulating productive investment and protecting domestic production; within the framework of Algeria's strategic efforts to achieve high levels of food security and reduce external dependency, we present a set of recommendations aimed at sustaining and further developing these outcomes:

-As the supreme monetary authority, the Bank of Algeria should adopt a strategic framework aimed at enhancing and diversifying the banking credit modalities directed toward the agricultural sector and agro-industrial activities. This can be achieved by developing flexible financing instruments tailored to the specific nature of agricultural production cycles. Furthermore, it is essential to implement selective credit mechanisms to channel financial resources toward strategic sub-sectors that contribute directly to narrowing the food gap.

-The government should enhance its regulatory oversight and technical support for public subsidies directed toward strategic agricultural and farming sectors. This can be achieved by adopting an integrated Monitoring and Evaluation system to ensure that subsidies are channeled toward the most efficient production units specifically those that effectively contribute to improving the food security index.

-The Bank of Algeria should strengthen macroeconomic stability by leveraging monetary policy instruments to manage inflation and target stable price levels, thereby ensuring the sustainability of food security measures. Maintaining control over inflationary pressures is a fundamental prerequisite for protecting consumer purchasing power while preventing the erosion of agricultural producers' profit margins caused by rising input costs (such as fertilizers and machinery). Furthermore, price stability reduces market uncertainty, which

incentivizes long-term investment in the agricultural sector and ensures the efficient transmission of bank credit into real productive channels. Ultimately, this leads to the stabilization of the national food supply, thereby ensuring a continuous improvement in the Food Security Index.

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