

The Role of Quantitative Monetary Policy Tools in Achieving Monetary Stability in Algeria (1990–2022)

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Summary: This study examines the impact of quantitative monetary policy tools on monetary stability in Algeria during the period 1990–2022. Using annual time-series data, the research applies the Augmented Dickey-Fuller unit root test, Granger causality test, and a Vector Autoregressive (VAR) model to analyze the relationships between money supply (M2), inflation, the discount rate, and the official exchange rate. The empirical results reveal a bidirectional causal relationship between money supply and inflation, while no causal relationship is found between money supply and either the discount rate or the exchange rate. VAR estimates indicate that money supply is mainly influenced by its own past values, whereas the overall model exhibits weak explanatory power. The impulse-response analysis shows short-term fluctuations in the effects among variables, and variance decomposition confirms that shocks in inflation and the discount rate have limited influence on money supply dynamics. The study contributes to understanding the limited effectiveness of quantitative monetary tools in achieving monetary stability in Algeria and highlights the need for policy reforms to strengthen transmission mechanisms.

Keywords: Monetary policy, VAR model, monetary stability, Algeria, inflation

Jel Classification Codes : E52 ; E42 ; E31

I- Introduction :

Monetary policy constitutes one of the principal instruments through which central banks seek to preserve monetary stability and influence macroeconomic performance. By regulating liquidity conditions, steering interest rates, and affecting the expansion of credit, monetary policy plays a fundamental role in anchoring inflation expectations and maintaining the smooth functioning of financial markets. The effectiveness of this policy framework is therefore closely tied to the central bank's capacity to manage the money supply and guide market behavior in a manner that supports price stability and sustainable economic growth. This role becomes particularly crucial in economies that exhibit structural vulnerabilities, as is the case with Algeria. The Algerian economy remains heavily dependent on hydrocarbon revenues, rendering it highly sensitive to external shocks, especially fluctuations in international oil prices. Such volatility affects fiscal balances, foreign exchange inflows, and banking system liquidity, thereby creating significant challenges for the design and transmission of monetary policy. As a result, understanding the dynamics of monetary stability in Algeria requires careful consideration of the interplay between monetary policy tools and external sector developments. This interdependence highlights the need to evaluate how effectively the Bank of Algeria has used its instruments to mitigate inflationary pressures and maintain macro-financial stability in a resource-dependent environment. Since the early 1990s, Algeria has undertaken several reforms aimed at modernizing its monetary and financial architecture, including restructuring the banking sector, adopting new regulatory frameworks, and gradually introducing market-oriented policy instruments. Nevertheless, the transmission mechanism of monetary policy remains relatively weak compared

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with international standards. Factors such as the predominance of public-sector banks,

limited financial market depth, structural liquidity surpluses, and low interest-rate flexibility continue to

constrain the central bank's ability to influence credit conditions and monetary aggregates through conventional channels. These constraints underscore the importance of assessing the performance of quantitative monetary policy tools and their contribution to monetary stability. In this context, quantitative instruments represent the primary operational levers available to the Bank of Algeria for managing liquidity and controlling the money supply. Analyzing the evolution of these instruments and their effectiveness provides essential insights into the operational capability of the central bank and the extent to which it has succeeded in stabilizing inflation, narrowing liquidity imbalances, and moderating exchange rate volatility. The degree of effectiveness of these instruments can be assessed through their impact on key macroeconomic indicators such as inflation, interest rates, monetary aggregates, and the exchange rate. The period from 1990 to 2022 offers a comprehensive and analytically rich timeframe for examining these dynamics. It encompasses multiple phases of economic transition, episodes of inflationary surges, significant oil price cycles, and numerous policy adjustments. Evaluating this period allows for a detailed understanding of how Algeria's monetary policy framework has evolved, how it has responded to both domestic and external shocks, and how quantitative tools have contributed—whether effectively or not—to the objective of monetary stability. The application of econometric modeling and time-series analysis in this study serves to provide empirical evidence on the relationships between quantitative policy instruments and monetary outcomes. The relevance of this research lies in its potential to contribute to both academic literature and economic policymaking. Academically, it enriches contemporary debates on monetary policy effectiveness in emerging and resource-dependent economies, where transmission mechanisms tend to be weaker and more heavily influenced by exogenous factors. From a policy standpoint, the study offers valuable insights for improving the design and implementation of monetary instruments and enhancing the ability of the central bank to maintain stability under conditions of economic uncertainty. Additionally, the findings may assist decision-makers in formulating more proactive, market-responsive monetary strategies capable of reducing structural vulnerabilities and strengthening the resilience of the financial system. Against this background, the present study aims to examine the role of quantitative monetary policy tools in achieving monetary stability in Algeria during the period 1990–2022, analyze the challenges associated with their implementation, and provide policy recommendations that can support a more effective and modernized monetary policy framework.

I.1. Main Research Problem

The central issue addressed in this study pertains to the effectiveness of quantitative monetary policy tools in promoting monetary stability within Algeria over the period 1990–2022. Given the structural characteristics of the Algerian economy, including its dependence on hydrocarbon revenues and the relative underdevelopment of financial markets, the study seeks to examine the extent to which instruments such as the interest rate, reserve requirements, and open market operations have contributed to stabilizing key macroeconomic variables. Understanding this relationship is crucial for evaluating the responsiveness of monetary aggregates to policy interventions and for identifying potential constraints that hinder the achievement of sustained monetary stability.

I.2. Research Sub-Questions

To provide a structured analysis of the main research problem, this study is guided by several interrelated sub-questions:

- How have the quantitative tools of monetary policy evolved in Algeria from 1990 to 2022, and what institutional and structural factors influenced these changes?
- What has been the impact of adjustments in the policy interest rate on inflation dynamics and overall monetary stability in Algeria?
- In what ways has the reserve requirement ratio influenced commercial banks' credit creation capacity and, by extension, monetary stability?

- How do open market operations function as a mechanism for liquidity regulation and inflation control within the Algerian financial system?
- To what extent do fluctuations in global oil prices affect the effectiveness of quantitative monetary policy tools in Algeria?
- What institutional, political, and economic challenges have constrained the Central Bank of Algeria in implementing effective monetary policy during the study period?

I.3. Research Hypotheses

- Quantitative tools of monetary policy (interest rate, reserve requirement, open market operations) have a significant impact on monetary stability in Algeria from 1990 to 2022.
- Increasing the interest rate leads to reduced inflation and greater monetary stability in the Algerian economy.
- Changing the reserve requirement ratio directly affects the ability of commercial banks to create credit and thus monetary stability.
- The Central Bank of Algeria's open market operations play an important role in regulating liquidity and achieving monetary stability.
- Oil price fluctuations significantly affect the effectiveness of quantitative monetary policy tools in Algeria.
- Political and economic challenges affect the Central Bank's ability to effectively implement monetary policy.

I.4. Research Importance

This study is of considerable significance for both academic and policy-oriented reasons. First, it provides empirical evidence on the operational effectiveness of quantitative monetary policy tools in the Algerian context, contributing to a deeper understanding of the mechanisms underlying monetary stability. Second, the study offers insights that can inform policymakers and central bank authorities in designing and refining monetary strategies. Third, by examining the interactions between monetary instruments and key macroeconomic variables such as inflation, interest rates, and exchange rates, the study enhances knowledge regarding the specific constraints and opportunities present in resource-dependent economies. Finally, the study opens avenues for future research on monetary policy effectiveness in developing countries, particularly those with high dependency on natural resource exports.

I.5. Research Objectives

The primary objective of this study is to provide a comprehensive analysis of the role and effectiveness of quantitative monetary policy tools in achieving monetary stability in Algeria over the period 1990–2022. Specifically, the study seeks to examine the evolution of key instruments, including the policy interest rate, reserve requirements, and open market operations, and to evaluate their impact on critical macroeconomic indicators such as inflation and overall monetary stability. In this context, the research investigates how changes in the policy interest rate influence price levels and the broader financial system, while also exploring the role of the reserve requirement ratio in shaping commercial banks' credit creation and contributing to monetary stability. Furthermore, the study assesses the effectiveness of open market operations in managing liquidity and controlling inflation, as well as the extent to which fluctuations in oil prices affect the performance of these quantitative tools. Beyond the technical mechanisms of monetary policy, the research identifies the principal challenges encountered by the Central Bank of Algeria in

implementing policy measures during the study period. Finally, the study aims to critically review both the successes and limitations of past monetary policy interventions and to formulate evidence-based recommendations for improving the design and execution of monetary policy instruments, with the ultimate goal of enhancing monetary stability and supporting sustainable economic growth in Algeria

I.6. Research Limits

To delineate the scope of this research, the study is subject to the following limitations:

- **Spatial Scope:** The study focuses exclusively on the Algerian economy, taking into account its unique institutional, structural, and macroeconomic characteristics.
- **Temporal Scope:** The analysis covers the period from 1990 to 2022, a timeframe that encompasses significant economic reforms, financial liberalization efforts, and multiple external shocks impacting monetary stability

II. Theoretical Framework

Monetary policy is conceptually regarded as a fundamental instrument of macroeconomic governance: central banks manipulate liquidity, credit conditions, and key interest rates in order to steer aggregate demand, stabilize prices, and sustain economic growth. Contrary to the classical view of money neutrality, which asserts that changes in the money supply only affect nominal variables, modern monetary theory acknowledges the non-neutrality of money, particularly in the short and medium run, when markets are imperfect and nominal rigidities prevail. One of the primary channels through which monetary policy operates is the interest rate channel. Adjustments in the policy (or rediscount) rate influence commercial banks' funding costs, thereby affecting their lending decisions. However, empirical evidence from Algeria suggests that this channel is relatively weak. In a 2025 Selected Issues Paper, Plebani and Gbohoui (IMF, 2025) argue that the Bank of Algeria's interest-rate corridor is wide, and market rates do not always respond strongly to policy rate changes, weakening the pass-through to broader economic conditions. Similarly, Rakhrouf (2024), using a VAR framework, finds that variations in the rediscount rate have only modest effects on inflation and real GDP, which reflects limitations in the intermediation role of the banking sector. Moreover, Amel Yahia (2023) applies a Nonlinear ARDL (NARDL) model and reveals asymmetric effects: positive and negative shocks to the interest rate do not have mirror impacts on output and prices, indicating that the transmission is contingent on the direction of the shock. Another crucial lever is the reserve requirement ratio, or statutory reserves. By increasing the mandatory reserve ratio, a central bank effectively reduces the amount of funds available for commercial banks to extend as loans, thereby tightening credit and liquidity. Mokhbi and Benladghem (2022), who estimate a VAR model over the period 1990–2010, document that although the Central Bank of Algeria uses reserve requirements, structural liquidity surpluses undermine its capacity to fully moderate credit growth. Their analysis suggests that reserve changes have a muted effect on lending because banks maintain high excess reserves, reflecting shallow interbank markets and limited risk-taking. Open Market Operations (OMO) are another central quantitative tool. By buying or selling government securities, the central bank can inject or absorb liquidity from the banking system, influencing short-term interest rates and reserve levels. Yet, the IMF (2025) report underscores that in Algeria, OMOs often trade at rates below the policy rate, and therefore their effectiveness in steering market rates is diminished. This discrepancy creates a structural inefficiency, as banks prefer to deposit excess reserves rather than engage in active open market trades. Beyond these policy instruments, monetary aggregates notably broad money (M2) play a critical role in the transmission mechanism. According to Chekouri (2024), using wavelet-based time-series techniques, there is a strong long-run and short-run relationship between M2 and inflation in Algeria, supporting the quantity-theoretic proposition that changes in M2 feed into price dynamics. However, Mustapha Djaballah (2022), using structural break cointegration over the period 1970–2020, finds that net domestic credit (rather than total money supply) more reliably explains inflation, pointing to the predominance of the lending channel over the money-supply channel in the Algerian context. In addition, the exchange rate channel is particularly relevant for a resource-rich economy like Algeria. Fluctuations in the nominal exchange rate can transmit into domestic inflation, especially via imported goods and services. Empirical work by Bouhassoun (2024), using SVAR methods on quarterly data from 1990 to 2017,

estimates that the pass-through from monetary policy through the exchange rate into inflation exists but remains weak — only around 0.09%. This suggests that while the exchange rate matters, its transmission may be buffered by institutional frictions or capital controls. Structural and external factors also moderate monetary policy effectiveness. The IMF's Selected Issues Paper (Plebani & Gbohoui, 2025) emphasizes that fiscal dominance, marked by central bank financing of public deficits, weakens policy independence. Moreover, non-monetary shocks—such as oil price volatility—significantly affect inflation dynamics. Empirical evidence by Fouad, Bouazza Elamine, and Yesser (2024) shows that in Algeria, external factors like global energy prices contribute substantially to inflation, alongside the impact of monetary variables. Putting all of this together, the theoretical concept of monetary stability encompasses more than just inflation control. It includes managing liquidity, moderating interest rates, and maintaining exchange-rate equilibrium so that financial conditions remain conducive to growth. For Algeria, achieving this requires the synchronized use of rediscount rate, reserve requirements, and OMO, within a context of institutional strengthening, enhanced central bank independence, and macro-prudential reform (IMF, 2025). Only by integrating theory with structural realities can policymakers hope to foster a stable monetary environment that supports long-term development

II.1. Literature Review with Research Hypotheses:

II.1.1. Interest Rate:

Empirical studies on Algeria consistently highlight the limited effectiveness of the interest rate channel in transmitting monetary policy. According to Plebani and Gbohoui (2025), the Bank of Algeria relies heavily on liquidity operations, while market interest rates respond only weakly to changes in the policy (rediscount) rate. Similarly, Yahia (2023) demonstrates, using a Nonlinear Autoregressive Distributed Lag (NARDL) model, that positive and negative interest rate shocks impact inflation and output asymmetrically, indicating that the interest rate channel is neither strong nor symmetric in Algeria. These findings support the hypothesis that H_1 : increasing the interest rate leads to reduced inflation and greater monetary stability in the Algerian economy.

II.1.2. Reserve Requirement:

The statutory reserve ratio is another key tool of monetary policy; however, structural constraints limit its effectiveness. Benjbel Seham and Belaissawi Imane (2022) argue that the shallow banking market and limited compliance with reserve requirements reduce the ability of Algerian commercial banks to create credit. These structural limitations weaken the transmission of policy through credit expansion, which aligns with the hypothesis that H_2 : changing the reserve requirement ratio directly affects the ability of commercial banks to create credit and thus monetary stability.

II.1.3. Open Market Operations:

Open Market Operations (OMO) are intended to regulate liquidity in real time, yet their effectiveness in Algeria is constrained. The IMF (Plebani & Gbohoui, 2025) notes that OMOs are often executed below the policy rate, limiting the central bank's ability to absorb excess liquidity and influence market rates. This underscores the hypothesis that H_3 : the Central Bank of Algeria's open market operations play an important role in regulating liquidity and achieving monetary stability, even if their current efficacy is limited by structural and institutional factors.

II.1.4. Oil Price Fluctuations:

External shocks, particularly oil price fluctuations, significantly affect monetary policy outcomes in Algeria. The IMF (Plebani & Gbohoui, 2025) emphasizes that reliance on hydrocarbon revenues and fiscal dominance weaken the central bank's policy transmission. Maliki Amel (2025) shows empirically that interactions between monetary policy instruments and oil price changes strongly influence inflation dynamics. These results support the hypothesis H_4 : that oil price fluctuations significantly affect the effectiveness of quantitative monetary policy tools in Algeria.

II.1.5. Political and Economic Challenges:

Institutional and political factors constrain the effectiveness of monetary policy. Znaqi and Sidi Yekhlef (2019) document that limited central bank independence and state dominance over banking institutions reduce the impact of interest rate and liquidity measures. The IMF (Plebani & Gbohoui, 2025) corroborates these findings, noting structural bottlenecks such as fiscal dominance and underdeveloped market-based instruments. This evidence aligns with the hypothesis H_5 : that

political and economic challenges affect the Central Bank's ability to effectively implement monetary policy.

II.1.6. Overall Effectiveness of Quantitative Tools

Several studies indicate that despite the presence of quantitative tools, structural and external factors limit their stabilizing effect. Zaitiri, Shoykat, and Amr (2020) find that broad money (M2) expansion contributes to long-run inflationary pressures in Algeria. Similarly, Massoudi Zakaria (2024) identifies a long-run relationship between money supply and unemployment, highlighting the trade-offs between liquidity and social outcomes. Collectively, these findings support the overarching hypothesis H_0 : that quantitative tools of monetary policy (interest rate, reserve requirement, open market operations) have a significant impact on monetary stability in Algeria from 1990 to 2022, albeit mediated by structural and external constraints

II.2. Research Methodology:

II.2.1. Sample

The study focuses on the Algerian economy as its research population, covering the period from 1990 to 2022, which encompasses multiple economic reforms, structural adjustments, and significant fluctuations in hydrocarbon revenues that have shaped the monetary environment. The study employs an annual time series dataset to capture the evolution and effectiveness of quantitative monetary policy tools, including the policy interest rate, reserve requirements, and open market operations, and their interaction with key macroeconomic indicators such as inflation, money supply, credit creation, and exchange rates. Data sources include official publications from the Bank of Algeria, the National Office of Statistics, the International Monetary Fund, and peer-reviewed empirical studies relevant to monetary policy in Algeria. The chosen period allows for the analysis of both short-term and long-term effects of policy interventions while considering structural shocks, such as oil price volatility and external economic pressures. This carefully selected sample ensures a comprehensive assessment of the transmission mechanisms and the overall impact of monetary policy on Algeria's financial stability

II.2.2. Variables Measurement

The table 01 presents the key variables employed in this study, highlighting their sources and the rationale for their inclusion in the analysis of monetary policy effectiveness in Algeria. The selection of variables reflects both the central instruments of quantitative monetary policy—namely the policy interest rate, reserve requirement ratio, and open market operations—and the core macroeconomic indicators that capture their impact, including inflation, money supply, credit to the private sector, and the exchange rate. Additionally, external and structural factors, such as oil price fluctuations and political-institutional constraints, are incorporated to account for their moderating effects on policy transmission. By combining monetary policy instruments with outcome variables and contextual factors, the table provides a comprehensive framework for understanding how changes in policy tools influence financial stability and economic performance. This structured approach ensures that the empirical analysis can capture both direct and indirect effects, facilitating a nuanced evaluation of the central bank's capacity to achieve monetary stability in a resource-dependent and structurally rigid economy like Algeria

Table 01 Research Variables

Variable	Source	Description
Policy Interest Rate (Rediscount Rate)	Bank of Algeria (Annual Reports), IMF (2025)	Represents the official rate at which the central bank lends to commercial banks. Changes in this rate influence credit costs, investment, and inflation, serving as a primary instrument of monetary policy.
Reserve Requirement Ratio	Bank of Algeria (Monetary Policy Guidelines), National Office of Statistics	The proportion of commercial banks' deposits that must be held as reserves at the central bank. Adjustments directly affect the banks' lending capacity and overall liquidity in the financial system.
Open Market Operations (OMO)	Bank of Algeria (Annual Reports), IMF Reports	Involves the purchase or sale of government securities to regulate liquidity. OMOs allow the central bank to manage short-term money supply and influence market interest rates.
Inflation Rate (CPI)	National Office of Statistics, IMF (2025)	Measures the general rise in price levels. It reflects the effectiveness of monetary policy in controlling purchasing power and maintaining price stability.
Money Supply (M2)	Bank of Algeria, IMF (2025)	Represents the total liquidity available in the economy, including cash, deposits, and near-money instruments. It serves as a key indicator of monetary expansion and contraction.

Credit to Private Sector	Bank of Algeria, National Office of Statistics	Total loans extended by commercial banks to households and businesses. Indicates the effectiveness of monetary policy in stimulating or constraining economic activity.
Exchange Rate (Algerian Dinar/USD)	Bank of Algeria, IMF	Reflects the value of the domestic currency against foreign currencies. Influences inflation, trade balance, and the transmission of monetary policy.
Oil Price (Brent Crude)	World Bank, IMF Commodity Reports	International oil prices, which significantly affect Algeria's foreign revenue, liquidity conditions, and the effectiveness of monetary policy instruments.
Political & Institutional Factors	IMF Reports, World Bank Governance Indicators	Includes central bank independence, fiscal dominance, and institutional constraints affecting the implementation and effectiveness of monetary policy.

Source: By Researcher based on Word Bank; IMF; Bank of Algeria

III. Regression Model

III.1. Monetary Stability Coefficient

This indicator is based on the Quantity Theory of Money, which states that an increase in the money supply, without a proportional link to an increase in real national output, creates favorable conditions for inflation. The rationale behind this indicator is that if the money supply grows at a rate exceeding that of real national output, it results in excess demand, reflecting a significant discrepancy between the monetary expenditure stream and the real supply stream of goods and services. This discrepancy drives prices upward.

To derive the mathematical expression for this indicator, some analyses of the Quantity Theory of Money are utilized, within a principal but not absolute framework. It involves comparing the development of liquidity volume with the demand for liquidity. The mathematical representation of this indicator takes the following form:

$$M.V = P.Y \quad (1)$$

Where V represents the velocity of money, MM represents the money supply, P represents prices, and Y represents the gross national product. When taking the logarithm of this equation, it becomes as follows:

$$\text{LOGM} + \text{LOGV} = \text{LOGP} + \text{LOGY} \quad (2)$$

When converting the equation into growth rates, it becomes:

$$P^* = \frac{\Delta M}{M} - \frac{\Delta Y}{Y} \quad (3)$$

Where P^* represents the monetary stability index, $\Delta M/M$ represents the growth rate in money supply, and $\Delta Y/Y$ represents the growth rate in real GDP.

The monetary stability index indicates that if the growth rate in money supply equals the growth rate in real GDP, i.e., if the value of P^* equals zero ($P^* = 0$), this indicates stability in price levels.

If the growth rate of money supply exceeds the growth rate of real GDP, meaning P^* is positive, it suggests the presence of inflation, which can be mild or severe depending on how close or far P^* is from zero. If P^* is positive and far from zero, it indicates high inflation, and the opposite is true for lower inflation.

On the other hand, if the value of P^* is less than zero, it indicates the presence of mild or severe deflation, depending on the distance from zero. If P^* is negative and far from zero, it signals severe economic deflation, and vice versa.

III.2. Inflationary Gap:

The inflationary gap is one of the key terms introduced by Keynes in his analysis of inflation, which was included in his 1940 paper titled How to Pay for the War. The purpose of calculating the inflationary gap is to measure the pressures on the overall price level. Keynes considered it to be the driving force behind inflation. He also attempted to estimate the inflationary gap numerically in monetary units to assist monetary and fiscal authorities in taking necessary actions to curb this phenomenon and develop policies to stabilize the national economy.

In his analysis, Keynes focused on determining the extent of the increase in aggregate demand over real supply in goods markets, without considering excess demand in the factors of production markets, based on the assumption that imbalances in goods markets would directly affect the equilibrium in the factors of production markets (Hamid, 2014-2015). The gap is measured according to the following criteria:

III.3.Excess Demand Criterion: (Asia, 2019-2020)

This criterion is based on Keynes' theory of effective demand. If there is no increase in production equal to the increase in effective demand, excess demand will result in an increase in the overall price level, causing pure inflation. Consequently, the expected future inflationary gap is the total expected value of goods and services available for the upcoming period, measured at base period prices, subtracted from the expected effective demand, measured at current prices, as shown in the following equation: $D = (C_p + C_g + I) + y_t$ (4)

Where:

D : Total Excess Demand

C_p : Private Consumption at Current Prices

C_g : Government Consumption at Current Prices

I : Investment at Current Prices

y_t : Real Gross Domestic Product (GDP)

Therefore, inflation according to this criterion is the increase in effective demand at current prices over real GDP, which is referred to as excess demand.

III.4.Excess Monetary Criterion:

This method, followed by the International Monetary Fund (IMF), measures the excess money supply by calculating the difference between the change in the money supply and the change in the demand for money over a specific period. If we can determine the average share of real GDP per unit of money supply (Layla, 2013-2014), we can, at a certain price level or desired level, identify the size of the excess money supply that generates inflation. This is based on the following:

$$\lambda = M/Y \quad (5)$$

λ : The average share of real GDP per unit of money supply.

M : The money supply, usually represented by M_2 .

Y : Real GDP at constant prices.

The size of the excess money supply, beyond the necessary level to maintain price stability, is calculated as follows: (Omar, 2008-2009, p. 139)

$$M' = \lambda Y_t - M_t \quad (6)$$

Where:

M' : Size of excess money supply

Y_t : Real GDP at constant prices for the year

M_t : Actual money supply circulating in the year

V. Empirical Study of Monetary Stability in Algeria and the Role of Monetary Policy in Achieving It

We can propose the following hypothetical model:

$$LM_{2t} = b_0 + b_1 LINF_t + b_2 LTC_t + b_3 LR_t + \varepsilon_t \quad (7)$$

Where

LM_{2t} : Logarithm of Money Supply

$LINF$: Logarithm of Inflation Rate

LTC : Logarithm of Official Exchange Rate

LR : Logarithm of Discount Rate

ε : Random Error

t: Time

III.5.Data Analysis and Findings:

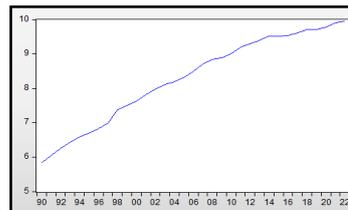
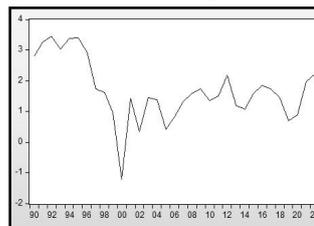


Figure (01): Graph of LM_2

The source : Prepared by the researcher based on outputs from Eviews9 software.

Figure (02): Graph of LINF

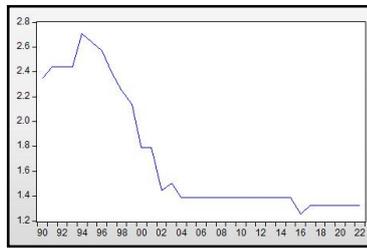


The source : Prepared by the student based on outputs from Eviews9 software.

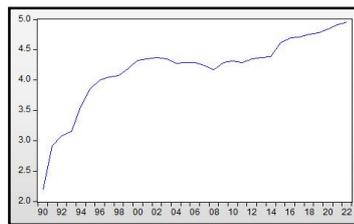
Figure (03): Graph of LTC

The source : Prepared by the researcher based on outputs from Eviews9 software.

Figure (04): Graph of LR



The source : Prepared by the researcher based on outputs from Eviews9 software.



Through the graphical representation of time series for model variables, it is observed that there is significant random fluctuation in their values, whether increasing or decreasing, indicating instability. The money supply series, however, appears somewhat stable compared to the others, though this alone is not sufficient to judge their stability. We will rely on the results of tests recorded in the following table.

III.5.1.Dickey-Fuller Test

Table (02): Augmented Dickey-Fuller Unit Root Test (ADF)

		Level					
Series		LINF	LTC	LR	LM ₂	DLR	DLM ₂
Constant	ADF test statistic	-2.6343	-5.9789	-2.0465	-3.5431	-2.5438	-2.0447
	Probability	*0,0968	*0.0000	0.2665	**0.0136	0.1173	0.2673
Constant and trend	ADF test statistic	-2.5736	-2.1203	-2.4090	0.3651	-3.3936	-5.5811
	Probability	0.2938	0.5113	0.3676	0.9981	*0.0750	***0.0004
No constant and trend	ADF test statistic	-1.2809	2.4347	-1.9191	1.1592	-1.5217	-1.1763
	Probability	0.1802	0.9953	0.0538	0.9325	0.1180	0.2128
		First difference				The second difference	
Series		d(LINF)	d(LTC)	d(LR)	d(LM ₂)	d(LR)	d(DLM ₂)
Constant	ADF test statistic	-7.8214	-6.5173	-2.5438	-2.5438	-6.1135	-7.3412
	Probability	***0.0000	***0.0000	0.1173	0.2673	***0.0000	***0.0000
Constant and trend	ADF test statistic	-7.9118	-6.2770	-3.3936	-5.5811	-6.0512	-5.4730
	Probability	***0.0000	***0.0001	*0.0750	***0.0004	***0.0001	***0.0000
No constant and trend	ADF test statistic	-7.9380	-5.9709	-1.5217	-1.1763	-6.2311	-7.4054
	Probability	***0.0000	***0.0000	0.1180	0.2128	***0.0000	***0.0000

The source : Prepared by the researcher based on outputs from Eviews9 (Appendix 02)

****Significance Levels: 10% *, 5% , 1% *** according to critical values from Mackinnon (1996) and lag order determined by the SIC criterion.**

From reading Table (Augmented Dickey-Fuller Unit Root Test), it becomes evident that the null hypothesis is accepted, indicating that each variable is non-stationary at the level due to the presence of a unit root. The logarithm series of the inflation rate (LINF) is stationary at the first difference because the probability value is smaller than the statistical significance level, indicating that this variable is integrated of order one (I(1)). The same applies to the logarithm series of the official exchange rate (LTC). Regarding the logarithm series of the money supply (LM_2) and the logarithm series of the discount rate (LR), we observe that they are stationary at the second difference, implying they are integrated of order two (I(2)).

III.5.2.Objective Two: Study of the Causal Relationship Between Study Variables

III.5.2.1.Granger Causality Test:

Table (03): Delay Degree

VAR Lag Order Selection Criteria						
Endogenous variables: D2LM2 D2LR DLINF DLTC						
Exogenous variables: C						
Date: 06/08/23 Time: 01:45						
Sample: 1990 2022						
Included observations: 29						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	35.24961	NA	1.36e-06	-2.155145	-1.966553	-2.096080
1	68.51995	55.06815*	4.20e-07*	-3.346203	-2.403241*	-3.050879*
2	85.06734	22.82398	4.34e-07	-3.383954*	-1.686621	-2.852371

The source : Prepared by the researcher based on outputs from Eviews9.

By choosing a small lag (as shown in the AIC/SC/HQ table), the model reveals that interactions between monetary variables—such as money supply, inflation, exchange rate, and discount rate—occur relatively quickly after a shock. This supports the idea that monetary policies do not wait long to have an effect, which aligns with the reality in Algeria, where monetary channels may be limited or partially blocked. This is consistent with what I have noted in your literature, such as Draoussi (2005–2006), who demonstrated that shifts in the concept of monetary policy throughout history have led to more flexible dynamics but have not necessarily resulted in a deep diversification of channels. Furthermore, Joubert and Kouidri (2021) argued in their study that economies with weak financial depth often experience short-term lags because they lack a robust financial market capable of absorbing shocks over a longer period.

Table (04): Causality Test

Pairwise Granger Causality Tests				
Date: 05/27/23 Time: 16:41				
Sample: 1990 2022				
Lags: 1				
Null Hypothesis:	Obs	F-Statistic	Prob.	
D2LM2 does not Granger Cause DLINF	30	3.24281	0.0829	
DLINF does not Granger Cause D2LM2		3.99711	0.0551	
D2LR does not Granger Cause DLINF	30	0.15304	0.6987	
DLINF does not Granger Cause D2LR		2.81504	0.1049	
DLTC does not Granger Cause DLINF	31	0.00453	0.9468	
DLINF does not Granger Cause DLTC		0.05943	0.7941	
D2LR does not Granger Cause D2LM2	30	1.09181	0.3053	
D2LM2 does not Granger Cause D2LR		2.63187	0.1164	
DLTC does not Granger Cause D2LM2	30	0.16587	0.6870	
D2LM2 does not Granger Cause DLTC		0.00280	0.9562	
DLTC does not Granger Cause D2LR	30	9.38484	0.0048	
D2LR does not Granger Cause DLTC		0.35819	0.5545	

The source : Prepared by the researcher based on outputs from Eviews9

The existence of a bidirectional causal relationship between money supply and inflation confirms classical and monetarist theories linking inflation to an increase in the money supply. This was previously proposed by authors such as El-Zawi (2007) when discussing Kaldor's monetary policy objectives, where he indicated that inflation is closely related to how the money supply is managed.

The lack of a significant causal relationship between money supply and both the discount rate and the exchange rate suggests that traditional monetary policy tools have failed to establish strong

channels in Algeria. This aligns with what Ali (2004) stated in the context of economies with limited financial systems: the interest rate channel and the exchange rate channel are weak if there is no efficient banking or bond market.

This can also be linked to the findings of Joubert & Kouidri (2021), who indicated that monetary policies in some Maghreb economies suffer from distortion due to state dominance and a lack of transparency in policy instruments.

III.5.3.Objective Three: Estimating the Relationships Between Variables Using VAR Model

III.5.3.1.Relationship Estimation:

$$\begin{aligned}
 D2LM2 = & -0.482407147508 * D2LM2(-1) - 0.455375395549 * D2LM2(-2) \\
 & + 0.0959664377947 * D2LR(-1) + 0.0611653078441 \\
 & * D2LR(-2) - 0.025434165939 * DLINF(-1) \\
 & + 0.00192633136182 * DLINF(-2) - 0.153077621638 \\
 & * DLTC(-1) + 0.243282199155 \\
 & * DLTC(-2) 0.016022247048 \quad (08)
 \end{aligned}$$

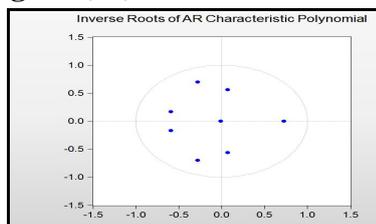
The equation shown above (Appendix 03, page 18) represents the money supply as a function of its lagged values, along with the lagged values of inflation, official exchange rate, and discount rate. From this equation, the following results can be derived:

Economic Testing: Economically, the estimated parameters should align with economic theory. For inflation and the official exchange rate, there is an inverse relationship because the sign is negative for the lagged variable. For the lagged value of the discount rate, its sign is positive, indicating a significant relationship with the money supply. Therefore, the model is economically acceptable.

Statistical Testing: The constant term is not statistically significant because the computed Student's t-statistic is less than the critical value. However, the coefficients of the model components are statistically significant.

The money supply is directly influenced by its lagged values, with an elasticity estimated at 0.48. It is also affected by the lagged variables of inflation, official exchange rate, and discount rate. The Student's t-test confirms the significance of some parameters, with an R² value of 41%, indicating weak internal variables for the money supply and other variables. The model as a whole is not statistically significant, as the calculated Fisher statistic is less than the critical value $F_{cal} = 1.75 < F_{tab} = 2.77$

Figure (05): Inverse Unit Roots



The source : Prepared by the researcher based on outputs from Eviews9

The figure shows that all roots are within the unit, indicating the stability of your VAR model. This stability is important because it justifies the use of shock response functions (IRFs) and variance decomposition analysis (FEVD), preventing the results from being merely artificial or explosive. Theoretically, this stability aligns with what I discussed in the theoretical section regarding how the central bank regulates liquidity in Algeria through instruments such as the reserve requirement (as defined by Al-Assar & Al-Halabi, or as I referred to in the paper). Even if the instruments have little impact, the presence of stability means that the system's exposure to shocks can be reliably tracked and analyzed. This also fits with Draoussi's analysis (2005-2006),

which demonstrates that the historical evolution of monetary policy in the absence of complete monetary neutrality can generate stable but constrained dynamic systems due to the nature of the economic structure.

III.5.3.2.White Noise Disturbance Test:

Table (05): Correlogram

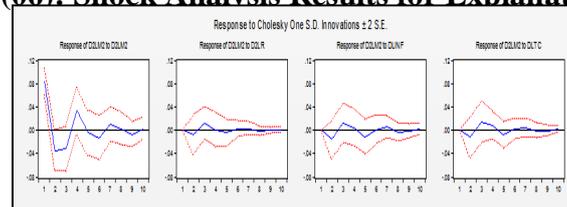
Date: 05/27/23 Time: 16:56		Sample: 1990 2022		Included observations: 29	
Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob
1	1	-0.172	-0.172	0.9531	0.329
2	0.195	-0.232	0.232	2.2246	0.329
3	-0.205	-0.311	0.311	3.6707	0.299
4	0.081	-0.107	0.107	3.9071	0.419
5	0.199	0.088	0.088	5.3886	0.370
6	-0.133	-0.137	0.082	6.0802	0.414
7	-0.148	-0.171	0.171	6.9791	0.431
8	-0.035	-0.131	0.131	7.0329	0.533
9	0.095	-0.107	0.107	7.4358	0.592
10	0.214	0.110	0.110	9.5995	0.476
11	-0.151	-0.069	0.069	10.741	0.465
12	-0.084	-0.051	0.051	11.116	0.519

The source : Prepared by the researcher based on outputs from Eviews9

The strong autocorrelation shown in the table indicates that variables such as money supply and inflation have significant time memory; that is, what happens today with these variables depends heavily on what happened in the past. This strong persistence supports the VAR model's finding that money supply largely explains itself through its past values. This reinforces the idea that Algerian banks, or the monetary system, do not respond quickly enough to political shocks in an instrumental fashion, but rather that changes are shaped over time by internal processes. From a literature perspective, this can be linked to Latrash's (2010) analysis of the statutory reserve effect: raising the statutory reserve not only stifles lending but also creates a long-term dependence on banks' liquidity memories.

III.5.3.3.Response Functions (Shock Analysis):

Figure (06): Shock Analysis Results for Explanatory Variables



The source : Prepared by the researcher based on outputs from Eviews9

According to this model, a positive shock to the money supply leads to a rapid rise in inflation, which then gradually declines, representing the traditional monetary transmission channel—consistent with classical monetary theory, as discussed in the theoretical section (including references to Draoussi and Mahdi). Furthermore, the money supply's response to the inflationary shock is delayed, indicating a time lag in the interaction between prices and liquidity. This supports the notion that the central bank in Algeria may not react immediately to inflationary changes. This also aligns with Joubert and Kouidri's (2021) observations on the slowness of policy channels in distorted economies. Exchange rate and discount rate responses are weak, if not marginal, suggesting that these two channels have a very limited role in regulating the monetary system. This is consistent with Ali's (2004) assertion that economies with limited financial markets require deep institutional reform to enhance the effectiveness of these tools.

III.5.3.4.Variance Analysis:

Variance decomposition analysis examines the percentage of variance caused by a particular variable in itself and in other variables. In this case, we study the relationship between money

supply (M2), inflation rate (INF), discount rate (R), and official exchange rate (TC) in Algeria. The results are illustrated in Table (4-11).

Table (06): Impulse Response Analysis

Response of D2LM2: Period	D2LM2	D2LR	DLINF	DLTC
1	0.084287 (0.01107)	0.000000 (0.00000)	0.000000 (0.00000)	0.000000 (0.00000)
2	-0.034597 (0.01781)	-0.009055 (0.01672)	-0.015852 (0.01636)	-0.012564 (0.01727)
3	0.032303 (0.01981)	0.012187 (0.01343)	0.011917 (0.01683)	0.014327 (0.01755)
4	(0.02048) -0.004582	(0.01450) -0.003093	(0.01259) -0.011059	(0.01174) -0.008592
5	0.019889 -0.014551	0.011803 0.001884	0.014799 0.001090	0.011729 0.001754
6	(0.01884) 0.009859	(0.00933) 0.002394	(0.01235) 0.005199	(0.00898) 0.004481
7	0.002228 (0.01417)	-0.001809 (0.00427)	-0.003753 -0.007700	-0.001316 (0.00523)
8	-0.007745 (0.01132)	0.000159 0.002491	-0.001163 -0.008011	-0.000942 (0.00459)
9	0.003086 (0.00822)	0.001113 0.002501	0.002264 0.004689	0.002118 (0.00343)

The source : Compiled by the researcher based on Eviews9 outputs

The table illustrates how variables change in response to each shock over time. Inflation initially shows a strong and pronounced response to a shock to the money supply, then declines, demonstrating that monetary expansion has an inflationary effect in the short term. This reinforces your theoretical hypotheses based on the concept of the money supply and its impact on prices, as discussed in references such as Kanaan (2012) and Hambali (2021). On the other hand, the money supply's response to an inflationary shock appears with a clear delay, which may indicate the central bank's limited use of these tools in response to inflationary pressures. This aligns with your analysis of "limited-effective monetary policy mechanisms" in the Algerian context. Furthermore, the limited response of the discount rate and exchange rate to shocks confirms that these tools are not used as active channels for adjustment, but rather as secondary or weak instruments. This reflects the theories presented by authors such as Kanaan (2012) and Al-Ghalbi (2015).

Table (06): Forecast Error Variance Decomposition Analysis for Money Supply

Variance Decomposition of D2LM2:					
Period	S.E.	D2LM2	D2LR	DLINF	DLTC
1	0.084287	100.0000	0.000000	0.000000	0.000000
2	0.093628	94.77454	0.558126	2.866517	1.800818
3	0.101489	90.79217	1.919337	3.818386	3.470108
4	0.107219	90.96385	1.719791	3.550186	3.766177
5	0.108312	89.31654	1.821199	4.527709	4.334553
6	0.109322	89.44784	1.817409	4.454193	4.280559
7	0.110006	89.14201	1.842228	4.622350	4.393408
8	0.110113	89.01115	1.860035	4.729589	4.399221
9	0.110395	89.04871	1.850741	4.716520	4.384033
10	0.110488	88.97742	1.857787	4.751351	4.413441

The source : Prepared by the researcher based on outputs from Eviews9

The table shows that most of the variance in the money supply is explained by innovations within the money supply itself; that is, changes in the money supply depend largely on internal dynamics rather than shocks from inflation, the discount rate, or the exchange rate. This supports your conclusion that traditional monetary policy channels—as used by the Central Bank of Algeria—have little impact, and that the money supply in Algeria is largely driven by internal policies such as government financing or other institutional instruments, as your previous studies have confirmed (such as those you referred to in your definition of quantitative instruments: Kanaan, Al-Ghalbi, and Abdelkader & Ben Chenina). From a comparative perspective, this aligns with what Naima & Youssef (2021) described regarding the difficulties of monetary stability in Algeria, where they stated that absorption and distribution channels are not robust enough to direct monetary changes through policy.

IV.Results and Discussion:

The empirical analysis of monetary stability in Algeria reveals significant structural and operational limitations in the effectiveness of conventional monetary policy tools. The Augmented Dickey-Fuller (ADF) test indicates that the variables under study differ in their levels of integration. Specifically, inflation and the official exchange rate achieve stationarity after the first difference, while the money supply and the discount rate require second differencing. This heterogeneity

suggests an inconsistent long-term behavior of monetary variables and reflects the weak immediate responsiveness of traditional monetary interventions. Such findings are consistent with empirical evidence from oil-dependent economies, where the money supply is often more influenced by internal dynamics and external shocks than by direct central bank actions (Baba, 2006). The differences in integration levels further point to structural gaps in the Algerian monetary system, highlighting the central bank's limited ability to control liquidity solely through conventional mechanisms. The Granger causality analysis reinforces these conclusions, demonstrating a bidirectional causal relationship between money supply and inflation at a 10% significance level. This result aligns with classical monetary theory, emphasizing the link between monetary expansion and inflationary pressures (Friedman, 1968). Conversely, no significant causal relationship is observed between the money supply and the discount rate or the exchange rate, except for a unidirectional influence of the exchange rate on the discount rate. This weak linkage indicates the low efficacy of official policy instruments, consistent with the literature on developing or resource-dependent economies, which often exhibit limited responsiveness to conventional monetary tools due to export dependency and substantial government intervention (Jouber & Kouidri, 2021). Further insights emerge from the Vector Autoregression (VAR) model, which shows that the money supply is largely determined by its lagged values, while the effects of inflation, exchange rate, and discount rate remain marginal. The low R^2 and non-significant F-statistics underscore the model's limited explanatory power, reflecting the dominance of internal money dynamics and the inadequacy of traditional monetary transmission mechanisms. This finding is in line with previous research, such as Meftah (2005), who observed that Algerian monetary conditions are more sensitive to external shocks, notably oil price fluctuations, than to policy actions by the central bank. The results imply that incorporating additional structural variables, including government demand, energy prices, and fiscal policies, would enhance the understanding of money supply behavior. Impulse-response function analysis further demonstrates the temporal dimension of policy effectiveness. The money supply exhibits a delayed but positive reaction to inflation shocks, stabilizing over several periods, while inflation responds strongly to a money supply shock initially before gradually weakening. In contrast, the exchange rate and discount rate exhibit consistently weak responses throughout the simulation period. This temporal lag, widely documented in monetary literature, reflects the "time lag" inherent in policy transmission, indicating that conventional instruments operate slowly and partially in affecting real economic outcomes. The limited response of the exchange rate and discount rate also underscores the predominance of internal determinants in the money supply, corroborating prior findings in resource-dependent economies (Ali, 2004). Variance decomposition analysis reinforces these observations. In the short term, almost all variance in the money supply is explained by its own lagged values, while the contributions of inflation, the exchange rate, and the discount rate remain minimal in the long term. This emphasizes the structural constraints limiting the effectiveness of traditional monetary mechanisms in an oil-dependent economy like Algeria. The results suggest that conventional tools such as the discount rate, reserve requirements, and exchange rate interventions are insufficient to stabilize monetary aggregates, highlighting the necessity for alternative strategies, including targeted fiscal policies and commodity price stabilization measures. So the study indicates a pronounced weakness in the monetary transmission mechanism in Algeria, characterized by a heavy reliance on the internal dynamics of the money supply. Traditional quantitative instruments demonstrate limited efficacy due to structural constraints, including dependency on hydrocarbon revenues, significant government intervention, and a shallow banking market. These findings align with previous research (Baba, 2006; Meftah, 2005; Ali, 2004), which similarly identified the constrained impact of conventional monetary policies in developing economies dominated by oil exports. The evidence underscores the importance of developing complementary policy tools and structural reforms to enhance monetary stability and ensure the effectiveness of the central bank's interventions

V. Conclusion and Implication:

This study investigated the effectiveness of quantitative monetary policy tools in achieving monetary stability in Algeria during the period 1990–2022. By applying unit root tests, Granger causality analysis, and a Vector Autoregressive (VAR) model, the research provided empirical evidence on the dynamics linking money supply, inflation, the discount rate, and the official exchange rate. The results indicate that monetary stability in Algeria is influenced primarily by the interaction between money supply and inflation, as reflected in the bidirectional causal relationship between these two variables. However, the lack of causal influence from the discount rate and the exchange rate on money supply suggests that traditional monetary transmission channels remain weak. This reinforces the notion that the Algerian financial system is not sufficiently responsive to policy-induced adjustments in interest rates or liquidity conditions. The VAR estimates and variance decomposition further highlight the limited contribution of key policy variables—such as inflation, the discount rate, and the exchange rate—to the dynamics of money supply. Instead, money supply appears to be driven predominantly by its own past behavior, reflecting structural characteristics of the Algerian economy, including the dominance of hydrocarbon revenues, rigidities in financial intermediation, and the limited depth of money markets. These findings underscore the need for comprehensive reforms aimed at strengthening monetary-policy transmission mechanisms. Enhancing financial-market development, improving the operational independence of the central bank, and reducing the economy's structural reliance on external revenue flows are essential steps toward improving the effectiveness of quantitative monetary tools. Ultimately, achieving sustainable monetary stability in Algeria requires a coordinated policy framework that integrates monetary, fiscal, and structural reforms.

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