

Money supply and the policy of financing public investments in Algeria: An econometric study for the period (1990-2023)

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Abstract--- This study aims to analyze and measure the impact of money supply on investment financing in Algeria during a specific time period (1990-2023), using the Autoregressive Distributed Lag (ARDL) model relying on official annual data processed through Eviews 12 software. The findings reveal that money supply does not significantly affect investment in Algeria in the long term, while a dynamic relationship exists between the two variables in the short term. This outcome can be explained by the nature of the Algeria's economy, where public investment financing primarily relies on state treasury funds, consequently, investment levels are more influenced by oil prices and GDP growth than by various monetary policy instruments.

Keywords--- monetary policy, money supply, public investments, money stock, GDP.

Jel Classification Codes : C32, E62, E41

Introduction

Investment, in its various forms is a key component of aggregate demand. The state focuses on public investment by targeting economic sectors that generate wealth. Public investments have played a significant rôle in driving development in Algeria since independence. During the era of centralized

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planning, they were a cornerstone for fulfilling national independence requirements. This rôle remained prominent in the 1980s and 1990s, despite unmet targets due to the collapse of oil prices at the time.

The financial recovery Algeria experienced due to rising hydrocarbon prices, especially after emerging from the security crisis, paved the way for massive investment programs aimed at boosting economic growth and employment. The first of these was **the Economic Recovery Program (2001-2004)**, followed by **the Complementary Program for Economic Growth Support (2005-2009)**, and the third, **the Program to Support and Consolidate Economic Growth (2010-2014)**. These investments acted as a pump, injecting new dynamism into the national economy and supporting economic development across sectors devastated by the security crisis.

On the other hand, monetary policy seeks to serve economic development goals, though these vary from country to another, depending on their economic nature. As a rentier state (over 97 % oil-dependent), Algeria has benefited from significant financial surpluses since the early 2000s due to rising oil prices. Consequently, the Algerian government had to intervene to regulate the money supply under the central bank's supervision, ensuring its proper use in the line with the economy's conditions and capabilities.

Research Problem :

Considering that Algeria is an oil-dependent economy and its adoption of an expansive investment policy (infrastructure projects), which requires increased money supply to finance these investments, the following problem can be raised :

- To what extent does money supply affect the policy of financing public investments in Algeria ?

Research Hypothesis :

This paper is based on the following hypothesis :

- Public investments in Algeria are influenced by money supply.

Significance of the Study :

This research highlights the impact of money supply on public investment financing policy, which is one of the state's key tools for stimulating development. This drives the need to secure the necessary liquidity for investment financing, given the substantial financial allocations directed toward structured investment programs.

Study Objectives :

1. Clarify the basic concepts of monetary policy and money supply.
2. Explain the objectives of public investments.
3. Examine the relationship between money supply and public investments.

Methodology :

To address the research problem, a descriptive-analytical approach was adopted, supplemented by econometric modeling to measure the impact of money supply on public investments in Algeria.

Study Structure :

The paper is divided into three main sections :

- 1) Theoretical Framework of Monetary Policy and Money Supply.
- 2) Basic Concepts of Public Investment.
- 3) Measuring the Impact of Money Supply on Public Investments in Algeria (1990-2023).

Axis 01 : Theoretical Framework of Monetary Policy and Money Supply :

Monetary policy is one of the most important tools available to monetary authorities, led by the central bank, which oversees its implementation and monitors its effectiveness in any economy.

1. *Concept of Monetary Policy :*

Monetary policy can be understood in two ways :

- Narrow sense : Measures taken by monetary authorities to control money supply to achieve economic goals.
- Broad sense (since the 20th century) : Monetary policy addresses economic problems through measures to manage money supply, interest rates, exchange rates, and credit conditions, aiming for stability and economic growth. (Belazouz, 2004, p. 167)

2. *Ultimate Goals of Monetary Policy :*

There is a comprehensive agreement and consensus among many references and books that the ultimate objectives of monetary policy are summarized in four main objectives :

- 1) **Economic Growth** : This objective is achieved through the use of monetary policy tools, such as increasing the money supply by commercial banks under the encouragement of the central bank, which leads to a decline in interest rates, and consequently an increase in private investment. Additionally, directing credit through a policy of framing loans contributes to supporting productive sectors to achieve higher added value, thereby bolstering economic growth. Monetary policy can also influence savings levels by encouraging the accumulation of savings through the domestic banking system, further supporting economic growth.
- 2) **Full Employment** : Monetary policy intervenes by increasing the money supply, which leads to lower interest rates. This can be considered an incentive for businessmen to invest, thus creating new jobs.
- 3) **Price Stability** : By implementing a set of necessary measures to bring about desired changes in the value, supply, and cost of credit in the national economy, in a manner and timing that aligns with improving the performance of economic activities. This aims to achieve price stability and curb inflationary pressures.
- 4) **Balance of Payments Equilibrium** : This is typically achieved by adjusting interest rates (in the case of a balance of payments deficit), which leads to increased attraction of foreign capital inflows, while limiting credit-especially consumer credit, thereby reducing domestic prices and boosting exports. Additionally, it helps achieve a balance between financial outflows and revenues at the macroeconomic level, as well as a balance between investment and consumption on the one hand, while achieving a kind of stability in the currency. (Delaplace, 2003, p. 118)

3. *Concept of Money Supply :*

The study of money supply involves estimating the quantity of money that should be issued to finance and manage the economy. However, the general concept of money supply varies from one country to another, depending on the level of development of its banking system. A precise definition of money supply can be given as the quantity of money circulating in a society during a specific period. In Algeria, the money supply consists of legal tender, demand deposits, and time deposits. The money supply in Algeria is generated through the following means :

- I. **Money Issuing** : The bank of Algeria is responsible for this function according to Article 4 of the monetary and Credit Law (90/10), which states : « The state holds the exclusive right to issue banknotes and coins in the national territory, and delegates the exercise of this right to the Central Bank-The Bank of Algeria-subject to the provisions of Title 2 of book 2 of this law, without exception. »
- II. **Bank Credit** : The contribution of commercial banks to the money supply in the Algerian economy occurs through the credit (loans) provided to the economy. This is stipulated in Article 70 of the Monetary and Credit Law (90/10), which states : « Only banks

are exclusively authorized to carry out the operations mentioned in Articles 66 to 68, namely receiving deposits from the public, granting loans, and finally creating and managing means of payments. » (Sari, 2014, p. 22)

Axis 02 :

Public investment can be considered as an effective tool for economic development, as it is a key driver of growth by increasing the gross domestic product (GDP), providing additional raw materials to complement national savings, and mobilizing investment resources within each country. Additionally, public investment encompasses all types of expenditures aimed at enhancing the state's productive capacity and improving the standard of living for individuals.

1. The Concept of Public Investment :

Public investment, also known as government or state investment, is defined as the funds expended by public authorities (government, local communities) to achieve a public benefit, with the goal of increasing the productive capacity of society. Government spending takes various forms, including :

- ▶ Consumption expenditure (spending on public services such as education and health).
- ▶ Military expenditure.
- ▶ Infrastructure expenditure.
- ▶ Government investment expenditure, which involves establishing numerous investment projects to create job opportunities and reduce unemployment. (Benmalek, Ammar., & Dehan, Mohamed, 2017)

2. Public Investment : Factors and Determinants :

There are several factors that contribute to determining the volume of public investment, including :

- a) **Population Size :** An increase in population size generally leads to higher demand for public utility services such as housing, roads, transportation, healthcare, and education. This prompts the government to increase public investment spending. Additionally, a larger population results in a greater supply of labor. If the national economy fails to absorb this increase, unemployment rates may rise, leading to economic and social problems. This compels the state to find solutions to meet these demands by establishing new investment projects.
- b) **National Income :** The state and level of economic activity in a country are typically determined by the level of national income. For example, if national income rises, the level of government investment spending also tends to increase. This is particularly evident during periods of economic recovery.
- c) **Other Factors :** There are other contributing factors in determining government investment in general and consultancy investment in particular, such as the volume of funding resources available to the government. These resources include local financing sources from public savings and domestic revenues, as well as external financing sources from loans, aid, and grants (Khelout, (2013/2014)., p. 85)

Axis 03 : Measuring the Impact of Monetary Expansion on Public Investment in Algeria for the Period (1990-2023)

Macroeconomic variables are interconnected through a set of relationships that will ultimately lead to outcomes crucial for achieving economic sustainability in any country. Accordingly, policymakers must consider the degree of interaction between these macroeconomic variables

when formulating policies, aiming to achieve stable and sustainable outcomes that avoid any adverse ripple effects or threats to national economies.

1. Defining the Study Variables :

- **Dependent Variable :** Investment Fluctuations (INV) (estimated values from the state budget)
- **Independent Variable 1 :** Broad Money Supply (M2) (measured in local currency terms)
- **Independent Variable 2 :** Gross Domestic Product (GDP) (measured in local currency terms)

Therefore, the standard study model can take the following form :

$$INV_t = a_0 + a_1 M_{2t} + a_2 GDP_t + \varepsilon_t$$

2. Definition of the Study Methodology :

The Autoregressive Distributed Lag (ARDL) model is defined as follows : The ARDL methodology was developed by Shin and Sun (1997-1998). As noted by Pesaran (2001), what distinguishes this approach from others is that it does not require the principal variables to be integrated of the same order.

3. The Impact of Money Supply on Investment in the Short and Long Run Using ARDL Methodology :

The Autoregressive Distributed Lap (ARDL) methodology is based on a series of steps, which can be summarized as follows :

- Pre-estimation Tests :
- Model Construction :

$$INV_t = a_0 + \sum_{i=1}^p a_i INV_{t-i} + \sum_{j=0}^q \beta_j M_{2t-j} + \sum_{k=0}^r GDP_{t-k} + \varepsilon_t$$

INV_t : Investment at time t (dependent variable) M_{2t-j} : Broad money supply at time t-j

GDP_{t-k} : Gross Domestic Product at time t-j a_0 : Model constant

P, q, r : Lag order for each variable

- Time series stationarity study:

We will test the time series stationarity of the study variables using two methods: the Advanced Dickey-Fuller (ADF) method and the Phillips-Perron (PP) method.

Table No 01: Time series stationarity test

Variables		INV Prob		M ₂ t-statistic	Prob	t-statistic	GDP Prob	t-statistic
ADF	At the level	Trend and Intercept	0.40	-2.334804	0.051	-3.5357	0.065	-3.4306
		Intercept	0.29	-1.979539	0.035	-3.1089	0.088	-2.6879
		None	0.99	2.281081	//	//	0.602	-0.2125
	First difference and s	Trend	0.002	-4.950030	//	//	0.001	-5.0260
		Intercept						
PP	At the level	Trend and Intercept	0.379	-2.387142	0.052	-3.5281	0.459	-2.2272
		Intercept	0.293	-1.979537	0.044	-3.0048	0.156	-2.3730
		None	0.992	2.246565	//	//	0.692	0.05269
	First difference and s	Trend	0.000	-5.582650	//	//	0.000	-9.8708
		Intercept						

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

For the ADF test, it is noted from the table at the level (Level) that the absolute value of the t- statistic, which is subject to the Student distribution for the variables of investment expenditures (INV) and gross domestic product (GDP), is smaller than the absolute and critical tabular value at the level of 1%, 5%, and 10%. Hence, the null hypothesis H₀ is not rejected, i.e., the presence of unit roots, and thus the instability of the two series, unlike the money supply variable (M₂), which stabilized at the level. This is confirmed by the probability value p-value, which is equal to 0.0356, which is smaller than 0.05.

After that, we move to the first differential test of the variables, where we note from Table No. (01) that at the first differential, the absolute value of the Student t-statistic for the variables INV and GDP became greater than the absolute and critical tabular values at the level of 1%, 5%, and 10%. Therefore, the time series are first-degree stable according to the ADF test. The same results apply to the PP test.

- Testing the optimal lag periods for the model:

Figure No 01 shows the total number of possible models when changing the lag degrees of the model variables. It is clear from this that the optimal model is ARDL (1.1.0), which is the model with the lowest value according to the Akaike Information Criterion statistic.

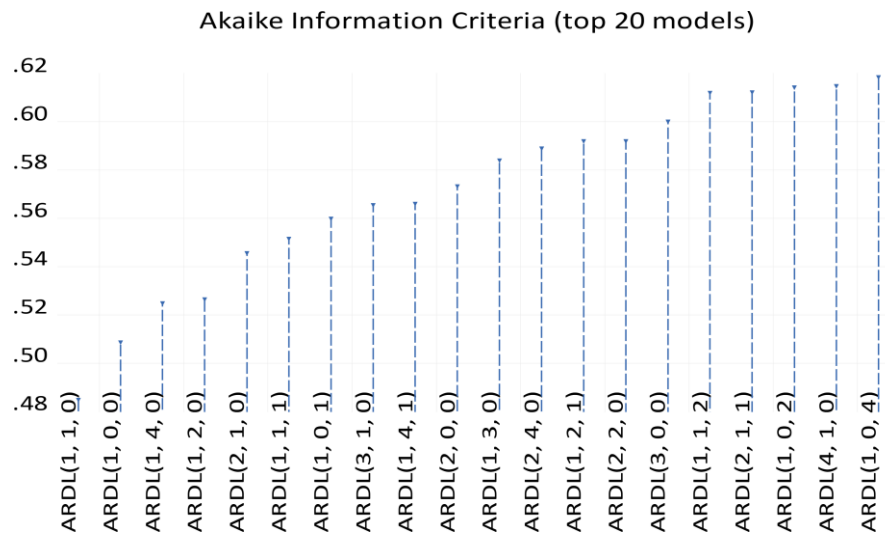


Figure No 01: Results of the lag period test

Before adopting the ARDL (1.1.0) model to estimate long- and short-term effects, the quality of this model's performance must be verified by using the following tests:

→ Model quality: In order to study the quality of the model, the actual values must be compared with the estimated values, as shown in Figure (2) below:

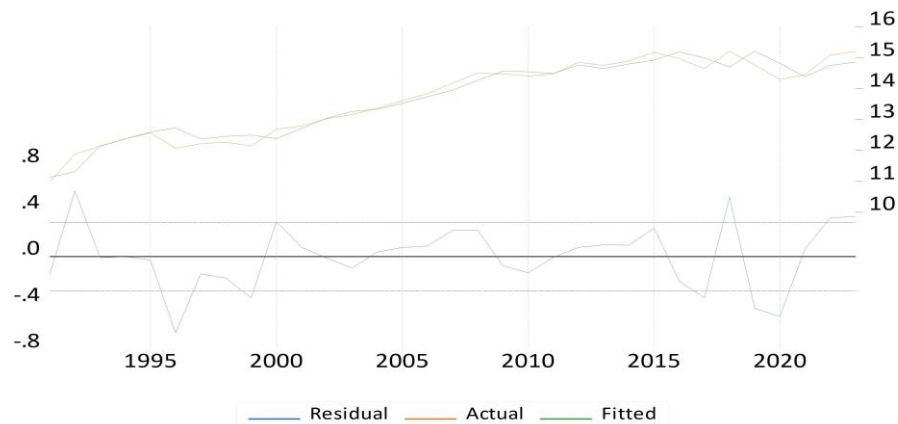


Figure 02: Actual and estimated values and residuals (model quality)

From the figure, we notice that the estimated values are close to the actual values, indicating the quality of the estimated model. Therefore, it can be relied upon in analyzing and interpreting the results.

→ Normal distribution of residuals: This test stipulates two important hypotheses:

Null hypothesis H0: The residual series are normally distributed. Alternative hypothesis H1: The residual series are not normally distributed. The test results are as follows:

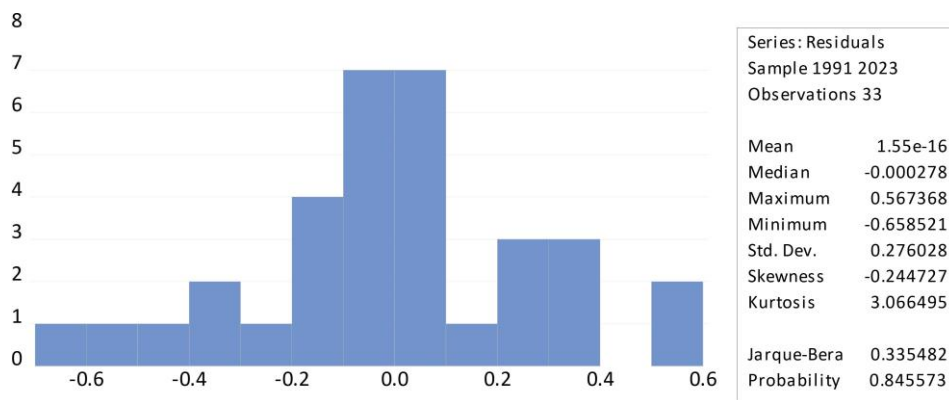


Figure No 03: Normal distribution test

The null hypothesis states that the residual series are normally distributed.

→ Serial Correlation LM Test: This test is based on two hypotheses: Null hypothesis H0: There is no autocorrelation of errors.

Alternative hypothesis H1: There is autocorrelation of errors. The test results are as follows:

Table No 2: Autocorrelation test of errors

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 2 lags			
0.6088	Prob. F(2,26)	0.505873	F-statistic
0.5390	Prob. Chi-Square(2)	1.236040	Obs*R-squared

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

From the results shown above, we note that the probability associated with the Obs*R-squared statistic for this period is 0.5390, which is greater than 0.05. Therefore, we accept the null hypothesis stating that there is no autocorrelation of errors in the ARDL (1.1.0) model.

→ Test of homogeneity of error variance: This test stipulates two important hypotheses: Null hypothesis H0: homogeneity of variance (Homoskedasticity).

Alternative hypothesis H1: heterogeneity of variance (Heteroskedasticity). The test results are as follows:

Table No 03: Test of homogeneity of error variance stability

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
Null hypothesis: Homoskedasticity			
0.7308	Prob. F(4,28)	0.507127	F-statistic
0.6937	Prob. Chi-Square(4)	2.229242	Obs*R-squared
0.7983	Prob. Chi-Square(4)	1.658249	Scaled explained SS

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

Given the probability associated with the Obs*R-squared statistic, which is 0.6937, which is greater than 0.05, we accept the null hypothesis, meaning that the error term variance is stable.

→ Stability Test:

To ensure that the data used is free of any structural changes, and that the model is valid for prediction, the model's stability must be assessed through a graphical test of the movement of the model's residuals and the squares of the model's residuals, as shown in Figure 4 below:

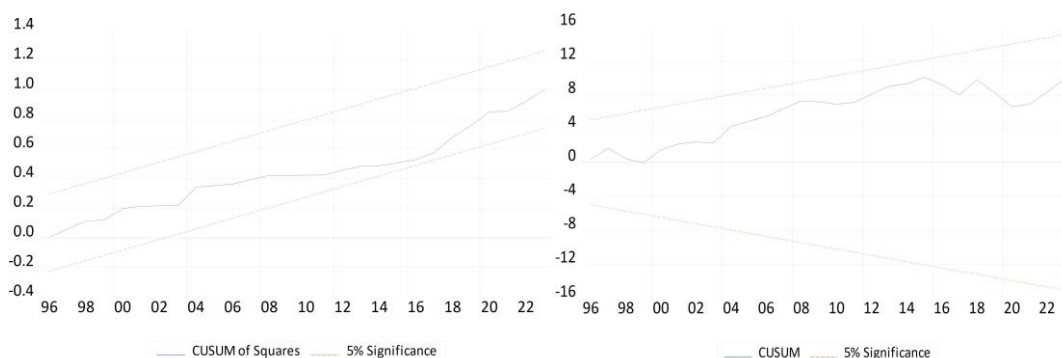


Figure 4: Model Stability Test Results

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

Since the graphs in the CUSUM Test and CUSUM of Squares are within the critical limits at the 0.05 level, we accept the model's stability.

3. Testing the Model Parameters in the Short and Long Runs:

Here, we examine the possibility of cointegration between the model variables and evaluate the impact of the independent variables on the investment variable in Algeria in both the short and long runs.

→ Cointegration Test Using the Bounds Test: Here, we examine the possibility of cointegration using the following hypothesis: There is cointegration between the model variables.

This test is performed for the ARDL model using the following formula: Null Hypothesis H0: There is no cointegration between the variables.

Alternative Hypothesis H1: There is cointegration between the variables. The test results are as follows:

Table No 04: Bounds Test Results

	Asymptotic: n=1000			
3.35	2.63	10%	2.781200	F-statistic
3.87	3.1	5%	2	K
4.38	3.55	2.5%		
5	4.13	1%		

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

The results indicate that the calculated F-statistic is not greater than the critical upper and lower limits at all levels of significance, and thus the null hypothesis is accepted, which states that there is no joint integration relationship between the variables, meaning that there is no long-term equilibrium relationship between investment expenditures and the independent variables.

→ Analysis and interpretation of the short-term relationship:

The following Table No. (05) shows the results of estimating the short-term relationship between the variables of money supply, gross domestic product, and investment expenditures in Algeria during the period from 1990 to 2023:

Table No 05: Results of estimating the short-term parameters and the error correction parameter

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0774	1.833496	0.010867	0.019925	D(M2)
0.0015	-3.509522	0.022568	-0.079203	CointEq(-1)*

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

The results of Table (05) can be interpreted as follows:

- There is no effect between money supply (M2) and investment expenditures (INV) in the short run, because the probability associated with the money supply parameter is 0.0774, which is greater than 0.05.
- There is a short-term dynamic relationship between investment expenditures and the independent variables. This is due to the negative and statistically significant estimated error, whose value was: CointEq(-1) = -0.079203, which measures the proportion of imbalances in the dependent variable that can be corrected in a later time period (7.92% of the specific changes in investment expenditures are due to structural changes in the independent variables).
- The negative sign in the estimated error parameter supports the existence of a long-term equilibrium relationship between the study variables.

→ Analysis and interpretation of the long-term relationship:

The following Table No. (06) shows the results of estimating the long-term relationship between money supply and GDP with investment expenditures in Algeria from 1990 to 2023:

Table No 06: Results of estimating long-term parameters

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.9542	-0.057987	0.220763	-0.012801	M2
0.8355	0.209552	0.246620	0.051680	GDP
0.2551	1.161883	12.17988	14.15159	C
EC = INV - (-0.0128*M2 + 0.0517*GDP + 14.1516)				

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

From the results of this table, we note that all the probabilities associated with the parameters of the independent variables, whether money supply or GDP, are greater than 0.05. This is evidence of the lack of statistical significance, meaning that the independent variables do not contribute to explaining the dependent variable in the long run. This result can be explained by the nature of the Algerian rentier economy, as the Algerian government relies on hydrocarbon revenues to finance public investments.

4. Results from the Econometric Study :

After conducting an econometric study to track the impact of money supply on investment financing policy in Algeria, we took three variables: one dependent variable, representing investment (equipment expenditures) included in the state budget for each year, and two independent variables: the first variable is the money supply in its broad sense, and the additional independent variable is the gross domestic product. We reached a set of results, which can be summarized in the following points:

- When examining the stability of the time series of the three variables using the Advanced Dickey-Vollar method and the Phillips-Perron method, we found that the money supply series stabilized at the level in both methods, while the remaining two series stabilized at the first differences.
- The results of the aforementioned stationarity test allowed us to choose the Autoregressive Distributed Lag (ARDL) model, as one of the conditions for its application is that it does not require the time series to be integrated at the same degree.
- When testing the optimal lag periods for the model, we concluded that there is a single lag period for the investment expenditure variable, and the same applies to the money supply variable, while the GDP variable has no lag period.
- When examining the quality of the estimated model, we observed that the estimated values closely match the actual values, which allows us to conclude that this model is reliable for analyzing and interpreting the results.
- The residual series of the estimated model are normally distributed, which enhances its quality.
- There is no autocorrelation in the errors in the ARDL (1.1.0) model. • The variance of the error term is stable.
- The model as a whole is stable according to the Cusum test and the Cusum of Squares test.
- When conducting the cointegration test, we concluded that there is no cointegration relationship between the variables, and therefore no long-term equilibrium relationship between investment expenditure and the independent variables.
- There is a short-term dynamic relationship between the study variables.

Conclusion

As a conclusion to this econometric study, the primary results of which indicate the absence of a statistically significant relationship between money supply and investment financing in Algeria during the period from 1990 to 2023. This result can be explained by several reasons: the weak effectiveness of the banking system in directing savings and converting available liquidity into investment loans; the dominance of government financing, as all public investments are financed by the state treasury, which has made the money supply ineffective in financing investment; and the nature of the Algerian financial market, which lacks advanced financial instruments, which negatively impacts the effectiveness of monetary policy tools in activating investment. Based on these results, a set of proposals can be formulated to enhance the effectiveness of money supply in financing investment in Algeria in the future. These include giving greater importance to financial inclusion, which can stimulate savings and increase the financial system's ability to mobilize resources and direct them toward financing investment activities; reviewing the effectiveness of the currently applied monetary policy, while attempting to coordinate it with fiscal policy to activate investment financing. This study also has future prospects, such as expanding the proposed model to include other variables, such as the interest rate, for

example. Trying to introduce qualitative monetary policies such as quantitative easing, for example, and knowing the extent of its impact on investment financing.

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