

## **TESTING THE RELATIONSHIP BETWEEN MONEY SUPPLY AND GDP IN ALGERIA. USING AN ARDL APPROACH**

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**Abstract:**

This study investigates the relationship between broad money supply (m2) and Gross domestic product (GDP) in Algeria using time-series data from 1980 to 2017 . The study has employed the autoregressive distributed lag (ARDL)-bounds testing cointegration. The model is specified with six macroeconomics variables, namely, (GDP), Broad money supply (M2), Discount rate (DR), Inflation rate (INF), real exchange rate (reer) , (gov) . The findings reveal that there is statistically significant positive relationship between money supply and GDP both in short run and long run. Where The central banker in Algeria should maintain consistency and follow “the Taylor rule” to allow (M2) increase at a steady rate keeping pace with the economic growth.

**Key words:** Relationship, Money supply, GDP, Autoregressive Distributed Lag (ARDL), Algeria  
**Jel Codes Classification :** B22, C22, E51, E52, E58, O40.

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## دراسة قياسية للعلاقة بين كمية النقود و الناتج الداخلي الإجمالي

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ملخص:

تبحث هذه الدراسة في تحليل العلاقة بين العرض النقدي  $BM2$  والناتج المحلي الإجمالي في الجزائر خلال فترة من 1980 إلى 2017. باستخدام الأساليب القياسية الحديثة كنماذج التحليل المشترك وذلك بتقدير نموذج (ARDL) - حدود الانحدار الذاتي للإبطاء الموزع ، وقد تم تحديد النموذج بستة متغيرات للاقتصاد الكلي ، وهي الناتج المحلي الإجمالي ، و العرض النقدي ( $M2$ ) ، ومعدل الخصم ( $DR$ ) ، ومعدل التضخم ( $INF$ ) ، سعر الصرف الحقيقي ( $reer$ ) ، و الإنفاق الحكومي. و تشير النتائج أن هناك علاقة إيجابية ذات دلالة إحصائية بين عرض النقود والناتج المحلي الإجمالي على المدى القصير وال المدى الطويل على حد سواء. حيث يجب على البنك المركزي في الجزائر الحفاظ على الاتساق واتباع "قاعدة تايلور" للسماح بزيادة ( $M2$ ) بمعدل ثابت مع الحفاظ على مواكبة النمو الاقتصادي.

الكلمات المفتاحية: العلاقة، العرض النقدي، الناتج المحلي الإجمالي، حدود الانحدار الذاتي للإبطاء الموزع ، الجزائر.

التصنيف: JEL: O40،E58،E52،E51،C22،B22

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## **Introduction:**

The relationship of money supply on economic growth (GDP) has received little coverage in the literature of Algerian context. Most of the studies on the similar topic are focused in other countries. Yet, it is equally significant to establish the impact of money supply on economic growth in Algeria for policy makers to effectively harness and augment economic growth.

Empirical researches have largely focused on addressing two issues first, to examine if money could forecast output given predictive power of past values of output, the second issue is to examine whether such relationship is stable over time or not.

Some researchers have found evidence of the predictive ability of monetary aggregates (Krol R. & Chainian,1993,p405). Though, some of these studies argued that such a relationship seems to have changed overtime (Cagan,1956,p25) . Similar studies that have found a strong support for a positive relationship between money supply and economic growth include (Sims,1992,p540) (Bernanke, Boivin,Eliasz,2005,p387)

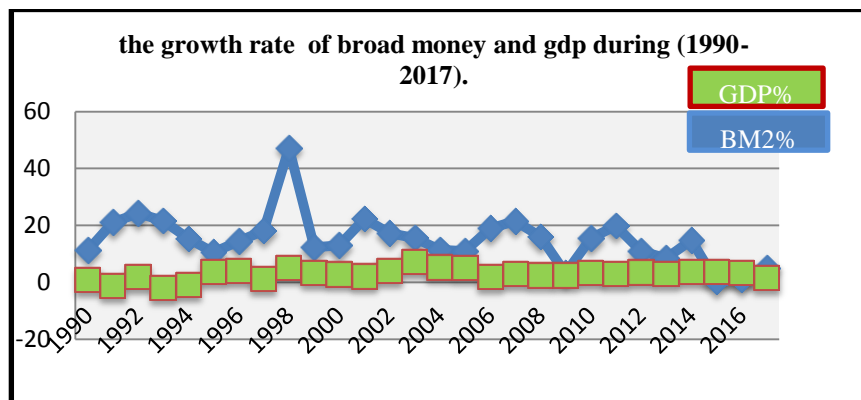
The linkage between Money supply and economic growth has received tremendous attention than any other subject matter in the field of monetary economics in recent times This is as a result of the pertinent nature of economic growth among the macro-economic goals of nations either developed or developing. Persistent concern has always been given among scholars including (McKinnon,R,1973,p87), (O. Odedokun,1996,p119) (Ross Levine,1997,p688) to the linkage between money supply and output. As far as the relationship between money supply, output and prices is concerned there are disagreements and a puzzle that does money supply has any impact on prices and output.

According to the monetary policy in Algeria has made progress in reforms banking system ,The April 1990 Law of Money and Credit provided a new legal and regulatory framework for the financial sector. Designed to support economic reforms undertaken since 1989, it constitutes the cornerstone of Algerian monetary and financial reform. It established greater independence for the Bank of Algeria (BA), Algeria's central bank, authorised private domestic and foreign banks, applied new and strengthened central bank regulations to commercial banks, created a stock market.

The Law of Money and Credit 1990 has been modified, abandoning fixed-term mandates for the governor and vice-governors as of 20 April 2001 ,and thereby reducing the independence of monetary authorities – the BA- and the Council of Money and Credit. This resulted in the loss of more than a decade of monetary credibility by sustaining the impression that the government conducts monetary policy, even if indirectly. with implementation of indirect monetary policy tools (Kada A,2006,p119)

The Figure N(1) shows an increase in the period from 1990 to 2002, reaching its peak in 1998 about 47.24% in GDP and about 5.1% in BM2. This data is due to the recovery of the International markets of oil prices aslo we notice during the periods of 1994-1997 a decrease in the gross domestic product growth due to the decrease in the growth of the money supply as a result to the Implementation of the international financial institutions conditions. While at the beginning of the year 2009, the growth rate of money supply and the growth rate of the gross domestic product (GDP) witnessed fluctuation, were the GDP growth declined at 2.4 % and the growth of of money supply recorded 3.2% after the global financial crisis due to lower oil prices, and returning to rise gradually again.

**Figure n°1: the evolution of annual Growth Rate money supply M2 and annual Growth Rate GDP during (1990-2017).**



Source: Prepared by author using world bank data

We conclude that the GDP in Algeria was characterized after the oil boom known as an expansionary fiscal policy, to develop growth; These policies were used in the frame of many development strategies and programs and based on large financial packages directed to stimulate the dynamics of economic sectors Such as: agriculture, industry and tourism. where the Algerian authorities set up five programs, from the economic recovery program 2000-2004 (to stimulate national institutions and market demand) to the growth support program 2005-2009 (to expand the infrastructures) in addition to the growth program known as the five-year plan covering the period 2010-2014 (for the diversification of the Algerian economy and stimulation of the national production machinery). The final strategy was in 2015 (The new plan for the growth of the green Algeria 2015- 2019) (Boulila.H, Benbekhti.S,2018,p1)

This paper makes a contribution to existing literature at first using Autoregressive “Distributed” Lag (ARDL) approach to investigate the relationship between broad money supply on GDP in Algeria. We ask the crucial question : **What are the characteristics of the causal relationship between money supply and GDP in ALGERIA?**

The answers to this question has been highly idiosyncratic, depending on the structure of the economy under investigation, the approach being adopted, the choice of variables used and the identifying Short-long -run co-integrating relationships between the macroeconomics variables.

This contribution is structured as follows. Section 1 reviews the corresponding academic literature. Section 2 Econometric framework and estimation. Section 3 presents the results and analysis Section 4 Concludes with a summary

This research intends to achieve the following objectives:

1. To determine the relationship between money supply on gross domestic product in Algeria for the period 1980 to 2017

2. Based on my findings, to recommend ways in which money supply could be used more effectively in achieving its intended effects of promoting GDP in Algeria

#### ✓ **EMPIRICAL REVIEW:**

The literature on the relationship between money supply and economic growth is still at the nascent stage in Algeria. Of the few studies that have attempted to analyze relationship

between money supply and economic growth, the results are mixed. Some studies have found positive relationship between money supply and economic growth, while others have found insignificant relationship between these variables.

In the algerian economy the study of (Bouatros , Dahhan,2009,p97) examined the relationship between Money supply, and economic growth using annual data of algeria covering a period from 2005-1970 employed the Granger causality, the findings reveal the existence of a long run equilibrium between real GDP and money supply indicating causality running from money supply to GDP in the short run as well as in the long run ,they ascertain money supply and gross domestic product are in a close relationship.

(Sharma.A,2011,p1) using monthly data from 1993:1 to 2009:9 and employed the Granger causality between the variables under study,the results found that money supply causes output in the short run while in the long run it only affects prices not the output.

(El seoud.M,2014,p1) tested the relationship between money supply and GDP in Bahrain for the period of 13years. Using Cointegration, Error Correction model and granger causality techniques, the findings reveal the existence of a long run equilibrium between real GDP and real money supply while the Error term and F-test indicate unidirectional causality running from real GDP to real money supply in the short run as well as in the long run.

(Eldjanabi .M , Mter A,2015,p118) examined the relationship between Money, and economic growth using annual data of IRAQ covering a period from 1980 to 2012 employed the Granger causality between the variables under study they found the significant positive relationship between money supply and economic growth both in short run and long run in iraq the same result of study to

(Chaitip,2015,p115) , investigated the money supply influence on economic growth for Authorized Economic Operators (AEO) open region in the period 1995-2013, using Autoregressive Distribution Lag (ARDL) model. They found money supply is associated with economic growth.

(Muhammad Qadeer,2016,p66) test short and the long run relationships between money supply, output and prices in India.Using, Pesaran Bound Testing methodology followed by Autoregressive Distributive Lags Models during period 1971 to 2013. The variables M3 as a measure of money supply, WPI with base 2004-05 for price level and GDPFC at constant prices with base 2004-05 as an output variable are used. The results are in line with the Neoclassicals and Monetarists and suggest that money supply strongly affects output and prices in the short run, while in long run it only affects prices and has no significant impact on output. This shows the neutrality of money supply in the long run. Thus, monetary policy has limited implications to enhance long run economic growth in India. If inflation is to be controlled, output must be increased.

(Hussain.M,Haque, M.2017,p44), examined the relationship between money supply and GDP growth rate per capita for Bangladesh, using vector error correction model (VECM). They ascertain that the money supply has significant role on the growth rate. The same results are proven by other researchers.Like (S. Dingela, H Khobai, 2017,pp1) examined the dynamic impact of broad money supply (m3) on economic growth (GDP) per capita in South Africa using time-series data from 1980 to 2016. The study has employed the autoregressive distributed lag (ARDL)-bounds testing approach to cointegration and error correction model to investigate the impact of m3 on GDP per capita they found that there is statistically significant positive relationship between money supply and economic growth both in short run and long run.

(Mihaela , Jenica,2017,p476) examined the relationship between Money, and economic growth using quartely data of romania covering a period from 2000 to 2015 employed BVAR Bayesian Techniques , Engle-Granger. They ascertain money supply and gross domestic product are in a close relationship.

On the other hand, there are few studies found statistical insignificant and negative impact between money supply and economic growth. These studies are (Tomsik, Viktorova,2006,p39). investigated The Relationship between Money and Output in the Czech Republic: over the period 1996-2004, employed VAR Model quartely data. They showed that money supply is not significant in the short-run. In the long-run money supply is significant but has a negative impact on economic growth. The causality test showed that money and economic growth are independent of each other,. These results were proven correct by other few studies. Like, (Odumusor, Joseph,2019,p46) Examined the impact of money supply on the growth of the Nigerian economy. The research was anchored on the classical quantity theory, Keynesian theory and the Monetarist theory that provided justifications for the conceptual and empirical discussion. they employed econometrics techniques to time series data., they showed that money supply is not significant in the short-run. In the long-run money supply is significant but has a negative impact on economic growth. The causality test showed that money and economic growth are independent, meaning that there is no predictive power of money supply in explaining the economic growth and vice versa. they concluded that money supply is incapable of generating growth in the Nigerian economy and government should encourage capital investments in productive sectors of the economy such as agriculture, education, health etc.

## I- THEORETICAL REVIEW:

### I-1- Quantity Theory of Money (QTM) :

Fisher's (1911) exchange equation ( $MV=PT$ ) is considered the famous classical mathematical formulas. It expresses the relationship between the amount of money and the general price level, where (M) is the amount of money, (V) is the money velocity, (P) is the general price level, and (T) is the volume of transactions. He assumes that output will be fixed at full employment, velocity of the money will be fixed too, and thus the equation shows only the relationship between the amount of money and the general price level, especially in the long run. Fisher's has explained his theory in terms of his equation of exchange:

$$PT = MV + M'V'$$

In order to find out the effect of the quantity of money on the price level or the value of money, we write the equation as

$$P = \frac{MV + M'V'}{T}$$

### I-2: Cambridge Cash Balance Theory :

The neo-classical economists(Cambridge school), point out, the money supply affects both prices and output in the short run, but in the long the money supply only affects the general price level and not output. They reformulated the exchange equation to new equation called the equation of Cambridge. Which states that "the amount of nominal money demand and then money supplies (at money market equilibrium) are proportional linked directly to the nominal per capita income or output"; this equation had the following formula:

$$Ms = Md = KY$$

Where (Md) is money demand, (Ms) Money supply, (K) is the liquidity preferences, and (Y) is nominal income (Pigou, 1917).

**I-3: Keynesian Theory of Money :** Keynes (1936) rejected the Quantity Theory of Money in the short run because their assumptions (Y was fixed at full employment and V was fixed) do not apply in uncertainty real world with high level of unemployment. Keynes argues that changing in money supply is not the only reason for changing in the general price level, but there is another variable affects the price level which is the employment of production factors. In the case of absence of full employment, the increasing in money supply will lead to increasing total spending, and then increased the total output. When the economy reaches to full employment, the increasing in money supply only leads to higher prices. Thus, the money supply is non-neutral when the economy operated at less than the full employment level, where there is indirect effect of money supply on economic activity, through the influence of money supply on interest rates, and then investment and output (Iwedi Marshal,2016,p43).

According to Monetarists, prominently Milton Friedman explains inflation in term of excess demand of goods and services like Keynes but the emergence of excess demand does not come into being as a result of government expenditure but on account of increase of money supply. Thus according to Monetarists Inflation is always and every where a monetary phenomenon and can be produced only by a more rapid increase in the quantity of money than output . (Fridman & Schwartz ,1963,p 888)

Monetarism consists of the school of thought that the demand for money is a stable function of many variables and that money supply is the most important determinant of interest rate, incomes (output), employment and prices (Woods,1980). The monetarists contend that all changes in money income can be traced to changes in the supply or demand for money. The central theme in all the views of the monetarists headed by Milton Friedman is that money matters in economic activities and as such monetary policy is a more viable economic stabilization measure than fiscal policy. This contention contrast sharply with the views of the Keynesians of fiscalists, who believe that fiscal policy is a more potent instrument for economic stabilization and aggregate income performance. However the Keynesians and the monetarists agree that both fiscal and monetary policies have significant effects on aggregate demand and general price levels. However the Keynesians and the monetarists agree that both fiscal and monetary policies have significant effects on aggregate demand and general price levels.

## **II. METHODS AND MATERIALS:**

This study employed the use of Autoregressive Distributed Lag (ARDL) approach. The ARDL was developed by (Pesaran M, Shin Y, Smith R,2001,p189) as a surrogate co-integration technique to investigate the relationship at both the long run and short run between two or more variables. The model in preferred to other existing techniques like Engle and Granger (1987), Johansen (1991), Johansen and Juselius (1990) and Gregory and Hansen (1996) for a number of reason: First; it is more appropriate when faced with small sample size Lawal et al. (2015); second, it is applicable whether or not the underlying regressions are purely I(0), purely I(1) or mutually co-integrated Marashdeh (2005); third, the techniques accommodates different optimal lags unlike other conventional co-integration procedures . These advantages motivate the choice of ARDL procedure in investigating the relationship among the variables. The ARDL model specification is as follows:

### **II-1- Description of data :**

This study links money supply controlling for the influence of, gdp gross domestic product . The model is specified with six macroeconomics variables, namely, Gross Domestic Product (GDP), Broad money supply (M2), Discount rate (DR), Inflation rate (INF) real exchange rate (reer) , government expenditure(gov) during period 1980 to 2017. The reason for our

selection of government spending variable, which is has important effects on the money supply, and that the financial policy considered as the dominant tool in the national economy The choice of this period is to enable us focus strictly on the monetary reforms of market-regime in Algeria

The data were obtained from The World Bank, the variables are used. Log transformation to minimize the hetroskedasticity problem (Gujarati,Sangeetha,2007,p12). All the empirical tests have been carried out by using Eviews10 Software.

**II-2- Model specification:**

The empirical model: This relationship is given in the long-linear empirical **Cointegration** Following Odhiambo (2008) and Narayan and Smyth (2008), the ARDL-bounds specification for Model are given Equation ARDL Specification for Model (GDP, LM2 ,LDR, LREER , LINF and LGOV)

$$\Delta LGDP_t = c + \sum_{i=1}^p \beta_1 \Delta LGDP_{t-1} + \sum_{i=0}^{q_1} \beta_2 \Delta LM2_{t-1} + \sum_{i=0}^{q_2} \beta_3 \Delta LREER_{t-1} + \sum_{i=0}^{q_3} \beta_4 \Delta LDR_{t-1} + \sum_{i=0}^{q_4} \beta_5 \Delta LINF_{t-1} + \sum_{i=0}^{q_5} \beta_6 \Delta LGOV_{t-1} + \alpha_1 LGDP_{t-1} + \alpha_2 LDR_{t-1} + \alpha_3 LREER_{t-1} + \alpha_4 LM2_{t-1} + \alpha_5 LINF_{t-1} + \alpha_6 LGOV_{t-1} + \varepsilon_t \dots \dots (1)$$

Where  $\varepsilon_t$  is the error term, GDP represents economic growth, BM2 represent Money supply indicators, the variables for DR, inf ,reer, gov indicate the affecting tools on BM2 and gdp.

**III. METHODS AND MATERIALS:**

**III -1- Stationarity of time series:**

In order to examine the stationarity of time series ,we have used the ADF and PP test , The results of the ADF and PP tests in the table (1) indicate the probability of calculated values is greater than the critical value (0.05) for all variables and therefore we accept null hypothesis  $h_0$ , which states the existence of a unit root in all time series. After the same test all variables possess unit roots and became stationary only after we transformed them to their first differences. so they are integrated of order 1. The results confirm the aptness of the ARDL-bounds test for cointegration and granger-causality analysis.

**Table n°1: Unit Root Test**

Variables	Test Techniques				Results
	ADF test (prob)		P-P test (prob)		
	Level	1st difference	Level	1st difference	
LGDP	0.6279	0.0118	0.4899	0.005	Stationary at 1st diff
LM2	0.3775	0.0016	0.3775	0.001	Stationary at 1st diff
LREER	0.0860	0.1721	0.6785	0.001	Stationary at 1st diff
LDR	0.6055	0.0022	0.6292	0.0001	Stationary at 1st diff
LINF	0.0924	0.0000	0.0924	0.006	Stationary at 1st diff
LGOV	0.6200	0.0001	0.6200	0.0001	Stationary at 1st diff

Source: Eviews: 10 output

**III -2- Lag Selection of ARDL model :** Having established that the variables are stationary, the next step is to examine the long run relationship between variables. But before determining whether the variables are integrated, it is necessary to determine the optimal lag length. The Akaike information criterion is employed to find the optimal lag length and the results are illustrated in Table (2). The lag order of model based on Akaike Information Criterion (AIC) is :ARDL Selected Model: ARDL(2, 2, 0, 0, 2, 0)



**Table n°2: Selection order criteria**

AIC*	BIC	HQ	Adj. R-sq	Specification
-2.380481	-1.820002	-2.201179	0.986595	ARDL(2, 2, 0, 0, 2, 0)
-2.353827	-1.746641	-2.159583	0.986363	ARDL(2, 2, 0, 1, 2, 0)
-2.338829	-1.871763	-2.189411	0.985628	ARDL(1, 2, 0, 0, 0, 1)
-2.335979	-1.822206	-2.171619	0.985807	ARDL(1, 2, 0, 0, 0, 2)

source : Eviews 10 output

The ARDL model can be specified as:

$$(GDP) = 4.776776 + 0.803602GDP(t-1) - 0.284803LPIB(t-2) + 0.069LBM2(t) - 0.284LREER(t) - 0.006LDR(t) - 0.007LDR(t-1) - 0.16LDR(t-2) - 0.018LINF(t) + 0.018LINF(t-1) + 0.032LINF(t-2) + 0.069LGOV(t) \dots \dots (2)$$

**III -3- Co-integration-Bound Test** : The results in the table N (3) indicate that the F-statistic is greater than the upper critical bound at all significance levels. This study therefore rejects the null hypothesis of no co-integration. This shows that there is a long-run causal relationship among the variables. We then infer that there is a long run relationship between money supply and gdp in Algeria.

**Table n°3: ARDL Bounds Test**

T-Statistic	Value	K	Result Pesaran et al. 2001 test wald
F-statistic	5.058	5	there is a long-run causal relationship among the variables
Significance	I0 Bound	I1 Bound	
10%	2.08	3	
5%	2.39	3.38	
1%	3.06	4.15	

source : Eviews: 10 output

$$\text{Long-Run Estimates: } EC = LPIB - (+ 0.1451*LM2 - 0.0590*LREER - 0.3843*LDR + 0.0386*LINF + 0.0656*LGOV + 9.9268) \dots \dots (3)$$

The estimated coefficients suggest that money supply has a statistically significant positive effect on economic growth, which is in line with theoretical argument that money supply boosts economic growth. More specifically, the long run elasticity of money supply is 0.14. The results coincide with the findings of see (Muhammad Qadeer, 2016, p66) (Mihaela, Jenica, 2017, p476) study of (Bouatros, Dahhan, 2009, p97) (Hussain.M, Haque, M. 2017, p44)

Also we observe that (M2) broad money has a big influence on GDP compared by (GOV), government expenditure (gov) its represents just (6%) of changes in, indicating that export of oil and hydrocarbon investment are the long-run driver of economic growth in Algeria the result shown in the table (4)

**Table n°4: Long run results**

Dependent Variable = LGDP				
Variable	Coefficient	Std. Error	t-Statistic	Prob
LM2	0.145146	0.149631	0.97002	0.0417
LREER	-0.059049	0.295681	-1.99706	0.0573
LDR	-0.384272	0.166117	-2.31326	0.0296
LINF	0.038565	0.064170	0.60098	0.5535
LGOV	0.065553	0.086564	0.75727	0.0463
C	9.926777	2.376474	4.17710	0.0003

source : Eviews: 10 output

**III -4- Short-run error correction estimates:** The coefficient of the error correction model the ECMt-1 is -0.48 is negative and highly significant, suggesting that short-run disequilibrium is corrected in the long-run equilibrium.the table N (5)

**Table n°5: Short-run results**

Cointegrating Form				
Variable	Coef	Std.Error	t-Stat	Prob
LPIB(-1)	-0.48120	1.666780	2.8658	0.0214
LM2	0.0698	0.107748	-2.6375	0.0401
LREER	-0.2841	0.114482	-1.6152	0.0144
LDR(-1)	-0.1849	0.195431	-2.4622	0.1193
LINF(-1)	0.0185	0.097365	0.7173	0.6167
LGOV	0.0315	0.036591	0.5071	0.0712
D(LPIB(-1))	0.2848	0.034617	0.9112	0.1800
D(LDR)	-0.0069	0.206204	1.3811	0.9381
D(LDR(-1))	0.1699	0.088639	-0.0785	0.1833
D(LINF)	-0.0325	0.124066	1.3701	0.0119
R <sup>2</sup> Adjusted	0.9883			
D-W	2.1017			
Prob(F-stat)	258.268			(0.0012)
CointEq(-1)*	-0.4812			(0.0001)

source: Eviews: 10 output

The results indicate that departure from long-term growth path due to a certain shock is adjusted by 48% each year.

The short-run coefficients of money supply are a positive and significant impact on economic growth.it means If money supply increases by 1.0 percent on an average will increase the gdp by 0.03 percent in short run and by 3 percent in the long run.

The results further suggested that inflation has a negative effect on economic growth at 5% level . Because inflation led to a decrease of domestic currency value due to increases prices and consequently a decrease in domestic demand And it is matches with monetary Theories Lastly, government expenditure (gov) have a positive and significant impact on economic short run. it means If government expenditure (gov) increases by 1.0. per cent on an average will increase gdp by 0.03 per cent in short run.

The results confirm the dominant role of the money supply tool on economic activities with Implementing an expansionary fiscal policy in Algeria.

### III -5- The diagnostic tests :

The diagnostic tests results are illustrated in Table(6). It was validated that the error terms of the short run models are free of heteroscedasticity, have no serial correlation and are normally distributed. It was also discovered that the Durbin Watson statistics is greater than the R2 , which implies that the short run models are not spurious

**Table n°6: The diagnostic tests**

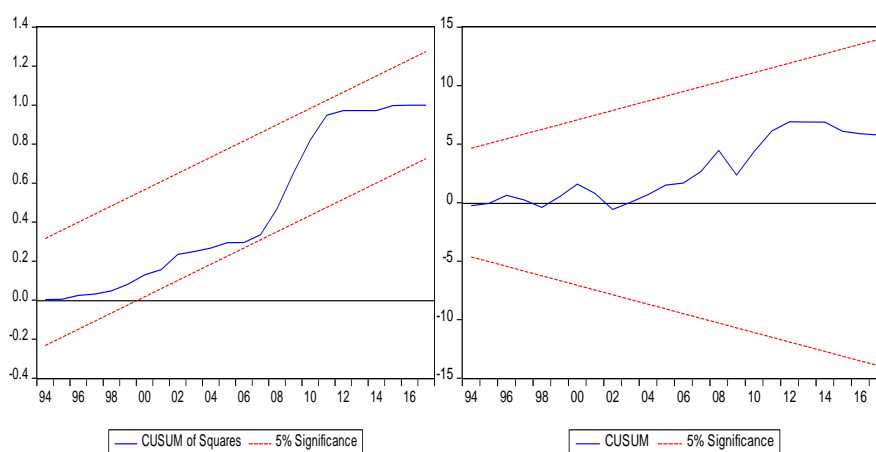
Short run diagnostics		
Test	F-statistics	P-value
Normality	3.91	0.14
Heteroskedasticity	1.858	0.1587
Serial correlation	0.985	0.389

Source: Eviews10 output

**III -6- CUSUM and CUSUMSQ stability tests:**

We also performed the CUSUM and CUSUMSQ stability test for estimated long-run and short-run models based on the estimates of equation. It can be seen from the figures N(2) that the plots of CUSUM and CUSUMSQ statistics are well within critical bounds, implying that all the coefficients in the error correction model are stable

**Figure n°2: CUSUM and CUSUMSQ stability tests**



The source : Eviews: 10 output.

**III -7- Toda –Yamamoto causality analysis :**

In this section, we examine causal relationship (Toda, H, Yamamoto T,1995,p250) in order to investigate Granger causality (1961), they developed a method based on the estimation of augmented VAR model (k+dmax) where k is the optimal time lag on the first VAR model and dmax is the maximum integrated order on system’s variables (VAR model). The Toda and Yamamoto approach follows the steps below

- find the integration order for each series. If the integration order is different we get the maximum (dmax).
- We create a VAR model on series levels regardless of integration order that we found.
- We define the order of VAR model (k) from lag length taken from LR, final prediction error (FPE), AIC, SC, HQ criteria. • We test if VAR (k+dmax) (adjusted VAR model) is correctly specified. • If series have the same integration order then we continue on cointegration test using Johansen methodology. Otherwise, we employ Pesaran et al. (2001) approach.
- We get VAR (k+dmax) model using suitable lags for every equation of the system.
- We apply Granger causality test for non-causality using pairwise equations and modified Wald test (MWald) for the significance of parameters on examined equations on number time lags (k+dmax).
- The modified Wald test (MWald) follows Chi-square ( $\chi^2$ ) distribution asymptotically and the degrees of freedom are equal to the number of time lags (k+dmax).
- Rejection of null hypothesis entails the rejection of Granger causality.

- Finally, we check if there is cointegration on VAR model.
- If two or more series are cointegrated, then there is one causal relationship (unidirectional or bilateral) but not vice versa.
- **VAR model of Toda and Yamamoto causality is set up as follows:**

Where  $k$  is the optimal time lag on the initial VAR model and  $d_{max}$  is the maximum integration order on variables system (VAR model). The results of Toda and Yamamoto causality Table N(8) seems to suggest that supply money has a positive relationship and influences  $gdp$ .

**Table n°7: Toda and Yamamoto causality**

Variable	Lag (k)	Lag (k+d <sub>max</sub> )	Chi-sq	Prob	Direction of causality
Dependent variable: Lgdp Lbm2	1	1+1	0.021347	0.038	Lbm2 → Lgdp
Dependent variable: Lbm2 Lgdp	1	1+1	13.22385	0.0003	Lgdp → Lbm2

source : Eviews: 10 output

### Conclusion:

This paper has examined the relationship between money supply (M2) and gross domestic product (GDP) in ALGERIA using time-series data from 1980 to 2017. The study has employed the recently developed Autoregressive Distributed Lag (ARDL) modeling approach to estimate both the short and long run elasticities of the selected macroeconomics variables Broad money supply (M2); discount rate (DR); Inflation rate (INF) The real exchange rate (reer) government expenditure (gov) and Gross Domestic Product (GDP). The study results reveal that there is statistically significant positive relationship between money supply and Gross Domestic Product GDP both in short run and long run. These results shown by this study are proven by many other studies. These results have a paramount importance in policy implication in Algeria.

The study came up with recommendations that would be of great importance in the monetary policy makers. The government in Algeria should maintain consistency and follow the Taylor rule to allow money supply to increase at a steady rate keeping pace with the economic growth. In respect to such rule will help central bank of Algeria keeping foreign Reserve to avoid the inefficiencies that caused by execution of discretionary policy. In addition to that, the government should promote friendly and open agreement to attract short term and long term investment that will be quick to be converted into cash. In that respect the crises of unemployment and poverty would be alleviated in Algeria . Since this study shows very clear that money supply is a good vehicle to convey the economy of algeria into the right direction.

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