

## Empirical analysis of the relationship between public debts, financial system stability and economic growth: the case of Algeria during the period 2000 – 2021

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Received: 10/07/2022

Accepted: 5/10/2022

Published: 14/10/2022

### Abstract:

This paper seeks to empirically explore the relationship between public debts, financial system stability and economic growth in Algeria during the period 2000 - 2021. In particular, it addresses the question of what kind of influence public debts, the banking sector and the financial system has on economic growth in Algeria. The proposed approach is Vector Autoregressive (VAR) modeling, which allows, with the introduction of a minimal number of restrictions, to identify some structural shocks and to derive their effects on aggregate variables.

The results show that the link between economic growth and public debt is twofold: in the short term, an increase in debt supports domestic demand and growth. The debt and deleveraging cycles are therefore correlated with the economic cycle. Moreover, the impact of the stability of the financial system on economic growth is significant. It facilitates the exchange of goods and services.

**Keywords:** financial system; public debts; economic growth; VAR model.

**JEL Classification Codes:** A10, B40, C10, C20, C40.

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## 1. INTRODUCTION

For a country, the subject of the relationship between public debts, the stability of the financial system and economic growth is an issue of primary importance, it gives rise to a political debate and policy makers, as well as

to their main role in the economy, reason for which, we opted for research in the subject.

The international financial system is the normative and institutional architecture that structures the exchanges belonging to the international finance. This system facilitates the conjunction between supply and demand of capital (loan able funds), financial assets or currencies. The main players in the financial system include central banks, commercial and investment banks, insurance companies, brokers, exchanges, traders, trading platforms and clearing houses.

Economic stability of a country is a situation in which a country does not have large variations in its main macroeconomic indices. The most important are inflation, unemployment and economic growth.

Economic growth is the main instrument that allows the management of all national economies in the short and long term. Industrial production, national income and gross national product are three quantities that represent the level of economic activity of a country and the extent of growth.

Since the Algerian economy is dependent on hydrocarbons, the revenues from the commercialization of this national wealth are influenced by external hazards and international systemic crises.

Since independence, Algeria has implemented several reforms and regulations in banking and finance. Thus, the Algerian economy has undergone several transformations and changes such as the application of the stabilization and structural adjustment program, and the promulgation of the law 90 -10 relating to money and credit during the 90s. For this reason, without a functional banking and payment system, it would be impossible to manage the complex set of economic relations necessary for a decentralized economy characterized by a high level of division and specialization of labour.

Since the 2000s, Algeria has embarked on a policy of economic revival to give a new dynamic to the Algerian economy. In this respect, three plans have succeeded each other, namely the plan to support economic

recovery, the complementary plan to support growth and finally the five-year development plan.

From this work, we try to verify the contribution of public debt, the financial system stability on economic growth, by quantifying the effectiveness of public debts, financial stability on economic growth in Algeria during the period 2000 -2021.

To this end, the general objective of this article is represented in three objectives: to describe the link between public debts, the financial system and economic growth; to analyze the influence of both of public debt and the financial system stability on economic growth, and to determine the effects of indicators of the financial system on economic growth by adopting an empirical methodology based on the use of a VAR model.

In this context, our problematic is articulated in the following question: What is the relationship between public debt and the stability of the financial system on economic growth in Algeria?

The main objective of this study is to determine the effectiveness of the financial system and public debts on economic growth in Algeria during the period 2000-2021.

To achieve this objective, the study relies on VAR modelling (Vector Autoregressive Model) between the rate of economic growth, the rate of domestic credit provided by the financial sector, the rate of public debt, the rate of money supply and the rate of inflation.

To answer the main question, this study will be divided into four parts.

- The first is devoted to the review of literature concerning public debts and stability of the financial system and the relationship between the banking sector and economic growth.
- The second presents a general overview of the evolution of the Algerian financial system.
- The third will focus on the analysis of the state of the Algerian banking and financial system.

- The fourth will focus on the empirical study: the relationship between public debts, the stability of the financial system and economic growth in Algeria and the estimation results.

## **2. Review of literature**

### **2.1 Public debts and financial system stability:**

On the whole, financial stability is roughly associated with the stability of financial markets, leading to a low level of macroeconomics variables volumes and rates, counting prices, the money supply, the bank's credits to the private sector, the exchange rate, equity prices, bond spreads, interest rates, and cross-currency swap rates, among others (International Monetary Fund [IMF], 2010).

Hence, a high level of indebtedness causes negative consequences on the financial system stability; companies and households slow down their investments and consumption, which mechanically reduces their overall demand and thus disrupts credits and loan cycles. Debelle (2014) states that the massive recourse to debt causes financial instabilities by; influencing the level of household income, as well as the interest rate relative to asset prices. A high level of debt can cause a situation of debt burden which consequently positions the country in a shift towards a debt crisis.

On the other hand, the macroeconomic effects of the debt-based capital inflows and the pre-emptive actions of international financial institutions between countries generate economic shocks, causes inflation and price fluctuation risk, and ultimately exchange rate depreciation (Davis, 2014).

The concept of public debts has a double effect on economic growth; divided into two categories: internal debts or domestic debts, which refer to the country's own financial resources, and external debts or foreign debts, which refer to the resources provided by a foreign country that are repaid with principal and interest at the end of a certain period, mainly, for developing country case financial resources are provided by international financial institutions or international capital market.

Burriel et al., (2020) aligned in a study focusing on the economic consequences of high debts, that; policy makers should plan for low public

debt ratios, considering that in one hand; these high ratios generate significant economic problems. On the other hand, public debts transform the economic architecture to less resilient and fragile to shocks and reduce the scope for countercyclical fiscal policy.

Therefore, a growth of debt levels creates vulnerabilities and affects the economic performance of the country, by causing problems of banking solvency, amplify monetary shocks related to inflation and price increase. Thus increase the possibility of bankruptcy and economic recession; because when the level of public debt exceeds a certain one, it increases the probability of entering into recession (OECD, 2012).

Developing countries that use a reasonable level of debt tend to promote economic growth, improve socio-economic living standards, effective debt management therefore are paramount in order to achieve these goals (Babu, 2015).

Since these countries have small stocks of capital, Pattillo et al., (2004) explain that this economic growth during the phases of indebtedness is achieved by the accumulation of capital, thus, the growth of productivity. Jointly in their analyses they emphasize that, that they are able to reach the objectives of high returns on the investments made, and that they use the funds borrowed in the form of debt for significant and productive investments so that it does not destabilize their macroeconomic structure.

The ultimate long-term objective of debt is to increase the level of economic growth, avoid any possible negative monetary and fiscal shocks, and repay debts in a time (Pattillo et al. 2004).

(Babu, 2015) explains that internal debt impacts economic growth positively and negatively, according to the classics a tax cut financed by internal public debt would have many effects on the economy in the short medium and long term.

The effects of internal debt in the short term relate to the mechanism of increased public spending, which encourages investment and consumption and therefore increase aggregate demand, and negatively if the debt was not exploited for productive purposes and significant to the economy.

On the other hand Fisera et al., (2021) investigated on the study of the relationship between currency depreciation and external debt management, they concluded that the depreciation of the nominal currency contributes to an increase in the burden of external debt, this depreciation can reduce in the long run the sustainability of external debt, especially in the case of weak economies such as poor emerging economies.

As external debt is considered as a source of financing capital formation in the economy; Adenike et al., (2007) characterized African developing countries by an inadequacy of internal capital formation due to low productivity, incomes and savings; which pushes Western countries to give technical, managerial and financial support to them in the form of debts.

Nevertheless, this support strongly influences the process of economic development of any nation because external financing supports sustainable economic growth, but at a certain level, it can be a major dilemma.

The availability of access to external finance strongly influences the economic development process of any nation. Debt is an important resource needed to support sustainable economic growth if it is well managed and productive (Adenike et al., 2007).

## **2.2 Review of literature about the relationship between banking sector and economic growth:**

The banking sector is an essential part of the economy that plays a decisive role in the economic growth and individuals well-being. A strong financial system enables value creation and economic development, as well as, a weak banking system could generate financial crisis and lead to economic recession cycles.

The banking sector, composed of a group of commercial banks, plays an important role in capital formation, which is vital to a country's economic development and growth. Over the years, these commercial banks were oriented to perform the economic system by providing capital for the global economy, and therefore, the banking system has a vital role in the economy (LE, 2021).

Tuuli (2002) has examined the link between financial development

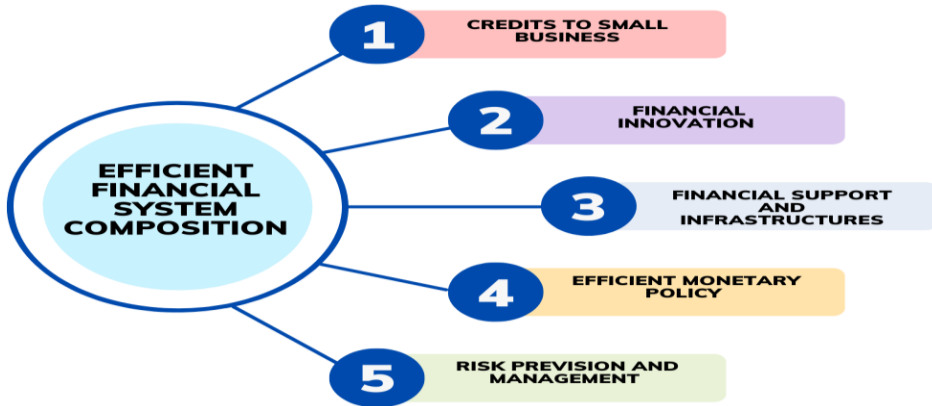
sector and its output on economic growth in transition economies; he founded that financial sector is a qualitative significant measure that influence the economic growth, and the bank's interest rate is negative and significantly associated with economic growth. Hence, in transitioning economies; the bank's credits do not help public policies to achieve growth.

On a point of fact, results demonstrate that banking sector reforms and the interest rate are negatively correlated between them, each variable is strongly associated with growth; this amplifies a significant public policy implication (Tuuli, 2002). Rushchyshyn et al., (2021) examined the impact of banking sector development on economic growth; considered that a high level of financial sector development has a significant impact on the social and economic development of a given country, thus, an efficient banking system is a condition and a key driver parameter to achieve social and economic progress and growth.

One main role of financial sector development is to assure the long-term sustainable development of the global economy, in this manner, financial inclusion can take part of the financial development by; increasing household's consumption and their living standards.

The authors suggest different dimensions that can measure the financial system efficiency; hence it can be characterized with main parameters that differ depending on the economic nature of the country, recent studies demonstrate that financial inclusion implementation is necessary for banking sector stability, others demonstrate the impact of smart and digital solutions in performing the banking sector. Besides, we present in figure 01 five main elements that describe an efficient financial system that can boost economic growth and long-term sustainability.

**Fig.1.borrowers from commercial banks**



**Source:** By the authors.

Credits are given to economic household to invest and create wealth; develop business activities and decrease unemployment. Digitalization and financial innovation reduce the bank's costs and improve collaborative work between employees. Thus, individuals can reach financial services easily. Otherwise, monetary policy provides the economic system with tools to fight inflation, it can boost economic growth and decrease market prices, and raise the employment rates.

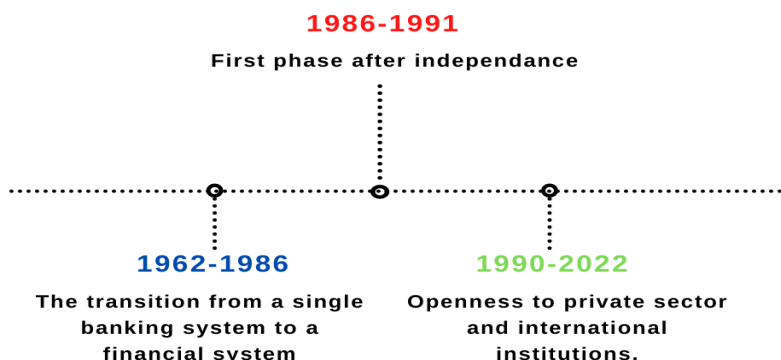
Besides, banking risks are of multi-dimensions, associated with the bank solvability and liquidity; these risks could generate financial crisis and economic recession. For that an implementation of an efficient risk management framework is necessary for value protection of the banks and the overall economic system.

### **3. General overview about the Algerian financial system evolution**

After independence, Algeria wanted to rebuild its dominance by implementing a detailed plan of reforms; one of the first steps was to conceptualize a deep banking and financial architecture of the country's economy. We will briefly present the history of the Algerian banking system and its evolution presented in figure 02.



**Fig.2.** Algerian financial system evolution timeline



**Source:** By the authors.

### **Phase 01:**

Major construction was built during this first phase, the creation of the first Algerian bank as a monetary authority that issue money for the country. Second the formalization of national currency: « Algerian dinars ». Algeria has implemented Law No.62-144 of 13 December 1962, in order to restore its monetary sovereignty and the right to issue its own currency by creating its own money issuing institution, the "Central Bank of Algeria. Later on, transitioning to a planned economy and three financial institutions was created to support economic conceptualization and development; three banks were created National Bank of Algeria (BNA), Popular Credit of Algeria (CPA), and External Bank of Algeria (BEA).

### **Phase 02:**

During the second phase, Algeria has shifted to a market economy, which has performed radical changes in the financial system, especially with the application of the law on money and credit of April 14, 1990. Major changes had affected the banking system, where, government expenditures were financed directly from the treasury.

- The law of January 12, 1988: Gave to the public enterprises to decide and an the autonomy in the decision making

- The law of 14 April 1990 on money and credit: through the application of this law a new banking and financial environment was revolutionizing coherent with economic liberation and interaction with international financial institutions.

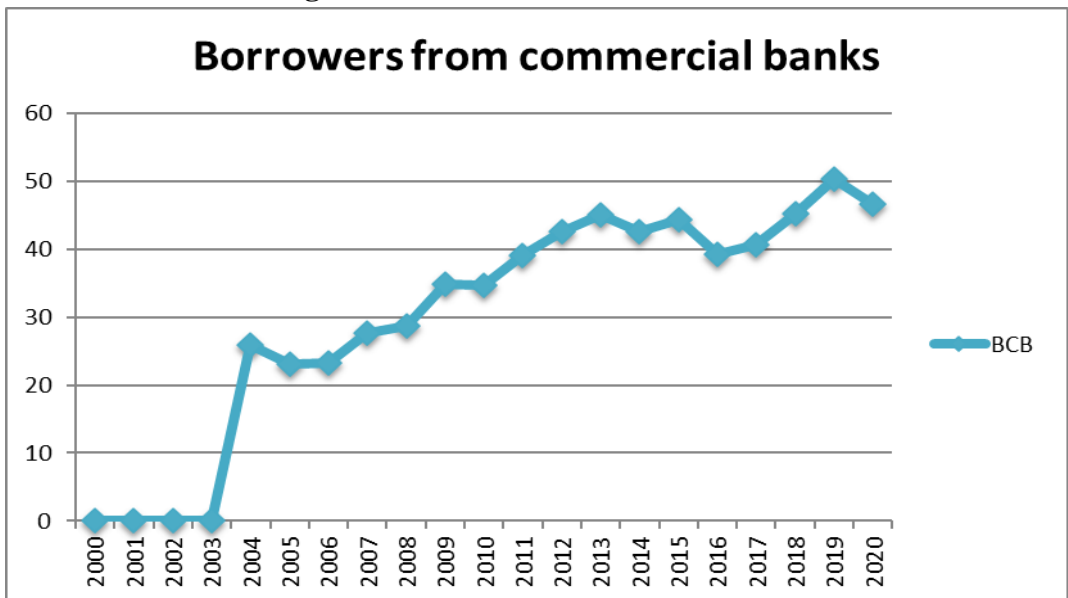
The Bank of Algeria has been promoted as the first monetary authority of the economy that is responsible on the monetary policies related to prices, inflation and market regulation.

### **Phase 03:**

The bank of Algeria has announced a couple of reforms and measures to protect the banking system from crisis related to liquidity and solvability. The implementation of double institutions was established; the first focuses administrative tasks of the bank of Algeria, and the second act as a monetary authority, later on financial liberalization was instituted for the Algerian banking system.

## **4. Analysis of the Algerian banking and financial sector state**

**Fig.3.** borrowers from commercial banks



**Source:** By the authors.

As the graph shows, the year 2004 is characterized by an appreciable peak in the granting of credits by commercial banks to economic agents for financial and investment purposes after a strong stagnation during the

period 200-2003. On the other hand, a continuous growth of bank loans are maintained between 2005 and 2014; this growth can be explained by the increase in the rate of non-hydrocarbon growth and to the applications of economic recovery programs by policy makers in Algeria.

A remarkable drop in bank loans during the period 2013-2018; this may be due to oil price fluctuations, and the high level of internal indebtedness which may subsequently create inflation.

In 2019, a second peak in bank lending has been reported which is justified by the willingness of public banks to mobilize credit and collect financial resources in return to ensure a dynamic business cycle.

At the end of 2019, the diagnosis of the World Bank underlines that Algeria from this year is able to reduce its rate of indebtedness and financial resources in order to avoid a possible economic crisis, this expresses the fall of the amount of credit granting in 2020 by commercial banks.

**Fig.4.Financial intermediary services**



**Source:** By the authors.

In conjunction with the previous analysis, there is a gathering between the direction of the two variables; according to the waterfall the period during (2017-2020) was marked by the strongest years in terms of financial intermediation services, in which an appreciable exposure to financial services during the year 2018 considered the most remarkable.

The period between: (2000-2010) is considered low in the use of banking and financial intermediation services, this can be explained by several cultural factors, beliefs of individuals.

Another element plays a very important role is the digitization of the country, Algeria has launched a group of plans during the period 2003-2011 to shift to a digital economy; nevertheless, several factors prevent the digital transition of the country such as the need for human capital trained in information technology and communication, and the huge amount of investment in infrastructure and financial innovations.

## **5. The empirical study**

The purpose of the empirical study is to highlight the importance between public debts, stability of the financial system and economic growth in Algeria through the determination of a relationship between public debts, money supply, inflation rate, and bank credit with the GDP per capita in Algeria during the period 2000 - 2021.

This investigation will be elaborated with advances econometric methods from with an autoregressive vector estimation. In order to elaborate this study, we included five essential variables in our model, namely: the variable to be explained "the GDP per capita" and the explanatory variables "the public debts", "the money supply", "the bank credit" and "the inflation".

### **5.1 Data sources used:**

This study was carried out using available economic series (2000-2021), notably those of the National Statistics Office (ONS), those of the Bank of Algeria, and finally those of the World Bank. The estimation period is from 2000 to 2021, for which the data are expressed annually, i.e. 21 observations.

### **5.2 Specifying the model:**

Economic modelling is considered a starting point for empirical analysis, but it is common to use economic theory. For this reason, it can be said that the specification of the model is an important step, as it allows us to formulate a number of hypotheses to solve the problem.

After determining and identifying the variables of the model, we gave an

initial formulation in the mathematical form of the model that can be written as follows:

$$\text{GDP} = F(\text{Debt}, \text{Br\_Money}, \text{Inf}, \text{credit})$$

Où :

GDP = Gross Domestic Product

Debt = Central government debt

Br\_Money = Broad money

Inf = Inflation

Credit = Domestic credit provided by financial sector

The choice of variables is determined by economic theory but also by data considerations. After specifying the economic model, it is necessary to transform in form of an econometric model. From our variables coded above, we obtain the following equation:

$$\text{GDP} = B_0 + B_1\text{Debt} + B_2\text{Br\_Money} + B_3\text{Inf} + B_4\text{credit} + u$$

### **5.3 The results of the econometric analysis estimates using the (VAR) model:**

In order to develop a VAR model, the first step is to study the stationarity of the data series. Therefore, the analysis of time series is the most appropriate way to conduct our study.

#### **Study of the stationary:**

When using time series in a VAR model, it is essential that all variables are stationary. To do this, before any econometric treatment, it is necessary to ensure the stationarity of the variables in order to avoid the problems of spurious regressions.

By applying the Augmented Dickey-Fuller unit root method, the study of stationary shows that the GDP, BR\_MONEY and INF are stationary in level on the one hand, and on the other hand, that some variables are not stationary, such as DEBT and a CREDIT.

These variables were stationary by taking their first difference. The results of the study of the stationarity of the variables are shown in the table below:

**Table 1: Result of the stationarity test (ADF test)**

**UNIT ROOT TEST RESULTS TABLE (ADF)**

Null Hypothesis: the variable has a unit root

		<u>At Level</u>				
		GDP	DEBT	CREDIT	BR_MONEY	INF
With Constant	t-Statistic	-1.7012	0.0379	-0.3850	-1.7915	-3.9992
	<b>Prob.</b>	<b>0.4162</b>	<b>0.9522</b>	<b>0.8950</b>	<b>0.3740</b>	<b>0.0063</b>
		n0	n0	n0	n0	***
With Constant & Trend	t-Statistic	-1.5522	-2.6710	-3.1721	-0.2830	-3.7482
	<b>Prob.</b>	<b>0.0771</b>	<b>0.2566</b>	<b>0.1166</b>	<b>0.9854</b>	<b>0.0412</b>
		n0	n0	n0	n0	**
Without Constant & Trend	t-Statistic	-1.8574	1.5337	0.8773	-2.1559	-0.6339
	<b>Prob.</b>	<b>0.0614</b>	<b>0.9644</b>	<b>0.8912</b>	<b>0.0329</b>	<b>0.4299</b>
		*	n0	n0	**	n0
		<u>At First Difference</u>				
		d(GDP)	d(DEBT)	d(CREDIT)	d(BR_M...)	d(INF)
With Constant	t-Statistic	-3.9290	-4.0136	-3.8904	-3.2207	-6.7018
	<b>Prob.</b>	<b>0.0077</b>	<b>0.0065</b>	<b>0.0084</b>	<b>0.0337</b>	<b>0.0000</b>
		***	***	***	**	***
With Constant & Trend	t-Statistic	-2.7104	-4.0812	-3.8923	-3.4769	-6.9209
	<b>Prob.</b>	<b>0.2440</b>	<b>0.0225</b>	<b>0.0323</b>	<b>0.0695</b>	<b>0.0001</b>
		n0	**	**	*	***
Without Constant & Trend	t-Statistic	-3.7569	-3.6157	-3.7456	-3.3355	-6.7527
	<b>Prob.</b>	<b>0.0007</b>	<b>0.0010</b>	<b>0.0008</b>	<b>0.0021</b>	<b>0.0000</b>
		***	***	***	***	***

**Notes:**

a: (\*)Significant at the 10%; (\*\*)Significant at the 5%; (\*\*\*) Significant at the 1% and (no) Not Significant

b: Lag Length based on SIC

c: Probability based on MacKinnon (1996) one-sided p-values.

**Source:** Results obtained from EVIEWS 12.0 software

**Johannsen cointegration test:**

The Johannsen cointegration test is considered as a tool to verify the existence of a cointegrating relationship between the integrated variables.

According to the results obtained from the analysis of the stationarity of the variables of our model, they are not integrated at the same order: [DEBT, CREDIT] are integrated of order one, 1(1) while the variables [GDP, MR\_MONEY, INF] are integrated of order zero, 1(0). Thus, we can say that these results show us that the variables of our empirical model are not of the same order, so we conclude that there is no cointegration relationship in the sense of Granger. Therefore, since there is no cointegrating relationship in the sense of Granger, we cannot construct a vector error correction model (VECM). For this, the vector autoregressive model (VAR) will be our analysis model.

**Determination of the optimal number of delays:**

The direction of the model (VAR), requires the determination of the optimal number of delays. In this sense, according to R. Bourbonnais

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(2015), "when the value h of the number of delays of the model is unknown, there are statistical criteria to determine it». In our study, the following table gives the values of the two criteria after estimating the models up to the order of 2:

**Table 2:** Determination of the optimal number of delays

VAR Lag Order Selection Criteria  
Endogenous variables: GDP DEBT CREDIT BR\_MONEY INF  
Exogenous variables: C  
Date: 06/22/22 Time: 10:56  
Sample: 2000 2021  
Included observations: 21

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-308.6061	NA	6441157.	29.86724	30.11594	29.92122
1	-238.4661	100.1999*	94902.53*	25.56820*	27.06038*	25.89204*

\* indicates lag order selected by the criterion  
LR: sequential modified LR test statistic (each test at 5% level)  
FPE: Final prediction error  
AIC: Akaike information criterion  
SC: Schwarz information criterion  
HQ: Hannan-Quinn information criterion

**Source:** Results obtained from EVIEWS 12.0 software

Based on the Akaike and Schwarz criteria which minimize the information criteria, we retain the first order VAR system because the value 25.56 is qualified as the lowest.

### **VAR modelling :**

VAR models represent a statistical methodology used in the analysis of time series, AVR modelling is proposed by SIMS (1989) as an alternative to single equation models and simultaneous equation models.

In our study, and starting from the fact that the series [GDP, DEBT, CREDIT, BR\_MONEY, INF] are stationary, it is therefore possible to model them by VAR processes. The following table presents the results of the estimation of the model (VAR) with a delay, i.e. VAR (1):

**Table 3 : Modelling (VAR)**

Vector Autoregression Estimates

Date: 06/22/22 Time: 21:59

Sample (adjusted): 2002 2021

Included observations: 20 after adjustments

Standard errors in ( ) & t-statistics in [ ]

	GDP	D(DEBT)	D(CREDIT)	BR_MONEY	INF
GDP(-1)	0.558444 (0.13853) [ 4.03133]	-0.052149 (0.06349) [-0.82134]	-0.449009 (0.25460) [-1.76359]	0.077175 (0.32472) [ 0.23766]	-0.040039 (0.05316) [-0.75319]
D(DEBT(-1))	0.141727 (0.66406) [ 0.21343]	-0.261010 (0.30437) [-0.85755]	0.074468 (1.22048) [ 0.06102]	0.480948 (1.55664) [ 0.30897]	0.093784 (0.25483) [ 0.36802]
D(CREDIT(-1))	0.170413 (0.17824) [-0.95608]	0.090664 (0.08170) [ 1.10977]	-0.186733 (0.32759) [-0.57001]	0.103779 (0.41782) [ 0.24838]	0.058160 (0.06840) [ 0.85030]
BR_MONEY(-1)	0.006740 (0.04497) [ 0.14989]	0.000264 (0.02061) [ 0.01279]	0.013753 (0.08264) [ 0.16641]	0.885355 (0.10541) [ 8.39939]	0.037560 (0.01726) [ 2.17667]
INF(-1)	-1.008299 (0.54611) [-1.84633]	-0.085029 (0.25031) [-0.33970]	-0.859643 (1.00370) [-0.85647]	-0.773977 (1.28015) [-0.60460]	-0.057959 (0.20957) [-0.27656]
C	5.275995 (2.45315) [ 2.15070]	1.283693 (1.12439) [ 1.14168]	7.750790 (4.50868) [ 1.71908]	2.486177 (5.75052) [ 0.43234]	3.283341 (0.94139) [ 3.48775]
R-squared	0.793733	0.205574	0.224530	0.877636	0.372409
Adj. R-squared	0.720066	-0.078150	-0.052424	0.833934	0.148269
Sum sq. resids	180.5498	37.92998	609.8854	992.1187	26.58822
S.E. equation	3.591157	1.645990	6.600246	8.418172	1.378100
F-statistic	10.77462	0.724557	0.810712	20.08249	1.661502
Log likelihood	-50.38151	-34.77887	-62.55416	-67.41988	-31.22613
Akaike AIC	5.638151	4.077887	6.855416	7.341988	3.722613
Schwarz SC	5.936871	4.376606	7.154136	7.640707	4.021333
Mean dependent	5.873486	0.594397	1.704955	17.89319	3.635000
S.D. dependent	6.787446	1.585214	6.433758	20.65749	1.493239
Determinant resid covariance (dof adj.)		49693.46			
Determinant resid covariance		8351.979			
Log likelihood		-232.1964			
Akaike information criterion		26.21964			
Schwarz criterion		27.71324			
Number of coefficients		30			

**Source:** Results obtained from EVIEWS 12.0 software

Based on the application of VAR (1) modelling, what we are really interested in this estimation is expressing the real economic growth equation in terms of the other variables in the model.

The equation of the examined model takes the following form:

$$\text{GDP} = 0.55 * \text{GDP}(-1) + 0.14 * \text{D}(\text{DEBT}(-1)) + 0.17 * \text{D}(\text{CREDIT}(-1)) + 0.006 * \text{BR\_MONEY}(-1) - 1.008 * \text{INF}(-1) + 5.27$$

For this, and according to the results of the VAR Estimates modelling (1), we conclude that all the coefficients of our econometric model are



significant so that the Student's t-value of these coefficients is lower -in absolute value- than the critical value read in the Student's table for a threshold  $\alpha = 5\%$ , i.e., 2.135. In addition, our model is still good because the computed Fisher's statistic is higher than the theoretical value.

**Econometric interpretation:**

**Global significance test:**

The estimation of our VAR Estimates (1) model shows that this equation is globally significant with ( $R^2 = 0.79$ ), i.e. 79.37% since it can explain the variation of economic growth. In addition, the Bayesian VAR Estimates (1) model of the GDP equation is significant because ( $F\text{-statistic} > 10.77 > F\text{-statistic } 5\% \text{ of the table}$ ). Thus, we can say that our model is globally significant.

**Significance test of the variables of the empirical model:**

- DEBT: the t-Student value of Central government debt is higher than 2.17 (tabulated t-Student value) with a lag. Thus, we can say that the Central government debt variable is a determining variable in the explanation of the real economic growth in Algeria, and the latter is considered significant.
- BR\_MONEY: the t-Student value of Broad money is higher than 2.17 (tabulated t-Student value) with a lag. Therefore, we can say that the Broad money variable is a determinant and explanatory variable of the real economic growth in Algeria (significant variable).
- CREDIT: the t-Student value of Domestic credit provided by financial sector is higher than 2.17 (tabulated t-Student value) with a lag. Thus, we can say that the Domestic credit provided by financial sector variable is a determinant and explanatory variable of the real economic growth in Algeria (significant variable).
- INF: the value of t-Student of the inflation rate is higher than 2.17 (value of t-Student tabulated) with a delay. Thus, we can say that the inflation rate variable is a determining variable in the explanation of real economic growth in Algeria, it is significant.

**Economic interpretation:**

According to the results obtained, we could observe a positive and significant influence of the Domestic credit provided by financial sector delayed by one period in the economic growth knowing that this variable is considered as a very important and determining element of the economic growth. An increase of 1% in the Domestic credit provided by financial sector leads to an increase of 0.14 in economic growth. A positive impact of the Domestic credit provided by financial sector on economic growth, which explains the increase in the productive apparatus following the public investments carried out by the State. Moreover, financial systems facilitate the exchange of goods and services. Money and financial innovations allow for a reduction in transaction and information costs that promote specialization, technological innovation and growth.

According to the results obtained, we could observe a positive and significant influence of the Broad money delayed by one period in the economic growth knowing that this variable is considered as a very important and determining element of the economic growth. An increase of 1% in the Broad money leads to an increase of 0.006 in economic growth. The money supply is a regulatory tool for the financial market and the economy used by central banks to promote growth while keeping inflation under control. Their monetary policy varies according to the effects attributed to variations in this sum of liquidity.

In addition, the Central government debt delayed by one period has a positive influence on economic growth. A 1% increase in budget revenues leads to a 0.14 increase in economic growth. The link between economic growth and debt is twofold: in the short run, an increase in debt supports domestic demand and growth. The debt and deleveraging cycles are therefore correlated with the economic cycle.

Moreover, the inflation rate has a negative influence on economic growth, an increase of 1% in the inflation rate leads to a decrease of 1.008 in economic growth. A negative effect of inflation that reflects the repercussions of inflationary pressures on economic growth, knowing that, following an inflationary acute, the monetary authorities intervene by

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reducing the money supply by increasing interest rates; on the other hand, this increase in interest rates will constrain investment by limiting it and leading to a decline in production.

**Granger causality test:**

In our study, we are interested in studying the variables that cause economic growth (GDP). For this, the following table shows the study of causality tests between the series, it leads to the following results:

**Table 4: Granger causality test**

VAR Granger Causality/Block Exogeneity Wald Tests  
Date: 06/22/22 Time: 22:00  
Sample: 2000 2021  
Included observations: 20

Dependent variable: GDP

Excluded	Chi-sq	df	Prob.
D(DEBT)	3.494712	1	0.0514
D(CREDIT)	4.021458	1	0.0410
BR_MONEY	3.984753	1	0.0601
INF	3.408948	1	0.0648

**Source:** Results obtained from EVIEWS 12.0 software

According to the table below, public debts and the financial system cause economic growth, through two indicators, on the one hand, the indicator of public debts [DEBT] and, on the other hand, the indicators of the financial system [the inflation rate, domestic credit provided by the financial sector and the money supply].

For this purpose, it was noted that the hypothesis that [D(DEPT)], [D(CREDIT)], [ (INF)] , [D(BR\_MONEY)] cause [ (GDP)] in the sense of Granger is accepted at the threshold of 10%. The associated probability are 0.0514, 0.0410, 0.0601 and 0.0648, they are lower than the statistical threshold of 10%, which explains that [D(DEPT)], [D(CREDIT)], [(INF)] , [D(BR\_MONEY)] cause [ (GDP)] in the sense of Granger, they are thus a unidirectional causality.

Thus, these results show the existence of a unidirectional causality of public debts and the indicators of the financial system [the inflation rate, the domestic credit provided by the financial sector and the money supply] towards the economic growth which confirms the importance of public debts and the financial system on the economic growth in the Algerian

economy, knowing that the financial system plays a crucial role in the economy by mobilizing savings to finance the investment which is at the base of the growth. The evolution of the economic activities of a country depends on the health of its financial system.

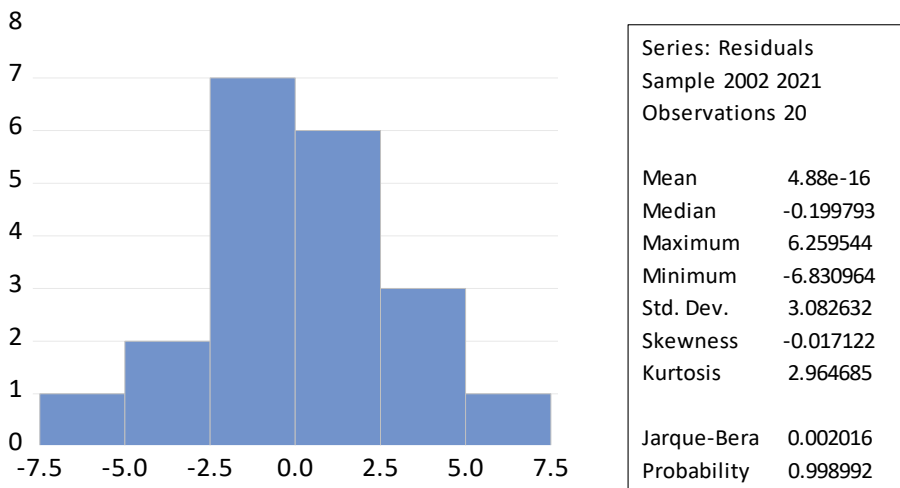
### **Validation test of the empirical model :**

After estimating a VAR model, it is necessary to check whether the model adequately represents the dynamics of the tested variables.

### **Validity test of the economic growth equation (GDP)**

#### **Normality test**

**Fig.5.**Jarque-Beranormality test



**Source:** Results obtained from the EVIEWS 12.0 software

From the results obtained, we note that the Jarque-Bera test has a probability of 0.99, a statistical probability that is greater than 0.05=5%, which means that we accept the null hypothesis of normality of the error terms or residuals.

#### **Autocorrelation test (Breusch-Godfrey test):**

In our model, the probability of the Breusch-Godfrey test is 0.35, a value greater than 0.05=5%, which means that we accept the null hypothesis of non-correlation of the error terms. The result of this test is represented in the following figure:

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**Table 5: Breusch-Godfrey test**

Breusch-Godfrey Serial Correlation LM Test:

Null hypothesis: No serial correlation at up to 2 lags

F-statistic	1.145373	Prob. F(2,12)	0.3506
Obs*R-squared	3.205915	Prob. Chi-Square(2)	0.2013

**Source:** Results obtained from EVIEWS 12.0 software

**Heteroscedasticity test:**

The heteroscedasticity test is used to examine whether the perturbations of a model are heteroscedastic.

**Table 6: Heteroscedasticity test**

Heteroskedasticity Test: Breusch-Pagan-Godfrey

Null hypothesis: Homoskedasticity

F-statistic	1.033197	Prob. F(7,12)	0.4573
Obs*R-squared	7.521044	Prob. Chi-Square(7)	0.3767
Scaled explained SS	3.620238	Prob. Chi-Square(7)	0.8223

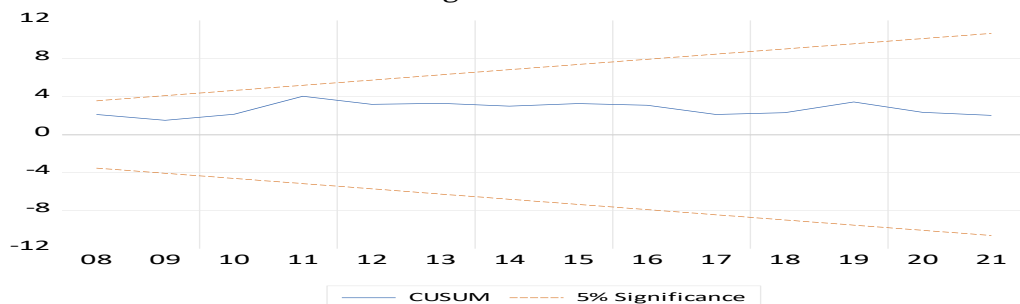
**Source:** Results obtained from EVIEWS 12.0 software

From the results obtained, we note that the probability of the BREUSCH-PAGAN-GODFREY test here is 0.4573 which is greater than 0.05=5%, which leads us to accept the null hypothesis of homoscedasticity of residuals or error terms.

**Stability test of the economic growth equation**

From the application of the CUSUM test, we observe that the curve does not go out of the band. For this, we can say that the model is stable over the entire study period (2000 - 2021).

**Fig.6.CUSUM test**

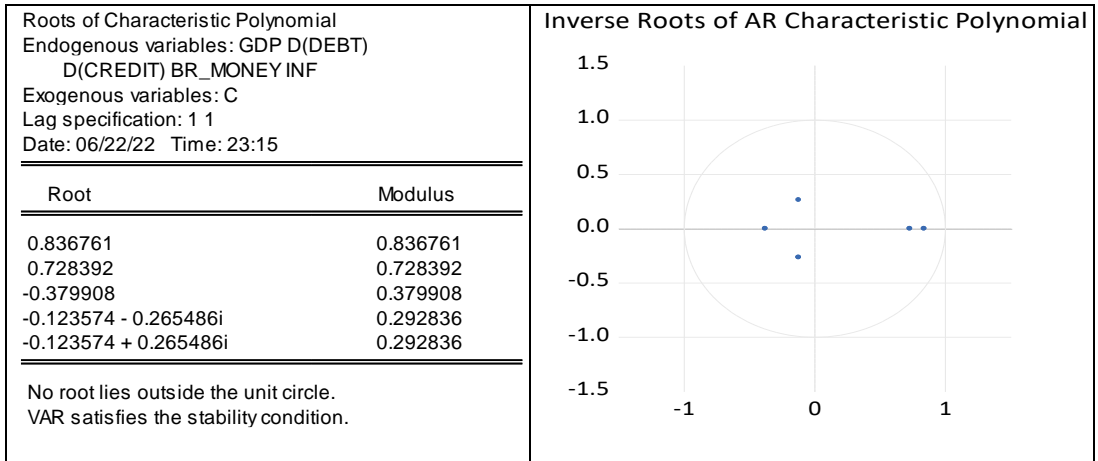


**Source:** Results obtained from EVIEWS 12.0 software

## Validation test of the model (VAR) in general:

### Study of the stationarity of VAR:

**Fig.7.**Test of stationarity of the model (VAR)



**Source:** Results obtained from EVIEWS 12.0 software

According to the results obtained, were that the inverse of the roots associated with the AR part belongs to the unit circle, i.e. that the VAR model (1) is stationary because all the values lie inside the unit circle. Thus the condition of stationary is verified and the VAR model is indeed stationary.

### Normality test:

According to the results obtained from this test, the P-value of our model is equal to  $0.9917 > 5\%$ . We conclude that the majority of the variables follow the normal distribution.

**Table 7:**Result of the Normality test

VAR Residual Normality Tests				
Orthogonalization: Cholesky (Lutkepohl)				
Null Hypothesis: Residuals are multivariate normal				
Date: 06/22/22 Time: 23:17				
Sample: 2000 2021				
Included observations: 20				
Component	Skewness	Chi-sq	df	Prob.*
1	-0.017122	0.000977	1	0.9751
2	0.331175	0.365590	1	0.5454
3	-0.194456	0.126044	1	0.7226
4	0.024614	0.002020	1	0.9642
5	0.071975	0.017268	1	0.8955
Joint		0.511899	5	0.9917

**Source:** Results obtained from EVIEWS 12.0 software

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**Heteroscedasticity test:**

The results obtained at the table below show that the probability of Chi-sq is higher than 5%. Therefore, we conclude that the null hypothesis is accepted and our model is validated.

From the above, we can say that our model is validated and it qualifies as significant. Therefore, having validated our model, we will move on to interpreting the results econometrically and economically.

**Table 8: Heteroscedasticity test**

VAR Residual Heteroskedasticity Tests (Levels and Squares)  
Date: 06/22/22 Time: 23:17  
Sample: 2000 2021  
Included observations: 20

Joint test:					
<hr/>					
Chi-sq	df	Prob.			
<hr/>					
148.2302	150	0.5255			
<hr/>					
Individual components:					
<hr/>					
Dependent	R-squared	F(10,9)	Prob.	Chi-sq(10)	Prob.
<hr/>					
res1*res1	0.679092	1.904544	0.1733	13.58184	0.1929
res2*res2	0.630725	1.537206	0.2649	12.61449	0.2460
res3*res3	0.534924	1.035168	0.4840	10.69848	0.3815
res4*res4	0.793716	3.462916	0.0376	15.87432	0.1033
res5*res5	0.598973	1.344238	0.3336	11.97946	0.2864
res2*res1	0.286878	0.362056	0.9354	5.737557	0.8368
res3*res1	0.641142	1.607956	0.2437	12.82284	0.2337
res3*res2	0.475489	0.815885	0.6243	9.509788	0.4845
res4*res1	0.567081	1.178911	0.4072	11.34162	0.3315
res4*res2	0.559882	1.144906	0.4243	11.19764	0.3423
res4*res3	0.602826	1.366008	0.3250	12.05651	0.2813
res5*res1	0.490842	0.867624	0.5888	9.816841	0.4567
res5*res2	0.749768	2.696659	0.0755	14.99536	0.1322
res5*res3	0.496129	0.886172	0.5765	9.922583	0.4473
res5*res4	0.335974	0.455369	0.8818	6.719487	0.7516

**Source:**Resultsobtainedfrom EViews 12.0 software

## 6. CONCLUSION

The analysis of our study has allowed us to study the relationship between public debt, financial system stability and economic growth in Algeria during the period 2000-2021.

To allow the meeting of supply and demand of capital, a financial system must assume two main functions: - to produce the information necessary for the realization of financial transactions; - to treat the risks of investments and to distribute them as well as possible between the

economic agents.

Based on the results presented in this paper, our contribution is summarized in the following points:

The results retained from the econometric estimation show that the Gross Domestic Product series, Broad money and Inflation are stationary in level. On the other hand, the variety of Domestic credit provided by the financial sector and Central government debt are stationary in first difference.

- There is no cointegration relationship between the variables of the empirical model.
- The estimation of our VAR (1) model shows that the economic growth equation is significant with ( $R^2 = 0.79$ ), an indexation of 79.37% since it can explain the variation of economic growth.
- The existence of a unidirectional causal of the exogenous variables: Broad money, Inflation, Domestic credit provided by the financial sector and Central government debt towards the endogenous variable "Gross Domestic Product".

Knowing that the Algerian economy is an economy dependent on hydrocarbons, and that oil revenues are the main foreign exchange resource for Algeria. The latter adopts a policy of economic recovery to instill a new dynamic in the Algerian economy. In this respect, three plans have succeeded each other, namely the plan to support economic recovery, the complementary plan to support growth and finally the five-year development plan.

The results show that the stability of the financial system and the public debt plays an important role in determining the variation of growth in Algeria. Moreover, we can say that the financial system is the set of financial institutions which, thanks to the markets, ensure the connection and the adequacy between the supply and the demand of financing. An efficient financial system is necessary to make the real economy work.



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