Public debt effects on the Algerian economy: ARDL approach

تأثير المديونية العامة على الاقتصاد الجزائري

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Abstract :

In this paper we investigate on the short- and long-term effects, results and consequences of public debt on the Algerian economy during the period 2000 to 2021, in particular its outcome on inflation, investment and economic growth. The empirical analysis primarily includes a dataset of 21 observations Of the Algerian state regardless public debt rising volume, where the methodology used the most recent advanced econometric methods: Auto-Regressive Distributed Lag model, focusing on the relationship between the selected variables with data gathered from the world of bank and international monetary. To test the short- and long-term effects. The results demonstrate that at this level, public debt generates incentive effects on investment in short term and long-term adverse effects on investment and on economic growth as a result of capital stock accumulation, and heightened long term interest rate in which generate inflation.

Keywords:
Macroeconomic effects - Public debt – Inflation – Investment – Economic Growth
Jel Classification Codes : J11-H6-B31-H54-O4

ملخص

نتحرى في هذه الورقةعلى الآثار والنتائج والتأثيرات قصيرة وطويلة الأجل للدين العام على الاقتصاد الجزائري خلال الفترة من 2000 إلى 2021 ، ولا سيما نتائجه على التضخم والاستثمار والنمو الاقتصادي. يتضمن التحليل التجريبي في المقام الأول مجموعة بيانات من 21 ملاحظة للاقتصاد الجزائري بغض النظر عن حجم الدين العام المتزايد ، حيث استخدمت المنهجية أحدث الأساليب الاقتصادية القياسية المتقدمة: نموذج الانحدار التلقائي للتأخر الموزع ، مع التركيز على العلاقة بين المتغيرات المختارة مع البيانات المجمعة من عالم البنوك وصندوق النقد الدولي. لاختبار الآثار قصيرة وطويلة المدى. تظهر النتائج أنه عند هذا المستوى ، يولد الدين العام آثارًا محفزة على الاستثمار في المدى القصير وسلبية على المدى الطويل والنمو الاقتصادي نتيجة لتراكم رأس المال ، وارتفاع معدل الفائدة طويلة الأجل التي تولد التضخم.

كلمات مفتاحية: تاثيرات الاقتصاد الكلي – الديون العامة – التضخم-الاستثمار-النمو الاقتصادي

تصنيف **JEL** :*J11-H6-B31-H54-O4*

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Introduction

"For a long time to come, one of the priorities of macroeconomic policy will be to slowly but steadily return debt to less dangerous levels, to move away from the dark corners."

Olivier Blanchard (2014).

Algeria suffered from intense violence and considerable sovereign debt problems during the 1990s—an experience that continues to influence policymaking these days where by 1995 to face damage causes by the civil strife, the volume of external debt raised up to 75 percent of GDP which had affect the economic performance, mainly inflation which had reached to30%, the unemployment to 28%. An aversion to public debt was maintained in particular an overhang of external debt which gives an accumulation of payment burden and a loss of sovereignty. Since 2000 Algeria has implemented reforms to achieve economic stability after experiencing a long period of recession, especially with boom oil price; an early repayment of 1.1 billion $ to European investment bank and the African development bank lowering the external debt-GDP ratio (from 26% in 2004 to 16.5% in 2005) ; followed by an early redemption of loans from the IMF and completed by the repayment of $10½ billion to Paris Club and London Club creditors, bringing the debt-to-GDP ratio down from 17 percent in 2005 to less than 4.5 percent in 2006.The government then where able to repay nearly all its external debt which resulted in a huge surplus of the external transactions account up to 18% percent of GDP.

Following the financial crisis in 2009 and the Arab Spring, Algeria found itself in the need to increase its volume of public spending mainly to feed the salaries in order to control inflation and ensure an adequacy of household purchasing power, and due to the oil crisis in 2014 that made the price fall; an explosion of internal debt in 2016 of 19. 5% of GDP was reached represented by treasury bills, bonds and outstanding debt purchased from public enterprises, as a result of which deep budgetary and external imbalances were experienced justifying the massive growth in the volume of public debt which increased from 8.3% of GDP in 2015 to 45.2% of GDP in 2019 to a volume of 63% of GDP in 2022. This increase is associated with several effects, which justifies our choice of problematic of which we try to analyze the adverse and incentive effects of the public debt on the Algerian economy, mainly investment, inflation and economic growth.

Moreover, debt impact economic performance and the financial market structure, as they have an adverse effect of capital accumulation, productivity, and economic growth by a variety of channels as interest rates, higher distortionary taxation, inflation, uncertainty and vulnerability to crisis (Kumar and Woo, 2010).With the intention to that, public debt play an important macroeconomic role in financing economic activities and investment, governments attend to mobilize external and domestic debts to cover budget deficits, hence Algerian economy is strongly dependent on domestic taxation and external natural resources of oil rents as a source of financing economic activities and public expenditures. In order for in this study we aim to empirically analyses the effects of public debt on the Algerian economy. In particular the research addresses the question of which effects hold public debt on macroeconomic indicators such as: Real GDP per capita growth, Inflation, Investment and public expenditures using Auto Regressive Distributed Lag Model [ARDL].

The purpose of this work aims to clarify the effects of public debt on the Algerian economy economic during the period 2000 – 2012, as one of the first macroeconomic objectives is achieving economic growth, we will be focusing on different macroeconomic indicators and their relationship with public debt, such as: economic growth, inflation, investment and public expenditures. In this context, our research is based on a central question: what are the effects of public debts on Algerian economy during the period 2000- 2021? In order to better define our problem, we have deemed it useful to subdivide it into several questions:

1. What are the theoretical foundations of public debt?
2. What are the theoretical foundations on the public debt effects?
3. What are the short- and long-term effects, consequences and results of public debt on the Algerian economy, in particular on investment, inflation and economic growth?

1. Review of literature:

2.1. Theorical debates on the question of public debt effects:

Major theories debate the linkage between public debt, investment and inflation are discussed by the classical school of thoughts and Keynesians. While classical theorists developed a debt pessimist view and suggest that while a state aim to finance its government expenditure with national debt, none of fully offset will be achieved to face *crowding out* negative effects associated with investment and consumption, and a decline of economic state will be developed (Hilton,2021). Discrepancy, Keynesian economic theorists argue that volume of public debt destinated to finance government expenditures generate a *crowding-in* effect, which causes a positive multiplier effect on national output or income (Elmendorf and Mankiw, 1999).

The crowding out effect is also discussed by Modigliani (1961) who aligns that domestic borrowing from the domestic market causes liquidity crises and interest rate hikes which discourages private investment, by reducing credit to the economy or by increasing long-term interest rates on public debt. He argues that it presents a burden on future generations in the form of a reduced income stream from a lower stock of private capital (Checherita, 2012). Otherwise, external debt financing give rise to negative consequences; as the public debt repayments, typically foreign debt, which crowd out economic growth by dissuading potential foreign investors entrance to the economy (Hilton,2021).Besides major classical economists: David Hume, Adam Smith, David Ricardo, Jean-Baptiste Say, and John Stuart Mill; argue that government investment and government consumption need to be function of the own government's means which should be efficiently managed and limited, as government investment has both crowd-in and crowd-out effects on private investment (Chuanglian et al., 2016).

Considering all classical theories of public debt, none is much discussed than David Ricardo (1772–1823) anti-capitalist theory, he holds a pessimist camp of public debt, and any kind of state expenditure. Ricardo's debt theory is overexamined today due largely to the formalism of "Ricardian equivalence," which is much treated by economists but rejected. The doctrine affirms that there's no monetary or mathematical difference (hence an "equivalence") between the effects of public spending whether it's tax financed or debt financed, because debt forms

future taxes for households (Salsman, 2017).The Ricardian equivalence theorem is constructed on the assumption that variations in public expenditures and revenues are matched by changes in private savings, as households will increase their savings level comparing to their consumption and demand level, as potential tax will allow debt repayment (Hilton,2021).Moreover, Malthus agrees that fiscal policy, which aims at increasing aggregate demand through increased government spending and budget deficits, is therefore inefficient because it generates inflationary effects. Malthus advocates the maintenance of "an adequate level of public debt, otherwise the generalized overproduction of commodities would become a harsh reality.In opposition, Keynesian theorists affirm that growth model is mono-causal with public debts, and the public expenditures financed by public debts lead to a crowding-in effect, which causes a positive fiscal Keynesian multiplier effect on national output or income level (Elmendorf and Mankiw, 1999).Defendant of state intervention in economic activity hypothesis, Keynesians postulate that an increased in public expenditures generate benefits in enhancing domestic economic activity rise and crowds in private investment (Hilton, 2022).

2.2. Empirical effects of public debt on economic growth:

Economic growth with subsequent of real per Capita GDP using panel modelling including reverse causality and endogeneity estimation between advanced and emerging economies during the period 1970-2009; founded that there is an inverse relationship between public debt and economic growth, as there is a nonlinearity between the tested variables, and only high public debt that represent 90 percent of GDP have a significant negative effect on economic growth, this was justified by the inefficient labour productivity growth which had reduced the investment and capital accumulation. They founded that on average, the impact of public debt differs between advanced and emerging economies, 10 percent of debt-GDP ratio reduced growth with 0.4 points in emerging countries and 0.15 points in advanced countries. (Reinhart & Rogoff, 2010) tested the consequences of high public debts levels on particular variable of inflation by exploiting a new multi-country historical dataset of 44 countries spanning about 200 years in order to search their effects on growth and inflation. The data was incorporating many changes in regimes, political systems, exchange rates and monetary policies. At normal debt levels, the relationship between growth and public debt is weak. When public debts maintain a higher level that 90 percent of GDP, the countries survive moderate state of growth with one percent lower. (Panizza et al., 2013) focused on another economic classification of advanced economies; the tested relationship between public debts and economic growth show that there is a causal effect running from high debt to low growth and there is different way through which debt overhang situation could harm the economy. Mencinger et al. (2014) had empirically explored the short-term transmission mechanism of public debt impact on economic growth by evaluating the direct effect of high level of indebtedness on economic growth in 25 European countries as they had survived the sovereign debt financial crisis; they suggest that there is a significant statistical non-linear impact of debt-GDP ratios on annual growth. Using panel transitional regression with a dataset of 65 country subdivided between developed and developing countries; (Chen et al., 2016) studied the optimal levels needed for an economy of its government expenditures, investment and public debts for achieving a growth model over the period 1991-2014. The core finding of this research demonstrate that when the level of government expenditures rises; the effect of government spending on economic growth

decreases. Hence, there is an optimal level for economic growth caused by the volume of public or government investment ratio where the effect could change from positive to negative or from negative to positive although the optimal level of debts may vary in different economies. Another consequence of public debt could be more correlated with economies where there is a high percentage of shadow economy; mainly developed in poor and developing countries where there is a relationship between corruption, shadow economy and public debt. (Cooray et al., 2016) had examined this relationship empirically by testing 126 countries between the period 1996 and 2012; they founded that increased corruption and a larger shadow economy led to an increase in public debt. A larger shadow economy reduces tax revenues because of corruption which effect the fiscal budget alimented by taxation which increase in consequences the public debt volumes.

Given this complementarity; public policy makers should focus on reducing corruption level to maintain a fiscal sustainability and stability mainly in public debts and government expenditure management. Another effective policy may be related with minimizing the propagation of the shadow economy bey insuring monetary and fiscal mechanisms to control it and levitate it. (Butkus and Seputiene, 2018) developed GMM model to investigate on whether the household debt depend on the government policies effectiveness as the variable of institutional quality and trade balance based on a panel approach of 152 countries over the period 1996 and 2016. The obtained results demonstrate that good governance justified by effective public policies are not enough to avoid the negative consequences of public debts, moreover trade balance is more decisive variable than the institutional quality variable on which threshold depend while judging the quality of banking and financial system effectiveness and performance.(Abd Rahman et al., 2019) re-examined the hypothesis of (Reinhart & Rogoff, 2010) and suggested that the percentage of debt ratio related to growth fixed with 90 percent is not operational across all the countries, and there is no mutual consensus on the relationship between public debt and economic growth, the relationship between both variables could be positive, negative or nonlinear. Besides they argue that the percentage of 90% of debt ratio cannot be applied cross countries.(Ndoricimpa,2020) has re-examined the threshold effects of public debt on economic growth in Africa applying panel smooth transition regression where the sample is divides into low- and middle-income countries, and into resource- and non-resource intensive countries to estimate heterogeneity and the changes of regression from a regime to another, low debt has been founded to be neutral next to economic growth, but high volume of public debt is detrimental.

2.3. Empirical effects of public debt on inflation:

Public debt is commonly associated with mix of monetary and fiscal policy, which have different effects on their macroeconomic indicators, mainly on economic growth, investment, consumption, exchange rate and interest rates and inflation.(Dumitrescu, 2022) states that there is a non-linear relationship between the volume of public debt and the inflation rate through the moderating effect of the excess underground economy in a country; that is, economies where the underground economy exceeds 24.3% of GDP tend to survive a higher inflation rate caused by a previous increase in public debts. Conversely, countries with an underground economy below 24.3% of GDP experience a decline in the level of inflation due to an increase in the level of public debt.Several studies show that inflation targeting is a good strategy to deal with

debt crises; (Ogrokhina, 2018) demonstrates that inflation targeting leads to a reduction of 3 to 6 percentage points in the foreign exchange share of external debt in inflation-targeted countries compared to non-targeted countries, with the effect being particularly pronounced for international sovereign debt

In this context (Bhattarai, 2014) shows that public debt has a dynamic dual effect on inflation: when a restrictive monetary policy is combined with an expansionary fiscal policy, public debt plays a role of wealth creator for households. In the case of an expansionary monetary policy and a passive fiscal policy, inflation deviates from the objective, which generates monetary shocks linked to interest rate fluctuations.

2.4. Empirical effects of public debt on investment:

In particular, a high level of indebtedness leads to vulnerabilities; companies and households slow down their investments and consumption, which mechanically reduces their aggregate demand and thus disrupts macroeconomic stability.The effects of public domestic debt in the short term are relative to the mechanism of increased public spending, which encourages investment and consumption and thus increases aggregate demand, and negatively if the debt was not exploited for productive purposes and significant to the economy.Here, the marginal propensity to consume is greater than the marginal propensity to save; the increase in private savings is not enough to compensate for public dissaving, which increases the real interest rate of banks and encourages the inflow of capital from abroad.In the long term, the growth of the interest rate continues; it discourages private investment through the crowding out effect.The investment of private economic agents will therefore be crowded out, domestic savings will decrease, which translates into a decrease in the capital stock. On the other hand, the influx of capital abroad would lead to an increase in the level of external debt, and a high demand from households which generates an increase in prices and therefore inflation.

Therefore, (Sheikh et al., 2010) points out that the effects of internal debts in the long run, results in a decrease in total output, and thus a decrease in the level of consumption and economic welfare. However, even if the crowding out dilemma and the increase in the national interest rate would be addressed and controlled by the government; public debts still remain a source of credit and investment limitation (Fsicher and Easterly, 1990)(Putunoi et al., 2013) point out that the use of domestic debt has a positive effect on the economy, this would be achieved provided that the borrowed funds are used in productive economic channels so that it does not influence the interest rate of credit and investment.According to (M. Bildirici, O. Ersin, 2007), the internal debt is an important factor of inflation related to the increase of the interest rate, mainly in the developing countries; which has experienced several inflationary spirals because of internal indebtedness.
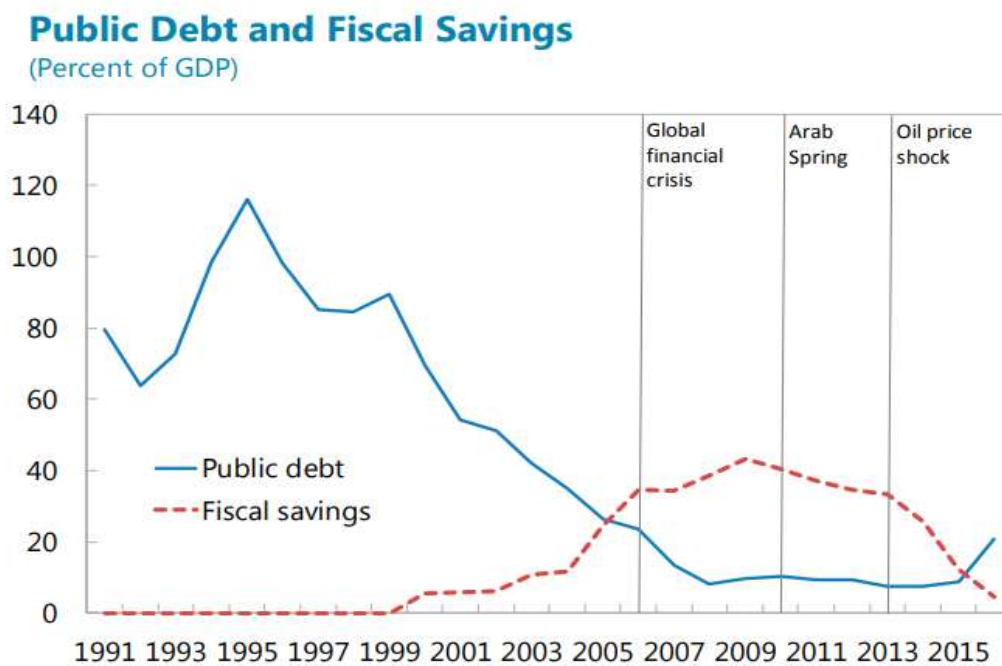
2. The development of public debt in Algeria:

Table 1. Government debt

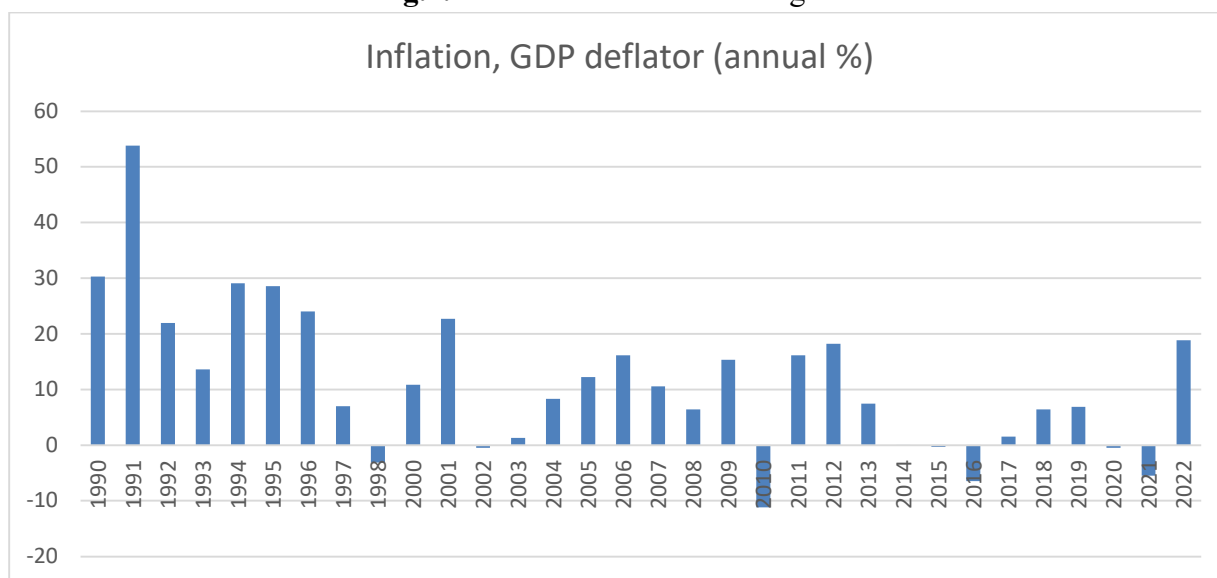| Central government debt, end -2016 US 1$= DZD 110.9			
	US $ Billion	**DZD Billion**	**Percent of GDP**
External debt	1.6	174.8	1.0
Domestic debt	30.7	3,407.3	19.9
Total	32.3	3,582.1	21.0

Source: (International Monetary Fund, 2017, P4)

Fig.1. Public debt and fiscal savings

Source: (International Monetary Fund, 2017, P4)

Fig.2. Inflation rate annual in Algeria

Source: (Authors' own elaboration, data provided from world of bank database)

During inflationary tendencies, high inflation may lead to positive effects correlated with salary increase, debt deleveraging and balance sheet regularisation, but in controverse; negative effects which are mainly associated with macroeconomic imbalances and income distribution; act as a favour to borrowers but a dilemma for savers and creditors. Moreover, inflation causes distribution in investment volume with intermediate channel of interest rate; during high inflation the central bank may implement a restrictive monetary policy that aim to absorb liquidity and increase the interest rate to fight inflation which causes negative effects on the household investment level and consumption.

- ▪ **The period from 1990 to 1995:**

During the 1990s, the Algerian economy was characterized by a fall in the national currency. Algeria experienced during this period (1990-1995) a galloping inflation, the annual inflation rate rising from 16.65% in 1990 to 25.88% in 1991 to reach a peak of 31.66% in 1992, which is the year in which Algeria experienced the highest level of inflation since independence
After the oil shock in 1986, the structure of the Algerian economy worsened considerably due to socio-political and economic instabilities. During the black decade the real value of the Algerian dinar was devalued which led to a galloping hyperinflation rate of 25.88%, the highest inflation rate since independence.
This can be expressed by the fall in the price of oil, the first source of external revenue of the country and the sharp devaluation of the Algerian dinar, and the transition of Algeria to a market economy and price liberalization.

- ▪ **The period from 1996 to 2001:**

During this period, we explain the decreasing rhythm of the inflation rate which went from 18.66% in 1992 to 0.33% in 2000 forming the lowest rate of inflation in Algeria. This decrease can be justified by the effectiveness of the monetary policy employed during this period in order to limit the development of inflation and control price stability.

**Fig.3.** Public debt ratio to GDP in Algeria.
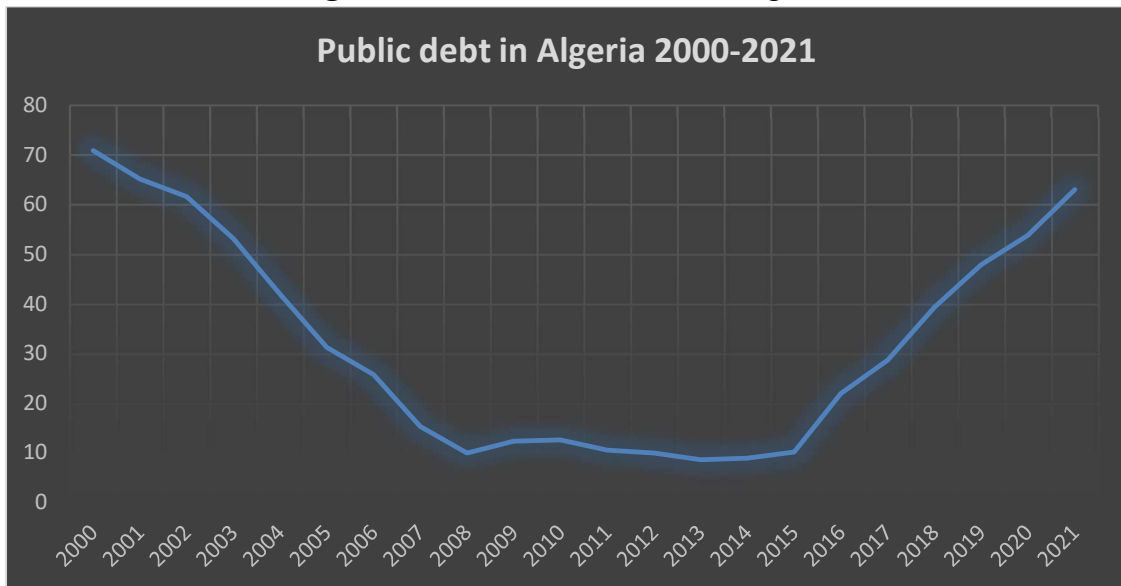
▪ **The period 2003-2013:**

During the period 2003-2013 Algeria experienced a growth in inflation which is due to the increase in wages which disrupted the inflationary spiral circle by causing an increase in the cost of production of goods and services. Other factors express the soaring increase in the general price level during 2012, mainly due to food inflation enriched by the growth of public spending and an increase in the money supply in circulation in the economy.

▪ **The period 2013-2022:**

Inflation at an overall increasing rate, since it is endogenous in nature, imports of goods disrupt price stability, also monetary expansion it may be effective in the short term but will cause inflationary pressures in the long term because of the excess liquidity through the growth of the M2 monetary aggregate of demand deposits and time deposits and cash in the economy.Figure (03) shows that there is globally there is a opposite tendance between the public debt and money broad, public debt limits money supply and bank credits.

Another important contribution is related to the growth of public debt in Algeria which is directly associated with an increase in the level of inflation, the public debt in Algeria is growing it will go from 83% of GDP in 2015 to 45.2% of GDP to 60.5% in 2022 as it is shown in figure 02.

Fig.4. Public debt and money supply evolution in Algeria.
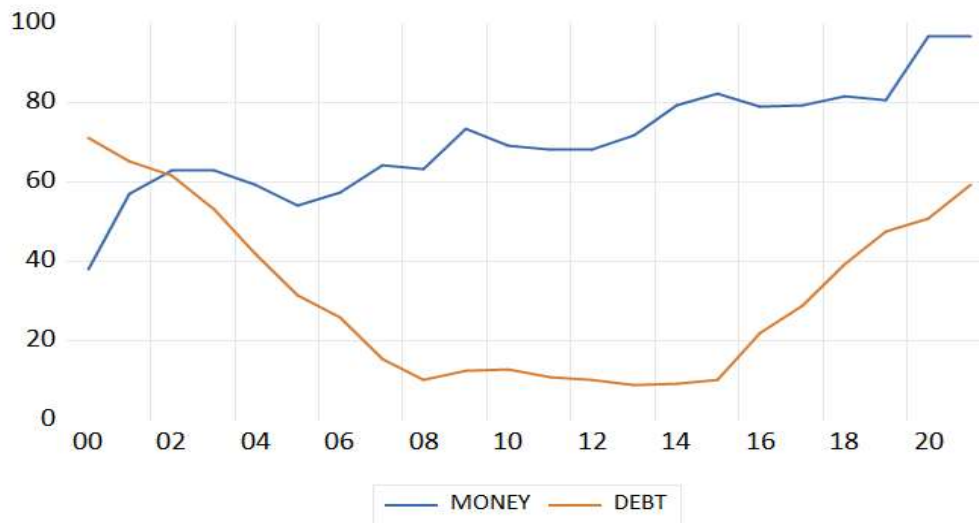
Source: (Authors' own elaboration, data provided from world of bank database)

3. Research methodology:

The aim of our research was to identify and analyse the short- and long-term effects, consequences and results of public debt on the Algerian economy based on conceptual framework selected from the previous discussed theories and models covering the period between 2000-2021.

The dependent variable in our models is represented by the real GDP per capita growth rate, used as a proxy for economic growth, while the exogenous variables framework is selected according to a review of a selected empirical studies discussing the question of public debt effects measured in our study by the general government debt as a percentage of GDP (Kumar and Woo 2010; Ndoricimpa 2020; Mencinger et al. 2014; Panizza et al., 2013; Chen et al., 2016; Cooray et al., 2016; Butkus and Seputiene, 2018; Ribeiro et al., 2012; Abd Rahman et al., 2019; Reinhart & Rogoff, 2010).

This investigation will be elaborated with advances econometric methods using an autoregressive distributed lag modelling [ARDL]. 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 inflation", "the investment" and "public expenditure".

The data on these variables were mainly obtained from the IMF's World Economic Outlook Database and World of Bank World Development Indicators (WDI) Database. A brief description of the variables and data sources is highlighted in Table 02.

Table N° 3. Variables and data description

Variable	Definition	Data source
Real GDP per capita growth (PIB)	GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.	WB
Public debt (DETTE)	Debt is the entire stock of direct government fixed-term contractual obligations to others outstanding on a particular date.	WB/IMF
Inflation (INF)	Inflation as measured by the annual growth rate of the GDP	WB
Investment (INVEST)	The involvement of capital in the production process.	WB
Public expenditure (DEP)	total general government expenditure, refers to local, regional and central governments.	WB

Source: Authors' own elaboration.

The econometric methodology is based on an AutoRegressive Distributed Lag model, to estimate and analyse the impact of public debt and other relevant variables on economic growth (real GDP) during the period 2000-2021:

PIB = F (DEP, DETTE, INF, INVEST).

4. Results:

4.1. Stationarity test:

The Unit Root Test allows not only to detect the existence of a non-stationarity but also to determine which non-stationarity it is (TS or DS process) and therefore the right method to station the series (Bourbonnais, 2018). There are three models used as a basis for the construction of these tests. The principle of the tests is simple: if the hypothesis H0: $\varphi 1 = 1$ is retained in one of these three models, then the process is non-stationary aligned in table 04.

Table **N° 4.** Unit Root Test

UNIT ROOT TEST RESULTS TABLE (ADF)						
Null Hypothesis: the variable has a unit root						
	At Level					
		DEP	DETTE	INF	INVEST	PIB
With Constant	t-Statistic	1.2710	-2.0404	-3.1046	-3.9558	-0.8896
	Prob.	**0.9975**	**0.2687**	**0.0424**	**0.0069**	**0.7700**
		n0	n0	**	***	n0
With Constant & Trend	t-Statistic	-0.2897	-3.0035	-3.6395	-3.5035	-4.6202
	Prob.	**0.9852**	**0.1543**	**0.0518**	**0.0649**	**0.0074**
		n0	n0	*	*	***
Without Constant & Trend	t-Statistic	2.1318	-2.0803	-0.0869	0.0403	-1.0326
	Prob.	**0.9893**	**0.0387**	**0.6407**	**0.6840**	**0.2612**
		n0	**	n0	n0	n0
	At First Difference					
		d(DEP)	d(DETTE)	d(INF)	d(INVEST)	d(PIB)
With Constant	t-Statistic	-3.7737	-6.9264	-4.7202	-6.9918	-7.5490
	Prob.	**0.0108**	**0.0000**	**0.0016**	**0.0000**	**0.0000**
		**	***	***	***	***
With Constant & Trend	t-Statistic	-4.3252	-6.8703	-4.2679	-7.0805	-7.4986
	Prob.	**0.0141**	**0.0001**	**0.0187**	**0.0001**	**0.0000**
		**	***	**	***	***
Without Constant & Trend	t-Statistic	-3.2908	-6.8435	-4.8195	-7.2352	-7.6773
	Prob.	**0.0023**	**0.0000**	**0.0001**	**0.0000**	**0.0000**
		***	***	***	***	***

Source: Author's own elaboration (EViews 12)

At level, the critical probabilities are all greater than 0.05, we do not reject the H0 hypothesis; we can therefore conclude that the process has a unit root and is therefore not stationary.

At the first difference, the critical probabilities are all lower than 0.05, we reject the hypothesis H0; we can thus conclude that the process does not have a unit root and thus the variables are stationary.

4.2. Optimal ARDL Bound test:

The F-statistic value 5.034621 is evidently greater than the I(1)(0) critical value bound. Our analysis of this series indicates that we reject the null hypothesis that there is no equilibrating relationship. Moreover, since we have rejected the null and since we have not included a constant or trend in the cointegrating relationship, our exposition in the next section of this series indicates that we can use the t-Bounds Test critical values to determine which alternative emerges. In this particular case, the absolute value of the t-statistic is $|-1.433346|=1.433346$, and it is greater than the absolute value of either the I(0)(0) or I(1)(1) t-bound. Recall that this indicates that we should reject the t-Bounds test null hypothesis, and conclude that the cointegrating relationship is either of the usual kind, or is valid but degenerate.

Nevertheless, a look at the fit between the dependent variable and the equilibrating equation should lead us to believe that the relationship is indeed valid. The graph results are presented below.F statistic is significant and greater than p value of 0.05 and the bounds of I(0) and I(1). the model is globally significant.

The results show that C and TREND are statistically significant and less than the critical probability of 0.05.The F statistic is significant and above the p-value of 0.05 and the bounds of I(0) and I(1). The model is globally significant. There is therefore a long-term relationship between economic growth and the independent variables studied (investment, inflation, public debt, public spending).

Table **N° 4.** ARDL optimal bounds test

ARDL Long Run Form and Bounds Test
Dependent Variable: D(PIB)
Selected Model: ARDL(3, 1, 1, 1, 1)
Case 5: Unrestricted Constant and Unrestricted Trend
Date: 12/24/22   Time: 09:44
Sample: 2000 2021
Included observations: 19

Conditional Error Correction Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	110.6362	33.75466	3.277656	0.0169
@TREND	-0.493215	0.198200	-2.488468	0.0473
PIB(-1)*	-1.210902	0.844808	-1.433346	0.2017
INVEST(-1)	-9.712197	3.208558	-3.026966	0.0232
INF(-1)	0.295418	0.402307	0.734309	0.4905
DETTE(-1)	-0.699409	0.406259	-1.721583	0.1359
DEP(-1)	-0.825632	0.361473	-2.284074	0.0624
D(PIB(-1))	-0.828447	0.724954	-1.142759	0.2967
D(PIB(-2))	-0.243471	0.378790	-0.642759	0.5441
D(INVEST)	-4.906296	2.455662	-1.997953	0.0927
D(INF)	0.322809	0.258147	1.250486	0.2577
D(DETTE)	-0.095006	0.222449	-0.427092	0.6842
D(DEP)	0.260097	0.471011	0.552209	0.6008

* p-value incompatible with t-Bounds distribution.

Levels Equation Case 5: Unrestricted Constant and Unrestricted Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
INVEST	-8.020629	5.276329	-1.520115	0.1793
INF	0.243965	0.393912	0.619339	0.5585
DETTE	-0.577593	0.656742	-0.879483	0.4130
DEP	-0.681832	0.374631	-1.820012	0.1186

EC = PIB - (-8.0206*INVEST + 0.2440*INF -0.5776*DETTE -0.6818*DEP)

Source: Author's own elaboration (EViews12)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
		Asymptotic: n=1000		
F-statistic	5.034621	10%	3.03	4.06
k	4	5%	3.47	4.57
		2.5%	3.89	5.07
		1%	4.4	5.72
Actual Sample Size	19	Finite Sample: n=35		
		10%	3.374	4.512
		5%	4.036	5.304
		1%	5.604	7.172
		Finite Sample: n=30		
		10%	3.43	4.624
		5%	4.154	5.54
		1%	5.856	7.578

| t-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-1.433346	10%	-3.13	-4.04
		5%	-3.41	-4.36
		2.5%	-3.65	-4.62
		1%	-3.96	-4.96

Source: authors' own elaboration(EViews12)

4.3. Diagnostic tests:

CUSUM tests are a simple graphical examination of the evolution of the model's coefficients - along with their confidence intervals at ± two standard deviations - to possibly identify structural changes. Based on the dynamics of the forecast error. Allows the detection of structural instabilities of the regression equations over time (Bourbonnais, 2018).

-TEST CUSUM

Figure 1. Cusum Test
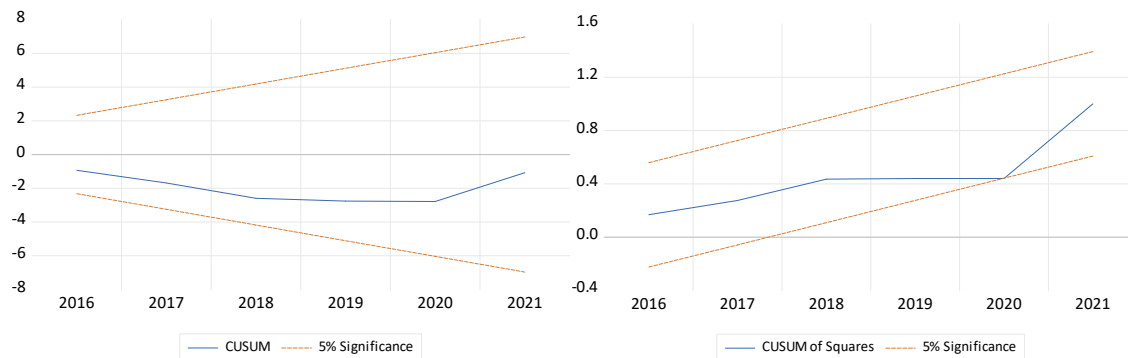
Source: authors' own elaboration(EViews12)

The model is assumed to be stable, the coefficients are stable over time, since the recursive residuals remained in the interval defined by the two lines: [K,±α √n - K] and [n,± 3α √n - K] for 1%, 5%, and 10% confidence levels, respectively.

-CUSUM SQ TEST :
The CUSUM SQ statistic is given by the square of the recursive residual, allows to detect random (punctual) changes in the behavior of the model. The coefficients are stable over time, as the square recursive residuals stayed in the defined interval (Bourbonnais, 2018).

5. Long- and short-term effects and discussion of results:

- The error correction term, is represented as **CointEq(-1)**, the coefficient is negative with an associated coefficient estimate of -1.210902. Moreover, given the very large t-statistic, namely -1.210902, we can also conclude that the coefficient is highly significant as the p value is less than 0.05. C and TREND are statistically significant and below the critical probability of 0.05.

- R-squared and Adjust r-squared are measured the in-sample success of the regression equation in forecasting the dependent variable. Used to determine "goodness of fit. Our model is fit at 91.43 % level with an adjusted r-squared of 84.57% level. The tests for serial correlation in the error term of the regression demonstrate an acceptable level of 1.46.

- We test, at a threshold of 5%, the hypothesis H0: a1 = 0 against the hypothesis H1: a1 > 0 or a1 < 0 depending on whether the estimated coefficient is positive or negative, we retain the following results:

- There is a negative relationship between economic growth and investment (INVEST), the investment variable is significant at the 05% threshold and contributes to the explanation of the dependent variable of economic growth.

- There is a positive relationship between economic growth and inflation (INF), the inflation variable is significant at the 05% level and contributes to the explanation of the dependent variable of economic growth.

- There is a negative relationship between economic growth and public debt, the public debt variable (DEBT) is not significant at the 05% level and does not contribute to the explanation of the economic growth dependent variable.

- There is a positive relationship between economic growth and public spending, the public spending variable (PSE) is not significant at the 05% level and does not contribute to the explanation of the economic growth dependent variable.

- The probability (F-statistic) is significant, the model is globally significant. Moreover, the coefficient of determination R^2 has an explanatory power of 91%, the model is fit

ARDL Error Correction Regression
Dependent Variable: D(PIB)
Selected Model: ARDL(3, 1, 1, 1, 1)
Case 5: Unrestricted Constant and Unrestricted Trend
Date: 12/24/22   Time: 09:44
Sample: 2000 2021
Included observations: 19

ECM Regression
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	110.6362	16.97778	6.516527	0.0006
@TREND	-0.493215	0.081504	-6.051386	0.0009
D(PIB(-1))	-0.828447	0.172120	-4.813190	0.0030
D(PIB(-2))	-0.243471	0.190182	-1.280196	0.2477
D(INVEST)	-4.906296	1.549400	-3.166578	0.0194
D(INF)	0.322809	0.118291	2.728945	0.0342
D(DETTE)	-0.095006	0.124478	-0.763236	0.4743
D(DEP)	0.260097	0.199970	1.300681	0.2411
CointEq(-1)*	-1.210902	0.186946	-6.477282	0.0006

R-squared	0.914318	Mean dependent var		-0.110526
Adjusted R-squared	0.845773	S.D. dependent var		2.950121
S.E. of regression	1.158565	Akaike info criterion		3.437756
Sum squared resid	13.42273	Schwarz criterion		3.885122
Log likelihood	-23.65868	Hannan-Quinn criter.		3.513468
F-statistic	13.33887	Durbin-Watson stat		1.462511
Prob(F-statistic)	0.000207			

* p-value incompatible with t-Bounds distribution.

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	5.034621	10%	3.03	4.06
k	4	5%	3.47	4.57
		2.5%	3.89	5.07
		1%	4.4	5.72

t-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-6.477282	10%	-3.13	-4.04
		5%	-3.41	-4.36
		2.5%	-3.65	-4.62
		1%	-3.96	-4.96

Source: authors' own elaboration (EViews12)

6. Conclusion:

In the recent years, the Algerian economy is facing an increase in public debt levels, similar to other countries with same or different economic structure and characteristics. Economists and policy makers started to put a focus on designing an optimal fiscal policy level that guaranty an efficient volume of public debt. Regardless the literature review which is in rise discussing the relationship between public debt and economic growth, shows that there could be a linear positive or negative effect or a non-linear relationship between both variables. In this paper we aim to in particular discuss the impact of public debt on aggerate macroeconomic variables (Economic growth, Inflation, Investment) with moderating variable of government expenditures focusing on the case of the Algerian economy during the period between 2000-2021.

Where the aim of this research was to examine the effects of public debt on the Algerian economy focusing on its consequences and result on inflation, investment and economic growth mainly. Although this issue was mainly debated in the post-war era, leading to a variety of theoretical models involving the long-term effects of public debt, as well as the short-term effects, the debate about this subject. The paper focused on testing the theorical models of debt effects on interest rates and inflation (Pigou effect), on investment (Kaldor effect) and on economic growth (Wealth effect).

At this level, the methodology used the most recent advanced econometrics methods, focusing on the relationship between the selected variables with data gathered from the world of bank and international monetary fund. The core finding of this research demonstrate that public debt generates adverse effects on investment and on economic growth. Hence public debt doesn't generate negative effect on inflation rate in Algeria.

We utilized several econometric methodologies related to ARDL (autoregressive distributed lag models), Bounds test, Error correction model using the methodology proposed by researchers discussed already in the methodology section.

In the study, we conducted tests in order to justify the use of the methodology selected, as well as tests for determining the stationarity of the series implied. In addition, we tested for cointegration between the principal variables, economic growth and public debt, inflation, investment, public expenditures, and the results obtained are in line with the findings of the empirical studies mentioned in this paper.

Our empirical results, show that an increase in the public debt-to-GDP rate leads to a decrease in the real GDP per capita growth rate in Algeria, both in the short and long term. Specifically, the estimated public debt coefficients appear statistically not significant and negative.

On the whole, the findings of our empirical investigation confirm the conclusions of some previous empirical studies which focused on evaluating the impact of public debt on economic growth, both in the short and long term.

Moreover, public debt is associated with short- and long-term effects on investment by negatively affecting capital stock accumulation and economic growth via causing the heightened long-term interest rates which discourages, higher distortionary tax rates and inflation in short term by placing constrains for the future generation with generating as the government is in commitment of repayment of high public expenditures by taxation as demonstrated on the results where high public debt is associated with high government

spending. This can place future restraints on countercyclical fiscal policies that will be needed to fight the next recession.

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