PUBLIC EXTERNAL DEBT AND ECONOMIC GROWTH IN TUNISIA

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ABSTRACT

The relationship between public external debt and the economic growth of a country is still a subject of significant interest and controversy for researchers.

This article focuses on the issue of the effect of the management of the external debt of developing countries on macroeconomic aggregates. The objective is to conduct an in-depth study of the issue of foreign debt carried out by Tunisia and to know its effects on the economy, notably economic growth in long-term. Using a simple methodological approach, VAR techniques were used to reach the aim of the study over the period 2000-2019.

Keywords: External public debt, VAR, economic growth, Tunisia.

INTRODUCTION

The sound functioning of an economy relies on public finances. The state must have its own financing resources necessary to cover its financing needs. In case of a financial imbalance, recourse to external debt to fill the deficit is the right solution for the State. Indebtedness is an international phenomenon found in all countries; therefore, the inevitability of public debt is recognized accordingly.

Borrowing is one of the fundamental components of modern public finances. It is considered a temporary and also convoluted resource.

Indeed, this variable is firmly related to the budget deficit. To fulfill its missions, the State incurs expenses, collects taxes, borrows, accumulates and manages a more or less considerable debt.

Economies that are at an initial phase of development have a limited stock of capital and usually bid more fruitful investment opportunities than mature economies. This menace these countries with debt.

Indeed, like all other economic factors, it is undeniable that indebtedness has affected the economic growth of countries. However, the question is to know how this variable influences the growth rate especially in Tunisia's case. Theoretically, public debt should allow a country to invest capital beyond its financial possibilities by borrowing surplus capital (Klein 1994). In essence, in general, debt is supposed to generate growth, development and investment.

In 1863, the local government, struggling with serious financial difficulties, succumbed to the fatal seduction of external borrowing. What led to the submission of the state to the colonial powers?

Thus, Tunisia's first foreign loan marks the beginning of a tragic turning point in the country's history: that of colonization and underdevelopment.

In 1957, at the beginning of the postcolonial period, the debt reappeared in the form of loans granted by the former French metropolis to the Tunisian government to enable it to purchase agricultural land, acquired under colonial influence by French settlers.

After the 2011 revolution, which failed to profoundly challenge Tunisia's economic and social structures, the taps of external financing were opened wide by foreign powers, pushing post-revolutionary governments to take out a record number of loans.

In recent decades, the external debt of developing countries has reached multiple levels, making the study of the role of external indebtedness in financing development a critical and still topical research topic. Indeed, like all the other economic variables, it is undeniable that indebtedness affects the economic growth of countries. However, the question is how this variable acts on the growth rate.

In this regard, this work quantitatively examines the effects of external financing on economic activity, answering the following question: What is the impact of debt and external financing on economic growth in Tunisia?

This article is in line with recent empirical work on the financing resources of the

Tunisian economy in the face of the current global situation. Eventually the purpose of this paper is to study the effect of public external debt on economic growth in Tunisia.

The approach adopted in this work is the deductive method. Hence, the work is articulated around four sections. From the data collected, we use an econometric

Stylized facts on external debt and economic growth in Tunisia

Public debt, which represents the total financial commitments of the central government and national public organizations with the guarantee of the state, comes by borrowing from both external and domestic partners.

Table 1: Evolution of the main parameters of the external debt in MDT

	2000	**2002**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Outstanding Debt	13854	16331	19408	20373	19683	19728	21301	21977	23582
Debt Rate as % of GNP	52.3	49.4	49.6	48.9	43	39.7	38.9	37.3	37.3
Debt Rate as % of GDP	52	49.6	50	48.7	43	39.6	38.6	37.5	37.4
Debt Service	2536	2294	2662	2716	3881	3334	2621	3184	3269

Source: BCT

method based on the time series analysis using EVIEWS software to analyze the link between public external debt and economic growth in Tunisia.

We used in the first place the descriptive method; it is to describe the evolution of public external debt and economic growth in Tunisia by analyzing data collected from national and international agencies during the period 2000-2019. The second part consists of a review of theoretical and empirical work on the relationship between external debt and economic activity. The third part presents our model's identification (linear model) and the methodology we adopted: VAR techniques. Finally, the fourth part contains the regression tests and the empirical results obtained.

In 2000, the evolution of the main currencies of indebtedness on the international exchange markets. On this hand, the US dollar and the Japanese yen. On the other hand, and the variations in net capital flows in the form of medium and long-term borrowing, on the other, modified the structure of Tunisia's debt.

This improvement of the indicators of Tunisian debt is the result of a development strategy on the economy focused on the evolution of economic growth as well as the trade balance.

Between 1990 and 2004, the external debt decreased by about 38% of the total volume of debt; this is due to the change in state orientations toward the privatization of some public enterprises and the opening of their capital to foreign investors. Indeed, between 2000 and 2004, the external debt rate rose from 51.7% to 54.2%. However, this rate has declined since 2005 to stick out

42.8% in 2008. On the other hand, the considerable increase in the external debt rate hardly translates into a dominance of external debt in the total Tunisian public debt.

In addition, the external debt composition, particularly the outstanding debt, is broken down by interest rate band. In 2004 the outstanding variable rate debt fell by 4.3% compared to 2003. On the other hand, in the same year, the share of the total debt contracted at fixed rates increased by 4.4% compared to 2003.

In terms of public finances, the real estate crisis in the United States of America led to a revision of the initial balances and the adoption of a supplementary budget law for the 2007 fiscal year in order to achieve an additional need for subsidies for basic consumer products. As a result, the execution of the 2007 State budget resulted in a budget deficit, excluding privatization and grants, of 3% of GDP, while the outstanding public debt was reduced from 53.9% in 2006 to 50.9% in 2007, despite the increase in the price of the main currencies, especially the euro, which accounted for 59% of the external debt in 2007.

On another level, in 2007, national savings experienced a deceleration in its expansion rate, which was limited to 12.3% compared to 16% in 2006. Nevertheless, this aggregate did not decline, as in 2003, savings were around 9.9%. This recovery, which reflects the slight decrease in the marginal propensity to consume, is attributable to strengthening economic activity. Thus, in 2007, the savings rate as a percentage of gross national disposable income improved slightly to 22.5% from 23.1% in 2006. As for investments, they
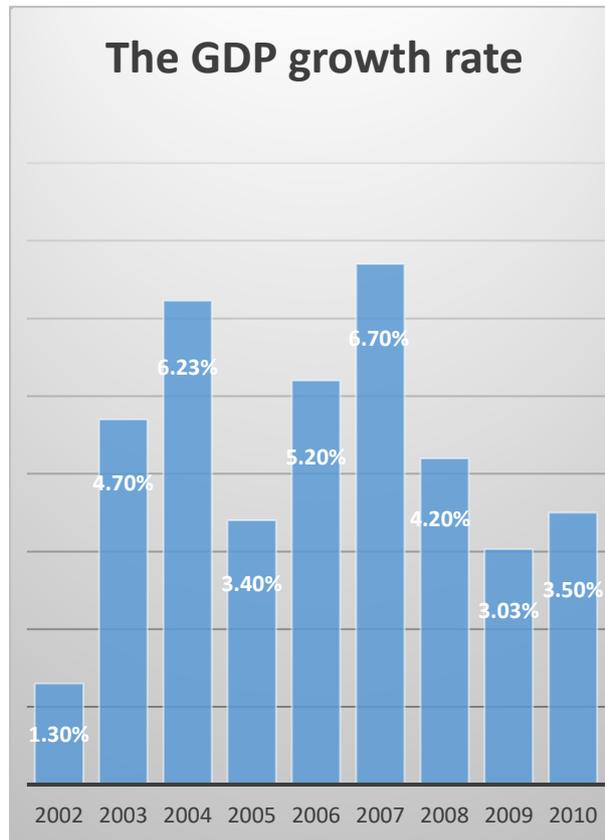
increased in 2007 but at a lower rate than in previous years. In current terms, gross fixed capital formation grew by 12.7% compared with 15.3% in 2006. The shortfall in investment income directly influences the inflow of resources to service the government's debt. In the same year, the increase in transfers made by oil companies as immediate investment income worsened the overall trade deficit, which reached 13.1%.

Net foreign exchange assets in 2007 showed a deceleration; they were around 141 days of imports compared to 157 days in 2006. However, this decline is not very significant, as in 2005 and 2004; assets recorded 124 and 107 days of imports, respectively. As a result, in 2007, the total debt to GDP ratio at current prices fell from 123.6% in 2006 to 119.7%. This regression is justified by a more critical variation in value-added than in debt. Nevertheless, between 2005 and 2004, the rate fell from 141.6% to 136.5%. The evolution of economic growth explains this decrease at a higher rate than that of external debt. In the same year, the external debt's stock increased slightly in 2007 because of the euro's appreciation. In 2007, the gross external debt position fell by 2% compared to 2006. While in 2005, it increased by 4.2% compared to 2004. As for the commitments of Tunisia, in 2007, they represented 54.8% of the RNDB and 54.7% of the GDP, against 66.9% of the RNDB and 66.5% of the GDP in 2006.

The public debt began to decline gradually from 2002 until 2010. The debt to GDP rate during this time interval was around 47.81%.

Tunisia recognized an acceleration of its GDP from 2003, which reached 4.7% against 1.3% in 2002, and it continued to improve until 2007 with a rate of 6.7% before starting to deteriorate again.

Figure1: The GDP growth rate

The GDP growth rate

Year	Rate
2002	1.30%
2003	4.70%
2004	6.23%
2005	3.40%
2006	5.20%
2007	6.70%
2008	4.20%
2009	3.03%
2010	3.50%

Source: made by authors

The 2008 financial crisis also affected Tunisia by lowering FDI by 29%, which explains the decline in GDP from that date. On the other hand, the euro zone crisis has heavy consequences on the industrial sector.

MENA countries have lived through several economic shocks following the "Arab Spring". Starting in January 2011, a series of revolutions began to blow out in the MENA region, the first of which was in Tunisia.

Among the objectives of this revolution; dignity, freedom, work and equality between regions, the government, and increased recruitment and salaries in the public sector, so there was an increase in public spending. But unfortunately, this has worsened the budgetary situation of the country.

In 2011, the transitional government, unelected, took a loan for 250 million dollars, and 168.3 million euros was granted by the IBRD belonging to the group of the World Bank (Report No. 61627-TN, 2011). This 40-year loan was granted to visibly improve transparency and accountability, meet the population's aspirations, and send a message to investors that Tunisia is establishing a level playing field for private sector-driven growth.

The report published by the BCT specifies on page 10, that in 2011 internal debts were 58.612 billion TND that external debts were 23.768 billion TND and this was without the BCT accounting for short-term external debts. Thus the BCT indicates that the total debt of Tunisia is 82.380 billion TND or 136% of the GDP. To the extent that the short-term debt should be accounted for, the total debt of Tunisia amounted to more than 129% of the GDP in 2010.

To illustrate the state of bankruptcy in which the country finds itself, the graph below shows the cumulative domestic and external debt levels of Tunisia for 2010 and 2011.

Figure2: Domestic and external debt as a % of GDP in 2010 and 2011
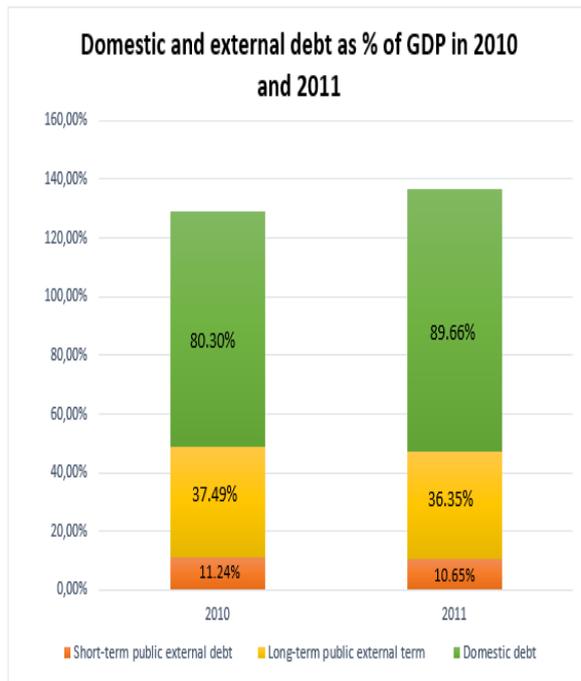
Source: The external debt of Tunisia 1970 – 2011. Part I. Nawaat

Thus the total debt of Tunisia has increased from 129.03% of the GDP in 2010 to 136.67% of the GDP in 2011. Considering the current political instability and the economic anemia that is again massively affecting the country, the anarchic default of the payment of external debt becomes inevitable. It is no longer a matter of years, but of a few months.

In 2012, Tunisia is more than ever sucked into the debt spiral. The excessively serious economic situation, combined with a deep social and political crisis, is leading the country directly towards an anarchic default whose real consequences for the Tunisian people are still difficult to measure.

The public debt continues to grow. It reached over 60% of the GDP in 2016. This debt is notably reflected in loans granted by international organizations, including the IMF, under favorable conditions (long maturities and reduced interest rates). Although it is considered sustainable by the IMF, this debt, generally denominated in foreign currencies, is still a burden to be controlled, practically in the current context of Tunisia, which is characterized by a decrease in the value of the dinar, which raises the cost debt (being subject to an unfavorable exchange rate risk).

In 2015, the Government agreed with the union to follow a calendar of wage increases, resulting in a wage bill that went from 10.7% to 14.6% from 2010 to 2016.

To finance its deficits, Tunisia has relied on official resources. Indeed, thanks to the Japanese and American guarantees of 2014, the Government launched a Euro bond in 2015, which allowed it to collect 1 billion dollars. In 2016, Tunisia has collected more than 320 million dollars from the IMF, 420 million dollars from the European Union, and 500 million dollars from the ADB.

Despite various attempts by the Government and Tunisian Central Bank, the situation has not been able to improve, but on the contrary, it has worsened further. Indeed, the exchange rate depreciation reached 3.42 and 2.99 respectively euro/dinar and dollar/dinar in 2018.

The major cause of the accumulation of public debt in Tunisia is the budget deficit. Indeed, mathematically speaking, the debt at date t is equal to the debt at date t-1 plus the budget balance. By definition, this balance represents the difference between the revenues and expenditures of the State, if it is positive then the State has generated a primary surplus and consequently the debt decreases, otherwise, the debt will increase.

REVIEW OF LITERATURE

Theoretical underpinning

According to Adam Smith (1881) and the other authors of the neoclassical school, David Ricardo and John Stuart Mill, state intervention in economic activity must be limited. Smith defends the principle of the natural order; the economy balances automatically and without the intervention of the state.

This is thanks to market forces that systematically resolve imbalances. In fact, from his analysis of public financing resources, it appears his strong criticism of the solution of indebtedness. Public debt reinforces the dependence of nations on the outside world, which leads to a flight of capital abroad and a reduction in the savings available to finance the economy. As a result, public debt is detrimental to economic growth.

In some cases, states must boost their economy by increasing public spending or reducing taxes, according to Keynesian conceptions. According to Keynes, in the event of a crisis, the public deficit is a solution to accelerate the recovery of the country's economy. However, examining the theory on foreign debt and economic growth, Keynesians reason that public indebtedness creates no benefit for either present or future generations.

State debt has always been an essential element in the history of States. Public debt is such an old issue that it is difficult to situate it historically without fail and with precision;

In contrast to the Keynesian view, which prioritizes public spending, the Barro-Ricardian theory of the classics considers debt as a future tax that disfavors capital accumulation and consumption by present and future generations.

The zero effect of public spending financed by debt is often called Ricardian equivalence.

EMPIRICAL EVIDENCE

Since the debt crisis of the 1980s, several models have evaluated the relationship between public external debt and economic growth, showing the existence of positive or negative effects of debt on growth. (Raffinot and Gürbüz, 2001 is one of the research satisfied with linear estimation. His study was conducted in 2001 on the Turkish case from 1963 to 2000, starting from two sub-periods (identified as interrupted in 1984). The author explores the link between Turkey's public debt and economic growth to show the effectiveness of the country's recourse to domestic debt to replace part of its external public debt. They concluded that external debt positively affected private investment and growth, while domestic debt had a crowding-out effect.

El-Mahdy and Torayeh (2009) conducted an empirical analysis on Egypt's debt sustainability and economic growth. Their study covers a period from 1981 to 2006. To explain the effects of domestic public debt on economic growth, the authors use an econometric model of growth. Therefore, they use stationarity tests, Johansen's Co-integration tests and the error correction model to estimate the impact of domestic public debt on short and long-term growth. They show a negative

impact of debt on economic growth in Egypt.

Emmanuel (2012) analyzed the long-term relationship and impact of debt in his paper "Empirical Analysis of the Impact of Public Debt on Economic Growth: The Case of Nigeria", and analyzed the long-term relationship and impact of debt in Nigeria over 1975 to 2005. It has integrated the two forms of debt: external debt and domestic debt. In this estimation of the Nigerian case, the author used a Cobb-Douglas model developed by applying the co-integration technique. The main result found by the analysis of the regressions is the negative proportional impact of long-term debt on the growth of the Nigerian economy. Both the external debt ratio and the domestic debt ratio hurt the growth.

Patillo *et al.* (2002), in their study "External Dept and Growth," by analyzing sample data from 93 developing countries from 1969 to 1998, solidly confirmed the relationship between external debt stock and economic growth. They estimated the debt threshold based on an empirical study, beyond which public debt can cause a negative impact on economic performance. Furthermore, these authors attempt to answer questions about the transmission channels of the effects of external debt on long-term economic growth.

The methodology adopted by Patillo *et al.* to estimate all the specified dynamic panel models (linear, quadratic, and spline) is the fixed effects method and the generalized system method of moments (SGMM).
While in most traditional theories, it is generally accepted that the impact of external debt on economic growth remains positive up to a certain threshold where its

impact becomes negative. Therefore, a non-linear approach must be applied.

The main result of the work of Patillo, Ricci, and Poirson (2004), based on a nonlinear analysis, is that when debt exceeds 35% to 40% of GDP and 160% to 170% of exports, the effect of external debt on GDP per capita growth starts to be negative.

Mencinger, *et al*. (2014) examined and assessed the forthright effect of great public debt levels on economic growth in European countries currently at the epicenter of the sovereign debt crisis. They studied the transmission mechanisms of the short-term impact of public debt on development through an empirical analysis including panel data from 25 EU countries. This sample is divided into two subgroups by distinguishing between the old member countries covering the period from 1980 to 2010 and the sub-sample of new member countries over 15 (1995 to 2010).

The main result of Mencinger *et al*. is that the influence of public debt ratios on the economic growth rate of GDP per capita is nonlinear and statically significant for the subgroups of countries in the sample. The coefficient of the quadratic variable "Debt/GDP" is negative, which shows the concave relationship (inverted U) between public debt and economic growth. However, the positive effect of debt on economic growth becomes negative when it crosses the threshold of 80% to 94% for the new European Union countries. In addition, the threshold effect is different for the new EU countries. It is estimated by econometric models to be between 53% and 54%. Therefore, the value of the threshold of public debt is lower in the new countries

than in the old countries of the European Union.

In their empirical study, Chercherita and Rother (2012) evolve a theoretical model in which they show that in a business cycle, the government can issue debt only to subsidize and sponsor public investment and that the optimal level of public debt is determined by the ratio of public and private capital that increase economic growth. The debt function that increase economic growth is a function of the capital stocks output elasticity. From the estimation of the optimal debt ratio for the different sub-samples of the OECD countries (Australia, Italy, Belgium, Portugal, Germany, Finland, France, Greece, Luxembourg, the Netherlands, Spain and Ireland), Chercherita *et al.* find percentages that range from 43 to 63% of GDP.

The principal result concluded by these authors is that the impact of public debt on economic growth is non-linear with a threshold debt/GDP ratio. When this threshold exceeds 90% or 100% the debt will have a disastrous impact on long-term growth.

This effect starts to be negative at levels of 70% and 80% of GDP, which calls for a prudent debt policy. At the parallel, Checherita *et al.* highlight the negative and linear correlation between the public debt ratio and the ratio of the public deficit to GDP.

In their book "This Time is Different" which was accompanied by a recent paper in 2009 Reinhart and Rogoff analyze the impact of public debt's diverse levels on real GDP growth in the long run. They consider a sample of 20 developed and 24 emerging countries during 200 years. The authors show that the consequences of a deep crisis lead to a prolonged period of macroeconomic adjustment, particularly in housing prices and employment. Thus, the public debt rises to more than 80% in three years after a crisis. Payment defaults and bankruptcies that occur cause a prolonged slowdown in economic growth and incur very large costs (Reinhart and Rogoff, 2009).

The main result of their investigation is that although the relative relationship between public debt and GDP is low in normal levels of debt, there is a statistical correlation between these two variables; namely, inferior a threshold of 90% of GDP, the debt has both positive and small impact on GDP growth in the long turn. However, the effect of a debt of more than 90% is negative and significant, the median growth rate falls by 1% and the average falls further. This conclusion concerns both developed and developing countries. However, when external debt crosses the threshold of 60% of GDP, economic growth falls by 2%. If it reaches a higher level, the growth rate decreases by about half.

Kumar and Woo (2010) confirm such a result, these authors find a non-linear relationship between the initial level of public debt and the evolution of GDP based on a panel comprising 38 developed and emerging countries in a 38-year period from 1970 to 2007. Kumar and Woo (2010) identify several transmission channels through which a great level of debt can negatively affect the economy growth. They include in their model the high level of the long-term interest rate, the high level of future tax distortion, high inflation and high vulnerability to crisis.

EMPIRICAL STRATEGY

Econometric specification

Our method is based on econometric modeling using a multiple linear models. Indeed, the development of macroeconomic models relies on the interaction between economic agents and public authorities (Greene, 2011); in this case, the public policy oriented toward external debt financing.

We apply the estimation and analysis of the econometric model in order to confirm or reject this policy with scientific justifications.

This model is estimated by the EVIEWS software from the collected data.

Our study is based on an article entitled "The public external debt and its impact on Moroccan economic growth" by Es-Sounboula and Hefnaoui published in 2019, the selection of this article is based on its clear methods of analysis and by the fact that our study will be carried out by a single country (the article presented the case of a single country: Morocco).

The model refers essentially to the model of Rubio Mendoza *et al.* (2003) and that of Patillo (2002). The first reason for choosing the Mendoza model is that this model concerns a study carried out on a single country and also because it has empirically demonstrated the existence of a link between economic growth and external debt. The Patillo model was chosen because of its efficiency (this model has been the basic reference for several studies in this area, its linearity and above all its reliability because it is recognized and supported by the IMF. Moreover, this model combines the Keynesian theory of the impact of debt on growth and the classical theory of equivalence.

The idea of using VAR models for economic analysis and forecasting was put forward by Sims (1980). It was based on the observation that the restrictions imposed a priori on the structural forms of traditional macroeconomic models are not justified and must be questioned.

Indeed, in a correctly specified general equilibrium model, each variable depends a priori on all the other variables in the equation. This general idea naturally leads to the use of VAR models. VAR models have been very successful because of their simplicity of estimation. And their predictive power, given that these VAR models have proven an excellent predictive quality compared to other models (Salah Eddine *et al.*, 2018).

VAR models have three advantages: first, they make it possible to explain a variable about its lags according to the information contained in other relevant variables, which raises problems of co-integration. Secondly, a very large information space is available and finally, this method is quite simple to implement and includes estimation procedures and tests.

Data

Concerning the models selected, and after having made some modifications to these two models to obey the concern of data availability and the orientation of the study, which highlights the specificities of Tunisia, we have chosen a dependent variable, "the economic growth rate: GDP" as an indicator of economic activity and

four independent variables, namely service of external debt, gross national savings, the investment rate and the outstanding of public external debt.

Table:2 Identification of variables

Variables	Descriptions	Frequency temporally	Period	Proxy de calculus	Sources
TCE	Rate of growth Economic	Annual	2000-2019	Annual GDP growth rate	World Bank
TINV	Investment rate	Annual	2000-2019	Gross fixed capital formation (%GDP)	World Bank
ENB	Gross National Savings	Annual	2000-2019	Gross National Savings (in Logarithm)	MDICI Reports
SDE	Service of external debt	Annual	2000-2019	External debt service growth (%GDP)	World Bank
EDEP	Outstanding public external debt	Annual	2000-2019	outstanding public external debt (in Logarithm)	MDICI Reports

The model to be estimated

The VAR model with "5" variables and "p" lags in our study is written as follows:

$Y_t = C_0 + C_1 Y_{t-1} + C_2 Y_{t-2} + C_3 Y_{t-3} + C_4 Y_{t-4} + C_5 Y_{t-5} + v_t$

Y_{1t}: **Rate of** Growth Economic;

Y_{2t}: investment rate;

Y_{3t}: Gross National Saving;

Y_{4t}: Service of External debt;

Y_{5t}: Outstanding public external debt;

To model the link between growth and public external debt, we will estimate our model using the VAR method (because of the absence of long-term co-integration between variables), following its steps to identify the results and interpret them.

RESULTS

Baseline results: stationarity test and determination of the optimal number of lags

Unit root test (Dikkey-fuller): To test this property, we opted for the Augmented Dickey-Fuller test noted ADF, allowing to test the non-stationarity conditionally to the specification of a model used.

The test procedure starts by testing the unit root from the most general model, namely "model 3", and follows the steps of the ADF test until we obtain a series that is stationary.

Assumptions:

H0: Unit root (non-stationary)

H1: Non unit root (stationary)

We will apply the test on the variables and the results will appear in a summary table.

From the various Dickey-Fuller tests, we find that external debt service, gross national savings and the economic growth rate are stationary processes.

root test in the first difference, the investment rate and outstanding public external debt are integrated into order one because they have become stationary.

Variables	In level			In 1st difference
	Model (3) with constant and trend	**Model (2)** with constant	**Model (1)** without constant or trend	
TCE	The trend is not significant because (prob=0.0582>0,05)	The constant is significant (prob=0,0227<0.05), and we reject H0 of unit root unit, so the process is **stationary**		
TINV	The trend is not significant because (prob=0.1499>0,05)	The constant is not significant (prob=0.9304>0.05)	We accept H0 of unit root. The process is **not Stationary** (prob=0.0587>0.05)	The trend is not significant because (prob=0.6222>0,05), The constant is not significant also (Prob=0.1090>0.05). The series has become **stationary** in model (1) because (prob=0.0024<0.05).
ENB	The trend is not significant (prob=0.0717>0,05)	The constant is not Significant (prob=0.5417> 0.05)	We accept H1 as a non-unitary root, the process is **Stationary** (prob=0.0302<0.05)	
SDE	The trend is significant (prob=0.0086<0.05) and we accept H1 for non-unitary root because (prob=0.0088<0.05), the process is Stationary			
EDEP	The trend is not significant (prob=0,0814>0,05)	The constant is significant (prob=0,98>0.05) but the series is not stationary because (prob=1>0.05)	We accept H0 of unit root, the process is non stationary (prob=1>0.05)	The trend is significant (prob=0.0015<0.05) and we accept H1 for non-unitary root because (prob=0.0040<0.05), the process has become stationary

While for the other two variables, the trend and constant are not significant, and these series are not stationary; they need to be differentiated and tested for stationarity another time. According to the ADF unit

Therefore, a Co-integration test in the sense of Granger is unnecessary since all the variables are not integrated at the same level; the vector autoregressive method (VAR) will be our analysis method.

C(31)*D(EDEP(-1)) +
C(32)*D(EDEP(-2)) + C(33)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	61.57581	NA	8.86e-10	-6.655978	-6.410915	-6.631618
1	111.7696	64.95664*	5.35e-11	-9.619950	-8.149574	-9.473792
2	161.3258	34.98086	8.71e-12*	-12.50892*	-9.813228*	-12.24096*
*indicates lag order selected by the criterion						
LR sequential modified LR test statistic (each test at 5% level)						
PFE; Final prediction error						
AIC: Akaike information criterion						
SC : Schwarz information criterion						
HQ : Hannan-Quinn information criterion						

Determination of the optimal number of lags

The majority of the decision criteria chose p*=2 as the optimal number of delays

Estimation of the VAR model and interpretations

➢ TCE = C(1)*TCE(-1) + C(2)*TCE(-2) + C(3)*D(TINV(-1)) + C(4)*D(TINV(-2)) + C(5)*ENB(-1) + C(6)*ENB(-2) + C(7)*SDE(-1) + C(8)*SDE(-2) + C(9)*D(EDEP(-1)) + C(10)*D(EDEP(-2)) + C(11)

➢ D(TINV) = C(12)*TCE(-1) + C(13)*TCE(-2) + C(14)*D(TINV(-1)) + C(15)*D(TINV(-2)) + C(16)*ENB(-1) + C(17)*ENB(-2) + C(18)*SDE(-1) + C(19)*SDE(-2) + C(20)*D(EDEP(-1)) + C(21)*D(EDEP(-2)) + C(22)

➢ ENB = C(23)*TCE(-1) + C(24)*TCE(-2) + C(25)*D(TINV(-1)) + C(26)*D(TINV(-2)) + C(27)*ENB(-1) + C(28)*ENB(-2) + C(29)*SDE(-1) + C(30)*SDE(-2) +

➢ SDE = C(34)*TCE(-1) + C(35)*TCE(-2) + C(36)*D(TINV(-1)) + C(37)*D(TINV(-2)) + C(38)*ENB(-1) + C(39)*ENB(-2) + C(40)*SDE(-1) + C(41)*SDE(-2) + C(42)*D(EDEP(-1)) + C(43)*D(EDEP(-2)) + C(44)

➢ D(EDEP) = C(45)*TCE(-1) + C(46)*TCE(-2) + C(47)*D(TINV(-1)) + C(48)*D(TINV(-2)) + C(49)*ENB(-1) + C(50)*ENB(-2) + C(51)*SDE(-1) + C(52)*SDE(-2) + C(53)*D(EDEP(-1)) + C(54)*D(EDEP(-2)) + C(55)

Stand errors in () and t-statistics in []					
	TCE	**D(TINV)**	**ENB**	**SDE**	**D(EDEP)**
TCE (-1)	-0.765738 (0.63755) [-1.20106]	-0.006026 (0.00930) [-0.64770]	-0.011711 (0.01873) [-0.62520]	-0.073936 (0.10500) [0.70415	0.003294 (0.00772) [0.42651]
TCE (-2)	-0.056304 (0.31687) [0.17769]	0.006834 (0.00462) [1.47802]	0.001912 (0.00931) [0.20537]	-0.080325 (0.05219) [-1.53919]	-0.000566 (0.00384) [-0.14748]
D(TINV(-1))	-28.36767 (34.3626) [-1.98959]	-0.018378 (0.50141) [-0.03665]	-1.463818 (1.00956) [-1.44996]	0.967577 (5.65931) [0.17097]	-0.236478 (0.41620) [-0.56818]
D(TINV(-2))	-23.82874 (36.1403) [0.65934]	-0.358712 (0.52735) [-0.68022]	0.199297 (1.06179) [0.18770]	9.112252 (5.95208) [1.53094]	0.760939 (0.43774) [1.73835]
ENB (-1)	50.23626 (27.0115) [1.85981]	0.180662 (0.39414) [0.45836]	1.951688 (0.79358) [2.45933]	-4.068496 (4.44861) [-0.91455]	-0.619786 (0.32717) [-1.89257]
ENB (-2)	48.73453 (33.2688) [-1.46487]	-0.176826 (0.48545) [-0.36425]	-0.833688 (0.97742) [-0.85295]	4.680771 (5.47915) [0.85429]	0.229425 (0.40296) [0.56936]
SDE (-1)	-6.192055 (2.83051) [-2.18761]	-0.023647 (0.04130) [-0.57254]	-0.079818 (0.08316) [-0.95982]	-0.389999 (0.46617) [-0.83661]	-0.060791 (0.03428) [-1.77320]
SDE (-2)	-7.745371 (3.83204) [-2.02121]	0.032004 (0.05592) [-0.57236]	-0.114396 (0.11258) [-1.01610]	0.466405 (0.63111) [0.73902]	-0.007724 (0.04641) [-0.16642]
D(EDEP(-1))	-2.255225 (31.4504) [-0.07171]	0.227036 (0.45892) [0.49472]	0.348134 (0.92400) [0.37677]	4.767769 (5.17967) [0.92048]	-0.301724 (0.38093) [-0.79207]
D(EDEP(-2))	-2.799933 (24.4060) [1.63072]	0.029734 (0.35613) [0.08349]	1.247877 (0.71704) [1.74032]	2.239552 (4.01952) [0.55717]	-0.047551 (0.29561) [-0.16086]
C	50.98300 (25.6174) [1.99017]	0.165929 (0.37380 [0.44389]	0.479110 (0.75263) [0.63658]	2.173766 (4.21902) [0.51523]	0.763150 (0.31028) [2.45954]
R-squared	0.758878	0.409220	0.966132	0.615654	0.929567

TCE = - 0.765*TCE (-1) - 0.0563*TCE (-2) - 28.367*D (TINV (-1)) - 23.828*D (TINV (-2)) + 50.236*ENB (-1) + 48.734*ENB (-2) - 6.192*SDE (-1) - 7.745*SDE (-2) - 2.255*D (EDEP (-1)) -2.799933*D (EDEP (-2)) + 50.983.

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.765738	0.378761	-2.021692	0.0522
C(2)	-0.056304	0.188249	-0.299091	0.7669
C(3)	-28.36767	20.41445	-3.348984	0.0022
C(4)	-23.82874	21.47056	-1.109833	0.2759
C(5)	50.23626	16.04720	3.130531	0.0039
C(6)	48.73453	19.76459	-2.465749	0.0196
C(7)	-6.192055	1.681574	-3.682298	0.0009
C(8)	-7.745371	2.276572	-3.402207	0.0019
C(9)	-2.255225	18.68430	-0.120702	0.9047
C(10)	-2.799933	14.49935	2.744905	0.0101
C(11)	50.98300	15.21900	3.349958	0.0022

The growth rate and the investment rate:

The estimation results show that the investment rate significantly negatively impacts Tunisia's growth rate. An increase in the investment rate of - 28,367 leads to a decrease in the growth rate of the current year and - 23,828 for the next year. Indeed, it is possible to see this sign when the investments made are not useful to the population or simply a wrong use of these infrastructures can induce negative revenue flows and therefore financing for maintenance is quite costly and thus slow down the growth.

The growth rate and gross national savings:

This result is significant at the 5% level because the probability of its coefficient is less than 0.05. Changes in gross national savings positively affect the growth rate, i.e. an increase in gross national savings leads to an increase in the growth rate of 50.236. Theoretically, an increase in savings increases investment and economic growth (Solow). This is the same case for Tunisia.

The growth rate and service of external debt:

The external debt service negatively influences the growth rate, so when the external debt service increases by one point, the growth rate falls by 6.192. This result is significant at the 5% threshold.

But this result can be validated theoretically in terms of economic theory. Indeed, debt service refers to the amortization and interest payments made by the debtor due to loans taken out. Also, when resources from exports are insufficient to meet the repayment of loans contracted, the country accumulates payment arrears up to a specific period. Faced with the high amounts of arrears and the pressure of creditors in the long term, the government is obliged to go into debt to repay the old debts contracted, which increases the service of the external debt and slows down the growth of GDP.

The growth rate and the outstanding of public external debt:

This result is not significant at the 5% level. Changes in the outstanding public external debt have a negative effect on the growth rate, i.e. an increase in the outstanding

public external debt leads to a deterioration in the growth rate of 2.255. This result confirms the results of Patillo *et al.* (2002).

Robustness checks

- Presentation of stability of VAR model

Root	Modules
0.875031 – 0.267389i	0.914973
0.875031 + 0.267389i	0.914973
0.526907 – 0.611463i	0.807167
0.526907 + 0.611463i	0.807161
-0.804551	0.804551
-0.339422 – 0.726204i	0.801610
-0.339422 + 0.726204i	0.801610
-0.121213 – 0.615703i	0.627521
-0.121213 + 0.615703i	0.627521
-0.602205	0.602205
No root lies outside the unit circle. VAR satisfies the stability condition	

→ The roots in modulus are less than 1, therefore our VAR is well stationary and stable.

- Normality of the residuals

| Component	Jarque-Bera	df	Prob.
1	1.575929	2	0.4548
2	0.285322	2	0.8670
3	0.063233	2	0.9689
4	1.034519	2	0.5962
5	1.626359	2	0.4434
Joint	4.585361	10	0.9171

→ The probabilities of the Jarque-Bera test are more significant than 0.05. So we accept the null hypothesis of normality. The residuals have a normal distribution.

- Impulse response functions

The impulse response functions allow to trace the dynamics of a variable, following an impulse (shock) in another variable of the system. The latter's dynamics allow to simulate this response. Using the EVIEWS software, we will generate the graphs of the impulse response functions. To provide a graphical representation that is consistent with our study, we chose to focus on the responses of the economic growth rate following shocks to all other variables:

Figure 3: Accumulated Response of TCE to innovations using Cholesky factors
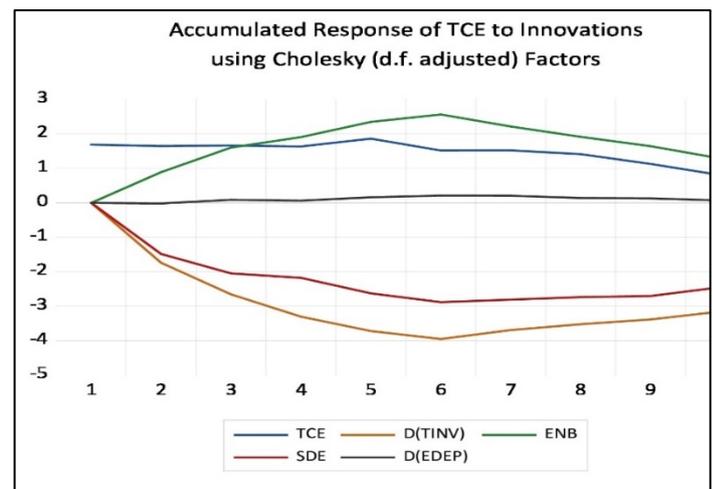
On the one hand, it can be seen that a shock to gross national savings has a positive effect on the growth rate from the following year onwards, but this effect gradually diminishes in the long run. On the other hand, shocks to the investment rate and external debt service have a negative effect on GDP. However, the public debt stock's effect is almost insignificant on the economic growth rate.

CONCLUSION

VAR processes are particularly useful for studying the impact of macroeconomic shocks and their transmission channels, which explains why many empirical works have used them to study the effect of economic policies.

VAR modeling allowed us to discover new aspects of econometrics and to deepen the study, by integrating new variables. We have highlighted a significant fact, namely, the existence of a causal relationship between economic growth and public external debt. After discovering it, we were able to confirm its validity, in particular thanks to the analysis of impulse response functions.

Finally, the VAR representation is still an essential reference when it comes to evaluating the performance of macro-econometric models. Thus, the VAR methodology has made an essential contribution to empirical research in macroeconomics and has become an essential reference in macroeconomic analysis and forecasting.

In this paper we used the VAR technique with a linear model during a period of 20 years (2000-2019) whose objective is to conduct an in-depth study of the problem of external public debt and to highlight its possible impact on the economy, particularly the economic growth in Tunisia in order to answer the main research question "what is the impact of external public debt on economic growth in Tunisia?

According to the results, there is a negative relationship between the outstanding debt and economic growth, reflecting a deceleration effect, which allows us to validate the **hypothesis that external debt has a negative effect on economic growth**. This hypothesis is verified by several

authors in certain underdeveloped countries benefiting from foreign debt. Savvides (1992) states that if a debtor country cannot meet its foreign debt, debt payments become dependent on the performance of the country's economy.

Thus, this increase in external debt increases taxation through debt services and discourages domestic capital formation that can improve investment. Our result is confirmed by Nguyen Clement and Bhattacharya in their paper "Can Debt Relief Boost Growth for the Poor?" who give a clear idea about the debt overhang hypothesis, i.e. 30 to 37% of GDP and 115 to 120% of exports; beyond this threshold, the external debt is a brake on economic growth. In addition to the point, the authors find that debt service has no effect on GDP but acts indirectly through public and private investment through crowding out.

In Tunisia the outstanding public debt as well as the external public debt services never cease to increase between 2010 and 2018 because of several economic, social and political factors which influence the economic growth negatively; it has depreciated from 3.51 in 2010 to 1.82 in 2017.

The economic situation is getting steadily worse in the face of the Covid-19 pandemic crisis on a global scale. The international financial institutions are planning budgetary support to "mitigate the impact of the pandemic", thus re-launching the spiral of indebtedness.

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