The Relationship between Government Expenditures and Revenues in Algeria During the Period (1990-2019): Granger Causality Approach

Abdelkader Sahed, Mohammed Mékidiche, Hacen Kahoui

Abstract — The aim of this study is to examine the causal relationship between government revenues and expenditures in Algeria during the period 1990 to 2019. Data properties were analyzed to determine their stationarity using the Dickey-Fuller (ADF) test, Phillips-Perron test and Kwiatkowski, Phillips, Schmidt, Shin (KPSS) test, as well as the Granger Causality Test (1969) of showing the direction. The results show that there is unidirectional causal relationship between government expenditure and revenue with the direction of causality running from government revenues to expenditures.

Index Terms — Government expenditures, Government Revenue, Granger Causality Test.

I. INTRODUCTION

The government is an important institution in every country because, by implementing appropriate economic policies, it can help stabilize the economy, and among them we have the fiscal policy which is reflected in the government's annual budget plan [1]. The causal relationship between government revenues and government spending is an important issue in fiscal policy [2], as it is an issue that has sparked much controversy around the world. Over the years among economists and policy analysts who have shown an interest in this relationship, it is extremely important to formulate sound or excellent fiscal policy to prevent or reduce unsustainable fiscal deficits. Indeed [3].

The nature of the relationship between government revenues and expenditures is always a problem in the economies of developing and developed countries, due to financial imbalances and the consequent damage to their economies. Algeria faced great challenges in planning and implementing financial reform policies due to the need to increase public spending on infrastructure and investment and raise the standard of living for the individual on the one hand, as the Algerian government took many measures in order to obtain revenues away from oil revenues due to its heavy dependence on them (oil revenues). Despite these measures the government has been weak in providing the

necessary financing. Therefore budgeting for government revenues and expenditures is a necessary component to ensure economic stability in the context of financial sustainability.

The literature that examines the relationship between government revenue and government expenditures has had known different hypotheses, and can be summed up into four hypotheses, which are as follows [4]:

The first hypothesis based on the tax spending hypothesis, developed by M. Friedman 1978 [5], indicates that changes in government revenue lead to changes in government spending, which means that more government revenue (taxes) leads to budget deficits, and from which Friedman found a relationship. Positive causation between spending and taxes, so economic policy must focus on reducing tax revenues in order to reduce the budget deficit [5].

Another explanation for this hypothesis was provided by both Buchanan and Wagner under the hypothesis of financial illusion. Several studies have also confirmed that there is a negative causal relationship between government revenues and expenditures, as they agree with Friedman in the direction of the relationship from revenues to government expenditures. However, they differ with him in the nature of the effect, as they believe that an increase in revenues will negatively affect the direction of government spending [6].

The second hypothesis based on spend and tax, was developed by Peacock and Wiseman 1961 [7], includes that government spending is a factor that changes government revenue, that is, increases in government spending allow for increased tax revenue (increased revenue) [7].

The third hypothesis, which is the financial synchronization hypothesis, proposed by Peacock and Wiseman 1979 [8]. This type of causality indicates the existence of a two-way relationship between government revenues and government expenditure, and from it the synchronization of government spending and government revenues is done simultaneously, by this we mean that government revenue decisions are not independent of government spending and from it take decisions simultaneously [8].

Finally, the fourth hypothesis, called the fiscal independence or institutional separation hypothesis, was developed by Baghestani and McNown 1994 [9]. According to this hypothesis, government decisions regarding expenditures are independent of decisions regarding government revenue (taxes). It is characterized by non-causality between government expenditure and government revenue. That is, tax rates are imposed independently of

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government spending fluctuations [10].

Through the above, the problematic of this paper includes the following:

Is there a relationship between government expenditures and government revenues in Algeria?

To answer the problematic at hand the study will have to test the following hypotheses:

There is a causal relationship from government expenditures to government revenues in Algeria.

There is a causal relationship from government revenues to government expenditures in Algeria.

The main objective of this paper is to examine statistically the causal relationship between government revenues and government expenditures using Granger causality test, through which it is possible to come up with a practical argument that shows the trend and pattern of the causal relationship between government revenues and government expenditures in Algeria.

II. LITERATURE REVIEW

There are many studies that have investigated the causal relationship between government expenditures and revenue, Has been that have emerged prominently in both theoretical and experimental literature, And Through the use of different econometric methods, studies have reached to different results.

Study for Saysombath [11], the aim of this paper is to investigate the relationship between spending and revenue in PDR during the period 1980 to 2010, and this paper applies an approach that uses cointegration and an autoregressive distributed lag (ARDL) combined with a Granger causality within a vector error correction framework (VECM). The results revealed a long-term causal relationship between government spending and revenue, and this one-way causal relationship from spending to revenue, which supports the spend-and-tax hypothesis.

Study for Luković [10], this paper aimed to study the causal relationship between government revenues and government spending in Serbia, The Toda-Yamamoto long-term non-causal method was used to determine if there is a causal relationship between government revenue and government expenditures in Serbia. The results of applying this method showed that there is a one-way (one-way) causal relationship extending from government spending to government revenue, which means that government spending generates government revenue Granger.

Study for Elyasi [12], the purpose of this study is to investigate the relationship between government revenue and government expenditure in Iran by applying the bounds testing approach to cointegration, The results of the causality test show that there is a bidirectional causal relationship between government expenditure and revenues in both long run and short run.

Study for Al-Zeaud [13], the purpose of the study is to examine the causal relationship between government revenues and expenditures for the Jordanian government during the period 1990 to 2011 using the Granger causal methodology and VECM tests. Experimental results showed that the two-way causality operates between revenues and expenditures. This result supports the proposition of a

financial synchronization hypothesis, which means that the government Jordan makes revenue and expenditure decisions simultaneously.

Study for Al-Khulaifi [14], the purpose of this paper is to examine the relationship between government revenue and spending in Qatar, Annual data were used for the period from 1980-2011, time series analysis was applied to unit root tests, Engle-Granger integration and Granger causality. The experimental results found a one-way causal relationship extending from government revenues to expenditures to support the hypothesis of revenue expenditures.

Study for Ravinthirakumaran [15], the aim of this paper is to examine the relationship between government revenue and expenditures in Sri Lanka. It studies the causal relationship between government revenues and expenditures using the modeling and error correction model for the period from 1977 to 2009. Empirical results show that there are two-way reasons between government revenue and spending and there is a long-term equilibrium between these two causes variables in Sri Lanka.

Study for Sani [16], aim the causal relationship between government expenditure and revenues in Indonesia during the period 1963 to 2017 by using the Vector Auto Regression (VAR) model. The results show that there is a strong relation and it represents a bi-directional causality between expenditure and revenue.

Study for Taha [17], the purpose of this study is to conduct empirical tests of the causal relationship between tax revenue and government spending in Malaysia over the past 36 years by applying an econometric model. The results provide evidence for the existence of a long-run relationship between tax revenues and government spending with unidirectional and bidirectional causality in VAR models for the sample period 1970-2006.

Study for Jalil [18], this study aimed to determine the causal relationship between government spending and revenues in the case of Romania using the autoregressive method of distributive delay for cointegration, analysis of variance, and rolling regression method. The results showed that there is a long-term two-way relationship between government spending and government revenues. The variance analysis method indicates that the government revenue shock has a more severe impact on government spending compared to the shock in government spending and the response to government revenue collection.

Study for Carneiro [19], this paper aimed to assess the temporal relationship between government expenditures and revenues in the case of Guinea-Bissau. The basic premise of this paper included that government expenditures are determined before government revenues, which is known in the literature as the expenditure - tax hypothesis. Using annual data of government expenditures and revenues over the period 1981 to 2002 and sequential modern econometric techniques, we were unable to reject the spending tax hypothesis. The results showed that there is a stable long-term relationship between government expenditures and revenues, but there is a one-sided causal relationship from expenses to revenues in Guinea-Bissau.

Study for Abdulrasheed [20], this study identified the causal relationship between government spending and

government revenue in Nigeria during the updated time period between 1986-2015, this study used the statistical method of co-integration and vector Autoregressive techniques that include error correction model (ECM) as methods of analysis. The results indicate that there is a practice of revenue spending in Nigeria with the observation that changes in government spending have brought about changes in government revenues. Cointegration tests also revealed the existence of long-term equilibrium relationships between variables of government revenue and expenditures. Finally, the results of this study showed that an increase in government spending without an increase in revenues could lead to an increase in the budget deficit.

III. DATA AND METHODOLOGY

This paper is based on study relations between the two phenomena, namely: government revenue and government expenditure in Algeria. The government revenues are expressed as the trends of incomes in the state budget (Government revenue – GRS) and the government expenditures are expressed as the trends of the outflow from the state budget (Government Expenditure – GES). For both variables, which are the subject of this analysis, the data were used from 1990 to 2019. Therefore, in this case, there are 30 observations. The data used in the study are taken from the World Bank website.

A. Test of Stationarity

In most cases, time series data are not static and thus produce erroneous results when used for regression analysis. In order to examine the stationarity of time series, we have used the Augmented Ducky Fuller (ADF) and Fillips Peron (PP) test :

The ADF test in the X-series stability study is based on the estimation of the following models by the method of least squares [21]:

$$\begin{aligned}\text{Model: } \Delta W_t &= \beta w_{t-1} + \sum_{i=1}^n a_i \Delta w_{t-i} + u_t \quad (1) \\ \text{Model2: } \Delta W_t &= \alpha + \beta W_{t-1} + \sum_{i=1}^n a_i \Delta W_{t-i} + \mu_t \quad (2) \\ \text{Model3: } \Delta W_t &= \alpha + \beta W_{t-1} + \gamma T + \sum_{i=1}^n a_i \Delta W_{t-i} + \mu_t \quad (3)\end{aligned}$$

where the second model differs from the first in that it contains a constant, and the third model differs from the first and the second in that it contains a constant and direction.

Estimating the model using the usual least squares method is as follows, we test the hypotheses $H_0: \beta = 0$ (Contains a unit root), against $H_1: \beta < 0$ (Contains a no unit root), if the null hypothesis is acceptable, it means that there is a unit root and therefore that series are non-stationary.

Phillip-Perron (PP) test includes the (t)value (ρ)test, which tests the null hypothesis of time series stationary at $\rho = 0$ against the alternative hypothesis indicating the are non-stationary of time series $\rho < 0$ If it is significant and negative, then it rejects the null hypothesis and accepts the alternative hypothesis indicating the stationary of the time series [22].

The Wiatkowski Phillips Schmidt Sahin test (KPSS) is the reverse of PP and ADF test where the null hypothesis is the other way around. It is tests t see if the test can reject stationarity [23].

B. The Granger Causality Test

In this part of the study, the causal relationship between the study variables (government spending and government revenue) will be analyzed, and in order to analyze the causal trend between the two variables, we use the causal Granger test, Granger causality test assumes that only time series data can explain the information required for the relationship between variables. The Granger causality test is based on the standard F test [24], according to the Granger causation test, the variable X Granger causes Y if Y can be predicted with improved accuracy by means of previous values of the variable X. According to Granger then causation exists in at least one direction .The causal relationship between government revenues and expenditures is known in many economic studies And it reached inconclusive results, as theoretical discussion and applied studies led to the highlighting of four trends that clarify the assumed relationship between the mentioned variables, namely [14]:

- A- one-way causation from X to Y, denoted by $X \rightarrow Y$.
- B- one-way causation from Y to X, denoted as $Y \rightarrow X$.
- C- feedback or bidirectional causation.
- D- no causal relationship.

The short-run relationship (X_t), (Y_t) is tested using causality and the error correction model (ECM), the causality test requires estimating the following two equations in a manner (OIS) [25]:

$$\begin{aligned}Y_t &= a_0 + \sum_{j=1}^k a_j Y_{t-j} + \sum_{i=1}^k \beta_i X_{t-i} + \mu_t \quad (4) \\ X_t &= \beta_0 + \sum_{j=1}^k \beta_j X_{t-j} + \sum_{i=1}^k a_i Y_{t-i} + \mu_t \quad (5)\end{aligned}$$

According to Granger's causation, the null hypothesis that (X_t) does not cause (Y_t) can be tested in Equation (4):

Alternate hypothesis (X_t) cause (Y_t) that is:

$$\begin{aligned}H_0: \beta_1 &= \beta_2 = \dots \beta_k = 0 \\ H_1: \beta_1 &= \beta_2 = \dots \beta_k > 0\end{aligned}$$

With respect to the null hypothesis test (Y_t) does not cause(X_t) against the alternative hypothesis (Y_t) cause (X_t) in equation (5):

$$\begin{aligned}H_0: a_1 &= a_2 = \dots a_k = 0 \\ H_1: a_1 &= a_2 = \dots a_k > 0\end{aligned}$$

Engle and Granger (1987) showed that if two non-constant variables are integrated, the automatic regression of the vector in the first variables is not uniform, and the simple Granger causality test should not be used. Hence cointegration must be tested before causality tests are performed. For this purpose, Granger (1986) and Engle and Granger (1987) have suggested a more comprehensive method for testing causality when combining variables together is the error correction model (ECM) [26]. The ECM formulation for testing causation writes as:

$$\begin{aligned}\Delta X_t &= a_0 + \sum_{j=1}^n a_j y_{t-j} + \sum_{i=1}^m \beta_i \Delta X_{t-i} + \pi_0 e_{t-1} + \mu_t \quad (6) \\ \Delta Y_t &= \beta_0 + \sum_{j=1}^n \beta_j \Delta Y_{t-i} + \sum_{i=1}^m a_i \Delta X_{t-j} + \pi_1 e_{t-1} + \mu_t \quad (7)\end{aligned}$$

where Δ represent the first differences, e_{t-1} represent the

error-correction terms which are the lagged residuals from the Cointegration relation, The lagging values of ΔX_t and Δy_t are the explanatory variables in the Y_t model that indicate a causal relationship in long-term. Short-term causality is based on standard F-test statistics to jointly test the significance of the explanatory variable coefficients in their first differences. Long-term causality is based on the T-test [27].

IV. RESULTS

Before applying the Granger causality test, we have introduced algorithms to the data to eliminate the Heteroscedasticity problem and minimize values for ease of interpretation. We will perform an analysis of the data using time plots of the two series (Government Revenues and Expenditures) as shown in Fig. 1 and 2 respectively.

Fig.1 .Time series plot for Algerian government revenues data.

Figure 1 represents government revenues, where the highest value was 25.79723, and the minimum value is 24.19847, as for the mean and standard deviation, their values are as follows (24.96474, 0.594500). As for visual inspection of the time plots of government revenues has an increasing trend, it indicates that is not stationary series.

Fig. 2. Time series plot for Algerian government expenditures data.

As for Fig. 2, it represents government expenditures, where the highest value was (30.70783), and the minimum is (27.05850). As for the mean and standard deviation, their values are as follows (29.29943, 1.073368). As for visual

inspection of the time plots of government expenditures it has an increasing trend, indicates that is not stationary series.

As we saw earlier through visual inspection of the time plots, the two series are non-Stationarity, but this check is not used to judge that the series is not stable, and for this there are many tests that show us that they are stable or unstable. Among the most popular tests that show the Stationarity or non-Stationarity of the series used, we have the ADF test, the PP test, and the KPSS test.

Stationarity tests were carried out to confirm the initial presumption that they were non-stationary. The results for the ADF test, PP test, KPSS test are presented in Table 1. The tests confirmed that all the data series were non-stationary. The Dickey-Fuller test and PP and the KPSS test showed that all Two series had unit roots. Therefore, required we have to make it stationary by differencing non-stationary series one or more times to achieve stationarity.

The same Table 1 shows the unit root test results. The first-order differenced confirmed the stationarity of the two series.

TABLE 1: ADF, PP AND KPSS UNIT ROOT TEST RESULTS

test	variable	Level (p-value)	decision	1 st Diff (p-value)	decision
ADF	LGR	0.9222	non-stationary	0.0002	Stationary
	LGS	0.6969	non-stationary	0.0272	Stationary
PP	LGR	0.8834	non-stationary	0.0002	Stationary
	LGS	0.2443	non-stationary	0.0288	stationary
KPSS	LGR	0.001	non-stationary	0.15	stationary
	LGS	0.0003	non-stationary	0.1	stationary

The Granger Test of Causality showing the Causality way, is the most widely used method for estimate Causality. Before applying the Granger Causality test, static variables must be verified. Where many studies of macroeconomic time series have shown that most of them are not stationary, which make a problem, if applied to not stationary variables, will lead to false regression, and may provide false results.

After converting the time series of government revenues and government expenditures into a stationarity time series ,and After ensuring that is stationarity time series, the causal relationship and its direction between these variables can now be measured, as we can distinguish between three The possible results, which are the existence of a one-way causal relationship from one variable to another, or the existence of a two-way causal relationship between the two variables, or the absence of a causal relationship between them. Test results show causality in Table 2 :(Notice: the number of lag was used in the Granger causality test is three).

TABLE2: GRANGER CAUSALITY TEST RESULTS

Null Hypothesis:	Obs	F-Statistic	Prob.
DLGR does not Granger Cause DL	GS 27	4.07766	0.0206
DLGS does not Granger Cause DLGR		1.14097	0.3567

We note through Table 2, the result of Granger causality test reject the null hypothesis that the government revenues

does not cause the government expenditures, Since the probability value of the Granger causality test is less than 5% significance level, this means that we reject the null hypothesis and accept the alternative hypothesis that states the existence of a causal relationship from government revenues towards government expenditures. This means that higher revenues will lead to an increase in government spending indicating a one-way causal relationship extending from the government revenues to the government expenditures.

V. CONCLUSION

The study mainly focuses on knowing the causal relationship between government revenue and government expenditure in Algeria for the during period of 1990-2019 and this using Granger causality tests. The results from ADF and PP and KPSS unit root tests showed that both government expenditure and revenue that they were non stationary, after taking their first differences. The results tests showed that two series are stationary.

after taking sure of the stationary of that two series are stationary, we tested the Engle Granger causality between government revenue and government expenditure, and the results showed that there is there is one-way causality running from revenues to expenditures. the findings of this study will help the government Algerian formulating their annual budget.

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