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Wagner's Law in Algeria: An Econometric Analysis during 1967-2018

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Abstract:

The study aims to test the validity of five versions of Wagner's hypothesis for the Algerian case using time series annual data over the period from 1967 to 2018. The paper tries to examine the existence of long-run relationship between public expenditure and economic growth, and it has been used Autoregressive Distributed Lag (ARDL) bounds testing approach to cointegration and ECM based on ARDL procedure and granger causality test. The findings indicated that there is no cointegration between the variables whether in the Peacock-wiseman model (Model1) or in the Goffman one (Model 2). However, in case of Pryor (Model 3), Mustgrave (Model 4) and Mann (Model 5), the series are cointegrated. The estimated coefficients of the long-run relationships showed that Wagner's law runs in Algeria in case of Pryor model (Model 03), While the coefficients of the long-run relationships in fourth and fifth model are not significant.

Keywords: Wagner's Law, Algeria, ARDL.

Jel Classification Codes : C01, H 50, P 24

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1. INTRODUCTION :

The relationship between government expenditure and economic growth has been an important subject of analysis and debate among economists for decades. Thus, there are mainly two schools of thought that try to clarify the correlation between national income and government spending.

The first school of thought is "Keynesian school". Keynes in his General Theory of Employment, Interest and Money (1936) believes that public spending determine economic growth and can be used as a stabilization policy instrument. The Keynesians see public expenditure as an exogenous factor, which could be used as a policy instrument to influence growth and the government has a major role to play in the process of accelerating economic development. Therefore, in the Keynesian view causality runs from government expenditure to economic growth.

The second school of thought is the "Wagner's law" whose view is the direct opposite of the Keynesian school. Actually, this school of thought views public expenditures as an endogenous factor or as an outcome but not a cause of growth in national income. In 1893 Adolf Wagner's propound his famous "law of increasing expansion of public, and particularly state, activities". According to his view there is a positive relationship between economic activities and government expenditure (Henrekson, 1993). Hence, by an increase in economic activity, the economic growth triggers expansion of the public sector. Therefore, While Keynesian approach states that, the causality runs from government expenditure to economic development, according to the Wagnerian approach, the direction of causality runs in the opposite side from economic growth to government expenditure. Therefore, Keynesian and Wagnerian approaches represent two alternative viewpoints in explaining the causality between government expenditure and national income.

Hence, this paper takes an important step in the above direction to contribute to the existing literature by shedding light on the relationship between public expenditures and economic growth of small open economy of Algeria by using time series econometrics techniques during the period from 1967 to 2018.

The structure of the remaining paper is organised such that section two explores the literature review; and section three essentially focuses on methodological techniques and data used in the study. Section four discusses the empirical findings, and section five presents the conclusion.

2. Literature Review:

2.1. Wagner's Law: A Theoretical Framework.

Because of government expenditure's importance as a policy tool in economics, the relationship between government expenditure and economic growth has been one of the most widely investigated issue especially since the post-Second World War.

The economic literature related to the relationship between government expenditure and economic growth is delineated along the two contending views, which are the hypotheses of Wagner (1883) and Keynes (1936). However, for this study, the relevant literature is that pertaining to the former.

Although the relationship between government expenditure and economic growth has attracted the attention of economists, policy makers and politicians over the years, the debate is still raging.

In 1893, the German political economist Adolph Wagner put forward his well-known proposition that regards public expenditure growth as a natural consequence of economic growth. He did not express his ideas in the form of a law and avoided making definitive formulations.

His views were later formulated as a law and came to be known as "Wagner's law" or "Wagner's hypothesis" (Henrekson, 1993; Halicioglu, 2003).

The law suggests that the share of the public sector in the economy will rise as economic growth proceeds, owing to the intensification of existing activities and extension of new activities. Wagner observed the existence of relationship between economic growth and public expenditure. The primary idea behind this relationship is that the growth in public expenditure is a natural consequence of economic growth. Accordingly, public expenditure is an endogenous factor that is driven by the growth of national income.

However, in the Keynesian paradigm (Keynes, 1936), economic growth occurs as a result of rising public expenditure and is considered as an independent exogenous variable to influence the economic growth. While according to Wagner's approach causality runs from output to public expenditure, the Keynesian approach assumes that causality runs from public expenditure to output.

Although Wagner's writings had been well known among German economists, it was not until the 1950s when they reached their Englishspeaking counterparts in the form of "Classics in the Theory of Public Finance" (1958), compiled by Musgrave and Peacock.

The most explicit form of this law, interpreted from the economic-political point of view, expresses the absolute, and also relative, extension of the public organization structure alongside and even partially replacing the private economic structure within the public economy.

The Law suggests that an expansion of a country's level of economic development leads to an increase in its relative size of public sector.

This statement includes a comparison of development between private and public sectors. According to Wagner's law as the national economy grows, the public sector will grow at a faster rate than the private sector.

Wagner offered three reasons why this would be the case. First, with economic growth, industrialization and urbanization would generate an increase in government expenditures. Development of the economies makes legal relationships between the economic agents more complex, which triggers the administrative, regulatory and protective functions of the government.

Second, the rise in real income would lead to more demand for basic infrastructure particularly education and health facilities. In such a case, there would be a need for increased provision of social and cultural goods and services. As a result, with development, the need for culture and welfare expenditures, particularly education expands.

Third, government has to interfere to the market to ensure the functioning of natural monopolies and to enhance economic efficiency (Bird, 1971). In contrast, Keynes viewed public expenditure as an exogenous policy instrument for correcting cyclical fluctuations in aggregate demand.

Despite Wagner did not present his Law in a mathematical form and he was not explicit in the formulation of his hypothesis, mathematical forms have been applied by different authors. Thus, Wagner's law contains at least six versions which have been empirically tested by different economists over the years. The most well-known of these versions can be summarized as follows:

- **Peacock and Wiseman (1961)**: Functional form 1 is referred to as the Peacock-Wiseman version. According to them, growth in real government expenditure (RGE) is dependent upon the growth in real (RGDP). So:

$$Ln\, RGE_t = \alpha_1 + \beta_1 Ln(\, RGDP_t) + e_t \dots\dots\dots\dots\dots\dots\dots\dots (01)$$

- **Goffman (1968):** in the functional form 2, which is called as the Goffman version, known as the absolute version of the law, he emphasized taking into account the real government expenditure (RGE) which dependents upon the growth in real GDP per capita (RGDP/P). Consider

$$Ln\ RGE_t = \alpha_2 + \beta_2 Ln(\ RGDP_t/P_t) + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (02)$$

- **Pryol (1968):** in this third version, which is adopted by Pryol, he gave similar explanation by using government consumption expenditure (GCE) instead of total government expenditure (GE) as a dependent variable and the GDP as an independent variable without take into account the effect of increase in population. We have

$$Ln\ GCE_t = \alpha_3 + \beta_3 Ln(\ GDP_t) + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (03)$$

- **R. A. Musgrave and P. B. Musgrave (1969):** functional form 4 was proposed by Musgrave (1969). In this version, the share of nominal government expenditures in nominal GDP (G/GDP) depends upon the real GDP per capita (RGDP/P). Consider

$$Ln\ G_t/GDP_t = \alpha_4 + \beta_4 Ln(\ RGDP_t/P_t) + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (04)$$

- **Mann (1980):** functional form 5, proposed by Mann (1980), represents the modified version of Peacock-Wiseman. In this model, Mann interpreted the law in relative sense. He used the share of government expenditures in nominal GDP (G/GDP), (instead of real government expenditures) depend upon real GDP (RGDP) as follows:

$$Ln\ G_t/GDP_t = \alpha_5 + \beta_5 Ln(\ RGDP_t) + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (05)$$

- **Gupta (1967):** Finally, in the last version which is adopted by Gupta (1967). This specification model affirmed that growth in real per-capita government expenditure (RGE/P) is dependent upon the growth in real GDP per capita (RGDP/P). Consider:

$$Ln\ RGE_t/P_t = \alpha_6 + \beta_6 Ln(\frac{RGDP_t}{P_t})\ + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (06)$$

This study attempts to test the validity of the first five_versions of Wagner's law in case of Algeria during the period from 1967 to 2018, and the last version (Gupta Version) is excluded because the data of G/P is not available.

2.2. Empirical Studies:

Economists around the world have dissenting views on Wagner's hypothesis that an increase in economic growth influences government expenditure (Keynesians). Since the early 1990s, economists have devoted a lot of research work to testing Wagner's law (an increase in economic growth will lead to an increase in government expenditure) for various countries around the globe making it impossible to review all of them.

Barro (1991) in a study of 98 developed and developing economies found a positive but weak relation between public expenditure and economic growth over the 1960 to 1985 period. Ghali (1999), through the application of multivariate cointegration technique, analysed the dynamic interactions between government size and economic growth for 10 OECD countries. The outcome of the study shows that government size Granger causes growth in all the countries with some disparities in the proportion by which government size contributes to economic growth rate. Similarly, several panel country studies prompted to test Wagner's law. Perhaps the most interesting study on Wagner's law, in the European Union area, is Karagianni, Pempetzoglou and Strikou (2002) who employed Engle-Granger and Johansen cointegration techniques in conjunction with Granger causality for 15 individual EU countries. The study shows validity for only Finland and Italy for the period 1949-1998. Perhaps the most interesting studies on Wagner's law for the EU area is Magazzino, C (2012). Dividing the regions into 'poor' and 'rich' and using panel GMM in addition to time series analysis for individual 27 EU countries, Magazzino, C (2012) validates Wagner's law for both groups, casting doubt on the view that Wagner's law is a developed country phenomenon.

Lyare and Lorde (2004) applied the two step Engle and Granger (1987) cointegration and error correction procedures and the Granger (1969) causality procedure on aggregate time series data on nine Caribbean countries. Their results indicate that with the exception of Grenada, Guyana and Jamaica, there is no long-run relationship between income and government expenditure. While the direction of the causality runs from income to government expenditure for Guyana, it is the opposite for the other two countries. They also had mixed results in the short-run but the predominant causal relationship appears to run from income to government expenditure.

Alam et al. (2010) examined the long-run relationship between social expenditure and economic growth in Asian developing countries. According to the analysis the study concluded that expenditure in infrastructure, education, and health played an important role in promoting economic growth in all the selected Asian countries. Dogan (2006) investigated the relationship between national income and public expenditures for Indonesia, Malaysia, Philippines, Singapore, and Thailand. Granger causality tests were used to investigate the causal links between the two variables. The result of Granger causality revealed that causality runs from public expenditures to national income only in the case of Philippines, and there was no evidence for other countries. Huang (2006) analysed Wagner's law for China and Taiwan by using data covering 1979 to 2002 by employing ARDL bounds test approach. His results from the test indicate that there is no long-run relationship between government spending and output in China and Taiwan. Likewise, Toda and Yamamoto’s (1995) Granger non-causality test results illustrate that Wagner’s Law does not hold for China and Taiwan over this same period.

Attari and Javed (2013) also applied Augmented Dickey fuller Unit Root test, Autoregressive Distributed Lag Model (ARDL), Johansen cointegration and Granger-causality test and data from 1980 to 2010 to investigate the relation between government spending, inflation and economic growth for Pakistan. They concluded that there is a long-run relationship between inflation rate economic growth and government expenditure. The causality test also shows that there is a unidirectional causality between the rate of inflation, economic growth and government expenditure.

Keshar (2019) analysed the impact of government expenditure in economic growth of Nepal by using data covering 1974 to 2018 by employing ARDL approach. It implies that this model is robust and stable as the both lines long run and short run coefficients are acceptable over the study period 1994/75 to 2017/18. The diagnostic tests confirm that the models have the desired econometric properties. It is concluded that the models are structurally stable.

Stephen T. O. et al (2020) have studied the impacts of government expenditures on economic growth in Nigeria. This study has adopted the auto-regressive distributed lag models to examine the impacts of public spending on economic growth in the context of the Nigerian economy from 1981 to 2017. Their findings support the existence of a long-run relationship between economic growth and public expenditures in Nigeria over the period of the study. The results revealed that both recurrent expenditures of the government and public debt have significant negative impacts on economic growth while capital expenditure of the government has a positive, but insignificant impact on the economic growth of the nation in the long-run relationship.

Therefore, available empirical evidence on the impacts of government spending on growth have revealed that the subject matter is still very open to more discussion as existing results vary from one place to another. The variation in the evidence could be explained by various factors ranging from the peculiarity of the series of fiscal policy reforms that each country implemented over a period of time to the choice of the methodology that researchers adopt in their studies.

3. Methodology and Data:

3.1. Methodology:

In testing the validity of Wagner's Law, this study uses Autoregressive Distributed Lag (ARDL) bounds testing approach to cointegration and ECM based on ARDL procedure developed by Pesaran and Shin (1999) and advanced by Pesaran, et al. (2001). When one cointegrating vector exists, Johansen and Juselius(1990) cointegration procedure cannot be applied. Hence, it becomes imperative to explore Autoregressive Distributed Lag (ARDL) approach to cointegration or bound procedure for a long-run relationship; Therefore, the use of ARDL bounds testing is motivated by the following advantages (Emeka and Aham, 2016, p 78):

- Irrespective of whether the underlying variables are I(0) or I(1) or a combination of both, ARDL technique can be applied. In such situation, the application of ARDL approach to cointegration will give realistic and efficient estimates.
- If the F-statistics (Wald test) establishes that there is a single long run relationship and the sample data size is small or finite, the ARDL error correction representation becomes relatively more efficient.
- If the F-statistics (Wald test) establishes that there are multiple long-run relations, ARDL approach cannot be applied.

Furthermore, ARDL framework allows the derivation of an ECM through a simple transformation, which generates short-run adjustment with long-run equilibrium without losing the long-run information (Lira and Senei, 2017, p 11).

In order to carry-out the bounds test the following ARDL model is estimated:

$$\Delta Y_t = \underbrace{\beta_0 + \sum_{i=1}^{p} \beta_i \Delta y_{t-1} + \sum_{i=0}^{q} \delta_i \Delta x_{t-1}}_{\text{Short-run}} + \underbrace{\varphi_1 y_{t-1} + \varphi_2 x_{t-1}}_{\text{Long-run}} + \mu_t \ldots . (1)$$

Where Δ is the first difference operator, Y_t is the natural logarithm of the measure of government expenditure and X_t is the natural logarithm of the measure of output, p and q are the lag lengths, β_0 is the drift component and μ_t are random error terms.

In this framework, the existence of a long-run relationship between the variables of interest is assessed by testing the null hypothesis H0: $\varphi_1 = \varphi_2 = 0$; against the alternative hypothesis; H1: $\varphi_1 \neq 0 , \varphi_2 \neq 0$ .The F – statistic derived from this test is compared with two sets of critical values (lower and upper bound values) for a given level of significance reported in Pesaran, et.al (2001) and Nayaran (2005) for large samples and small sample sizes, respectively. The lower bound values assume that all variables in ARDL model are I (0) while the upper bound values assume that the variables are I (1). Therefore, if the computed F-statistic is less than the lower bound value, the null hypothesis of no cointegration cannot be rejected. On the other hand, if the computed F-statistic is greater than the upper bound value, the null hypothesis of no cointegration is rejected and it is concluded that the variables are cointegrated. Nonetheless, the test becomes inconclusive in cases where the computed F-statistic falls between the two critical bound values (Lina and Sensei, 2017, p 13).

If there exist a long-run relationship among the variables, the second step is to estimate the long-run model for Y_t by selecting the orders of ARDL:

$$Y_t = \beta_0 + \sum_{i=1}^{p} \vartheta_i Y_{t-i} + \sum_{i=0}^{q} \gamma_i X_{t-1} + \varepsilon_t \ldots \ldots \ldots \ldots . (2)$$

In the final step of the bounds testing procedure short-run dynamic parameters are obtained by estimating an error correction model (ECM) associated with the long-run estimates. In order to estimate the speed of adjustment of the dependent variable to independent variable(s), the lagged level variables in equation (1) are replaced by ECT_{t-1}:

$$\Delta Y_t = C + \sum_{i=1}^{p} \vartheta_i \Delta Y_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta X_{t-1} + \Psi ECT_{t-1} + \varepsilon_t \ldots \ldots \ldots \ldots . (3)$$

In equation (3), ϑ_i and γ_i are the short-run dynamic coefficients of the model's convergence to equilibrium, Ψ is the speed of adjustment and ECT is the error correction term derived from the long-run relationship. If the value of speed of adjustment is zero it means that there exist no long-run relationships, if it's between -1 and 0, there exists partial adjustment. A value smaller than "-1" indicates that the model over-adjusts in the current period; finally a positive value implies that the system moves away from equilibrium in the long-run (Asuman and Nagihan, 2013, p 292).

3.2. Data:

In this study, we test the validity of Wagner's law in Algeria by performing a cointegration technique. The definitions of the variables we use in the models are as follows; (RGDP) is real GDP, (RGDP/ P) is real GDP per capita, (RGE) is real government expenditure, (GCE) is government consumption expenditure instead of total government expenditure (GE), (G/GDP) is the share of nominal government expenditures in nominal GDP and finally (RGE/P) is per capita real government expenditure. However, this statistic is not available either at the official websites of the Algerian authorities or at the level of the websites of international financial institutions. Therefore, the sixth and last model related to the Gupta model (1967) will be excluded from this study, and only the first five models will be studied.

Per capita real GDP (RGDP/P) and per capita government expenditure (RGE⁄P) were obtained by, respectively, dividing real GDP and real government expenditure by population (P). The data on all these variables was obtained from World Bank Development Indicators (WDI 2020). For analysis, the data series are expressed in natural logarithms.

This paper employs time series data on measures of these variables for Algeria covering the period 1967 to 2018 (52 observations). The theoretical framework discussed in this study is premised on the endogenous growth theory which analyses the nature of the relationship between fiscal policy variables and economic growth in the Algerian economy. A simple model representation to capture the relationships among our variables is as follows:

$$G = f(Y)$$

Where G is Government expenditure as dependent variable upon the economic growth Y as an independent variable.

4. RESULTS AND DISCUSSION

4.1. Unit root test :

The paper undertakes unit root test by employing the standard Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. Table 1 presents the results of the ADF and PP unit root tests both in levels and first differences.

Table1. Unit Root Test Results

	Augmented Dickey Fuller Test (ADF)				Phillips-Perron (PP)				Result
	Level		First Difference		Level		First Difference		
	Intercept	Intercept & trend	Intercept	Intercept & Trend	Intercept	Intercept &Trend	Intercept	Intercept & Trend	
Log (RGE)	-2.1531	-1.9214	***- 6.0101	***- 6.301	-2.0758	-1.946802	***- 6.0218	***- 6.2941	I(1)
Log (RGDP)	*-2.6402	***- 4.38	/	/	**- 2.8	-2.8331	***- 8.4462	***- 8.8965	I(0) , I (1)
Log (GCE)	-2.2853	-1.9475	***- 4.8180	***- 5.119	-2.1036	-1.8109	***- 5.0377	***- 5.3159	I(1)
Log (GDP)	**- 3.136	-2.9264	***- 4.9475	***- 5.361	-2.5910	-1.9575	***- 5.1613	***- 5.5434	I(1)
Log (G/GDP)	*-2.8085	-2.8440	***- 6.0721	***- 5.998	-2.5882	-2.6353	***- 6.0514	***- 5.9978	I (1)
Log (RGDP/P)	-2.0109	***- 4.52	***- 8.7419	/	-2.2937	-2.3998	***- 8.5272	***- 8.5952	I(0) , I(1)

*, **, *** are significant at ten percent, five percent, and one percent level respectively.

Source: Output of EViews 9.

In table 1 above the results of stationarity test are shown, where both ADF and Philip-Perron's unit root test for a model with constant and trend are employed. From the unit root results, Real Government Expenditure (RGE), government consumption expenditure (GCE), nominal gross domestic product (GDP), total government recurrent expenditures as a percent of GDP (G/GDP), are non-stationary variables at level but at first difference implying that they are I(1) variables while real gross domestic product (RGDP) was stationary at level I(0) (According to ADF test) and at first difference I(1) (According to PP test). However, the real per-capita government expenditure (RGE/P) is, according to ADF test, stationary at level (with trend and intercept) and at first difference (with just trend). The same variable was stationary at first difference I(1) according to PP test. It means the data are of mixed type of I (0) and I (I). When the data are of mixed order of integration, the study is proceeded for Auto-regressive Distributive Lag (ARDL) model for further processing.

4.2. Bounds test :

In the next stage of the investigation, this paper estimates an unrestricted autoregressive distributed lag model (ARDL). Bounds test is then conducted to make inference about long run relationship between public expenditure and economic growth.

Having determined that the variables are stationary in first differences, we conduct the ARDL cointegration procedure to examine whether the variables in question have common trends. Table 2 reports the results of the calculated F-statistics of all five models.

Table 2. ARDL Bounds Testing to Cointegration Results

Model Version	F-statistic	Critical value bounds of the F- statistic						Evidence of cointegration
		90%		95%		99%		
	k = 1	I(0)	I (1)	I(0)	I (1)	I(0)	I (1)	
Peacock-Wiseman	4.01	4.04	4.78	4.94	5.73	6.84	7.84	No
Goffman	2.53							No
Pryor	5.51							Yes***
Musgrave	8.44							Yes *
Mann	6.76							Yes**

Note: 1) k is the number of regressors and 2) ***, ** and * denote the level of statistical significance at 10%, 5% and 1 % respectively.

Source: Authors using output of EViews 9.

Table 2 reports the results of ARDL bounds testing procedure to cointegration between alternative measures of government expenditure and output. Using Schwarz information criterion (SIC) for the choice of the optimal lag length, the results indicate that the calculated –statistic is beneath the lower critical bound I(0) whether in the Peacock-wiseman model or in the Goffman one. Hence, it fails to reject the null hypothesis of no cointegration between the variables which implies that the series are not cointegrated. However, in case of Pryor, Mustgrave and Mann Models, the F-statistic is above the upper critical bound, I (1), at the level of statistical significance 10%, 1% and 5 % respectively. Then we reject the null hypothesis of no cointegration and hence conclude that the series are cointegrated. Therefore, these outcomes provide empirical evidence of the existence of long-run relationship between alternative measures of government spending and output used in the study in Algeria.

4.3. Long and short run :

Once a long-run cointegration relationship is found between the variables, in the last three models (Model 3, 4 and 5) the second step is to estimate the long-run model for the dependent variable by selecting the orders of ARDL (n, m) model using the AIC. The orders of ARDL specifications are ARDL (2,2) for Model 3, ARDL (2,3) for Model 4, and finally ARDL (2,3) as well for Model 5. The results obtained on dependent variables in the models in the long-run are reported in Table 3.

Table 3. Long-run coefficients

Model	Dependent variable	Variable	Coefficient	Std. Error	t-Statistic	Prob.
Model 3 ARDL (2,2)	LGCE	LGDP	1.004985	0.042530	23.630101	0.0000
		C	-1.884285	1.059389	-1.778653	0.0822
		ECT_{t-1} = LGCE - (1.0050*LGDP -1.8843)				
Model 4 ARDL (2,3)	LG_GDP	LRGDP_P	0.117860	0.222245	0.530317	0.5987
		C	1.889356	1.827943	1.033597	0.3072
		ECT_{t-1} = LG_GDP - (0.1179*LRGDP_P + 1.8894)				
Model 5 ARDL (2,3)	LG_GDP	LRGDP	-0.044128	0.097195	- 0.454020	0.6522
		C	4.097647	2.494557	1.642635	0.1079
		ECT_{t-1} = LG_GDP - (-0.0441*LRGDP + 4.0976)				

Source: output of Eviews 09.

The estimated coefficients of the long-run relationships in the Table above, show that Wagner's law runs in Algeria in case of a third model (Model 3), While the coefficients of the long-run relationships in fourth and fifth model are not **significant (** prob > 0.05).

Therefore, according to model 4 and 5, there are no long-run relationship between government expenditure, as independent variable, and economic growth, as dependent variable. However, ln GDP in Model 3 has the impact on ln GCE, by having 1.005 coefficient which means a %1 growth in ln GDP leads to a 1% increase in ln GCE ; Where:

$$LGCE = -1.8843 + 1.0050*LGDP$$

Table 4. Short run coefficients*:*

Model	Dependent variable	Variables	Coefficient	Std. Error	t-Statistic	Prob.
Model 3 ARDL (2,2)	LGCE	D(LGCE(-1))	0.264313	0.137522	1.921974	0.0611
		D(LGDP)	0.720551	0.105892	6.804553	0.0000
		D(LGDP(-1))	-0.223186	0.165012	-1.352546	0.1831
		ECT_{t-1}	-0.314715	0.095472	-3.296398	0.0019
Model 4 ARDL (2,3)	LG_GDP	D(LG_GDP(-1))	0.280645	0.136817	2.051251	0.0465
		D(LRGDP_P)	-0.642782	0.296233	-2.169851	0.0357
		D(LRGDP_P(-1))	0.254458	0.361804	0.703304	0.4857
		D(LRGDP_P(-2))	-0.694133	0.286653	-2.421510	0.0199
		ECT_{t-1}	-0.343304	0.086710	-3.959228	0.0003
Model 5 ARDL (2,3)	LG_GDP	D(LG_GDP(-1))	0.292120	0.139556	2.093213	0.0424
		D(LRGDP)	-0.666798	0.307421	-2.169005	0.0358
		D(LRGDP(-1))	0.267137	0.371318	0.719429	0.4759
		D(LRGDP(-2))	-0.656323	0.298307	-2.200161	0.0333
		ECT_{t-1}	-0.316679	0.087461	-3.620781	0.0008

Source: output of EViews 09.

In the final step of the ARDL cointegration procedure short-run dynamic parameters obtained are given in Table 4. In all of the models in the Table, coefficients of the error correction terms ECT_{t-1} are found negative and statistically significant at 1% level of significance (prob =0.00 <0.01). In all three type model versions aiming to test the validity of the Wagner's law in short term, it's observed that the speed of adjustment is ranging from 31% to 34% per year (four months). Thus, total output, according to all three models, influences the dynamics of government spending in short-run in Algeria.

4.4. Diagnostic tests:

The estimated models are congruent with the data and pass all specification tests such as serial correlation, non-normality of residuals and heteroskedacitity. Specifically, the Jacque Bera(JB), BPG Heteroskedasticity and Breusch-Godfrey-LM tests fail to reject the null hypotheses of normality of errors, homoskedasticity and no serial correlation, respectively.

Therefore, the residuals are white noise and serially uncorrelated. In addition, Ramsey's RESET test suggests that the model is well-specified. Furthermore, the short-run model stability, investigated by the CUSUM and

CUSUMQ tests (though not presented here) on the recursive residuals, shows that the values of the parameters fall within the 5% critical bands and this suggests that the parameters of the estimated model are stable over the sample period.

Finally, various diagnostic tests have been carried out to ensure that our estimated model is free from autocorrelation, heteroscedasticity and structural instability as reported in Table 5:

Table 5. Residual diagnostic test results

Test Statistics	Model 03	Model 04	Model 05
Jarque–Bera normality test	2.001 (0.367)	0.290 (0.864)	0.084 (0.958)
Breusch–Godfrey serial correlation LM test	2.697787 (0.2595)	4.478864 (0.1065)	6.250662 (0.1000)
Breusch–Pegan -Godfrey test heteroscedasticity	8.693607 (0.1219)	11.02089 (0.0877)	9.694913 (0.1381)
RESET Test	2.411128 (0.1020)	0.020361 (0.8872)	0.104100 (0.7486)

(.) : is p-value.

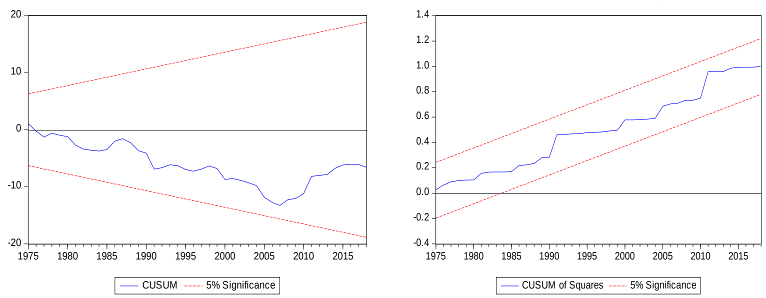
Source: Output of EViews 09

The study employs Cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMQ) test to check the stability of the model. The result of the CUSUM and CUSUMQ is presented by the following figures respectively.

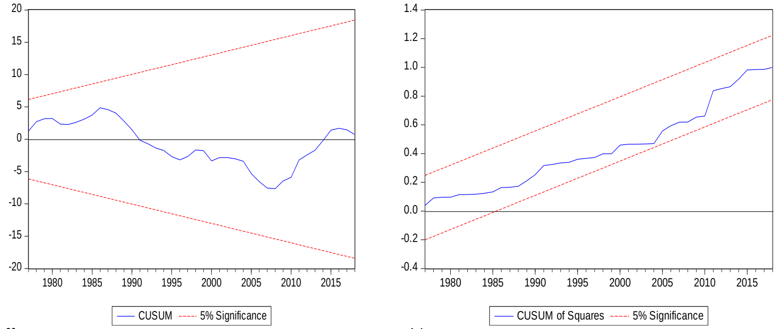
Fig 1.CUSUM and CUSUMSQ Tests

CUSUM CUSUMSQ

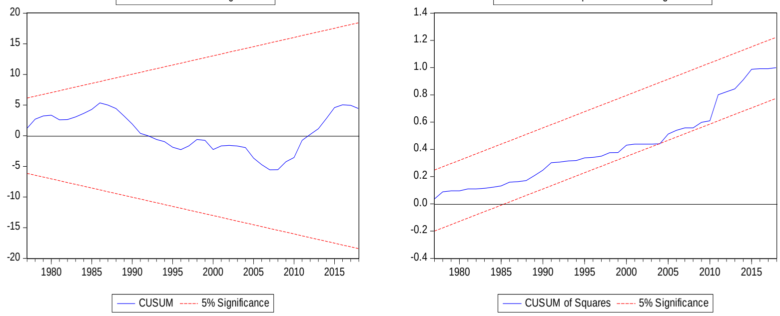
Model 3



Model 4



Model 5



Source: Output of EViews 09

The CUSUM procedure is based on the cumulative recursive sum of recursive residuals. However, the CUSUMSQ framework is based on the cumulative sum of squares of recursive residuals. To draw inferences relative to the stability of the parameters and the model in particular, the CUSUM and the CUSUMSQ procedures are updated recursively and are plotted against the break points. The null hypothesis of instability is rejected when the plots of the CUSUM and the CUSUMSQ stay within the 5 percent significance level. However, the model is unstable when the plots of the CUSUM and the CUSUMSQ move outside the 5 percent critical lines. Our findings suggest that the ARDL models are stable because both the CUSUM and the CUSUMSQ remained within the 5 percent critical bounds. The plot of CUSUMSQ tests are provided by Figures above.

The diagnostic tests confirm that the models have the desired econometric properties. We conclude that the models are structurally stable.

4.5. Causality Tests:

The next step of the estimation is to test the causality among the variables. For this purpose, the causal direction framework developed by

Granger (1969) and Sims (1972) has been used (the systematic testing and determination of causal direction framework developed by Granger (1969), and Sims (1972) are simply based on the axiom that past and present may cause the future, but the future cannot cause the past).

Where *Yt* and *Xt* are two stationary series. The unilateral causality exists when *Yt* is said to be Granger caused by *Xt* which means that the coefficients on the lagged of *Xt* are statistically significant. On the other hand, a bilateral causality is said to exist when both coefficients are statistically significant, and there is independence when both are statistically insignificant.

The pairwise Granger causality test carried out on which is depicted in table 7. Many variables are statistically significance at 5 percent significance level leading to the rejection of the null hypothesis they have unidirectional causality. The summary of pair wise Granger causality has been shown as table 7 shows:

Table 6. Granger Causality Test

Model	Null Hypothesis	Obs	F-Statistic	Prob.
Peacock-Wiseman	LRGE does not Granger Cause LRGDP	50	1.29794	0.2831
	LRGDP does not Granger Cause LRGE		3.03285	0.0581
Goffman	LRGDP_P does not Granger Cause LRGE	50	0.66227	0.5206
	LRGE does not Granger Cause LRGDP_P		0.91539	0.4077
Pryor	LGDP does not Granger Cause LGCE	50	5.08218	0.0102
	LGCE does not Granger Cause LGDP		1.02315	0.3677
Musgrave	LRGDP_P does not Granger Cause LG_GDP	48	4.55252	0.0041
	LG_GDP does not Granger Cause LRGDP_P		0.50097	0.7351
Mann	LRGDP does not Granger Cause LG_GDP	48	4.33857	0.0053
	LG_GDP does not Granger Cause LRGDP		0.43864	0.7799

Source: output of Eviews 9.

From the Granger Causality result as shown in the above table, there is no causality for the independent and dependent variables in the first and second models, which confirms the independence of the variables. However, the third, fourth and fifth models show that the unilateral causality exists from the economic growth, represented by the LGDP, the real GDP and the per capita GDP, respectively, towards government spending represented by LGCE for the third model and the share of government spending of GDP, for the fourth and fifth models. Our results, for the last three models, comply with Wagner's law which says that the direction of causality is from economic growth towards government spending.

5. CONCLUSION:

This study tested the validity of Wagner's law in Algeria by examining the first five models and excluding the sixth and last model related to the Gupta model (1967) because of non availability of its statistics. The study has adopted the auto-regressive distributed lag models to examine the impacts of public spending on economic growth in the context of the Algerian economy from 1967 to 2018 by performing a cointegration technique.

The results indicated that there is no cointegration between the variables whether in the Peacock-wiseman model (Model 1) or in the Goffman one (Model 2), which implies that the series are not cointegrated. However, in case of Pryor (Model 3), Mustgrave (Model 4) and Mann (Model 5), the series are cointegrated.

The estimated coefficients of the long-run relationships showed that Wagner's law runs in Algeria in case of Pryor model (Model 3), While the coefficients of the long-run relationships in fourth and fifth model are not significant. Therefore, according to model 4 and 5, there are no long-run relationship between government expenditure, as independent variable, and economic growth, as dependent variable. However, ln GDP in Model 3 had the impact on ln GCE, by having 1.005 coefficient which means a %1 growth in ln GDP leads to a 1% increase in ln GCE.

In all three type model versions aiming to test the validity of the Wagner's law in short term, it's observed that the speed of adjustment ranging from 31% to 34% per year (four months). Thus, total output, according to all three models, influences the dynamics of government spending in short-run in Algeria.

The diagnostic tests confirmed that the models have the desired econometric properties. We concluded that the models are structurally stable. Furthermore, Granger causality method showed that there is no Granger causality between economic growth and public expenditure in the first and second models, which confirms the independence of the variables; Therefore, refuting the Wagner's hypothesis with respect to the Algerian economy. However, the third, fourth and fifth models showed that the unilateral causality exists from the economic growth towards government spending. Our results, for the last three models, comply with Wagner's law which says that the direction of causality is from economic growth towards government spending.

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