The effect of fiscal policy on economic growth: The Case of Algeria- during the period 1980-2018

أثر السياسة المالية على النمو الاقتصادي: حالة الجزائر خلال الفترة 1980_2018

- **HASSAINE ASMA**: *PhD student, MIFMA Lab, MAGHNIA University Center, hassaineasma88@gmail.com*
- **SAHED ABDELKADER**: *MC A, POLDEVA Lab, MAGHNIA University Center, sahed14@yahoo.fr*

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ملخص

تهدف هذه الدراسة إلى تحليل أثر السياسة المالية على النمو الاقتصادي في الجزائر للفترة 1980–2018، باستخدام نموذج ARDL. وجدت النتائج أن الإنفاق العام له تأثير إيجابي على النمو الاقتصادي على المدى القصير والطويل. أما بالنسبة للضرائب المباشرة، فقد وجدنا أن لها علاقة إيجابية مع النمو الاقتصادي على المدى القصير ولكن على المدى الطويل تصبح العلاقة سلبية .بالنسبة للضرائب غير المباشرة، لها تأثير سلبي على المدى القصير، لكنها لا تستمر في التأثير على المدى الطويل. الدين العام والعجز المالي له تأثير سلبي على النمو الاقتصادي على المدى الطويل.

الكلمات المفتاحية: السياسة المالية، النمو الاقتصادي، الجزائر، نموذجARDL

التصنيف: C32، F43،E62

Abstract

This study aims to analyze the impact of fiscal policy on the economic growth in Algeria for the period 1980-2018, using the ARDL model. The results found that public spending has a positive impact on economic growth in the short and long run. As for direct taxes, we found that it has a positive relationship with economic growth in the short run but in the long run however, the relationship becomes negative. Indirect taxes, has a negative effect in the short run, but do not continue to affect in the long run. Public debt, fiscal deficits have a negative impact on economic growth in the long run.

Key words: fiscal policy, economic growth, Algeria, ARDL model

Jel Classification Codes :E62، F43،C32

Introduction:

Fiscal policy is one of the most powerful instruments that governments use to maintain macroeconomic stability for growth and for correcting market failures. Fiscal policy implementation, in essence, is done through changes in taxes or expenditures, as optimal fiscal policy plays a pivotal role and a vital instrument in the growth process and Creating job opportunities and cut inflation for developing countries, and Algeria like other developing countries expanded in the use of fiscal policy within the framework of various legislations that allow the Ministry of Finance through spending and revenue policies to achieve the goals of the country's economic policy. Considered fiscal policy, in essence, is a short-run issue. Therefore to her is predominantly viewed as an instrument to mitigate short-run fluctuations of output and employment, nonetheless, we should not ignore their long-run effects. Fiscal policy in the short-run is considered expansionary (contractionary), when public expenditures exceed (fall short of) public revenues. The resulting deficit can be interpreted as a means to finance additional government expenditures. If these expenditures are growth enhancing, then a government deficit exhibits an indirect effect on long-run economic growth.

Therefore, this study aims to show the relationship between fiscal policy and economic growth in the long run in Algeria using a model ARDL during the period 1980-2018. Also, we seek to define an appropriate policy to encourage economic growth based on the results. Thus, the following problem is posed: What is the relationship between fiscal policy tools and economic growth in Algeria?

Research hypotheses

H_0: The fiscal policy adopted by Algeria did not contribute to achieving economic growth.

H_1: The fiscal policy adopted by Algeria contributed to achieving economic growth.

Empirical evidence:

- (Tun Lin Oo, 2019), in a study titled "The Effect of Fiscal Policy on Economic Growth in Myanmar ", this study examines the effect of fiscal policy on economic growth in Myanmar. Using the ordinary least squares (OLS) method with annual data from 1979-2016. The variables include: gross domestic product, gross capital formation, real exchange rate, budget deficit, general government expenditure, trade openness. The results reveal a statistically significant relationship between the country's fiscal deficit and economic growth. Analysis shows the existence of a multiplier effect of deficit spending on economic growth, which confirms Keynesian assumptions.

- (Abdullah Ali Al-Masaeed, Evgeny Tsaregorodtsev, 2018), in a study titled "the impact of fiscal policy on the economic growth of Jordan", the study examined the impact of fiscal policy measures by (government expenditure, government revenue, internal public debt, external public debt) in addition to exports and inflation factors on the Jordanian GDP growth, for the period 1990-2010, the study used multiple linear regression and (ols). The study found that government expenditure, government revenue, and exports have a positive and significant impact, internal public debt and inflation has a negative and significant impact, while external public debt has a negative but not significant impact of the Jordanian GDP growth.

- (Horst Hanusch,Lekha S. Chakraborty,Swati Khurana, 2017), in a study titled "Fiscal Policy, Economic Growth, and Innovation ", the paper examines the relationship between fiscal policy and economic growth for the G20 countries over the period 2000–2010, using a panel data analysis. This analysis included human capital, infrastructure, and defense spending as control variables, results show that Public expenditures for R&D (innovation) have a significant positive macroeconomic impact on economic growth, so investment in R&D is crucial for sustainable economic growth in the G20 countries.

- (Bakare-Aremu and all, 2015), in a study titled:" Effect of Fiscal and Monetary Policies on Industrial Sector Performance- Evidence from Nigeria" During the period 1970-2009, using VECM, in short, to encourage domestic investors and gain more foreign investors the government should maintain its moderate tax pattern Since it affects the investor and encourages the growth of production.

- (Alex E. Osuala,Ebieri Jones, 2014), in a study titled "Empirical Analysis of the Impact of Fiscal Policy on Economic Growth of Nigeria ", during the period 1986-2010, using (ARDL) model, The variables the study include: Real Gross Domestic Product, government Non-oil Taxes, government recurrent expenditure, government capital expenditure, government total debt. The findings were, that Specific fiscal policy variables that have a significant and positive impact on economic growth in Nigeria are: expenditures recurrent and capitalism. Non-oil taxes and government total debts have no significant impact on real GDP, only capital expenditure has a short-run equilibrium relationship with economic growth.

- (SHAHID ALI and NAVED AHMAD, 2010), in a study titled "The Effects of Fiscal Policy on Economic Growth" for the period 1972–2008, using ADF test, PP test, and Ng Perron unit root test, the variables include: GDP, Overall Budget Deficit/Surplus, Gross Private Domestic Investment, Public Debt, Exchange Rate, Interest Rate, Money Supply. The results show that there is a negative long-run relationship between the overall fiscal deficit and economic growth using the nonlinear equation; we find that fiscal deficit positively affects economic growth. The results of ECM suggest that in the short run overall fiscal deficit exerts a significant impact on economic growth, this reveals the fact that in the short run rising fiscal deficit creates excess demand, which encourages firms to use more of their existing capacity, and hence economic situation in the short run improves, but in the long run, the growing fiscal deficit him has some serious implication for economic growth.

- (Matthew Kofi Ocran, 2009) , in a study titled "Fiscal Policy and Economic Growth in South Africa". The fiscal policy variables include government gross fixed capital formation, tax expenditure, and government consumption expenditure as well as the budget deficit. The study covered the period 1990 -2004, quarterly data was used in the estimation with the aid of vector regressive modeling technique and impulse response functions. The outcome supports four key conclusions. First, government consumption expenditure has a significant positive effect on economic growth. Gross fixed capital formation from the government also has a positive impact on output growth but the size of the impact is less than that attained by consumption expenditure. The tax also has a positive effect on output growth. However, the size of the deficit seems to have no significant impact on growth outcomes.

- (Nikos Benos, 2009), in a study titled "Fiscal policy and economic growth ", this paper studies whether a reallocation of the components of public spending and revenues can enhance economic growth using data on 14 EU countries during 1990-2006. The variables included in this study: the growth rate of real GDP per capita, government expenditure, taxes. The results are: a) public expenditures on infrastructure and property rights protection exert a positive impact on growth; b) distortionary taxation depresses growth; c) government expenditures on human capital enhancing activities (education, health, housing-community amenities, environment protection, recreation-culture-religion) and social protection do not have a significant growth effect.

I -Theories of study and research methodology*:*

I-1- Theories of study:

Various researchers have written on different aspects of fiscal policy. The studies of the effect of public expenditure on the economy have shown a positive relationship according to (Ram, R. , 1986); (Barro, R. J. , 1991); (Easterly, W., & Rebelo, S. , 1993); (Otani, I., & Villanueva, D. , 1990), while others such as (Abu-Bader, S., & Abu-Qarn, A. S., 2003), and (Laudau, D., 1986)found a negative relationship. However, (Kormendi, R. C., & Maguire, D. G., 1985) could not find any relationship (Sylvia Uchenna Agu and all, 2015). According to Hume,

public debt was likely to lead to injurious tax increases in the short run and possibly to default in the long run. The consensus view was that debt financing was to be used only under exceptional circumstances, such as wars (Abderrahim Chibi and all, 2019). According to "Endogenous growth theory", fiscal policy can affect both the level and growth rate of per capita output. A group of economists believes that economic growth is the result of capital accumulation and another group believes that technical progress is effective and does not accept that economic growth is influenced by factors such as fiscal policy. To examine the effects of fiscal policy on economic growth, first, need to be properly classified and then the impact of each of them separately to be examined on economic growth. These authors employ a Cobb-Douglas-type production function with government-provided goods and services as an input to show the positive effect of productive government spending and the adverse effects associated with distortionary taxes. The endogenous growth models predict that an increase in productive spending financed by non-distortionary taxes will increase growth, whilst the effect is ambiguous if distortionary taxation is used. Also, an increase in non-productive spending financed by non-distortionary taxes will be neutral for growth, while if distortionary taxes are used the impact on growth will be negative (Morakinyo, Faith Opeyemi and all, 2018). In addition, fiscal policy is based on the theories of British economist John Maynard Keynes whose theory states that governments can influence macroeconomic productivity levels by increasing or decreasing tax levels and public spending. This influence, in turn, curbs inflation, increases employment, and maintains a healthy value of money (Morakinyo, Faith Opeyemi and all, 2018). The Keynesians believe that there is a strong linkage between government expenditure and economic growth. In their model, it is indicated that an increase in government expenditure leads to higher economic growth. In opposition to this view, the neo-classical growth models again argue that government fiscal policy is at variance with the growth of national output. This leads to the further argument that government fiscal policy (intervention tool) helps to adjust failure that might arise from the inefficiencies of the market (Nwankwo and all, 2017). The proponents of the classical view assert that the effect of government spending is temporary and not effective particularly in the long-run when prices adjust and output and employment are at their optimum levels, Glomm and Ravikumar (1997) demonstrate that investment and education spending government affects directly and positively on the economic growth, Zagler and Durneker (2003) concede that while certain public consumptive expenditures may not directly impact on long-run growth they may well have positive welfare implications in the economy. There is also debate about taxation as a short-run fiscal policy instrument and its effect on long-run growth. While one group of taxes such as those on savings, R&D, profits, raw capital, and labor are deemed to have a direct impact on economic growth, all other tax forms are regarded as inconsequential to growth (Matthew Kofi Ocran, 2009). The fiscal policy is not important in the Ricardian equivalence theory because economic agents will reduce their current consumption after an increase in government spending or a reduction in taxation because they would expect, the tax rate will increase in the future to reduce the deficit caused by an expansionary fiscal policy. Finally, the theory of expansionary fiscal contraction argues that an increase in fiscal spending that is coupled with increasing uncertainty and the low credibility of government could reduce the desire for current consumption, leading to negative reactions of output to expansionary fiscal policy (Malaysia, 2016).

I-2- Research methodology:

- **Methodology:**

Autoregressive Distributed Lag (ARDL) Bounds testing approach to determine the existence of long-run equilibrium relationships between variables, developed by Pesaran and Shin (1998) and later expanded by Pesaran, Shin, and Smith (2001). One of the most important advantages of the ARDL method is that the variables used in the analysis can be a mix of I(0) or I(1). Also, with the help of using this approach, one is allowed to estimate short-run, long-run effects simultaneously by (ECM) derived from the ARDL model without loss of long-run

information. Moreover, it provides efficient and unbiased estimator in small sample size and it has opportunities to determine different lag length with their respective variables (Tekilu Tadesse,Tesfaye Melaku, 2019). Once the model is estimated, the first step is to analyze the long-run relationship between variables. In this sense, the F-statistic of the Bounds Test is computed and compared to the asymptotical critical values of the test. If the calculated F-statistic is greater than the upper bound critical value, then the null hypothesis of no cointegration relationship can be rejected and it can be concluded that a long-run relationship exists between the variables. If F-statistic falls between the lower and upper bounds, the results of the test are inconclusive. If the long-run relationship is confirmed by the Bounds Test, the coefficient − of the error correction term (ECT) will show how quickly an equilibrium distortion is corrected. Also, the long-run and short-run coefficients of the model will be discussed to assess their impact on the dependent variable, the ARDL model is tested for stability with the aid of the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests. The stability of the estimated coefficients is confirmed if the values of both tests remain within the critical values at 5% (Andreea STOIAN, 2019).

- **Data:**

We will try to build a standard model that explains to us the effect of fiscal policy on economic growth, it is necessary to define before that the variables of the model, the reason for its choice and its mathematical form.

Dependent variable: Real GDP per capita as an indicator of economic growth, we denote it as "y"

Independent variables: There are a set of factors affecting economic growth, including:

-Total real government spending, denoted in "RG"

-Real direct taxes, denoted by "RTDIR"

-Real indirect taxes, denoted by "RTINDIR"

-The level of public debt, denoted by "DEPT"

-Government budget balance (deficit/surplus), denoted by "DEFT"

The data is compiled from the World Bank (WDI) and some national special bodies such as the National Bureau of Statistics, the Ministry of Finance, and the Algerian Central Bank. The analysis from the applied side is based on an annual data series for the Algerian economy (1980 -2018), as standard quantitative methods will be used to identify the nature of the impact of fiscal policy on the Algerian economic growth.

After describing the fiscal policy in Algeria, and based on the previous theoretical approaches and applied studies previously described in the theoretical section, a model for the economic growth in Algeria, can be presented in the form of:

$$\log(y_t) = a_0 + a_1\log(RG_t) + a_2\log(RTDIR_t) + a_3\log(RTINDIR_t) + a_4\log(DEPT_t) + a_5 DEFT_t + \varepsilon_t$$

II- Estimation of Autoregressive Distributed Lag approach model (ARDL Model):

II-1- Testing of the Unit Root Hypothesis:

Despite the multiplicity of unit root tests, but we will use the Phillips-perron test and the following table shows the results of the test:

Table n°1: Phillips-perron (PP) unit root test

Variable	test ADF	Prob			Variable	test ADF	Prob		
y	/Level Model03	0.9564	acptH_1	I(1)	RTINDIR	Model01/Level	1.0000	acptH_1	I(1)
	/D(-1) Model03	0.0050				Model02l/D(-1)	0.0001		
RG	/Level Model03	0.9997	acptH_1	I(1)	DEPT	Model01/Level	0.6967	acptH_1	I(1)

	/D(-1) Model01	0.0000				Model03/D(-1)	0.0000		
RTDIR	/Level Model01	0.9980		I(1)	DEFT	Model03/Level	0.0074	acptH_0	I(0)
	/ D(-1) Model02	0.0034	acptH_1			/D(-1)	//		

Source: Prepared by researchers using outputs EVIEWS10

Where: Form 01: Contains only static / Model 02: Contains static and general direction / Model 03: Without static and general direction

Through table n°1, it clear that the hypothesis of a unitary root in the level cannot be rejected for all variables, where we note that prob <from the level of significance 1%. This means that these variables are not stable in the level, and for this, we apply the difference first degree, where all the variables become stable in it, except for the DEFT variable, it is stable in the level I(0) because prob <from the level of significance 1%.

II-2- Lag Selection of ARDL:

We will use the ARDL model with a delay rank (p = 4). This rank was chosen based on a set of tests, the most important of which are Akaike (AIC) and (SC) Schwarz, and Table n°2 illustrates this.

Table n°2: Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	331.8030	NA	9.05e-16	-17.61097	-17.34974	-17.51888
1	572.4969	390.3145*	1.46e-20	-28.67551	-26.84690	-28.03084
2	609.0812	47.46067	1.66e-20	-28.70709	-25.31110	-27.50985
3	653.8604	43.56899	1.63e-20	-29.18164	-24.21828	-27.43182
4	720.0084	42.90678	9.59e-21*	-30.81126*	-24.28051*	-28.50887*

Source: Prepared by researchers using outputs EVIEWS10

II-3- Bounds test:

We compute a statistic (F) according to Table n°3.

Table n°3: Bounds test

Test statique	value	Signif	I(0)	I(1)
F-statique K	9.356362 5	10% 5% 01%	2.08 2.39 3.06	3 3.38 4.15

Source: Prepared by researchers using outputs EVIEWS10

From the Bounds test, it appears that the hypothesis of a common integration relationship cannot be rejected at the levels 1%, 5%, 10%, as the calculated statistic (9.356362) is higher in all boundaries. This means, there is a balance relationship long-run between model variables.

II-4- A balance relationship long-run:

We measure the long-run relationship within the ARDL model. This stage involves obtaining an estimate of the parameters for the long run, as shown in Table n°4.

Table n°4: Estimated Long Run Coefficients Using the ARDL

Variable	coefficient	Prob	Variable	Coefficient	Prob
Log(RG)	0.155287	(0.0223)**	Log(DEPT)	-0.228302	(0.0000)*
Log(RTDIR)	-0.203109	(0.0076)*	DEFT	-11667.14	(0.0076)*
Log(RTINDIR)	-0.021039	(0.5162)	C	9.507574	(0.0000)*
R-squared	0.99		F-STATIQUE	162.7546	(0.0000)*

Source: Prepared by researchers using outputs EVIEWS10

Where as: (): error probability / *: at the level of significance 1%, **: at level of significance 5%, ***: at level of significance 10%

$$\log(y)\,t = 9.507574 + 0.155287\log(RGt) - 0.203109\log(RDIRt) - 0.021039\log(RTINDIRt) - 0.228302\log(DEPTt) - 11667.14DEFTt + \varepsilon$$

II-5- Error Correction model (ECM ARDL)

Table n°5: Error Correction model (ECM ARDL)

Variable	coefficient	Prob	Variable	Coefficient	Prob
Log(RG)	0.034895	(0.0309) **	Log(DEPT)	-0.078400	(0.0000)*
Log(RTDIR)	0.064801	(0.0001)*	DEFT	956.8423	(0.0251)**
Log(RTINDIR)	-0.034234	(0.0003)*	ECM (-1)	-0.47	(0.0000)*
D.W				2.426692	

Source: Prepared by researchers using outputs EVIEWS10

II-6- Standard tests for the *model*:

Table n°6: Diagnostic tests

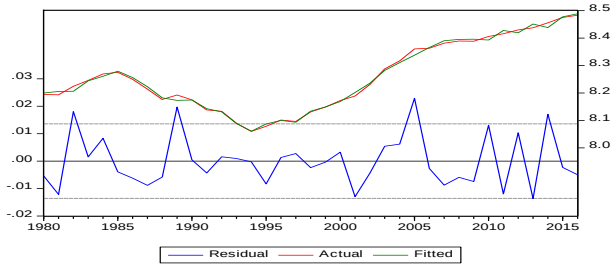
Type de test		H_0	prob
Breusch-Godfrey Serial Correlation LM Test		No self-correlation between errors.	0.2971
Heteroskedasticity Test	Breusch-Pagan-Godfrey	There is no problem with the variance fixity.	0.9509
	ARCH		0.9872
	Harvey		0.2202
Histogram-Normality Test		The residuals are distributed naturally.	0.1360

Source: Prepared by researchers using outputs EVIEWS10

A set of diagnostic tests was also applied to the empirical model to gauge the efficiency of the specification of the model (Table n°6). The diagnostic tests confirm that there is no evidence of a problem with the model because PROB> of a 5% level of significance for all tests, and accordingly we accept H0.

✓ **Comparing actual and estimated values of the model:**

Figure n°1: Actual and estimated values of the model

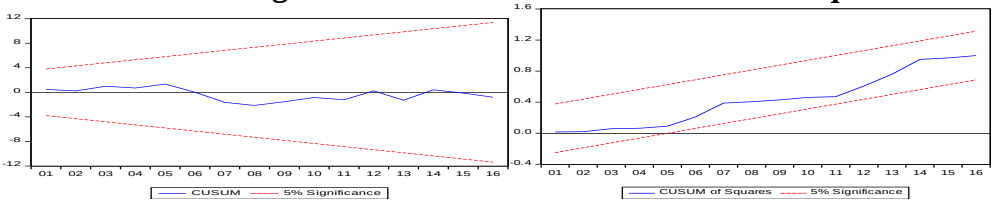


Source: outputs EVIEWS10

Through the figure, it becomes clear to us that the behavior of the actual and estimated values is identical, and therefore this model can be relied upon for the purposes of economic policies.

✓ **Model stability test:**

Figure n°2: CUSUM test and CUSUM of squares test



Source: outputs EVIEWS10

Through Figure n°2, we note the test of the cumulative sum of the rest and the cumulative sum of the remaining squares, they are located inside the critical bounds at the level of 5%, this indicates the presence of stability and harmony in the model between the results of the long-run and the results of the short-run.

II-7- Results of the estimate:

- ✓ The value of the coefficient of determination R^2=0.99, which means that the interpreted variables explain to us about 99% of the changes in the dependent variable.
- ✓ Regarding the Ficher test, we note that "Prop (F-statistic) = 0.000", and therefore the model as a whole is important, and the estimated model is able to explain the dependent variable during the period Subject of study.

As for the significance of the variables explained, we find:

- ✓ For the RG variable, we find that the latter has a positive relationship with the economic growth in the short and long run and statistically significant, which means that expansionary fiscal policy through the government spending channel has a positive impact on the economy, by spending more than 443 billion $ through development programs, this gave dynamism to investment And for economic growth anew. This is consistent with both studies (Ram, R. , 1986); (Barro, R. J. , 1991); (Easterly, W., & Rebelo, S. , 1993); (Otani, I., & Villanueva, D. , 1990), and Keynes' theory, which holds that an increase in government spending leads to higher economic growth.
- ✓ For the RTDIR variables, we find a positive relationship with the economic growth in the short run and Statistically significant, it can be explained economically, that paying the tax on profits reduces the financial pressure on companies, but it deprives her of the opportunity to use in other activities, and on it shows that it has a negative relationship in the long run, and it is statistically significant at the level of 1%, As income taxes weaken the incentives for work among individuals, and thus negatively effect on economic growth, through influence on the ability to work and the size of the investment, as this latter depends on the size of savings. If the tax leads to a decrease in income, this leads to a lack of savings, this is consistent with (Bakare-Aremu and all, 2015)study, which holds that a tax system is hostile to production and can lead to an economic threat.
- ✓ For the RTINDIR variables, it has a negative effect in the short run, it can be explained this the higher the indirect tax rate, the more it leads to the economy shrinking and weakening the purchasing power of the citizen and thus the production is affected which negatively affects economic growth, but in the long run, it has no illustrative ability in the model and this is consistent with a study (TESAR,RAZIM ,MENDOZA, 1994), where researchers found that indirect taxes have a negative and important effect on investment, but this effect is not sufficient to obtain statistically significant effects on growth long-run.
- ✓ Regarding the variable DEFT, we find that the fiscal deficit has a positive relationship with economic growth in the short run, but in the long-run has a negative relationship, this is consistent with a study (SHAHID ALI and NAVED AHMAD, 2010). As for the variable DEPT, we find that it has a negative relationship with economic growth in the short and long run, unlike the economic Keynesian theory, and we explain that the fiscal policy is dependent in Algeria for the economic cycle. High debt and fiscal deficit is evidence of adoption deflationary fiscal policy, the main reason of fiscal contraction in Algeria is that government activities are mostly unproductive and therefore restrains growth, as for the statistical aspect, the two variables are statistically significant and therefore the two variables have an explanatory ability in the model in the long and short run.

Conclusion:

The relationship between fiscal policy and economic growth was a fundamental issue for many economists; sound fiscal policy plays a large role to achieve the desired goal, which is economic

growth. This study examined the impact of fiscal policy on economic growth in Algeria during the period 1980-2018, through using the ARDL model. However, the effect of the variables under study did not have the expected positive impact, this Evidence that defect in the fiscal policy in Algeria, thus we accept the hypothesis H0. In light of the results of this study, we believe that the main challenge of the state is to achieve sustainable and diversified growth with the strength of productive investment, thus we will provide a set of suggestions and recommendations where the public authorities should work on achieve:

- Government expenditures could be restructured to transform them into better instruments for reducing poverty, and promoting sustainable growth. This implies reducing perverse subsidies and reallocating public expenditures directed toward productive areas for long-run growth, such as infrastructure development, health, and education. It does not mean that the government could select a growth trajectory that is not consistent with its comparative advantages. On the contrary, the quality of growth would be higher if the comparative advantage of a country were allowed to develop to the fullest extent. Structural inequality would be narrowed by mitigating market imperfections.
- With a significant reduction in hydrocarbon revenues, Algeria needs to mobilize more no-hydrocarbon revenues, so in order to increase the latter, tax exemptions (e.g., on VAT) should be significantly reduced, excise taxes increased, and property taxes overhauled. Medium and long term solutions lie in improving, facilitating tax, and customs legislation, which can lead to more revenue collection. Therefore, tax reforms should be in a way that encourages investment and fights corruption.
-There is a need for the Algerian government to invest heavily in productive investment and infrastructure to boost economic growth. Financing the real sector could do the magic. Therefore, the financial sector reforms and liberalization should be strengthened to link up with the real sector.
- Government should fight the problem of corruption because, without a reduction of the level of corruption in the country, fiscal policy components will not achieve the required level of economic growth in Algeria.
- The government should ensure that policy consistencies and policy reversals are properly checked for both short and long-run effects on the economy.

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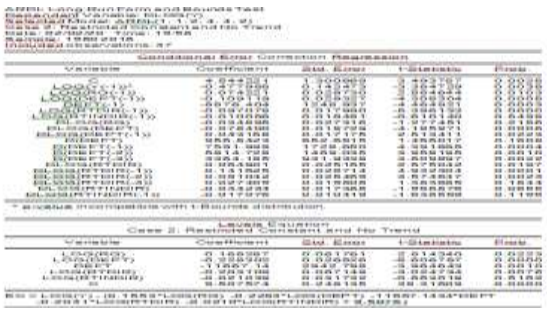
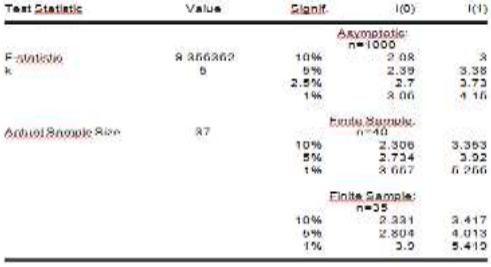
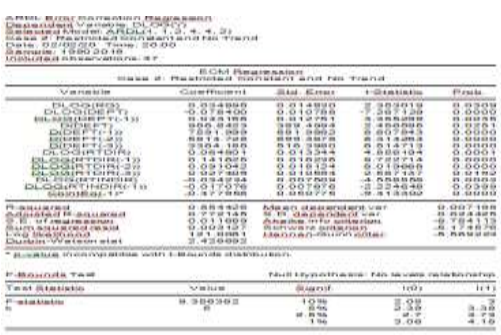
Appendix

Appendix 01: bounds test and estimate parameters in the long run





Appendix 02: Error Correction regression. Appendix 03: lag model.



VAR Lag Order Selection Criteria
Endogenous variables: LOG(Y) LOG(RG) LOG(RTDIR) LOG(RTINDIR) LOG(DEPT) DEFT
Exogenous variables: C
Date: 02/06/20 Time: 12:48
Sample: 1980 2018
Included observations: 37

Lag	LogL	LR	FPE	AIC	SC	HQ
0	331.8030	NA	9.05e-16	-17.61097	-17.34974	-17.51888
1	572.4069	390.3145*	1.46e-20	-28.67551	-26.84690	-28.03084
2	609.0812	47.46067	1.66e-20	-28.70709	-25.31110	-27.50985
3	653.6604	43.56886	1.63e-20	-29.18164	-24.21828	-27.43182
4	720.0084	42.90678	9.59e-21*	-30.81126*	-24.29051*	-28.50887*

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

Appendix 04: Diagnostic tests

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.453097	Prob. F(19,17)	0.9509
Obs*R-squared	12.43818	Prob. Chi-Square(19)	0.8661
Scaled explained SS	2.642023	Prob. Chi-Square(19)	1.0000

Heteroskedasticity Test: ARCH

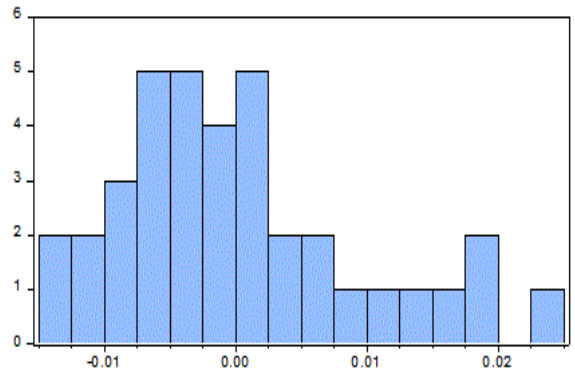
F-statistic	0.082066	Prob. F(4,28)	0.9872
Obs*R-squared	0.382401	Prob. Chi-Square(4)	0.9839

Heteroskedasticity Test: Harvey

F-statistic	1.456389	Prob. F(19,17)	0.2202
Obs*R-squared	22.91940	Prob. Chi-Square(19)	0.2409
Scaled explained SS	22.06621	Prob. Chi-Square(19)	0.2810

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.161798	Prob. F(1,16)	0.2971
Obs*R-squared	2.504780	Prob. Chi-Square(1)	0.1135



Series: Residuals
Sample 1980 2016
Observations 37

Mean	-3.34e-15
Median	-0.002298
Maximum	0.022900
Minimum	-0.013668
Std. Dev.	0.009319
Skewness	0.804243
Kurtosis	3.012405
Jarque-Bera	3.988879
Probability	0.136090