

Fiscal Policy and Economic Growth a Cointegration Approach Based on Structural Breaks: Evidence from Algeria

Mustapha Djaballah¹

¹ Professor, Economics Department, Mohamed Boudiaf University, Algeria

Correspondence: Mustapha Djaballah, Professor, Economics Department, Mohamed Boudiaf University, Algeria.
E-mail: mustapha.djaballah@univ-msila.dz

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Abstract

In this paper, we studied the impact of fiscal policy tools on economic growth in Algeria for the period from 1970 to 2022, and after testing this impact, we took that oil taxes and non-oil taxes represent two independent variables of economic growth. This study shows that there is a long-term relationship between the two variables. The study also found that the cointegration test of Gregory Hansen and Hatami -J applies under regime change. The results of the study showed that there is a cointegration relationship between the variables in the case of the presence of one constructive interval. As for the two structural breaks, our paper confirmed the presence of a cointegration The relationship between these variables. We find the long-run coefficients for. The cointegration test has showed that there is an absence of a cointegration relationship, This method supported the hypothesis of the absence in a cointegration relationship in the case of the absence of structural breaks, while when we used the cointegration approach based on breaks, we confirmed clear evidence of this, in the case of more than three structural breaks in the long-run relationship between variables.

The results of this study were confirmed by the Maki test, for example it appears first that fiscal policy exerts a weak positive impact on economic growth, after 2015, while regular taxes are only affected in the long run according to New Keynesian expectations, and it is natural that taxes exert the opposite effect. We concluded that this is due to the decline in the price of oil and the impact on its revenues for approximately 5 years

Keywords: Fiscal policy, Economic Growth, Structural Break, Algeria

JEL Classification Codes: C54;H3; H6; O5; O55

1. Introduction

The Algerian economy considers itself a transitional economy from a planned economy to a market economy. Algeria adopted a planning program immediately after independence (1967-1989), and the launch of the central planning program was aimed at building an economy specific to Algeria, an economy that would create an independent Algeria by confronting and ending political and economic bias. Since 1990, the Algerian economy has been qualified as a transitional economy from a planned economy to a market economy, where investment is strongly Based on the cointegration approach, we confirmed the absence of a cointegration relationship in the absence of structural breaks. We also proved the existence of a cointegration relationship, especially with the presence of more than 3 breaks, which means the presence of breaks. The long-run relationship between variables when economic growth is the explanatory variable

From the results of this study, it appears first that fiscal policy exerts a weak positive impact on economic growth, after 2015, while regular taxes are only affected in the long run according to New Keynesian expectations, and it is natural that taxes exert the opposite effect. We concluded that this is due to the decline in the price of oil and the impact on its revenues for approximately 5 years encouraged by supporting the sector. In addition, it has opened up to the global economy, especially the European continent, and has taken advantage of the geographical proximity to Europe to establish strong economic relations with some European countries such as Spain. Italy and Germany

However, the structural reforms that Algeria initiated by adopting and installing new methods within the framework of supporting the regular tax compared to oil by diversifying non-fuel revenues, amending the tax law in 1991 within the framework of the financial program and through the policy of diversifying income from taxes, but the Algerian economy is like many economies. Developing countries are characterized by the dominance of fiscal policy, Bulut

U(2016) while the role of monetary policy with the central bank is very weak when compared to many developed and emerging countries. Dufour J Mand King M(1991), drawing on the ideas of the classical school, public authorities should avoid interfering in the normal functioning of the productive sector, by maintaining moderate tax pressure and public spending at the lowest possible level. Easterly W and Rebelo S (1993, while Keynes's followers justify state intervention in economic and social life. Therefore, the concept of tax neutrality has become questionable. In fact, the tax creates distortions in individuals' financial plans (income tax), and disturbances in their consumption (tax on expenditures such as VAT that leads to higher prices). Thus, all fiscal measures, i.e. creation of a tax, i.e. amendment or abolition of a tax or levy, have an impact on production. The effects of tax measures on economic growth have been highlighted in the context of work on endogenous growth models. Barro (1990) explains that high tax pressure slows down the economic growth of a country. Econometric studies by Engen and Skinner (1996), Melisi-Ferretti and Roubini (1998), and Föllster and Henriksson (2001) have confirmed the conclusions of Barro (1990), while Easterly and Rebelo (1993) and Mendoza et al. (1997) have confirmed that the effect of cuts The level of tax development and the rate of economic growth is difficult to isolate the tax system

The tax system in Algeria is essentially a declarative tax system subject to the right of monitoring and verification. It consists of two main parts, especially ordinary taxes and taxes on oil. The decline in oil prices that began in June 2014 prompted public authorities to intensify discussions on favorable tax measures to mobilize sufficient revenues to finance the state budget. Through a fiscal policy explanations, this study provides an econometric assessment of the macroeconomic effects of tax policy, in particular tax levies, on economic growth in Algeria. The approach used is based on an estimate through structural cointegration from annual data covering the period 1970-2022. Organizing this paper into three sections, the first section is devoted to reviewing the theoretical and empirical literature on the relationship between fiscal policy and economic growth, and the second section will provide an analysis of some unit root and cointegration tests with the presence of structural fraction in the methodology and data. Finally, the third section will discuss the empirical results

2. Lilerature Review

Many previous and contemporary studies have focused on the methodology of breakpoints cointegration and non-linear relationships between variables. This is a sample of studies that focus on economic growth and fiscal policy, which we will mention in the following table. Table1. Some applied studies

Author(s)	Time Period	Research area	methods	Findings
Juanna Siwińska and Bujak (2003)	1975-2001	oecd	Pooled Least Squares	results suggest that, similarly to OECD countries, consumption function does not react in linear changes in fiscal policy also in transition economies.
Ndoricimpa Arcade 2013	1985-2012.	East African Community (EAC)	Structural break cointegration	The finding implies that for Burundi, Kenya, Tanzania and Uganda, fiscal sustainability needs to be reinforced otherwise the countries are at high risk of default since they spend more than they earn.
Apergis (2015)	1980-2014	five European countries Union(5EU)	GARCH	the findings suggest that the current austerity programmes implemented by these economies, especially the Greek government, is expected to trigger upward debt spirals, contributing to further fiscal unsustainability.
Trachanas, and Katrakilidis (2014)	1960-2011	Greece	Regime shifts	the Greek budget deficit is unsustainable. The parameter after the second detected break reflects the structural deficiencies of the Greek economy
Yasa and Zerif	1960-2013	some European countries and Turkey	Panel Cointegration Analysis	the level of energy demand exceeds the level of energy, these countries are diversified from each other with varying degrees of budget balances, supply-demand relations,
Chibi and al (2019)	1963Q1-2017Q1	Algeria	STAR models	the time series of budget balance is not stationary (not mean reverting characteristic), and therefore cannot sustain the budget deficit in Algeria
Jibrilla A (2016)	1961 to 2014.	Nigeria	ECM and ARDL in structural with presence of breaks	The results did not indicate the presence of asymmetries in either the threshold autoregression adjustment process.
Djaballah and Bissar (2020)	1990Q1-2013Q4	Algeria	DSGE model	Fiscal policy can impact the conduct of monetary policy through multiple channels. Indeed, the increase in public spending short-term demand, while long-term investments act on the production path of the economy
ASIF and	1990-2016	INDIA	ARDL	no co- integration relationship between the variables in

Husain (2018)				case of single structural break, but for two structural break our study confirms existence of co-integration relationship for the given variables.
NEIL and VERSPAGEN 2016	1990-2010	Asian Economies	OLS	The results indicate that labor productivity developed in most Asian economies It was the dominant variable whose effect appears on GDP per capita

Source: Author work

3. Research and Methodology

We begin by reviewing some of the basic properties of unit root without structural break and trend-stationary processes including the possible structural breaks in such processes.

3.1 Unit Root Test without Structural Break

In this section we will present unit root tests that are parametric or semi parametric extensions of the Dickey-Fuller test, see Ng - Perron(2001). We will state the underlying assumptions and consider generalizations in various directions. Malik M I and Atiq ur R(2014)

3.1.1 NG- Perron

Dufour and King (1991) and Elliott, Rothenberg, and Stock (1996) found that local GLS detrending of the data yields significant power gains. Phillips and Perron (1988) found that use of SD could improve performance of test. Ng and Perron (2001) combines GLS detrending with SD to design new test. The proposed test consists of a suite of four tests, namely MZa, MZt, MSB and MPT. The four test statistics proposed by Ng-Perron are

$$MZ_a = \frac{((T^{-1} \bar{y})^2 - \hat{f})}{2k} \tag{1}$$

$$MSB = \left(\frac{k}{\hat{f}(0)}\right)^{1/2} \tag{2}$$

$$MZ_t = MZ_a * MSB \tag{3}$$

$$MPT = \begin{cases} \frac{\bar{c}^2 k \hat{c} T^{-1} (\bar{y})^2}{\hat{f}(0)} & \text{when } d_t^0 \\ \frac{\bar{c}^2 K(1-\bar{c})T^{-1}(\bar{y})^2}{\hat{f}(0)} & \text{wwhen } d_t^1 \end{cases} \tag{4}$$

Where d_t^0 represent drift and d_t^1 represent drift and trend in DGP

$$\text{and } k = \frac{\sum_{t=1}^T ((\hat{y}_{t-1}))^2}{T^2}$$

The symbol $\hat{f}(0)$ indicates of spectral density at frequency zero Irfan and Rahman(2014)

3.2 Unit Root Test with One and Two Structural Breaks

We will choose lee strazicitch (2013) which represents unit root test with a single break and for two breaks there is Clemente, J., Montañés, A., Reyes, M., (1998)

3.2.1 Lee -Strazicitch with One Structural Break

The Langrange Multiplier (LM) based structural break test was developed by Lee and Strazicich (2013) the spurious rejection problems associated with the Zivot and Andrews (1992) and Perron (1989) endogenous break test. Consider the data generating process (DGP) as follows:

$$y_t = \Phi' z_t + X_t, \quad X_t = \beta x_{t-1} + \varepsilon_t \tag{5}$$

In previous equation X_t is a vector of independent variables and \sim IID $N(0, \sigma^2)$.

$X_t = [1, T X_t \text{ DUM1, DUM2}]'$, also $\text{DUM } j = 1$ for $T \geq + 1, j = 1, 2$, and 0 otherwise. TCj indicates the period of time which there is a break. we include two changes in level and trend and is noted by $X_t = 1, t, \text{DUM1t}$,

$$H_0: y_t = \Omega 1 + \text{DUM1} + C1t + \text{DUM2} C2t + y_{t-1} + U1t \tag{6}$$

$$H1: y_t = \Omega_2 + Y_t + DUM1 D1t + DUM2 D2t + U2t \tag{7}$$

We have a stationary error terms $C_j T=1$; for $t= TC_j +1, j=1,2$ and 0 otherwise; Bulut (2016)

3.2.2 CMR Test with two Structural Breaks (1998)

Clemente et al (1998) base their approach on Vogelsang and Perron(1992), allowing for the possibility of having two structural breaks in the mean of the series, the case of two changes in the mean, the hypothesis is that

$$H0: y_t = y_{t-1} + \delta_1 DTB_{1t} + \delta_2 DTB_{2t} + u_t \tag{8}$$

$$H1: y_t = \mu + d_1 DU_{1t} + d_2 DTB_{2t} + e_t \tag{9}$$

Where DTB_{1t} is a pulse variable which equals to 1 if $t = TB_1 + 1$ and zero if otherwise; $DU_{it} = 1$ if $t > TB_i$ takes this values $i = 1,2$ and zero if otherwise; TB_1 and TB_2 are the two times Whenever we modify the mean of this time series. Clemente et al. (1998)

3.3 Cointegration Analysis with Accounting for Structural Breaks

3.3.1 Gregory-Hansen cointegration Test

In this case, we used the cointegration test with an unknown structural break, and this is what Gregory and Hansen (1996) suggested. The structural change will be reflected in a change in the intercept, a change in the slope, or both. Gregory and Hansen (1996) also used four different models as follows:

Model 1: Level Shift (C)

$$y_t = \gamma_1 + \gamma_2 \Psi_t + \alpha_1 x_1 + \alpha_2 x_{2t} + \alpha_3 \mu_{1t} + \alpha_4 \mu_2 + v_t \tag{10}$$

A shift in the cointegration relationship can be observed, depending on a change in the intercept, noting that the slope coefficient is always constant. Which means that the cointegration relationship has been transformed in a parallel manner. In this parameter, it represents the intercept before and after the transformation.

Model 2: Level Shift with Trend (C/T)

$$y_t = \gamma_1 + \gamma_2 \Psi_t + b_t + \alpha_1 x_1 + \alpha_2 x_{2t} + \alpha_3 \mu_{1t} + \alpha_4 \mu_2 + v_t \tag{11}$$

In this case b_t is the coefficient of the trend term, t.

Model 3: Regime Shift (C/S)

$$y_t = \gamma_1 + \gamma_2 \Psi_t + \alpha_1 x_1 + \alpha_{11} \Phi_{1t} + \alpha_2 x_{2t} + \alpha_{22} x_{2t} + \alpha_3 \mu_{1t} + \alpha_{33} \Phi_t \mu_t + \alpha_4 \mu_2 + \alpha_{44} \Phi_t + v_t \tag{12}$$

Model 4: Regime shift with trend (C/S/T)

$$y_t = \gamma_1 + \gamma_2 \Psi_t + b_t + \alpha_1 x_1 + \alpha_{11} \Phi_{1t} + \alpha_2 x_{2t} + \alpha_{22} x_{2t} + \alpha_3 \mu_{1t} + \alpha_{33} \Phi_t \mu_t + \alpha_4 \mu_2 + \alpha_{44} \Phi_t + v_t \tag{13}$$

The following parameters $\alpha_1, \alpha_2, \alpha_3$ and α_4 represent the slope coefficients for cointegration before the system transformation, while the features $\alpha_{11}, \alpha_{22}, \alpha_{33}$ and α_{44}

show the change in the slope coefficients referred to previously. Also, the same methodology can be relied upon in the equations to test models (10) to (12) if The timing of the regime shift was known in advance. Despite this, we believe that these stopping points are known in practice without relying on data. Gregory and Hansen (1996) proposed a cointegration test with an unknown break-off date, which relies on calculating the usual statistics (ADF and Philips) for all possible break-off points and then choosing the smallest value. There is a strong possibility that it will lead to rejecting the null hypothesis of no cointegration. In this regard, the relevant statistics are $ADF(\tau)$, $Z_a(\tau)$ and $Z_t(\tau)$

3.3.2 Hatemi- J Cointegration Test

There is a test proposed by Hatemi-J (2008) and it is based on the following equation:

$$y_t = \alpha + \beta x_t u_t \quad T= 1,2,\dots,m$$

This equation is generalized to take into account for the effects of two structural breaks on both the intercept and the slopes (two regime shifts) as follows:

$$y_t = \mu_0 + \mu_1 D1t + \mu_2 D2t + \Omega_0' x_t + \Omega_1' DUM1t z_t + \beta_2' DUM2t z_t + v_t \tag{14}$$

Note that $D1t$ and $D2t$ are dummy variables that we can define as

$$DUM_{1t} = \begin{cases} 0 & \text{if } T \leq mK_1 \\ 1 & \text{if } T \geq mK_1 \end{cases}$$

$$DUM_{1t} = \begin{cases} 0 & \text{if } T \leq mK_2 \\ 1 & \text{if } T \geq mK_2 \end{cases}$$

Knowing that mk_1 and mk_2 are unknown parameters $\in (0,1)$, and this affiliation depends on the relative timing of the regular change points, while the arc shows the correct duality. With two break points cointegration, the Hatami-G (2008) test is based on (ADF) asymptotic distribution of ADF statistics by Z_t calculations. (normal distribution)

we can define these tests as follows:

$$ADF^* = \inf(k_1, k_2) \in T ADF(k_1, k_2)$$

$$Z_t^* = \inf(k_1, k_2) \in T Z_t(k_1, k_2)$$

$$Z\alpha^* = \inf(k_1, k_2) \in T Z\alpha(k_1, k_2)$$

As these results reveal, the ADF test rejects the null hypothesis of no cointegration at the 1% significance level and the other two tests reject it at the 10% significance level. It should be mentioned that we conducted tests for unit roots in the presence of breaks prior to tests for cointegration, the results, not presented but available on request, showed that each variable is integrated of the first degree

3.3.3 MAKI Cointegration Test

We can also add in this study the Maki (2012) cointegration test which considers up to five structural breaks in the series. As a prerequisite for adopting this test, the selected variables are expected to be nonstationarity but integrated at $I(1)$. There are four alternative models proposed by the test

A- Model I : there is a break in the stable models, model without trend;

$$y_i = \Psi + \sum_{t=1}^k \Psi_t DUM_t \delta_t + e_t \dots\dots \dots \dots (15)$$

B- Model II: there is a break in stable term an slope, the model without trend;

$$y_i = \Psi + \sum_{t=1}^p \Psi_t DUM_t \delta_t \alpha z_t + \sum_{i=1}^p \alpha_t z_t DUM_{it} + e_t \dots\dots \dots \dots (16)$$

C- Model III : there is a break in stable term an slope, the model with trend;

$$y_i = \Psi + \sum_{t=1}^p \Psi_t DUM_t \delta_t + b_t + \alpha z_t + \sum_{i=1}^p \alpha_t z_t DUM_{it} + e_t \dots\dots \dots \dots (17)$$

D- Model IV: the model with break in stable term, slope and trend;

$$y_i = \Psi + \sum_{t=1}^p \Psi_t D_t \delta_t + b_t + \sum_{i=1}^p b_i t DUM_{it} + \alpha z_t + \sum_{i=1}^p \alpha_t z_t D_{it} + e_t \dots\dots \dots \dots (18)$$

We can watch that t takes the values $t=1,2,\dots,T$. $z_t = (z_{1t} \text{ to } z_{pt})'$ denote observable $I(1)$ variables, and u_t is the equilibrium error, y_t is a scalar, and $z_t = (z_{1t}, \dots, z_{pt})'$ is an $(p \times 1)$ vector. Maki (2012) assumes that an $(q \times 1)$ vector z_t is generated by $z_t = (z_t, z_t')' = z_{t-1} + \epsilon_t$, where ϵ_t are independent identically distributed. with null mean, and its matrix of variance-covariance Σ is positive and Symmetrical, we can also show that The expected absolute value of the residuals $E|\epsilon_t| < \infty$. DUM_t is a dummy variables and takes a value of 1 if $t > TB_i$ ($i=1,\dots,p$) and of 0 otherwise, where m is a number in extreme of breaks and TB_i means a time of break.

4. Results

4.1 Unit Root Test

4.1.1 Unit Root Without Structural Break

the econometric outcomes based on cointegration analysis and structural break cointegration approach we have used a conventional unit root tests such Ng – Perron Djaballah (2022) this study based on the comparison between the two analyzes in time series co-integration and unit root test , we will start with the first analysis, which is using a test that does not depend on structural breaks after the test proposed by Vogelsang, T., and P. Perron (1998) We use the last Ng-Perron (2001) test without structural breaks it can be used in stationary series, let us assume that these series are without structural breaks.

Table 2. Unit root test Ng-Perron result

Variable	MZa	MZt	MSB	MST
GDP	-0.251	-0.834	0.563	45.901
OILTAX	-0.112	-0.416	0.839	33.451
ORDTAX	-0.378	-0.472	0.924	55.683
D(GDP)	-17.559 ***	-5.011	0.475	4.558
D(G)	-21.093***	-4.788	0.655	5.113
D(T)	-23.91 ***	-4.904	0.7332	4.295

*** the significance at 1% ; D(...)is the first differences.

Source : Own calculation

Depending on table 2 that all the variables are stationary in I(1) this is based on results for Ng-Perron test,

4.1.2 Unit Root with one Structural Break

Based on outputs of minimum LM unit root test of Lee and Strazicich (2004) we can judge that all series are not stationary around a broken trend at least at 5% and all series have the unit root break for itch date .

Table 3. One endogenous structural break Lee-Strazicich unit root test result

variable	K	Break date (SB)	T- stat	Break point λ	inference
GDP	2	2014	-2.657	0.9	Unit root
OILTAX	4	1992	-2.086	0.4	Unit root
ORDTAX	1	2020	-3.195	0.4	Unit root

***, ** and * denote statistical significance at 1%, 5% and 10% respectively .Note: is the AIC lag term is used to select the optimal lag, to make the residuals white noise. denotes the estimated break points.

Source: OWN

4.1.3 CMR Unit Root Test with Two Structural Breaks

Clemente-Montanes-Reyes (CMR) (Clemente et al., 1998) with two Structural Breaks to estimate the order of integration of the variables.

Table 4. Clemente-Montanes-Reyes (CMR) outputs

variable	Innovative Outliers			Decision	Additive Outliers			Decision
	T-stat	SB1	SB2		T-stat	SB1	SB2	
GDP	-3.051	2014	1987	I(1)	-3.298	1987	1990	I(1)
OILTAX	-2.129	2008	2012	I(1)	-3.298	1993	2012	I(1)
ORDTAX	-3.331	2014	2020	I(1)	-3.298	2009	2020	I(1)

source : Own calculation

4.2 Cointegration with Presence of Break Point

4.2.1 Gregory-Hansen Cointegration Test

It can be concluded that the results obtained from the table show the existence of a cointegration nexus of variables using one structural interval down the Gregory Hansen test for 3 models with a 5 % significance level and four tests of all models at a 10 percent significance level.

Table 5. Gregory Hansen Cointegration Test outputs

Model	ADF	break date	Z_t	break date	Za	break date	SIC
C	-6.674	1992	-5.963	1992	-56.018	1992	-095
C/S	-5.198	1996	-5.732	1996	-61.578	1996	-0.65
C/T	-5.077	2012	-5.992	2012	-62.065	2012	-0.86
C/S/T	-5.097	2012	-5.679	2012	-61.537	2020	-1.09

We rely on the critical values of 5 % for both ADF and Z t which are -5.56, -5.83, -6.41 for the four models, respectively, while Za for the same models are -59.40, -65.44, -78.52, respectively ** indicating the presence of cointegration at 5% level.

Source: Own calculation

4.2.2 Hatemi –J Cointegration with 2 Structural Breaks

Hatemi-J test with structural breaks. Of all the tests that make up this test, two can demonstrate the null hypothesis at significance level .of 5%. This is strong evidence of the presence of a long-run relationship between study variables.

Table 6. Hatemi – j cointegration test result

Tests	t-stat	SB1	SB2	Critical values		
				1%	5%	10%
ADF* (Modified)	-7.125	2012:1	2008:2	-8.353	-7.903	-7.705
Zt* (Modified)	-7.988	2012:1	2008:2	-8.353	-7.903	-7.705
Za* (Modified)	-56.018	2012:1	2008:2	-140.13	-123.87	-116.16

The critical values are taken from Hatemi-J (2008a).

Source: Own calculation

4.2.3 MAKI Multiple Structural Break Cointegration

From the Maki test in all models and for structural break 3, 4 and 5, we conclude that there is a long-run relationship between regular taxes, oil taxes and economic growth in Algeria during the period 1970-2022 in this situation we registered at least two structural break .

Table 7. MAKI test result

Model	Statistic test	1%	5%	10%	Breakdate
0	-7.882	-6.56	-5.08	-4.78	1990 1992 2000 2004 2008
1	-7.451	-5.83	-5.37	-5.10	1990 1994 2002 2008 2011
2	-6.573	-6.25	-5.70	-5.40	1994 2000 2005 2010 2012
3	-6.744	-7.08	-6.52	-6.26	2000 2004 2008 2012 2020

Source: Own calculation

5. Conclusion

The data used in the empirical analysis were collected from the Algeria database on an annual basis and cover the period 1970-2022. The variables examined are economic growth and some fiscal policy variables represented in fiscal taxes and oil collection, both of which are proportional to the gross domestic product. Measuring the dataset using GDP as a common divisor reflects a country's output capacity while at the same time alleviating problems of heterogeneity, which typically arise in long-term loans. In the context of empirical analysis, complementary alternative unit root tests are used to examine the properties of integration between economic growth and tax policy instruments.

We applied a set of unit root and cointegration tests in both branches without a structural break and with a structural break as adopted

This study analyzes the cointegration nexus of fiscal policy and economic growth in Algeria using data covering the period 1970-2022, where our study variables of the long-run relationship, which are explained by two types of structural breaks such as (Ng(-Perron (test)) and cointegration) were investigated. With structural breaks (Gregory-Hansen test (1996), Hatemi-J test (2008) and Maki test (2012), the cointegration approach confirmed the absence of a cointegration relationship in the absence of structural breaks. However, we reached the opposite result in the case of the attendance of breaks when we discovered the existence of a cointegration relationship is strong, particularly with the presence of more than 3 intervals, which means the existence of a long-term relationship between the variables when economic growth was the dependent variable.

From the results of this study, it appears first that fiscal policy, depending on its variables, exerts a weak positive effect on economic growth, after 2015, while regular taxes are only affected in the long run according to the expectations of New Keynesians, and it is natural that taxes exert the opposite effect.

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