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Co-integration with regime shift between government expenditure and poverty reduction in Algeria

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Abstract. *This study investigates the direct impact of government expenditure on poverty reduction in Algeria from 1970 to 2017 so as to be able to find out if the government expenditure is pro-poor people or not, the Gregory-Hansen (1996) co-integration technique allowing for the presence of potential structural breaks in data is applied to examine the long run co-movement between poverty rate and government expenditure, the results shows that there is a structural break in poverty rates in 1989 using the Zivot-Andrews unit root test and in 1972 and 1986 using CMR and LM unit root tests, and there is a co-integration relationship with one break in 1986 among the variables, the results also suggests that there is no evidence of any affect from government expenditure on poverty rate over the period of study both in short run and long run term which means that the government expenditure in Algeria is not pro-poor people and the expenditure efforts presented by the government still very limited to impulse and reduce the poverty rates and to improve the standard living for the poor people.*

Keywords: poverty, government expenditure, structural breaks, co-integration.

JEL Classification: C22; H50; I32.

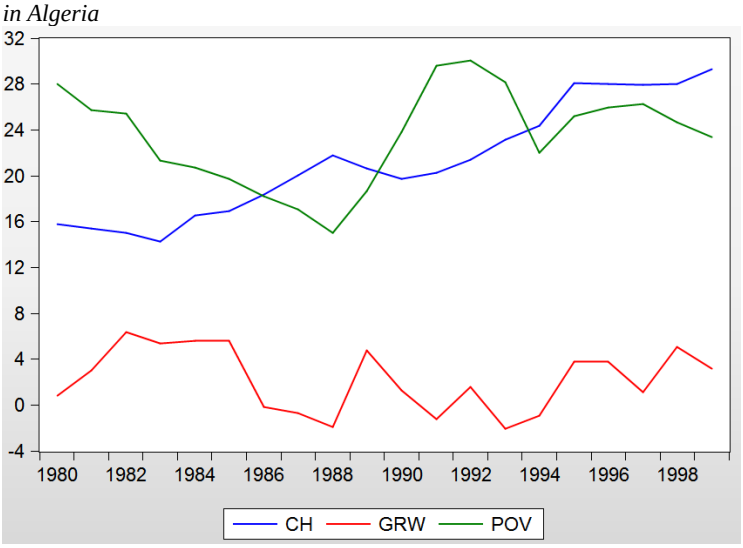
1. Introduction

In the last years, poverty reduction has been the biggest concern of countries around the world, it is considered the biggest goal of the development policy, but what is tangible in the last years is the increasing day per day, especially in Sub-Saharan Africa, Asia and Latin America, even in Europe when15% of people in the European member countries live below poverty line, and more than 2.7 million are homeless, although the millennium development goals, especially the first goal MDG1 (Halve, between 1990 and 2015 the proportion of people whose income is less than 1.25$ a day), it's claimed by the World Bank 2013a that the global poverty rate at 1.25$ a day fall in 2010 to less than half the 1990 rates, 700 million fewer people lived in conditions of extreme poverty in 2010 than in 1990. However, at the global level, 1.2 billion are still living in extreme poverty, but in 2015 970 million will remain poor, more than 80% of them are concentrated in Sub-Saharan Africa and South Asia.

The relationship between poverty reduction and public expenditure has generated much debate in the academic studies because of the importance of the poverty reduction and the necessary to find solutions to fight the spread of poverty especially in developing countries, the public expenditure can affect growth and poverty reduction in two different ways; the public spending can at first raise the overall growth performance of the economy and also it can increase the chance to contribute to the growth process for the poor people by supporting the human capabilities and reducing transactions costs.

After the oil price decline of 1986 in international markets, poverty is becoming a big problem in Algeria, the poverty rate was increase from 19.7% in 1985 to 23.8% in 1990 then to 29.6% in 1991 and 30.1% in 1992, this increase on poverty rates is accompanied by a significant increase in unemployment rates from 16.9% in 1985 to 19.8% in 1990 and 28.1% in 1994, and this was because of the negative economic growth rates in the period (5.6% in 1985, 1.3% in 1990, -1.2% in 1991 and -2.1% in 1993), these years (1990-1999) were marked by black decade because the insecurity in the country after the national problems that have caused a security chaos, all these events have had a big negative impact on economic performance and the social life.

Figure 1. *The evolution of poverty rates, unemployment rates and economic growth for the period 1980-1999 in Algeria*

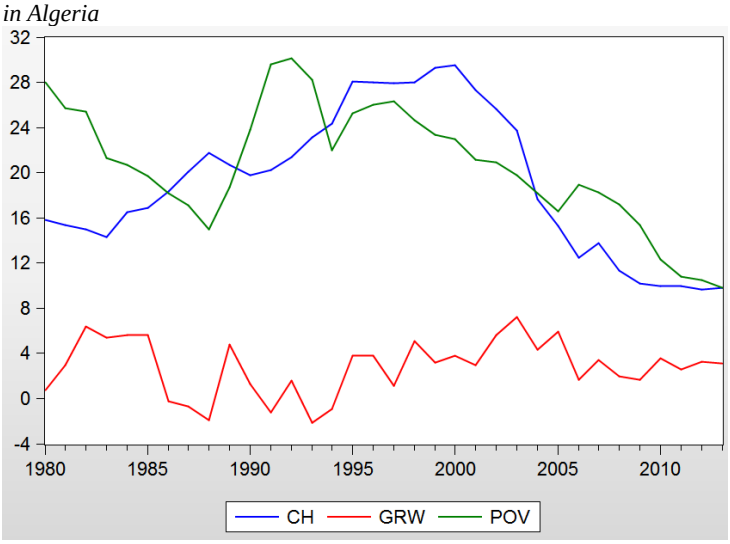


Source: Eviews10 output according to OMC databases 2017.

Where: POV is the poverty rate, CH is the unemployment rate and GRW is the economic growth rate.

By the return of the security in the country outset the 2000's, the Algerian government start to therapy the economic growth situation and the social life by many repairs and fortunately this years have seen significant increases in the crude oil prices in the international markets, this what help to reduce poverty rates from 23.35% in 1999 to 16.6% In 2005 and 12.3% in 2010 then 9.8% in 2013 because to the drop in unemployment rates from 29.3% in 1999 to 15.3% in 2005 and 10% in 2010 and 2013.

Figure 2. *The evolution of poverty rates, unemployment rates and economic growth for the period 1980-2013 in Algeria*



Source: Eviews10 output according to OMC databases 2017.

This paper specifically focuses on analyzing the co-integration relationship between poverty rates, public expenditure, unemployment rates and inflation rate for the period 1970-2017 in the case of Algeria, by using many econometric techniques as unit root tests (ADF, PP, NG-Perron and Zivot-Andrews, Clemente-Montanes-Reys and Lee-Strazicich for testing the structural breaks and regime shifts), Johansen and ARDL approach to examine the co-integration relationships, and we aim to show the weakness of the conventional co-integration tests in the case of presence of a structural break by using the Gregory Hansen co-integration with regime shift test (1996), the remainder of this paper is structured as follows, section 2 is for literature review on the poverty reduction and government expenditure relationship, while methodology and data are discussed in section 3, section 4 presents the results of the econometric study, and finally section 5 concludes the paper.

2. Literature review

Shahid Ali (2010), this paper examines the linkage among various categories of government expenditures and poverty rates in Pakistan over the period 1972-2008, using an Auto-Regressive Distributed Lag model (ARDL) to determine the robustness of the long-run relationships among the variables, the results suggest that poverty has dependency on the government expenditure and inequality, and the government expenditure increase employment generation and improve the standards of living, Mehmood and Sadiq (2010); this study examines the long run and short run relationships between fiscal deficits which is outcome of high government expenditure and poverty rates for the period 1976-2010,by applying a Johansen co-integration test and ECM model, depending on various variables (poverty head count ratio, government expenditure as percentage of GDP, private investment as percentage of GDP, secondary school enrollment and remittances), the results show that there exist both short run and long run relationship between poverty rate and government expenditure.

Odubunmi and Abayomi (2014), this study examines the relationship between government expenditure and poverty level in Nigeria based on the Keynesian macroeconomic framework which assumes that any increase in public spending has positive and significant impact on economic growth and poverty levels, the results indicate that population structure, total savings and foreign aids tend to aggravate to poverty level, and government expenditure on power generation is equally found to be aggravating the level of poverty in Nigeria.

Kalim and Hassen (2014); the principal attribute of this study is to answer the question that whether public defense spending is pro-poverty or anti-poverty in Pakistan using and ARDL approach for the period 1976-2012 depending on various variables as head count ratio as a proxy of poverty, military government expenditure, net inflows of foreign direct investment FDI, total development expenditures, consumer price index, service sector value added and industry value added, the results show that the public defense spending

is increasing poverty rates in both short run and long run terms, and also the development expenditures is significantly reducing poverty in the long run term in Pakistan, Nyarkoh (2016); this paper examines the effect of government expenditure on poverty rates in Ghana during the period 1960-2013 using Johansen test and VECM model, the results indicate that poverty incidence positively correlated with government expenditure The implication of the finding is that poverty is not reducing with increase in government expenditure.

3. Data and methodology

3.1. Data

We use in this paper annual data series covering the period 1970-2017 in Algeria collected from the World Bank Database (2018), the dependent variable is the household final consumption expenditure per capita as a proxy of poverty rate (POV) (Ravallion, 1992; Woolard and Leibbrandt, 1999; Quartey, 2005; Wicholasand and Odhiambo, 2009; Dhrifi, 2013; Ayad, 2017 and Odhiambo, 2017), while the explanatory variable is the government expenditure as a percentage of GDP (EXP), and the control variables are inflation rate as annual growth of consumer prices (INF) and the unemployment rate as percentage of total labor force (UNM) (national estimates).

3.2. Methodology

3.2.1. Structural breaks unit root tests

Following the important findings of Nelson and Plosser (1982), the traditional view of the unit root hypothesis was that the current shocks only have a temporary effect and the long-run movement in the series is unaltered by such shocks, but in 1989, Perron declared that in the presence of a structural break the standard Augmented Dickey Fuller test is biased towards the non-rejection of the null hypothesis, “Most macroeconomic time series are not characterized by the presence of a unit root. Fluctuations are indeed stationary around a deterministic trend function. The only ‘shocks’ which have had persistent effects are the 1929 crash and the 1973 oil price shock”.

Zivot and Andrews (1992) argue that the results of the conventional unit root tests (ADF, PP, KPSS and NG-Peroon) may be reversed by endogenously determining the time of structural breaks, for this reason they proposed the null hypothesis which is a unit root without any exogenous structural change, and the alternative hypothesis is a stationary process that allows for a one-time unknown break in intercept and/or slope, using the following regression equations:

$$\Delta_{yt} = c + \alpha_{yt-1} + \beta_t + \gamma DU_t + \sum_{j=1}^{K} d_j \Delta y_{t-j} + \varepsilon_t \quad (1)$$

$$\Delta_{yt} = c + \alpha_{yt-1} + \beta_t + \theta DT_t + \sum_{j=1}^{K} d_j \Delta y_{t-j} + \varepsilon_t \quad (2)$$

$$\Delta_{yt} = c + \alpha_{yt-1} + \beta_t + \gamma DU_t + \theta DT_t + \sum_{j=1}^{K} d_j \Delta y_{t-j} + \varepsilon_t \quad (3)$$

Where DUt is an indicator dummy variable for a mean shift occurring at each possible break point while DTt is the trend shift variable, as follows:

DUt = 1 if t > TB and 0 otherwise.

DTt = t-TB if t > TB and 0 otherwise.

3.2.2. Gregory-Hansen Co-integration test

The most used co-integration tests in the empirical literature are Engel-Granger (1987), Johansen- Juselius (1990) and Saikkonen and Lutkepohl (2000), this tests assume that the co-integrating vectors do not vary overtime and there is no structural breaks in the long run relationship, in 1996 Gregory and Hansen based on Engel and Granger test developed a new procedure for the co-integration test accounting for structural breaks (regime shift) in the co-integrating equation, after the note presented by Perron (1989) "ignoring the issue of potential structural breaks can render invalid the statistical results not only for unit root tests but also of co-integration tests", and also the note presented by Kunitomo (1996) "the presence of a structural change, traditional co-integration tests, which do not allow for this, may produce spurious co-integration".

The Gregory Hansen procedure test the null hypothesis (no co-integration) against the alternative hypothesis of co-integration in the presence of a break by unknown break point which determined by finding the minimum values of ADF t-statistic, for this reason Gregory and Hansen (1996a and 1996b) propose four models as follows:

First model: Level shift (C):

$$y_t = \mu_0 + \mu_1 \varphi_{t,} + \mu_2 x_t + \varepsilon_t,\ t = 1,\ldots, n \qquad (4)$$

Where φt, is a dummy variable such that $\varphi t,\tau = 1$ if $t > n\tau$ or 0 if $t \leqslant n\tau$, and $\tau \in (0,1)$ denotes the relative timing of the break point, in this model the effect of structural break is only on the intercept, which $\mu 0$ is the intercept before the break and $\mu 1$ is the change in intercept at the time of the break.

Second model: Level shift with trend (C/T):

$$y_t = \mu_0 + \mu_1 \varphi_{t,} + \mu_2 t + \mu_3 x_t + \varepsilon_t,\ t = 1,\ldots, n \qquad (5)$$

In this model the break affect only the intercept but it contains a trend.

Third model: Regime shift with changes in both intercept and slope (C/S):

$$y_t = \mu_0 + \mu_1 \varphi_{t,} + \mu_2 x_t + \mu_3 x_t \varphi t_{,} + \varepsilon_t,\ t = 1,\ldots, n \qquad (6)$$

In this model the structural break affects both the intercept and the slope coefficient, $\mu 2$ is the co-integrating slope coefficient before the break and $\mu 3$ is the change in the co-integrating slope coefficient at the time of the break.

Fourth model: Regime shift with changes in intercept, slope coefficient and trend (C/S/T):

$$y_t = \mu_0 + \mu_1 \varphi_{t,} + \mu_2 t + \mu_3 t\, \varphi_{t,} + \mu_4 x_t + \mu_5 x_t \varphi t_{,} + \varepsilon_t,\ t = 1,\ldots, n \qquad (7)$$

In this model the structural break affects the intercept, the slope coefficient and also the trend function.

For each model, unit root tests are performed on residuals series εt using the ADF, Zα and Zt tests, propose by Gregory and Hansen as follows:

$$ADF^{*} = \inf \tau \in T\ ADF(\tau) \quad (8)$$

$$Z_{\alpha}^{*} = \inf \tau \in T\ Z_{\alpha}(\tau) \quad (9)$$

$$Z_{t}^{*} = \inf \tau \in T\ Z_{t}(\tau) \quad (10)$$

4. Empirical results

4.1. Unit root test

The study performs the unit root tests on all variables, three unit root tests are used (Augmented Dickey Fuller, Philips Perron and NG-Perron) in addition to Zivot-Andrews unit root test for structural breaks in addition to CMR and LS tests. While the null hypothesis for all tests is that there is a unit root, the optimal lag lengths selection is done by the Akaike Bayesian criteria. And all unit root test regressions are run with a constant and trend term to determine the degree of integration of each variable to know what co-integration test we can apply in our study.

From the Table 1 it's clear that all variables using the three tests are not stationary at their level in all the degrees (1, 5 and 10%), but in the first differences, all the variables are stationary in the three tests, so we can apply the Johansen and Juselius (1990) test for testing the co-integration relationship among the variables.

Table 1. *Unit root tests without structural breaks*

	ADF	PP	NG-Perron			
			MZa	MZt	MSB	MPT
POV	-1.99 (-3.51)	-1.97 (-3.51)	-4.43 -17.30	-1.47 -2.910	0.33 0.168	20.45 5.480
D(POV)	-5.89*** (-3.51)	-6.20*** (-3.51)	-28.28*** -17.30	-3.75*** -2.910	0.13*** 0.168	3.22*** 5.480
EXP	-2.55 (-3.51)	-2.03 (-3.51)	-14.18 -17.30	-2.56 -2.910	0.18 0.168	6.98 5.480
D(EXP)	-4.48*** (-3.51)	-5.72*** (-3.51)	-20.63*** -17.30	-3.19*** -2.910	0.15*** 0.168	4.52*** 5.480
UNM	-1.52 (-3.51)	-1.56 (-3.51)	-5.57 -17.30	-1.63 -2.910	0.29 0.168	16.27 5.480
D(UNM)	-6.49*** (-3.51)	-6.49*** (-3.51)	-21.98*** -17.30	-3.31*** -2.910	0.15*** 0.168	4.16*** 5.480
INF	-2.20 (-3.51)	-2.27 (-3.51)	-7.82 -17.30	-1.97 -2.910	0.25 0.168	11.66 5.480
D(INF)	-6.24*** (-3.51)	-6.24*** (-3.51)	-21.73*** -17.30	-3.29*** -2.910	0.15*** 0.168	4.20*** 5.480
(): denotes the test critical values at 5%. ***: denotes the acceptance of the null hypothesis in 10%, 5% and 1%.						

Source: Calculated by the authors using Eviews 10.

4.2. Co-integration test

From Table 2, its clear that we cannot reject the null hypothesis of no co-integration relationship between the variables in both the trace and the maximum eigenvalue tests, and to make sure about this result we use the bound test in ARDL approach based on Pesaran (2001) and Narayan (2005) critical values, and the same result is obtain where we cannot reject the null hypothesis of no co-integration between the variables, so the variables are not co-integrated and there is no long-run relationship among the variables.

Table 2. *Co-integration tests without structural breaks*

Johansen and Juselius (1990) test						
Trace test						
Hypothesized No. of CE(s)	Eigenvalue		Trace statistic		0.05 critical value	Prob
None	0.3900		46.8877		47.8561	0.0615
At most 1	0.2428		25.1351		29.7970	0.1567
At most 2	0.1901		12.8953		15.4947	0.1187
At most 3	0.7891		3.6166		3.8414	0.0572
Maximum eigenvalue						
Hypothesized No. of CE(s)	Eigenvalue		Trace statistic		0.05 critical value	Prob
None	0.3900		21.7526		27.5843	0.2333
At most 1	0.2428		12.2397		21.1316	0.5242
At most 2	0.1901		9.2786		14.2646	0.2637
At most 3	0.7891		3.6166		3.8414	0.0572
Bound test co-integration						
K	10% level		5% level		1% level	
3	I(0) 2.37	I(1) 3.2	I(0) 2.79	I(1) 2.67	I(0) 3.65	I(1) 4.66
Calculated F-statistic					2.249	

Source: Calculated by the authors using Eviews 10.

4.3. Structural breaks unit root test

As said by Gregory and Hansen (1996a) the power of the Johansen test falls drastically when a structural break exists in the data, for this reason we use the Zivot-Andrews test to be sure if there is a structural break exist or not. Perron (1989) argued that the conventional unit root tests (ADF, PP, KPSS and NG-Perron) have low power to detect the structural breaks and to reject the unit root null hypothesis in this case, so the Zivot-Andrews (1992) unit root test can check the robustness of the conventional unit root tests.

Table 3. *Zivot-Andrews test with structural breaks*

variables	ZA statistic	Break	1%	5%	10%
POV	-4.462**	1989	-4.93	-4.42	-4.11
EXP	-3.456	2008	-4.93	-4.42	-4.11
UNM	-2.735	1997	-4.93	-4.42	-4.11
INF	-2.780	1992	-4.93	-4.42	-4.11
ZA: denotes Zivot-Andrews test **: denotes the acceptance of the null hypothesis at 5 and 10%.					

Source: Calculated by the authors using Stata 15.

From Table 3, the evidence show that only the poverty series has a structural break in 1989 where the other variables have not any structural break, the same results are obtained from Table 4 in Clemente-Montanes-Reyes test, and from the Lee-Strazicich where the results indicates that in addition to the poverty series both of government expenditure and unemployment rate series have a structural break in 2003 and 1996 respectively, so we cannot

adopt the Johansen-Juselius and the bound test results for co-integration relationship, in this case we must apply the Gregory Hansen (1996) test for co-integration with regime shift (with structural breaks).

Table 4. *Unit root tests with structural breaks*

Variables	Clemente-Montanes-Reyes Unit Root Test (1998)		Lee-Strazicich Unit Root Test (2001)	
	t-statistic	Break	t-statistic	Break
POV	-1.97**	1972	-0.27**	1986
EXP	-2.89	2012	-0.87**	2003
UNM	-6.15	2006	-1.75**	1996
INF	-2.43	1992	-2.92	1994
**: denotes the acceptance of the null hypothesis at 5 and 10%.				

Source: Calculated by the authors using Stata 15 for CMR and Rats 8 for LM.

4.3. Gregory-Hansen (1996) co-integration test

Based on the foregoing, we conduct the Gregory Hansen co-integration test in order to detect of the possible existence of a structural break, for this reason we estimate the most general model of Gregory Hansen test namely regime shift model as follows:

$$y_{1,t} = \mu_1 + \mu_2\varphi_{t,\tau} + \alpha_1 y_{2,t} + \alpha_2 y_{2,t}\varphi_{t,\tau} + e_t (11)$$

Where y1 represents Poverty rates, y2 represents the vector that includes EXP, UNM and INF, φt, is a dummy variable such that:

$$\varphi_t = 0\ if t \leq \tau and \varphi_{t,\tau} = 1\ if t > \tau$$

τ denotes a possible structural break date and the test statistic is given by:

$$ADF^* = inf\tau\epsilon T ADF(\tau), \qquad Z_\alpha^* = inf\tau\epsilon T Z_\alpha(\tau), \qquad Z_t^* = inf\tau\epsilon T Z_t(\tau)$$

From Table 5 according to two of three statistics (ADF* and Z*) of the Gregory Hansen, the existence of a co-integration relationship at the 1, 5 and 10% significance level cannot be rejected, thus, there is a long-run relationship among poverty rate, government expenditure, unemployment rate and inflation rate in Algeria with a structural break or regime shift, according to the results obtained from the Table 4, the break is 1986 is significant, this break refers to the 1986 oil recession that has a big negative effects on the Algerian economy.

Table 5. *Gregory Hansen co-integration test results*

Test	Test statistic	Breakpoint	Asymptotic critical values		
			1%	5%	10%
ADF	-9.68***	1986	-6.89	-6.32	-6.16
Zt	-9.45***	1986	-6.89	-6.32	-6.16
Zα	-60.52	1986	-90.84	-78.87	-72.75
***: denotes the reject of the null hypothesis in 10%, 5% and 1%.					

Source: Calculated by the authors using Stata 15.

4.4. Long-run and short-run elasticities

The results presented in Table 6 indicate that the parameter of expenditure is not statistically significant at 5% significance level for all the estimation methods (Fully Modified OLS (FMOLS), Dynamic OLS (DOLS) and Canonical Co-integrating Regression (CCR)) which means that the government expenditure does not affect the poverty rate in Algeria in the long run term, the only variable that affect the poverty rate in the long run term is the inflation rate

by a negative manner, the results indicate that the dummy variable (the structural break 1986) has a negative impact on the poverty rates at 5% significance level, this result confirms what we have pointed out in the introduction and the 1986 is very important year in the historical development of the Algerian economy in general and the poverty rate in particular.

Table 6. *Long run estimation results*

Variables	FMOLS		DOLS		CCR	
	Parameter	prob	Parameter	prob	Parameter	prob
EXP	-0.473	0.0895	0.0454	0.9268	-0.456	0.1129
UNM	-0.034	0.7572	0.0539	0.7601	-0.041	0.7131
INF	-0.274	0.0023	-0.3300	0.0132	-0.273	0.0023
DUM	-4.334	0.0031	-4.770	0.0053	-4.300	0.0026
Constant	16.109	0.0025	9.102	0.3694	15.948	0.0029

Source: Calculated by the authors using Eviews 10.

Engel and Granger (1987) have confirmed that the variables could be modeled with a dynamic ECM model (dynamic Error Correction Model) in the case of the existence of the co-integration relationship among them, according to the results obtained from Table 7, all the variables have no significant effect at 5% significance level on poverty rate in the short run term, except the error correction model which is significant at 5% level, this implies that about 33.20% adjustment towards long run equilibrium take place in one year.

Table 7. *The ECM results (short run term)*

Variables	Coefficient	T-statistic	Prob
ΔPOV	-0.432	-2.938	0.0023
ΔEXP	-0.116	0.226	0.9821
ΔUNM	-0.387	-1.177	0.7568
ΔINF	0.042	0.225	0.9758
DUM	-8.534	-1.443	0.7862
Constant	0.026	0.031	0.9925
ECT(-1)	-0.332	-2.395	0.0325

Source: Calculated by the authors using Eviews 10.

4. Conclusion

Unlike other studies, structural breaks were taken into consideration in this paper to examine the government expenditure effect on poverty rates in Algeria during the period 1970-2017, we examine the long run and short run relationships among the poverty rate measured as the household final consumption expenditure per capita, government expenditure as a percentage from GDP, inflation rate and unemployment rate using various econometric tests and models as the unit root tests (ADF, PP, NG-Perron, Zivot-Andrews, Clemente-Montanes-Reyes and Lee-Strazicich tests) the co-integration tests as the Johansen-Juselius and bound test under ARDL model, especially the co-integration test with regime shift based on Gregory Hansen test, the results indicate that there is no co-integration relationship among the variables without structural breaks but by using the Gregory Hansen we found that there is a co-integration relationship among the variables with one regime shift (structural break) exactly in 1986 the year of the big recession of oil prices in the international markets.

The results obtained from both short run and long run terms estimation show that there is no evidence of any effect from the government expenditure on poverty rates in Algeria among the period 1970-2017, which means that the poor people in Algeria did not benefit from the government spending, so despite all the expenditure efforts presented by the government still very limited to impulse and reduce the poverty rates and to improve the standard living for the poor people because the expenditure is not pro-poor in the period under study.

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