

## **Poverty Reduction, Financial Development and Economic Growth in Algeria: A Gregory Hansen Co-Integration Regime Shift Analysis**

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### **Abstract**

*This paper applies annual data from 1970 to 2017 in Algeria to investigate the long-run relationship between financial development, poverty reduction, economic growth and trade openness, we use the regime shift analysis for both unit root tests (Zivot-Andrews (1992), Clemente-Montanes-Reyes (1998) and Lee-Strazicich (2001)) and co-integration test (Gregory Hansen (1996)) to detect the long run and short run elasticities, the results confirm that there is a long-run relationship among the variables with a regime shift in 2009, and the financial development cannot reduce the poverty rates while the economic growth is pro-poor.*

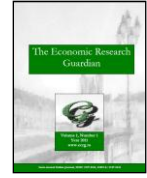
**Keywords:** Financial development, Poverty reduction, Regime shift analysis

**JEL classification:** C58, E44, I32

### **1. Introduction**

How can we reduce poverty? This is the oldest question posed by the humanity, whether through religions, sciences, organizations, ..., in economics, there are many reliable channels to reduce poverty, for example, in 2007, Rodrick (2007) said that historically nothing was worked better than economic growth in enabling societies to improve the life chances of their members, including those at the very bottom, this declaration is according to many previous studies, as Adams (2002) on examining the impact of economic growth on poverty using data from 50 developing countries when the elasticity of poverty to growth is -2.59, by returning to 1996 and the study of Ravallion and Chen (1996), the elasticity of poverty to economic growth is -2.60 and it is generally between -2.00 and -3.00, so any increase in the average level of income in a country contributes to benefit indirectly to its weakest members, but many studies as Squire (1993), Bruno et al. (1998), Helteberg (2002), Bourguignon (2003), Gries and Redline (2010), Chee Man and Sial (2012), Ayad (2016) and many others showed that growth will be pro-poor if it accompanied by a decrease in inequality (income, asset and gender inequality) to have a maximum impact on poverty.

On the other hand, a few studies (Dollar and Kraay (2002), Honohan (2004) and Beck et al. (2007)) examines the relationship among poverty, economic growth and financial development, according to these studies, the financial development is considered as a sub-channel to reduce poverty rates, and



this is through three ways. Firstly, by the trickle-down theory the financial development may reduce poverty by increasing the economic growth from the supply-leading hypothesis proposing by Partick (1966) against the demand-following hypothesis when the economic growth inducing the financial development. Secondly, financial development encourages the poor people to start micro-enterprises rather than saving or even encourages them to borrow. Finally, the financial development can improve the opportunities for poor people to access formal finance after the adjustment of the financial market failures (information asymmetry, the high cost of lending).

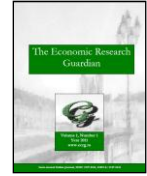
After the independence in 1962, Algeria as all developing countries, has tried to improve the living conditions of its people especially those in the lower classes, where the poverty rate then exceeded 45%, in its early years after independence, Algeria experienced several crises, such as the oil crises in 1986 and the ensuing budget and balance of payments problems leads government to adopt flexible economic policies to escape the rigidities of central planning; and also the black decade of the 1990s, which raised poverty rates from less than 20% to more than 35% in just 8 years, all of this has foiled many policies aimed at reducing poverty rate during this period, this paper tries to fill the gap of the scarcity of studies on poverty in Algeria in this period of crises up to nowadays by contributing to the analysis of the determinants of poverty (especially real sector and financial sector in addition to trade sector) using new techniques of regime shift analysis

The main goal of this paper is to econometrically investigates the links between poverty rates, economic growth and financial development in Algeria over the period 1970-2017, to have a clear idea about which sector benefits the poor people: the financial or the real sector, according a co-integration analysis with regime shift using the Gregory Hansen (1996) procedure after the unit root tests with structural breaks as Zivot-Andrews (1992) test, Clemente-Montanes-Reyes (1998) test and Lee Strazicich (2001) test, and the paper makes a contribution to existing literature at first by utilizing the Milesi-Ferreti index for the financial development instead of the traditional indexes as Kaopen index presented by Ito and Chinn (2006), the M3/GDP index (the liquid assets of the financial system (currency, demand and interest-bearing liabilities of banks and non-banks) as a share of GDP), private sector as a share of GDP. Secondly, this paper tries to examine the triangle poverty-growth- financial development for the first time by a non-linear analysis using regime shift tests.

The study consists of four sections, introduction of the study is given in section one, the second section reviews the relevant literature, the third section consists the data and the methodology of the study and the fourth section is for the results and discussion.

## **2. Literature review**

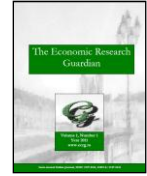
The links between poverty reduction and financial development are examined by a few studies, especially in the last 30 years, for example, in 2005, Jalilian and Kirkpatrick (2005) showed that there is a threshold level of economic growth, and financial sector growth contributes to poverty reduction through the growth-enhancing effect. Odhiambo (2009) by a causal relationship analysis in South Africa showed that both financial development and economic growth Granger cause the poverty reduction both in the short run and long run terms, Moreno (2011) examined the causal relationship between the two variables in 35 developing countries using two proxies of financial development



(M3/GDP and private sector/GDP) and after dividing the study period to several periods, the results showed that only in the period between 1970-1980 the financial development leads the reduction of moderate poverty, in the table below we collect the most recent researches in this area.

Table 1 - The most researches in area

No.	Authors	Countries	Periods	Econometric methods	Results
1	Honohan (2004)	China, Korea, Russia and United Kingdom	1960-200	Panel regression	FD=>PR
2	Kappel (2010)	78 developing and developed countries	1960-2006	Panel regression	FD=>PR
3	Akhter and Liu (2010)	54 developing countries	1993-2004	Panel regression (FEVD theqnique)	FD=>PR
4	Jeanneney and Kpodar (2011)	75 developing and developed countries	1966-2000	Panel regression (GMM)	FD=>PR
5	Fowowe and Adeboye (2012)	Sub Saharan African countries	/	Panel regression (GMM)	FD#PR
6	Khan et. Al (2012)	Pakistan	1981-2010	ARDL	FD=>PR
7	Dhrifi (2013)	89 developing and developed countries	1990-2011	Panel regression (Simultaneous equations)	FD=>PR
8	Gazi et. Al (2014)	Bangladesh	1975-2011	ARDL	FD=>PR
9	Chemli (2014)	8 MENA countries	1990-2012	ARDL	FD=>PR
10	Dandume (2014)	Nigeria	1970-2011	ARDL and causality	FD#PR
11	Aldin (2016)	Bangladesh	1974-2013	OLS and GMM estimator	FD=>PR
12	Sehrawat and Giri (2016)	India	1970-2014	ARDL	FD=>PR
13	Cepparulo et. Al (2016)	58 developing and developed countries	1984-2012	Panel regression (GMM)	FD=>PR
14	Ficawoyi and Sylwester (2016)	71 developing countries	2002-2011	OLS and 2SLS estimator	FD=>PR
15	Rewelak (2017)	developing countries	2004-2015	Panel regression (GMM)	FD=>PR
16	Zahanogo (2017)	42 Sub Saharan African countries	1980-2012	Panel regression (GMM)	FD=>PR



17	Keho (2017)	9 African countries	1970-2013	ARDL and causality	FD=>PR for 5 countries
18	Abdul Rashid and Intartaglia (2017)	60 developing countries	1985-2008	Panel regression (two step GMM)	FD=>PR
19	Bayar (2017)	21 Emerging economies	1993-2012	Panel regression (Westerlund co-integration)	FD=>PR
20	Ayad (2017)	14 Arabic countries	1980-2014	Panel regression (co-integration and TYDL causality)	FD#PR
21	Sin Yu Ho (2018)	Ghana	1960-2015	ARDL	FD=>PR
Note: FD means financial development, PR means poverty reduction, => means there is an effect from FD to PR, # means there is no effect from FD to PR.					

It is clear from this studies that there is no study had carried about the regime shifts and structural breaks in the series to examine the relationship between financial development and poverty reduction.

### 3. Data and methodology

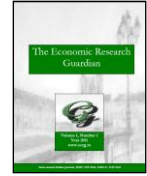
We use in this paper a new procedure of co-integration analysis by introducing regime shift tests and estimation according to many studies that emphasized the need to incorporate the structural changes in the series, for this reason we use four variables: (i) poverty rate, (ii) financial development, (iii) economic growth, and (iv) trade openness.

#### 3.1. Unit root test with structural breaks

The problem with conventional unit root tests (Augmented Dickey-Fuller (ADF), Philips Perron (PP), Kwiatkowski-Phillips-Schmidt-Shin (kpss), Elliott-Rothernberg-Stock Point-Optimal test and NG-Perron test) is that they do not allow for the possibility of the existence of a structural break, as said by Perron (1989) the presence of a structural break, the standard ADF test is biased towards the non-rejection of the null hypothesis.

##### 3.1.1. Zivot Andrews unit root test

In 1992, Zivot and Andrews suggested the following regression equations based on Dickey-Fuller and Phillips Perron tests to test both the unit roots and the structural breaks:



$$\Delta y_t = c + \alpha y_{t-1} + \beta t + \gamma DU_t + \sum_{j=1}^K d_j \Delta y_{t-j} + \varepsilon_t \quad (1)$$

$$\Delta y_t = c + \alpha y_{t-1} + \beta t + \theta DT_t + \sum_{j=1}^K d_j \Delta y_{t-j} + \varepsilon_t \quad (2)$$

$$\Delta y_t = c + \alpha y_{t-1} + \beta t + \gamma DU_t + \theta DT_t + \sum_{j=1}^K d_j \Delta y_{t-j} + \varepsilon_t \quad (3)$$

Where,  $\Delta y_t$  is the variable to be studied,  $c$ ,  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $d$  and  $\theta$  are the parameters of regression,  $\varepsilon_t$  is the white noise,  $DU_t$  is an indicator dummy variable for a mean shift occurring at each possible break point, while  $DT_t$  is the trend shift variable, as follows:  $DU_t = 1$  if  $t > TB$  and 0 otherwise; and  $DT_t = t - TB$  if  $t > TB$  and 0 otherwise. The  $TB$  is the break date.

### 3.1.2. Clemente-Montanes-Reyes test

Clemente, Montanes and Reyes (1998) following Perron and Vogelsang (1992) statistics to the case of two structural breaks suggested to test null hypothesis against the alternative hypothesis as follow:

$$H_0: x_t = x_{t-1} + a_1 DTB_{1t} + a_2 DTB_{2t} + \mu_t \quad (4)$$

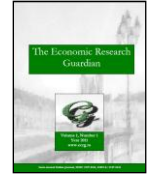
$$H_1: x_t = u + b_1 DU_{1t} + b_2 DTB_{2t} + \mu_t \quad (5)$$

Where,  $DTB_{it}$  is the pulse variables equivalent to 1 if  $t = TB_i + 1$  and zero if not, and  $TB_1$  and  $TB_2$  represents the time periods when the mean is being modified.  $DU_{it} = 1$  if  $TB_i < t$  ( $i=1,2$ ) and if this assumption is violated then it is equal to zero.  $x_t$  is the variable to be studied, while  $a$  and  $b$  are the parameters of regression and  $\mu_t$  is the white noise.

### 3.2. Gregory Hansen co-integration test with regime shift

The Gregory-Hansen (1996) test in contrast of Engel-Granger test, Johansen-Juseluis and Bound test (ARDL) addressed to the problem of estimating co-integration relationship (long-run relationship) in the presence of a least a potential structural break, Kunitomo (1996) declared that the presence of a structural break (structural change), traditional co-integration tests, which don't allow for this, may procedure spurious co-integration results, for this reason, Gregory and Hansen (1996) proposed the following equations:

$$y_t = \mu_0 + \mu_1 \varphi_t + \mu_2 x_t + \varepsilon_t, t=1, \dots, n \quad (6)$$



$$y_t = \mu_0 + \mu_1 \varphi_t + \mu_2 t + \mu_3 x_t + \varepsilon_t, t=1, \dots, n \quad (7)$$

$$y_t = \mu_0 + \mu_1 \varphi_t + \mu_2 x_t + \mu_3 x_t \varphi_t + \varepsilon_t, t=1, \dots, n \quad (8)$$

$$y_t = \mu_0 + \mu_1 \varphi_t + \mu_2 t + \mu_3 t \varphi_t + \mu_4 x_t + \mu_5 x_t \varphi_t + \varepsilon_t, t=1, \dots, n \quad (9)$$

Where  $\varphi_{t,\tau}$  is a dummy variable such that  $\varphi_{t,\tau} = 1$  if  $t > n\tau$  or 0 if  $t \leq n\tau$ , and  $\tau \in (0,1)$  denotes the relative timing of the break point, which  $\mu_0$  is the intercept before the break and  $\mu_1$  is the change in intercept at the time of the break, and  $\mu_2$  is the co-integrating slope coefficient before the shift and  $\mu_3$  is the change in the co-integrating slope coefficient at the time of the break.

The equation (6) is for the level shift (C) model which the structural break affects the intercept only, the equation (7) is the level shift with trend (C/T) model where the structural break affects the intercept only but with a trend, equation (8) is the regime shift where intercept and slope coefficient change (C/S) in this model the structural break affects both intercept and slope coefficient, and the last equation (9) is the regime shift where intercept, slope coefficient and trend change (C/S/T) is a model in which the structural break affects the intercept, slope coefficient and the trend function, in this case and to test the co-integration relationship we test this equations under three unit root tests for the residuals series as follows:

$$ADF^* = \inf_{\tau \in T} ADF(\tau) \quad (10)$$

$$Z\alpha^* = \inf_{\tau \in T} Z\alpha(\tau) \quad (11)$$

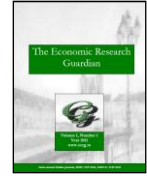
$$Zt^* = \inf_{\tau \in T} Zt(\tau) \quad (12)$$

where,  $\tau \in (0,1)$  denotes the relative timing of the break point.

### 3.3. Data

In this paper, we carried out of the relationship between poverty reduction, financial development, economic growth and trade openness in Algeria over the period 1970-2017, our data are obtained from different sources like the World Bank database and Trilemma database (for financial development).

The index used in this paper is the Lane-Milesi-Ferreti (2006) proxy presented by Lane and Milesi-Ferreti calculated as the ration of the sum of the total external liabilities and total external assets to GDP, a high level of this proxy means more capital mobility in the economy, downloading from Trilemma database (2018).



Instead of the traditional proxies of poverty we used the consumption per capita as Ravallion (1992), Woolard and Leibbrandt (1999), Quarty (2005), Odhiambo (2009), Dhrifi (2013) and Ayad (2016, 2017), downloading from the World Bank database (2018).

As said by many economists the best index of economic growth to test the relationship with poverty rates is the GDP per capita, downloading from the World Bank database (2018).

Finally, the trade openness is measured by the sum of total exports and total imports as a percentage of GDP at 2005 constant prices, downloading from the World Bank database (2018).

## 4. Results and discussion

### 4.1. Unit root tests

In this study, we use the two kinds of unit root tests (without structural breaks (NG-Perron test) and with structural breaks (Zivot-Andrews test, Clemente-Montanes-Reyes test and Lee Strazicich test), the optimal lag length selection is done by the Akaike Bayesian criteria, and all the tests are run with a constant and trend term to determine the degree of integration of each variable as shown in the following tables 2 and 3:

Table 2 - Unit root test without structural breaks (NG-Perron)

Variables	Ng-Perron			
	MZa	MZt	MSB	MPT
FD	-12.41	-1.48	0.19	11.76
$\Delta$ (FD)	-19.22	-3.02	0.11	4.22
POV	-4.43	-1.47	0.33	20.45
$\Delta$ (POV)	-28.28	-3.75	0.13	3.22
GRW	-21.08	-3.24	0.15	4.34
TRA	-5.78	-1.69	0.29	15.73
$\Delta$ (TRA)	-19.92	-3.14	0.15	4.61

Notes: The critical values at 5%: -17.30, -2.91, 0.168 and 5.480.

FD: Financial Development, POV: Poverty Reduction, GRW: Economic Growth, TRA: Trade Openness.

$\Delta$ : The first differences.

Table 2 presents the summary of the unit root test results for the four series at both their levels and first differences, it's clear that all the variables except the economic growth are non-stationary at their level, but they are stationary at the first differences.

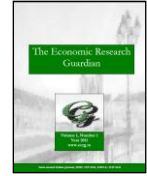


Table 3 - Unit root test with structural breaks

Zivot-Andrews test						
variables	ZA statistic	Break	1%	5%	10%	decision
FD	-4.735**	2008	-4.93	-4.42	-4.11	Exist
POV	-4.462**	1989	-4.93	-4.42	-4.11	Exist
GRW	-8.170***	1988	-4.93	-4.42	-4.11	Exist
TRA	-4.481**	1987	-4.93	-4.42	-4.11	Exist
Clemente-Montanes-Reyes test						
variables	Innovative Outliers		Additive Outliers		Decision	
	t statistics	Break	t statistics	Break		
FD	-0.781	1988	-4.549***	2012	AO exist	
POV	-3.252***	1976	-1.973	1972	IO exist	
GRW	-4.325***	1978	-1.596	1977	IO exist	
TRA	-5.620***	1997	-1.274	1984	IO exist	
Lee Strazicich test						
variables	t statistics	Break	Decision			
FD	-0.30***	1994	exist			
POV	-0.42***	1996	exist			
GRW	-0.53***	1989	exist			
TRA	-0.28***	2001	exist			

Notes: \*\*\* and \*\* denote significances at 1%, 5% and 10% and 5% and 10%.

Innovative Outliers: the effect of the break is instantaneous effect.

Additive Outliers: the effect of the break is distributed over the time

The results inspired from table 3 is that all the variables have at least one structural break in different years, so we cannot apply the bound test due the ARDL model to test the long-run relationship between the variables that's why we rely on the co-integration with regime shift and Gregory Hansen test.

#### 4.2. Co-Integration with regime shift test (Gregory Hansen test)

As said by Perron (1989) the ignoring of the issue of potential structural breaks can render invalid results not only of the unit root tests, but also the co-integration results, the results of the Gregory Hansen are in table 4, and according to the three tests and statistics 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 the variables with one regime shift (structural break) in 2009.



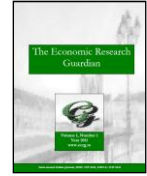


Table 4 - Gregory Hansen test results

Test	Statistic Value	Break	Critical Value		
			1%	5%	10%
ADF	-14.07***	2009	-6.89	-6.32	-6.16
Zt	-14.54***	2009	-6.89	-6.32	-6.16
Z $\alpha$	-87.68**	2009	-6.89	-6.32	-6.16

Note: \*\*\* and \*\* denote significances at 1%, 5% and 10% and 5% and 10%.

### 4.3. Long-run estimation

The results presented in table 5 show that only the economic growth is statistically significant at 5% significance level for the three estimation methods, which means that the economic growth is pro-poor in the long run term in Algeria over the period 1970-2017, the results also indicate that there is no evidence of a significant effect of financial development on poverty rate at 5% significance level which means the financial development in Algeria doesn't help the poor people in the long run term, and the same result is for the break estimator except the DOLS regression, in addition to this there is a significant effect of trade openness at 5% significance level for the three estimation methods on poverty rate which means that the poor people benefit from the international trade in the long-run term.

Table 5 - Long run estimation (DOLS, FMOLS and CCR)

Variables	FMOLS		DOLS		CCR	
	Parameters	Prob.	Parameters	Prob.	Parameters	Prob.
FD	-0.001	0.915	-6.799	0.119	-6.978	0.624
GRW	0.561***	0.000	0.752***	0.023	0.560***	0.035
TRA	23.361***	0.000	15.976**	0.045	25.57***	0.000
Break	-0.377	0.849	4.631**	0.031	2.382	0.329
Constant	-12.33	-12.33	-4.232	0.321	9.006***	0.028

Note: \*\*\* and \*\* denote significances at 1%, 5% and 10% and 5% and 10%.

### 4.4. Short-run estimation

As declared by Engle and Granger (1987) in the case of the existence of the co-integration relationship among the variables must model these variables with a dynamic error correction model (ECM), according to the results obtained from tables 6, the economic growth is the only variable that has a significant effect on the poverty rates on 5% significance level, which means that also in the short run term the economic growth is pro-poor in Algeria for the period 1970-2017 in contrast of financial development that have any effect on poverty rates, in addition, the error correction term is significant at 5% significance level, this implies that about 89% adjustment towards long-run equilibrium in one year.

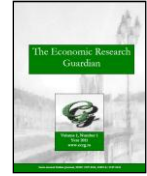


Table 5 - Short run estimation (VECM model)

Variables	Parameters	T-student	Probability
$\Delta(\text{POV})$	-0.019	-0.107	0.635
$\Delta(\text{FR})$	-4.234	-0.585	0.833
$\Delta(\text{GRW})$	0.788***	4.770	0.000
$\Delta(\text{TRA})$	7.170	0.498	0.972
ECT	-0.89***	-3.71	0.000
Break	2.75	1.26	0.512
Constant	-0.455	-0.536	0.806

Notes: \*\*\* denote significances at 1%, 5% and 10%.

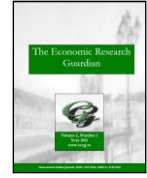
ECT: Error Correction Term.

$\Delta$ : The first differences.

## 5. Conclusion

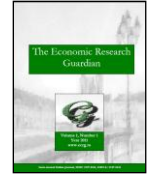
In this article, we examined the impact of financial development on poverty reduction in Algeria using time series data from 1970 to 2017, to achieve our objective, we apply a regime shift analysis both for unit root tests (Zivot-Andrews test (1992), Clemente-Montanes-Reyes test (1998) and Lee Strazicich test (2001)) and co-integration test (Gregory Hansen test (1996)) to run the long-run and short-run estimations to detect the effects of financial development, economic growth and trade openness on poverty rates, empirical results show that all the variables have structural breaks in different years that's what forces us to apply the Gregory Hansen test for co-integration with regime shift (with structural breaks) instead of the ARDL model, in the other hand, the co-integration analysis shows that all variables are co-integrated with one regime shift in 2009, in addition, the results shows that there is no evidence of any effect from financial development to poverty reduction both in long-run and short-run terms, while the economic growth is pro-poor in both long-run and short-run terms and the trade openness has a significant effect on poverty rates in the long-run term at 5% significance level.

The financial sector is an important tool to reduce poverty rates in all the times but in the case of Algeria there is no evidence of the effectiveness of this sector, and the main problem is the government ownership of the majority of the Algerian's financial sector, and the neglect of the private sector by no more 15% from total lending in the economy, in addition, the banking sector is occupied 90% of the financial sector by more than 90% of the banking sector is under government control, without forgetting the absence of the microfinance sector, our results in this paper reveals that all the efforts made by the government like the order 03011 (2006) to reduce the corruption within the financial system, and the microfinance programs (the National Microfinance Agency (ANGEM), the National Agency for Youth Employment (ANSEJ) and the National Unemployment Benefit Fund (CNAC)) is still very limited to reduce poverty and improve the standard living conditions.



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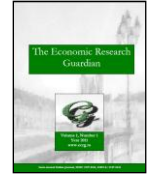
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