POVERTY, INEQUALITY AND ECONOMIC GROWTH IN ALGERIA: AN ARDL APPROACH

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Abstract

This analytical review explores the links between poverty, inequality and growth in Algeria for the period 1970-2013, we use in this paper an ARDL approach to investigate the relationships between poverty as measured by the consumption per capita, inequality measured as Thail index and growth measured as GDP per capita, using data from different sources, the study tries to answer the following questions: Whether growth, poverty and inequality are co-integrated? How are the long-run and short-run relations between the three variables? The results suggest that poverty, inequality and growth are co-integrated, and we found that the relation between poverty and growth is negative; and the relation between poverty and inequality is positive either in short-run or in long-run terms.

Keywords: Poverty, Inequality, Growth, ARDL, Algeria.

JEL Classification: A13, C12, C22, C32, I32, O40.

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1. Introduction

In the last years, poverty reduction has been the biggest concern of countries around the world, it was considered the goal of development policy, but what it is tangible with this global phenomenon is the increasing day per day, especially in Sub-Saharan Africa, Asia and Latin America, even in Europe when 15% 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 rate, 700 million fewer people lived in conditions of extreme poverty in 2010 than in 1990. However, at the global level, 1.2 billion people are still living in extreme poverty, but in 2015 970 million will remain poor, more than 80% of the mare concentrated in Sub-Saharan Africa and South Asia.

From the World Development Report 1990, the economic growth was considered the best tool to reduce poverty, Kraay 2005 decomposes poverty changes into three types: growth in average incomes, the sensitivity of poverty to growth and finally changes in the distribution of income (inequality), from these three types we perceive the relation between poverty reduction and economic growth, Ravaillon and Chen 1996 estimate that the elasticity of poverty to growth is negative for most of poverty lines, Dollar and Kraay 2000 declare that « any increase in the average of income contributes benefit indirectly to poor members », in fact, from the Kraay study 2006 of 80 developing countries showed that the correlation between average income and poverty is negative for most of the poverty indicators.

On the other hand, the results show that this relation is not realized in all cases, even when growth happens doesn't cause a reduction in poverty, for example Costa Rica in the period 1981-2005 declined the level of poverty from 21.4% to 2.4%, in the same period Brazil reduce it from 17.4% to 7.8%, and this case brighten up the role of inequality, the Gini coefficient in Brazil is higher than Costa Rica coefficient (0.58 for Brazil and 0.47 in Costa Rica).

Ravaillon 1997, Bourguinon 2003, Epaulard 2003, Kalwij Verschoor 2007 and Fosu 2009, the growth-poverty nexus is affected by role of inequality especially in developing countries, thus the 7% of average annual GDP growth to realize the MDG1 is insufficient without breaking up the inequality in developing countries, Ali and Thorbecke 2000 confirmed that the poverty rates are more sensitive to inequality than are to level of income,

Ravaillon 1997, Easterly 2000 and Adams 2004 shows that the growth elasticity of poverty decreases with inequality, where the growth elasticity is higher for the smaller Gini group.

2. The link between poverty, inequality and growth
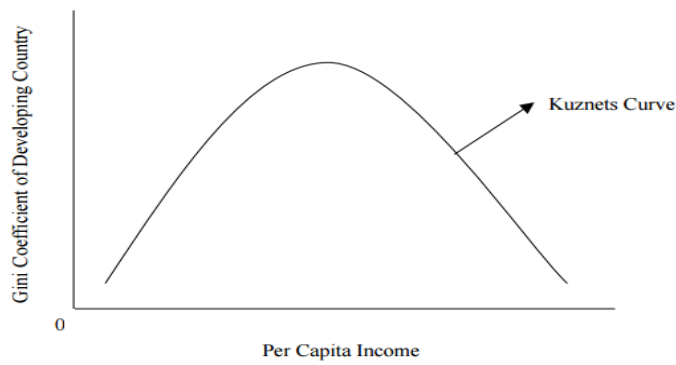### 2.1. The link between poverty and growth

There are a various findings in the empirical studies about the relation between poverty and growth. We can summarize as follows:
- ➢ The economic growth is an important and necessary condition, but insufficient because of the effects of inequality.
- ➢ Over the extended periods, a high pace of growth is very necessary to reducing poverty.
- ➢ Poverty reduction from high growth rates can be realized only when the sources of growth are expanding, especially the share of « L » force.
- ➢ The effects of growth to poverty vary across countries because of many factors as distribution, depth of poverty, poverty characteristics, etc.

2.2. The link between inequality and growth

In the 1950's and 1960's, economists such Nicholas Kaldor and Simon Kuznets argued that there is trade-off between reducing inequality and economic growth, The Nobel laureate economist Simon Kuznets write : "One might thus assume a long swing in the inequality characterizing the secular income structure: widening in the early phases of economic growth when the transition from the pre-industrial to the industrial civilization was most rapid; becoming stabilized for a while; and then narrowing in the later phases".

So high levels of inequality reduce growth in relatively but encourage in richer countries, the traditional relationship here is the Kuznets Curve, the curve describes a U-shaped relationship between inequality and growth, inequality increases and later decreases in the process of economic growth, Kuznets explained this in terms of a shift from the rural agricultural sector of the economy to an urban industrial sector.

Figure 1: Kuznets U curve

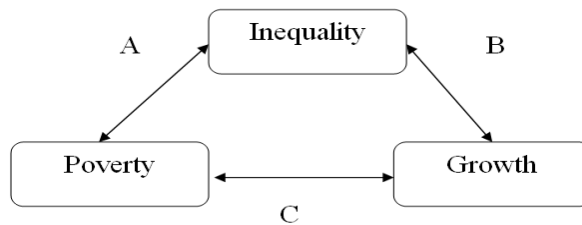## *2.3. The link between poverty and inequality*

Does increasing income inequality also imply increased poverty? The answer is "yes", inequality it's the key to reducing poverty, inequality and poverty affect each other directly and indirectly through their link with economic growth, so small changes in inequality can have a large effect on poverty, therefore, poverty reduction will be hard to achieve without declines in inequality.

Table 1: The effect of small changes in distribution on poverty measures

	Headcount (incidence)	Poverty gap (depth)	Poverty gap squad (severity)	Gini
1	0.20	0.10	0.052	0.324
2	0.40	0.08	0.018	0.312
3	0.30	0.09	0.029	0.318

Source: Creedy, J. (1998).

Poverty, inequality and growth interact with one another through a set of two way link, as in the following figure, inequality can indirectly influence poverty (A) as effects growth (B), and even growth effect on poverty (C).

Figure (2): The Poverty, Inequality and Growth Triangle

3. Poverty, Inequality and Growth in the World

Unlike previous decades, like the '80s when the poverty rate increased in Africa and the '90s when it increased in Latin America and the former Soviet Union, from Table 2 poverty reduction is currently taking place in all regions of the world the sharpest fall in poverty is occurring in Asia. South Asia alone is expected to see a reduction in the number of its poor of more than 430 million over the 10 years period, representing a fall in its poverty rate of over 30 percentage points. East Asia already recorded a vast drop in poverty between 1980 and 2005, and this trend is continuing: a further 250 million people in the region are expected to escape poverty by 2015, two-thirds of whom have likely already done so.

In the current period, for the first time the poverty rate in Sub-Saharan Africa fall below 50% albeit slowly, and by 2015 the poverty rate is expected to fall below 40%, in the other hand at the national level the poverty rate is fallen from 25.7% in 2005 to 9.9% in 2015, from 1,337.8 million people around the world to 585.5 million most of them in Sub-Saharan Africa (349.9 millions).
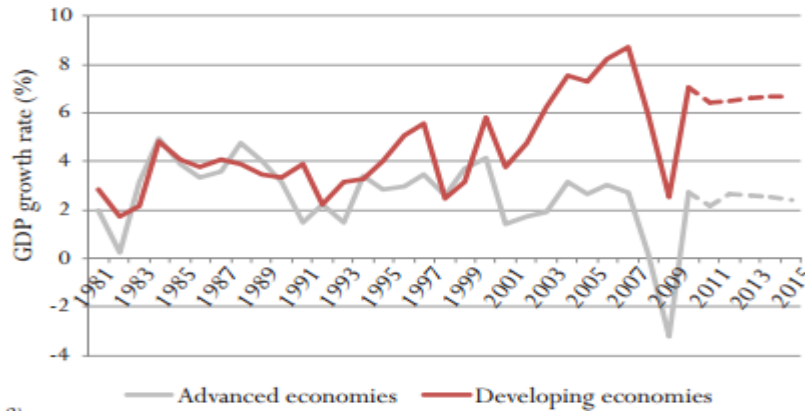
Table 2: Regional and Global Poverty, 2005, 2010, 2015

	Humber of poor (millions)			Poverty rate (% population)		
	2005	2010	2015	2005	2010	2015
East Asia	304.5	140.4	53.4	16.8	7.4	2.7
Europe and Central Asia	16.0	8.4	4.3	3.4	1.8	0.9
Latin America and Caribbean	45.0	35.0	27.3	8.4	6.2	4.5
Middle East and North Africa	9.4	6.7	5.4	3.8	2.5	1.9
South Asia	583.4	317.9	145.2	40.2	20.3	8.7
Sub-Saharan Africa	379.5	369.9	349.9	54.5	46.9	39.3
World	1,337.8	878.2	585.5	25.7	15.8	9.9

Source: Laurence Chandy, Geoffrey Gertz, Poverty in Numbers: The Changing State of Global Poverty from 2005 to 2015, The Brookings Institution 1775 Massachusetts Ave., NW Washington, DC 20036, January 2011, Page 4.

For the economic growth, from Figure3 we note that developing economies As a group mustered an average annual growth rate in the 80s and 90s of just 3.5 and 3.6%, respectively, hardly above their population growth, but with the new millennium, however, growth in the developing world has been considerably faster than the 80s and 90s, well above that the average annual growth rate in advanced economies, From 2003 onwards, developing economies have achieved significant rates exceeded the threshold of 6% every year except 2009 because of the height of the Great Recession. And unlike advanced economies, which today appear destined for an extended period of below-average growth, developing countries

bounced back quickly from the downturn. Growth is once again back above 6% and is expected to stay there through at least 2015.

Figure 3: The Rise of Developing Economy Growth (actuals and projections)
Source: IMF report (2010).

In the other side for the inequality, Nowadays almost everyone will probably acknowledge that growing inequality has become a pressing issue even business leaders in Davos recently identified it as one of the biggest threats to the world economy, Now, discussions around the post-2015 global agenda include a specific focus on reducing inequalities, In 2006, scholars with the United Nations University's World Institute for Development Economics Research published the first paper to tally, for the entire world, all the major elements of household wealth, everything from financial assets and debts to land, homes, and other tangible property, This research, based on year 2000 data, found that the richest 1% of world adults, individuals worth at least $514,512, owned 39.9% of the world's household wealth, a total greater than the wealth of the world's poorest 95%, those adults worth under $150,145. [*]

In this paper we will try to explore the links between poverty, inequality and growth in Algeria for the period 1970-2013, the paper tries to answer the following questions:

✓ Whether growth, poverty and inequality are co-integrated?

✓ How are the long-run and short-run relations between the three variables?

To answer these questions we use an ARDL approach proposed by Pesaran et Al 2001, the ARDL approach has become increasingly popular in the last few years.

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[*]- See more at: http://inequality.org/global-inequality/#sthash.HjjNMbNB.dpuf

4. Data and Methodology

4.1. Data

We use in this paper an annual time series data, which covers the period 1970-2013, the series are obtained from different sources, and we have three variables (poverty, inequality and economic growth).

Poverty: data on poverty in most of the developing countries are very limited because they have started recording data on poverty in the 90s, and to override this lack, many indicators have been proposed, for example the Deininger and Squire 1996 database or Lundberg and Squire 1998 database, this two databases reckon on income and headcount data from the poor people, many others have used the annual income per capita and others used the rate of population living under 1 or 2$ per day, but on the other side, many recent studies have shown that the measure of poverty by the consumption per capita is more efficacy than income see for Ravallion 1992, Woolard and Leibbrandt 1999, Quartey 2005, Wicholasand Odhiambo 2009 and Dhrifi 2013.

Therefore, we will use in our study the consumption per capita, and this indicator is exists in the World Bank database for a long period in most of developing countries.

Inequality: in most of empirical literature inequality is measured by the Gini coefficient, but same problem which in poverty data, in the developing countries this index is not available for long periods, for example, in Algeria there are just six values of it (34.37 in 1980, 40.14 in 1988, 39.1 in 1990, 35.33 in 1995, 39.5 in 1998 and 35.1 in 2000), for this reason we shall use Theil index that exists in the University of Texas data.

Growth: the most of studies used the growth rate of GDP per capita which exists in the World Bank database.

4.1. Methodology

The Autoregressive distributed Lag ARDL models deal with single co-integration, and it was developed by Pesaran and Shin 1999, and it has been extensively used in empirical modelling due to its desirable features. Johansen test was the major method to test the co-integration relationships, the condition to use Johansen co-integration is to have all the series in the same order of stationarity. Therefore ARDL approach has led to use in the same model both stationary and nonstationarity series. This approach has several desirable statistical features:

1. The co-integrating relationship can be estimated normally using OLS after selecting the number of lags using Akaike or Schwarz criterion.

2. Testing simultaneously for the long run and short run relationships.

3. The ARDL approach procedure is valid irrespective for both of the variables are I(0) or I(1) but not the I(2) variables.

4. The ARDL model provides unbased coefficients of explanatory along with t-statistic.

5. The ARDL model corrects the omitted lagged variables bias.

6. The ARDL model is very efficient with small sample sizes.

In this paper we use the following model:

$$\Delta \text{POV}_t = \alpha 0 + \sum_{i=1}^{n} \alpha 1 i \, \Delta \text{POV}_{t-1} + \sum_{i=1}^{n} \alpha 2 i \, \Delta \text{INQ}_{t-1} + \sum_{i=1}^{n} \alpha 3 i \, \Delta \text{GRW}_{t-1}$$

$$+ \beta_1 \text{POV}_{t-1} + \beta_2 \text{INQ}_{t-1} + \beta_3 \text{GRW}_{t-1} + e_t \qquad (1)$$

Where:

Δ : Denotes the first difference operator.

$\alpha 0$: Is the drift component.
e_t : Is the white noise residuals.
POV: The rate of poverty.

INQ : The inequality index.

GRW: Economic growth.

From the equation (1), when a long run relationship exists between the variables, the F test indicates which variable should be normalized, the null hypothesis of no co-integration amongst the variables is:

$$H_0: \beta_1 = \beta_2 = \beta_3 = 0$$

$$H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq 0$$

Then we compare the F statistic with critical values of Pesaran and Narayan tables.

Table 3 : Pesaran 2001 and Narayan 2005 critical values for bounds test:

	Pesaran 2001		Narayan 2005	
Critical values	Lower bound	Upper bound	Lower bound	Upper bound
1%	3.74	5.06	4.59	6.37
5%	2.86	4.01	3.28	4.63
10%	2.45	3.52	2.70	3.90

The calculated F-statistics values will be compared with two sets of tabulated critical values developed by Pesaran et al. (2001) where one set assumes all the series are I(0) while the other one assumes they are I(1). If the computed F-statistics exceeds the upper bound of the critical values, then the null hypothesis of no cointegration is rejected whether the series are I(0) or I(1). If it is below the lower bounds value, then the null cannot be rejected whether the series are I(0) or I(1) , and the cointegration test becomes inconclusive if calculated F-statistic falls between the two levels of the bounds.

As a next step, we estimate the ARDL-VECM model (Unrestricted Error Correction model), The results of the error correction term will indicate the speed of adjustment to reach equilibrium after a short-term shock. Stability and diagnostic tests will be employed to ensure goodness of fit for the chosen ARDL model, which include serial correlation, heteroskedasticity, functional form and normality tests, in addition stability tests known as Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Square of Recursive Residuals (CUSUMQ) tests will be conducted and the ARDL-VECM model is as follows:

$$\Delta POV_t = \alpha 0 + \sum_{i=1}^{n} \alpha 1i \, \Delta POV_{t-1} + \sum_{i=1}^{n} \alpha 2i \, \Delta INQ_{t-1} + \sum_{i=1}^{n} \alpha 3i \, \Delta GRW_{t-1} +$$

$$\lambda ECT_{t-1} + \mu_t \tag{2}$$

Where:

λ: The speed of adjustment parameter.

ECT: The residuals from the estimated co-integration model of equation (1).

5. Empirical results

5.1. Unit test roots

Before conducting the bounds test for cointegration, we applied unit root test to ensure that our variables are not integrated at I(2) because F-test would be spurious if variables are stationary at 2nd difference ; so we must test the order of integration for each variable using ADF (Augmented Dickey Fuller) PP (Philips Perron) and KPSS test (Kwialkowski Phillips Schmidt Shio). With these tests, we know whether or not the ARDL model should be used, Table 2 shows the results of the tests:
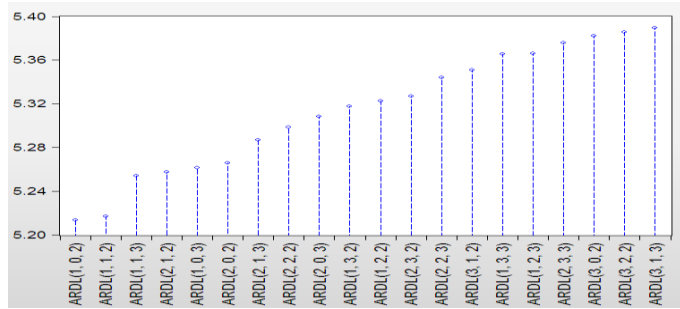
Table 4: Unit test roots

Variables	ADF			PP			KPSS		
	Level	1st difference	Decision	Level	1st difference	Decision	Level	1st difference	Decision
POV	-1.72	-6.15	I(1)	-1.72	-6.13	I(1)	0.16	0.08	I(1)
INQ	-2.27	-6.15	I(1)	-2.04	-7.06	I(1)	0.17	0.24	I(1)
GRW	-8.41	/	I(0)	-8.16	/	I(0)	0.16	/	I(0)

From the table (4), the results suggest that both of poverty and inequality series are not stationary at the level for the three tests, but it's stationary at the first differences, in other way the growth serie is stationary at the level for all tests, so we have a mixture of I(0) and I(1) and therefore we can run an ARDL approach for investigating one or more long-run relationship between the three variables.

5.2. ARDL model

After getting assured about the order of integration of the variables, we move towards determining the cointegrating relationship among the variables. However before this, there is a need to determine the optimal lag length , we select the optimal lag length based on Schwartz Bayesian Criterion (SBC) and Akaike Criterion (AIC), From the fig 1, we suggest that the optimal model is ARDL (1,0,2), one lag for poverty two for growth and no lags for inequality :
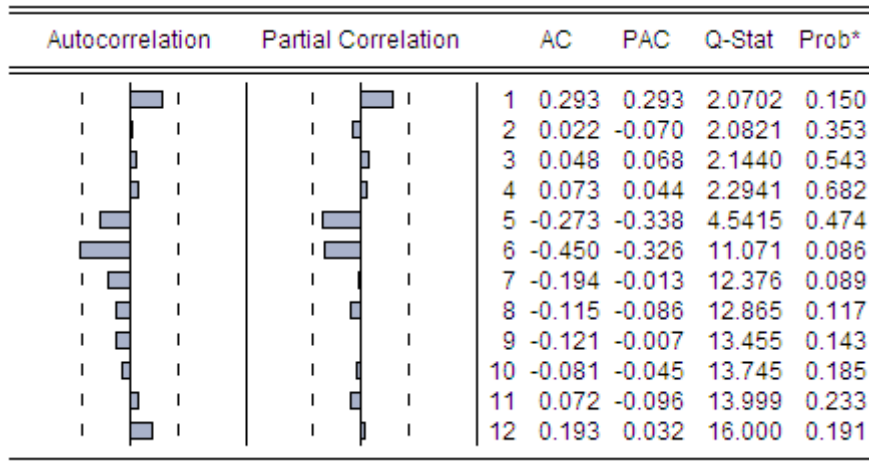
Figure (4): The optimal model using Akaike criterion

And the following table shows the ARDL(1,0,2) estimation:

Table 5: The estimation of ARDL model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.99	24.30	-0.24	0.80
POV(-1)	0.31	0.17	1.79	0.12
INQ	1.08	0.66	1.62	0.12
GRW	-0.13	0.12	-1.08	0.29
GRW(-1)	-0.29	0.12	-2.34	0.03
GRW(-2)	-0.25	0.13	-1.93	0.07
R-squared	0.75	Mean dependent var		51.80
Adjusted R-squared	0.66	S.D. dependent var		5.33
S.E. of regression	3.07	Akaike info criterion		5.31
Sum squared resid	141.48	Schwarz criterion		5.61
Log likelihood	-49.82	Hannan-Quinn criter.		5.38
F-statistic	9.07	Durbin-Watson stat		1.25
Prob(F-statistic)	0.00			
Jaque berra	0.18			0.91
ARCH	0.67			0.42
Ramsey RESET	0.004			0.94

It's important that the errors of this model are serially independent, if not parameter estimates won't consistent, because of the lagged values of dependent variable that appear as regressors in the model:
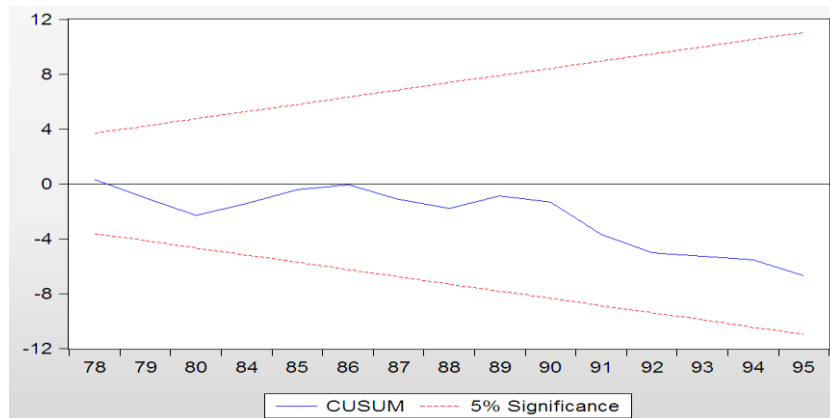
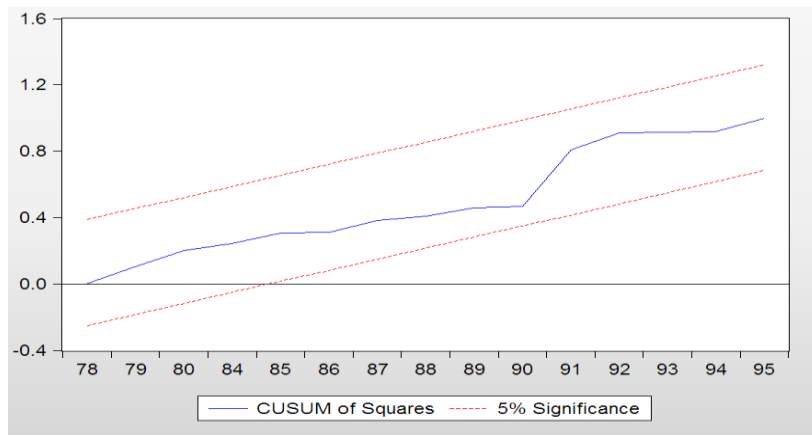| Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.293	0.293	2.0702	0.150
		2	0.022	-0.070	2.0821	0.353
		3	0.048	0.068	2.1440	0.543
		4	0.073	0.044	2.2941	0.682
		5	-0.273	-0.338	4.5415	0.474
		6	-0.450	-0.326	11.071	0.086
		7	-0.194	-0.013	12.376	0.089
		8	-0.115	-0.086	12.865	0.117
		9	-0.121	-0.007	13.455	0.143
		10	-0.081	-0.045	13.745	0.185
		11	0.072	-0.096	13.999	0.233
		12	0.193	0.032	16.000	0.191

Figure 5: The autocorrelation test for residuals

The P values are only approximate, but they strongly suggest that there is no evidence of autocorrelation in the model's residuals, because all the p-value for Q statistic in all 12 observations are higher than 0.05 so we accept the null hypothesis for no evidence of autocorrelation.

5.3. Cusum test:

By applying the CUSUM and CUSUMSQ tests to the model, we show that the model stable for the two tests in 5% degree of liberty, and the following fig shows the results:

Figure 6: CUSUM test

Figure 7: CUSUMSQ test

Finally, stability of the model is checked by applying CUSUM and CUSUMQ tests, and it can be seen from figures 1 and 2 that the results are within the critical bounds implying that estimated coefficients of the model are stable and the straight lines in figures 1 and 2 represent critical bounds at 5% significance level.

5.4. Bounds test:

After estimating the ARDL model and the sureness of the stability and the non correlation of residuals, we check the co-integration of the three variables using the bounds test, this test depends on Ficher statistic from Wald test, the F-statistic for our model is 9.07, so bigger than all critical values even Pesaran or Narayan values in all degrees of liberty, it's clear that there is a long run relationship between the variables when Poverty is the dependent variable, so we reject the null hypothesis of no co-integration among the variables.

According to table (3) There is a negative relation between growth and poverty in the long-run term, whereas any increase in growth rate the poverty rates will fall directly, in the other hand the poverty rates have a positive relation in the long-run term with inequality index, whereas any increase in inequality index will have unfavourable effects on poverty rates, so the inequality is an impediment to the role of growth in reducing poverty rates in the long-rub term in Algeria among the period of the study.

5.5. VECM-ARDL model:

Table 6: VECM-ARDL model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INQ)	1.08	0.66	1.62	0.12

13

D(GRW)	-0.13	0.12	-1.08	0.29
D(GRW(-1))	0.25	0.13	1.93	0.07
ECT(-1)	-0.68	0.17	-3.89	0.001
Long run coefficients				
INQ	1.58	0.90	1.74	0.10
GRW	-0.99	0.36	-2.74	0.01
C	-8.74	35.50	-0.24	0.80

The results of the short-run estimation suggest that the results of long-run terms the same in the short-run term, so we have a positive relation between poverty rates and inequality index, and a negative relation between growth rates and poverty rates, and the absolute value of coefficient of the error-correction term indicates that about 68% of the disequilibrium in the poverty rates is offset by short-run adjustment in each year, we conclude that economic growth in Algeria is PRO-POOR growth which (growth that leads to significant reductions in poverty), but in other hand the inequality play the role of the impediment of this relation between poverty and growth, However, growth is not sufficient for poverty reduction; it is necessary but it must be also accompanied by the introduction of policies to reduce inequalities.

Conclusion

Dollar and Kraay (2000) suggest that the role of economic growth is crucial for poverty reduction, because of its direct role in increasing the incomes of the poor people and rise there opportunities to enjoy the fruits of growth, in the field of development ; it must accelerat growth to achieve the international development goal, which is to reduce by half the proportion of poor in the world between 1990 and 2015, but the rising of economic growth without a small Decrease in the inequality index can curb the role of growth to reduce poverty, Bourguignon (2003) showed that a high level of inequality is associated with a slower reduction in poverty during episodes of positive growth.

This study has considered the relationship between poverty, inequality and economic growth in Algeria using an ARDL approach for the period 1970-2013, the results of co-integration suggest that poverty, inequality and growth are co-integrated, and there is a negative relation between growth and poverty and a positive relation between poverty and inequality in the long-run term, and this relation remains the same in the short-run term.

So according to this result, the economic growth in Algeria help to reduce the poverty rates in the short-run and the long-run terms, but the inequality is the impediment of this reduction in the all terms, so it is necessary but it must be also accompanied by the introduction of policies to reduce inequalities.

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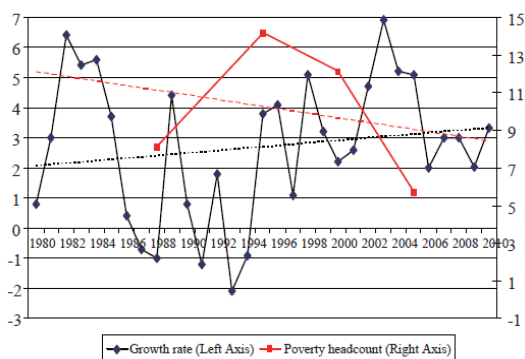
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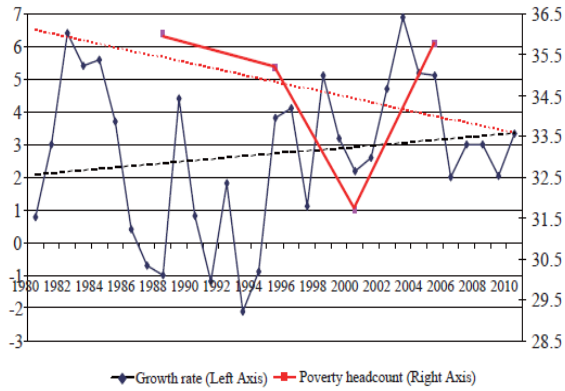
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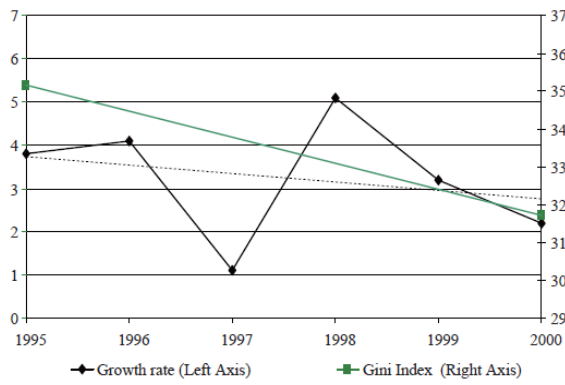
Appendixes:
Figure 1. Growth and Poverty Evolution During 1980-2010
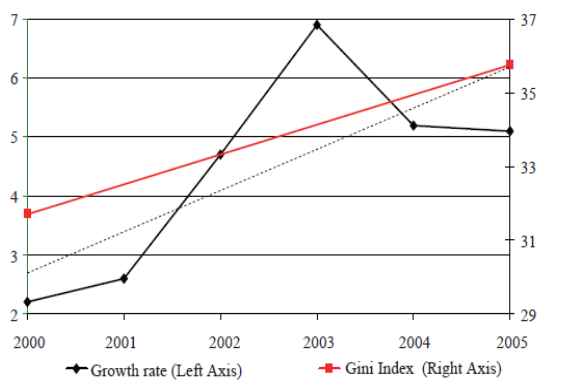
Figure 2. Evolution of Growth Rate and Gini Index During 1980-2010
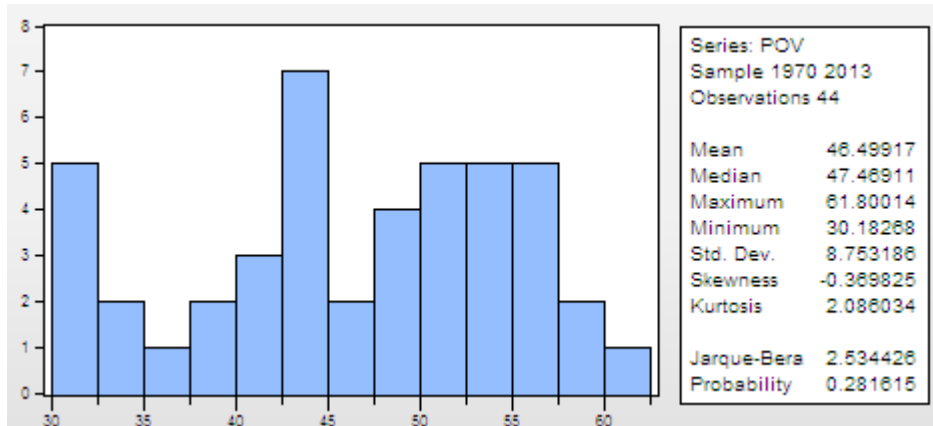

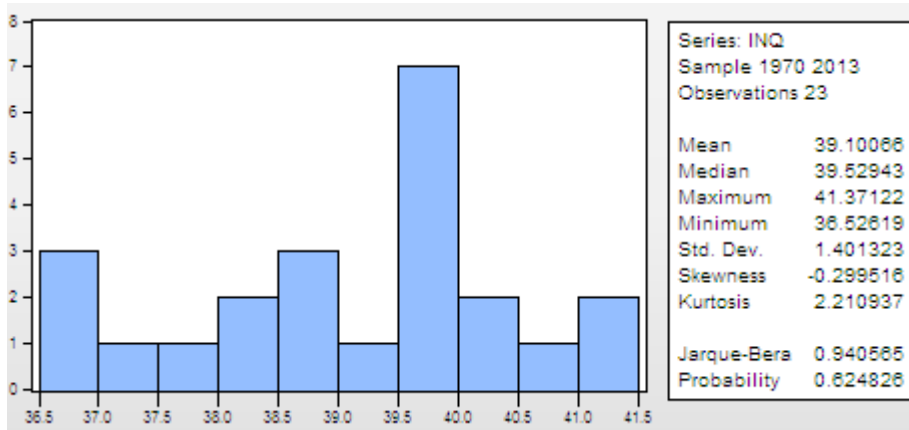**Figure 3. Evolution of Growth Rate and Gini Index During 1995-2000**

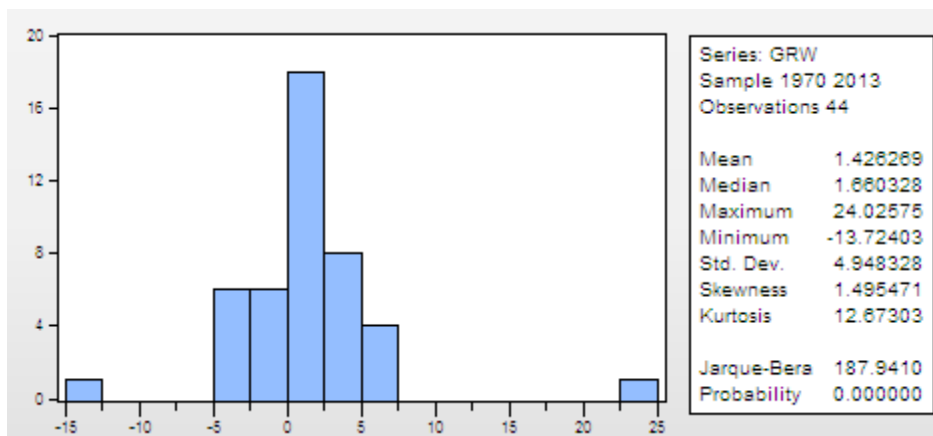**Figure 4. Evolution of Growth Rate and Gini Index During 2000-2005**

Figure 5. Normality Test for poverty

Figure 6. Normality Test for inequality

Figure 7. Normality Test for growth

Figure 8. Actual, Fitted and Residual 1970-2013