Is there a relationship between economic growth and CO2 emissions in Algeria? An econometric analysis

هل هناك علاقة بين النمو الاقتصادي وانبعاثات ثاني أكسيد الكربون في الجزائر؟ تحليل قياسي

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Abstract:

The study attempts to investigate the relationship between economic growth and CO2 emissions Through Testing the existence of Environmental Kuznets Curve (EKC) hypothesis in Algeria for the 1970-2020, using the bounds test of ARDL co-integration model, where some time series are stationary at the level and others series are stationary at the first differences. Our findings reveal that EKC hypothesis does not exist in the long-run and short-run for quadratic and cubic Kuznets relationships models, the error correction parameter has a negative signal and statistically significant, -0.8592 in model 1, -0.6561 in second model, In long-run models, population appears to have a positive significant impact on CO2 emission with Weak impact from trade openness.

Key words: *Environmental Kuznets Curve, CO2 emissions, economic growth, ARDL model, Algeria.*

ملخص:

تهدف الورقة البحثية إلى محاولة التحقق من العلاقة بين النمو الاقتصادي وانبعاثات ثاني أكسيد الكربون من خلال اختبار تحقق فرضية منحنى كوزنتس البيئي في الجزائر 1970-2020، باستخدام اختبار الحدود لنموذج التكامل المشترك (الانحدار الذاتي ذو فترات إبطاء موزعة)، حيث تكون بعض السلاسل الزمنية مستقرة عند المستوى وأخرى مستقرة عند الفروق من الدرجة الأولى. وكشفت النتائج التي توصلنا إليها أن فرضية منحنى كوزنتس البيئي غير متحققة على المدى الطويل والقصير لنماذج دوال كوزنتس التربيعية والتكعيبية، ومعلمة تصحيح الخطأ لها إشارة سالبة وذات دلالة إحصائية، -0.8592 في النموذج الأول، -0.6561 في النموذج الثاني، أما في النماذج طويلة المدى فإن لعدد السكان تأثيرًا إيجابيًا كبيرًا على انبعاثات ثاني أكسيد الكربون مع وجود تأثير ضعيف للانفتاح التجاري.

الكلمات المفتاحية: *منحنى كوزنتس البيئي، انبعاثات ثاني أكسيد الكربون، النمو الاقتصادي، نموذج الانحدار الذاتي ذو فترات الإبطاء الموزعة، الجزائر.*

1. INTRODUCTION

Pollution is now a commonplace term. We hear about the various forms of pollution every day and read about it, specially: the air pollution that is one such form that refers to the contamination of the air, irrespective of indoors or outside.

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Air pollution refers to the emission of gases, solids, or finely dispersed liquids into the atmosphere at levels that exceed the natural capacity of the environment to dissipate, dilute, or absorb them. The presence of these substances in the air can lead to adverse health, economic, or aesthetic consequences due to their elevated concentrations.

Human activities have significantly altered the natural environment, resulting in persistent patterns of escalating environmental degradation. The interconnection of this trend creates significant challenges for the future. In response to these threats, reducing CO2 and other greenhouse gas emissions is crucial. Achieving excessive emission reduction targets offers hope for the world's ecosystems.

The link between levels of income and environmental degradation is an ongoing one. It is feasible that economic growth can be aligned with enhanced environmental conditions. But it necessitates a conscientious implementation of policies and a willingness to produce energy and goods in the most environmentally sustainable manner, although the opposite can also be true.

With the presumption of Kuznets hypothesis, we point our inverted hypothesis. Which states that economic growth worsens income inequality first and improves it later at a higher stage of economic development. In addition to economic growth, other factors such as population growth, resource endowment, price instability, openness, currency devaluation, and others determination. Has been identified as determinants of income inequality.

This paper attempts to investigate the relationship between economic growth and CO2 emissions in Algeria from period 1970-2020 by testing the environmental Kuznets curve (EKC) hypothesis, using bounds test of ARDL co-integration test and the diagnosis tests of the estimate model.

Given this theoretical approach to the relationship between carbon dioxide emissions and economic growth, we aim through this research to answer the following question:

-Is there a relationship between economic growth and CO2 emissions in Algeria?

2. LITERATURE REVIEW

(Cederborg & Snöbohm, 2016) Examine the relationship between GDP per capita and emissions of $CO2$ per capita in order to observe the influence of economic growth on environmental degradation. Their study conducts on 69 industrial countries as well as 45 poor countries using cross-sectional data, the empirical result implies there is a relationship between GDP per capita and CO2 emissions. The correlation is positive, no turning point is found at which emissions start to decrease when reaching a high enough GDP.

(Caporale, Claudio-Quiroga, & Gil-Alana, 2021) test the relationship between the logarithms of CO2 emissions and real GDP in China using fractional integration and co-integration methods. The univariate results indicate that the two series are highly persistent, the cointegration tests imply that there exists a long-run equilibrium relationship between the two variables in first differences, i.e. Their growth rates are linked over the long term.

(Govindarajua & Tang, 2013) Use recent and robust estimation techniques of cointegration estimation techniques to offer more definitive findings regarding the relationship between CO2 emissions, economic growth, and coal consumption in China and India. The empirical findings of this study indicate that the variables are cointegrated in China, whereas this relationship is not observed in India. Furthermore, it establishes a long-term association between CO2 emissions, economic growth, and coal consumption specifically in China.

(Acaravci & Ozturk, 2010) Examine the cause relationship between CO2 emissions, energy consumption, and economic growth by using ARDL model with bounds test for 19 European countries. The bounds test yields evidence of a long-run relationship between co2 per capita, energy consumption per capita, real GDP per capita and the square of per capita real GDP in Denmark, Germany, Greece, Iceland, Italy, Portugal and Switzerland, also explores cause relationship between the variables, and the estimated parameters are stable for the sample period. Another results support that the validity of environmental Kuznets curve (EKC) hypothesis in Denmark and Italy

(**Saidi & Hammami, 2015)** Examine the impact of energy consumption and the CO2 emissions on economic growth for 58 countries over the period 1990–2012 by usnig simultaneous-equation models (SEM) with panel data. The empirical results conclude that energy consumption has a positive impact on economic growth. On the other hand, the CO2 emissions have a negative effect on economic growth.

(Shahbaz, Hye, Kumar Tiwari, & Carlos, 2013) Examine the relationship among economic growth, energy consumption, trade openness and financial development and CO2 emissions in Indonesia during the period of quarter one (1) of 1975 – quarter four (4) of 2011. The empirical results confirm that the long run relationship exists in the presence of structural breaks. In addition, the empirical findings indicate that economic growth and energy consumption increase CO2 emissions, while financial development and trade openness compact it. There are feedback hypothesis between energy consumption and CO2 emissions. Economic growth and CO2 emissions are also interrelated. bidirectional causality. Financial development causes CO2 emissions.

(Apergis & Ozturk, 2015) Test the Environmental Kuznet Curve hypothesis during the period 1990–2011 for 14 Asian countries, the estimating result have the expected signs and are statistically significant, yielding empirical support to the presence of the Environmental Kuznets Curve hypothesis.

(Farhani , Chaib, & Rault, 2014) test the dynamic relationship between CO2 emissions, GDP, energy consumption, and trade, using the ARDL co-integration model with bound testing approach during the period 1971–2008 for Tunisia. The empirical results show the existence the long-run relationships between the variables. In the short term, there are three unidirectional Granger causality relationships: one from GDP, one from squared GDP, and one from energy consumption to CO2 emissions. The parameters remained stable, and the findings carry significant policy implications.

(Ozturk & Acaravci, 2013) Examine the cause relationship between energy consumption, financial development, trade, economic growth, and carbon emissions during the period 1960–2007 in Turkey. The bounds test yields evidence of a long-run relationship between the variables. The empirical results support the validity of EKC hypothesis in the Turkish economy .It implies that CO2 emissions initially rise with income until they reach a point of stabilization, after which they decline in Turkey.

(Saboori , Sulaiman , & Mohd, 2012) Examine a long run and cause relationship between economic growth and CO2 emissions for Malaysia during the period 1980 - 2009. The empirical results suggest the existence of a long-run relationship between per capita CO2 emissions and real per capita GDP when the CO2 emissions level is the dependent variable. We found an inverted-U shape relationship between CO2 emissions and GDP in both short and long run, thus supporting the EKC hypothesis, Also presents an absence of causality between CO2 emissions and economic growth in the short-run.

3. MODEL SPECIFICATION AND DATA

To test the relationship between economic growth and CO2 emissions we examine the presence or absence the environmental Kuznets curve (EKC) hypothesis, where the EKC suggests that economic development initially leads to a deterioration in the environment. However, after a certain level of economic growth, a society begins to improve its relationship with the environment and levels of environmental degradation reduces.

The EKC hypothesis Based a non-linear quadratic Form (Lacheheb, Abdul Rahim, & Sirag, 2015) that:

$$C_t = f\left(Y_t, Y_t^2, D_t\right) \qquad \text{Or} \qquad C_t = \alpha + \beta_1 Y_t + \beta_2 Y_t^2 + \beta_{i+3} D_t + \varepsilon_t$$

The specifications of specific functional forms are:

If $\beta_1 = \beta_2 = 0$; no growth-CO_2 emissions association

If $\beta_1 > 0, \beta_2 = 0$; linearly increasing growth-CO_2 emissions association

If $\beta_1 < 0, \beta_2 = 0$; linearly decreasing growth-CO_2 emissions association

If $\beta_1 > 0, \beta_2 < 0$; inverted U-shaped growth-CO_2 emissions association

If $\beta_1 < 0, \beta_2 > 0$; U-shaped growth-CO_2 emissions association

Though the number of studies on the EKC estimation for CO2 emissions is extensive (Shahbaz & Avik, 2018) , those studies share some common characteristics in terms of the model specification. The model used by those studies can take the following generalized form:

$$C_t = f\left(Y_t, Y_t^2, Y_t^3, D_t\right) \qquad \text{or} \qquad C_t = \alpha + \beta_1 Y_t + \beta_2 Y_t^2 + \beta_3 Y_t^3 + \beta_{i+3} D_t + \varepsilon_t$$

Where C is CO_2 emissions,

Y is economic growth,

D is the additional context specific explanatory variables,

α is the constant term,

β_i are the coefficients,

t is the time series,

ε is the standard error term.

The specifications of specific functional forms are:

If $\beta_1 = \beta_2 = \beta_3 = 0$; no growth-$CO_2$ emissions association

If $\beta_1 > 0, \beta_2 = \beta_3 = 0$; linearly increasing growth-CO_2 emissions association

If $\beta_1 < 0, \beta_2 = \beta_3 = 0$; linearly decreasing growth-CO_2 emissions association

If $\beta_1 > 0, \beta_2 < 0, \beta_3 = 0$; inverted U-shaped growth-CO_2 emissions association

If $\beta_1 < 0, \beta_2 > 0, \beta_3 = 0$; U-shaped growth-$CO_2$ emissions association

If $\beta_1 > 0, \beta_2 < 0, \beta_3 > 0$; N-shaped growth-$CO_2$ emissions association

If $\beta_1 < 0, \beta_2 > 0, \beta_3 < 0$; inverted N-shaped growth-CO_2 emissions association

In this study for the additional explanatory variables, we propose a three-importance variables financial development, trade openness and population.

- Carbon dioxide emissions: the primary sources of these emissions are attributed to the combustion of fossil fuels and the production of cement. This encompasses carbon dioxide generated through the utilization of solid, liquid, and gaseous fuels, as well as gas flaring.

- Annual percentage growth rate of GDP: The measurement is based on market prices using a constant local currency. Aggregates are calculated using fixed 2015 prices and are expressed in U.S. dollars. GDP represents the total value added by all resident producers in the economy, including product taxes and excluding subsidies that are not accounted for in the product value. Depreciation of fabricated assets and the depletion and degradation of natural resources are not deducted in the calculation.

- Financial development: We express it as the growth rate of Broad money, which includes currency held outside banks, demand deposits (excluding those of the central government), time deposits, savings deposits, foreign currency deposits (excluding those of the central government), bank and traveler's checks, as well as other securities like certificates of deposit and commercial paper.

- Trade openness: It is calculated as the ratio of exports and imports to GDP.

Exports represent the value of all goods and market services provided to the rest of the world, including merchandise, freight, insurance, transport, travel, royalties, license fees, and other services such as communication, financial, construction, information, personal, business, and government services. Excluded from exports are compensation of employees, transfer payments, and investment income (formerly known as factor services).

The Imports represent the value of all goods and market services received from the rest of the world. This includes freight, merchandise, insurance, travel, royalties, transport, license fees, and other services such as communication, business, construction, information, financial, personal, and government services. Excluded from imports are compensation of employees, transfer payments, and investment income (formerly known as factor services).

- Population: The population estimate is based on the de facto definition, which includes all residents regardless of legal status or citizenship. The values provided represent midyear estimates.

Table (1): Descriptive statistics

	lncoe	***eg***	***eg2***	***eg3***	***fd***	***lnpop***	***topen***
Mean	11.19244	3.449744	35.50657	481.7530	15.83159	17.10580	57.91966
Median	11.22217	3.400000	13.68998	39.30400	14.64465	17.17442	58.06549
Maximum	11.95118	27.42397	752.0741	20624.86	54.05141	17.59631	76.68452
Minimum	9.620795	-11.33172	0.160001	-1455.082	-0.757531	16.48724	32.68458
Std. Dev.	0.526282	4.906928	105.5288	2891.083	9.632811	0.322327	10.64825
Observations	51	51	51	51	51	51	51

Source: *Eviews's results*

4. ECONOMETRICS TECHNIQUES

In this section, by applying the above methodologies, we derive six time series, in model 1, Carbon dioxide emissions, Economic growth, Economic growth square, financial development, Trade open, population, In addition to the seventh time series in Model 2, its Economic growth cube.

This long-term estimation process may make false regression if variables are not stationary in the sense of convergence of the behavior of variables without causation between them, to avoid this, we use co-integration model, which also allows the long-term relationship to be studied and applies this on non-stationary time series but integrated a same degree.

In addition to addressing the problem of false regression, the famous models used, is the Engel-Granger model, Johanson and Juselius Model, ARDL model of Pesaran.

An ARDL is a least squares regression containing lags of the dependent and explanatory variables. ARDLs are usually denoted with the notation $ARDL(p, q_1, ..., q_k)$, where p the number of lags of the dependent variable is, q_1 is the number of lags of the first explanatory variable, and q_k is the number of lags of the k-th explanatory variable.

An ARDL model may be written as:

$$y_t = \alpha + \sum_{i=1}^{p} \gamma_i y_{t-1} + \sum_{i=1}^{k} \sum_{i=0}^{q_j} X_{j,t-i}{}' \beta_{j,i} + \varepsilon_t$$

Some of the explanatory variables, X_j, may have no lagged terms in the model $(q_j = 0)$.

These variables are called static or fixed regressors. Explanatory variables with at least one lagged term are called dynamic regressors.

- Bounds Testing

Using the co-integrating relationship form in previous Equation, (Pesaran, Shin, & Smith, 2001) describe a methodology for testing whether the ARDL model contains a level (or long-run) relationship between the independent variable and the regressors.

The Bounds test procedure transform into the following representation:

$$\Delta y_t = -\sum_{i=1}^{p-1} \gamma_i^* \Delta y_{t-1} + \sum_{i=1}^{k} \sum_{i=0}^{q_j-1} \Delta X_{j,t-i}{}' \beta_{j,i}^* - \rho y_{t-1} - \alpha - \sum_{j=1}^{k} X_{j,t-1}{}' \delta_j + \varepsilon_t$$

The test for the existence of level relationships is then simply a test of:

$$\rho = 0$$
$$\delta_1 = \delta_1 = ... = \delta_k = 0$$

5. EMPIRICAL RESULTS

Unit Root Testing: Augmented Dickey-Fuller test can help avoid false results through stationary tests of times series. Our results represented in table 2, we accept the null hypothesis in the level for economic growth square, population and trade openness, and rejection it from Co2 emission in first difference that an others time series signifies integration of the variables at order 1.

Table (2): Unit Root Test Results (ADF)

Null Hypothesis: the variable has a unit root				
variables	**At Level**		**At First Difference**	
	τ_{cal}	***Prob.***	τ_{cal}	***Prob.***
fd	*-6.1527*	***0.0000***	*-2.0478*	***0.0403***
eg	*-9.2185*	***0.0000***	*-12.3138*	***0.0000***
eg²	*-2.4918*	*0.3303*	*-13.7714*	***0.0000***
eg³	*-8.0782*	***0.0000***	*-33.5669*	***0.0000***
lncoe	*-4.4709*	***0.0042***	*-0.7652*	*0.3783*
lnpop	*-3.0308*	*0.1358*	*-2.0256*	***0.0422***
topen	*-2.4138*	*0.3682*	*-5.3489*	***0.0000***

Source: *Eviews's results*

- Bounds Testing: The objective is to verify that there is co-integration between our variables or not, the result of Bounds Test draw in the table (3), that we reject the Null Hypothesis (No long-run relationships exist), as long-run relationships exist between variables in the two models.

Table (3): ARDL Bounds Test

Model 1			**Model 2**		
Test Statistic	**Value**	**k**	**Test Statistic**	**Value**	**k**
F-statistic	*6.336738*	*5*	F-statistic	*5.345916*	*6*
Critical Value Bounds					
Significance	**I0 Bound**	**I1 Bound**	**Significance**	**I0 Bound**	**I1 Bound**
5%	*2.39*	*3.38*	5%	*2.27*	*3.28*
1%	*3.06*	*4.15*	1%	*2.88*	*3.99*

Source: *Eviews's results*

To estimate the relationship in the short and long term we specified the model, the next output gives a summary of the settings used during estimation. Here we see that automatic selection (using the Akaike Information Criterion), the procedure has selected an ARDL(1, 2, 2, 0, 1, 3) model for case 1 and ARDL(1, 4, 4, 4, 3, 4, 3) for second case.

Table (4): Model Selection Criteria Table

Model 1			Model 2		
Model	AIC*	Specification	Model	AIC*	Specification
10992	**-1.494849**	**ARDL(1, 2, 2, 0, 1, 3)**	**46902**	**-2.553947**	**ARDL(1, 4, 4, 4, 3, 4, 3)**
10727	-1.477524	ARDL(1, 2, 4, 0, 4, 3)	46901	-2.547573	ARDL(1, 4, 4, 4, 3, 4, 4)
12492	-1.473326	ARDL(1, 0, 0, 0, 1, 3)	46905	-2.555858	ARDL(1, 4, 4, 4, 3, 4, 0)

Source: *Eviews's results*

Findings of co-integration test are given in Table 5,

Table (5): Long Run Coefficients

Dependent Variable: ***lncoe***								
	Model 1				**Model 2**			
Variables	***Coefficient***	***S E***	***t-Statistic***	***Prob.***	***Coefficient***	***S E***	***t-Statistic***	***Prob.***
eg	0.012517	0.016462	0.760358	0.4524	0.078356	0.047356	1.654639	0.1136
eg^2	0.001666	0.001653	1.007341	0.3211	-0.020269	0.011664	-1.737796	0.0976
eg^3	-	-	-	-	0.001419	0.000854	1.660742	0.1124
fd	-0.002343	0.002460	-0.952247	0.3479	-0.019465	0.007417	-2.624385	**0.0162**
lnpop	1.606600	0.161319	9.959164	**0.0000**	0.378415	0.451498	0.838132	0.4119
topen	-0.000439	0.002660	-0.164946	0.8700	-0.004936	0.004999	-0.987516	0.3352
c	-16.628412	2.866862	-5.800214	**0.0000**	6.061075	8.243586	0.735247	0.4707
Diagnostic Testing								
test	***Jarque-Bera***	***Breusch-Godfrey***	***Breusch-Pagan-Godfrey***	***Ramsey RESET***	***Jarque-Bera***	***Breusch-Godfrey***	***Breusch-Pagan-Godfrey***	***Ramsey RESET***
prob	*0.059*	*0.31*	*0.07*	*0.516*	*0.91*	*0.37*	*0.27*	*0.089*

Source: *Eviews's results*

Through the short Run Coefficients estimation, we extract the Error correction equation like:

Table (6): Error correction equation

Model 1	$\text{Cointeq} = \ln coe - (0.0125eg + 0.0017eg^2 - 0.0023fd$ $+ 1.61\ln pop - 0.0004topen - 16.63)$
Model 2	$\text{Cointeq} = \ln coe - (0.078eg + 0.0203eg^2 + 0.0014eg^3 - 0.0195fd$ $+ 0.378\ln pop - 0.0049topen + 6.061)$

Source: *Eviews's results*

Table 7 and Table 8 exhibits the results of short Run Coefficients relationship test

Table (7): short Run Coefficients (Model 1)

Model 1	*Dependent Variable :* ***lncoe***			
Variable	***Coefficient***	***S E***	***t-Statistic***	***Prob.***
d(eg)	-0.011867	0.006697	-1.771901	**0.0856**
d(eg(-1))	-0.022721	0.008138	-2.791868	**0.0086**
d(eg2)	0.001506	0.000423	3.556392	**0.0012**
d(eg2(-1))	0.000786	0.000313	2.512757	**0.0170**
d(fd)	-0.002752	0.001365	-2.016347	**0.0520**
d(lnpop)	15.209037	2.045734	7.434514	**0.0000**
d(topen)	-0.003108	0.003148	-0.987144	0.3308
d(topen(-1))	0.000037	0.003084	0.011871	0.9906
d(topen(-2))	-0.009747	0.002856	-3.413046	**0.0017**
cointeq(-1)	-0.859239	0.119935	-7.164180	**0.0000**
tests				
test	***Adj R-squared***	***Durbin-Watson***	***F-statistic***	***Log likelihood***
value	*0.4929*	*1.88*	*4.26*	*50.91*

Source: *Eviews's results*

Table (8): short Run Coefficients (Model 2)

Model 2	*Dependent Variable :* ***lncoe***			
Variable	***Coefficient***	***S E***	***t-Statistic***	***Prob.***
d(eg)	-0.018797	0.005524	-3.402637	**0.0028**
d(eg(-1))	-0.080384	0.011719	-6.859141	**0.0000**
d(eg(-2))	-0.084132	0.012085	-6.961698	**0.0000**
d(eg(-3))	-0.024734	0.010505	-2.354548	**0.0289**
d(eg2)	-0.003900	0.001080	-3.611974	**0.0017**
d(eg2(-1))	0.014945	0.002100	7.116596	**0.0000**
d(eg2(-2))	0.018313	0.002239	8.178735	**0.0000**
d(eg2(-3))	0.004439	0.001826	2.431519	**0.0246**
d(eg3)	0.000637	0.000139	4.594167	**0.0002**
d(eg3(-1))	-0.000620	0.000085	-7.320581	**0.0000**
d(eg3(-2))	-0.000593	0.000084	-7.067537	**0.0000**
d(eg3(-3))	-0.000121	0.000053	-2.265266	**0.0348**
d(fd)	-0.000903	0.001093	-0.826551	0.4182
d(fd(-1))	0.008387	0.001377	6.090678	**0.0000**
d(fd(-2))	0.004819	0.000936	5.150808	**0.0000**
d(lnpop)	112.927156	109.565831	1.030679	0.3150
d(lnpop(-1))	-735.400983	325.644380	-2.258295	**0.0353**
d(lnpop(-2))	1190.200349	343.301688	3.466923	**0.0024**
d(lnpop(-3))	-586.827932	127.984354	-4.585154	**0.0002**
d(topen)	-0.002632	0.002178	-1.208433	0.2410
cointeq(-1)	-0.656058	0.085758	-7.650075	**0.0000**
tests				
test	***Adj R-squared***	***Durbin-Watson***	***F-statistic***	***Log likelihood***
value	*0.8159*	*2.092*	*8.84*	*86.29*

Source: *Eviews's results*

6. ANALYZE AND DISCUSSIONS:

Since the result of bounds test shows a no existence of long-run relationship between CO2 emission and its determinants based on bound testing approach permits us to estimate long- and short run models.

Through the results of the short-term and long-term estimation of Ardl model, the error correction parameter has a negative signal and statistically significant, this result supports the long-term equilibrium relationship between CO2 emission and its explanatory variables, the parameter value reflects the speed of adjustment to move from short-term imbalances to long-term equilibrium.

Since the value of the error correction factor was -0.8592 in model 1 CO2 emission is adjusted towards the equilibrium value during one period (year) by 85.92%, meaning that; if the level of Algerian CO2 emission deviates from the short-term equilibrium (t-1) from the long-term, it is 85.92%, which needs to be adjusted entirely within one year and two months.

In model 2; the error correction factor was -0.6561, CO2 emission is adjusted towards the equilibrium value during one period (year) by 65.61%, meaning that; if the level of Algerian CO2 emission deviates from the short-term equilibrium (t-1) from the long-term, it is 65.61%, which needs to be adjusted entirely within one year and six months.

Provided long-run and short-run computed models, there is no evidence of EKC hypothesis in all models.

In long-run models (Table 5), population appear to have a positive significant impact on CO2 emission that is, an increase by 1% in population leads to 1.61% increase in CO2 emission from. In addition, we note that there is no impact of both Trade openness and financial development, this latter has an effect on CO2 emission, where an increase by 1% in financial development leads to 0.019% decrease in CO2 emission.

The results of model 1 estimate in short-term showed that the current population is significant and positive impact, and weak negative impact from financial development on CO2 emission, but there is a negative impact of trade openness with two periods' delay where an increase by 1% in trade openness leads to 0.01% decrease in CO2 emission (Weak impact).

In model 2; in addition to the significant and positive impact current population in model 1. There is a late impact of population and financial development in model 2, these results indicate the lasting impact of population growth on environmental degradation in general and on CO2 emission in particular that the Pollution rates continue to rise. This can primarily be attributed to the release of toxic gases and smoke from factories, particularly chemical factories, as well as the emissions of CO2 from vehicles.

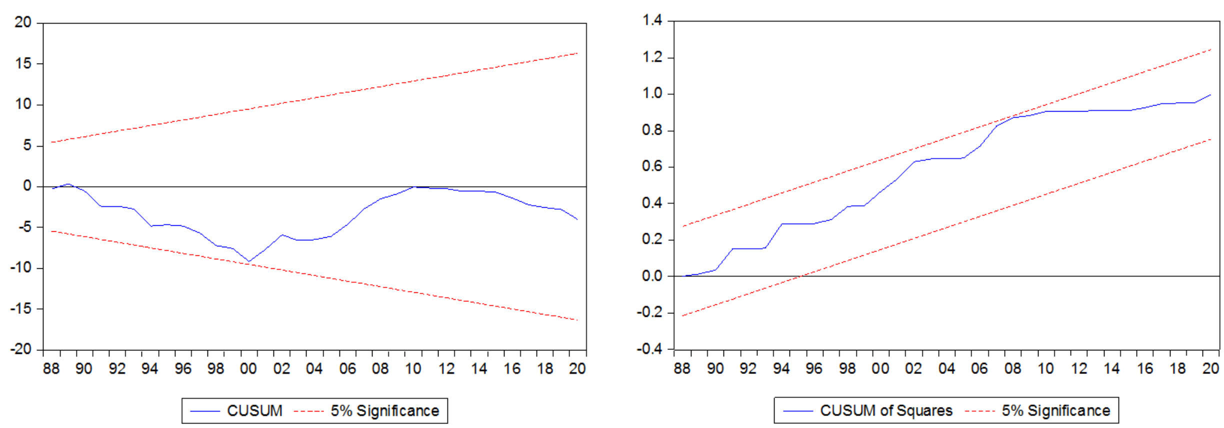
So that GDP gap has a negative impact on exchange rate, and the term (negative) As a mathematical expression of the parameter's reference. Because high levels of exchange rate are an economically undesirable effect, according to the results, with the 1% degree of GDP gap in the (t) and (t-3) period, the changes of exchange rate are 57.2% and 6.64% In the reverse direction, that high current proportion.

The adjusted determination Coefficient of model one (1) was 0.4929. This indicates the medium quality of the model's reconciliation. So that the independent variables interpreted CO_2 emissions at 49.29%, which is a medium degree of explanation, as Fisher's statistics demonstrate the overall statistical significant of the model's parameters. and there are no autocorrelation between errors, "Durbin-Watson" if his statistic is worth 1.88 and is within the field of no autocorrelation errors.

Jarque-Bera's statistic confirms that errors are normal distributed because the statistical probability value is 0.06, which is greater than 0.05, and errors are not related to k's degree. This is proven by Breusch-Godfrey's statistic, which is 0.31 greater than 0.05, and Breusch-Pagan-Godfrey's statistic showed Heteroscedasticity of variance, which is 0.07 greater than 0.05.

Also, the function form of this model is correct, given that the probability value of Ramsey RESET's statistic 0.516 that is greater than 0.05. In addition that the graphs of COSUM and COSUM of Squares indicate the realization of the structural stability. Where the graphic curve of these two tests statistics fell within critical boundaries at a 5% signification level. It is meaning that the estimated model coefficients are structurally stable during the study period (Figure 1).

Figure (1): COSUM and COSUM of Squares graphs of Model 1



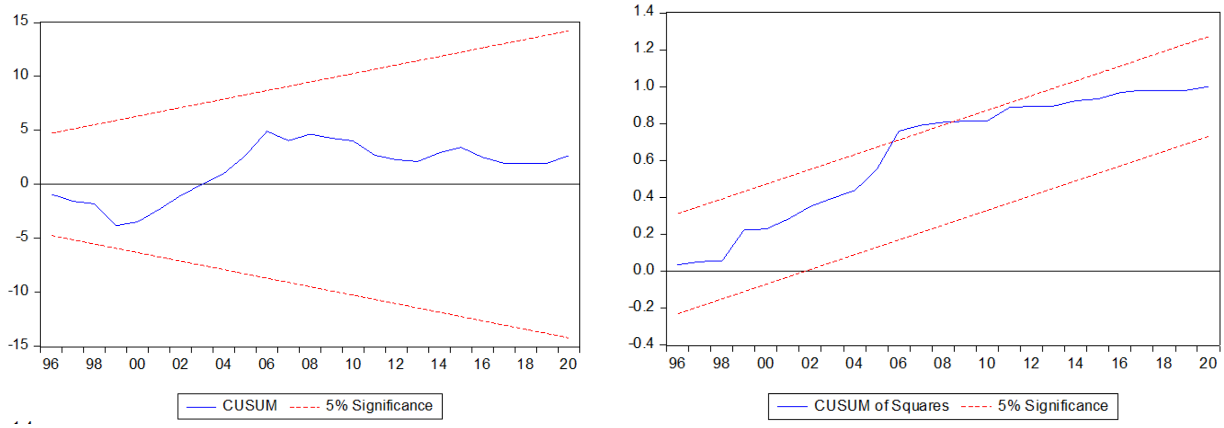
Source: *Eviews's results*

For the model 2 The Adjusted determination Coefficient 0.8195. This indicates the high quality of the model's reconciliation, that the independent variables interpreted CO_2 emissions at 81.95%, which is a high degree of explanation, also Fisher's statistics demonstrate the overall statistical significant of the model's parameters, and there are not autocorrelation between errors, "Durbin-Watson" if his statistic is worth 2.092 and is within the field of no autocorrelation errors.

Jarque-Bera's statistic confirms that errors are normal distributed because the statistical probability value is 0.91, which is greater than 0.05, and errors are not related to k's degree. This is proven by Breusch-Godfrey's statistic, which is 0.37, and Breusch-Pagan-Godfrey's statistic showed Heteroskedasticity of variance, which is 0.27.

The function form of the model 2 is correct, given that the probability value of Ramsey RESET's statistic 0.089, in addition that The graphs of Cosum and Cosum of Squares indicate the no perfectly realization of the structural stability, where the COSUM of Squares graph fell without critical boundaries at a 5% signification level, its meaning that the estimated model coefficients are no perfect structurally stable during the study period (Figure 2).

Figure (2): COSUM and COSUM of Squares graphs of Model 2



Source: *Eviews's results*

There are several reasons why the Environmental Kuznets Curve (EKC) hypothesis may not hold in the long-run and short-run for quadratic and cubic Kuznets relationships models. Here are some possible explanations:

- Complexity of the relationship: There may be other factors that have a larger impact on CO2 emissions than just the level of economic income, such as production technology, government policies, industry structure, supply and demand factors. Representing these factors accurately in economic models can be challenging.

- Data limitations: There may be constraints in the availability and quality of data used in economic and environmental studies. It can be difficult to obtain sufficient and reliable data for long time periods and for multiple countries worldwide.

- Structural changes effect: Changes in economic and industrial structure can lead to variations in emission patterns. For example, economies may shift from industries with high emissions to cleaner industries due to technological advancements and changes in environmental policies. These structural transformations can impact the relationship between economic growth and CO2 emissions.

- Regional variations: Regional disparities can also influence the relationship between economic growth and CO2 emissions. There may be significant differences in economic structure and development levels among regions, which can affect the emission patterns and the shape of the EKC.

It is important to note that the EKC hypothesis is a theoretical concept, and its applicability to real-world situations can be influenced by various factors. The absence of the EKC pattern in specific models does not negate the importance of addressing environmental concerns and pursuing sustainable development strategies.

7.CONCLUSION

This paper has analyzed the relationship between the logarithms of CO2 emissions and economic growth and another determination of CO2 emissions by applying co-integration method. Where the emissions reducing of the main anthropogenic greenhouse gases, such as carbon dioxide (CO2), is one of the major challenges of this century.

A partial solution to these environmental problems could be the capture and the conversion of carbon dioxide, the co-integration method are more general than the standard methods based on non-stationary series, where the long-term estimation process may make false regression if variables are not stationary in the sense of convergence of the behavior of variables without causation between them. To avoid this, we use co-integration model, which also allows the long-term relationship to be studied and applies this on non-stationary time series but integrated a same degree, the method has the basic steps resume in Unit Root Testing, Bounds Testing, long-term and short-run relationship between variable, and the diagnostic test.

Our results also have important policy implications. Specifically, they suggest to policymakers the need for environmental policies aimed at reducing emissions during periods of economic growth: if Algeria wants to be on a sustainable development path, decisive environmental policies appear to be necessary.

In particular, the Algerian government should adopt more environmental innovation measures, especially to increase energy efficiency through energy consumption restructuring, to promote social awareness, that the population growth was the important factor of air pollution.

In addition, the advantages of a low-carbon economy and of environmental protection, and to ensure the implementation of environmental protection legislation and compliance; this type of green development also offers new opportunities for entrepreneurship.

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