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## Article

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# Effects of Energy Prices on Environmental Pollution: Testing Environmental Kuznets Curve for Algeria

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## ABSTRACT

The current study is primarily motivated in testing Environmental Kuznets Curve (EKC) framework by including energy prices along with output growth. In addition, the current study is also important for analyzing the impact of energy prices by testing the effects of three different fuel prices. They include crude oil prices, natural gas prices and heating oil. The data is gathered from the period of 1980-2017. The results of auto regressive distributed lag (ARDL) confirm that economic growth has a positive and significant impact on carbon emission in Algeria. On the other hand, all energy prices (oil prices, heating oil and natural gas prices) confirm a negative and significant impact on carbon emission in Algeria. The results of ARDL also confirm a presence of U-Shaped EKC curve in the Algeria. The results variance decomposition model have confirm a bi-directional causal relationship between oil prices and carbon emission; however we found a unidirectional causal relationship from heating oil prices to carbon emission and no causal relationship between natural gas prices and carbon emission in Algeria.

**Keywords:** Oil Prices, Natural Gas Prices, Heating Oil Prices, Algeria

**JEL Classifications:** E31, Q5, Q56

## 1. INTRODUCTION

An environment in the present time is facing extreme deterioration (Koengkan et al., 2019). The rising environmental pressures that have become the inevitable part of economic development have been the prime sources of worsening ecological health. The theoretical notion for environmental degradation has been identified in early 1950s by the renowned economist Simon Kuznets in the form of Environmental Kuznets Curve (EKC). However, the quantitative testing of the EKC essentials were first analyzed by Grossman and Krueger in 1992 (Grossman and Krueger, 1992; Okechukwu and Hyginus, 2017). The fundamentals of EKC hypothesis suggested that the levels of ecological pollutions augment with the increase in economic development, however, they tend to decline with the progression in income levels and subsequently cause positive impact on environmental quality. Since then, the literature has witnessed many examinations attributed to inspect the existence of EKC hypothesis in several regions (Selden and Song, 1994;

Patel et al., 1995; Torras and Boyce, 1998; Andreoni and Levinson, 2001; Cole, 2004; Stern, 2004).

In recent studies, many researchers have analyzed the numerous indicators of EKC framework (Lacheheb et al., 2015; Shahbaz et al., 2015; Shahbaz et al., 2016; Anastacio, 2017; Solarin et al., 2017; Sarkodie, 2018; Sarkodie and Strezov, 2018; Adu and Denkyirah, 2018; Rauf et al., 2018; He et al., 2019; Sasana and Aminata, 2019). In order to examine the role of agriculture development in contributing to environmental degradation, Gokmenoglu and Taspinar (2018) tested EKC curve for Pakistan. For smog pollution, Xie et al. (2019) examined EKC in China. In testing transportation industry's contribution to ecological deterioration, Wang et al. (2017) analyzed EKC curve for Japan. As for African region, Bah et al. (2019) studied EKC existence for the case of Sab-Saharan African economies. Hence, the significance of EKC estimations have proved immensely valuable for studying environmental condition since its inception.

Among the variables that can validate the existence of EKC framework, the impact of energy prices is substantial to influence environmental degradation (Agras and Chapman, 1999; Myambo and Munyanyi, 2017). The association of energy prices with environment is theorized in accordance the popular economic theory. The basic of the theory suggested that changes in fuel prices are likely to bring changes in emissions levels that impact environmental condition. It is more evidently witnessed in the observing the trend analysis of emission and energy data. More commonly, the price increase in energy is likely to carry negative impact on toxic environmental emanations (Brown et al., 1996). This association is probable to remain constant for all income groups and therefore, impacts similar in emerging and industrialized countries (Agras and Chapman, 1999). However, the relationship in EKC curve tends to change with the enhancements in income levels. Thus, the investigation of EKC with the inclusion of energy prices has potential significance.

Therefore, keeping in mind the theoretical effect of energy prices in curtailing environmental deterioration, the present study aims to investigate the association between energy prices and environmental pollution in Algeria. Given the ability of EKC in testing quadratic association, the current study is primarily motivated in testing EKC framework by including energy prices along with income level (Obadi et al., 2017). In addition, the current study is also important for analyzing the impact of energy prices by testing the effects of three different fuel prices. They include crude oil prices, natural gas prices and heating oil. The comprehensive investigation of analyzing three core energy prices will be successful in providing more generalized impact of energy prices in carbon emanations of Algeria.

The remaining parts of the current investigation are discussed in the following. After chapter one, chapter two of this study analyzed the existing literature related to EKC examinations and its link with crucial ecological indicators including energy price. Later in chapter three, the explanation regarding the methods of the study are discussed. In chapter four, the empirical results and their interpretations are presented. In the end, chapter five offers study conclusion and implications.

## 2. LITERATURE REVIEW

The importance of EKC has been evident in literature since its inception. In earlier studies, the examinations of EKC model were largely confined to the sectoral and segregate developments (Hettige et al., 2000; Tamazian et al., 2009; Lekakis, 2000; Perrings, 1998). However, in more recent studies, the emphasis of scholars in analyzing EKC model for energy variables has been observed. In such investigations, Dogan and Seker (2016) examined EKC framework among the variables of renewable, non-renewable power and carbon dioxide emanations. Using the sample of European countries from 1980 to 2012, the results provided the significance of renewable and non-renewable power in altering emission levels. In particular the study found the positive relationship of non-renewable power and negative relationship of renewable power with environmental pollution in EU economies.

Focusing exclusively on oil prices, Balaguer and Cantavella (2016) also examined EKC model among the variables of economic growth, fuel prices and carbon dioxide emanations. Using the sample of Spain from 1874 to 2011, the results from auto regressive distributed lag (ARDL) estimates provided the significance of output and energy prices in altering emission levels. In particular the study found the unit increase in fuel prices is probable to decrease carbon emanations by 0.4 units in Spanish economy. For Pakistan, Zhang et al. (2017) examined EKC framework among the variables of renewable, non-renewable power and carbon emanations. Using the data from the period of 1970 to 2012, the findings concluded the significance of renewable and non-renewable power in altering emission levels. In specific, the authors found the positive relationship of non-renewable power and negative relationship of renewable power with environmental pollution in Pakistan.

Analyzing the role of aggregate and disaggregate energies in influencing carbon emissions, Alkhathlan and Javid (2013) studied the association between power utilization, output growth and carbon-di-oxide in Saudi Arabia. In doing so, the authors used the observations from the time of 1980 to 2011 (Haseeb et al., 2019). The study utilized VECM granger method to test the empirical association among the variables. The results of the study confirmed the significance of energy utilization at both aggregate and disaggregate levels in influencing emission in Saudi Arabia (Jermsittiparsert et al., 2019). The results suggested that energy utilization carry positive impact on emissions, so as oil consumption. However, the results suggested that natural gas underlies the potential to reduce carbon emission in the country.

Dong et al. (2017a) inspected the connection between natural gas utilization on environmental degradation. In doing so, the study used the data of thirty Chinese provinces from 1995 to 2014. The empirical investigation in the study was carried out by applying ARDL method (Jermsittiparsert, 2016; Myambo and Munyanyi, 2017). The outcomes of the examination confirmed the authenticity of EKC framework. The results also established the significance of natural gas in altering carbon emission in China. In particular, the findings suggested that natural gas declined environmental degradation in Chinese provinces in the studied period.

In another study, Dong et al. (2017b) analyzed the EKC framework among the variables of renewable power, natural gas and carbon dioxide emanations. Using the sample of BRICS countries from 1985 to 2016, the results provided the significance of natural gas and renewable power in influencing environmental pollution measured by carbon dioxide emissions. Particularly, the study found the negative association of natural gas and renewable power with environmental pollution in BRICS economies.

Similarly, Lotfalipour et al. (2010) also studied the link between fossil fuel, natural gas and petroleum products with carbon emission in Iran. The study used the data from the period of 1967 to 2007. Applying the methods of Toda-Yamamoto Granger causality, the findings of the investigation confirmed the significance of natural gas in causing carbon emissions in Iran. Apergis and Payne (2015) also investigated the relationship of green power,

economic growth and carbon dioxide emanations. Using the sample of eleven South America from 1980 to 2010, the results provided the significance of output growth in enhancing carbon emission. Furthermore, the results also concluded the positive significant association between oil prices and CO<sub>2</sub> emission in the sampled economies.

For G-7 economies, Sadorsky (2009) analyzed renewable power, carbon emanations and fuel prices. The study utilized the data from the period of 1980 to 2005. The results of the analysis reported the significance of output in enhancing green power consumption. In addition, the findings suggested the negative impact of oil prices in renewable consumptions in the sampled economies. Moreover, the result confirmed output and carbon-di-oxide to be the critical influencers of renewable power in G-seven nations. Furthermore, Lindmark (2002) also investigated the association between environmental degradation, technological advancements, output and energy prices (Umrani et al., 2016; Nguyen, 2018). The authors used the data of Sweden from the period of 1870 to 1997. The findings of the analysis established that change in fuel prices, output development, technological advancements and structural change are significant to influence environmental degradation in Sweden. Eddrief-Cherfi and Kourbali (2012) investigate the energy consumption-growth nexus in Algeria. The causal relationship between the logarithm of per capita energy consumption (LPCEC) and the logarithm of per capita GDP (LPCGDP) during the 1965-2008 period is examined using the threshold cointegration and Granger causality tests. The estimation results indicate that the LPCEC and LPCGDP for Algeria are non cointegrated and that there is a uni-directional causality running from LPCGDP to LPCEC, but not vice versa.

Analyzing the effects of several energy prices on carbon allowance prices, Zeng et al. (2017) examined Chinese carbon emission trading. In doing so, the study analyzed the data from April 2014 to November 2015. The outcomes of the study suggested that unit rise in coal prices enhances carbon prices by 0.1 units. In addition, the authors concluded that levels of carbon emanations in China is influenced mainly by its past prices. The results of the aggregate analysis established the positive but insignificant association of oil price, natural gas price and economic development of China.

Moreover, in Portugal, Pereira and Pereira (2010) studied the relationship of natural gas in predicting carbon di oxide levels. For empirical investigation, the study applied the methodology of Vector Auto Regressive (VAR) from the time period of 1977 to 2003. The results of the study, similar to Lotfalipour et al. (2010), confirmed the significance of natural gas in influencing carbon emission levels as well as economic growth in Portugal. Moreover, Agras and Chapman (1999) examined EKC framework among the variables of energy prices, output growth and carbon dioxide emanations (Ali and Haseeb, 2019) Using the panel data of International Energy Agency for thirty four economies, the results provided the significance of energy prices but failed to validate the association of trade in altering emission levels. In particular the study found the negative relationship of energy with environmental pollution in sampled economies.

### 3. METHODOLOGY

The current research looks at the association between oil prices, natural gas prices, heating oil prices, economic growth and carbon emission by utilizing EKC model and the system is given underneath:

$$CO_{2t} = \beta_0 + \beta_1 (Y_t) + \beta_2 (Y_t^2) + \beta_3 (OIL_t) + \beta_4 (GAS_t) + \beta_5 (HOIL_t) + \varepsilon_t$$

Where,  $\varepsilon_t$  is the residual term, CO<sub>2</sub> signifies the carbon emission which is calculated in Ktons of oil equivalent. *OIL* explains the international oil prices (WTI crude oil) which is measured in US dollars, *GAS* denotes the international gas prices which is measures in cubic feet meters. Moreover, *HOIL* signifies the international heating oil prices which is measured in US dollars. Moreover, *Y* specifies the output which is explained by the all final finished services and goods (in US dollars). Finally, *Y*<sup>2</sup> is the square of the output growth. The information is gathered from the time of 1980 to 2017. Entire information is collected from World Development Indicators. Finally, entire information is converted in natural logarithmic series as it provides more accurate results (Afshan et al., 2018).

#### 3.1. Unit Root Tests

So as to check the stationary properties for long haul connection of focused time series information, the present examination uses Augmented Dickey-Fuller (ADF) and Philip Perron (PP) unit root tests. Moreover, the current study also inspects the information at first on level and afterward on first differential of all considered variables.

#### 3.2. Long-Run Cointegration Analysis

Next, to examine the job of international oil prices, international natural gas prices and international heating oil prices in EKC in Algeria, the current study applies ARDL strategy of long-run association which was introduced by Pesaran and Pesaran (1997), Pesaran et al. (1999), Pesaran et al. (2001; 2000) is used with the help of unrestricted vector error adjustment model to inspect the long haul relationship among different energy prices (which includes international oil prices, heating oil prices and natural gas prices) and environmental degradation. The above-mentioned method has a few advantages on previous long-run association studies (like Johansen and Juselius Cointegration and further). This method could be valuable in any case of whether focused time series are totally I(0), I(1) or similarly co-incorporated. The auto regressive distributed lag structure is projected for the investigation is as follows:

$$\begin{aligned} \Delta CO_2 = & \varphi_0 + \varphi_1 \sum_{i=1}^p CO_{2t-i} + \varphi_2 \sum_{i=1}^p Y_{t-i} + \varphi_3 \sum_{i=1}^p Y_{t-i}^2 + \varphi_4 \sum_{i=1}^p OIL_{t-i} \\ & + \varphi_5 \sum_{i=1}^p GAS_{t-i} + \varphi_6 \sum_{i=1}^p HOIL_{t-i} + \gamma_1 CO_{2t-1} + \gamma_2 Y_{t-1} + \gamma_3 Y_{t-1}^2 + \\ & \gamma_4 OIL_{t-1} + \gamma_5 GAS_{t-1} + \gamma_6 HOIL_{t-1} + \mu_t \end{aligned}$$

Where,  $\varphi_0$  is consistent term and  $\mu_t$  is error term, the error adjustment limit is explained to by the indication of adding though the further proportion of the calculation identifies with a long haul association. The Schwarz Bayesian criteria (SBC) is used to look at the most extreme lag length choice for every factor.



Moreover, in this framework, the present examination figures the F-measurements importance by utilizing the appropriate systems. Following, the Wald (F-stats) test is used to examine the long haul relationship between the factors. If the long-run connection is found between economic growth, international oil prices, natural gas prices and heating oil prices, then the current research estimated the long-term coefficients using the following framework:

$$CO_{2t} = \zeta_0 + \zeta_1 \sum_{i=1}^p CO_{2t-i} + \zeta_2 \sum_{i=1}^p Y_{t-i} + \zeta_3 \sum_{i=1}^p Y_{t-i}^2 + \zeta_4 \sum_{i=1}^p OIL_{t-i} + \zeta_5 \sum_{i=1}^p GAS_{t-i} + \zeta_6 \sum_{i=1}^p HOIL_{t-i} + \mu_t$$

Next, if long run connection between economic growth, international oil prices, natural gas prices, heating oil prices and carbon emission are found with proof then we gauge the short run coefficients by utilizing following framework:

$$CO_{2t} = \delta_0 + \delta_1 \sum_{i=1}^p CO_{2t-i} + \delta_2 \sum_{i=1}^p Y_{t-i} + \delta_3 \sum_{i=1}^p Y_{t-i}^2 + \delta_4 \sum_{i=1}^p OIL_{t-i} + \delta_5 \sum_{i=1}^p GAS_{t-i} + \delta_6 \sum_{i=1}^p HOIL_{t-i} + nECT_{t-1} + \mu_t$$

The error correction model demonstrate the speed of modification permit to quantify the long-run symmetry because of a short run shock. The  $n$  is the coefficient of error correction term in the model that determines the speed of modification.

### 3.3. Variance Decomposition Analysis

Furthermore, the another aim of the current study is to applied G Generalized forecast error variance decomposition technique under VAR framework is connected to examine the causal connection of economic growth, international oil prices, international natural gas prices and international heating oil prices with carbon emission in Algeria. Moreover, the variance decomposition model (VDM) provide the size of the anticipated error fluctuation for an arrangement reason for fluctuation from every independent variable over the various time frame (Sharif et al., 2017).

## 4. DATA ESTIMATION AND INTERPRETATION

The present unit explains the information examination. Basically we utilized stationary test to affirm the stationary features of the

taken factors. The consequences of unit root test are presented in Table 1. In this study, we used two unit root tests to be specific ADF and PP test to confirm the stationary features of the factors. The discoveries affirm that economic growth, international oil prices, natural gas prices, heating oil prices and carbon emission at first are non-stationary at series of level data however, become stationary at a series of first differentials. In basic way, from the results of unit root test, the current study can infer that data of the considerable number of factors imitate the stationary features and permit for reports to the long-term evaluations.

Moreover, to explore the long run connection between economic growth, international oil prices, international heating oil prices, international natural gas prices and carbon emission in Algeria, the present examination connected the method of Autoregressive distributed lag technique for cointegration (ARDL). So as to accomplish, the primary stage is to recognize the maximum lag measurement of the considerable number of factors. The order of this lag measurement is picked by providing standards of SBC. Hence, the result of the ARDL bound testing cointegration is shown in Table 2.

The consequences of Table 2 affirm the null of no connection among the factors is refused. This is because of the value of the F-statistics is bigger than UBC value at 1% level of significance. Therefore, it is in the support of acknowledgment of the alternate hypothesis which propose that there is a powerful long haul association occur among economic growth, international oil prices, international heating oil prices, international natural gas prices and carbon emission in Algeria. The results of lag length selection is reported in Table 3.

The outcomes of bound testing, hence, confirm the power of attained outcomes. It is shown that a huge long haul affiliation exists among economic growth, international oil prices, international heating oil prices, international natural gas prices and carbon emission in Algeria. Besides, after affirming the proof of long haul association between the focused factors, the additional stage of the investigation is to use the framework with the point of result the coefficient estimation of long-short term period. As to accomplish, the current investigation estimates the lag measurement sequence of entire factors done by the lesser estimation of SBC.

The long term consequences of ARDL technique is shown in Table 4. The discoveries hence set up that economic growth, international oil prices, international natural gas prices and

**Table 1: Results of unit root test**

Variables	ADF unit root test				PP unit root test			
	I(0)		I(1)		I(0)		I(1)	
	C	C and T	C	C and T	C	C and T	C	C and T
OIL	0.446	0.421	-5.392	-5.344	0.441	0.395	-5.796	-5.690
GAS	1.482	1.272	-4.584	-4.399	1.294	1.302	-4.246	-4.130
HOIL	-1.137	-1.089	-5.338	-5.261	-1.009	-1.014	-5.332	-4.982
Y	-0.256	-0.224	-4.473	-4.674	-0.239	-0.218	-4.839	-4.772
CO <sub>2</sub>	-0.773	-0.667	-5.117	-5.149	-0.673	-0.702	-5.094	-5.022

Source: Authors' estimations. The critical values for ADP and PP tests with constant (C) and with constant and trend (C and T) 1%, 5% and 10% level of significance are -3.711, -2.981, -2.629 and -4.394, -3.612 and -3.243 respectively. ADF: Augmented Dickey-Fuller, PP: Philip Perron

**Table 2: Results of bound testing for cointegration**

Lags order	AIC	HQ	SBC	F-test statistics
0	-4.677	-4.983	-5.093	87.179*
1	-5.949*	-5.892*	-6.038*	
2	-5.382	-5.242	-5.132	
3	-4.884	-4.792	-4.954	

Source: Authors' estimation. \*1% level of significant. SBC: Schwarz Bayesian criteria

**Table 3: Results of lag length selection**

Lag	0	1	2	Nominated lags
	SBC	SBC	SBC	SBC
<i>OIL</i>	1.282	-3.483*	-2.495	1
<i>GAS</i>	1.485	-3.490*	-2.219	1
<i>HOIL</i>	1.932	-2.459*	-1.858	1
<i>Y</i>	1.084	-3.382*	-1.481	1

Source: Authors' estimation. \*Indicate minimum SBC values. SBC: Schwarz Bayesian criteria

**Table 4: Results using ARDL approach (long run)**

Variables	Coefficient	t-stats	Prob.
C	0.393	5.957	0.000
CO <sub>2</sub> (-1)	0.187	4.384	0.000
<i>Y</i>	0.209	4.184	0.000
<i>Y</i> (-1)	0.089	2.785	0.000
<i>Y</i> <sup>2</sup>	-0.194	-4.385	0.000
<i>Y</i> <sup>2</sup> (-1)	-0.006	-0.936	0.350
<i>OIL</i>	-0.535	-5.839	0.000
<i>OIL</i> (-1)	-0.148	-1.452	0.148
<i>GAS</i>	-0.281	-5.171	0.000
<i>GAS</i> (-1)	-0.019	-1.182	0.238
<i>HOIL</i>	-0.192	-3.643	0.000
<i>HOIL</i> (-1)	-0.015	-0.965	0.338
Adj. R <sup>2</sup>		0.902	
D.W stats		2.098	
F-stats (Prob.)		2494.436 (0.000)	

Source: Authors' estimation. ARDL: Auto regressive distributed lag

**Table 5: Results using ARDL approach (Short Run)**

Variables	Coefficient	t-stats	Prob.
C	0.209	2.588	0.010
ΔCO <sub>2</sub> (-1)	0.028	1.781	0.072
Δ <i>Y</i>	0.392	4.467	0.000
Δ <i>Y</i> (-1)	0.026	1.395	0.175
Δ <i>Y</i> <sup>2</sup>	-0.192	-5.432	0.000
Δ <i>Y</i> <sup>2</sup> (-1)	-0.014	1.592	0.112
Δ <i>OIL</i>	-0.351	-5.315	0.000
Δ <i>OIL</i> (-1)	-0.014	-0.287	0.774
Δ <i>GAS</i>	-0.129	-4.221	0.000
Δ <i>GAS</i> (-1)	-0.041	-1.182	0.238
Δ <i>HOIL</i>	-0.316	-3.984	0.000
Δ <i>HOIL</i> (-1)	-0.042	-2.335	0.021
error correction model (1)	-0.481	-4.313	0.000
Adj. R <sup>2</sup>		0.889	
D.W stats		2.149	
F-stats (Prob.)		938.257 (0.000)	

Source: Authors' estimation. ARDL: Auto regressive distributed lag

growth produce greater carbon emission in the country. On the other hand, the results of ARDL also confirm that square of output growth, international oil prices, heating oil prices and international natural gas prices are play a noteworthy role to decrease the CO<sub>2</sub> in Algeria which confirm an invert U-Shape EKC curve presents in Algeria. Finally, the outcomes of EKC curve and energy prices features that in the beginning the development of economy enhance the carbon outflow in the nation however later receiving the significant development it helps to decrease the ecological dilapidation in the situation of Algeria.

The short run outcomes of ARDL method is shown in Table 5. The discoveries detailed a legitimate short run connection between output growth, international oil prices, international heating oil prices, international natural gas prices and carbon emission in Algeria. The value of error term is demonstrating the estimation of around -0.481 recommend that around 48% of variability is adjusted in the present year. Moreover, the discoveries likewise affirm the noteworthy effect of energy prices (oil prices, heating oil prices and natural gas prices) on carbon outflow in Algeria in short running also.

The outcomes of Table 6 show the causal relationship between economic growth, international oil prices, heating oil prices, natural gas prices and carbon emission in Algeria. The outcomes of carbon emission model recommend that in 1<sup>st</sup> year, the variation in CO<sub>2</sub> is described 100% completely by its own enhancements. In the second period 86.14% explained by own enhancements, 0.049% by economic growth, 11.804% by international heating oil prices, 0.766% by international natural gas prices and 1.234% by international heating oil prices. In 3<sup>rd</sup> year, the variation in CO<sub>2</sub> explain 74.115% by its own enhancements, 1.420% by output advancement, 21.705% by international oil prices, 0.621% by international natural gas prices and 2.139 % by international heating oil prices. In the 5<sup>th</sup> year period, the shocks in CO<sub>2</sub> describe 57250% by its own improvement, 2.982% by output development, 36.639% by international oil prices, 0.457% by natural gas prices and 2.726% by international heating oil prices. The outcomes of Table 6 recommend the bi-directional causal relationship among international oil prices and carbon emission. However, we find a unidirectional causality between carbon emission and international heating oil prices where causality is running is from heating oil to carbon emission. Also, we do not find any causal relationship between carbon emission and natural gas prices in Algeria.

## 5. CONCLUSION

Environments in the present time is facing extreme deterioration. The rising environmental pressures that have become the inevitable part of economic development have been the prime sources of worsening ecological health. The theoretical notion for environmental degradation has been identified in early 1950s by the renowned economist Simon Kuznets in the form of EKC. Among the variables that can validate the existence of EKC framework, the impact of energy prices is substantial to influence environmental degradation. The association of energy prices with

international heating oil prices are the significant determinants of carbon emission in Algeria. Likewise, the outcomes affirm that output growth have a positive and significant effect on carbon emission in Algeria which implies that as more the economic

**Table 6: Results of variance decomposition approach**

Period	SE	CO <sub>2</sub>	Y	OIL	GAS	HOIL
Variance decomposition of CO <sub>2</sub>						
1	83.369	100.000	0.000	0.000	0.000	0.000
2	116.487	86.148	0.049	11.804	0.766	1.234
3	140.875	74.115	1.420	21.705	0.621	2.139
4	161.551	65.472	2.417	29.014	0.537	2.561
5	178.687	57.250	2.928	36.639	0.457	2.726
Variance decomposition of Y						
1	1.111	0.914	99.086	0.000	0.000	0.000
2	1.313	2.556	85.768	0.004	8.339	3.332
3	1.501	13.729	69.427	0.579	9.904	6.362
4	1.768	27.033	50.810	8.810	7.858	5.489
5	2.069	33.404	37.274	18.568	6.659	4.095
Variance decomposition of OIL						
1	167.533	0.514	26.009	73.477	0.000	0.000
2	208.880	0.485	30.091	65.370	1.900	2.154
3	230.294	7.578	27.604	59.445	1.743	3.630
4	251.130	20.015	23.781	51.181	1.501	3.522
5	269.434	30.388	20.662	44.511	1.326	3.113
Variance decomposition of GAS						
1	16.349	0.390	12.082	31.525	56.004	0.000
2	21.377	0.428	13.692	28.838	57.036	0.006
3	24.638	2.032	11.902	39.012	47.044	0.010
4	27.635	5.060	10.674	44.578	39.675	0.013
5	29.434	8.284	9.950	45.307	36.429	0.030
Variance decomposition of HOIL						
1	696.024	5.480	5.865	1.460	8.476	78.719
2	1160.195	15.576	4.308	0.751	5.111	74.254
3	1552.554	25.282	2.954	0.486	3.326	67.953
4	1901.064	33.441	2.022	0.331	2.319	61.887
5	2218.383	39.695	1.486	0.243	1.705	56.871

Source: Authors' estimations

environment is theorized in accordance the popular economic theory.

Therefore, keeping in mind the theoretical effect of energy prices in curtailing environmental deterioration, the present study aims to investigate the association between energy prices and environmental pollution in Algeria. Given the ability of EKC in testing quadratic association, the current study is primarily motivated in testing EKC framework by including energy prices along with income level. In addition, the current study is also important for analyzing the impact of energy prices by testing the effects of three different fuel prices. They include crude oil prices, natural gas prices and heating oil. The data is gathered from the period of 1980-2017. The results of ARDL confirm that economic growth has a positive and significant impact on carbon emission in Algeria. On the other hand, all energy prices (oil prices, heating oil and natural gas prices) confirm a negative and significant impact on carbon emission in Algeria. The results of ARDL also confirm a presence of U-Shaped EKC curve in the Algeria. The results VDM have confirm a bi-directional causal relationship between oil prices and carbon emission, however we found a unidirectional causal relationship from heating oil prices to carbon emission and no causal relationship between natural gas prices and carbon emission in Algeria.

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