Scientific Journal of Agricultural Sciences 4 (2): 34-43, 2022
Print (ISSN 2535-1796) / Online (ISSN 2535-180X) DOI: 10.21608/sjas.2022.144058.1238

Is the Environmental Kuznets Curve Hypothesis a Viable Basis for Environmental Policy in Egypt?

Victor Shaker

Department of Agricultural Economics Faculty of Agriculture, Cairo University, Egypt.
*Corresponding Email: victor.shaker@agr.cu.edu.eg

Received on: 11-6-2022 **Accepted on: 1-8-2022**

ABSTRACT

Shifting to sustainable and durable economic growth has become necessary considering the dangerous consequences of climate change. The growing literature has tested the Environmental Kuznets Curve (EKC) hypothesis that links economic growth and environmental degradation. The validity of the EKC hypothesis has sparked heated disputes among scholars. The Autoregressive Distributed Lag approach, ARDL, examines the nexus between carbon dioxide (CO_2) as a dependent variable and real GDP, energy consumption, and trade openness as independent variables in the Egyptian setting. Unlike prior studies, the findings validate the inverted N-shaped EKC hypothesis. Thus, the results do not support the EKC hypothesis, implying that environmental degradation cannot be explained necessarily by economic growth. Although this discovery is interesting and difficult to explain, it could be the result of Egypt's initial environmentally-friendly mindset. Another interesting conclusion is that a 1 percent rise in per capita energy consumption increases CO2 emissions per capita by 1.14 and 0.84 percent in the long and short run, respectively. Policymakers should think about establishing regulations to ensure the use of green energy technologies in business, as well as investing in renewable energy to increase its share in the energy mix. Future research should use a nonlinear ARDL methodology and longitudinal data to develop further and corroborate these initial findings.

KEYWORDS: Economic growth**;** Environmental Kuznets Curve; Autoregressive distributed lag approach; Egyptian economy.

1. INTRODUCTION

Grossman and Krueger's (1991) pioneering work was the starting point to delve into the analysis of the nexus depicted by the Environmental Kuznets Curve (EKC). Initially, Simon Kuznets hypothesizes that inequality in income will first rise and then fall in parallel with economic development.

EKC depicts the relationship between economic growth, energy consumption, and the environment. It takes an inverted U-shape, which means that improving the level of development will increase the level of pollution at a declining rate until it reaches a particular level, after which it progressively begins to decrease (Hanley et al., 2019) (Figure (1)).

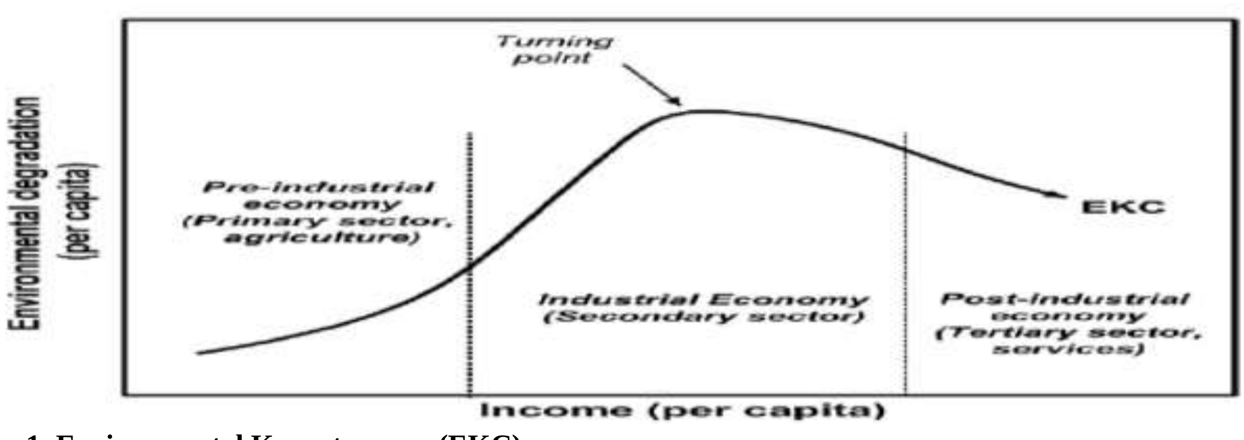

Figure 1. Environmental Kuznets curve (EKC).

According to Toma et al. (2020), massive economic growth requires the consumption of fossil fuels, which leads to enormous greenhouse gases (GHGs). Results, however, have not supported this hypothesis in all cases (Karsch, 2019), causing young researchers to engage in a heated dispute (Zhang, 2021).

Lorente and lvarez-Herranz (2016), on the other hand, explored the validity of the N-shaped hypothesis in the third stage, in which environmental deterioration intensifies as income rise continues. Furthermore, Bekhet and Othman (2018) validated an inverted N-shaped EKC hypothesis linking carbon dioxide (CO_2) emissions, renewable energy usage, and economic growth.

Egypt emitted 269.5 million tons of CO_2 in 2020. The emissions climbed dramatically from 25 to 269.5 million tons per year, with a rising annual rate between 1971 and 2020. It peaked at 15.83 percent in 1976 and has since fallen to 4.53 percent in 2020 (Knoema, 2021). Around 40 percent of CO2 emissions are created by the electricity generation industry, which is primarily reliant on oil and gas (90 percent) and renewable sources (10 percent). (Abdallah & El-Shennaw,2020). Having been a significant energy consumer in Africa, Egypt may be vulnerable to environmental challenges in its pursuit of economic growth (Mahmood et al., 2021).

The main practical problem that confronts the present work is that there have been inconsistent results about the validity of the EKC hypothesis in the Egyptian setting. It is of interest to know whether EKC is a sound basis for environmental policy in Egypt.

As a result, the current study investigates the EKC hypothesis for the period (1965–2020) using the Autoregressive Distributed Lag (ARDL) model. Furthermore, the significance of this work is stressed given the approaching UN Climate Change Conference (COP 27), expected to be hosted in Egypt in 2022. Although several previous studies have confirmed specific EKC hypotheses in the Egyptian setting, no study has confirmed the inverted N-shaped EKC hypothesis. The unexpected findings indicate that more research is needed to understand more about this area.

The following is how the paper is structured: The early work is presented in section 1 after this introduction, while section 2 outlines the methodology. The results and significant conclusions are discussed in the final two sections.

2. LITERATURE REVIEW

The seminal work of Grossman and Krueger (1991) on studying the potential consequences of the North American Free Trade Agreement (NAFTA) is the foundation for investigating the different EKC hypotheses. It is widely known that the findings of testing these hypotheses rely mainly on the country considered, the variables included, and the period specified. Some studies have validated U-shaped and N-shaped EKC hypotheses in the Egyptian setting, and others have denied their existence. The most prominent studies are reviewed in Table (1).

3. METHODOLOGY

To test the validity of the EKC hypotheses, different model specifications have to be analyzed. The annual dataset was collected from the World Bank and the International Energy Agency during period (1965–2020). First, CO_2 per capita (in metric tons) represents environmental pollution, while real GDP per capita (constant 2015 U.S. Dollar) is a proxy for income. Following the literature, two other variables are included: energy consumption per capita (in kilograms), which refers to the utilization of primary energy before transformation, and trade openness, which is the total value of goods and services exported and imported as a percentage of GDP. The data was analyzed using EViews12.

The fundamental theoretical model for CO_2 emission is:

$$\mathbf{CO_2PC_t = f\,(GDPPC_t, ECONPC_t, TOP_t)}$$

To avoid any heteroscedasticity difficulties and get direct elasticities, all possible models are transformed into logarithms. They may be rewritten like this:

$$\ln CO_2PC_t = \beta_0+\beta_1\ln GDPPC_t + \beta_2\ln GDPPC^2_t+ \mu_t \quad \textbf{M1}$$

$$\ln CO_2PC_t = \beta_0+\beta_1\ln GDPPC_t + \beta_2\ln GDPPC^2_t + \beta_4\ln ECONPC_t + \mu_t \quad \textbf{M2}$$

$$\ln CO_2PC_t = \beta_0+\beta_1\ln GDPPC_t + \beta_2\ln GDPPC^2_t + \beta_4\ln ECONPC_t + \beta_5\ln TOP_t + \mu_t \quad \textbf{M3}$$

$$\ln CO_2PC_t = \beta_0+\beta_1\ln GDPPC_t + \beta_2\ln GDPPC^2_t + \beta_3\ln GDPPC^3_t \quad \textbf{M4}$$

$$\ln CO_2PC_t = \beta_0+\beta_1\ln GDPPC_t + \beta_2\ln GDPPC^2_t + \beta_3\ln GDPPC^3_t + \beta_4\ln ECONPC_t + \mu_t \quad \textbf{M5}$$

$$\ln CO_2PC_t = \beta_0+\beta_1\ln GDPPC_t + \beta_2\ln GDPPC^2_t + \beta_3\ln GDPPC^3_t + \beta_4\ln ECONPC_t+ \beta_5\ln TOP_t + \mu_t \quad \textbf{M6}$$

where:

- **CO_2PC**: per capita CO_2 emissions.
- **ECONPC**: per capita energy consumption.
- **GDPPC**: ($GDPPC^2$, $GDPPC^3$): real GDP (squared, cubic) per capita
- **TOP**: trade openness
- **μ_t**: the error term

Table 1. Summary of the key important studies.

Author(s)	Period	Methodology	Major variables	Results
Ibrahiem (2016)	(1980-2010)	Johansen cointegration analysis	Real per capita GDP, energy consumption trade openness, and population density	EKC does not exist in the short or long term.
El-Aasar (2018)	(1971−2012)	ARDL	Real per capita GDP, renewable energy consumption (% of total), and trade openness.	EKC does not exist in the short or long run.
Bese (2019)	(1971 – 2014)	VAR model	Real per capita GDP and energy consumption.	No presence of EKC
Mahmood et al. (2019)	(1990–2014)	cointegration technique	GDP, energy usage, FDI/GDP, trade openness	The EKC hypothesis is confirmed.
Sghaier et al. (2019)	(1980–2014)	ARDL	GDP, energy consumption, and No. of international tourist arrivals.	EKC hypothesis validates
Fethi & Senyucel (2021)	(1996 -2016)	DSUR & DH tests.	Real income, energy consumption, and tourism proxy	EKC hypothesis validates
Mahmood et al. (2021)	1965–2019	ARDL models	GDP per capita and energy consumption. .	The EKC hypothesis holds for natural gas consumption and all proxies for renewable and nonrenewable energy. N-shaped nexuses validate in oil and coal cases. An inverted N-shaped hypothesis validates in the hydroelectricity case.

VAR: vector autoregressive; DSUR: Dynamic Seemingly Unrelated Regression; DH Dumitrescu and Hurlin (2012).
Source: Author's compilation.

Figure (2) shows the ARDL approach. The very first prerequisite for time series data is to test the variables' stationarity. As a result, the widely used unit root test suggested by Dickey and Fuller (1979) may be employed.

Pesaran et al. in 2001 developed the ARDL lag bounds tests, which have the following benefits: (i) using a combination of I(0) and I(1) processes; (ii) having a single-equation setup; (iii) decomposing error terms ; (iv) assigning a sufficient number of lag lengths (Rahman & Vu,2021).

The ARDL bounds tests can be performed in the following way: The joint F-statistic tests the null hypothesis of no cointegration. As a result, the null hypothesis fails to be rejected If the calculated statistic is below the lower bound of critical value. Alternatively, if it is above the upper bound of the critical value, the null hypothesis is rejected. However, no conclusion can be made if the calculated statistic is between the upper and lower limits of critical value.

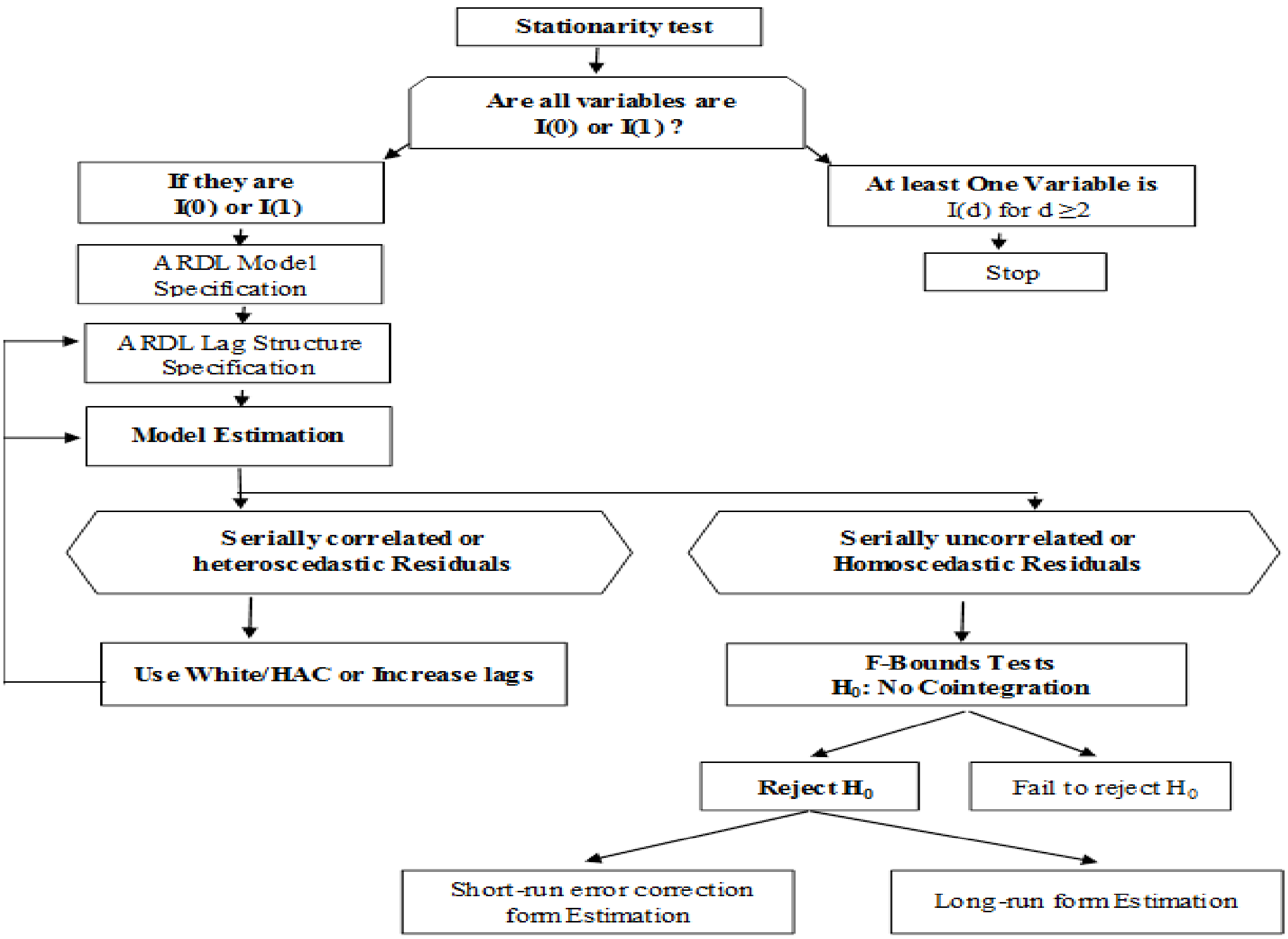

Figure 2. Flowchart of the ARDL approach.

Source: Rahman &Vu (2021).

The first step in estimating the long-run connection is to examine the long-run association between variables. If it exists, the next step is to estimate the long-run model using least-squares as well as the short-run error correction model. The lagged error term ECM (-1) coefficient must be negative and significant to be valid, indicating the convergence speed from the short-run equilibrium to the long-run equilibrium path.

Normality, serial correlation, heteroskedasticity, and Ramsey RESET are among the diagnostic tests performed to measure how well a model fits the data. Brown et al. (1975), as well as Pesaran and Pesaran (1997), created the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) stability tests. When these statistics are within the 5 percent critical boundaries, the model parameters are stable in both the long and short run.

The VECM Granger causality test (1969) can compensate for the ARDL cointegration approach's failure to consider the causality direction between the variables.

4. RESULTS AND DISCUSSION

Testing the EKC hypotheses in the Egyptian context is a critical step in developing effective environmental policy. After converting the variables to logarithmic form, the Augmented Dickey-Fuller (ADF) test was used to check for stationarity. The test concludes that the variables under study are integrated of order one, denoted I(1) (Figure (3) and Table (2)).

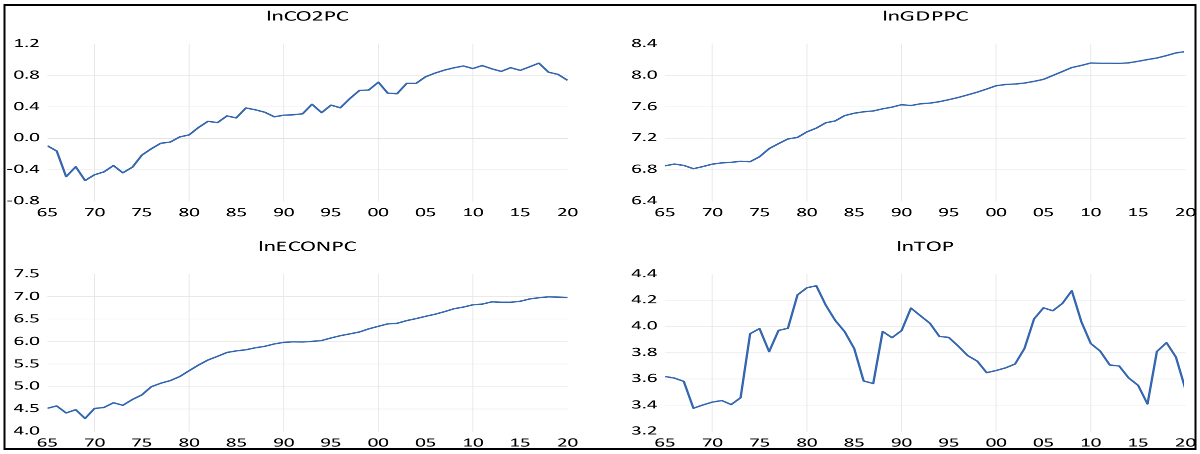

Figure 3. The model variables in logarithmic form.

Source: Author's calculations.

Table 2. Augmented Dickey-Fuller test for unit root.

Variables	Level Form			First Difference		
	Intercept	Trend and intercept	None	Intercept	Trend and intercept	None
$lnCO_2PC$	-0.79	-2.32	0.15	-8.63**	-8.55**	-5.13**
lnGDPPC	-0.70	-0.91	3.06	-4.32**	-4.62**	-1.89
$lnGDPPC^2$	-1.66	-2.188	3.058	-4.414**	-4.553**	-1.806
$lnGDPPC^3$	-1.27	-2.78	3.05	-4.49**	-4.50**	-1.73
lnECONPC	-5.52**	-2.60	2.50	-8.09**	-8.21**	-1.50
lnTOP	-2.14	-2.51	-0.23	-5.98**	-6.00**	-6.04**

Notes: ** indicates a 5% significance level.

Source: Author's calculations.

The Granger causality test stresses the existence of a causal link between CO_2 and economic growth, suggesting bidirectional effects. These findings point out that environmental policies mainly directed at reducing CO_2 emissions can substantially affect production, while policies designed to accelerate growth can significantly raise the stock of CO_2 emissions. Additionally, energy consumption appears to accelerate CO_2 emissions per capita, but trade openness seems irrelevant (Table (3)). The latter is consistent with what has been found by Mahmood et al. (2019), highlighting the fact that increased trade does not always lead to increased emissions, and that increased emissions do not always imply increased trade.

Table 3. Granger Causality Test.

Null Hypothesis:			F-Statistic	Prob.
lnGDPPC	does not Granger Cause	$lnCO_2PC$	5.78	0.01
$lnCO_2PC$	does not Granger Cause	lnGDPPC	5.89	0.01
$lnGDPPC^2$	does not Granger Cause	$lnCO_2PC$	4.26	0.02
$lnCO_2PC$	does not Granger Cause	$lnGDPPC^2$	5.42	0.01
$lnGDPPC^3$	does not Granger Cause	$lnCO_2PC$	3.00	0.06
$lnCO_2PC$	does not Granger Cause	$lnGDPPC^3$	4.98	0.01
lnECONPC	does not Granger Cause	$lnCO_2PC$	5.63	0.01
$lnCO_2PC$	does not Granger Cause	lnECONPC	0.57	0.57
lnTOP	does not Granger Cause	$lnCO_2PC$	2.42	0.10
$lnCO_2PC$	does not Granger Cause	lnTOP	0.40	0.67

Source: Author's calculations.

Exploring the cointegration for a long-run relationship between the variables, all potential model specifications (from M_1 to M_6) were estimated using ordinary least squares (OLS). Furthermore, because the test statistic exceeds the upper critical bounds value, the null hypothesis of no cointegration is rejected. Using the Akaike information criteria (AIC), a maximum lag order of two was determined for the conditional ARDL vector error correction model (Table 4). Accordingly, the variables included in M_2, M_3, M_5, and M_6 specifications have long-run links. The long-run model was then estimated using least-square and a short-run ECM approach.

The inverted-U shape of the EKC was examined using all the quadratic model specifications (M_1, M_2, and M_3). Interestingly, the results show that this hypothesis is not confirmed in the three specifications. On the other hand, the N-shaped hypothesis was examined using the cubic specifications (M_4, M_5, and M_6). Surprisingly, the findings show that the inverted-N shape of the EKC is valid in all cubic specifications. This hypothesis was evaluated using two conditions: (i) β_1, $\beta_3<0$, $\beta_2>0$, and (ii) $\beta_{22}–3\ \beta_1\beta_3 > 0$. (Sinha et al., 2018). Accordingly, M_5 proves to be the most efficient model to represent the inverted N-shaped EKC in both the short and long term.

Several diagnostic tests were conducted to check the selected model's validity for interpretation and forecasting (Table (4)). The absence of autocorrelation is confirmed using the LM autocorrelation test. Furthermore, the residuals are homoscedastic based on the Breusch-Pagan-Godfrey and ARCH tests. The Jarque–Bera test stresses residual normality, while Ramsey's test demonstrates that the selected model has an appropriate functional form. As the final stage in the ARDL estimate, the stability of the long-term and short-term parameters is tested. At the 5 percent threshold, the CUSUM and CUSUMQ statistics persist within the critical value interval, indicating the stability of the model's coefficients (Figure (4)).

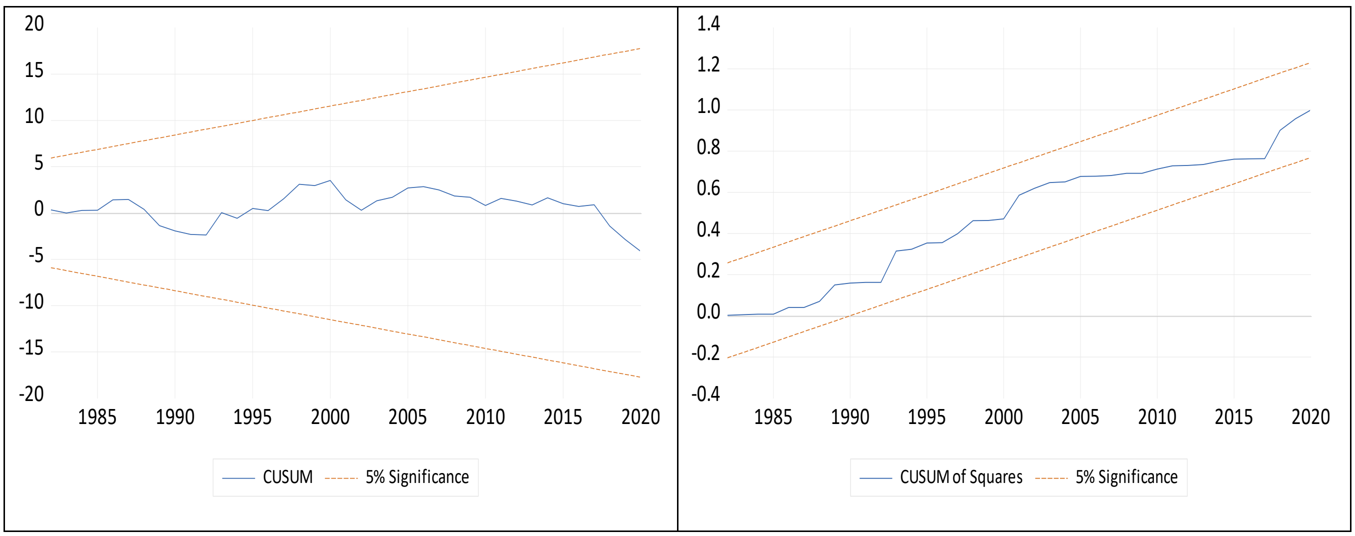

Figure 4. CUSUM and CUSUMQ statistics.

Source: Author’s calculations.

The selected model suggests that economic growth will enhance environmental quality, but only up to a particular level of income. Then it will be negative for a while before turning positive again. Despite the difficulty in interpreting this finding, it might be a result of Egypt's original environmentally favorable attitude. In addition, the statistically significant coefficient implies that a 1 percent increase in per capita energy consumption results in 1.14 and 0.84 percent increases in CO2 emissions per capita in the long and short term, respectively. Moreover, the significant coefficient of ECM (-1) is around -0.74, implying that when CO2 emissions per capita are above or below their equilibrium value, they will adjust by 74 percent per year.

Table 4. ARDL models and diagnostic results.

Variable	**Quadratic Models**			**Cubic Models**		
	M_1	**M_2**	**M_3**	**M_4**	**M_5**	**M_6**
				Long-term		
LPCGDP	5.83	-0.15	-0.64	-115.60**	-169.10**	-165.34**
$LPCGDP^2$	-0.33	-0.02	-0.001	15.55**	22.07**	21.52**
$LPCGDP^3$				-0.69**	-0.96**	-0.94**
LPECON		0.77	0.92		1.14**	1.19**
LOPS			0.008			0.04
Constant	-24.99	-2.18	-0.21	283.44**	427.08**	418.36**
				Short-run		
LPCGDP	2.33 **	-0.08	-0.27	-75.91**	-123.83**	-128.10**
$LPCGDP^2$	-0.09	-0.008	-0.0006	10.99**	16.33**	16.87**
$LPCGDP^3$				-0.52**	-0.71**	-0.74**
LPECON		0.87 **	0.88**		0.84**	0.93**
LOPS			0.003			0.03
Constant	-6.94	-1.08	-0.09	186.11**	316.06**	327.99**
ECM(-1)	-0.28**	-0.50**	-0.42**	-0.66**	-0.74**	-0.78**
F-Bounds	1.72	4.65 **	4.23**	2.71	8.70**	8.07**
Adjusted R^2	0.979	0.983	0.983	0.981	0.986	0.987
DW stat.	1.796	2.032	2.266	1.889	2.111	2.144
F-stat. (Prob.)	406.21 (0.00)	510.05 (0.00)	518.28 (0.00)	288.48 (0.00)	409.06 (0.00)	315.32 (0.00)
Breusch-Pagan-Godfrey (Prob.)	10.33 (0.11)	8.65 (0.19)	5.70 (0.46)	7.64 (0.57)	10.29 (0.33)	11.57 (0.48)
ARCH (Prob.)	0.97 (0.33)	0.02 (0.90)	0.03 (0.86)	0.41 (0.52)	0.05 (0.82)	0.15 (0.70)
Serial Correlation (Prob.)	1.85 (0.40)	1.30 (0.52)	3.02 (0.22)	0.40 (0.82)	0.57 (0.75)	0.93 (0.63)
Jarque-Bera (Prob.)	2.03 (0.36)	1.35 (0.51)	1.76 (0.41)	1.77 (0.41)	0.04 (0.98)	0.57 (0.75)
Ramsey RESET Test (Prob.)	3.76 (0.06)	6.01 (0.02)	1.59 (0.21)	9.64 (0.003)	2.79 (0.10)	3.82 (0.06)
$a_{22} – 3 a_1 a_3 > 0$	N. A			2.5105	0.0769	-3.1484
AIC	-2.53	-2.68	-2.68	-2.60	-2.94	-2.93
SIC	-2.27	-2.43	-2.42	-2.22	-2.57	-2.44

Notes: ** indicates a 5% significance level.
Source: Author’s calculations.

5. CONCLUSION

The findings demonstrate the relationship between environmental deterioration and economic growth. Interestingly, the inverted-N shape is validated by applying the ARDL approach, contributing to a new understanding of the EKC hypothesis in Egypt. Thus, the results do not support the EKC hypothesis, implying that economic growth is not necessarily the direct cause of environmental degradation. The findings also show that a 1 percent increase in per capita energy consumption raises CO_2 emissions by 1.14 and 0.84 percent in the long and short term, respectively.

Policymakers should consider enacting rules that would assure the use of green energy technology in the industry, as well as investing in renewable energy to raise its share in the energy mix. The main limitation of the present study is that it deals with energy consumption as a single variable due to classification problems. Future work should tackle this problem and implement a nonlinear ARDL methodology using longitudinal data.

6. REFERENCES

El-Aasar K.M., Hanafy S.A. (2018). Investigating the environmental Kuznets curve hypothesis in Egypt: the role of renewable energy and trade in mitigating GHGs. International Journal of Energy Economics and Policy, 8(3), 177-184.

Abdallah L., El-Shennawy T. (2020). Evaluation of CO2 emission from Egypt's future power plants. Euro-Mediterranean Journal for Environmental Integration, 5(3), 1-8.

Bekhet H.A., Othman N.S. (2018). The role of renewable energy to validate dynamic interaction between CO_2 emissions and GDP toward sustainable development in Malaysia. Energy economics 72:47–61.

Bese E. (2019). Testing the environmental Kuznets curve hypothesis: evidence from Egypt, Kenya, and Turkey. 670216917.

Brown R.L., Durbin J., Evans J.M. (1975). Techniques for testing the constancy of regression relationships over time. Journal of the Royal Statistical Society: Series B (Methodological), 37(2), 149-163.

Fethi S., Senyucel E. (2021). The role of tourism development on CO_2 emission reduction in an extended version of the environmental Kuznets curve: Evidence from top 50 tourist destination countries. Environment, development and sustainability, 23(2), 1499-1524.

Granger C.W. (1969). Investigating causal relations by econometric models and cross-spectral methods. Econometrica: Journal of the Econometric Society, 424-438.

Grossman G.M., Krueger A.B. (1991). Environmental impacts of a North American free-trade agreement" (No. w3914). National Bureau of Economic Research.

Hanley N., Shogren J., White B. (2019). Introduction to environmental economics. Oxford University Press.

Johansen, S. (1988). Statistical analysis of cointegration vectors. Journal of economic dynamics and control, 12(2-3), 231-254.

Knoema (2022). https://knoema.com/atlas/Egypt/CO_2 -emissions

Ibrahiem D.M. (2016). Environmental Kuznets curve: an empirical analysis for carbon dioxide emissions in Egypt. International Journal of Green Economics, 10(2), 136-150.

International Energy Agency (IEA) (2022). https://www.iea.org/data-and-statistics

Karsch N.M. (2019). Examining the validity of the environmental Kuznets curve. Consilience, (21), 32-50.

Lorente D.B., Álvarez-Herranz A. (2016). Economic growth and energy regulation in the environmental Kuznets curve. Environmental Science and Pollution Research, 23(16), 16478-16494.

Mahmood H., Alkhateeb T., Tanveer M., Mahmoud D. (2021). Testing the Energy-Environmental Kuznets Curve Hypothesis in Egypt's Renewable and Nonrenewable Energy Consumption Models. International journal of environmental research and public health, 18(14), 7334. https://doi.org/10.3390/ijerph18147334.

Mahmood H., Furqan M., Alkhateeb T.T.Y., Fawaz M.M. (2019). Testing the environmental Kuznets curve in Egypt: Role of foreign investment and trade. International Journal of Energy Economics and Policy, 9(2), 225.

Peseran M.H., Peseran B. (1997). Working with Microfit 4: Interactive Econometric Analysis; Oxford University Press: Oxford, UK.

Pesaran M.H., Shin Y., Smith R.J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of applied econometrics, 16(3), 289-326.

Rahman M.M., Vu X.B.B. (2021). Are energy consumption, population density, and exports causing environmental damage in China? autoregressive distributed lag and vector error correction model approaches. Sustainability, 13(7), 3749.

Sghaier A., Guizani A., Jabeur S.B., Nurunnabi M. (2019). Tourism development, energy consumption and environmental quality in Tunisia, Egypt and Morocco: A trivariate analysis. GeoJournal, 84(3), 593-609.

Sinha A., Shahbaz M., Balsalobre D. (2018). N-shaped environmental Kuznets curve: a note on validation and falsification. MPRA Paper No. 99313.

Toma P., Miglietta P.P., Morrone D., Porrini D. (2020). Environmental risks and efficiency performances: The vulnerability of Italian forestry firms. Corporate Social Responsibility and Environmental Management, 27, 2793–2803.

World Development Indicators (WDI) (2022). https://databank.worldbank.org/source/world-development-indicators.

Zhang Jihuan (2021). Environmental Kuznets Curve hypothesis on CO2 emissions: Evidence for China, Journal of Risk and Financial Management, ISSN 1911-8074, MDPI, Basel, Vol. 14, Iss. 3, pp. 1-16.

الملخص العربي

هل تعد فرضية منحنى كوزنتس البيئي أساس للسياسة البيئية في مصر؟

فيكتور شاكر

قسم الاقتصاد الزراعي، كلية الزراعة، جامعة القاهرة ، مصر

تمشياً مع الاتجاه العالمي للحد من المخاطر البيئة في ظل تفاقم التداعيات التي برزت بشدة في الآونة الأخيرة؛ تهدف الدراسة الحالية إلى دراسة العلاقة بين التدهور البيئي والنمو الاقتصادي فيما يعرف بمنحنى كوزنتس البيئي Environmental Kuznets Curve (EKC)، والذي يفترض أن جودة البيئة تتدهور في المراحل الأولى من النمو الاقتصادي وتتحسن في المراحل اللاحقة؛ ولذلك فإنه يأخذ مقلوب حرف U.

لتحقيق الهدف البحثي؛ تم استخدام متغير متوسط النصيب الفردي من انبعاثات غاز ثاني أكسيد الكربون (CO_2) كمقياس للتدهور البيئي الحادث، أما نصيب الفرد من الناتج المحلى الإجمالي الحقيقي فيمثل النمو الاقتصادي. بالإضافة إلى ذلك، تم استخدام متغيري متوسط نصيب الفرد من استهلاك الطاقة والانفتاح التجاري للتحقق من معنوية تأثيرهما على جودة البيئة. ولقد تم الاعتماد على السلاسل الزمنية السنوية المتاحة لمتغيرات الدراسة خلال الفترة (١٩٦٥ – ٢٠٢٠) وتحليها باستخدام نموذج الانحدار الذاتي لفترات الابطاء الموزعة Autoregressive Distributed Lag (ARDL) Model.

على خلاف نتائج الدراسات السابقة في حالة الاقتصاد المصري، أشارت النتائج إلى أن العلاقة بين جودة البيئة والنمو الاقتصادي هي علاقة تكامل في الأجل الطويل تأخذ شكل مقلوب حرف N؛ أي أن النمو الاقتصادي سيؤدى إلى تحسين جودة البيئة في البداية، ثم تصبح العلاقة عكسية وتتحول إلى طردية مرة أخرى. وبالرغم من صعوبة تفسير هذه النتيجة، إلا أنها قد تعزى إلى اعتماد النمو الاقتصادي في مراحله الأولى على المدخلات الصديقة للبيئة. بناءً على ذلك، لم ثبت فرضية منحنى كوزنتس في حالة مصر، الامر الذي يشير إلى أنه لا يمكن حل مشكلة التدهور البيئي مباشرة من خلال النمو الاقتصادي. كما أشارت النتائج إلى أن زيادة نصيب الفرد من استهلاك الطاقة في المتوسط بنسبة ١%؛ ستؤدى إلى زيادة متوسط نصيبه من انبعاثات ثاني أكسيد الكربون بنسبة ١,١٤% و٠,٨٤% على المديين الطويل والقصير على التوالي، بينما لم تثبت معنوية الانفتاح للتجاري في أي من منهما.

وتجدر الإشارة إلى أن التعامل مع استهلاك الطاقة كمتغير فردى دون تقسيمه وفقاً لمصدر الطاقة وآثارها البيئية يعد من أهم محددات الدراسة الحالية. في ضوء النتائج المتحصل عليها، توصى الدراسة بضرورة سن القوانين التي تكفل استخدام التكنولوجيا المعتمدة على الطاقة الخضراء (Green Energy) في الصناعة، بالإضافة إلى الاستثمار في الطاقة المتجددة لزيادة نصيبها في مزيج الطاقة المستخدم. ترى الدراسة ضرورة استمرار العمل البحثي في هذا المجال مع إدخال متغيرات أكثر تفصيلاً واستخدام منهجية الانحدار الذاتي لفترات الابطاء الموزعة غير الخطية اعتماداً على بيانات السلاسل الزمنية المقطعية.

الكلمات الدالة: منحنى كوزنتس البيئي، النمو الاقتصادي، نموذج الانحدار الذاتي للإبطاء الزمني الموزع، الاقتصاد المصري.