

Testing the EKC Hypothesis Considering Trade Openness, Urbanization, and Financial Development in Indonesia

Maya Moalla^{1*}

¹Mersin University, Turkiye

Info Articles

Keywords:

Co2 Emissions, Trade Openness, Urbanization, ARDL Approach, Economic Growth, Indonesia

Abstract

This paper delves into testing the validity of the Environment Kuznet's Curve (EKC) theory during the period spanning from 1970 to 2019, employing Narayan and Narayan's (2010) suggestion: if the long-term income elasticity is lower than the short-term one, the nation has effectively lowered its CO2 releases while observing an income surge, considering CO2 gas emissions as the environmental harm proxy; utilizing the Bounds Cointegration test. As far as we are aware, this marks the inaugural research for Indonesia scrutinizing the EKC's authenticity employing Narayan and Narayan's (2010) approach. The findings indicate that the EKC theory holds true in the interval studied because the long-term GDP elasticities doesn't exceed the short-term ones.

p-ISSN 2550-0368

e-ISSN 2549-0303

INTRODUCTION

Developing countries aspire to boost their economic growth and enhance well-being standards by accelerating the development of their industrial sectors and actively participating in global trade and financial development. However, the quest for greater economic growth often brings about higher levels of urbanization, escalating energy requirements, and subsequent air pollution and environmental deterioration. Therefore, it is crucial for researchers and policymakers to delve into the reasons behind air pollution and environmental degradation in these countries to tackle the related challenges and implement sustainable solutions (Ozatac et al., 2017). Several investigations have employed the Environmental Kuznets Curve (EKC) hypothesis, introduced by Grossman and Krueger (1991), to examine the nexus between economic growth and environmental degradation over the past decade. This hypothesis suggests a U-shaped nexus between real income and environmental degradation. Pollution increases at the initial phase of economic growth due to the production rise stemming from polluting industries; however, air pollution will decrease as economic growth attains a certain level because of factors like technological advancements, more stringent environmental regulations, and heightened public awareness. Mixed outcomes have arisen in the literature regarding the nexus between economic evolution and environmental deterioration. While some studies indicate that the increase in the income levels could exacerbate environmental deterioration, others argue that country's ability to address climate issues is bolstered by its economic growth; however, factors like robust institutional structures, the quality of education, and the financial sector need careful consideration. This paper will investigate the nexus between economic growth and CO₂ releases, which constitute the majority of greenhouse gas releases. The annual releases of CO₂ surged to 2 billion tons during the 20th century and the figure rose to 24 billion tons by the beginning of the 21st century, eventually reaching 37.1 billion tons in 2018 (Şahinöz, 2021). If this increasing trend continues at the same pace, the CO₂ concentration in the atmosphere is bound to double within 140 years (Huang et al., 2020). Without prompt international adoption of proactive measures and a reduction of anthropogenic greenhouse gas emissions, the facets of the climate crisis will exacerbate, posing severe threats to natural life (Miçoogulları, 2022). In this context, advanced countries and the international community have embarked on substantial international initiatives to mitigate the detrimental effects of greenhouse gas releases, encompassing the Montreal Protocol, the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, the European Union (EU) Green Deal, and the Paris Agreement (UNEP, 2016). The validity of EKC hypothesis had been investigated, incorporating various factors like energy consumption (Wang et al., 2016), trade openness (Ozturk and Acaravci, 2016), financial development (Katircioglu and Taspinar, 2017), and urbanization (Saidi and Mbarek, 2016). Many studies employed the autoregressive distributed lag (ARDL) approach to examine the validity of EKC hypothesis since its applicability irrespective of the stationarity properties of independent variables (Pesaran et al. 2001). The difference between this study and others is employing Narayan and Narayan's (2010) technique to verify Environmental Kuznets Curve validity, suggesting that if the long-term income elasticity is lower than its short-term one, then country has managed to cut down its emissions while experiencing an income boost. The main contributions of this manuscript to the existing literature can be summarized as following: a) employing Narayan and Narayan's (2010) technique to examine the validity of Environmental Kuznets Curve, b) investigating the nexus between the CO₂ gas emissions as an indicator for environmental degradation and GDP, coal consumption, oil consumption, trade openness, financial development and urbanization in Indonesia during the period spanning from 1970 to 2019. The reason behind selecting Indonesia is that it is one of the largest economies in Asia, having undergone considerable economic growth accompanied by a substantial increase in energy usage and CO₂ releases. This paper is arranged as follows: The literary

assessment is presented in Section 2. The data and methodological approach are detailed in Section 3. The empirical conclusions are highlighted in Section 4. Conclusions and policy recommendations are summarized in Section 5.

LITERATURE REVIEW

The nexus between economic evolution and environmental degradation has been the focus of considerable attention, driven by apprehensions regarding sustainable growth. However, literature has yielded mixed conclusions. The attribution of these mixed conclusions was connected to factors like backgrounds of sample countries, diverse country-specific policies (Ahmad et al., 2016), and the model misspecification. According to Narayan et al. (2016), the shift from a traditional regression model of economic evolution and environmental deterioration variables to a multivariate regression model with various control variables did not strengthen the empirical backing for the EKC hypothesis. Several studies incorporated energy consumption as a covariate in their empirical models to investigate the nexus between income and environmental deterioration. Kuo et al. (2014) investigated the Granger causality nexus among GDP, energy usage, and CO₂ releases in Hong Kong during the period spanning from 1965 to 2010. Their conclusions reveal a unidirectional causality running from CO₂ releases to both energy usage and GDP, with a two-way causality nexus between GDP and energy usage. Albiman et al. (2015) investigated the dynamic nexus among energy usage, environmental degradation, and per capita economic evolution in Tanzania during the period spanning from 1975 to 2013, utilizing the EKC framework and robust causality techniques. The conclusions revealed a one-way causality nexus running from economic growth rate and energy usage per capita to carbon releases in Tanzania. Subsequently, researchers refined their models by integrating additional variables striving for a more comprehensive understanding of the nexus between income and environmental deterioration—a trend mirrored in the (EKC) literature also. Bhattacharya et al. (2016) examined the mien of renewable energy usage on the economic evolution of 38 prominent renewable energy-consuming nations, confirming long-run dynamics between economic evolution and conventional and energy-related inputs. The results revealed that renewable energy usage has a significant positive mien on economic output in 57% of the selected nations, indicating the necessity for collaborative endeavors among governments, energy planners, global cooperation agencies, and related entities to boost renewable energy investment, ultimately striving for low-carbon growth in these economies. Shafiei and Salim (2014) explore the factors influencing CO₂ releases utilizing the STIRPAT model and during the period spanning from 1980 to 2011 for OECD nations. The empirical results revealed that whereas renewable energy consumption reduces CO₂ releases, non-renewable energy consumption amplifies them, supporting the validity of (EKC) hypothesis between urbanization and CO₂ releases; indicating the need for directing attention toward urban planning and clean energy development to make substantial contributions to both decreasing non-renewable energy consumption and addressing climate change. Dogan (2015) analyzed the causality nexus among economic evolution (GR), electricity usage from renewable sources (RELC), and electricity usage from non-renewable sources (NRELC) in Türkiye. The results revealed that NRELC has a long-run positive mien on GR, with supporting the neutrality hypothesis between NRELC and GR in the short run and the feedback hypothesis between NRELC and GR in the long run. These results suggest that it is crucial for policymakers to consistently reduce the percentage of electricity consumed from renewable sources while promoting the adoption of electricity from non-renewable sources to support sustainable long-term growth rates, underscoring the significance of investment projects aimed at enhancing the efficiency of electricity generation from non-renewable sources. Sharma (2011) revealed that per capita electric power consumption has a positive mien on CO₂ releases. Richmond & Kaufmann (2006), Iwata et al. (2012) and Iwata et al.

(2010) consider the role of nuclear electricity usage. Moreover, Govindaraju & Tang (2013), Saboori & Sulaiman (2013), Li & Leung (2012) and Bloch et al. (2012) consider the role of coal consumption. Despite the importance of energy in examining the (EKC) hypothesis, it is imperative to include supplementary variables such as financial development, urbanization, and trade openness to prevent omitted variable bias and improve the model for a more thorough grasp of the research question. Javid & Sharif (2016) investigated the mien of the financial development, per capita real income, the square of per capita real income, per capita energy consumption, and openness on per capita CO₂ releases in Pakistan during the period spanning from 1972 to 2013. The results revealed the presence of the EKC hypothesis in both the short and long term. Moreover, there was an important positive nexus between financial development and CO₂ releases, suggesting that environment's integrity has been traded off in order to achieve the financial growth. Shahbaz et al. (2015) explored the nexus between globalization and CO₂ releases during the period spanning from 1970 to 2012 in India, incorporating energy consumption, financial development, and economic growth. The results revealed that economic and financial development worsen environmental quality by elevating CO₂ releases in the long run. Wang et al. (2015) examine the validity of urbanization-carbon releases EKC hypothesis for OECD nations during the period spanning from 1960 to 2010, utilizing a semi-parametric panel fixed effects regression approach. The results revealed that urbanization have a significant mien on per capita carbon releases, indicating the presence of an inverse U-shaped curve nexus between urbanization and carbon releases. Conversely, Charfeddine & Khediri (2016) revealed an inverted U-shaped nexus between financial development and CO₂ releases. In turn, He et al. (2017) examined the impact of urbanization on CO₂ releases at different development levels during the period spanning from 1995 to 2013 in China. The results revealed that the mien of urbanization on CO₂ releases demonstrates notable variations across income levels. Moreover, they observed that beyond a certain income threshold, urbanization ceases to be a factor contributing to CO₂ releases. Another factor that has been integrated to understand the nexus between income and environmental deterioration is trade openness. Al-Mulali & Ozturk (2016) investigates the validity of the EKC hypothesis in 27 advanced nations during the period spanning from 1990 to 2012, revealing a cointegration nexus among CO₂ releases, GDP, non-renewable and renewable energy usage, urbanization, trade openness, and energy prices. Moreover, the results revealed that while trade openness, energy prices, and renewable energy usage decrease CO₂ releases; urbanization, GDP, and non-renewable energy usage increase them. Furthermore, the conclusions confirm the presence of the EKC hypothesis during the studied interval, indicating the need for applying strategies mitigating environmental degradation while maintaining economic growth and development. Sugiawan and Managi (2016) assess the validity of EKC for Indonesia during the period spanning from 1971 to 2010, considering the role of renewable energy in electricity production; utilizing the autoregressive distributed lag (ARDL) approach. The results revealed an inverted U-shaped EKC long-run nexus between economic evolution and CO₂ releases, with a turning point, approximated at 7729 USD per capita, lying outside the analyzed period. Moreover, the conclusions highlight the positive mien of renewable energy on decreasing CO₂ releases, both in the short and long term. In the context of Indonesia, Saboori et al. (2012) investigate the validity of the EKC hypothesis, considering CO₂ releases, economic evolution, energy usage, and foreign trade during the period spanning from 1971 to 2007 in Indonesia, utilizing ARDL methodology. The results revealed that the EKC hypothesis doesn't hold true during the studied interval, with identifying the foreign trade as the most important intergradient that causes CO₂ releases in Indonesia followed by energy usage. Massagony & Budiono (2022) investigated the validity of EKC hypothesis, considering renewable energy usage, fossil energy usage, and forest moratorium and restoration policies, revealing that EKC hypothesis doesn't hold true during the studied interval. Moreover, the conclusions revealed that whereas renewable energy usage, forest restoration

strategies and forest moratoriums have a negative mien on CO₂ releases, fossil energy usage have a positive mien on it, underscoring the significance of diminishing reliance on fossil energy, enhancing the utilization of renewable energy, and preserving Indonesia's forests. Utilizing ARDL and wavelet coherence technique, Adebayo (2021) revealed that EKC holds true in Indonesia during the period spanning from 1980 to 2016, considering ingredients like trade openness, energy usage, and economic evolution and CO₂ releases as a proxy for environmental degradation. Furthermore, economic evolution and energy usage are found to positively impact CO₂ releases, while trade openness boosts environmental quality. Utilizing the Error Correction Model (ECM) and Engel-Granger estimation techniques, Prasetyanto & Sari (2021) confirms the validity of EKC hypothesis in Indonesia during the period spanning from 1994 to 2018. The results revealed that while the primary energy usage and economic evolution have a significant positive mien on environmental deterioration, income inequality have an insignificant negative mien on it. Setyadharma et al. (2020) confirm the presence of the EKC hypothesis in Indonesia during the period spanning from 2012 to 2018, utilizing a data panel regression method covering 33 Indonesian provinces. According to Galuh Nuansa & Widodo (2018), there is inconclusive evidence relating to the presence of the inverted U-curve in Indonesia, indicating the need for further research to address the nexus between economic evolution and the quality of the environment. Mixed results are found in the literature, therefore further research is required

METHODS

The aim of this paper is to assess the indicators for economic evolution and environmental impact, utilizing the EKC theory suggested by Grossman & Krueger (1991). Despite the EKC theory being thoroughly examined over the decades, this is the first study to employ Narayan and Narayan's (2010) suggestion to explore the validity of EKC theory in Indonesia. The empirical model is exhibited as follows:

$$CO_2 = f(GDP, CL, GAS, MG, OIL, TR, UR) \quad (1)$$

In the course of arranging for econometric analyses:

$$CO_2_t = \beta_0 + \beta_1 GDP_t + \beta_2 CL_t + \beta_3 MG_t + \beta_4 OIL_t + \beta_5 TR_t + \beta_6 UR_t + \mu \quad (2)$$

Where CO₂ indicates annual carbon dioxide gas emissions, GDP is expressed in international-\$ at 2017 prices, using multiple benchmark years to adjust for differences in the cost of living between countries over time, CL denotes coal consumption measured as TWh, MG denotes annual broad money growth (%), OIL denotes oil consumption measured as TWh, TR denotes trade openness (share of exports and imports in GDP), UR denotes urban population (%), t is the time, and μ is the error term. The proposed nexus is estimated utilizing data for the period spanning from 1970 to 2019. All the utilized data is sourced from Our World in Data. Logarithmic forms of these variables were employed, since that logging the variables yields more robust results (Ehrlich, 1996). ARDL bounds testing method proposed by Pesaran et al. (2001) had been applied to estimate the cointegration nexus between the variables, since this method enables investigations for variables with different integration levels, addresses endogeneity and autocorrelation issues, and differentiates short-term adjustments from the long-term correlations (Pesaran and Shin, 1999). The ARDL unrestricted equation is presented as follows:

$$\begin{aligned} \Delta CO2_t = & \beta_0 + \beta_{GDP}GDP_{t-1} + \beta_{CL}CL_{t-1} + \beta_{MG}MG_{t-1} + \beta_{OIL}OIL_{t-1} + \beta_{TR}TR_{t-1} + \beta_{UR}UR_{t-1} + \\ & \sum_{i=1}^p \beta_{1i}\Delta CO2_{t-i} + \sum_{j=0}^q \beta_{2j}\Delta GDP_{t-j} + \sum_{k=0}^m \beta_{3k}\Delta CL_{t-k} + \sum_{m=0}^o \beta_{4m}\Delta MG_{t-m} + \\ & + \sum_{n=0}^r \beta_{5n}\Delta OIL_{t-n} + \sum_{o=0}^s \beta_{6o}\Delta TR_{t-o} + \sum_{p=0}^t \beta_{7p}\Delta UR_{t-p} + \mu_t \quad (3) \end{aligned}$$

Where,

H_0 : proposes the absence of cointegration if $B_{CO2} = \beta_{GDP} = \beta_{CL} = \beta_{MG} = \beta_{OIL} = \beta_{TR} = \beta_{UR} = 0$.

H_1 : proposes the presence of cointegration if one or more β_k isn't zero ($\beta_k \neq 0$).

The statistically cointegrating nexus between the variables could be affirmed in the case that derived F-statistic proceeds the critical value. Moreover, it is necessary to choose the optimal lag in order to address the response effect originating from the lag sequence. Equation (4) presents the ARDL model, capturing the short-run dynamics through incorporating the error correction term (ECT_{t-1}).

$$\begin{aligned} \Delta CO2_t = & a_0 + \sum_{i=1}^p a_{1i}\Delta CO2_{t-i} + \sum_{j=0}^q a_{2j}\Delta GDP_{t-j} + \sum_{k=0}^m a_{3k}\Delta CL_{t-k} + \sum_{m=0}^o a_{4m}\Delta MG_{t-m} + \\ & \sum_{n=0}^r a_{5n}\Delta OIL_{t-n} + \sum_{o=0}^s a_{6o}\Delta TR_{t-o} + \sum_{p=0}^t a_{7p}\Delta UR_{t-p} \\ & + \lambda ECT_{t-1} + \epsilon_t \quad (4) \end{aligned}$$

Where, λ denotes the error correction coefficient. It highlights the rapidity with which the model achieves long-term equilibrium, anticipated to possess a negative value, and indicate statistical significance.

Empirical Application

To start off, the stationary test is implemented. It is critical to verify that each variable attains the maximum I(1) order. This concludes testing if each variable corresponds to the I(0) or I(1) order. Therefore, the Dickey-Fuller test is utilized to confirm that the employed variables are integrated to the utmost I(1) level. Table (1) presents the results of the stationarity test. Only With Constant and With Constant & Trend results are reported.

Table 1. Results of unit root test

Variables	With Constant		With Constant & Trend	
	At level	First Difference	At level	First Difference
CO2	-1.84	-5.87	-2.79	-6.17
	0.36	0.0000***	0.21	0.0000***
GDP	-0.79	-3.84	-2.62	-3.82
	0.81	0.005***	0.27	0.02**
CL	-2.73	-10.85	-3.82	-6.88
	0.08*	0.0000***	0.02**	0.0000***
MG	-2.51	-9.50	-4.60	-9.404
	0.12	0.0000***	0.003***	0.0000***
OIL	-7.2414	-7.9178	-7.2657	-7.8146
	0.00***	0.0000***	0.000***	0.0000***
TR	-6.8900	-6.2186	-7.4221	-6.2994

	0.00***	0.000***	0.000***	0.0000***
UR	-3.45	-11.7439	-5.17	-11.62
	0.01**	0.00***	0.001***	0.0000***

The results revealed that the dependent variable is stationary at I(1) order, and the rest variables are stationary at either I(0) or I(1) order. As a second phase, we employed the boundary test in the context of the ARDL approach. Based on the Akaike information criteria, the optimal lag length is determined to be 4 (AIC: 3.982745), with the model's optimal lag selection being (3,4,4,4,4,4,4). The conclusions of the bound test are shown in table (2), suggesting that F-stat is higher in all levels, confirming a long-run co-integration of the analyzed variables

Table 2. Conclusions of the Bounds Test of the Selected model

F-stat	10%level	5%level	1%level
6.769857	2.188-3.254	2.591-3.766	3.540-4.931

Moreover, for model precision verification, we performed diagnostic assessments, namely, the Breusch-Godfrey serial correlation LM, the ARCH test, the Ramsey RESET, and CUSUM and CUSUM of squares. The results demonstrated the stability of the dataset. Table (3) presents the estimates for the long and short term.

Table 3. ARDL (3,4,4,4,4,4,4) Model Estimation Results and Error Correction Form

Dependent Variable: CO2			
Model: ARDL (3,4,4,4,4,4,4)			
Long Run			
Variable	Coefficient	t-statistics	Prop.
GDP	0.199	4.143	0.0014
CL	0.022	2.29	0.0406
MG	-0.021	-0.34	0.7400
OIL	-0.014	-2.004	0.0682
TR	-0.03	-1.43	0.1784
UR	-0.002	-0.005	0.9961
Short Run			
$\Delta\text{CO2}(-1)$	-0.52	-2.77	0.0170
ΔGDP	0.36	2.31	0.0392
ΔCL	0.006	1.39	0.1904
ΔMG	-0.034	-1.48	0.1625
ΔOIL	-0.005	-1.62	0.1318
ΔTR	-0.007	-1.22	0.2474
ΔUR	0.09	0.33	0.7506
ECM(-1)	-0.32	-9.26	0.0000
Diagnostic Tests			
F-Statistics		Prop.	

χ^2_{SERIAL}	0.71	0.4166
χ^2_{ARCH}	1.31	0.2586
χ^2_{RESET}	5.53E-05	0.9942
CUSUM	Stable	
CUSUMsq	Stable	

The results revealed that, in the long run, a unit surge in GDP causes an increase of CO₂ by 0.20 units ($p < 0.01$). Furthermore, a unit surge of CL increases CO₂ by 0.02 units for every unit increase ($p < 0.05$). MG's mien on CO₂ is a decrease of 0.02 units for every unit increase, but this result isn't statistically significant. Insignificant negative mien on CO₂ had been recorded for TR and UR, while a negative significant mien had been recorded for OIL at 10% significance level. The short run consequences showed statistically insignificant miens on CO₂ for all the studied variables except for GDP. The results revealed a positive significant nexus between GDP and CO₂ at 5% significance level. The COINTEQ term exhibits a noteworthy negative mien, suggesting that discrepancies from equilibrium are corrected by 32% over a one-year period. Grounded on Narayan and Narayan's (2010) proposition, which suggests that if the long-term income elasticity is lower than short-term one, a country has effectively decreased its releases while simultaneously increasing income; we can infer that (EKC) holds true throughout the examined period. This conclusion aligns with that obtained by Adebayo (2021), Prasetyanto & Sari (2021) and Setyadharma et al. (2020); but doesn't align with Saboori et al. (2012) and Massagony & Budiono.

CONCLUSION

This paper assesses the validity of the EKC hypothesis in Indonesia grounded on Narayan and Narayan's (2010) suggestion during the period spanning from 1970 to 2019. The ARDL developed by Pesaran et al. (2001) was employed to estimate the short- and long-term nexus between CO₂ gas emissions as an indicator for environmental degradation and GDP, coal consumption, oil consumption, trade openness, financial development and urbanization. The results revealed that EKC holds true for the reason that the long-run mien of GDP is lower than the coefficient indicating the short-run impact. Policymakers ought to develop specific approaches targeting coal consumption (CL), oil consumption (OIL), money growth (MG), trade openness (TR), and urbanization (UR) to mitigate environmental impact. Consistent monitoring and evaluation of policy efficiency, adherence to global sustainability goals, public engagement for responsible practices, and global collaboration are indispensable elements for shaping a green and resilient economic future.

REFERENCES

- Adebayo, T. S. (2021). Testing the EKC hypothesis in Indonesia: empirical evidence from the ARDL-based bounds and wavelet coherence approaches. *Applied Economics Journal*, 28(1), 78-100.
- Ahmad, A., Zhao, Y., Shahbaz, M., Bano, S., Zhang, Z., Wang, S. & Liu, Y. (2016) Carbon emissions, energy consumption and economic growth: an aggregate and disaggregate analysis of the Indian economy. *Energy Policy*, 96:131–143
- Albiman MM, Suleiman NN, Baka HO (2015) The relationship between energy consumption, CO₂ emissions and economic growth in Tanzania. *International Journal of Energy Sector Management* 9(3):361–375
- Al-Mulali, U. & Ozturk, I. (2016) The investigation of environmental Kuznets curve hypothesis in the advanced economies: the role of energy prices. *Renew Sust Energ Rev* 54:1622–1631
- Bhattacharya M, Paramati SR, Ozturk I, Bhattacharya S (2016) The effect of renewable energy consumption on economic growth: evidence from top 38 countries. *Appl Energy* 162:733–741

- Bloch, H., Rafiq, S., & Salim, R. (2012). Coal consumption, CO₂ emission and economic growth in China: Empirical evidence and policy responses. *Energy Economics*, 34(2), 518–528.
- Charfeddine L, Khediri KB (2016) Financial development and environmental quality in UAE: cointegration with structural breaks. *Renew Sust Energ Rev* 55:1322–1335
- Dogan E (2015) The relationship between economic growth and electricity consumption from renewable and non-renewable sources: a study of Turkey. *Renew Sust Energ Rev* 52:534–546
- Ehrlich, I. (1996), Crime, punishment and the market for offenses. *Journal of Economic Perspective*, 10(1), 43–67.
- Galuh Nuansa, C., & Widodo, W. (2018). Environmental Kuznets Curve Hypothesis: A Perspective of Sustainable Development in Indonesia. *E3S Web of Conferences*, 31, 09021.
- Govindaraju VC, Tang CF (2013) The dynamic links between CO₂ emissions, economic growth and coal consumption in China and India. *Appl Energy* 104:310–318
- Grossman, G., & Krueger, A. (1991). *Environmental Impacts of a North American Free Trade Agreement*. National Bureau of Economic Research. <https://doi.org/10.3386/w3914>
- He Z, Xu S, Shen W, Long R, Chen H (2017) Impact of urbanization on energy-related CO₂ emission at different development levels: regional difference in China based on panel estimation. *J Clean Prod* 140:1719–1730
- Huang, J., Tang, Z., Liu, D. & He, J. (2020). Ecological response to urban development in a changing socio-economic and climate context: Policy implications for balancing regional development and habitat conservation. *Land Use Policy*, 97, 104772.
- Iwata, H., Okada, K. and Samreth, S. (2010) Empirical study on environmental Kuznets curve for CO₂ in France: the role of nuclear energy, *Energy Policy*, 38, 4057–63
- Iwata, H., Okada, K., Samreth, S. (2012) Empirical study on the determinants of CO₂ emissions: evidence from OECD countries. *Appl Econ* 44(27):3513–3519
- Javid, M., Sharif, F. (2016) Environmental Kuznets curve and financial development in Pakistan. *Renew Sust Energ Rev* 54:406–414
- Katircioglu ST, Taspinar N (2017) Testing the moderating role of financial development in an environmental Kuznets curve: empirical evidence from Turkey. *Renew Sust Energ Rev* 68:572–586
- Kuo, K.C., Kanyasathaporn, P., Lai, S. (2014) The causal relationship between GDP, energy consumption and CO₂ emissions in Hong Kong. *Prod Res J* 46:127–138
- Li, R., & Leung, G. C. K. (2012). Coal consumption and economic growth in China. *Energy Policy*, 40, 438–443. <https://doi.org/10.1016/j.enpol.2011.10.034>
- Massagony, A., & Budiono. (2022). Is the Environmental Kuznets Curve (EKC) hypothesis valid on CO₂ emissions in Indonesia? *International Journal of Environmental Studies*, 1–12.
- Miçoogulları, S. A. (2022). Yüksek Kurumsal Kalite ve Düşük Karbon Emisyonu ile Yüksek Büyüme Mümkün mü? *İzmir İktisat Dergisi*, 37(4), 849–869
- Narayan, P. K., and Narayan, S. (2010). Carbon dioxide emissions and economic growth: Panel data evidence from developing countries. *Energy policy*, 38(1), 661–666.
- Narayan PK, Saboori B, Soleymani A (2016) Economic growth and carbon emissions. *Econ Model* 53:388–397
- Ozatac, N., Gokmenoglu, K. K., & Taspinar, N. (2017). Testing the EKC hypothesis by considering trade openness, urbanization, and financial development: the case of Turkey. *Environmental Science and Pollution Research*, 24(20), 16690–16701.
- Ozturk, I. & Acaravci, A. (2016) Energy consumption, CO₂ emissions, economic growth, and foreign trade relationship in Cyprus and Malta. *Energy Sources, Part B: Economics, Planning, and Policy* 11(4): 321–327
- Pesaran, M.H. and Shin, Y. (1999) An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis. In: Strom, S., Ed., Chapter 11 in *Econometrics and Economic Theory in the 20th Century the Ragnar Frisch Centennial Symposium*, Cambridge University Press, Cambridge, 371–413.
- Pesaran MH, Shin Y, Smith RJ (2001) Bounds testing approaches to the analysis of level relationships. *J Appl Econ* 16:289–326
- Prasetyanto, P. K., & Sari, F. (2021). Environmental Kuznets Curve: Economic Growth with Environmental Degradation in Indonesia. *International Journal of Energy Economics and Policy*, 11(5), 622–628.
- Richmond, A. K. and Kaufmann, R. K. (2006) Is there a turning point in the relationship between income and energy use and/or carbon emissions? *Ecological Economics*, 56, 176–89.
- Saboori B, Sulaiman J (2013) Environmental degradation, economic growth, and energy consumption: evidence of the environmental Kuznets curve in Malaysia. *Energy Policy* 60:892–905

- Saboori, B., Sulaiman, J. B., & Mohd, S. (2012). An Empirical Analysis of the Environmental Kuznets Curve for CO₂ Emissions in Indonesia: The Role of Energy Consumption and Foreign Trade. *International Journal of Economics and Finance*, 4(2).
- Setyadharma, A., Oktavilia, S., Tika Atmadani, Y., & Fajarini Sri Wahyuningrum, I. (2020). A New Insight of the Existence of the Environmental Kuznets Curve in Indonesia. *E3S Web of Conferences*, 202, 03023.
- Shafiei S, Salim RA (2014) Non-renewable and renewable energy consumption and CO₂ emissions in OECD countries: a comparative analysis. *Energy Policy* 66:547–556
- Shahbaz, M., Mallick, H., Mahalik, MK. & Loganathan, N., (2015). Does globalization impede environmental quality in India? *Ecol Indic* 52:379– 393
- Sharma SS (2011) Determinants of carbon dioxide emissions: empirical evidence from 69 countries. *Appl Energy* 88(1):376–382
- Sugiawan, Y., & Managi, S. (2016). The environmental Kuznets curve in Indonesia: Exploring the potential of renewable energy. *Energy Policy*, 98, 187–198.
- Şahinöz, A. (2021). Neoklasik iktisadın ekolojik ekonomiye dönüşü: Sosyal demokrat çevre politikaları. *İktisat ve Toplum Dergisi*, 11(129), 18-34
- United Nations Environment Programme. Ozone Secretariat. (UNEP). (2016). Handbook for the Montreal protocol on substances that deplete the ozone layer. UNEP/Earthprint.
- Wang Y, Zhang X, Kubota J, Zhu X, Lu G (2015) A semiparametric panel data analysis on the urbanization-carbon emissions nexus for OECD countries. *Renew Sust Energ Rev* 48:704–709
- Wang, Z., Bao, Y., Wen, Z. & Tan, Q. (2016). Analysis of relationship between Beijing's environment and development based on environmental Kuznets curve. *Ecol Indic* 67:474–483.