

**CARBON DIOXIDE EMISSIONS,  
GROSS DOMESTIC PRODUCT  
AND ENERGY CONSUMPTION:  
EFFECT OF THE KYOTO  
PROTOCOL**

**Editor**

Emrah BEŞE

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## ABBREVIATIONS

AIC	: Akaike Information Criteria
ARDL	: Autoregressive Distributed Lag
BDD	: Banerjee, Dolado and Mestre
BEW	: Block Exogeneity Wald
CO	: Breusch-Godfrey Serial Correlation LM Test
CO <sub>2</sub>	: Carbon dioxide emissions
CS	: Coal Consumption
CSQM	: Cusum Square Test
CSSM	: Cusum Test
C.V.	: Critical Value
D.V.	: Dependent Variable
ECM	: Error Correction Model
EI.	: Eigenvalue
EKC	: Environmental Kuznets Curve
ENC	: Energy consumption
EXCL.	: Excluded
FPE	: Final Prediction Error
GDP	: Gross domestic per capita
HE	: Heteroscedasticity Test Breusch-Pagan-Godfrey
HQ	: Hannan-Quinn Information Criterion
IRRA	: Impulse Response Analysis
JCT	: Johansen Cointegration Test
LR	: Sequential modified LR test statistic
LRR	: Long run results
MAX. ER.	: Maximum Eigenvalue



### *Abbreviations*

MG	: Mean Group
NARDL	: Non-linear Autoregressive Distributed Lag
NO	: Normality Test
PB.	: Probability
PER.	: Period
PMG	: Pooled Mean Group
PSS	: Pesaran, Shin and Smith
RE	: Ramsey Reset Test
SC	: Schwarz information criterion
SQ	: Square of gross domestic per capita
SRR	: Short run results
TR	: Trace
TR. STAT.	: Trace Statistics
UCRT	: Unrestricted Cointegration Rank Test
UR	: Unit Root Test
VAR	: Vector Autoregressive Model
VDDA	: Variance Decomposition Analysis
VECM	: Vector Error Correction Model
VGC	: Var Granger Causality
VMSR	: VAR Model Stability Results
VRHT	: VAR Residual Heteroskedasticity Tests
VRSC	: VAR Residual Serial Correlation

## REFERENCES

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- Acaravci, A., & Ozturk, I. (2010). On the relationship between energy consumption, CO<sub>2</sub> emissions and economic growth in Europe. *Energy*, 35(12), 5412–5420. <https://doi.org/10.1016/j.energy.2010.07.009>
- 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. <https://doi.org/10.1016/j.enpol.2016.05.032>
- Aichele, R., & Felbermayr, G. (2013). The Effect of the Kyoto Protocol on Carbon Emissions. *Journal of Policy Analysis and Management*, 32(4), 731–757. <https://doi.org/10.1002/pam>
- Akpan, U. F., & Chuku, A. (2011). Economic Growth and Environmental Degradation in Nigeria: Beyond the Environmental Kuznets Curve. *MPRA Paper*, (31241).
- Al-Mulali, U., Solarin, S. A., & Ozturk, I. (2016). Investigating the presence of the environmental Kuznets curve (EKC) hypothesis in Kenya: an autoregressive distributed lag (ARDL) approach. *Natural Hazards*, 80(3), 1729–1747. <https://doi.org/10.1007/s11069-015-2050-x>
- Alaoui, A. E. (2017). What is the relationship between environmental quality, economic growth and free trade? *International Journal of Social Sciences and Education Research*, 3(1), 124–144. <https://doi.org/10.24289/ijsser.283594>
- Almer, C., & Winkler, R. (2017). Analyzing the effectiveness of international environmental policies : The case of the Kyoto Protocol. *Journal of Environmental Economics and Management*, 82, 125–151. <https://doi.org/10.1016/j.jeem.2016.11.003>
- Ankarhem, M. (2005). A Dual Assessment of the Environmental Kuznets Curve : The Case of Sweden. *The S-WoPEc Working Paper Collection*, (660). Retrieved from <http://www.usbe.umu.se/404?contentId=52945&languageId=3&assetKey=ues660>

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Energy Consumption: Effect Of The Kyoto Protocol*

- Appiah, K., Du, J., Musah, A. I., & Afriyie, S. (2017). Investigation of the Relationship between Economic Growth and Carbon Dioxide (CO<sub>2</sub>) Emissions as Economic Structure Changes: Evidence from Ghana. *Resources and Environment*, 7(6), 160–167. <https://doi.org/10.5923/j.re.20170706.02>
- Asghari, M. (2012). Environmental Kuznets Curve and Growth Source in Iran. *Panaeconomicus*, 5(September 2010), 609–623. <https://doi.org/10.2298/PAN1205609A>
- Azlina, A. A., Hook, S., Hashim, N., & Mustapha, N. (2014). Dynamic linkages among transport energy consumption, income and CO<sub>2</sub> emission in Malaysia. *Energy Policy*, 73, 598–606. <https://doi.org/10.1016/j.enpol.2014.05.046>
- Baek, J. (2015). Environmental Kuznets curve for CO<sub>2</sub> emissions: The case of Arctic countries. *Energy Economics*, 50, 13–17. <https://doi.org/10.1016/j.eneco.2015.04.010>
- Balaguer, J., & Cantavella, M. (2016). Estimating the environmental Kuznets curve for Spain by considering fuel oil prices (1874 – 2011), 60, 853–859.
- Banerjee, A., Dolado, J. J., & Mestre, R. (1998). Error-correction mechanism tests for cointegration in a single-equation framework b. *Journal of Time Series Analysis*, 19(3).
- Begum, R. A., Sohag, K., Abdullah, S. M. S., & Jaafar, M. (2015). CO<sub>2</sub> emissions, energy consumption, economic and population growth in Malaysia. *Renewable and Sustainable Energy Reviews*, 41, 594–601. <https://doi.org/10.1016/j.rser.2014.07.205>
- Benavides, M., Ovalle, K., Torres, C., & Vinces, T. (2017). Economic Growth, Renewable Energy and Methane Emissions: Is there an Environmental Kuznets Curve in Austria? *International Journal of Energy Economics and Policy*, 7(1), 259–267.
- Boutabba, M. A. (2014). The impact of financial development, income, energy and trade on carbon emissions: Evidence from the Indian economy Mohamed Amine Boutabba. *Economic Modelling*, 40, 33–41. <https://doi.org/10.1016/j.econmod.2014.03.005>
- Bruyn, S. M. De, Bergh, J. C. J. M. Van Den, & Opschoor, J. B. (1998). Economic growth and emissions: reconsidering the empirical basis of environmental Kuznets curves, 25, 161–175.
- Chudik, A., Mohaddes, K., Pesaran, M. H., & Raissi, M. (2016). Long-run effects in large heterogeneous panel data models with cross-sectionally correlated errors. *Advances in Econometrics*, 36, 85–135. <https://doi.org/10.1108/S0731-905320160000036013>
- Chudik, A., & Pesaran, M. H. (2015). Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors. *Journal of Econometrics*, 188(2), 393–420. <https://doi.org/10.1016/j.jeconom.2015.03.007>
- Chuku, A. (2011). Economic development and environmental quality in Nigeria: is there an environmental Kuznets curve? *MPRA Paper*, (30195).
- Day, K. M., & Grafton, R. Q. (2003). Growth and the Environment in Canada: An Empirical Analysis. *Canadian Journal of Agriculture Economics*, 51, 197–216.

## References

- Dickey, D. A., & Fuller, W. A. (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. *Econometrica*, 49(4), 1057–1072.
- Dogan, E., & Turkekel, B. (2016). CO2 emissions, real output, energy consumption, trade, urbanization and financial development: testing the EKC hypothesis for the USA. *Environmental Science and Pollution Research*, 23(2), 1203–1213. <https://doi.org/10.1007/s11356-015-5323-8>
- 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.
- Esteve, V., & Tamarit, C. (2012a). Is there an environmental Kuznets curve for Spain ? Fresh evidence from old data. *Economic Modelling*, 29(6), 2696–2703. <https://doi.org/10.1016/j.econmod.2012.08.016>
- Esteve, V., & Tamarit, C. (2012b). Threshold cointegration and nonlinear adjustment between CO 2 and income : The Environmental Kuznets Curve in Spain , 1857 – 2007. *Energy Economics*, 34(6), 2148–2156. <https://doi.org/10.1016/j.eneco.2012.03.001>
- Fosten, J., Morley, B., & Taylor, T. (2012). Dynamic misspecification in the environmental Kuznets curve : Evidence from CO 2 and SO 2 emissions in the United Kingdom. *Ecological Economics*, 76, 25–33. <https://doi.org/10.1016/j.ecolecon.2012.01.023>
- Gill, A. R., Viswanathan, K. K., & Hassan, S. (2017). A test of environmental Kuznets curve ( EKC ) for carbon emission and potential of renewable energy to reduce green house gases ( GHG ) in Malaysia. *Environment, Development and Sustainability*, 20(3), 1103–1114. <https://doi.org/10.1007/s10668-017-9929-5>
- Grunewald, N., & Martinez-Zarzoso, I. (2016). Did the Kyoto Protocol fail ? An evaluation of the effect of the Kyoto Protocol on CO2 emissions Environment and Development Development Economics : *Environment and Development Economics*, 21(1), 1–22. <https://doi.org/10.1017/S1355770X15000091>
- Halkos, G. E., & Tzeremes, N. G. (2014). Measuring the effect of Kyoto protocol agreement on countries' environmental efficiency in CO 2 emissions : an application of conditional full frontiers. *Journal of Productivity Analysis*, 41, 367–382. <https://doi.org/10.1007/s11123-013-0343-1>
- Hao, Y., Liu, Y., Weng, J. H., & Gao, Y. (2016). Does the Environmental Kuznets Curve for coal consumption in China exist? New evidence from spatial econometric analysis. *Energy*, 114, 1214–1223. <https://doi.org/10.1016/j.energy.2016.08.075>
- Haq, I. ul, Zhu, S., & Shafiq, M. (2016). Empirical investigation of environmental Kuznets curve for carbon emission in Morocco. *Ecological Indicators*, 67, 491–496. <https://doi.org/10.1016/j.ecolind.2016.03.019>
- Hausman, J. A. (1978). Specification Tests in Econometrics. *Econometrica*, 46(6), 1251–1271.
- He, J., & Richard, P. (2010). Environmental Kuznets curve for CO2 in Canada. *Ecological Economics*, 69(5), 1083–1093. <https://doi.org/10.1016/j.ecolecon.2009.11.030>

*Carbon Dioxide Emissions, Gross Domestic Product And  
Energy Consumption: Effect Of The Kyoto Protocol*

- 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. <https://doi.org/10.1504/IJGE.2016.10001598>
- Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115(1), 53–74. [https://doi.org/10.1016/S0304-4076\(03\)00092-7](https://doi.org/10.1016/S0304-4076(03)00092-7)
- Iwata, H., Okada, K., & Samreth, S. (2012). Empirical study on the determinants of CO<sub>2</sub> emissions: evidence from OECD countries. *Applied Economics*, 44(27), 3513–3519. <https://doi.org/10.1080/00036846.2011.577023>
- Johansen, S. (1991). Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models Author ( s ): Søren Johansen Published by : Econometric Society Stable URL : <http://www.jstor.org/stable/2938278> REFERENCES Linked references are available, 59(6), 1551–1580.
- Kanjilal, K., & Ghosh, S. (2013). Environmental Kuznet ' s curve for India : Evidence from tests for cointegration with unknown structural breaks. *Energy Policy*, 56, 509–515. <https://doi.org/10.1016/j.enpol.2013.01.015>
- Kharbach, M., & Chfadi, T. (2017). CO<sub>2</sub> emissions in Moroccan road transport sector : Divisia , Cointegration , and EKC analyses. *Sustainable Cities and Society*, 35(July), 396–401. <https://doi.org/10.1016/j.scs.2017.08.016>
- Kumazawa, R., & Callaghan, M. S. (2012). The effect of the Kyoto Protocol on carbon dioxide emissions. *Journal of Economics and Finance*, 36, 201–210. <https://doi.org/10.1007/s12197-010-9164-5>
- Kunnas, J., & Myllyntaus, T. (2007). The Environmental Kuznets Curve Hypothesis and Air Pollution in Finland The Environmental Kuznets Curve Hypothesis and Air Pollution in Finland, 5522. <https://doi.org/10.1080/03585520701435970>
- Kuznets, S. (1955). Economic Growth and Income Inequality. *The American Economic Review*, 45(1), 292–302. <https://doi.org/10.1596/978-0-8213-7318-7>
- Lau, L., Choong, C., & Eng, Y. (2014). Investigation of the environmental Kuznets curve for carbon emissions in Malaysia : Do foreign direct investment and trade matter ? *Energy Policy*, 68, 490–497. <https://doi.org/10.1016/j.enpol.2014.01.002>
- Levin, A., Lin, C. F., & Chu, C. S. J. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics*, 108(1), 1–24. [https://doi.org/10.1016/S0304-4076\(01\)00098-7](https://doi.org/10.1016/S0304-4076(01)00098-7)
- Maamoun, N. (2019). The Kyoto protocol : Empirical evidence of a hidden success. *Journal of Environmental Economics and Management*, 95, 227–256. <https://doi.org/10.1016/j.jeem.2019.04.001>
- Mert, M., & Çağlar, A. E. (2017). Kyoto Protokolünün Karbon Emisyonu Üzerine Etkisi : Kırılmalı Panel Birim Impact of Kyoto Protocol on Carbon Emissions : An Application of Panel Unit Root Tests with Structural Breaks. *Business and Economics Research Journal*, 8(4), 661–672.
- Muhammad, S., Solarin, S. A., & Ozturk, I. (2016). *Environmental Kuznets curve hypothesis and the role of globalization in selected African countries.*

## References

- Olusegun, O. A. (2009). Economic growth and environmental quality in Nigeria does the environmental kuznets curve hypothesis hold.pdf. *Environmental Research Journal*, 3(1), 14–18.
- Oyinlola, M. A. (2010). Does the Level of Economic Growth Influence Environmental Quality in Nigeria : A Test of Environmental Kuznets Curve ( EKC ) Hypothesis ? *Pakistan Journal of Social Science*, 7(4), 325–329. <https://doi.org/10.3923/pjssci.2010.325.329>
- Pesaran, M. H. (2004). General Diagnostic Tests for Cross Section Dependence in Panels. *Iza*, (1240, (August)), 1–42. Retrieved from <http://www.dspace.cam.ac.uk/handle/1810/446>
- Pesaran, M. H. (2015). Testing Weak Cross-Sectional Dependence in Large Panels. *Econometric Reviews*, 34(6–10), 1089–1117. <https://doi.org/10.1080/07474938.2014.956623>
- 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. <https://doi.org/10.1002/jae.616>
- Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled Mean Group Estimation of Dynamic Heterogeneous Panels. *Journal of the American Statistical Association*, 94(446), 621–634. <https://doi.org/10.1080/01621459.1999.10474156>
- Pilatowska, M., Włodarczyk, A., & Zawada, M. (2015). CO2 emissions, energy consumption and economic growth in the EU countries: Evidence from threshold cointegration analysis. *2015 12th International Conference on the European Energy Market (EEM)*, 1–5. <https://doi.org/10.1109/EEM.2015.7216646>
- Roca, J., Padilla, E., Farre, M., & Galletto, V. (2001). Economic growth and atmospheric pollution in Spain : discussing the environmental Kuznets curve hypothesis, 39, 85–99.
- Saboori, B, & Soleymani, A. (2011). CO 2 emissions , economic growth and energy consumption in Iran : A co- integration approach. *International Journal of Environmental Sciences*, 2(1), 44–53. <https://doi.org/10.6088/ijes.00202010005>
- Saboori, Behnaz, & Sulaiman, J. (2013). Environmental degradation , economic growth and energy consumption : Evidence of the environmental Kuznets curve in Malaysia. *Energy Policy*, 60, 892–905. <https://doi.org/10.1016/j.enpol.2013.05.099>
- Saboori, Behnaz, Sulaiman, J., & Mohd, S. (2012). Economic growth and CO2emissions in Malaysia: A cointegration analysis of the Environmental Kuznets Curve. *Energy Policy*, 51, 184–191. <https://doi.org/10.1016/j.enpol.2012.08.065>
- Sephton, P., & Mann, J. (2013). Further evidence of an Environmental Kuznets Curve in Spain. *Energy Economics*, 36, 177–181. <https://doi.org/10.1016/j.eneco.2013.01.001>
- Sephton, P., & Mann, J. (2016). Compelling Evidence of an Environmental Kuznets Curve in the United Kingdom. *Environmental and Resource Economics*, 301–315. <https://doi.org/10.1007/s10640-014-9871-z>
- Shahbaz, M., Jalil, A., & Dube, S. (2010). Environmental Kuznets curve (EKC): Times series evidence from Portugal Muhammad. *MPRA Paper*, (27443).

*Carbon Dioxide Emissions, Gross Domestic Product And  
Energy Consumption: Effect Of The Kyoto Protocol*

- Shahbaz, M., & Sinha, A. (2019). Environmental Kuznets curve for CO2 emissions: a literature survey. *Journal of Economic Studies*, 46(1), 106–168. <https://doi.org/10.1108/JES-09-2017-0249>
- Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework. In *Festschrift in Honor of Peter Schmidt* (pp. 281–314). [https://doi.org/https://doi.org/10.1007/978-1-4899-8008-3\\_9](https://doi.org/https://doi.org/10.1007/978-1-4899-8008-3_9)
- Sulaiman, J., Azman, A., & Saboori, B. (2013). The Potential of Renewable Energy : Using The Environmental Kuznets Curve Model. *American Journal of Environmental Science*, 9(2), 103–112. <https://doi.org/10.3844/ajes-sp.2013.103.112>
- Taghvaei, V. M., & Parsa, H. (2015). Economic growth and environmental pollution in Iran: Evidence from manufacturing and services sectors. *MPRA Paper*, (67885).
- Tiwari, A. K., Shahbaz, M., & Hye, Q. M. A. (2013). The environmental Kuznets curve and the role of coal consumption in India : Cointegration and causality analysis in an open economy. *Renewable and Sustainable Energy Reviews*, 18, 519–527. <https://doi.org/10.1016/j.rser.2012.10.031>
- Toda, H. Y., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics*, 66(1–2), 225–250. [https://doi.org/10.1016/0304-4076\(94\)01616-8](https://doi.org/10.1016/0304-4076(94)01616-8)
- Twerefou, D. K., Adusah-Poku, F., & Bekoe, W. (2016). An empirical examination of the Environmental Kuznets Curve hypothesis for carbon dioxide emissions in Ghana: an ARDL approach. *Environmental & Socio-Economic Studies*, 4(4), 1–12. <https://doi.org/10.1515/enviro-2016-0019>
- Urban, F., & Nordensvärd, J. (2018). Low Carbon Energy Transitions in the Nordic Countries : Evidence from the Environmental Kuznets Curve. *Energies*, 11(9), 2209. <https://doi.org/10.3390/en11092209>