International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2020, 10(6), 656-661.

Pollution, Energy and Growth: Evidence from Post-Communist Countries

Avazbek Sadikov[1], Nargiza Kasimova[2], Arletta Isaeva[3], Anastas Khachaturov[3], Raufhon Salahodjaev[4,5]*

[1]National University of Uzbekistan Named After Mirzo Ulugbek, Tashkent, Uzbekistan, [2]Tashkent Institute of Finance, Tashkent, Uzbekistan, [3]ERGO Analytics, Uzbekistan, [4]Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, Uzbekistan, [5]Westminster International University in Tashkent, Uzbekistan. *Email: salahodjaev@gmail.com

Received: 25 March 2020 **Accepted:** 22 August 2020 **DOI:** https://doi.org/10.32479/ijeep.9637

ABSTRACT

This paper investigates the empirical relationship between carbon dioxide emissions, economic growth and energy use in post-communistic countries during 1990-2018. Pedroni's (1999) panel cointegration test discovered cointegrating relationship between the variables. To distinguish short- and long-term effect, as well as to account for homogeneity caused by previous common socio-political system and current country specific characteristics, Pesaran's et al. (1999) Pooled Mean Group estimator is employed. PMG estimates identified short- and long-term relationship between energy use and CO_2 emissions and short-term relationship between CO_2 emissions and economic growth. Finally, the Dumitrescu and Hurlin's (2012) Granger non-causality test for heterogeneous panels revealed bidirectional causality between CO_2 emissions, energy use and economic growth.

Keywords: CO_2 Emissions, Economic Growth, Energy Consumption, Post-communistic Countries
JEL Classifications: C23, P18, O47

1. INTRODUCTION

The humanity has been facing two main challenges since last century: sustainable economic development and environmental protection, which are closely related to each other. The energy consumption, as a significant factor of economic performance, affects environmental conditions by increasing level of emissions associated with energy use and in particular, carbon dioxide (CO_2) emissions. The CO_2 emissions play significant role in greenhouse effect and exacerbate this problem (Zhang and Cheng, 2009). The growth-energy-emissions nexus is the focus of numerous studies which provide evidence from different countries including China (Zhang and Cheng, 2009), Malaysia (Ang, 2008), Turkey (Halicioglu, 2009), United States (Soytas et al., 2007).

A vast of existing literature identified three possible dimensions on growth-energy-emissions nexus. The first strand is related to Environmental Kuznets Curve (EKC) and tests its validity. The EKC hypothesis documents non-linear relationship between economic growth and level of CO_2 emissions, meaning that environmental degradation grows with GDP in the early stages of economic performance and after a threshold it starts to decline. The initial empirical study is conducted by Grossman and Krueger (1991) and it is further developed by De Bruyn and Opschoor (1997), Unruh and Moomaw (1998), Heil and Selden (1999) and others. However, Stern (2004) and Hung and Shaw (2002) criticize EKC hypothesis, placing emphasis on exogeneity of economic growth. According to Dinda (2004), the review of existing literature on EKC fails to identify a turning point in the level of income after which CO_2 emissions start declining. The later study by Managi and Jena (2008) generally proves the EKC relationship in Indian economy during 1991–2003 and documents that higher economic development of the state corresponds to more rapid decline in emissions level. Similarly, the existence of inverted U-shaped relationship between GDP and CO_2 emissions is confirmed by Arouri et al. (2012) based on the analysis of the

MENA countries during 1981-2005. However, EKC hypothesis is not proved at sub-national level. It generally supports the EKC idea, but the threshold varies from county to country. In contrast Begum et al. (2015) find the evidence of convex relationship between observed variables in Malaysia from 1970 to 2009. These findings are based on the Dynamic Ordinary Least Squared (DOLS) and Sasabuchi–Lind–Mehlum U-test (SLM U test) results. General results suggest that GDP has positive impact on the level of CO_2 emission in the long-run. Apergis and Ozturk (2015) using Generalized Method of Moments (GMM) state that there is unidirectional causal relationship running from GDP growth to emissions level in 14 Asian countries during the period from 1990 to 2011 under the EKC hypothesis.

Another strand is suggested by Kraft and Kraft (1978) and concentrates on the relationships between economic growth and energy consumption. This relationship has four causal forms which are called "hypotheses" (Apergis and Payne, 2009a; Chen et al., 2007; Yoo, 2005; Jumbe, 2004; Shiu and Lam, 2004). The "growth hypothesis" documents the causal uni-directional relationship running from energy usage to economic performance. This nexus implies that change in the level of energy consumption have a significant impact on economic growth. In contrast, the "conservation hypothesis" exhibits uni-directional causal relationship running from GDP growth to energy usage. According to this hypothesis changes in energy consumption cannot affect economic performance (Gozgor et al., 2018). The "feedback hypothesis" implies two-way causal relationship between GDP growth and energy consumption. In this case any measures undertaken to reduce energy consumption will also cause a decline in economic growth and further new reduction in energy consumption (Dagher and Yacoubian, 2012; Wesseh and Zoumara, 2012; Zhixin and Xin, 2011). The "neutrality hypothesis" claims no causal relationship between economic growth and energy consumption. The vast number of studies tests these hypotheses using different approaches, samples and periods. Most of them report mixed results - causality directions differ from country to country over the same time period. According to Yildirim et al. (2014), analysis of ASEAN countries (Indonesia, Malaysia, the Philippines, Singapore and Thailand) during 1971-2009 identifies the uni-directional causal relationship, favoring the conservation hypothesis in Indonesia, Malaysia, the Philippines and Thailand by employing the Granger causality test. However, the authors don't observe any causal relationship in the case of Singapore. Using Arellano and Bover's (1995) GMM-SYS on the sample of 82 countries during 1972 -2002, Huang et al. (2008) demonstrate that there is no causal relationship between economic development and energy consumption in low-income countries while lower middle income, upper middle income, and high-income countries have a commitment to conservation hypothesis. Causality analysis of all countries included in the sample supports the feedback hypothesis. Similarly, Rezitis and Ahammad (2015) use the sample of nine South and Southeast Asian countries including Malaysia, Pakistan, Bangladesh, Brunei Darussalam, India, Indonesia the Philippines, Sri Lanka and Thailand during 1990-2012 to analyze the character of relationship between economic growth and energy consumption. Results of Granger causality test document the bi-directional nexus between variables among observed countries. However, the cases of Bangladesh, Brunei Darussalam, India, and Thailand prove the growth hypothesis. Malaysia and the Philippines support the general results, favoring the feedback hypothesis while Sri Lanka exhibits unidirectional causal relationship running from economic growth to energy usage.

The third and least developed strand underlines the income-energy-pollution nexus based on the first two more investigated income-emission and income-energy links. For example, using data on US economy during 1960-2004, Soytas et al. (2007) fail to identify causality in income-energy and income-emission models using Granger test. However, the results document the long-run causality between energy consumption and environmental degradation. Similarly, Soytas and Sari (2009), analyzing the sample of Turkey between 1960 and 2000, state the uni-directional relationship running from emissions to energy usage in the long-run. Granger test doesn't show any causality running from energy to income. More recent studies continue investigating the growth-energy-pollution nexus providing the evidences for different samples. According to Salahuddin and Gow (2014) there is positive bidirectional causal relationship between CO_2 emissions and energy consumption in both short- and long-run in Gulf Cooperation Council (GCC) countries during the period of 1980-2012. Thus, the Granger causality test results support conservation hypothesis; however, it doesn't identify any causal link between GDP growth and CO_2 emissions. Similarly, Esso and Keho (2016) document that economic growth causes CO_2 emissions in the short-run based on the evidence from Benin, Democratic Republic of Congo, Ghana, Nigeria and Senegal, applying Granger causality test. On the other hand, Gabon, Nigeria and Togo demonstrate causal relationship running from emissions level to economic growth. The bi-directional nexus between these variables is found in cases of Nigeria in the short-run and in Congo and Gabon in the long-run. Similarly, Benin, Congo, Cote d 'Ivoire, Gabon, Ghana, Nigeria, Senegal, South Africa and Togo show long run causality running from energy consumption and GDP growth to CO_2 emissions. The uni-directional nexus from economic growth to environmental degradation is found in Benin, Democratic Republic of Congo, Ghana and Senegal in the short-run.

Based on the observed literature, this paper aims to investigate growth-energy-pollution nexus. First, we describe the sample and present the empirical model. Further, we explain methodology and present empirical results. Based on empirical results, we finally provide policy recommendations.

2. DATA

To accomplish this study, we use secondary data on post-communistic countries during 1990-2018. The sample includes 26 post-communistic countries - Armenia, Azerbaijan, Bulgaria, Bosnia and Herzegovina, Belarus, Czech Republic, Estonia, Georgia, Croatia, Hungary, Kazakhstan, Kyrgyz Republic, Lithuania, Latvia, Moldova, Poland, Romania, Russian Federation, Serbia, Slovak Republic, Slovenia, Montenegro, Tajikistan, Turkmenistan, Ukraine and Uzbekistan. Annual data on GDP per capita and energy use was obtained from World Bank's World

Development Indicators while carbon dioxide emissions data was obtained from the Global Carbon Atlas.

To avoid the problems of non-linear modeling and heteroscedasticity and to obtain the growth rate of the relevant variables, all variables were transformed to natural logarithmic form (Salahuddin and Gow, 2014). Empirical model represented as:

$$\ln C = \alpha + \beta_1 \ln Y + \beta_2 \ln EU + \varepsilon \quad (1)$$

where C denotes carbon dioxide emissions per capita (metric tons), Y is GDP per capita (constant 2010 US$) and EU is energy use (kg of oil equivalent). Thus β_1 and β_2 coefficients represent elasticity estimates of CO_2 emissions with respect to energy use and GDP per capita.

Due to some empirical tests require strongly balanced data, the GDP per capita and energy use were extrapolated for missed values. Thus, the sample amounts for 728 observations. Table 1 depicts summary statistics as well as variables description.

3. METHODS AND RESULTS

According to Asteriou (2009), long-term parameters are usually expected to be cointegrated when working with time-series data. Pedroni (1999; 2004) emphasizes that cointegrating relationship exists for a set of variables that are individually integrated of order one, thereby stationarity test is imperative. In the level form, however, variables must exhibit stochastic trend, so that they can cointegrate in the long-term. Following Esso and Keho (2016), Salahuddin and Gow (2014), Arouri et al. (2012) we run panel unit-root test to check for the non-stationarity at levels and stationarity after first differencing. In line with Maji and Sulaiman (2019) and Inglesi-Lotz (2016), we employ IPS panel unit-root test, proposed by Im et al. (2003). Some noticeable advantages of IPS test are that it allows heterogeneity of the autoregressive parameter (rho), for different orders of serial correlation (Inglesi Lotz, 2016) as well as it follows normal Augmented Dickey Fuller averaging (Apergis and Payne, 2010b). Specification of the test is represented below:

$$y_{it} = \rho_i y_{i(t-1)} + \sigma_i x_{it} + \varepsilon_{it} \quad (2)$$

where x_{it} represent the combination of all the explanatory variables in the model; ρ_i denotes the autoregressive elasticities, ϵ_{it} is the residual term, i = 1,…N for each country and t=1,…T is the time period. The null hypothesis of the IPS test claims non-stationarity of the panels and testing procedure is based on *z-bar tilde* statistic.

However, there is an opinion that Fisher-type panel unit root tests provide more robust results if panels are exposed to cross-sectional dependence (Maddala and Wu, 1999). As a measure of robustness, we run Fisher type test, employing both Augmented Dickey Fuller and Phillips-Perron test statistics. The tests check for non-stationarity from a meta-analysis perspective, combining test statistics of each individual panel and producing overall test result. Similar to the IPS test, the null hypotheses of the Fisher-type test claims non-stationarity, while alternative assumes that at least one panel is stationary. According to Table 2, *ln* CO_2 and *ln Energy use* are formed by stationary process in both level and difference forms while *ln GDP per capita* is stationary after first differencing.

Following Gozgor et al. (2018) and Salahuddin and Gow (2014), long-term relationship between variables is tested

Table 1: Summary statistics

Indicator	ln C	ln Y	ln EU
	CO_2 emissions per capita (metric tons)	GDP per capita (constant 2010 US$)	Energy use (kg of oil equivalent)
Source	Global Carbon Atlas	WDI	WDI
Mean	1.507	8.466	7.584
Std. dev.	0.843	0.994	0.656
Min.	−1.233	5.901	5.647
Max.	3.09	10.199	8.676
N. of observations	728	728	728

Table 2: Panel unit root test results

Variable	Form	Method	Statistic	P-value	Conclusion
ln CO_2	Level	IPS	−5.496	0.000	Stationary
		Fisher-ADF	126.259	0.000	Stationary
		Fisher-PP	226.768	0.000	Stationary
	1st difference	IPS	−11.705	0.000	Stationary
		Fisher-ADF	260.859	0.000	Stationary
		Fisher-PP	436.163	0.000	Stationary
ln GDP per capita	Level	IPS	6.664	1.000	Non-stationary
		Fisher-ADF	34.378	0.972	Non-stationary
		Fisher-PP	39.992	0.888	Non-stationary
	1st difference	IPS	−7.995	0.000	Stationary
		Fisher-ADF	320.744	0.000	Stationary
		Fisher-PP	244.183	0.000	Stationary
ln Energy use	Level	IPS	−4.167	0.000	Stationary
		Fisher-ADF	91.316	0.000	Stationary
		Fisher-PP	192.418	0.000	Stationary
	1st difference	IPS	−13.193	0.000	Stationary
		Fisher-ADF	403.793	0.000	Stationary
		Fisher-PP	581.089	0.000	Stationary

by employing one-tailed Pedroni (1999) cointegration test. “The test statistics can be divided into two categories: group statistics that average the results of the individual country, and test statistics and panel statistics that pool the statistics along the within-dimension” (Neal, 2014). Pedroni’s cointegration test reports seven parametric and non-parametric test statistics which are v-statistic, panel rho-statistic, nonparametric panel PP-statistic, parametric panel ADF-statistic, group rho-statistic, nonparametric group PP statistic, and parametric group ADF-statistic. All of them follows standard normal distribution. The null hypothesis of no cointegration can be rejected in the favor of the alternative when the majority of tests exceed the critical value of approximately 1.28 (Neal, 2014). Additionally, we conduct Kao (1999) and Westerlund (2005) panel cointegration tests. Table 3 describes the results of Pedroni, Kao and Westerlund panel cointegration tests. According to Pedroni’s cointegration test, 6 out of 7 test statistics rejects the null hypothesis of no cointegration, confirming long-term cointegrating relationship between carbon emissions, economic growth and energy consumption. Similarly, Kao and Westerlund’s cointegration tests results support the alternative hypothesis of cointegration at 5% and 10% significance levels.

The shortcoming of Pedroni’s (1999) cointegration tests is that they do not differentiate estimates in short- and long-terms. Therefore, following Salahuddin and Gow (2014), we employ Pooled Mean Group estimator (PMG). PMG estimator, developed by Pesaran et al. (1999), is an alternative to estimation of separate regressions and fixed effects, which assumes homogeneous long-term coefficients. It constrains long-term coefficients to be homogeneous but allows heterogeneity in the short-term coefficients and error variances across groups. In post-communistic countries, some variables are likely to be impacted by long-term homogeneous conditions (e.g. historical legacies, previously common political system) while the short-term shifts are associated with country-specific characteristics such as geography and culture. Pesaran et al. (1999) describe the PMG estimator as the autoregressive distributed lag (ARDL) approach to long term modelling since its formed by reparameterization of ARDL model. The main feature of cointegrated variables is “their responsiveness to any deviation from long-run equilibrium”, which implies an error correction model (ECM), where deviation from equilibrium influences short-term dynamics of the variables (Blackburne and Frank, 2007). Thus, dynamic panel ARDL model reparametrized into the error correction equation:

Table 3: Pedroni, Kao and Westerlund panel cointegration tests results

	Statistics
V-stat	0.656
Panel rho-stat	−2.287**
Panel PP-stat	−4.369***
Panel ADF-stat	−0.485
Group rho stat	−1.63*
Group PP stat	−5.416***
Group ADF stat	−1.699**
Kao (ADF stat)	−2.323**
Variance ratio	4.529***

***, ** and * indicate significance at 1%, 5% and 10% levels, respectively

$$\Delta y_{it} = \phi_i \left(y_{i,t-1} - \theta_i^{'} X_{it} \right) + \sum_{j=1}^{p-1} \lambda_{i,j}^{*} \Delta y_{i,t-1} + \sum_{j=0}^{q-1} \delta_{ij}^{'*} \Delta X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (3)$$

where, in our case, y_{it} is CO_2 emissions, $x_i s$ are independent variables (energy use and economic growth), $\lambda_{i,j}^{*}$ and $\delta_{ij}^{'*}$ are the short-term coefficients, $\theta_i^{'}$ is the long-term coefficient, μ_i group specific effects and ϵ_{it} stochastic error term.

PMG estimates suggest that there is positive and highly significant long-term relationship between energy use and CO_2 emissions (Table 4). Moreover, energy use is positive and significant (at 5%) short-term effect on CO_2 emissions. The coefficient of per capita GDP is positive and significant in the short-, but insignificant in the long-term. The error correction term in the short-term is approximately −0.24 meaning that 24% of the long-term disequilibrium dissipated before the next time period.

Once the long-term relationship is confirmed, we proceed to identify the direction of causality by using the panel Granger non-causality test for heterogeneous panel data models proposed by Dumitrescu and Hurlin (2012). The standard model is presented below, where $y_{i,t}$ and $x_{i,t}$ are observations of two stationary variables for individual i in period t.

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_{ik} y_{i,t-k} + \sum_{k=1}^{K} \beta_{ik} x_{i,t-k} + \varepsilon_{i,t} \quad (4)$$

The test is based on the individual Wald statistics and the null hypothesis of non-causal relationship is tested by *z-bar* and *z-bar tilde* statistics. It considers fixed coefficients and takes into account heterogeneity of the regression model and causal relationship (Salahuddin and Gow, 2014). Lopez and Weber (2017) suggest to rely on *z-bar tilde* statistic when both number of panels (N) and time period (T) are small. Lag order selection is based on an information criterion (AIC), as suggested by Chang et al. (2015) and Lopez and Weber, 2017. Panel Granger causality results are reported in Table 5. The findings suggest bidirectional causal relationship between carbon dioxide emissions and energy use, supporting the findings of Salahuddin and Gow (2014). Moreover, bidirectional link is also observed between carbon dioxide emissions and economic growth. No causal link is found between economic growth and energy use in the post-communistic countries.

Table 4: Pesaran’s pooled mean group estimator results

Δ ln CO_2 emissions (dependent variable)	Pooled mean group	
Variable	Coefficient	Standard error
Long-term coefficients		
ln GDP per capita	0.009 (0.449)	0.013
ln Energy use	0.953*** (0.000)	0.034
Error correction term	−0.236*** (0.000)	0.058
Δ ln GDP per capita	0.219** (0.026)	0.099
Δ ln Energy use	0.649*** (0.000)	0.103
Intercept	−1.407*** (0.000)	0.339

***, ** and * indicate significance at 1%, 5% and 10% levels, respectively. While figures in parentheses are P-values

Table 5: DH granger non-causality test results

Dependent variable	Independent variables					
	ln CO_2 emissions	prob.	ln Energy use	prob.	ln GDP per capita	prob.
ln CO_2 emissions	-	-	9.685***	0.000	5.24***	0.000
ln Energy use	13.749***	0.000	-	-	−0.108	0.914
ln GDP per capita	8.3***	0.000	0.594	0.553	-	-

***, ** and * indicate significance at 1%, 5% and 10% levels, respectively. While figures in parentheses are P-values

4. CONCLUSION

Thus, this paper explores the empirical relationship between carbon dioxide emissions, economic growth and energy use in post-communistic countries during 1990-2018. Pedroni's (1999) panel cointegration test discovered cointegrating relationship between the variables. To distinguish short- and long-term effect, as well as to account for homogeneity caused by previous common socio-political system and current country specific characteristics, Pesaran's (1999) Pooled Mean Group estimator is employed. PMG estimates identified short- and long-term relationship between energy use and CO_2 emissions and short-term relationship between CO_2 emissions and economic growth. Finally, the Dumitrescu and Hurlin's (2012) Granger non-causality test for heterogeneous panels revealed bidirectional causality between CO_2 emissions, energy use and economic growth.

The policy implications of this research are the following. Policies that encourage energy consumption use do not affect economic growth but environment. Thus, energy conservation measures should not impact the economic progress of post-Communist states. On the contrary, our results indicate that pollution reduction policies should impact economic growth. Adopting renewable energy strategies may mitigate pollution without hampering economic growth. Moreover, the impact of economic growth on pollution diminishes in the long-run. Consequently, if government adopt policies to mitigate climate change policies to decrease greenhouse gas emissions by 2050 would not hamper growth prospects. At the same time, any measures aimed at fostering economic growth should be carefully instituted as they might have environmental impacts.

To conclude, prospective studies should assess the link between energy use, economic growth and environment using sub-national data. For example, there is significant variation in CO_2 emissions across regions of Russia. In a similar vein, in Uzbekistan the difference in air pollution between highest air polluting region (Tashkent region) and the lowest (Surkhandarya) in 2018 was more than 5-fold.

REFERENCES

Ang, J.B. (2008), Economic development, pollutant emissions and energy consumption in Malaysia. Journal of Policy Modeling, 30(2), 271-278.

Apergis, N., Ozturk, I. (2015), Testing environmental Kuznets Curve hypothesis in Asian countries. Ecological Indicators, 52, 16-22.

Apergis, N., Payne, J.E. (2009), CO_2 emissions, energy usage, and output in Central America. Energy Policy, 37(8), 3282-3286.

Arellano, M., Bover, O. (1995), Another look at the instrumental variable estimation of error-components models. Journal of Econometrics, 68(1), 29-51.

Arouri, M.E.H., Youssef, A.B., M'Henni, H., Rault, C. (2012), Energy consumption, economic growth and CO_2 emissions in Middle East and North African countries. Energy Policy, 45, 342-349.

Asteriou, D. (2009), Foreign aid and economic growth: New evidence from a panel data approach for five South Asian countries. Journal of Policy Modeling, 31(1), 155-161.

Begum, R.A., Sohag, K., Abdullah, S.M.S., Jaafar, M. (2015), CO_2 emissions, energy consumption, economic and population growth in Malaysia. Renewable and Sustainable Energy Reviews, 41, 594-601.

Blackburne, E.F., Frank, M.W. (2007), Estimation of non-stationary heterogeneous panels. The Stata Journal, 7(2), 197-208.

Chang, T., Gadinabokao, O.A., Gupta, R., Inglesi-Lotz, R., Kanniah, P., Simo-Kengne, B.D. (2015), Panel granger causality between oil consumption and GDP: Evidence from BRICS countries. International Journal of Sustainable Economy, 7(1), 30-41.

Chen, S.T., Kuo, H.I., Chen, C.C. (2007), The relationship between GDP and electricity consumption in 10 Asian countries. Energy Policy, 35(4), 2611-2621.

Dagher, L., Yacoubian, T. (2012), The causal relationship between energy consumption and economic growth in Lebanon. Energy Policy, 50, 795-801.

De Bruyn, S.M., Opschoor, J.B. (1997), Developments in the throughput-income relationship: Theoretical and empirical observations. Ecological Economics, 20(3), 255-268.

Dinda, S. (2004), Environmental Kuznets Curve hypothesis: A survey. Ecological Economics, 49(4), 431-455.

Dumitrescu, E.I., Hurlin, C. (2012), Testing for Granger non-causality in heterogeneous panels. Economic Modelling, 29(4), 1450-1460.

Esso, L.J., Keho, Y. (2016), Energy consumption, economic growth and carbon emissions: Cointegration and causality evidence from selected African countries. Energy, 114, 492-497.

Gozgor, G., Lau, C.K.M., Lu, Z. (2018), Energy consumption and economic growth: New evidence from OECD countries. Energy, 153, 27-34.

Grossman, G.M., Krueger, A.B. (1991), Environmental Impacts of a North American Free Trade Agreement, No. W3914. Cambridge, Massachusetts: National Bureau of Economic Research.

Halicioglu, F. (2009), An econometric study of CO_2 emissions, energy consumption, income and foreign trade in Turkey. Energy Policy, 37(3), 1156-1164.

Heil, M.T., Selden, T.M. (1999), Panel stationarity with structural breaks: Carbon emissions and GDP. Applied Economics Letters, 6(4), 223-225.

Huang, B.N., Hwang, M.J., Yang, C.W. (2008), Causal relationship between energy consumption and GDP growth revisited: A dynamic panel data approach. Ecological Economics, 67(1), 41-54.

Hung, M.F., Shaw, D. (2004), Economic growth and the environmental Kuznets Curve in Taiwan: A simultaneity model analysis. In: Human Capital, Trade, and Public Policy in Rapidly Growing Economies: From Theory to Empirics. Cheltenham: Edward Elgar Publishing. p269.

Im, K.S., Pesaran, M.H., Shin, Y. (2003), Testing for unit roots in heterogeneous panels. Journal of Econometrics, 115, 53-74.

Inglesi-Lotz, R. (2016), The impact of renewable energy consumption to economic growth: A panel data application. Energy Economics, 53, 58-63.

Jumbe, C.B. (2004), Cointegration and causality between electricity consumption and GDP: Empirical evidence from Malawi. Energy Economics, 26(1), 61-68.

Kao, C. (1999), Spurious regression and residual-based tests for cointegration in panel data. Journal of Econometrics, 90, 1-44.

Kraft, J., Kraft, A. (1978), On the relationship between energy and GNP. The Journal of Energy and Development, 3(2), 401-403.

Lopez, L., Weber, S. (2017), Testing for Granger causality in panel data. The Stata Journal, 17(4), 972-984.

Maddala, G.S., Wu, S. (1999), A comparative study of unit root tests with panel data and a new simple test. Oxford Bulletin of Economics and Statistics, 61(S1), 631-652.

Maji, I.K., Sulaiman, C. (2019), Renewable energy consumption and economic growth nexus: A fresh evidence from West Africa. Energy Reports, 5, 384-392.

Managi, S., Jena, P.R. (2008), Environmental productivity and Kuznets Curve in India. Ecological Economics, 65(2), 432-440.

Neal, T. (2014), Panel cointegration analysis with xtpedroni. The Stata Journal, 14(3), 684-692.

Pedroni, P. (1999), Critical values for cointegration tests in heterogeneous panels with multiple regressors. Oxford Bulletin of Economics and Statistics, 61, 653-670.

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.

Rezitis, A.N., Ahammad, S.M. (2015), The relationship between energy consumption and economic growth in South and Southeast Asian countries: A panel VAR approach and causality analysis. International Journal of Energy Economics and Policy, 5(3), 704-715.

Salahuddin, M., Gow, J. (2014), Economic growth, energy consumption and CO_2 emissions in Gulf Cooperation Council countries. Energy, 73, 44-58.

Shiu, A., Lam, P.L. (2004), Electricity consumption and economic growth in China. Energy Policy, 32(1), 47-54.

Soytas, U., Sari, R. (2009), Energy consumption, economic growth, and carbon emissions: Challenges faced by an EU candidate member. Ecological Economics, 68(6), 1667-1675.

Soytas, U., Sari, R., Ewing, B.T. (2007), Energy consumption, income, and carbon emissions in the United States. Ecological Economics, 62(3-4), 482-489.

Stern, D.I. (2004), The rise and fall of the environmental Kuznets Curve. World Development, 32(8), 1419-1439.

Unruh, G.C., Moomaw, W.R. (1998), An alternative analysis of apparent EKC-type transitions. Ecological Economics, 25(2), 221-229.

Wesseh, P.K. Jr., Zoumara, B. (2012), Causal independence between energy consumption and economic growth in Liberia: Evidence from a non-parametric bootstrapped causality test. Energy Policy, 50, 518-527.

Yildirim, E., Aslan, A., Ozturk, I. (2014), Energy consumption and GDP in ASEAN countries: Bootstrap-corrected panel and time series causality tests. The Singapore Economic Review, 59(2), 1450010.

Yoo, S.H. (2005), Electricity consumption and economic growth: Evidence from Korea. Energy Policy, 33(12), 1627-1632.

Zhang, X.P., Cheng, X.M. (2009), Energy consumption, carbon emissions, and economic growth in China. Ecological Economics, 68(10), 2706-2712.

Zhixin, Z., Xin, R. (2011), Causal relationships between energy consumption and economic growth. Energy Procedia, 5, 2065-2071.