Print ISSN: 2288-4637 / Online ISSN 2288-4645
doi:10.13106/jafeb.2021.vol8.no2.0801

The Relationships between CO_2 Emissions, Economic Growth and Life Expectancy*

Uma MURTHY[1], Mohd Shahidan SHAARI[2], Paul Anthony MARIADAS[3], Noorazeela Zainol ABIDIN[4]

Received: October 01, 2020 Revised: December 06, 2020 Accepted: January 15, 2021

Abstract

The issue of the relationship between environmental degradation and human health has been widely addressed by medical doctors. However, economists have sparsely debated it. The release of carbon dioxide (CO_2) into the air can cause several environmental problems and, thus, it can affect human health. Therefore, it is imperative to examine the effect of CO_2 emissions on life expectancy in the D-8 countries (Malaysia, Indonesia, Bangladesh, Nigeria, Egypt, Iran, Pakistan, and Turkey) from 1992 to 2017. The panel ARDL method is employed and, then, the PMG estimator is selected. The results show that economic growth, population growth and health expenditure can significantly and positively affect life expectancy, but CO_2 emissions can have a significant and negative effect on life expectancy. Since, the major findings reveal that life expectancy can be explained by CO_2 emissions. Hence, it is important to formulate policies on reducing CO_2 emissions so that life expectancy will not be affected. Energy diversification policies should be formulated or improved in some countries. This is to ensure that the countries are not highly dependent on non-renewable energy that can harm the environment. The government should increase its expenditure on the health sector to save more lives by extend human lifespan.

Keywords: Life Expectancy, CO_2 Emissions, Economic Growth

JEL Classification Code: J11, Q53, O44

1. Introduction

A large number of researchers have delved into the linkage between energy use and economy growth. It cannot be denied that economic growth entails energy consumption. Therefore, the main factor of production other than capital and labor is energy. Esen and Bayrak (2017) stated that energy consumption can spur the economy to growth.

Besides, energy regardless of its types whether renewable or non-renewable plays an important role in boosting the economy. Output in all sectors such as industries, agriculture and transportation are dependent on energy. However, energy sources such as oil, gas and coal can be exhausted and, thus, its supply remains inconsistent. The scarcity of energy can set alarm bells ringing as it can pose an enormous challenge and thus every country finds it hard to manage the resource efficiently. Even worse, it takes billions of years to form the resource. Hence, economists are worried if there is a shortage of energy as it can affect economic growth.

As economic growth increases, life expectancy will rise. The issue of life expectancy has come to the fore and merited attention from a small number of researchers. Life expectancy has been said to be highly dependent on government expenditure on health and economic growth. Several studies, for example, Shkolnikov et al. (2019), Kim (2020), Afroz et al. (2020), and Shafi and Fatima (2019), ascertained that income per capita is inextricably associated with life expectancy. Poverty can serve as a

***Acknowledgements:**
This research was funded by Ministry of Higher Education, Malaysia.
[1]First Author. Lecturer, Faculty of Business, Social Sciences and Hospitality Management, SEGi University, Kota Damansara, Malaysia. Email: umamurthy@segi.edu.my
[2]Corresponding Author. Senior Lecturer, Faculty of Applied and Human Sciences, Universiti Malaysia Perlis, Malaysia [Postal Address: Pengkalan Jaya, Jalan Alor Setar - Kangar, 01000 Kangar, Perlis, Malaysia] Email: shahidanshaari@gmail.com
[3]Lecturer, Faculty of Business, Social Sciences and Hospitality Management, SEGi University, Kota Damansara, Malaysia. Email: paulanthonydas@segi.edu.my
[4]Senior Lecturer, Faculty of Applied and Human Sciences, Universiti Malaysia Perlis, Malaysia. Email: noorazeela@unimap.edu.my

stumbling block for better life expectancy. This is because poor countries have less access for healthy food and, thus, it can contribute to their lower life expectancy. This implies that life expectancy will increase if income per capita rises. Therefore, high-income countries usually have longer life expectancy compared to low-income countries. Furthermore, a rise in GDP per capita can lead to a decrease in the death rate and thus higher population growth ensues. However, Ilegbinosa (2014) argued that higher population growth is not necessarily good as it can hinder economic development. This is the reason why China has controlled its population growth. Higher population growth can result in excess supply of labor. Consequently, wages will drop and thus the poverty rate will be on the rise.

The issue becomes complex when energy consumption is increased to boost economic growth can be detrimental to life expectancy. Previous literature has investigated the relationship between energy consumption and life expectancy. Households are exposed to numerous health problems if there is an increasing amount of harmful energy consumption such as coal and oil. Youssef (2016) believed that clean energy plays an important role in determining life expectancy. Melody and Johnston (2015) added that coal combustion can cause lung and esophageal cancer. Producing and even consuming energy can have negative impacts on the environment through air and water pollution. Energy comprises coal, oil, gas and electricity. The types of energy can produce hazardous emissions, such as carbon dioxide (CO_2) and carbon monoxide (CO). The process of producing energy, such as burning, is harmful to the environment as it involves chemical reactions with oxygen in the air. It releases CO_2 and, thus, affects the environment. Hence, global warming occurs. Subsequently, it results in a reduction of snow and sea ice, a higher of sea and coastal flooding. A warmer climate can prompt extinction in many animal species living on earth. Increasing global temperatures can also affect human as it triggers health risks such as mental illness and cancers and thus life expectancy can be reduced. Therefore, it is important to use renewable energy such as biomass and solar to replace non-renewable energy in a bid to reduce environmental problems, and therefore life expectancy can be improved.

While previous studies have addressed the relationship between energy consumption and life expectancy, they did not lay emphasis on the direct impact of CO_2 emissions on life expectancy. Wang et al. (2020) examined the effect of total energy consumption on life expectancy. However, the study still falls short due to the fact that energy consumption includes non-renewable and renewable energy. Only non-renewable energy can release CO_2 emissions and, thus, directly affect human health. Therefore, this study embarks on an investigation into the impact of CO_2 emissions on life expectancy. This study focuses on the D-8 countries as the economy of the countries has been increasing rapidly. The majority of the total population is Muslim. The average life expectancy for D-countries is 69.5 years with most of the countries reaching more than 70 years except for Nigeria. Nigeria has the shortest life expectancy among the D-8 countries, despite the country being ranked the second lowest in terms of CO_2 emissions. Turkey has the longest life expectancy among the countries. The issue of environmental degradation has come to the fore in the D-8 countries due to a marked increase in total CO_2 emitted. Figure 1 shows total CO_2 emissions in the D-8 countries (Bangladesh, Egypt, Indonesia, Iran, Malaysia, Nigeria, Pakistan & Turkey) over a period of 10 years. Total CO_2 emissions for all of the countries exhibited a steady increase from 2008 to 2017 with the largest increase of 14.4% in 2017. Iran was the largest emitter of CO_2 emissions among the D-8 countries in 2017, followed by Indonesia and Turkey. Bangladesh made up the smallest share of total CO2 emissions. Even though Turkey was the largest economy among the countries, Turkey was not the largest emitter.

2. Literature Review

Due to a very limited number of previous studies on the effect of energy consumption or environmental degradation on CO_2 emissions, we conduct a review of literature on life expectancy with respect to several perspectives: the relationship between economic growth and life expectancy, the effect of energy consumption on CO_2 emissions, the effect of energy consumption on life expectancy and the effect of environmental degradation on life expectancy. Several previous studies investigated the relationship running either from economic growth to life expectancy or the other way around. Lorentzen et al. (2008) as well as Ngangue and Manfred (2015) examined the impact of economic growth on life expectancy in various countries. However, Ngangue and Manfred (2015) focused on 141 developing countries by employing the generalized method of moments (GMM). Data on life expectancy and GNI per capita from 2000 to 2013 were collected. The results showed that life expectancy can increase economic growth.

However, Kunze (2014) found that life expectancy will reduce economic growth due to a rising number of people aged more than 60 years old. Their productivity depreciates, but health expenditure escalates (Shafi & Fatima, 2019). Studies on the effect of economic growth on life expectancy remain sparse. For example, Luo and Xie (2020) conducted their study in China using data ranging from 1960 to 2010. The results disclosed that higher economic growth can increase life expectancy, but higher income inequality can reduce life expectancy. Wang et al. (2020) also found a positive effect of economic growth on life expectancy in Pakistan.

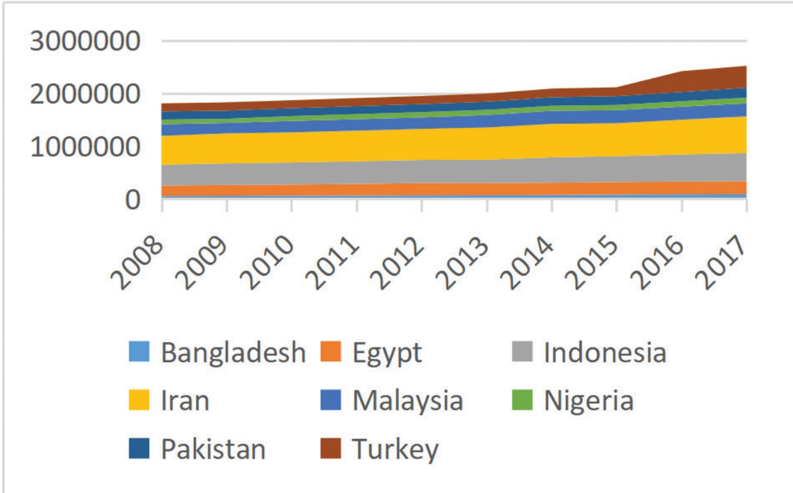

Figure 1: Total CO_2 emissions in the D-8 countries (ktons)

Source: countryeconomy.com

Another perspective is the effect of energy consumption on CO_2 emissions. It has been tenable and evidenced by a vast array of previous literature (Khan et al., 2020; Shaari et al., 2020; Sasana & Putri, 2018; Albiman et al., 2015; Alkhathlan et al., 2012; Islam et al., 2017). Various methods have been conducted and the results are consistent that energy consumption can contribute to environmental degradation. For example, Albiman et al. (2015) investigated the dynamic association between energy consumption, economic growth and emissions from 1975 to 2013 in Tanzania. The study conducted several tests such as Toda and Yamamoto non-Causality and Variance Decomposition and the finding suggested that economic growth and energy consumption can influence CO_2 emissions. Sasana and Putri (2018) supported the findings of Albiman et al. (2015), however the OLS approach was employed to analyze data from 1990 to 2014 in Indonesia. The results also showed that fossil energy consumption and population growth can positively affect the environment. In addition, renewable energy consumption was found to conserve the environment. Khan et al. (2020) and Alkhathlan et al. (2012) employed the ARDL approach to examine the relationship between energy consumption, economic growth and CO_2 emissions. Khan et al. (2020) focused on Pakistan while Alkhathlan et al. (2012) focused on the USA and Saudi Arabia. Both of the studies obtained similar results that energy consumption can contribute to CO_2 emissions in the respective countries.

Khan et al. (2019) and Shaari et al. (2020) divided energy into several types (oil, gas and coal) and found that energy consumption can contribute to environmental degradation. Khan et al. (2019) proved the results in Pakistan while Shaari et al. (2020) in OECD countries. Shaari et al. (2020) used the panel ARDL and expounded that the effect of oil on the environment is larger than the effect of gas consumption. Energy has been divided into renewable and non-renewable energy by Amri (2017). This is to prove that non-renewable energy consumption can be harmful to the environment.

Sarkodie et al. (2019) and Wang et al. (2020) examined several determinants of life expectancy, such as economic growth and energy consumption. Wang et al., (2020) included financial development as a potential determinant. They conducted their study in Pakistan and used the autoregressive distributed lag (ARDL) method to analyze data from 1972–2017. The results revealed that higher energy consumption and financial development can reduce life expectancy. This is because energy consumption contributes to higher environmental degradation. Besides, economic growth plays an important role in determining life expectancy in Pakistan. Sarkodie et al. (2019) employed the generalized least squares (GLS) random-effects. The results based on data ranging from 2000 to 2016 showed that an increase in energy consumption can lead to higher CO_2 emissions, and thus reduce life expectancy in 54 countries. Higher income, on the other hand can increase the mortality rate. Based on the review of previous literature, it can be understood that none of previous studies focused on the effects of CO_2 emissions. Therefore, it is imperative to fill the gap.

3. Methodology

3.1. Data

Secondary data from the year 1992 to 2017 were utilized in this study. The World Bank website was accessed to gather the data involving life expectancy and real gross domestic product (GDP), whereas the country economy website was reached to gather the data on CO_2 emissions.

3.2. Model Specification

Pooled cross-sectional data were applied to examine the extent to which life expectancy, real GDP, and CO_2 emissions are related to one another. This yields the following equation:

$$\text{LE} = f\left(\text{GDP, CO}_2\text{, HE, P}\right) \quad (1)$$

Where LE denotes life expectancy, GDP denotes real GDP per capita, HE represents health expenditure (5 of GDP), *P* represents the population, and CO_2 represents CO_2 emission. Time-varying explanatory variables were employed in this analysis with CO_2 as the key variable. Stemmed from the data accessed from 1995 to 2017, the variables were chosen relative to D-8 countries involving Malaysia, Turkey, Indonesia, Pakistan, Bangladesh, Iran, Egypt, and Nigeria. Through a panel data analysis, some tests were conducted such as panel unit root tests and dynamic heterogeneous panel estimations that include dynamic fixed-effect (DFE), pooled mean group (PMG), and mean group (MG). The specification of the model is expressed as follows:

$$\text{lnLE}_{\text{it}} = \beta_0 + \beta_1\text{lnGDP}_{\text{it}} + \beta_2\text{lnCO}_{2\text{it}} + \beta_3\text{lnHE}_{\text{it}} + \beta_4\text{lnP}_{\text{it}}\varepsilon_{\text{it}} \quad (2)$$

Where Equation (1) expresses and defines E, GDP, and CO_2. In reference to the model above, the constant term is denoted by β_0, whereas the estimated parameters of the model are represented by β_1, β_2, β_3, and β_4. The cross-sectional data of the selected countries are denoted by *i*, with t representing the time span (years), and the error term is denoted by ε_{it}. Subsequently, the variables were interpreted into a log form.

3.3. Panel Unit Root Tests

All of the selected variables in this study underwent panel unit root tests to prevent spurious regression upon the application of the panel data. The reason is that, when Augmented Dickey-Fuller (ADF) is applied, the low power problem can thus be solved. As the unit root test has low power since less than 50 observations were used in time-series studies, the reliability of the estimation is, therefore, questionable. Correspondingly, this can be overcome by panel unit root tests due to its standard asymptotic distribution in addition to having more power. Hence, instead of the time series unit root tests, this study would opt for the LLC (Levin, Lin, and Chu) and IPS (IM, Pesaran, and Shin) unit root tests owing to their effectiveness.

3.4. Panel Estimation

The panel ARDL approach is employed in this study and it is the most appropriate method as it can capture the long-term effect of CO_2 emissions on life expectancy. Chris Lim (2019) stated that humans are exposed to the long-term effects of air pollution. The approach consists of three main estimators, namely PMG, MG, and DFE. While the long-term slope coefficient is confined to homogeneity, the PMG estimator is likely to include a short-term estimate towards heterogeneity along with the error variance, the adjustment speed, and the intercept. Despite the efficiency and consistency of this method in allowing for a long-term relationship, it is imperative that the coefficient of the error correction is negative and does not exceed 2. Additionally, a critical assumption of the estimation consistency is crucial for preventing exogeneity in the explanatory variables as well as serial correlation in the residual of the error correction model. The conditions are met once the lags (*p*, *q*) are structured per the dependent (*p*) and independent (*q*) variables. This method also expects *T* and *N* to be large in that *T* should be larger than *N*. The second estimator, MG, enables separate regressions for each country and respective coefficient (Pesaran et al., 1999). This estimator is capable of producing heterogeneous coefficients for each country in the long and short-run despite its slight difference from PMG since it is not confined to the estimator's procedures. The third estimator, dynamic fixed effect (DFE), is the same as the PMG estimator in that it limits the coefficient of vector co-integration to be the same among all long-term panels. DFE also limits the adjustment speed; thus, it produces similar short-term coefficients and enables a specific panel coefficient. The expression below denotes the long-term relationship models involving MG:

$$\begin{aligned}\text{lnLE}_{it} &= \theta_{\text{i}} + \delta_{0i}\text{lnLE}_{t-1} + \delta_{1\text{i}}\text{lnGDP}_{it} + \delta_{2i}\text{lnCO}_{2it} \\ &\quad + \delta_{3i}\text{lnHE}_{it} + \delta_{4i}\text{lnP}_{it} + \varepsilon_{it} \quad (3)\end{aligned}$$

The following expression entails the long-term relationship models involving PMG and DFE:

$$\begin{aligned}\text{InLE}_{it} &= \mu_i + \sum\nolimits_{j=1}^{p} \lambda_{ij}\text{InE}_{t-j} + \sum\nolimits_{j=1}^{q} \delta_{1ij}\text{InGDP}_{it-j} \\ &\quad + \sum\nolimits_{j=1}^{q} \delta_{2ij}\text{InCO}_{2it-j} + \sum\nolimits_{j=1}^{q} \delta_{3ij}\text{InHE}_{it-j} \\ &\quad + \sum\nolimits_{j=1}^{q} \delta_{4ij}\text{InP}_{it-j} + \varepsilon_{it} \quad (4)\end{aligned}$$

The countries (1, 2, 3, …., 8) are denoted by *i*, while time (1992–2017) is denoted by *t*, and the optimum time lag is denoted by j, while the fixed effect is denoted by μ_i.

The expression below indicates the short-term relationship involving the error correction models:

$$\Delta \ln E_{it} = \mu_i + \varphi_i(\ln LE_{t-1} - \lambda_1 \ln GDP_{it} - \lambda_2 \ln CO2_{it} + \sum_{j=1}^{p}\lambda_{ij}\ln E_{t-j} + \sum_{j=1}^{q}\delta_{1ij}\ln GDP_{it-j} + \sum_{j=1}^{q}\delta_{2ij}\ln CO2_{it-j} + \sum_{j=1}^{q}\delta_{3ij}\ln HE_{it-j} + \sum_{j=1}^{q}\delta_{4ij}\ln P_{it-j} + \mu_{it} \quad (5)$$

3.5. Hausman Test

The Hausman test used in this study is crucial for the selection between PMG or MG and PMG or DFE. As such, the acceptance or rejection of the null hypothesis between PMG and MG implies that PMG is more favorable than MG, or MG is more favorable than PMG, respectively. On the other hand, the acceptance or rejection of the null hypothesis between PMG and DFE indicates that PMG is more favorable than DFE, or DFE is more favorable than PMG, respectively.

4. Results

Table 1 shows the results of the LLC and IPS unit root tests. The results of the LLC test reveal that at the level, only $\ln CO_2$ is significant while lnLE, lnGDP, lnHE and lnP are not significant. However, at the first difference, all of the variables are significant. This indicates that all of the variables are stationary and thus we fail to reject the alternative hypothesis. To confirm the results of the LLC test, the IPS test is conducted and the results also show that all of the variables are not significant or not stationary at the level. On the other hand, all of the variables are significant at the first difference. Therefore, the ARDL approach can be used in this study.

Table 2 shows the results of variance inflation factor (VIF). VIF is used to measure whether there is multicolinearity in a set of variables used. The results show that all values of VIF are lower than 10. This indicates that there is no multicolinearity, thus Model 2 can be regressed using the panel ARDL approach.

Table 3 shows the results of panel ARDL (1,1,1,1,1) using three estimators (PMG, MG and DFE). The Hausman test is conducted to choose either PMG or MG. The probability value is insignificant and thus PMG is better than MG. The Hausman test is conducted again to determine which estimator is better: whether PMG or DFE. The results show that the probability value is higher than the significance level of 5%. Therefore, the PMG estimator will be selected in this study. Based on the PMG estimator, lnGDP can have a significant impact on lnE in the long run in the D-8 countries. The coefficient value is 0.0266. This indicates that a 1% increase in real GDP per capita will increase life expectancy by 0.03%. The results obtained are consistent with the results of the other estimators, namely MG and DFE. In addition, $\ln CO_2$ can also have a significant and negative impact on lnLE using the PMG estimator. The coefficient value is -0.009. This indicates that a 1% increase in CO_2 emissions can reduce life expectancy by 0.01%. The results are supported by the results of the DFE estimators. The results also show that lnP can influence lnLE. The coefficient value is 0.2648. This suggests that a 1% increase in the population can cause life expectancy to increase by 0.26%. These findings are similar to the findings obtained from the DFE estimator. Other than that, lnHE can positively and significantly affect lnLE with a coefficient value of 0.0254. This means that a 1% rise in health expenditure as a percentage of GDP can result in a 0.03% rise in life expectancy. These results are supported by the results of the DFE and MG estimators.

Table 2: Variance Inflation Factor Results

Variable	VIF	1/VIF
lnCO2	3.00	0.3337
lnGDP	2.65	0.3775
lnHE	2.33	0.4295
lnP	1.99	0.5037
Mean VIF	2.49	

Table 1: Unit Root Results

Variable	LLC		IPS	
	Level	1st Difference	Level	1st Difference
lnLE	1.90915	–12.3407***	–1.37923*	–10.0316***
lnGDP	2.07420	–1.95025**	4.90428	–3.55095***
lnHE	–0.04524	–4.60511***	0.78621	–5.70004***
lnP	1.13071	–8.94584***	5.45424	–6.24854***
$\ln CO_2$	–2.78160***	–3.28703***	0.80474	–3.69330***

Note: *** and ** indicate the significance levels of 1% and 5%, respectively.

Table 3: Estimation Results

Variable	PMG		MG		DFE	
	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
lnGDP	0.0266***	0	0.0631 ***	0.002	0.1650***	0
lnP	0.2648***	0	–0.0595	0.736	0.3186***	0
$\ln CO_2$	–0.0090***	0	0.0333	0.464	–0.1707***	0
lnHE	0.0254***	0	0.0300***	0.002	0.02713***	0.026
Hausman test	1.02	0.906			0	1

Note: *** indicates the significance levels of 5%.

Table 4: Robustness Checks Results

Variable	FMOLS		DOLS	
	Coefficient	Prob.	Coefficient	Prob.
lnGDP	0.0200***	0	0.0812***	0
lnP	0.2889***	0	0.1152***	0
$\ln CO_2$	-0.0076**	0.0245	-0.0114*	0.064
lnHE	0.0035***	0.0003	0.0221***	0

Note: *** and * indicate the significance levels of 1% and 10%.

This study also conducts some robustness checks to ensure that the results obtained are consistent. Table 4 shows the results of FMOLS and DOLS. Based on the FMOLS analysis, it is found that lnGDP can have a significant and positive effect on lnE in the D-8 countries. This indicates that a 1% increase in GDP per capita will increase life expectancy by 0.02%. These results are supported by the results of DOLS. In contrast, $\ln CO_2$ has a negative effect on lnE. This suggests that a 1% increase in CO_2 emissions will reduce life expectancy by 0.001%. The DOLS estimation also shows similar results. Besides, lnP can also significantly and positively affect lnE. A 1% rise in the population can result in a 0.289% rise in life expectancy. These results are consistent with the results of DOLS. Other than that, lnHE can also have a positive and significant effect on life expectancy and this is supported by the results of DOLS.

5. Conclusion

The aim of this study is to examine the impact of CO_2 emissions on life expectancy in the D-8 countries, namely, Malaysia, Indonesia, Bangladesh, Nigeria, Egypt, Iran, Pakistan, and Turkey. Data ranging from 1992 to 2017 were collected and analyzed using the panel ARDL approach. This approach comprises three estimators, namely, MG, PMG and DFE. PMG is selected over the other two estimators. The results show that economic growth plays an important role in determining life expectancy. Furthermore, an increase in economic growth can increase the average number of years that people live in the D-8 countries. These findings are supported by Shkolnikov et al. (2019). Besides, CO_2 emissions can affect life expectancy in those countries. Higher environmental degradation can reduce the average number of years that people live. These findings are similar to the results of Erdoğan et al. (2019). Apart from that, the results also show that health expenditure and population growth can help improve life expectancy. This means that, when the government spends more money on the health sector, it can save more lives and extend the human lifespan. Population growth implies that the mortality rate is low, and thus, life expectancy can be increased.

These findings are important for policymakers to formulate the right policy pertaining to CO_2 emissions. Due to the fact that environmental degradation can affect life expectancy, the countries should use more renewable energy such as solar, biogas and biodiesel. This can reduce the amount of CO_2 released into the air and thus save the environment. Other than that, the use of green technology in production can also reduce environmental degradation. The government should increase its expenditure on the health sector to save more lives and, thus, extend the human lifespan. Increasing the number of medical staff members can also increase life expectancy.

References

Afroz, R., Muhibbullah, M., & Morshed, M. N. (2020). Impact of information and communication technology on economic growth and population health in Malaysia. *The Journal of Asian Finance, Economic, and Business*, *7*(4), 155–162. https://doi.org/10.13106/jafeb.2020.vol7.no4.155

Albiman, M. M., Suleiman, N. N., Baka, H. O. (2015). The relationship between energy consumption, CO_2 emissions and economic growth in Tanzania. *International Journal of Energy Sector Management, 9*(3), 361–375. https://doi.org/10.1108/IJESM-05-2014-0006

Alkhathlan, K., Alam, M., & Javid, M. (2012). Carbon dioxide Emissions, Energy Consumption and Economic Growth in

Saudi Arabia: A Multivariate Cointegration Analysis. *British Journal of Economics, Management & Trade*, *2*(4), 327–39. https://doi.org/10.9734/BJEMT/2012/1673.

Amri, F. (2017). Carbon dioxide emissions, output, and energy consumption categories in Algeria. *Environmental Science and Pollution Research, 7*(24), 14567–14578. https://doi.org/10.1007/s11356-017-8984-7

Campbell, J. Y., & Perron, P. (1991). Pitfalls and opportunities: what macroeconomists should know about unit roots? *NBER Macroeconomics Annual*, *6*, 141–201.

Cover, M. (2010). *Government Report Says Global Warming May Cause Cancer, Mental Illness*. Retrieved October 3, 2020 from http://www.cnsnews.com/news/article/government-report-says-global-warming-may-cause-cancer-mental-illness.

Dritsaki, C., & Dritsaki, M. (2014). Causal Relationship between Energy Consumption, Economic Growth and CO2 Emissions: A Dynamic Panel Data Approach. *International Journal of Energy Economics and Policy, 4*(2), 125–136.

Erdoğan, S., Yıldırım, D. C., & Gedikli, A. (2019). The Relationship between CO2 Emissions and Health Indicators: The Case of Turkey. *Econometrics Letters*, *6*(1), 28–39.

Farhani, S., & Rejeb, J. B. (2012). Energy Consumption, Economic Growth and CO2 Emissions: Evidence from Panel Data for MENA Region. *International Journal of Energy Economics and Policy*, *2*(2), 71–81.

Farooq, M. U., Shahzad, U., Sarwar, S., & ZaiJun, L. (2019). The impact of carbon emission and forest activities on health outcomes: empirical evidence from China. *Environmental Science and Pollution Research*, *26*(13), 12894–12906.

Hou, Q. (2009). The Relationship between Energy Consumption Growth and Economic Growth in China. *Journal of Economics and Finance*, *1*(2), 232–237.

Imran, K., & Siddiqui, M. M. (2010). Energy Consumption and Economic Growth: A Case Study of Three SAARC Countries. *European Journal of Social Sciences*, *16*(2), 206–213.

Ilegbinosa, I. A., Moses, O. L., & Praise, U. I. (2014). Population and its Impact on Level of Unemployment in Least Developed Countries: An Appraisal of the Nigerian Economy. *Arts and Social Sciences Journal*, *5*(2), 1–7.

Islam, M. Z., Ahmed, Z., Saifullah, M. K., Huda, S. N., & Al-Islam, S. M. (2017). CO2 Emission, Energy Consumption and Economic Development: A Case of Bangladesh. *Journal of Asian Finance, Economics and Business*, *4*(4), 61–66. http://dx.doi.org/10.13106/jafeb.2017.vol4.no4.61

Khan, M. K., Jian, Z. T., Khan, M. I. (2019). Effect of energy consumption and economic growth on carbon dioxide emissions in Pakistan with dynamic ARDL simulations approach. *Environmental Science and Pollution Research, 26,* 23480–23490.

Kim, J. J. (2020). A Study on Influence of Economic Preparation for Later Life after Retirement. *Journal of Asian Finance, Economic, and Business*, *7*(5), 279–290. https://doi.org/10.13106/jafeb.2020.vol7.no5.279

Kunze, L. (2014). Life expectancy and economic growth. *Journal of Macroeconomics*, *39*(PA), 54–65. https://doi.org/10.1016/j.jmacro.2013.12.004

Lorentzen, P., Mcmillan, J., & Wacziarg, P. (2008). Death and development. *Journal of Economic Growth*, *13*(2), 81–124. https://doi.org/10.1007/s10887-008-9029-3

Luo, W., & Xie, Y. (2020). Economic growth, income inequality and life expectancy in China. *Social Science & Medicine, 256*, 113046. https://doi.org/10.1016/j.socscimed.2020.113046

Melody, S. M., & Johnston, F. H. (2015). Coal mine fires and human health: What do we know? *International Journal of Coal Geology*, *152*, 1–14. https://doi.org/10.1016/j.coal.2015.11.001

Menyah, K., Wolde-Rufael, Y. (2010). CO2 Emissions, Nuclear Energy, Renewable Energy and Economic Growth in the US. *Energy Policy, 38*, 2911–2915. https://doi.org/10.1016/j.enpol.2010.01.024

Ngangue, N., & Manfred, K. (2015). The impact of life expectancy on economic growth in developing countries. *Asian Economic and Financial Review*, *5*(4), 653–660. https://doi.org/10.18488/journal.aefr/2015.5.4/102.4.653.60

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/10.2307/2670182

Ramirez, M. D. (2007). A panel unit root and panel cointegration test of the complementarity hypothesis in the Mexican case: 1960–2001. *Atlantic Economic Journal*, *35*(3), 343–356. https://www.jstor.org/stable/20642508

Sarkodie, S.A., Strezov, V., Jiang, Y., & Evans, T. (2019). Proximate determinants of partic- ulate matter (PM2. 5) emission, mortality and life expectancy in Europe, Central Asia, Australia, Canada and the US. *Science of Total Environment, 683*, 489–497. https://doi.org/10.1016/j.scitotenv.2019.05.278

Sasana, H., & Putri, A. E. (2017). The increase of energy consumption and carbon dioxide (CO_2) emission in Indonesia. *E3S Web of Conferences, 31,* 01008(2018). https://doi.org/10.1051/e3sconf/20183101008

Shaari, M. S., Karim, Z. A., & Abidin, N. Z. (2020). The effects of Energy Consumption and National Output on CO2 Emissions: New Evidence from OIC Countries Using a Panel ARDL Analysis. *Sustainability*, *12*(8), 3312.

Shafi, R., & Fatima, S. (2019). Relationship between GDP, Life Expectancy and Growth Rate of G7 Countries. *International Journal of Sciences*, *8*(6), 75–79.

Shkolnikov, V. M., Andreev, E. M., Tursun-Zade, R., & Leon, D. A. (2019). Patterns in the relationship between life expectancy and gross domestic product in Russia in 2005–15: a cross-sectional analysis. *The Lancet Public health*, *4*(4), 181–188. https://doi.org/10.1016/S2468-2667(19)30036-2

Stern, D. I., & Cleveland, C. J. (2004). Energy and Economic Growth. *Rensselaer Working Papers in Economics 0410,* Rensselaer Polytechnic Institute, Department of Economics.

Wang, Z., Asghar, M. M., Zaidi, S. A. H., Nawaz, K, Wang, B., Zhao, W., & Xu, F. (2020). The dynamic relationship between economic growth and life expectancy: Contradictory role of energy consumption and financial development in Pakistan. *Structural Change and Economic Dynamics, 53*, 257–266. https://doi.org/10.1016/j.strueco.2020.03.004

Youssef, A. B., Lannes, L., Rault, C., & Soucat, A. (2016). Energy consumption and health outcomes in Africa. *Journal of Energy and Development*, *41*(2), 1–32.

Zakaria, M., & Bibi, S. (2019). Financial development and environment in South Asia: the role of institutional quality. *Environmental Science and Pollution Research*, *26*(8), 7926–7937.

Zaleski, P. (2001). Energy and Geopolitical Issues. In: D. B. Rao & D. Harshyita (Eds.), *Energy Security.* New Delhi: Discovery Publishing House.