International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2025, 15(5), 429-446.

Managing Sustainable Development through Governance and Health Indicators: A Strategic Analysis using Dynamic ARDL for the U.S.

Nouf Awadallah Alsulamy*

Business Administration Department, College of Business, University of Jeddah, Jeddah, Saudi Arabia.
*Email: nalsulami@uj.edu.sa

Received: 03 June 2025 **Accepted:** 20 August 2025 **DOI:** https://doi.org/10.32479/ijefi.21365

ABSTRACT

The study contributes the literature by examining the impact of life expectancy and governance indicators to achieve sustainable objectives in the US. For empirical estimations, we have used the dynamic autoregressive distributed lagged model. We have used three base models with economic growth, carbon emission and human development as dependent variables. Life expectancy reports positive coefficients for carbon emission and human development. The results mention that higher life expectancy causes environmental degradation. However, it enhances the human development indicators. As far as sustainable economic growth, life expectancy has confirmed the insignificant relationship. In light of governance indicators, governance effectiveness helps to reduce carbon emission. Regulatory quality has mentioned positive coefficients, indicating the significance of improving human development indicators. In concise, life expectancy and governance indicators influence the sustainable environment and human development, while sustainable economic growth is insignificant. The findings propose important policy implications to enhance the environmental and human quality.

Keywords: Life Expectancy, Sustainable Economy, Sustainable Environment, Human Development, Dynamic ARDL
JEL Classification: O44, Q01, Q56

1. INTRODUCTION

It is a fact that governments, either at the local or national level, usually try their best to meet the integrated objectives of sustainable development goals to establish societies that are not only prosperous but also environmentally sustainable. Overall, the main objective of governments around the globe is to achieve sustainable economic development and the same is true for the United States of America as well. However, it is also true that this sustainable economic development is the most enigmatic challenge for the country at present because, although the country is creating wealth and progressing in terms of technology, society is alienated in terms of needs and economies, which increases economic growth but at the cost of destruction of the natural environment. The idea behind sustainable development is that enhancing economic growth without enhancing the wellbeing of human beings is of no use because hurting the life support system provided by a clean environment as well as the safe climate at the cost of economic growth is of no use. Currently, in the overall global ranking, the US is at number 31 in terms of sustainable development and the same can be viewed in Table 1.

Hence, besides the fact that this country is the richest in the world, it is also true that this growth is at the cost of destroying the natural environment through neglecting the excessive emission of greenhouse gases, especially carbon. It is noted that carbon emissions are extremely high in the US because the country's economy is growing fast. This economic growth is based on the development and growth of many sectors, including industrial, agricultural, transportation, electricity, commercial and residential

Table 1: Sustainable development ranking

Rank	Country	Score
25	Portugal	77.65
26	Iceland	77.52
27	Slovak Republic	77.51
28	Chile	77.42
29	Hungary	77.34
30	Italy	77.01
31	United States	76.43

Source: Sustainable development ranking (Sustainable Development Report, 2020)

sectors. As is a known fact that all these sectors are dependent on heavy usage of energy which is the main source of carbon emission. In 2019, overall carbon emission by the country was about 6.6 billion metric tons (Fast Facts 1990-2018 National-Level U.S Greenhouse Gas Inventory, 2019).

Besides the issues of the environment as well as sustainable development, another main issue faced by the U.S is low human development. Even though the country is spending 16.89 of its GDP on health care (Current Health Expenditure [% of GDP], 2020), the lives of Americans is shorter compared to other developed nations. While having 53748.97 U. S dollars as per capita GDP, the rank of the country in life expectancy is 46 Life Expectancy of the World Population (2021), which shows how much is still there to solve in terms of human development. These are some of the statistics which show why the rank of the U.S in human development is 17. Besides many other problems behind this low ranking, the less coverage of insurance is one of the main issues as many Americans don't have health insurance and that is why the mortality rate at birth is high.

The problem of carbon emission is discussed previously by researchers, and they provided some solutions to mitigate this problem as well. In this regard, (Farooq et al., 2019; Waheed et al., 2018) advised that forests can be used to reduce the problem of carbon emission. According to them with increased forests, excess carbon can be absorbed from the atmosphere, and also, forests can provide a less carbon-emitting energy solution in the form of timber. Besides this, renewable energy is provided as a solution to environmental problems by Saidi and Omri (2020) as they suggest that renewable energy emits less carbon as compared to non-renewable energy. Additionally, an increase in income level is also suggested by Sarwar (2019) and Shaheen et al. (2020) as a solution to this problem as they suggest that increasing income can make expensive environmentally-friendly appliances affordable. Besides all these solutions, (Cordero et al., 2020; Molthan-Hill et al., 2020; Versteijlen et al., 2017) advised that education can also play an important role in reducing carbon emission as it makes people aware of the importance of a green environment.

Besides carbon emission, the problems regarding sustainable economic development are also discussed in the literature and researchers tried to advise some solutions as well. Le and Bao (2020), Lutfi (2016), Saad and Kalakech (2009) advised that government expenditure can enhance sustainable economic development as if this expenditure is toward the profitable as well as people and environment-oriented, then it ensures the sustainable economic development. Alongside, another solution is provided by Academy (2011), Ahmed and Shimada (2019), and Kutan et al. (2018) in the form of renewable energy as it can enhance economic growth without deteriorating the environment and sustainable development can be achieved. Additionally, technology is also mentioned as a viable factor enhancing sustainable development by Adamczyk et al. (2019), Adams et al. (2018), and Berawi (2019).

As far as human development is concerned, it is noted that the majority of the countries are at a lower rank in this regard, along with the U.S. Previous studies explored different factors which can be used to enhance human development in any country (Bechtel and Bechtel, 2020; Wang et al., 2018) mentioned that an increase in GDP level can help in the improvement of human development in any country. Although these previous studies provided some solutions for sustainable economic development as well as human development along with a reduction in carbon emission. However, none of the studies addressed these problems with complete detail. Hence, the current study is an effort to provide essential input in existing studies.

The current study contributes to the existing literature in a multiple-way and exploring the impact of life expectancy on sustainable economic development as well as carbon emission and human development is one of these. There is no study that explores the impact of life expectancy on these variables in the U.S. There are some studies that explore how carbon emission can impact life expectancy (Rodriguez-Alvarez, 2021; Sarkodie et al., 2019), but this study argues that the relationship between these variables is in the opposite direction and life expectancy affects carbon emission. The main reason is the fact that when life expectancy will be higher, people will live longer; however, as they get aged, their energy demand increases. The reason behind this increased energy demand is their longer stay at home. Due to health conditions, they would require heating and lighting facilities, which are contributors to carbon emission. However, this relationship gets negative as well because, with age, people get more insight regarding the importance of a healthy environment. This will enable them to use voting rights wisely in favor of those parties, which will help combat environmental problems. Also, when they realize that exercise and recreational activities are necessary for their health they will demand more forests and natural parks where they can spend time and improve health.

Besides the impact on carbon emission, life expectancy can improve economic growth as well. However, previous studies do not (Luo and Xie, 2020; Wang et al., 2020) check this link for the U.S and the current study is filling this gap. Because, when people expect to live longer, they try to save more money to be used in the later stage of life. This saving promotes the overall economy. Additionally, people expecting to live longer usually spend more time in education before entering the job market. This investment in human capital adds to their overall ability to serve the economy in a better sense. Also, people of higher ages are considered more experienced and they usually make decisions about the education and health of family members. Hence, when life expectancy increases, human development gets enhanced through improved decision-making by elders. The second contribution of this study is exploring the impact of good governance on economic and human development along with carbon emission in the U.S. Previous studies tried to explore these relationships (Emara and El Said, 2021; Halkos and Tzeremes, 2013; Sarkodie and Adams, 2020) but none of the studies is there which is focusing U.S data. The current study is an attempt to fill this gap. Because good governance not only enhances economic development by reducing corruption and political stability but also helps in the reduction of carbon emission through proper regulations and accountability.

Based on these contributions, major objectives of this study include (1) To fill the existing gap by examining the impact of life expectancy on sustainable economic development of U.S. (2) To fill the existing gap by examining the impact of life expectancy on environmental externalities of U.S. (3) To fill the existing gap by examining the impact of life expectancy on human development of U.S. (4) To examine the role of governance to enhance sustainable economic development in the U.S. (5) To examine the role of governance to reduce environmental externalities in the U.S. (6) To examine the role of governance to enhance human development in the U.S.

2. LITERATURE REVIEW

2.1. Impact of Life Expectancy on Sustainable Economic Development

Life expectancy and economic development can be directly or indirectly related and previous literature tried to explore this nexus as He and Li (2020) explored data from 65 countries to check this link. According to them, life expectancy and economic growth are positively related in the long run however, it is also noted that this relationship gets stronger with age. Similarly, Azam et al. (2019) used data from 33 developing countries from the year 1995-2016 to check if this relationship is valid. Their analysis proved that life expectancy increases economic growth in all selected countries. Another study done by Rjoub et al. (2021) is focused on Turkish data to check how sustainable economic growth can get affected by life expectancy. By using different econometric techniques, they concluded that bidirectional causality is present between life expectancy and economic growth of Turkey because higher life expectancy leads to less environmental deterioration along with enhancing economic growth.

2.2. Impact of Life Expectancy on CO_2 Emission

The majority of the literature examines the impact of carbon emission on life expectancy however, this nexus can go in the opposite direction as well because life expectancy can also affect carbon emission. The main reason is explained by Estiri and Zagheni (2019) as he explored this nexus in the US context and confirmed that with increasing age, people usually spend the majority of their time at home however, they consume a high amount of energy for heating and lite. As energy is the main source for carbon emission hence, with more age more carbon is emitted into the air. This positive association is not always the case because (Liddle and Lung, 2010) conducted research on developing countries and by dividing the sample into different age groups they concluded from results that when people reach higher age, they spend less time outside and driving. Also, they use public transport less frequently which reduces the carbon emission as a higher amount of carbon is emitted through the transportation sector.

2.3. Impact of Life Expectancy on Human Development

It is a fact that age plays a vital role when it comes to human development because it is mentioned in Zaidi (2015) that decision power, as well as the power to exercise authority, develops in later stages of life. Hence, mature people play a significant role in the family regarding making decisions about education and health which are essential for proper development. Also, Zaidi (2015) claims that people of higher age levels can effectively contribute to development as well and by giving an example of Japan, where life expectancy is high, he argues that this country is ranked higher in development index as well because it uses the full potential of aged people as well.

2.4. Impact of Governance on Sustainable Economic Development

It is a fact that currently almost all countries are in search of a reliable tool for sustainable economic development and good governance can be that tool. The main reason for the importance of governance is because accountability, as well as transparency and efficiency, can be promoted through good governance. In this regard Kardos (2012) researched EU countries to explore if good governance is playing any role in the sustainable development of these countries and found that good governance is reflected in the achievement of sustainable development goals in these countries. Also, as Morita and Zaelke (2007) mentioned that good governance enhances transparency and involvement of people in decision making which is necessary for sustainable development. The main reason for this positive association is provided by Bass and Dalal-Clayton (2002) as relevant information is needed by people so that they can make a decision and can force government as well as relevant departments to formulate that type of policies which are helpful in sustainable development. Moreover Personal and Archive (2017) explains the way governance can enhance sustainable development. According to them, it ensures long-term planning which is the main element of sustainable development. Also, different dimensions of sustainable development can be properly integrated through good governance and collaboration as well as innovation is also only possible through proper governance mechanism.

2.5. Impact of Governance on CO_2 Emission

Carbon emission is a problem faced by the whole country and researchers tried to explore factors that can combat this problem and governance is one of them. The research is done on oil and non-oil producing countries by Sarpong and Bein (2020) revealed that good governance is beneficial for the environment of countries producing oil as it helps in reducing carbon emission in these countries. However, when it comes to the countries which are not producing oil, governance enhances the carbon emission which is surprising. Besides this direct connection, governance can reduce carbon emission indirectly as well because Omri and Ben Mabrouk (2020) proved this in countries of the MENA region and concluded that human behavior can be changed through good governance and human development is achieved which help in the formulation of policies essential for the reduction of carbon emission. Likewise, a study is conducted in BRICS countries by Danish et al. (2019) to check the relationship between governance and carbon emission and analysis from 1996 to 2017 revealed that carbon emission is significantly decreased in these countries due to effective governance.

2.6. Impact of Governance on Human Development

Human development is essential when it comes to the improvement of overall wellbeing and improvement of living standard of people. However, for effective human development, good governance is a must component and researchers tried to check the link between these two as Sarkodie and Adams (2020) used African data from the year 1990-2017 to check how and through which channel good governance can impact human development. They found that through good governance, income inequality can be reduced and when income inequality will be lower, human development gets enhanced. Additionally, while investigating the nexus between governance and human development in 33 European Union states by taking data from 2002 to 2012, Keser and Gökmen (2018) found that majority of the governance components are significantly and positively related to human development level. Similarly Bhanumurthy et al. (2018) researched a state of India to know how much human development can be achieved through good governance. They concluded that some dimensions of good governance are proved to be highly effective in improving human development. The same type of results is also found by Davis (2017) as he used data from countries of sub-Saharan Africa and found that improvement in terms of government effectiveness as well as political stability is significantly and positively related to human development.

3. DATA AND METHODOLOGY

The data for this study to empirically investigate the effect of life expectancy and governance on economic growth, carbon emission, and human development is taken from World Development Indicators (WDI) and HDR. By collecting data from the official website of the world bank, we explore these relationships through a dynamic ARDL model on time series data of the US from the year 1990 to 2019. This study has two independent variables: life expectancy and governance and three dependent variables, including economic growth, carbon emission, and human development. As far as the measurement of the variables is concerned, economic growth is measured in current US$, carbon emission as kg per 2010 US$ of GDP, and human development index through the index. In the case of population, a total population is taken, gross fixed capital formation as annual % growth, energy use as kg of oil equivalent per capita, and life expectancy as life expectancy at birth. To check the actual change independent variables, a dynamic ARDL model is used and to check the stationarity, the Zivot-Andrews unit root test with structural brake is applied. According to Abbasi et al. (2021) and Adedoyin et al. (2021), the dynamic ARDL model is best to ignore the issues related to the traditional ARDL model. The equations are used to check the impact of independent variables on economic growth are presented in EQ-1.

$$EG = f(CO_2, HDI, L, K, EC, LIFE, \text{Governance Indicators}) \quad (1)$$

EG is economic growth in the above equations, CO_2 is carbon emission, and *HDI* is the human development index. *EC* is energy consumption, *EDU* is education, LIFE is life expectancy, *VA*, *PS*, *GE*, *RQ*, *LAW*, and *CC* are governance dimensions. On the basis of these equations, we have constructed are mentioned as EQ-2 and EQ-3. The details about variable description along with measurement is presented in Table A1.

Following equations are used to check the impact of independent variables on carbon emission.

$$CO_2 = f(EG, HDI, L, K, EC, LIFE, \text{Governance Indicators}) \quad (2)$$

Following equations are used to check the impact of independent variables on human development.

$$HDI = f(EG, CO_2, L, K, EC, LIFE, \text{Governance Indicators}) \quad (3)$$

3.1. Econometric Methodology

3.1.1. Zivot-Andrews unit root test with structural break

Previously, researchers used traditional unit root tests, including the ADF test, to deal with structural breaks (Said and Dickey, 1984). However, it is noted that there were some problems in these tests, including misspecification along with size distortion whenever it deals with structural shifts. This leads to the wrong acceptance of the null hypothesis (Perron, 1989). Zivot and Andrew advance this point and argue that the exact time is not known about when are the breakpoints happens (Zivot and Andrews, 1992). To determine these points, an algorithm is used by them. Hence, due to the ability of Zivot and Andrew's test to estimate the structural changes endogenously, many researchers used this test to check unit root (Mehta et al., 2021; Nathaniel, 2020; Rahman and Saadi, 2008; Waheed et al., 2006). Under the ZA test, $H_0: y_t = \mu + y_{t-1} + e_t$ shows the null hypothesis.

3.1.2. Pesaran et al. (2001) bounds cointegration

Zivot and Andrew's unit root test confirms that only a few variables are stationary at the level, and all variables are stationary at first difference. This proves that integration is I(0) and I(1); hence, cointegration between variables is possible. Pesaran et al. (2001) bounds cointegration test is used to check the cointegration. Although there are many other techniques, the econometric advantages of this test make it the best choice to check cointegration (Ilyas et al., 2010). In this approach same order of integration is not required, and fractional integration is addressed through it (Perron, 1989). Under bound cointegration test, $H_0^F : (\rho = 0) \cap (\sum_{S-0}^{q} \beta_S = 0)$ shows null hypothesis and $H_1^F : (\rho \neq 0) \cup (\sum_{S-0}^{q} \beta_T \neq 0)$ shows alternative hypothesis. The decision regarding the rejection of the null hypothesis is made through t-statistics. The equation for the null hypothesis takes the form $H_0^t : \alpha = 0$, whereas the alternative hypothesis takes the form $H_1^t : \alpha \neq 0$.

3.1.3. ARDL bound co-integration test

The autoregressive distributed lag model, formally known as the ARDL model is introduced by Pesaran et al. (2001) is based on the commands of unrestricted error correction model to check the impact of independent variables on dependent variables in the long run and short run. In an ARDL model, the current values of a variable are presented as a function of its past value and other variables' present and past values. Although there are many benefits of this model, handling different lag order variables through statistical regression analysis is the major advantage of the ARDL model. Also, when there is a mixed order cointegration as I(0) and I(1) between variables, ARDL can better predict the cointegration relationship through upper and lower bound. The same is true for this study because there is a mixed order of integration.

3.1.4. Dynamic ARDL simulations

After being initially proposed by Jordan and Philips (2018), many researchers used the Dynamic simulated ARDL approach, including (Abbasi et al., 2021; Adedoyin et al., 2021; Khan et al., 2021; Sarkodie and Owusu, 2020; Zhang et al., 2021). The main reason to propose this model is the shortcoming in the traditional ARDL model, which is used to test the short-run and long-run relationships. In dynamic model automatic graphic presentation of positive and negative shocks related to independent variables can be examined, simulated, and predicted by making all other variables constant. However, the main requirement to apply this model is the presence of cointegration in study variables which is fulfilled because in this research are variables are co-integrated. The dynamic ARDL model for this study forms the following equations by incorporating all variables.

$$\Delta EG_t = \alpha_0 + \theta_0 EG_{t-1} + \beta_1 \Delta CO2_t + \theta_1 CO2_{t-1} + \beta_2 \Delta HDI_t + \theta_2 HDI_{t-1} + \beta_3 \Delta L_t + \theta_3 L_{t-1} + \beta_4 \Delta K_t + \theta_4 K_{t-1} + \beta_5 \Delta EC_t + \theta_5 EC_{t-1} + \beta_6 \Delta LIFE_t + \theta_6 LIFE_{t-1} + \beta_7 \Delta VA_t + \theta_7 VA_{t-1} + \beta_8 \Delta PS_t + \theta_8 PS_{t-1} + \beta_9 \Delta GE_t + \theta_9 GE_{t-1} + \beta_{10} \Delta RQ_t + \theta_{10} RQ_{t-1} + \beta_{11} \Delta LAW_t + \theta_{11} LAW_{t-1} + \beta_{12} \Delta CC_t + \theta_{12} CC_{t-1} + \gamma_1 ECT_{t-1} + \varepsilon \quad (4)$$

$$\Delta CO2_t = \alpha_0 + \theta_0 CO2_{t-1} + \beta_1 \Delta EG_t + \theta_1 EG_{t-1} + \beta_2 \Delta HDI_t + \theta_2 HDI_{t-1} + \beta_3 \Delta L_t + \theta_3 L_{t-1} + \beta_4 \Delta K_t + \theta_4 K_{t-1} + \beta_5 \Delta EC_t + \theta_5 EC_{t-1} + \beta_6 \Delta LIFE_t + \theta_6 LIFE_{t-1} + \beta_7 \Delta VA_t + \theta_7 VA_{t-1} + \beta_8 \Delta PS_t + \theta_8 PS_{t-1} + \beta_9 \Delta GE_t + \theta_9 GE_{t-1} + \beta_{10} \Delta RQ_t + \theta_{10} RQ_{t-1} + \beta_{11} \Delta LAW_t + \theta_{11} LAW_{t-1} + \beta_{12} \Delta CC_t + \theta_{12} CC_{t-1} + \gamma_1 ECT_{t-1} + \varepsilon \quad (5)$$

$$\Delta HDI_t = \alpha_0 + \theta_0 HDI_{t-1} + \beta_1 \Delta EG_t + \theta_1 EG_{t-1} + \beta_2 \Delta CO2_t + \theta_2 CO2_{t-1} + \beta_3 \Delta L_t + \theta_3 L_{t-1} + \beta_4 \Delta K_t + \theta_4 K_{t-1} + \beta_5 \Delta EC_t + \theta_5 EC_{t-1} + \beta_6 \Delta LIFE_t + \theta_6 LIFE_{t-1} + \beta_7 \Delta VA_t + \theta_7 VA_{t-1} + \beta_8 \Delta PS_t + \theta_8 PS_{t-1} + \beta_9 \Delta GE_t + \theta_9 GE_{t-1} + \beta_{10} \Delta RQ_t + \theta_{10} RQ_{t-1} + \beta_{11} \Delta LAW_t + \theta_{11} LAW_{t-1} + \beta_{12} \Delta CC_t + \theta_{12} CC_{t-1} + \gamma_1 ECT_{t-1} + \varepsilon \quad (6)$$

4. RESULTS

4.1. Descriptive

Descriptive statistics including mean, standard deviation, minimum, and maximum regarding the main variables of the study are presented in Table 2. In this study, economic growth, carbon emission, and human development index are the dependent variables whereas, labor, capital, energy consumption, life expectancy, and governance are the independent variables. It is evident from the table that the highest mean value is for economic growth whereas political stability, a dimension of governance, shows the lowest mean value. Likewise, a standard deviation of political stability is highest which means this variable is highly volatile. In terms of least volatile, the human development index is showing the lowest standard deviation value. Hence, it can be said that in the U.S, political stability is highly volatile but the human development index is not much volatile.

4.2. Correlation

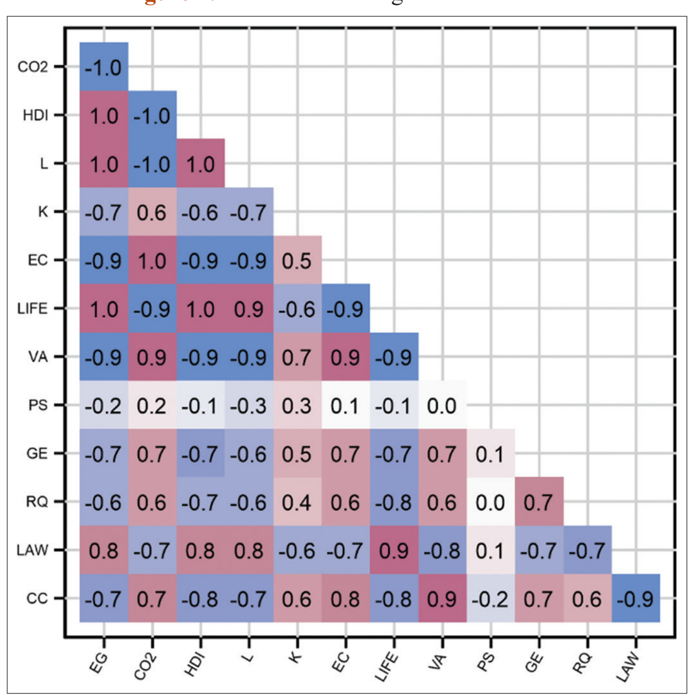
Results of correlation analysis are presented in Figure 1. It can be observed that labor as well as life expectancy, and rule of law are positively correlated with economic growth which suggests that an increase in these variables will increase the economic growth of the U.S. However, capital, energy consumption, voice and accountability, political stability, governance effectiveness, regulatory quality, and corruption control are negatively correlated with economic

Table 2: Descriptive statistics

Variable	No of Obs	Mean	Standard deviation	Min	Max
EG	30	30.014	0.187	29.720	30.302
CO_2	30	−0.831	0.082	−0.953	−0.702
HDI	30	0.893	0.007	0.884	0.906
L	30	18.809	0.035	18.747	18.860
K	30	1.706	0.411	0.939	2.229
EC	30	8.967	0.011	8.949	8.994
LIFE	30	4.378	0.006	4.371	4.389
VA	30	0.254	0.073	0.097	0.299
PS	30	−0.789	0.829	−2.510	0.081
GE	30	0.513	0.059	0.422	0.589
RQ	30	0.488	0.043	0.401	0.566
LAW	30	2.147	0.158	2.079	2.485
CC	30	0.487	0.105	0.303	0.654

EG stands for economic growth, CO_2 is the carbon emission, HDI shows human development index, L and K are labor and capital, respectively. EC is the energy consumption, LIFE shows life expectancy. In governance indicators, VA, PS, GE, RQ, LAW and CC represents the voice and accountability, political stability, governance effectiveness, regulatory quality, law and corruption control, respectively

Figure 1: Correlation among studied variables



growth and an increase in these variables will decrease economic growth in the U.S. In the case of carbon emission, capital, energy consumption, voice and accountability, political stability, governance effectiveness, regulatory quality, and corruption control are positively correlated with carbon emission. However, labor, life expectancy, and rule of law are negatively correlated with carbon emission. As human development index is the third dependent variable, labor, life expectancy, and rule of law are positively correlated with the human development index whereas capital, energy consumption, voice and accountability, political stability, governance effectiveness, regulatory quality, and corruption control are negatively correlated with human development index.

4.3. Unit Root Test

To check for the presence of unit root Zivot-Andrews unit root test with structural break is used and results are presented in Table 3. The results of this test suggest that ARDL co-integration test is the best to check co-integration between variables. Because all variables are stationary at 1st difference and integrated at I(I).

4.4. Co-integration Test using ARDL

In order to check if co-integration is there between variables of the study, Pesaran et al. (2001) bounds test for ARDL is used and results regarding the upper as well as lower bound and F-statistics values are presented in Table 4. According to the results, it can be seen that in the case of economic growth as the dependent variable, in all models, the F-statistics value of lagged dependent variable along with other variables is higher than critical values of upper bound. This suggests the presence of co-integration between study variables. Likewise, when carbon emission and human development index are used as dependent variables, the F-statistics value of independent as well as lagged dependent variable value is higher than upper bound critical values. This suggests that in all models, there exists co-integration and to check the long-run relationship between variables, ARDL estimation will be appropriate.

Table 3: Zivot-Andrews unit root test with structural break

At level	Statistics	Break	Result
EG	−3.992	2009	Unit Root
CO_2	−0.417	2002	Unit Root
HDI	−2.413	2006	Unit Root
L	−3.905	2010	Unit Root
K	−5.200**	2011	Stationary
EC	−1.674	2002	Unit Root
LIFE	−2.117	2015	Unit Root
VA	−4.643*	2005	Stationary
PS	−3.921	2001	Unit Root
GE	−3.436**	2005	Stationary
RQ	−4.008	2011	Unit Root
LAW	−7.035***	2006	Stationary
CC	−3.102	2005	Unit Root
At difference	Statistics	Break	Result
ΔEG	−5.534***	2008	Stationary
ΔCO_2	−7.610***	2016	Stationary
ΔHDI	−5.365***	2012	Stationary
ΔL	−6.261***	2010	Stationary
ΔK	−6.282***	2015	Stationary
ΔEC	−7.541***	2012	Stationary
ΔLIFE	−5.399**	2001	Stationary
ΔVA	−5.037***	2008	Stationary
ΔPS	−6.148***	2004	Stationary
ΔGE	−6.243***	2001	Stationary
ΔRQ	6.925***	2014	Stationary
ΔLAW	−7.477***	2006	Stationary
ΔCC	−7.004**	2003	Stationary
CV	1%	5%	10%
	−5.34	−4.8	−4.58

Zivot-Andrews unit root test have null hypothesis "time series has unit root with structural break". EG stands for economic growth, CO_2 is the carbon emission, HDI shows human development index, L and K are labor and capital, respectively. EC is the energy consumption, LIFE shows life expectancy. In governance indicators, VA, PS, GE, RQ, LAW and CC represents the voice and accountability, political stability, governance effectiveness, regulatory quality, law and corruption control, respectively. "Δ" is the difference of variable. "CV" mentions the critical value. ***,**,*Presents the level of significance at 1%, 5% and 10%, respectively

4.5. Empirical Results

4.5.1. ARDL estimation

Results regarding the ARDL estimation are presented in Table 5 and details for the long run along with the short-run relationship of independent variable with economic growth are shown. It can be seen that carbon emission is significantly and negatively related to economic growth in the long run in six out of nine models which means that increase in carbon emission results in a significant reduction of economic growth in the long run. However, in the short run, carbon emission doesn't show any significant effect on economic growth. Likewise, the human development index is not showing any effect on economic growth in both the long run as well as short run. The same is the case for labor as there is no long-run as well as the short-run relationship between labor and economic growth which is consistent with the findings of Muliadi et al. (2020). In the case of capital long-run analysis shows that in the majority of the models, capital is enhancing the economic growth in the U.S.

When it comes to energy consumption ARDL estimation shows that in the majority of models in long run and all models in the short run, energy consumption is significantly and positively related to economic growth. This result is consistent with the findings of Acheampong et al. (2021), Namahoro et al. (2021). Contrary to this, it can be observed that life expectancy is not related to economic growth in both the long run as well as short-run which means that in the U.S, life expectancy doesn't matter for the economy. This result is against the findings of He and Li (2020), Kunze (2014), and Wang et al. (2020). As far as governance is concerned, all of its dimensions are not showing any relationship with economic growth in the long run however, the only rule of law is significantly and positively related to economic growth.

Carbon emission is the second dependent variable of the study and ARDL estimates for carbon emission is presented in Table 6. It can be seen that economic growth is significantly and positively related to carbon emission in the long run which suggests that in the U.S, an increase in economic growth results in increased carbon emission. Adedoyin et al. (2020), Ameyaw and Yao (2018) also found the same type of positive association between economic growth and carbon emission. The results regarding labor and capital show that there is no association between these variables and carbon emission in the U.S. However, energy consumption is significantly and positively related to carbon emission in both the

Table 4: Pesaran, Shin, and Smith (2001) bounds test for ARDL

	I (0)	I (1)		I (0)	I (1)		I (0)	I (1)
EG=f (CO_2, HDI, L, K, EC, LIFE, VA)			CO_2=f (EG, HDI, L, K, EC, LIFE, VA)			HDI=f (EG, CO_2, L, K, EC, LIFE, VA)		
10% critical value	2.457	3.797	10% critical value	2.457	3.797	10% critical value	2.457	3.797
5% critical value	2.97	4.499	5% critical value	2.97	4.499	5% critical value	2.97	4.499
1% critical value	4.27	6.211	1% critical value	4.27	6.211	1% critical value	4.27	6.211
F	13.215	CI exist	F	14.103	CI exist	F	12.19	CI exist
EG=f (CO_2, HDI, L, K, EC, LIFE, PS)			CO_2=f (EG, HDI, L, K, EC, LIFE, PS)			HDI=f (EG, CO_2, L, K, EC, LIFE, PS)		
10% critical value	2.457	3.797	10% critical value	2.457	3.797	10% critical value	2.457	3.797
5% critical value	2.97	4.499	5% critical value	2.97	4.499	5% critical value	2.97	4.499
1% critical value	4.27	6.211	1% critical value	4.27	6.211	1% critical value	4.27	6.211
F	13.121	CI exist	F	14.18	CI exist	F	12.185	CI exist
EG=f (CO_2, HDI, L, K, EC, LIFE, VA, PS)			CO_2=f (EG, HDI, L, K, EC, LIFE, VA, PS)			HDI=f (EG, CO_2, L, K, EC, LIFE, VA, PS)		
10% critical value	2.384	3.728	10% critical value	2.457	3.797	10% critical value	2.457	3.797
5% critical value	2.875	4.445	5% critical value	2.97	4.499	5% critical value	2.97	4.499
1% critical value	4.104	6.151	1% critical value	4.27	6.211	1% critical value	4.27	6.211
F	9.018	CI exist	F	7.285	CI exist	F	7.864	CI exist
EG=f (CO_2, HDI, L, K, EC, LIFE, GE)			CO_2=f (EG, HDI, L, K, EC, LIFE, GE)			HDI=f (EG, CO_2, L, K, EC, LIFE, GE)		
10% critical value	2.457	3.797	10% critical value	2.384	3.728	10% critical value	2.384	3.728
5% critical value	2.97	4.499	5% critical value	2.875	4.445	5% critical value	2.875	4.445
1% critical value	4.27	6.211	1% critical value	4.104	6.151	1% critical value	4.104	6.151
F	7.565	CI exist	F	17.921	CI exist	F	6.788	CI exist
EG=f (CO_2, HDI, L, K, EC, LIFE, RQ)			CO_2=f (EG, HDI, L, K, EC, LIFE, RQ)			HDI=f (EG, CO_2, L, K, EC, LIFE, RQ)		
10% critical value	2.457	3.797	10% critical value	2.457	3.797	10% critical value	2.457	3.797
5% critical value	2.97	4.499	5% critical value	2.97	4.499	5% critical value	2.97	4.499
1% critical value	4.27	6.211	1% critical value	4.27	6.211	1% critical value	4.27	6.211
F	5.656	CI exist	F	9.404	CI exist	F	10.172	CI exist
EG=f (CO_2, HDI, L, K, EC, LIFE, GE, RQ)			CO_2=f (EG, HDI, L, K, EC, LIFE, GE, RQ)			HDI=f (EG, CO_2, L, K, EC, LIFE, GE, RQ)		
10% critical value	2.457	3.797	10% critical value	2.457	3.797	10% critical value	2.457	3.797
5% critical value	2.97	4.499	5% critical value	2.97	4.499	5% critical value	2.97	4.499
1% critical value	4.27	6.211	1% critical value	4.27	6.211	1% critical value	4.27	6.211
F	8.363	CI exist	F	8.588	CI exist	F	7.956	CI exist
EG=f (CO_2, HDI, L, K, EC, LIFE, LAW)			CO_2=f (EG, HDI, L, K, EC, LIFE, LAW)			HDI=f (EG, CO_2, L, K, EC, LIFE, LAW)		
10% critical value	2.457	3.797	10% critical value	2.457	3.797	10% critical value	2.457	3.797
5% critical value	2.97	4.499	5% critical value	2.97	4.499	5% critical value	2.97	4.499
1% critical value	4.27	6.211	1% critical value	4.27	6.211	1% critical value	4.27	6.211
F	9.336	CI exist	F	14.457	CI exist	F	11.655	CI exist
EG=f (CO_2, HDI, L, K, EC, LIFE, CC)			CO_2=f (EG, HDI, L, K, EC, LIFE, CC)			HDI=f (EG, CO_2, L, K, EC, LIFE, CC)		
10% critical value	2.384	3.728	10% critical value	2.384	3.728	10% critical value	2.384	3.728
5% critical value	2.875	4.445	5% critical value	2.875	4.445	5% critical value	2.875	4.445
1% critical value	4.104	6.151	1% critical value	4.104	6.151	1% critical value	4.104	6.151
F	7.328	CI exist	F	14.231	CI exist	F	6.503	CI exist
EG=f (CO_2, HDI, L, K, EC, LIFE, LAW, CC)			CO_2=f (EG, HDI, L, K, EC, LIFE, LAW, CC)			HDI=f (EG, CO_2, L, K, EC, LIFE, LAW, CC)		
10% critical value	2.384	3.728	10% critical value	2.384	3.728	10% critical value	2.384	3.728
5% critical value	2.875	4.445	5% critical value	2.875	4.445	5% critical value	2.875	4.445
1% critical value	4.104	6.151	1% critical value	4.104	6.151	1% critical value	4.104	6.151
F	13.388	CI exist	F	12.313	CI exist	F	10.845	CI exist

Notes: Where I (0) and I (1) shows the lower and upper band critical values at 10%, 5% and 1% level of Pesaran, Shin, and Smith (2001) bounds test - CI stands for Cointegration

long run as well as short-run which means energy consumption is the main reason behind increased carbon emission in the U.S. This result is consistent with the findings of Belbute and Pereira (2020). Likewise, life expectancy is also significantly and positively related to carbon emission which suggests that improvement in life expectancy increases carbon emission. Estiri and Zagheni (2019) also found the same type of positive association between life expectancy and carbon emission in the U.S. Besides this, governance effectiveness is significantly and negatively related to carbon emission in both the long and short run. This result is consistent with the findings of Danish et al. (2019).

Besides economic growth and carbon emission, human development is the third dependent variable of this study, and ARDL estimates for this variable are given in Table 7. It is evident from the table that the majority of the variables are not related to human development in the U.S. In this regard, capital is significantly and negatively related to human development in just a few models in the long run whereas there is a significant and positive association between capital and human development in the short run. The most significant relationship is observed between life expectancy and human development. It can be seen that life expectancy is significantly and positively affecting human development in long run. Additionally, regulatory quality is significantly and positively related to human development in both the long as well as short run.

Tables 8-10 present major diagnostic tests' results. In Table 8, economic growth is the dependent variable; in Table 9, carbon emission is the dependent variable, and in Table 10, human

Table 5: ARDL estimations – Economic growth as dependent variable

EG	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
ADJ	−0.307	−0.278	−0.197	−0.572*	−0.475*	−0.193	−0.538*	−0.472*	−0.557*
	(0.354)	(0.480)	(0.365)	(0.031)	(0.012)	(0.560)	(0.048)	(0.033)	(0.013)
Long run									
CO_2	−2.3809*	−2.3635	−2.5553	−1.3851***	−2.0842***	−2.1770	−1.7972***	−2.3396***	−1.7394***
	(0.09)	(0.17)	(0.19)	(0.00)	(0.00)	(0.32)	(0.00)	(0.01)	(0.00)
HDI	11.1727	15.2051	28.8309	−1.0181	0.1403	3.6602	3.9045	5.3451	2.7522
	(0.39)	(0.61)	(0.49)	(0.69)	(0.97)	(0.78)	(0.25)	(0.29)	(0.34)
L	−0.8906	−1.1300	−1.6822	2.3362*	−0.2302	0.7018	0.2169	−0.6054	0.6029*
	(0.78)	(0.78)	(0.74)	(0.06)	(0.88)	(0.88)	(0.84)	(0.74)	(0.09)
K	0.0191	0.0484**	0.1113	0.0212***	0.0079	0.1457**	0.0148*	0.0089*	0.0096*
	(0.64)	(0.02)	(0.51)	(0.03)	(0.62)	(0.01)	(0.06)	(0.06)	(0.07)
EC	2.7417	2.6591**	3.6454	1.4596***	2.1484***	2.8260	1.8738***	2.6049**	1.8907***
	(0.13)	(0.06)	(0.28)	(0.00)	(0.00)	(0.39)	(0.00)	(0.02)	(0.00)
LIFE	−7.8549	−12.7169	−27.4318	2.1069	7.1456	2.5560	3.9235	−2.5404	3.2012
	(0.63)	(0.72)	(0.56)	(0.49)	(0.16)	(0.84)	(0.18)	(0.69)	(0.33)
VA	0.0293		−0.2447						
	(0.91)		(0.62)						
PS		−0.0145	−0.0126						
		(0.45)	(0.66)						
GE				−0.3188		−1.1127			
				(0.10)		(0.57)			
RQ					0.1149	0.6960			
					(0.32)	(0.62)			
LAW							−0.0863		−0.0229
							(0.21)		(0.73)
CC								−0.0876	−0.0018
								(0.39)	(0.99)
Short run									
Δ CO_2	0.0558	0.1793	−0.5817	−0.5477	0.2049	0.0709	0.5390	−0.6039*	0.2188
	(0.91)	(0.73)	(0.17)	(0.15)	(0.15)	(0.86)	(0.21)	(0.07)	(0.16)
Δ HDI	4.0961	3.0767	2.4587	5.4679**	1.7345	2.7729	4.2526	3.1111	3.2726
	(0.17)	(0.27)	(0.46)	(0.04)	(0.62)	(0.40)	(0.13)	(0.26)	(0.33)
Δ L	0.4872	0.1828	0.0802	0.5854	0.0964	0.0936	0.4776	0.4670	0.5492
	(0.61)	(0.83)	(0.94)	(0.46)	(0.92)	(0.92)	(0.54)	(0.56)	(0.56)
Δ K	0.0067	0.0026	0.0056	0.0122	0.0081	0.0137	0.0095	0.0112	0.0124
	(0.50)	(0.75)	(0.60)	(0.20)	(0.37)	(0.18)	(0.29)	(0.23)	(0.26)
Δ EC	1.0285***	0.9164***	0.8647**	1.1408***	0.9161***	0.9613**	0.8684***	1.0598***	0.9328**
	(0.00)	(0.00)	(0.02)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)
Δ LIFE	1.2559	1.3351	0.7145	0.1419	2.5174	0.2516	1.4270	1.2685	1.2015
	(0.51)	(0.41)	(0.73)	(0.94)	(0.18)	(0.91)	(0.36)	(0.43)	(0.50)
Δ VA	−0.0218		−0.0556						
	(0.77)		(0.55)						
Δ PS		0.0029	−0.0000						
		(0.67)	(1.00)						
Δ GE				0.0858		0.1122			
				(0.22)		(0.14)			
Δ RQ					0.0890	0.0602			
					(0.21)	(0.34)			
Δ LAW							0.0710**		0.0228*
							(0.04)		(0.09)
Δ CC								−0.0588	−0.0455
								(0.14)	(0.31)
Constant	13.7319	18.7753	23.8923	−20.7718	−8.5750	−4.7566	−6.8852	10.6391	−8.9786
	(0.46)	(0.46)	(0.23)	(0.17)	(0.51)	(0.80)	(0.61)	(0.55)	(0.55)
N	23	23	23	23	23	23	23	23	23
R-square	0.904	0.930	0.917	0.917	0.876	0.955	0.928	0.878	0.892

EG stands for economic growth, CO_2 is the carbon emission, HDI stands for human development index, L and K are labor and capital, EC is the energy consumption, EDU depicts education. LIFE shows life expectancy. In governance indicators, VA, PS, GE, RQ, LAW and CC represents the voice and accountability, political stability, governance effectiveness, regulatory quality, law and corruption control, respectively. "( )" contains the *P* values. ***,**,*Presents the level of significance at 1%, 5% and 10%, respectively

development is the dependent variable. Durban- Watson, ARCH LM, and Breusch-Godfery LM tests are used to check the autocorrelation. In contrast, heteroscedasticity is checked through Cameron & Trivedi's and Breusch Pagan tests. The results of all tests are almost insignificant for economic growth, carbon emission, and human development in the majority of the models. Hence, there is no issue of heteroscedasticity and autocorrelation.

Table 6: ARDL estimations – Carbon emission as dependent variable

CO_2	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
ADJ	−1.075*	−0.902***	−0.903**	−1.028***	−0.945*	−1.357**	−0.738**	−0.935***	−0.951*
	(0.032)	(0.000)	(0.003)	(0.000)	(0.014)	(0.009)	(0.008)	(0.000)	(0.027)
Long run									
EG	−0.5711***	−0.5651***	−0.5340**	−0.6202***	−0.5312***	−0.6272***	−0.5693***	−0.5758***	−0.5254***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
HDI	−1.0530	−0.2780	−2.6054	1.8309	−0.3922	1.8288	−1.1152	−0.1435	−0.2484
	(0.73)	(0.85)	(0.58)	(0.23)	(0.87)	(0.28)	(0.78)	(0.96)	(0.94)
L	0.2972	0.3623	0.0496	0.6170	0.1658	0.5785	0.4784	0.4123	0.1034
	(0.62)	(0.53)	(0.96)	(0.27)	(0.85)	(0.21)	(0.60)	(0.42)	(0.87)
K	−0.0180	−0.0084	−0.0165	−0.0037	−0.0119	−0.0033	−0.0145	−0.0060	−0.0135
	(0.89)	(0.25)	(0.27)	(0.12)	(0.48)	(0.84)	(0.57)	(0.39)	(0.36)
EC	0.9412***	0.9773***	0.8802**	1.0611***	0.9683***	1.0548***	0.9609***	0.9816***	0.9859***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LIFE	4.1072	2.8291*	5.3984**	0.2596**	2.8177**	0.7252***	2.6406	2.7154**	2.8226**
	(0.25)	(0.09)	(0.01)	(0.02)	(0.02)	(0.00)	(0.52)	(0.01)	(0.02)
VA	0.0139		−0.0647						
	(0.79)		(0.67)						
PS		0.0008	−0.0077						
		(0.84)	(0.47)						
GE				−0.0947*		−0.0823*			
				(0.06)		(0.07)			
RQ					−0.0028	0.0012			
					(0.96)	(0.97)			
LAW							0.0301		−0.0050
							(0.56)		(0.90)
CC								−0.0067	−0.0080
								(0.86)	(0.90)
Short run									
Δ EG	−0.4057	−0.5071	−0.4954	−0.4469	−0.3544	−0.3461	−0.2177	−0.5771*	−0.2836
	(0.17)	(0.10)	(0.17)	(0.15)	(0.27)	(0.40)	(0.54)	(0.07)	(0.43)
Δ HDI	0.5980	0.6066	0.0814	1.6945	1.3545	2.2229	0.0361	0.7638	−1.0073
	(0.83)	(0.82)	(0.98)	(0.53)	(0.67)	(0.50)	(0.99)	(0.79)	(0.74)
Δ L	−1.2124	−1.1846	−1.2877	−0.9605	−1.0773	−0.8163	−1.1539	−0.9641	−0.5936
	(0.11)	(0.11)	(0.13)	(0.16)	(0.22)	(0.35)	(0.11)	(0.20)	(0.47)
Δ K	−0.0086	−0.0090	−0.0079	−0.0093	−0.0103	−0.0106	−0.0112	−0.0033	−0.0023
	(0.30)	(0.22)	(0.42)	(0.29)	(0.20)	(0.32)	(0.19)	(0.73)	(0.83)
Δ EC	0.8240***	0.8551***	0.7881**	0.9377***	0.7994**	0.8793**	0.6803**	0.9428***	0.7099**
	(0.01)	(0.00)	(0.02)	(0.01)	(0.01)	(0.03)	(0.04)	(0.00)	(0.04)
Δ LIFE	2.0195	2.0296	1.7149	2.7398*	1.4299	2.3560	1.6543	1.8949	1.0666
	(0.20)	(0.16)	(0.35)	(0.08)	(0.42)	(0.29)	(0.27)	(0.21)	(0.49)
Δ VA	0.0038		−0.0158						
	(0.95)		(0.86)						
Δ PS		0.0032	0.0006						
		(0.62)	(0.94)						
Δ GE				−0.0914*		−0.0853**			
				(0.07)		(0.03)			
Δ RQ					−0.0386	−0.0299*			
					(0.57)	(0.05)			
Δ LAW							−0.0119		0.0109
							(0.73)		(0.83)
Δ CC								−0.0334	−0.0522
								(0.42)	(0.24)
Constant	−15.8417	−10.4380	−13.4422	−6.2152	−8.1723	−9.6442	−8.8292	−11.0834	−7.5456
	(0.40)	(0.32)	(0.53)	(0.60)	(0.63)	(0.50)	(0.61)	(0.41)	(0.60)
N	23	23	23	23	23	23	23	23	23
R-square	0.919	0.911	0.893	0.931	0.916	0.937	0.921	0.915	0.920
F-statistics									

EG stands for economic growth, CO_2 is the carbon emission, HDI stands for human development index, L and K are labor and capital, EC is the energy consumption, EDU depicts education. LIFE shows life expectancy. In governance indicators, VA, PS, GE, RQ, LAW and CC represents the voice and accountability, political stability, governance effectiveness, regulatory quality, law and corruption control, respectively. "( )" contains the *P* values. ***,**,* presents the level of significance at 1%, 5% and 10%, respectively

4.5.2. Dynamic ARDL estimations

To examine the current and lagged effect of study variables on economic growth dynamic ARDL estimation is used and results are presented in Table 11. It can be seen that the current effect of carbon emission is insignificant which means carbon emission in the current year does not affect the economic growth of the

Table 7: ARDL estimations – Human development as dependent variable

HDI	Model 19	Model 20	Model 21	Model 22	Model 23	Model 24	Model 25	Model 26	Model 27
ADJ	−1.021***	−1.093***	−1.040**	−0.650**	−1.139***	−1.274***	−1.155***	−1.218***	−1.098**
	(0.001)	(0.001)	(0.002)	(0.009)	(0.000)	(0.000)	(0.001)	(0.001)	(0.005)
Long run									
EG	0.0358	−0.0020	0.0045	0.0324	0.0031	−0.0020	0.0114	0.0003	0.0099
	(0.24)	(0.97)	(0.88)	(0.74)	(0.89)	(0.93)	(0.77)	(0.99)	(0.77)
CO_2	0.0638	0.0099	−0.0027	0.0968	0.0099	−0.0046	0.0223	0.0294	0.0613
	(0.24)	(0.89)	(0.95)	(0.48)	(0.75)	(0.87)	(0.71)	(0.51)	(0.31)
L	0.0178	0.0594	−0.0209	0.1706	0.0280	0.0183	0.0396	0.1195	0.1329
	(0.79)	(0.44)	(0.78)	(0.56)	(0.77)	(0.76)	(0.57)	(0.21)	(0.19)
K	−0.0021*	−0.0027*	−0.0020	0.0018	−0.0019	0.0003	−0.0023*	0.0000	−0.0006
	(0.10)	(0.05)	(0.21)	(0.53)	(0.15)	(0.62)	(0.08)	(0.98)	(0.63)
EC	−0.0952*	−0.0453	−0.0358	−0.1096	−0.0433	−0.0257	−0.0590	−0.0620	−0.0947
	(0.09)	(0.52)	(0.43)	(0.42)	(0.19)	(0.40)	(0.33)	(0.18)	(0.13)
LIFE	0.7932***	1.0391**	0.9672***	0.7437	1.1302***	1.3004***	0.8313**	0.9976***	1.0188***
	(0.00)	(0.01)	(0.00)	(0.12)	(0.00)	(0.00)	(0.03)	(0.00)	(0.00)
VA	−0.0028		−0.0111						
	(0.72)		(0.45)						
PS		−0.0001	−0.0010						
		(0.92)	(0.35)						
GE				−0.0157		0.0001			
				(0.65)		(0.99)			
RQ					0.0057*	0.0127***			
					(0.07)	(0.00)			
LAW							0.0034		0.0021
							(0.34)		(0.62)
CC								−0.0017	0.0047
								(0.75)	(0.43)
Short run									
Δ EG	0.0530	0.0483	0.0385	0.0111	0.0325	0.0801**	0.0426	0.0452	0.0658*
	(0.17)	(0.40)	(0.46)	(0.79)	(0.24)	(0.04)	(0.42)	(0.22)	(0.09)
Δ CO_2	−0.0731**	−0.0294	−0.0212	−0.0412	−0.0272	−0.0378	−0.0471	−0.0194	−0.0355
	(0.04)	(0.62)	(0.33)	(0.14)	(0.12)	(0.33)	(0.36)	(0.74)	(0.19)
Δ L	0.0556	0.0082	0.0352	0.0728	0.0115	0.0216	0.0105	0.0386	0.0305
	(0.40)	(0.92)	(0.67)	(0.56)	(0.84)	(0.38)	(0.90)	(0.97)	(0.75)
Δ K	0.0022**	0.0025**	0.0022**	0.0120	0.0019*	0.0237	0.0024**	0.0149**	0.0156**
	(0.02)	(0.01)	(0.05)	(0.47)	(0.05)	(0.17)	(0.01)	(0.02)	(0.04)
Δ EC	0.0523*	−0.0032	−0.0567	−0.0541	−0.0498	−0.0056	0.0134	0.0818**	0.0625*
	(0.08)	(0.96)	(0.24)	(0.28)	(0.38)	(0.73)	(0.82)	(0.04)	(0.08)
Δ LIFE	−0.0947	−0.0518	−0.0942	0.0488	0.0830	0.0713	−0.1302	−0.1226	−0.1338
	(0.67)	(0.80)	(0.71)	(0.83)	(0.69)	(0.81)	(0.49)	(0.55)	(0.53)
Δ VA	0.0008		0.0059						
	(0.91)		(0.57)						
Δ PS		0.0001	0.0010						
		(0.88)	(0.26)						
Δ GE				0.0092		0.0097			
				(0.52)		(0.33)			
Δ RQ					0.0012**	0.0069**			
					(0.04)	(0.03)			
Δ LAW							−0.0023		0.0040
							(0.61)		(0.55)
Δ CC								0.0045	−0.0042
								(0.43)	(0.52)
Constant	−3.1475*	−4.6934*	−2.8701	−3.5580	−4.8756**	−6.1966***	−3.8039	−6.2773**	−6.0091**
	(0.07)	(0.07)	(0.15)	(0.26)	(0.02)	(0.00)	(0.11)	(0.03)	(0.03)
N	23	23	23	23	23	23	23	23	23
R-square	0.925	0.934	0.911	0.636	0.942	0.885	0.942	0.764	0.827
F-statistics									

EG stands for economic growth, CO_2 is the carbon emission, HDI stands for human development index, L and K are labor and capital, EC is the energy consumption, EDU depicts education. LIFE shows life expectancy. In governance indicators, VA, PS, GE, RQ, LAW and CC represents the voice and accountability, political stability, governance effectiveness, regulatory quality, law and corruption control, respectively. "( )" contains the *P* values. ***,**,*Presents the level of significance at 1%, 5% and 10%, respectively

U.S. However, in just two models, lagged impact of carbon emission on economic growth is significant. The same is the case with human development and labor as almost all models are showing insignificant current and lagged effects on economic growth. However, five out of nine models are showing that the current effect of capital on economic growth is significant and

Table 8: ARDL diagnostics – Economic growth as dependent variable

Diagnostics- EG as Dep	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Autocorrelation									
Durbin-Watson	2.461	2.674	2.430	2.502	1.806	2.553	2.424	2.439	1.866
ARCH LM	0.265	0.636	0.854	0.334	0.104	0.491	0.635	0.859	0.268
Breusch-Godfrey LM	0.028	0.003	0.056	0.005	0.880	0.003	0.041	0.038	0.958
Heteroskedasticity									
Cameron & Trivedi's	0.402	0.402	0.402	0.402	0.402	0.402	0.402	0.402	0.402
Breusch Pagan	0.271	0.026	0.012	0.884	0.873	0.832	0.310	0.688	0.930
Normality									
Pr (Skewness)	0.674	0.102	0.303	0.723	0.939	0.326	0.315	0.613	0.184
Pr (Kurtosis)	0.475	0.593	0.167	0.163	0.288	0.525	0.941	0.862	0.420
Pnorm	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Qnorm	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Stability									
Cusum	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
Structural break									
Recursive	0.285	0.288	0.351	0.369	0.230	0.395	0.224	0.439	0.279
Ols	0.383	0.313	0.286	0.293	0.396	0.264	0.367	0.375	0.382

Table 9: ARDL diagnostics – Carbon emission as dependent variable

Diagnostics- CO_2 as Dep	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
Autocorrelation									
Durbin-Watson	2.30454	2.385	2.236	2.487	2.433	2.594	2.338	2.303	2.311
ARCH LM	0.758	0.862	0.080	0.362	0.998	0.647	0.422	0.675	0.840
Breusch-Godfrey LM	0.006	0.003	0.228	0.021	0.006	0.004	0.014	0.002	0.033
Heteroskedasticity									
Cameron & Trivedi's	0.402	0.402	0.402	0.402	0.402	0.402	0.402	0.402	0.402
Breusch Pagan	0.562	0.650	0.852	0.390	0.768	0.457	0.626	0.804	0.754
Normality									
Pr (Skewness)	0.313	0.622	0.717	0.543	0.550	0.698	0.728	0.747	0.513
Pr (Kurtosis)	0.318	0.922	0.004	0.258	0.515	0.152	0.289	0.449	0.919
Pnorm	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Qnorm	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Stability									
Cusum	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
Structural break									
Recursive	0.399	0.320	0.553	0.308	0.497	0.376	0.386	0.520	0.397
Ols	0.388	0.330	0.299	0.408	0.426	0.320	0.415	0.400	0.395

Table 10: ARDL diagnostics – Human development as dependent variable

Diagnostics- HDI as Dep	Model 19	Model 20	Model 21	Model 22	Model 23	Model 24	Model 25	Model 26	Model 27
Autocorrelation									
Durbin-Watson	3.072	3.061	2.720	2.371	2.914	2.370	3.182	1.774	2.143
ARCH LM	0.054	0.048	0.970	0.271	0.030	0.675	0.037	0.593	0.835
Breusch-Godfrey LM	0.000	0.000	0.010	0.084	0.002	0.226	0.000	0.673	0.158
Heteroskedasticity									
Cameron & Trivedi's	0.402	0.402	0.402	0.402	0.402	0.402	0.402	0.402	0.402
Breusch Pagan	0.002	0.016	0.309	0.011	0.175	0.784	0.001	0.060	0.043
Normality									
Pr (Skewness)	0.951	0.944	0.246	0.890	0.755	0.796	0.704	0.591	0.613
Pr (Kurtosis)	0.725	0.564	0.577	0.677	0.586	0.153	0.133	0.443	0.373
Pnorm	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Qnorm	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Stability									
Cusum	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable
Structural break									
Recursive	0.330	0.563	0.467	0.348	0.416	0.333	0.333	0.224	0.385
Ols	0.309	0.331	0.326	0.316	0.335	0.344	0.320	0.270	0.252

positive which suggests that capital in the current year results in increased economic growth, however, capital in the previous year doesn't affect economic growth in the current year. Likewise, energy consumption is also significantly and positively related to economic growth in the current effect but lagged effect is insignificant. Contrary to this, only lagged effect of life expectancy

Table 11: Dynamic simulated ARDL estimations – Economic growth as dependent variable

EG	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
CO_2	−0.7317	−0.6564	−0.5035*	−0.7922**	−0.9890***	−0.4209	−0.9661**	−1.1042***	−0.9689***
	(−1.62)	(−1.24)	(−1.92)	(−2.65)	(−6.32)	(−0.96)	(−2.89)	(−5.52)	(−5.22)
HDI	3.4334	4.2231	5.6812*	−0.5823	0.0666	0.7076	2.0989	2.5227	1.5331
	(1.62)	(1.06)	(2.07)	(−0.42)	(0.04)	(0.36)	(1.15)	(1.36)	(1.05)
L	−0.2737	−0.3138	−0.3315	1.3362	−0.1092	0.1357	0.1166	−0.2857	0.3358
	(−0.37)	(−0.41)	(−0.49)	(1.61)	(−0.16)	(0.13)	(0.20)	(−0.39)	(0.49)
K	0.0059	0.0134*	0.0219	0.0121**	0.0038	0.0282*	0.0079*	0.0042**	0.0053
	(0.72)	(1.93)	(1.67)	(2.76)	(0.54)	(1.98)	(1.97)	(2.90)	(0.65)
EC	0.8425*	0.7385	0.7183***	0.8348**	1.0195***	0.5463	1.0072**	1.2294***	1.0532***
	(1.84)	(1.50)	(3.31)	(2.80)	(6.22)	(1.31)	(2.82)	(6.12)	(6.28)
LIFE	−2.4139	−3.5320	−5.4055	1.2050	3.3909	0.4941	2.1091	−1.1990	1.7832
	(−0.83)	(−0.67)	(−1.43)	(0.64)	(1.52)	(0.19)	(1.08)	(−0.45)	(0.87)
VA	0.0090		−0.0482						
	(0.11)		(−0.66)						
PS		−0.0040	−0.0025						
		(−0.71)	(−0.45)						
GE				−0.1824*		−0.2151**			
				(−1.90)		(−2.46)			
RQ					0.0545	0.1345*			
					(1.25)	(2.21)			
LAW							−0.0464		−0.0128
							(−1.31)		(−0.36)
CC								−0.0413	−0.0010
								(−1.15)	(−0.02)
Constant	13.7319	18.7753	23.8923	−20.7718	−8.5750	−4.7566	−6.8852	10.6391	−8.9786
	(0.77)	(0.77)	(1.29)	(−1.49)	(−0.67)	(−0.26)	(−0.53)	(0.61)	(−0.62)
Obs.	23	23	23	23	23	23	23	23	23
R−Square	0.904	0.930	0.917	0.917	0.876	0.955	0.928	0.878	0.892
F-Statistics	7.820	7.647	9.202	9.249	10.173	9.984	10.793	8.673	8.276
Δ CO_2	−0.4780	−0.9364**	−0.9930**	−0.4831	−0.3070	−0.3772	−0.3281	−0.4379	−0.2833
	(−0.99)	(−2.55)	(−2.68)	(−0.96)	(−0.64)	(−0.79)	(−0.72)	(−0.87)	(−0.60)
Δ HDI	−2.6708	−1.2794	−1.1952	−2.6460	−3.9912	−3.6472	−0.7393	−2.7255	−0.9084
	(−1.13)	(−0.74)	(−0.69)	(−1.07)	(−1.67)	(−1.53)	(−0.29)	(−1.04)	(−0.35)
Δ L	−0.6605	−0.5279	−0.4325	−0.3865	−1.2827*	−1.1566	−0.7299	−0.5709	−0.7071
	(−1.33)	(−1.51)	(−1.20)	(−0.70)	(−1.89)	(−1.69)	(−1.55)	(−1.10)	(−1.46)
Δ K	−0.0007	0.0034	0.0085	0.0082	0.0054	0.0080	−0.0018	0.0048	0.0000
	(−0.05)	(0.38)	(0.84)	(0.63)	(0.44)	(0.64)	(−0.14)	(0.34)	(0.00)
Δ EC	0.2026	0.6214	0.6848*	0.2690	0.0319	0.1526	0.1747	0.1869	0.1450
	(0.40)	(1.63)	(1.78)	(0.50)	(0.06)	(0.30)	(0.36)	(0.35)	(0.29)
Δ LIFE	3.6358	4.2540**	4.1462**	2.6354	5.8288**	5.2912*	3.5898*	3.3786	3.3945
	(1.71)	(2.78)	(2.71)	(1.13)	(2.19)	(1.97)	(1.80)	(1.51)	(1.64)
Δ VA	0.1233		−0.0986						
	(1.19)		(−1.06)						
Δ PS		−0.0211***	−0.0252***						
		(−4.11)	(−3.93)						
Δ GE				−0.0687		−0.0996			
				(−0.72)		(−1.08)			
Δ RQ					0.1114	0.1272			
					(1.52)	(1.71)			
Δ LAW							−0.0766*		−0.0887*
							(−1.86)		(−1.88)
Δ CC								0.0177	−0.0362
								(0.29)	(−0.57)
N	23	23	23	23	23	23	23	23	23
R-square	0.919	0.958	0.961	0.914	0.923	0.929	0.928	0.912	0.929
F-statistics	21.187	42.990	38.642	19.923	22.454	20.319	24.069	19.318	20.466

EG stands for economic growth, CO_2 is the carbon emission, HDI stands for human development index, L and K are labor and capital, EC is the energy consumption, EDU depicts education. LIFE shows life expectancy. In governance indicators, VA, PS, GE, RQ, LAW and CC represents the voice and accountability, political stability, governance effectiveness, regulatory quality, law and corruption control, respectively. "( )" contains the t-statistics. ***,**,*Presents the level of significance at 1%, 5% and 10%, respectively

is significant but the current effect is insignificant. He and Li (2020) also found the same type of positive association between life expectancy and economic growth. It can be seen that the majority of dimensions of governance are not related to economic growth, however, lagged affect political stability and rule of law is significant and negative whereas, the current effect of governance effectiveness is significant and negative. This suggests that these variables are decreasing economic growth.

Table 12 shows the Dynamic simulated ARDL estimations for carbon emission as dependent variables and it can be observed that the current effect of economic growth on carbon emission is not only significant in all models but also negative which means, economic growth in the U.S is not a problem for the environment anymore. Alexander-Kearns and Cassady (2015) also mentioned that in America, carbon emission is decreasing rapidly. However, it can be seen that energy consumption is increasing carbon emission

Table 12: Dynamic simulated ARDL estimations – Carbon emission as dependent variable

CO_2	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
EG	−0.6138*	−0.5099***	−0.4819**	−0.6374***	−0.5022**	−0.8514**	−0.4199**	−0.5386***	−0.4994**
	(−2.12)	(−4.17)	(−2.88)	(−4.94)	(−2.90)	(−2.94)	(−2.66)	(−3.81)	(−2.37)
HDI	−1.1318	−0.2509	−2.3514	1.8817	−0.3707	2.4826	−0.8226	−0.1342	−0.2361
	(−0.37)	(−0.20)	(−0.63)	(1.17)	(−0.18)	(0.96)	(−0.30)	(−0.06)	(−0.07)
L	0.3195	0.3269	0.0448	0.6342	0.1567	0.7853	0.3528	0.3857	0.0983
	(0.50)	(0.64)	(0.06)	(1.17)	(0.20)	(1.27)	(0.56)	(0.80)	(0.17)
K	−0.0194	−0.0075	−0.0149	−0.0038	−0.0113	−0.0045	−0.0107	−0.0056	−0.0128
	(−1.55)	(−1.32)	(−0.94)	(−0.70)	(−1.03)	(−0.76)	(−1.51)	(−0.93)	(−1.20)
EC	1.0116*	0.8819***	0.7944**	1.0905***	0.9153**	1.4319**	0.7087**	0.9182***	0.9372*
	(2.26)	(6.15)	(2.67)	(6.19)	(2.71)	(3.17)	(2.82)	(5.69)	(2.21)
LIFE	4.4146	2.5528*	4.8722*	0.2668**	2.6635	0.9844**	1.9476*	2.5400**	2.6832
	(1.23)	(1.85)	(1.91)	(2.89)	(1.15)	(2.35)	(1.87)	(2.87)	(1.00)
VA	0.0149		−0.0584						
	(0.26)		(−0.44)						
PS		0.0008	−0.0069						
		(0.21)	(−0.75)						
GE				−0.0974*		−0.1118*			
				(−1.88)		(−1.98)			
RQ					−0.0026	0.0016			
					(−0.06)	(0.04)			
LAW							0.0222		−0.0048
							(0.64)		(−0.13)
CC								−0.0063	−0.0076
								(−0.18)	(−0.14)
Constant	−15.8417	−10.4380	−13.4422	−6.2152	−8.1723	−9.6442	−8.8292	−11.0834	−7.5456
	(−0.88)	(−1.04)	(−0.65)	(−0.54)	(−0.49)	(−0.71)	(−0.52)	(−0.86)	(−0.54)
N	23	23	23	23	23	23	23	23	23
R−square	0.919	0.911	0.893	0.931	0.916	0.937	0.921	0.915	0.920
F−statistics	7.824	10.296	4.773	13.412	7.554	10.363	8.105	8.977	6.572
Δ EG	−0.2006	−0.2015	−0.2900	−0.1757	−0.4077	−0.3713	−0.2151	−0.1956	−0.2790
	(−0.70)	(−0.63)	(−0.87)	(−0.59)	(−1.46)	(−1.30)	(−0.94)	(−0.66)	(−1.23)
Δ HDI	−0.8306	−0.6273	−0.5156	−0.8091	0.6689	0.4057	−3.9515	−0.7528	−3.5997
	(−0.33)	(−0.24)	(−0.19)	(−0.31)	(0.28)	(0.17)	(−1.73)	(−0.28)	(−1.61)
Δ L	0.0762	−0.0018	0.1249	−0.0913	0.9396	0.8431	0.2723	0.0115	0.2248
	(0.14)	(−0.00)	(0.23)	(−0.16)	(1.39)	(1.21)	(0.64)	(0.02)	(0.54)
Δ K	−0.0082	−0.0130	−0.0063	−0.0141	−0.0117	−0.0137	−0.0008	−0.0122	−0.0047
	(−0.56)	(−0.95)	(−0.40)	(−1.02)	(−0.97)	(−1.09)	(−0.07)	(−0.83)	(−0.41)
Δ EC	0.2525	0.2712	0.3555	0.2186	0.4522	0.3598	0.2693	0.2655	0.3311
	(0.46)	(0.47)	(0.60)	(0.38)	(0.90)	(0.69)	(0.62)	(0.48)	(0.78)
Δ LIFE	0.6388	0.8909	0.7477	1.2455	−2.3882	−1.9768	0.4011	0.8323	0.8073
	(0.28)	(0.38)	(0.32)	(0.51)	(−0.90)	(−0.72)	(0.22)	(0.36)	(0.45)
Δ VA	−0.0836		−0.1309						
	(−0.75)		(−0.92)						
Δ PS		0.0001	−0.0054						
		(0.01)	(−0.55)						
Δ GE				0.0387		−0.0762**			
				(0.38)		(2.82)			
Δ RQ					−0.1423*	−0.1544*			
					(−1.95)	(−2.05)			
Δ LAW							0.1138		0.1390
							(1.05)		(0.42)
Δ CC								−0.0092	0.0753
								(−0.14)	(1.38)
N	23	23	23	23	23	23	23	23	23
R-square	0.808	0.800	0.812	0.802	0.841	0.848	0.877	0.801	0.892
F-statistics	7.872	7.516	6.704	7.608	9.887	8.667	13.348	7.528	12.782

EG stands for economic growth, CO_2 is the carbon emission, HDI stands for human development index, L and K are labor and capital, EC is the energy consumption, EDU depicts education. LIFE shows life expectancy. In governance indicators, VA, PS, GE, RQ, LAW and CC represents the voice and accountability, political stability, governance effectiveness, regulatory quality, law and corruption control, respectively. "( )" contains the t-statistics. ***,**,*Presents the level of significance at 1%, 5% and 10%, respectively

Table 13: Dynamic simulated ARDL estimations – Human development as dependent variable

HDI	Model 19	Model 20	Model 21	Model 22	Model 23	Model 24	Model 25	Model 26	Model 27
EG	0.0366	−0.0022	0.0047	0.0210	0.0035	−0.0025	0.0132	0.0004	0.0109
	(1.40)	(−0.04)	(0.16)	(0.35)	(0.14)	(−0.09)	(0.31)	(0.01)	(0.30)
CO_2	0.0652	0.0108	−0.0029	0.0629	0.0113	−0.0059	0.0258	0.0358	0.0673
	(1.38)	(0.14)	(−0.06)	(0.81)	(0.33)	(−0.16)	(0.40)	(0.72)	(1.24)
L	0.0182	0.0649	−0.0217	0.1108	0.0319	0.0233	0.0458	0.1456	0.1459
	(0.27)	(0.79)	(−0.30)	(0.59)	(0.30)	(0.30)	(0.59)	(1.29)	(1.41)
K	−0.0022*	−0.0029**	−0.0020	0.0011	−0.0022	0.0004	−0.0027*	0.0000	−0.0007
	(−2.07)	(−2.44)	(−1.43)	(0.65)	(−1.74)	(0.50)	(−2.21)	(0.02)	(−0.53)
EC	−0.0972*	−0.0495	−0.0372	−0.0712	−0.0493	−0.0328	−0.0681	−0.0755	−0.1039*
	(−2.15)	(−0.71)	(−0.87)	(−0.91)	(−1.51)	(−0.89)	(−1.11)	(−1.52)	(−1.97)
LIFE	0.8102**	1.1353**	1.0056**	0.4832	1.2877***	1.6563***	0.9603**	1.2153**	1.1182**
	(2.92)	(2.61)	(3.25)	(1.33)	(4.57)	(5.96)	(2.38)	(3.05)	(3.02)
VA	−0.0029		−0.0116						
	(−0.37)		(−0.82)						
PS		−0.0001	−0.0010						
		(−0.10)	(−1.06)						
GE				−0.0102		0.0001			
				(−0.46)		(0.01)			
RQ					0.0064	0.0162***			
					(0.87)	(3.97)			
LAW							0.0040		0.0023
							(0.98)		(0.48)
CC								−0.0021	0.0052
								(−0.32)	(0.87)
Constant	−3.1475*	−4.6934*	−2.8701	−3.5580	−4.8756**	−6.1966***	−3.8039	−6.2773**	−6.0091**
	(−2.07)	(−2.15)	(−1.61)	(−1.19)	(−2.85)	(−3.87)	(−1.83)	(−2.47)	(−2.57)
N	23	23	23	23	23	23	23	23	23
R−square	0.925	0.934	0.911	0.636	0.942	0.885	0.942	0.764	0.827
F−statistics	7.096	6.630	4.781	1.745	9.288	7.724	7.581	3.229	3.320
Δ EG	0.0795***	0.0765***	0.0733***	0.0799***	0.0941***	0.0931***	0.0797***	0.0825***	0.0847***
	(4.74)	(4.17)	(3.74)	(4.62)	(6.22)	(5.91)	(4.81)	(5.00)	(5.22)
Δ CO2	0.1023***	0.0974***	0.0947**	0.1022***	0.1123***	0.1109***	0.1039***	0.1047***	0.1113***
	(3.36)	(3.03)	(2.85)	(3.31)	(4.37)	(4.15)	(3.44)	(3.54)	(3.79)
Δ L	−0.0968***	−0.0980***	−0.0934**	−0.0994***	−0.1652***	−0.1627***	−0.1024***	−0.0928***	−0.0986***
	(−3.09)	(−3.20)	(−2.89)	(−2.96)	(−4.51)	(−4.25)	(−3.30)	(−3.08)	(−3.31)
Δ K	−0.0020**	−0.0021**	−0.0019*	−0.0021**	−0.0022***	−0.0021***	−0.0023**	−0.0018**	−0.0020**
	(−2.29)	(−2.67)	(−2.03)	(−2.60)	(−3.29)	(−3.06)	(−2.73)	(−2.14)	(−2.39)
Δ EC	−0.1226***	−0.1185***	−0.1154***	−0.1230***	−0.1350***	−0.1326***	−0.1222***	−0.1253***	−0.1271***
	(−3.82)	(−3.56)	(−3.35)	(−3.72)	(−4.96)	(−4.62)	(−3.86)	(−4.02)	(−4.17)
Δ LIFE	0.2990**	0.3118**	0.3066**	0.3086**	0.5374***	0.5268***	0.3112**	0.2784*	0.2790**
	(2.23)	(2.33)	(2.23)	(2.16)	(3.75)	(3.51)	(2.37)	(2.13)	(2.18)
Δ VA	−0.0015		−0.0048						
	(−0.22)		(−0.57)						
Δ PS		−0.0002	−0.0004						
		(−0.39)	(−0.65)						
Δ GE				0.0006		−0.0020			
				(0.10)		(−0.38)			
Δ RQ					0.0101**	0.0105**			
					(2.57)	(2.52)			
Δ LAW							−0.0018		−0.0038
							(−0.66)		(−1.30)
Δ CC								−0.0037	−0.0060
								(−1.02)	(−1.52)
N	23	23	23	23	23	23	23	23	23
R-square	0.899	0.900	0.902	0.899	0.930	0.930	0.902	0.906	0.916
F-statistics	16.731	16.859	14.346	16.680	24.810	20.817	17.203	17.967	16.885

EG stands for economic growth, CO_2 is the carbon emission, HDI stands for human development index, L and K are labor and capital, EC is the energy consumption, EDU depicts education. LIFE shows life expectancy. In governance indicators, VA, PS, GE, RQ, LAW and CC represents the voice and accountability, political stability, governance effectiveness, regulatory quality, law and corruption control, respectively. "( )" contains the t-statistics. ***,**,*Presents the level of significance at 1%, 5% and 10%, respectively

as the current effect is not only significant in all models but also positive. Sun and Ren (2021) also found that energy consumption affects the environment negatively through increased carbon emission. The same is the case with life expectancy because the current effect of life expectancy on carbon emission is significant as well as positive in the majority of the models. This suggests that with enhanced life expectancy, more carbon gets emitted as Estiri and Zagheni (2019) also asserts that life expectancy and carbon emission are positively related. Besides these factors, some dimensions of governance are showing a significant impact on carbon emission as governance effectiveness is significantly and negatively related to carbon emission in both current and lagged estimations. However, only in lagged effect, regulatory quality is helping to decrease carbon emission whereas the current effect is insignificant.

Table 13 presents the results regarding the human development as dependent variable. In this case, in long run, capital has significant negative impact on human development only in 3 models which means increase in capital reduces the human development. Likewise, it is clear that life expectancy has significant positive impact on human development is majority of the models. This aligns with the results of (Girum et al., 2018) who asserts that life expectancy and human development are positively related. In terms of lagged effect, all variables are significantly related to human development except governance factors from which only regulatory quality is significantly and positively related to human development.

5. DISCUSSION

The main motivation behind this research is to explore different solutions for environmental as well as economic issues faced by the U.S. Hence, based on proper research and evaluation of current literature, it is proposed that life expectancy, as well as governance, are the variables which can help in combating the problems related to sustainable economic development, carbon emission, and human development. As far as life expectancy is concerned, it is noted that it is impacting economic growth positively in the short-run as well as long-run. Also, the current effect of life expectancy is significant and positive which means increasing life expectancy results in increased economic growth. There are multiple ways through which life expectancy can increase economic growth including the effect on economic decisions of people, enhanced investment in human capital, and provision of more labor force. It is argued by He and Li (2020) that the aggregate demand to output ratio gets enhanced through higher life expectancy which encourages individuals to invest in physical capital, the main driver of economic growth. Hence, when people expect that they will live longer, they try to save more money and it is a fact that saving is necessary for economic growth. Besides this, human capital formation gets enhanced through high life expectancy because it is noted that when people expect to live longer they spend more years in education before entering the job market (Kunze, 2014). Hence, with a higher education level, people better serve and this investment in human capital enhances economic growth. Acemoglu and Johnson (2007) provided another channel through which life expectancy enhances economic growth naming more labor force. It is a fact that the labor force is necessary for the development of any economy hence, when life expectancy increases, more people will be available to work which ultimately affects the economic growth positively.

Results also revealed that life expectancy is significantly and positively related to carbon emission which is according to the expectations because, when people get aged they usually try to spend more and more time indoors. However, this increased indoor time increases the amount of energy spend including heating and light Liddle and Lung (2010) which is the main source of carbon emission. Also, Menz and Welsch (2012) assert that when life expectancy increases and people reach older age, they usually try to avoid strict regulations regarding the environment because they believe that the costs they pay for a better environment will not going to benefit them in the future. Also, the taxes related to the environment are generally not accepted by people with old age because they become less concerned about the environment, and hence, this rejection of regulation and taxes affects the environment negatively by increasing carbon emission. It is also noted that life expectancy is affecting human development significantly and positively in the majority of the estimations which suggest that when life expectancy will be higher, human development takes place rapidly. This can be explained through different channels and consideration given to education is one of these. As life expectancy increases, people usually try to invest and spend more on education, and through more years of education they can get better jobs and their overall wellbeing will be enhanced. Hence, it can be said that life expectancy increases human development through education. Because good health as well as enhanced professional preparation, through education, are essential elements of human development (Kabiru et al., 2013).

Besides life expectancy, the current study also proposed good governance as a tool to enhance economic growth, and human development while decreasing carbon emission. From different dimensions of good governance, it is noted that governance effectiveness is significantly and negatively related to carbon emission in all estimations. Hence, it shows that with effective governance structure carbon emission can be controlled in the U.S. The main channel through which effective governance impacts carbon emission is through reduction of bureaucracy as when decisions would be taken by public representatives, they will try to act for the betterment of the public instead of their self-interest, and hence, proper policies would be formulated regarding the environment. Also, the confidence of producers as well as firms gets enhanced when there is better governance in terms of financial integrity and efficient public service. This will enable the government to implement and enforce strong environment-related laws and ultimately carbon emission will decrease. Additionally, Sarpong and Bein (2020) mentioned that transparency in organizational processes can be ensured through control over unethical practices which can only be achieved through effective administration. Additionally, effective governance ensures the reduction of fraud as well as resource misuse which results in better protection of the environment and the ultimate result will be reduced carbon emission by organizations and communities (Azam and Khan, 2017). Another dimension of governance in the current study is the regulatory quality which is significantly and negatively associated with carbon emission in two estimations. This is according to the expectation because, when the documentation process would be quick and simple, producers will be encouraged to fulfill the requirements in terms of environmental protection. Hence, carbon emissions from production firms will be decreased (Sarpong and Bein, 2020). However, in absence of high-quality regulations, strict and complicated regulations including tax and licensing fees will result in increased emission as producers follow bad environmental practices to reduce the production cost, and hence emissions will be high.

It is also observed that regulatory quality is significantly and positively related to human development which means regulatory quality is an essential element for human development in the U.S. The main reason for this positive association is the fact that regulatory quality ensures that how government, as well as private agencies, are operating for social purposes. Alongside, it makes institutions accountable for promoting and protecting human rights so that people can participate in decision-making freely. It is also noted that through this dimension, public policy is shaped and goods and services are provided to the public by enabling officials as well as institutions to exercise authority in the proper way (Ahmad, 2015). Although life expectancy and governance are the main points of concern in the current study, however, some explanatory variables are also included in the analysis for better understanding. It is noted that from these variables, energy consumption shows a significant and positive impact on both economic growth and carbon emission. This is an obvious result because, it is a fact that a high amount of carbon is released just due to the consumption of energy-related products including oil, gas, etc. Wu et al. (2020). However, there are some benefits for energy consumption as well because according to (Gozgor et al., 2018) many sectors including industrial, and agriculture are essential for economic growth, however, it is also a fact that these sectors consumes a high amount of energy. Hence, economic growth cannot be achieved without energy use.

6. CONCLUSION

The main purpose of the current study is to explore the nexus between life expectancy, sustainable economic development, carbon emission, and human development in the United States. Alongside, it is also checked the relationship between good governance, sustainable economic development, carbon emission, and human development of United States. Though some researchers tried to explore the impact of different variables on life expectancy, however, none of them try to check how life expectancy can enhance economic as well as human development and how it can be used to reduce carbon emission. Likewise, there is a lack of research regarding the impact of governance on sustainable economic development, carbon emission, and human development in the United States. Hence, there is a need to explore these relationships in the U.S. For this purpose, Dynamic ARDL estimation is used and results show that life expectancy is significantly helping to reduce carbon emission in the U.S. Also, it is improving overall human development in the country however, economic growth is not affected by enhancing life expectancy. Also, governance effectiveness is proved to be a major factor to reduce carbon emissions in the country. Whereas, regulatory quality is showing a positive impact on human development in the U.S.

Based on results, some important policy implications for the government of the U.S as well as policymakers include more effort towards the governance system of the country so that full benefits can be achieved. It is noted that the majority of the dimensions of governance are not playing any role in the sustainable development of the country which is highlighting a problem in the system which needs to be rectified. Also, it is noted that life expectancy is not playing any part in the economy of the country which means people of higher age groups are not contributing to the economy. The main reason could be the factor that the government is not providing a proper platform for aged people to play their part in the betterment of the economy. It is advised that taking example from Japan, U.S policymakers should follow the same pattern so that the aging population of the country can play part in economic development. Additionally, there is a need to reduce carbon emissions in the country because overall it is impacting the economy negatively. Hence, it is needed to introduce reviewable energy resources including wind, and solar energy, etc. These policy implications will not only result in combating environmental externalities but also enhance economic and human development in the U.S.

REFERENCES

Abbasi, K.R., Adedoyin, F.F., Abbas, J., Hussain, K. (2021), The impact of energy depletion and renewable energy on CO_2 emissions in Thailand: Fresh evidence from the novel dynamic ARDL simulation. Renewable Energy, 180, 1439-1450.

Academy, C.L. (2011), Sustainable economic development sustainable economic development. Energies, 1-12.

Acemoglu, D., Johnson, S. (2007), Disease and development: The effect of life expectancy on economic growth. Journal of Political Economy, 115(6), 925-985.

Acheampong, A.O., Boateng, E., Amponsah, M., Dzator, J. (2021), Revisiting the economic growth-energy consumption nexus: Does globalization matter? Energy Economics, 2021, 105472.

Adamczyk, M., Betlej, A., Gondek, J., Ohotina, A. (2019), Technology and sustainable development: Towards the future? Entrepreneurship and Sustainability Issues, 6(4), 2003-2016.

Adams, R., Kewell, B., Parry, G. (2018), Blockchain for Good? Digital Ledger Technology and Sustainable Development Goals. World Sustainability Series. Germany: Springer. p. 127-140.

Adedoyin, F.F., Gumede, M.I., Bekun, F.V., Etokakpan, M.U., Balsalobre-lorente, D. (2020), Modelling coal rent, economic growth and CO_2 emissions: Does regulatory quality matter in BRICS economies? Science of the Total Environment, 710, 136284.

Adedoyin, F.F., Ozturk, I., Bekun, F.V., Agboola, P.O., Agboola, M.O. (2021), Renewable and non-renewable energy policy simulations for abating emissions in a complex economy: Evidence from the novel dynamic ARDL. Renewable Energy, 177, 1408-1420.

Ahmad, N. (2015), Governance, globalisation, and human development in Pakistan. The Pakistan Development Review, 44(4), 585-594.

Ahmed, M.M., Shimada, K. (2019), The effect of renewable energy consumption on sustainable economic development: Evidence from emerging and developing economies. Energies, 12(15), 1-15.

Alexander-Kearns, M., Cassady, A. (2015), Cutting Carbon Pollution While Promoting Economic Growth. Center for American Progress. Available from: https://www.americanprogress.org/issues/green/reports/2015/05/27/113865

Ameyaw, B., Yao, L. (2018), Analyzing the impact of GDP on CO_2 emissions and forecasting Africa's total CO_2 emissions with non-assumption driven bidirectional long short-term memory. Sustainability, 10(9), 3110.

Azam, M., Haroon Hafeez, M., Khan, F., Abdullah, H. (2019), Impacts of education and life expectancy on economic growth: Panel data evidence from developing economies. Pakistan Journal of Social

Sciences (PJSS), 39(4), 1629-1639.

Azam, M., Khan, A.Q. (2017), Growth-corruption-health triaca and environmental degradation: Empirical evidence from Indonesia, Malaysia, and Thailand. Environmental Science and Pollution Research, 24(19), 16407-16417.

Bass, S., Dalal-Clayton, B. (2002), Sustainable Development Strategies. Abingdon: Routledge.

Bechtel, G., Bechtel, T. (2020), GDP and human development. Open Journal of Social Sciences, 08(11), 333-343.

Belbute, J.M., Pereira, A.M. (2020), Reference forecasts for CO_2 emissions from fossil-fuel combustion and cement production in Portugal. Energy Policy, 144, 111642.

Berawi, M.A. (2019), The role of industry 4.0 in achieving sustainable development goals. International Journal of Technology, 10(4), 644-647.

Bhanumurthy, N., Prasad, M., Political, R.J.-E. (2018), Public expenditure, governance and human development. Economic Political Weekly, 53(14), 36-46.

Cordero, E.C., Centeno, D., Todd, A.M. (2020), The role of climate change education on individual lifetime carbon emissions. PLoS One, 15(2), 1-23.

Current Health Expenditure (% of GDP). (2020), The World Bank. Available from: Available from: https://data.worldbank.org/indicator/sh.xpd.chex.gd.zs

Danish, Baloch, M.A., Wang, B. (2019), Analyzing the role of governance in CO_2 emissions mitigation: The BRICS experience. Structural Change and Economic Dynamics, 51, 119-125.

Davis, T.J. (2017), Good governance as a foundation for sustainable human development in sub-Saharan Africa. Third World Quarterly, 38(3), 636-654.

Emara, N., El Said, A. (2021), Financial inclusion and economic growth: The role of governance in selected MENA countries. International Review of Economics Finance, 75, 34-54.

Estiri, H., Zagheni, E. (2019), Age matters: Ageing and household energy demand in the United States. Energy Research and Social Science, 55, 62-70.

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.

Fast Facts 1990-2018 National-Level U.S Greenhouse Gas Inventory. (2019), Available from: https://www.epa.gov/sites/production/files/2021-04/documents/fastfacts-1990-2019.pdf.pdf

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

Greenhouse Gas Emissions. (2019), EPA. Available from: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks

Halkos, G.E., Tzeremes, N.G. (2013), Carbon dioxide emissions and governance: A nonparametric analysis for the G-20. Energy Economics, 40, 110-118.

He, L., Li, N. (2020), The linkages between life expectancy and economic growth: Some new evidence. Empirical Economics, 58(5), 2381-2402.

Ilyas, M., Ahmad, H.K., Afzal, M., Mahmood, T. (2010), Determinants of manufacturing value added in Pakistan: An application of bounds testing approach to cointegration. Pakistan Economic and Social Review, 48(2), 209-224.

Jordan, S., Philips, A.Q. (2018), Cointegration testing and dynamic simulations of autoregressive distributed lag models. Stata Journal, 18(4), 902-923.

Kabiru, C., Izugbara, C., Beguy, D. (2013), The health and wellbeing of young people in Sub-Saharan Africa: An under-researched area? BMC International Health and Human Rights, 13(1), 11.

Kardos, M. (2012), The reflection of good governance in sustainable development strategies. Procedia - Social and Behavioral Sciences, 58, 1166-1173.

Keser, A., Gökmen, Y. (2018), Governance and human development: The impacts of governance indicators on human development. Journal of Public Administration and Governance, 8(1), 26.

Khan, M.I., Teng, J.Z., Khan, M.K., Jadoon, A.U., Khan, M.F. (2021), The impact of oil prices on stock market development in Pakistan: Evidence with a novel dynamic simulated ARDL approach. Resources Policy, 70, 101899.

Kunze, L. (2014), Life expectancy and economic growth. Journal of Macroeconomics, 39(PA), 54-65.

Kutan, A.M., Paramati, S.R., Ummalla, M., Zakari, A. (2018), Financing renewable energy projects in major emerging market economies: Evidence in the perspective of sustainable economic development. Emerging Markets Finance and Trade, 54(8), 1762-1778.

Le, H.P., Bao, H.H.G. (2020), Renewable and nonrenewable energy consumption, government expenditure, institution quality, financial development, trade openness, and sustainable development in Latin America and Caribbean emerging market and developing economies. International Journal of Energy Economics and Policy, 10(1), 242-248.

Liddle, B., Lung, S. (2010), Age-structure, urbanization, and climate change in developed countries: Revisiting STIRPAT for disaggregated population and consumption-related environmental impacts. Population and Environment, 31(5), 317-343.

Life Expectancy of the World Population. (2021), Worldometer. Available from: https://www.worldometers.info/demographics/life-expectancy

Luo, W., Xie, Y. (2020), Economic growth, income inequality and life expectancy in China. Social Science Medicine, 256, 113046.

Lutfi, M. (2016), The digital archive. Academic Journal of Economic Studies, 2, 55-63.

Mehta, A.M., Qamruzzaman, M., Serfraz, A., Ali, A. (2021), The role of remittances in financial development: Evidence from nonlinear ARDL and asymmetric causality. Journal of Asian Finance, Economics and Business, 8(3), 139-154.

Menz, T., Welsch, H. (2012), Population aging and carbon emissions in OECD countries: Accounting for life-cycle and cohort effects. Energy Economics, 34(3), 842-849.

Molthan-Hill, P., Robinson, Z.P., Hope, A., Dharmasasmita, A., McManus, E. (2020), Reducing carbon emissions in business through responsible management education: Influence at the micro-, meso- and macro-levels. International Journal of Management Education, 18(1), 100328.

Morita, S., Zaelke, D. (2007), A Review of Empirical Studies on Environmental Compliance. In: Seventh International Conference on Environmental Compliance and Enforcement. p9-10.

Muliadi, M., Darma, D.C., Kasuma, J. (2020), MSMEs as mediation in the effects of investment credit, interest rates, and labor on economic growth. International Journal of Finance Banking Studies (2147-4486), 9(2), 1-12.

Namahoro, J.P., Wu, Q., Xiao, H., Zhou, N. (2021), The asymmetric nexus of renewable energy consumption and economic growth: New evidence from Rwanda. Renewable Energy, 174, 336-346.

Nathaniel, S.P. (2020), Modelling urbanization, trade flow, economic growth and energy consumption with regards to the environment in Nigeria. GeoJournal, 85(6), 1499-1513.

Omri, A., Ben Mabrouk, N. (2020), Good governance for sustainable development goals: Getting ahead of the pack or falling behind? Environmental Impact Assessment Review, 83, 106388.

Perron, P. (1989), The great crash, the oil price shock, and the unit root hypothesis. Econometrica: Journal of the Econometric Society, 57, 1361-1401.

Personal, M., Archive, R. (2017), Governance and Sustainability. Oxfordshire: Routledge. p92544.

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

Rahman, A., Saadi, S. (2008), Random walk and breaking trend in financial series: An econometric critique of unit root tests. Review of Financial Economics, 17(3), 204-212.

Rjoub, H., Odugbesan, J.A., Adebayo, T.S., Wong, W.K. (2021), Investigating the causal relationships among carbon emissions, economic growth, and life expectancy in turkey: Evidence from time and frequency domain causality techniques. Sustainability (Switzerland), 13(5), 2924.

Rodriguez-Alvarez, A. (2021), Air pollution and life expectancy in Europe: Does investment in renewable energy matter? Science of The Total Environment, 792, 148480.

Saad, W., Kalakech, K. (2009), The nature of government expenditure and its impact on sustainable economic growth. Middle Eastern Finance and Economics, 1(4), 39-47.

Said, S.E., Dickey, D.A. (1984), Testing for unit roots in autoregressive-moving average models of unknown order. Biometrika, 71(3), 599-607.

Saidi, K., Omri, A. (2020), The impact of renewable energy on carbon emissions and economic growth in 15 major renewable energy-consuming countries. Environmental Research, 186, 109567.

Sarkodie, S.A., Adams, S. (2020), Electricity access, human development index, governance and income inequality in Sub-Saharan Africa. Energy Reports, 6, 455-466.

Sarkodie, S.A., Owusu, P.A. (2020), How to apply the novel dynamic ARDL simulations (dynardl) and Kernel-based regularized least squares (krls). MethodsX, 7, 101160.

Sarkodie, S.A., Strezov, V., Jiang, Y., Evans, T. (2019), Proximate determinants of particulate matter (PM2.5) emission, mortality and life expectancy in Europe, Central Asia, Australia, Canada and the US. Science of The Total Environment, 683, 489-497.

Sarpong, S.Y., Bein, M.A. (2020), The relationship between good governance and CO_2 emissions in oil- and non-oil-producing countries: A dynamic panel study of Sub-Saharan Africa. Environmental Science and Pollution Research, 27(17), 21986-22003.

Sarwar, S. (2019), Role of urban income, industrial carbon treatment plants and forests to control the carbon emission in China. Environmental Science and Pollution Research, 26(16), 16652-16661.

Shaheen, A., Sheng, J., Arshad, S., Salam, S., Hafeez, M. (2020), The dynamic linkage between income, energy consumption, urbanization and carbon emissions in pakistan. Polish Journal of Environmental Studies, 29(1), 267-276.

Sun, W., Ren, C. (2021), The impact of energy consumption structure on China's carbon emissions: Taking the Shannon-Wiener index as a new indicator. Energy Reports, 7, 2605-2614.

United Nations. (2020), Sustainable Development Report 2020. United Nations. Available from: https://unstats.un.org/sdgs/report/2020/.

Versteijlen, M., Perez Salgado, F., Janssen Groesbeek, M., Counotte, A. (2017), Pros and cons of online education as a measure to reduce carbon emissions in higher education in the Netherlands. Current Opinion in Environmental Sustainability, 28, 80-89.

Waheed, M., Alam, T., Ghauri, S.P. (2006), Structural Breaks and Unit Root: Evidence from Pakistani Macroeconomic time Series Structural Breaks and Unit Root: Evidence from Pakistani Macroeconomic Time Series. MRPA Paper 1797.

Waheed, R., Chang, D., Sarwar, S., Chen, W. (2018), Forest, agriculture, renewable energy, and CO_2 emission. Journal of Cleaner Production, 172, 4231-4238.

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.

Wang, Z., Danish, Zhang, B., Wang, B. (2018), Renewable energy consumption, economic growth and human development index in Pakistan: Evidence form simultaneous equation model. Journal of Cleaner Production, 184, 260.

Wu, H., Xu, L., Ren, S., Hao, Y., Yan, G. (2020), How do energy consumption and environmental regulation affect carbon emissions in China? New evidence from a dynamic threshold panel model. Resources Policy, 67, 101678.

Zaidi, A. (2015), Ageing and Development. Available from: https://hdr.undp.org/en/content/ageing-and-development

Zhang, L., Godil, D.I., Bibi, M., Khan, M.K., Sarwat, S., Anser, M.K. (2021), Caring for the environment: How human capital, natural resources, and economic growth interact with environmental degradation in Pakistan? A dynamic ARDL approach. Science of The Total Environment, 774, 145553.

Zivot, E., Andrews, D.W.K. (1992), Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. Journal of Business and Economic Statistics, 10(3), 251-270.

APPENDIX

Appendix A

Table A1: Data description

Notation	Description	Source
EG	GDP (current US$)	WDI
CO_2	CO_2 emissions (kg per 2010 US$ of GDP)	WDI
HDI	Human development index	HDR
L	Population, total	WDI
K	Gross fixed capital formation (annual % growth)	WDI
EC	Energy use (kg of oil equivalent per capita)	WDI
LIFE	Life expectancy at birth, male (years) + female (years)	WDI
VA	Voice and Accountability: Estimate	WDI
PS	Political Stability and Absence of Violence/Terrorism: Estimate	WDI
GE	Government Effectiveness: Estimate	WDI
RQ	Regulatory Quality: Estimate	WDI
LAW	Rule of Law: Number of Sources	WDI
CC	Control of Corruption: Estimate	WDI