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Impact of Economic Progress, Energy Consumption and Carbon Dioxide Emissions on Life Expectancy: Evidence from Asia and Africa

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Abstract: *In today's society, determining living standards requires taking into account life expectancy. Thus, a key concern for policymakers is the analysis of life expectancy characteristics. The life expectancy is evaluated using the panel quantile regression model across many quantile ranges, including 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, and 0.95. From 2000 through 2018, the study examines the effects of economic progress, energy use, and carbon dioxide releases on life expectancy across Asia and Africa. The analysis shows that CO2 emanations and life expectancy are intimately linked across all life expectancy quantiles. The impact of economic progress on life expectancy is negative in all except 0.95 quantiles. Additionally, except for the higher quantile (0.95), there is a negative and significant correspondence between hydroelectricity usage and life expectancy in the low and higher quantile series. The findings have thus shown beneficial impacts on life expectancy in low, medium, and greater quantities of petroleum and other liquid consumption. The outcomes suggest boosting the corporate structure to increase productivity and development. However, implementing a clean form of energy sources, i.e., renewable energy and technological efforts, need to employ excellently, contributing to environmental sustainability and a healthy ecosystem.*

Introduction

Every person has the right to a qualified, healthy life with a reasonable life expectancy free from illness and disability. The elements determining the character of health and the motivating reasons to pursue healthy lifestyles include life expectancy at birth and postnatal mortality (Starfield *et al.*, 1999). Health indicators are a measure of people's overall health and have a vital role in raising the development index. The most immediately noticeable benefit of better health is fewer illness days, which results in higher productivity, more job options, and longer working lives. Previous studies have identified a number of factors as health indicators (Emamgholipour and Asemane, 2016), including the mortality rate among children under five, the 65-year-old life expectancy rate, the life expectancy at birth, and maternal morbidity and mortality (Gitobu et al., 2018; Wang et al., 2018).

Life expectancy is the average number of years expected to accomplish that age for each individual. One of the primary standards for determining how well society is doing now is the index, which helps advanced societies live longer than average lifespans. As a result, life expectancy may be regarded as one of the most crucial health indicators, having a major impact on social welfare, human capital, and economic expansion (Crimmis and Zhang, 2019). However, in some cases, life expectancy has no influential impact on welfare but is considered the major contributor to economic growth, evidenced in previous research (Acemoglu and Johnson, 2007). Nevertheless, life expectancy is improving by intensifying health costs and distressing GDP per capita (He and Li, 2019; Shafi and Fatima, 2019). Okunade and Osmani (2020) argued that many previous studies have been in favor of survival rate as the utmost crucial contributor to per capita economic growth, while life expectancy with growing health costs negatively influences per capita income.

In the discussion of education and human capital, income and life expectancy are mainly influenced by investment in education and human capital. Long life expectancy and rising income are attained by financing human capital and education (Maitra, 2018). However, not as much education, training, and human capital lead to diminutive life expectancy. It is found that people with less education and training have a short life expectancy (Oster *et al.,* 2012). In concern of life expectancy, economic and social indicators affect individual and community health. Life expectancy is influenced by economic indicators such as economic growth and social factors such as welfare. In evidence of 199 countries, improvement in physicians' number, water access, and equitable income distribution positively influenced healthiness and life expectancy (Johanson, 2005). In contrast, it is evident that the death rate increases in economies with excessive income inequality (Lenthe and Mackenbach, 2015). However, life expectancy's key indicator is GDP per capita, which helps in its progression. In the evidence of Spain and Italy, the enhanced economic progression leads to an escalation in life expectancies. Simultaneously, better life expectancy provides a progression in economic activity (Felice *et al.,* 2016). In the developing country of Bangladesh, life expectancy is improved by economic progression. The rising per capita economic progression progresses the health status of Bangladesh (Zaman *et al.,* 2017).

The need for energy, supply, usage, and environmental concerns like carbon dioxide emissions are critical for health and life expectancy in this contemporary era of industrialization. Energy consumption, however, is one of the most important measures since it affects both individual and collective health. However, it is observed that excessive use of energy actually lowers life expectancy by releasing carbon gas, which pollutes the environment (Wang *et al.,* 2020). In Pakistan, nonrenewables are majorly utilized energy types. These energy indicators have excessive carbon dioxide discharges due to their excessive demand and usage, which is worrisome for environmental sustainability. The environment's deterioration results in serious illnesses, poor health, and a shorter life span. However, energy use has a detrimental impact on life expectancy and health, whereas economic development has a beneficial impact on both (Wang *et al.,* 2020). There is evidence that Pakistan's financial development is strengthened by economic expansion, which raises life expectancy.

Conversely, life expectancy is influenced by consuming different forms of energy and environmental effects. Mainly, there are two forms of energy used in the consumption process: renewable and non-renewable. However, these two types of energies are further divided into sub-types. For example, in discussing residential energy, past research has examined its influence on life expectancy at birth in China. The findings have figured that residential coal consumption negatively influences life expectancy, as it increases environmental pollution. In contrast, residential electricity consumption positively affects life expectancy in rural areas compared with urban areas. Therefore, electricity consumption is opposed to coal consumption in terms of environmental pollution, which leads to better health circumstances in China (Wang *et al.,* 2019). However, fossil fuel energy, the non-renewable energy form that consumes coal and gas, causes tuberculosis and death in sub-Saharan Africa. In contrast, renewable energy consumption is a sustainable energy type that mitigates carbon and nitrogen dioxide emissions, leads to environmental cleanliness, lessens mortality, and enhances life expectancy. Feeding nonrenewable energies such as coal, oil, and natural gas emits carbon dioxide, negatively affecting human health over a long period. In distinction, income and urban population confidently influence human health in the long run (Ahmad *et al.,* 2018). Oil exports elevate conservational pollution and implications of carbon secretions while offering the required income to enhance life expectancy. However, life expectancy negatively influences by oil exports in the long run (Agbanike *et al.,* 2019). In evidence of Pakistan, oil, gas, and coal increase carbon dioxide emanations, depriving environmental conditions. However, the high intakes of these non-renewables and environmental pollution cause measles and tuberculosis, which eventually surge mortality (Asghar *et al.,* 2020).

After the evidence of past studies, the importance of life expectancy and human health is understandable. Economic progression is the central indicator to measure life expectancy and health status. However, environmental factors and energy consumption are not negligible in measuring life expectancy. Moreover, past studies do not have as much evidence to prove the combined effects of energy consumption, economic progression, and carbon releases on life expectancy, especially for large samples of Asia and Africa. This research further follows as the second section contains the method and materials. The third section discusses the outcomes and the fourth section concludes the research with valuable suggestions.

Method and Materials

Empirical Models, Data, Variables, and Description

This research examines the impact of carbon secretions, economic progress and energy consumption on life expectancy in Asian and African nations. However, the countries' detail is in table 1 given below:

Table 1. Region-wise Countries

Continent	Country
Africa	Algeria, Angola, Cameroon, Cote d'Ivoire, Congo, Gabon, Ghana, Kenya, Namibia, Nigeria, South Africa, Sudan, Togo, Zambia, and Zimbabwe.
Asia	Bangladesh, Cambodia, China, India, Jordan, Kazakhstan, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, Turkey, Uzbekistan, and Vietnam.

The description of these coefficients, with measuring units and sources, is specified below in Table 2:

Table 2. Variables Description and Sources

Coefficient	Variable Name	Measuring Unit	Data Sources
LFE	Life expectancy at birth	Total (years)	World Bank
ECP	Economic Progress	GDP per capita constant at 2010 prices	World Bank
CEM	Carbon dioxide emissions	Metric tons per capita	World Bank
HYD	Hydroelectricity Consumption	Btu	Energy Information Administration
POL	Petroleum and Other Liquids Consumption	Btu	Energy Information Administration

Notes: Annual data of all variables over the years 2000-2018.

Succeeding previous studies of Xu and Lin (2016) and Davino *et al.* (2013), the conditional quantile equation is equated below as follows:

$$LFE_{it} = \alpha_i + \xi_t + \beta_1 ECP_{it} + \beta_2 CEM_{it} + \beta_3 HYD_{it} + \beta_4 POL_{it} \quad (1)$$

In equation 1 above, the conditional quantile equation of life expectancy reliant on explanatory variables is presented. The empirical model is equated with examining the influence of hydroelectricity energy, petroleum and other liquids, economic progress and carbon secretions on life expectancy. However, equation 1 is adjusted as below equation 2 to measure the influence of independent variables on the various quantiles of life expectancy:

$$Q_{LFE_{it}}(\tau|\alpha_i, \xi_t, x_{it}) = \alpha_i + \xi_t + \beta_{1\tau} ECP_{it} + \beta_{2\tau} CEM_{it} + \beta_{3\tau} HYD_{it} + \beta_{4\tau} POL_{it} \quad (2)$$

In equation 2 above, the constraints of quantile regression are $Q\tau$ in the life expectancy (LFE). The quantile regression parameters of independent coefficients are indicated as $\beta_{1\tau}$...., $\beta_{4\tau}$. However, energy is taken into two forms in the empirical model: renewable energy as hydroelectricity consumption (HYD) and non-renewable energy as petroleum and other liquids (POL). This panel quantile regression model estimates the influence of hydroelectricity energy, petroleum and other liquids, economic progress and carbon secretions on life expectancy for a large sample of African and Asian countries over the period 2000-2018. However, the countries are selected based on data availability, detailed information on variables, and life expectancy.

Results and Discussion

In this section 3, the results are estimated based on the empirical model and discussed with economic and past studies-based reasoning. This section consists of a descriptive statistics summary, unit root testing, and Panel quantile regression to examine the influence of hydroelectricity energy, petroleum and other liquids, economic progress and carbon secretions on different quantiles of life expectancy in Asia and Africa.

A Descriptive Statistical Summary of Variables

Initially, a descriptive summary is employed to quantify all variables' statistical worth. All variables' statistical fitness is indicated through different statistical aspects such as variables' direction, peakedness and probability. The below table 3 shows the descriptive statistical summary of selected indicators, which are interpreted below as follows:

Table 3. Descriptive Statistical Summary

Variables	LFE	ECP	CEM	HYD	POL
Mean	1.890	3.640	3.699	0.253	1.311
Minimum	1.697	1.760	0.016	0.001	0.004
Q1(0.25)	1.792	3.490	2.884	0.026	0.392
Median	1.741	3.826	3.641	0.093	0.474
Q3(0.75)	1.697	3.996	4.010	0.325	0.501
Maximum	1.893	4.123	16.480	8.490	31.050
Std. dev.	0.059	0.401	1.052	0.615	2.113
Skewness	-1.119	0.107	1.387	3.226	4.072
Kurtosis	3.517	2.228	5.061	26.157	18.150
J.Bera Prob.	0.000***	0.000***	0.000***	0.000***	0.000***

Note: ***, **, and * indicates significance at the 1%, 5%, and 10% level, respectively.

Table 3 above illustrates that each variable has a statistical significance. The designated indicators are distinct in the statistical term. However, the variations in variables following their mean points are indicated by standard deviation values. In terms of skewness, LFE is negatively skewed, while ECP, CEM, HYD, and POC positively direct their mean points. Moreover, the kurtosis values of LFE, CEM, HYD, and POL are greater than three and have a high peak, and fatter tails lead to leptokurtic. However, the kurtosis value of ECP is less than 3, with fewer peaked and thin tails than the normal distribution, leading to platykurtic. Finally, the Jarque-Bera probability significant *** values confirm that the overall model is statistically significant and fulfils the model's normalization requirements.

Panel Unit Root Testing

This critical step applies the unit root to variables to measure stationary order. Following different unit root tests, first, apply the Fisher ADF and then Fisher PP to find the variables' exact stationarity level. Further, Im, Pesaran, and Shin (IPS) are applied, followed by Im *et al.* (2003).

Table 4. Panel Unit root Tests for Stationarity

Variables	Levels	Fisher ADF		Fisher PP		IPS		Decision
		Constant	Trend and Constant	Constant	Trend and Constant	Constant	Trend and Constant	
LFE	Level	57.895***	78.589***	130.161***	175.561***	–11.008***	–19.007***	I(0)
	1st Diff	–	–	–	–	–	–	
ECP	Level	–	–	–	–	–	–	
	1st Diff	79.991***	87.890***	126.201***	156.917***	–9.919***	–11.002***	I(1)
CEM	Level	–	–	–	–	–	–	
	1st Diff	79.308***	156.838***	234.989***	458.129***	–11.107***	–16.706***	I(1)
HYD	Level	80.600***	93.808***	196.889***	301.007***	–8.004***	–9.956***	I(0)
	1st Diff	–	–	–	–	–	–	
POL	Level	–	–	–	–	–	–	
	1st Diff	125.019***	250.155***	435.889***	675.007***	–11.014***	-6.101***	I(1)

Note: ***, **, and * indicates significance at the 1%, 5%, and 10% level, respectively.

Table 4 above has identified the variables' stationarity level following Fisher ADF, Fisher PP, and IPS techniques. According to the outcomes of all stationarity techniques, we have seen that life expectancy (LFE) is integrated at a level. At the same time, hydroelectricity consumption (HYD) followed the same path and had an order of integration I(0). On the other hand, economic progress (ECP), carbon secretions (CEM) and petroleum and other liquids (POL) are integrated at the first difference I(1). The inclusive outcomes following all panel unit root tests have identified mixed order of integration among indicators of interest, leading to the P-quantile regression model for empirical assessment.

Panel Quantile Regression Model

In this section 3.3, a panel quantile regression model is applied to examine the influences of economic progress, carbon gas releases, hydroelectricity and petroleum and other liquids on life expectancy in developing economies of Asian and African regions. However, the empirical model has been assessed in several quantiles (5^{th}, 10^{th},…………………,90^{th}, 95^{th}). Therefore, the findings of the panel quantile regression model, which also includes the outcomes of fixed OLS, are presented below in Table 5.

Table 5. Panel Quantile Regression and Fixed OLS Model Results

Dependent Variable: LFE Quantiles: 0.05 - 0.95												
Variables	0.05	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	0.95	Fixed OLS
EGP	–0.060***	–0.051***	–0.043***	–0.029***	–0.025***	–0.015***	–0.007*	-0.006	–0.009*	-0.004	0.032***	–0.031***
CEM	–0.004**	–0.005***	–0.006***	–0.005***	–0.004***	–0.004***	–0.006***	–0.004***	–0.003***	–0.002***	–0.002*	–0.006***
HYD	–0.039***	–0.036***	–0.026***	0.004	0.003	0.003	0.001	0.002	–0.006***	–0.006***	-0.004	–0.016***
POL	0.006***	0.005***	0.003***	0.002	0.001**	0.000	0.002*	0.001	0.004***	0.003***	0.002*	0.004***
Pseudo R2	0.589	0.580	0.599	0.589	0.600	0.555	0.499	0.600	0.597	0.509	0.530	0.757

Note: ***, **, and * indicates significance at the 1%, 5%, and 10% level, respectively.

In table

5 above, economic progress (EGP) negatively influences life expectancy (LFE) in all regressed quantiles, from 0.05 to 0.90, while positive in 0.95 quantiles. However, economic progression positively influences life expectancy in higher quantiles, indicating that the positive influence of economic growth has a longer variation on life expectancy than the negative influences of other quantiles. According to table 3.3, the EGP value is 0.032 at the 95^{th} quantile, which illustrates that a 1 per cent progress in economic activity enhances life expectancy by 0.03 per cent. Some past studies have experienced the encouraging influence of economic progress on life expectancy in Bangladesh, Italy, and Spain (Felice *et al.*, 2016; Zaman *et al.*, 2017). Thus, fixed OLS directs that life expectancy is reduced when economic activities are progressed in selected economies of Asian and African regions. Carbon dioxide secretions (CEM) negatively affect life expectancy in entire quantiles, from 0.05 to 0.95. However, the measurements of fixed OLS have revealed the negative effect of carbon gas releases on life expectancy in all countries of selected Asian and African regions. Motherlands with average life expectancy are thus moderate, with comparable emission levels. In contrast, countries with comparatively higher life expectancies are sometimes more pollutant-emitting because of new technology and progress towards cleaner technologies to reach higher income. The estimated outcomes illustrate that the carbon secretions are more substantial in 0.10 to 0.90 quantiles by means of a 1 per cent significance level. Nevertheless, in starting quantile of 0.05, CO_2 significantly reduced life expectancy at a 5 per cent level. At the same time, in the highest quantile of 0.95, CO_2 emanations negatively

reduced life expectancy by 10 per cent. According to the higher quantiles of 0.95, a 10 per cent increase in carbon dioxide emissions reduces life expectancy by 0.002 per cent, a slight decrease in life expectancy. However, carbon dioxide emissions significantly reduce life expectancy, evidenced by past studies (Nkalu and Edeme, 2019; Wang *et al.*, 2019; Asghar *et al.*, 2020; Wang *et al.*, 2020; Murthy *et al.*, 2021).

Hydroelectricity (HYD) ingestions expressively diminish life expectancy in some quantiles, from 0.05, 0.10, 0.20, 0.80, and 0.90. However, hydroelectricity intake is inconsequential in intermediate and higher quantiles such as 0.30, 0.40, 0.50, 0.60, 0.70, 0.80, and 0.95. It means that the hydroelectricity consumption is not significant at a higher level to affect life expectancy. However, a 1 per cent intensification in hydroelectricity ingestion meaningfully lessens life expectancy by 0.016 per cent, evidenced by the fixed OLS outcomes. In this research, hydroelectricity consumption is taken as the proxy of renewable energy, but the estimates of HYD are not up to the mark to confirm its existence. The reason is that this study has proposed a large sample of countries, and most of them have not benefited from renewable energy sources such as hydroelectricity. However, countries consuming renewable sources have not reached the desired level to stabilize. That's why hydroelectricity consumption negatively affects life expectancy in some quantiles while mostly insignificant. It seems to be that the affiliation between hydropower consumption and expectations of life is negative in many countries in Asia and Africa with low life expectancy. A critical analysis shows that the majority of them are low development and that more hydroelectricity is generated and consumed as it hinders the distribution of water to food production and basic needs life expectancy. On either side, clean energy has a major impact in every fast-lived country consuming other kinds of renewable energy, i.e., solar and wind energy. At the same time, environmental problems associated with the building of dams and hydroelectric power stations can hurt life expectancy compared with other clean energy sources.

Petroleum and other liquid consumption (POL) positively influence life expectancy in countries of Asian and African continents. The panel quantile regression analysis in table 3.3 shows that the petroleum and other nonrenewable liquids are insignificant in 0.30, 0.50, and 0.70 quantiles while positively enhancing the life expectancy in low, medium, and higher quantiles. However, the fixed OLS has shown that with the 1 per cent escalation in petroleum and other liquid ingestion, the expectancy of life increases by 0.004 per cent. At the same time, petroleum and supplementary liquids slightly enhance the life expectancy in 0.95 quantiles at a 10 per cent significance level. Preserving petroleum and other liquids as assets in nations with oil resources may increase life expectancy effectively by providing people comfort and peace of mind. Even nations that lack oil resources have been able to retain their primary position as the main factor for the economy's expansion. This brings the inhabitants of both regions greater prosperity, health, and life expectancy.

Conclusion and Suggestions

The prevailing research inspected the influence of carbon dioxide secretions, economic growth, and renewable and nonrenewable energy ingestion on life expectancy in Asian and African countries over the period 2000 to 2018. Renewable energy is taken in hydroelectricity consumption, while the nonrenewable form is in use as petroleum and other liquids. Further, carbon secretions and economic progress are controlled variables to keep influencing life expectancy in countries of Asia and Africa. According to the verdicts of the suggested Panel Quantile Regression method, economic progress and carbon dioxide emissions negatively influence life expectancy. However, economic progress positively affects life expectancy in a high quantile of 0.95. Fixed-OLS outcomes revealed the destructive impact of economic progression and carbon gas releases on life expectancy. Renewable energy as hydroelectricity consumption, negatively influences life expectancy with no indication in 0.95 quantiles, while non-renewable energy, such as petroleum and other liquids, positively contributes to life expectancy. In fixed OLS findings, hydroelectricity consumption negatively and petroleum and other liquids positively contribute to life expectancy. The existing research following the outcomes endorsed that administrations and legislators of Asian and African economies should boost the corporate structure to increase productivity and development. This, however, may lead to ecological harm that can be brought into being by implementing a clean form of energy sources, i.e., renewable energy. Technological efforts must be made to excellently employ renewable sources, contributing to environmental sustainability and a healthy ecosystem of emerging Asian and African economies.

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