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Conditional Effect of Environmental Degradation and Institutional Environment on Human Development in Developing Countries: Evidence from Method of the Moment-Quantile Regression with Fixed Effect

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ABSTRACT

The study examines the conditional effect of environmental degradation and institutional environment on the conditional distribution of human development, using the method of the moment quantile regression technique with fixed effect, fully modified ordinary least square and dynamic ordinary least square estimators. The study uses strongly balanced data from 20 developing countries with the full data from 1996 to 2021. The findings confirmed heterogenous effects of environmental degradation and institutional environment on human development. The results reveals that lower environmental degradation promote human development across all levels of human development, but the effect higher in countries with low human development. The study shows that institutional environment has positive effect across all levels of human development, with higher effect in countries with low human development. The findings for the control variables show that financial development, population growth and FDI promote human development across all levels of human development. However, the strength of the coefficients also increases with higher quantiles. The results also confirmed unidirectional causality running from environmental degradation and institutional environment to human development, while bidirectional causality between financial development and human development. To promote human development, policymakers at developing countries should focus on climate action policies and building strong institutions.

Keywords: Environmental Degradations, Institutional Environment, Human Development, Quantile Regression
JEL Classifications: Q54; O17; O15; C31

1. INTRODUCTION

The world is in uncertain time. Widespread rising cost of living bedevilling economies throughout the world as a result of the covid 19 pandemic, the war in Ukraine and the Arab world crisis, which brought untold suffering to people not only in developing countries but also in developed societies. Even though people have previously battled with pandemics, wars and environmental disasters, but, the destabilising forces of the pandemic, expand the level of inequities and poverty, which slowdown societal progress. That is the new normal (Jesus et al., 2020). According human development report (HDR, 2022) six out of seven people in the world failed to afford the basic requirement of sustaining life during the lockdown period and afterwards, which saw the decline of the global human development index. More than 90% of countries experienced decline in human development index from 2020 to 2021. The troubles of the Covid pandemic coupled with the environmental degradations and volatility in the political environment, continue to threaten the progress recorded in global human development and takes the world aback, especially with regards to sustainable development goals (vision 2030).

Classical economics established that higher per capita income is associated with higher GDP growth, which require the use of more energy, resources, clearing forest and water resources. Thus, achieving higher economic growth is synonymous with burning more fossil fuels, deforestations and destroying biodiversity, which greatly increases greenhouse gas emissions, consequently increases the global warming (Atiku et al., 2021). The report by Intergovernmental Panel on Climate Change (IPCC, 2022) stated that, if the current carbon dioxide (CO_2) methane and nitrogen oxide (NO_2) emissions continue in the world, it will be higher than the benchmark of 1.5° by 2030. Although middle-and low-income developing countries emit less compared to higher income countries, but they are the worst hit by the climate impact. Their population are more vulnerable to environmental degradation, due to living in flood-prone areas, drought areas, using traditional agriculture, or living without access to improved water and sanitation, consequently having low human development. However, efficient allocation of scarce resources is one of the factors that greatly improve living conditions Strong institutional environment control corruption, curb mismanagement, protect property rights, rule of law and implement quality regulations, which have strong correlation with increasing human development (Brady, 2019). It is been argued that institutions determine almost everything in a society, hence, the difference between GDP growth is determine by the level of quality institutions in the society (Ali et al., 2020; Kamalu and Ibrahim, 2022).

This study examines the effect of environmental degradation and institutional environment across the distribution of human development in developing countries, method of the moment quantile regression (MM-QR). Previous studies (Dickerson et al., 2022; Rasoulinezhad et al., 2020; Tariq and Xu, 2022) mostly estimates long run coefficient without digging into the distribution of the human development. Therefore, this study makes important contribution in evaluating the effect of environmental degradation and institutional environment on the conditional distributions of human development. The MMQR with fixed effect use technique of differencing individual effect in the model, and it also provide information on how the independent variables affect the entire conditional distribution of the dependent variable, which is the most appealing aspect of the conditional quantile regression. However, the developing countries in our sample have heterogenous achievement in human development index (HDI), they also differ in terms of emissions and institutional capabilities, hence the choice of MMQR is appropriate for this study. Moreover, another important contribution of this study is the use of interaction of institutional environment to moderate environmental degradation-human development nexus.

The remining paper is structured as follows: Section 2 review relevant literatures; section 3 discusses the methodology and data; section 4 present the results and discussions; in section 5 the study concludes and discusses the policy implications.

2. LITERATURE REVIEW

Traditional growth theories emphasised that growing GDP per capita increase the standard of living, thereby, economic development. This idea was seen as inadequate, because development is multidimensional, hence, cannot be comprehensively measured by GDP per capita alone (Comim, 2016). Streeten (1994) stated that people are the means of achieving development, hence they must be the ends of all development agendas. In his work "Development as Freedom" Sen (1999) argued that the most important things that each societies should do is to provide people with opportunity sets and substantial freedom to live the life they aspire. He called it "capability." The capability approach to human development entails the "beings" and "doing" that people may achieve in order to live quality life. These may include being educated, being healthy, doing inventions, doing work, music etc. According to Sen, capability is the ability to achieve, while functionings are the achieved capabilities. The Capability approach provide a theoretical framework to explain the determinant of human development, not only for humans, but for nonhuman animals (Spatscheck, 2012)

Human Capabilities as Nussbaum (2011) pluralised it, is different from formal freedoms, it is a substantive freedom without any hindrance or obstacle, that provide opportunities for people to lead a life full of happiness. The argument of this study is that quality environment and institutional environment create conditions that directly expand human capabilities to achieve higher functionings, hence, higher human development. Environmental degradation is any alteration or disturbance to the environment that is either detrimental or harmful. It causes air pollution, water pollution, flooding, destruction of biodiversity, draught, extinction of wild life etc., which deteriorate living conditions, increase poverty and inequality. Thus, reduction of environment degradation will improve quality of life. Similarly, quality institutional environment that protect property rights and rule of law, implement quality regulations, control corruption and mismanagement, guarantee freedom and liberty, will create conditions that promote human capabilities, which directly promote human development.

Similarly, Asongu et al. (2018) found that ICT development moderate the negative effect of environmental degradation on human development in Africa. Shanty et al. (2018) show that environmental degradation increases poverty and lower the level of human quality in Indonesia. Also reveal that globalisation and economic growth promote higher human quality in Indonesia. Using a sample of 44 sub-Saharan African countries, Asongu and Odhiambo (2019) examine the effect of environmental degradation on inclusive human development using Fixed effect model, Tobit regression and Generalised Method of the Moment (GMM). The results show that CO_2 emission have positive and negative conditional and unconditional effect on inclusive human development in sub-Saharan African. This result confirmed the existence of threshold effect of environmental degradation on inclusive human development. The study of Rasoulinezhad et al. (2020) reported that increase consumption of fossil fuel have positive and significant effect on mortality rate as a result of chronic respiratory diseases and cancer.

Ahmad et al. (2021) evaluate the relationship between environmental degradation and financial development using the moderating role of human development. The results reveal that human capital conditioned the positive effect of financial development on environmental quality. Moreover, Omri et al.

(2022) examine the effect of environmental degradation on life satisfaction for 36 emerging markets, from 2005 to 2014 using GMM estimator. The results indicate that all the four indicators of environmental degradation have negative and significant effect on life satisfaction. The result also show that use of renewal energy and quality institutions promote life satisfaction. In addition, the results reveal that use of renewal energy reduces the negative effect of environmental degradation on life satisfaction. In another study, Elmassah and Hassanein (2022) found that natural resources abundance have negative link with human development. these findings support the notion of “resource curse”. The study by Dickerson et al. (2022) carried out an extensive literature review of the impact of climate change on human development. The studies they reviewed predicted that climate change can make more than 55 million people food insecure, increases malaria and cholera disease by 134 million cases and expose more than 921 million into water crisis by 2050.

Previous studies that examine the effect of institutions on various macroeconomic variables, found that better institutions promote economic growth (Ahmed et al., 2021; Arefin, 2018; Haini, 2020; Mira and Hammadache, 2017; Saad and Ayoub, 2019; Uddin et al., 2020). Another strand of empirical studies reported that institutions have significant positive effect on human development (Balcerzak and Pietrzak, 2017; Ejuvbekpokpo, 2017; Hashem, 2019; Kamalu and Wan Ibrahim, 2022; Muro and Tridico, 2008). The study of Kouadio and Gakpa (2022) show that quality institutions have negative effect on inequality and poverty, while Ali et al. (2020) found that institutions plays a significant role in enhancing positive effect of official development assistance on human development. However, a study by Ejemeyovwi et al. (2018) reported that ICT development have negative impact on human development, while Mardanov (2020) found that institutions have positive insignificant effect on human development in 22 transitional economies.

The studies reviewed reveal mix coefficients, due to differences in proxies and methods used. Most of these studies uses methods that provide unconditional coefficients. Therefore, this study uses conditional quantile via moment with fixed effect, that examine the effect of regressors on the outcome variable at each distributional quantile.

3. METHODOLOGY AND DATA

This study examines the effect of environmental degradation and institutional environment on conditional distribution of human development in 20 developing countries, selected based on the availability of full data from 1996 to 2021. To achieve this objective, the study employs MM-QR by Machado and Silva (2019). The dependent variable is the human development proxy by Human Development Index (HDI). Human development report categorised all countries into low, medium, high and very high human development. We use the traditional quantile distribution (0.25q, 0.50q, 0.75q and 0.95q) to represent each level of human development respectively. Therefore, countries with low human development are at lower quantile (0.25q), medium human development (0.50q), high human development (0.75q) and very high human development (0.95q). In order to examine the conditional effect of environmental degradation and institutional environment on human development, this study control for financial development, population growth, foreign direct investment (FDI) and inflation.

2. DATA

The variables are explained as follows.

2.1.1. Human development

Human development is the dependent variable in this study, proxy by Human Development Index (HDI). The HDI is considered as comprehensive measure of human development because it captures three important dimensions of well-being: knowledge, health and decent living. The knowledge dimension is measured using average and expected years of schooling. The health dimension is measured by life expectancy at birth and the decent living dimension measured by per capita income growth. The data for HDI is obtained from annual human development report by UNDP. The index is between 0 to 1, with 1 means very high human development, closer to zero means low human development.

2.1.2. Environmental degradation

Environmental degradation is the first variable of interest. Environmental degradation means depletion of natural resources, destruction of biodiversity, environmental pollution and ransacking the ecosystem (Adebayo et al., 2022). This study uses carbon dioxide ($C0_2$) emission per capita and $C0_2$ emission intensity to proxy environmental degradation. Carbon dioxide ($C0_2$) is considered a comprehensive proxy of environmental degradation because it is the major driver of the global greenhouse gas emission, that increases the global warming (Asongu and Odhiambo, 2019; Kousar et al., 2020; Omri et al., 2022). Donohoe (2003) maintained that environmental degradation increase the level of poverty and hunger, capable of plunging world into “Malthusian chaos and disaster”. The level of environmental degradation poses a great risk to recorded progress in human development globally, due to increasing level of pollutions (land, air and water), extreme floods, draught, species extinctions, deforestations, habitat and biodiversity destructions (Dabachi et al., 2020; Shanty et al., 2018). Thus, this study argue that environmental degradation will have negative effect on human development. The data is obtained from World Development Indicators (WDI, 2022).

2.1.3. Institutional environment

Institutions are very important when it comes to the issue of well-being. It is being argued that strong and effective institution is a prerequisite to expanding human capabilities of to achieve higher functioning in life, thereby higher human (Balcerzak and Pietrzak, 2017; Kamalu and Ibrahim, 2021). Institutional environment in this study refers to a collection of legal systems and government regulations that serves as a framework for production, distribution and exchanges. Strong Institutional environment provide a needed framework for efficient distribution of societal resources, protect rule of law and property right, formulates good regulation, control corruption and mismanagement (Carter, 2014). As the second variable of interest, institution is measure by institutional environment index, constructed using the average of rule of law, regulatory quality and control corruption. The data is obtained from World governance Indicators (WGI, 2022). This study expects institutional environment to have positive significant effect on human development.

2.1.4. Control variables

This study employs four control variables that determine human development base on literature. Firstly, financial development proxy by domestic credit to private sector (% of GDP), is an indicator that show the percentage of bank credit that goes to financing business and investment. Thus, countries with higher financial development, found to also have higher level of human development (Datta and Singh, 2019; Matekenya et al., 2020). Secondly, population growth, proxy by annual population growth rate, is an important determinant of human development. Population signifies market and stock of workforce needed for development purposes. The third control variable is Foreign Direct Investment (FDI) measured by FDI inflows (% of GDP). This study expects FDI to have positive effect on human development. The fourth control variable is Inflation, measured by consumer price index (CPI). Inflation is very important macroeconomic variables as it determines other macro variables. Inflation can affect productivity either negatively or positively, depending on the circumstances. The data for all the control variables were obtained from World Development Indicators.

2.1.5. Estimation strategy

To estimate the effect of environmental degradation and institutional environment via MM-QR with fixed effect, the following diagnostic tests and pre-estimation tests are carried out in three stages. First, the study performs homogeneity test, cross-sectional dependence tests, unit root tests and panel cointegration tests. Secondly, the study estimates its models using MM-QR estimator. The study uses Fully Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Square (DOLS) as robust. Thirdly, the study evaluates the causal link between human development, environmental degradations and institutional environment.

2.1.6. Homogeneity

Testing the slope coefficient of panel data is a very important step in achieving efficient outcomes free from sporous regression. Ditzen (2018) maintained that ignoring homogeneity tests to clarify whether the assumption hold or otherwise will lead to bias and incorrect choice of estimation method. Pesaran and Yamagata (2008) provides a homogeneity test with null hypothesis of homogenous slope coefficient. When the null is rejected, it means the panel has heterogenous slope coefficient.

2.1.7. Cross-sectional dependence tests

Even though panel data may exhibit cross-section independent, many of the macroeconomic variables have cross-section dependence due to some unobserved common factors, that are common to all individual cross-section, but may affect them differently. For instance, world oil price, global warming and economic integration. However, ignoring these common factors in modelling, especially when they are correlated with regressors, the standard homogenous estimators may provide misleading results (Henningsen and Henningsen, 2019). Thus, testing cross-section dependency is vital to achieving unbiased, consistent and efficient estimators, because it will serve as a signal to choose the right estimation method. The study uses Pesaran cross-sectional dependence (CD) test and Breusch and Pagan (1980) LM test as follows:

$$LM = T\sum_{i=1}^{N-1}\sum_{j=1+1}^{N}\hat{\rho}_{ij}^{2} \tag{1}$$

This test is valid when N is fixed and $T \rightarrow \infty$, where $\hat{\rho}_{ij}^{2}$ is the Pairwise correlation of the residual. However, Pesaran (2004) provided alternative CD test that is valid for $N \rightarrow \infty$ and sufficiently large T as follows

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i-1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right) \tag{2}$$

The basic difference between the two was that CD statistics has a zero mean N (0,1) at each fixed T and N, whether the model is homogenous or heterogenous dynamic and nonstationary models (De Hoyos and Sarafidis, 2006).

2.1.8. Panel unit root tests

This study uses panel unit root test to examine the stationarity nature of the variables. Based on the CD tests, the study choses second generation tests that account for cross-section dependence. Pesaran (2007) propose a simple cross-section IPS (CIPS) test that account for heterogeneity and cross-section dependency in the panel. The tests have a good small-sample powers compared with other tests based on first generation specifications. Thus, the study use one first generation test based on Maddala and Wu (1999) specification to compare.

2.1.9. Panel cointegration tests

Testing panel cointegration in panel data is important step to determine the long run relationship between the study variables. Several panel cointegration tests exist based on residual (Kao, 1999; Pedroni, 1997) and maximum likelihood (Larsson et al., 2001) tests. However, Westerlund (2007) proposed entirely different new cointegration test based on error correction. This test has advantage over the first-generation tests, as it accounts for cross-sectional dependence in panel data. Thus, this study uses Westerlund (2007) panel cointegration test to evaluate whether the variables move together towards long run equilibrium. We also use Pedroni (1997) test for comparison.

2.1.10. MM-QR

This study use MM-QR with fixed effect to examine the conditional effect of environmental degradation and institutional environment on human development in developing countries. This study argued that the effect of regressors varies across the conditional distribution of human development. The advantage of using MM-QR over unconditional estimators is that MM-QR gives the conditional marginal effect of the regressors at different level of the dependent variable. Therefore, by employing MM-QR this study is able to determine the extent that environmental degradation and institutional environment affect human development in countries with low, medium, high and very HDI. However, even though is possible to achieve that using standard quantile regression method by Koenker and Bassett (1978), MM-QR as proposed by Machado and Silva (2019) takes into account endogeneity and unobserved heterogeneity among the cross-section, via fixed effect, which makes it less bias, consistent and efficient. The model is given by the followings

$$Y_{i,t} = \propto_i + X'_{i,t}\beta + \left(\gamma_i + \grave{W}_{i,t}\,\delta\right)\mu_{i,t} \quad (3)$$

From (3), the dependent variable is $Y_{i,t}$ and $X'_{i,t}$ is the vector of endogenous regressors, while $\mu_{i,t}$ is the unobserved variable orthogonal to the vector of regressors ($X'_{i,t}$), which conform with the moment conditions of Machado and Silva (2019). Moreover, ∞_i is the intercept, β,γ,δ stand for the parameters to be estimated, i is the cross-section at time period t, and $W_{i,t}$ is k-vector component of the regressors, thus, $Pr\left[\sigma\left(\gamma + \grave{W}\,\delta\right) > 0\right] = 1$

$$Q_Y\left(\tau / X\right) = \propto + X'\beta + \sigma\left(\gamma + \grave{W}\,\delta\right)q\left(\tau\right) \quad (4)$$

The quantile distribution of the regressed variable ($Y_{i,t}$) is given by $Q_Y(\tau/X)$ and τ^{th} is the i^{th} quantile. The equation (4) when added the moment condition that represent time invariant individual cross-section characteristics is added, that have varied effect on conditional distribution of the dependent variable, it becomes:

$$Q_Y\left(\tau / X\right) = \left(\propto_i + \gamma_i q(\tau)\right) + \grave{X}_{i,t}\,\beta + \grave{W}_{i,t}\,\delta q\left(\tau\right) \quad (5)$$

Thus, following the work of Wolde-Rufael and Mulat-Weldemeskel (2022) the empirical model of this study is as follows:

$$\begin{aligned} QHDI_{i,t}\left(\tau_k / \propto_i, X_{i,t}\right) &= \propto_i + \beta_{1\tau} ED_{i,t} + \beta_{2\tau} IQ_{i,t} \\ &+ \beta_{3\tau} DC_{i,t} + \beta_{4\tau} PG_{i,t} + \beta_{5\tau} FDI_{i,t} + \beta_{6\tau} IF_{i,t} + \mu_{i,t} \end{aligned} \quad (6)$$

Where, HDI is the human development as the dependent variable; the variable of interest is the environmental degradation (ED) and institutional environment (IE); while the control, financial development (DC), Population growth (PG), foreign direct investment (FDI) and inflation (IF); $\beta_{1\tau}$ to $\beta_{6\tau}$ stand for parameters for i^{th} quantile.

2.1.11. Panel causality test

Although the cointegration tests may suffice to predict the long run relationship between economic variables, testing causality however, provide additional information regarding the nature and the direction of causal link. The classical Granger causality test is based on homogeneity assumption as it ignores heterogeneity and cross-section dependence in the panel (Tugcu, 2018). The work of Dumitrescu and Hurlin (2012) proposed a heterogenous non-Granger panel causality with good small sample properties and account for cross-section dependency. Therefore, this study uses Dumitrescu and Hurlin (2012) to evaluate the causal link between human development, environmental degradation and institutional environment.

4. RESULTS AND DISCUSSIONS

The empirical strategy of this study involves descriptive statistics, correlation matrix, normality test, homogeneity test, cross-section dependency tests, panel unit root tests and cointegration tests. The models of this study were estimated using MM-QR with fixed effect technique. The FMOLS and DOLS estimates are used as robust. Throughout this study, we use human development proxy by HDI is the dependent variable. The variables of interest are: environmental degradation proxy by co_2 per capita (EDP) and co_2 intensity (EDK) and institutional environment proxy by the average of the governance indicators (IE). The study uses 4 control variables that include financial development (DC), population growth (PG), inflation (IF) and foreign direct investment (FDI).

Table 1 present the descriptive statistics for all the variables. The mean value of EDK is the highest because it is in kilotons (billions), and the minimum (0.374) and maximum (0.81) values of HDI shows wide gap of human development in the sample of countries. Moreover, the minimum (0.155) and maximum (8.439) per capita emission indicates that some of the countries have higher per capita emissions than others. In Table 2, the correlation matrix show that all the independent variables have correlation with the dependent variable, and there is no higher correlation >70%, hence, no multicollinearity in the variables. Table 3 present the Shapiro-Wilk normality test, and the null hypothesis of normal distribution is rejected at 1% in all the variables, which indicate that all the variables are not normally distributed.

In Table 4, the result of Pesaran and Yamagata (2008) homogeneity test rejects the null of homogeneity slope for all variables. This confirmed that the variables of this study have heterogenous slope coefficient. Table 5 present the cross-section dependency tests, the result also rejects the null hypothesis of cross-section independent, and confirmed the cross-section dependency in all the variables at 1% level. Based on these findings, only methods that account for heterogeneity and cross-section dependency will produce efficient and less biased estimators. Table 6, present the results for CIPS unit root test that account for cross-section dependency, and compare it with the Maddala and Wu test. The results show that all the variables achieved stationarity at first difference except FDI that became stationary at level in the CIPS test. These results are the same in Maddala and Wu test except PG and FDI which became stationary at the level. Thus, our variables is the combination of I(1) and I(0).

Table 7 present the result of Westerlund cointegration test, where, the null of no cointegration was rejected in 3 out of 4 statistics

Table 1: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
HDI	480	0.654	0.099	0.374	0.81
EDP	460	2.852	2.144	0.155	8.439
EDK	460	69.82	2.8	10	220
IE	460	−0.271	0.517	−1.556	0.92
DC	479	46.352	37.392	3.907	182.868
PG	480	1.308	0.905	−2.171	3.558
IF	480	7.437	8.243	−7.114	16.374
FDI	480	3.141	3.431	−2.153	32.765

Table 2: Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) LHDI	1.000							
(2) LEDP	0.518	1.000						
(3) LEDT	0.079	0.313	1.000					
(4) IE	0.221	0.486	−0.010	1.000				
(5) LDC	0.174	0.659	0.513	0.469	1.000			
(6) LPG	−0.154	−0.255	−0.168	−0.205	0.209	1.000		
(7) IF	0.003	0.056	−0.025	−0.016	0.069	−0.103	1.000	
(8) LFDI	0.296	0.196	−0.042	0.182	0.030	−0.220	0.013	1.000

Table 3: Shapiro-Wilk normality test

Variable	Obs	W	V	Z	Prob>z
HDI	480	0.931	22.304	7.450	0.000
LEDP	460	0.941	18.567	6.996	0.000
LEDK	460	0.969	9.539	5.401	0.000
IE	460	0.984	4.857	3.785	0.000
LDC	479	0.982	5.905	4.261	0.000
LPG	446	0.809	58.023	9.711	0.000
IF	474	0.960	12.770	6.108	0.000
LFDI	480	0.051	307.666	13.746	0.000

Table 4: Homogeneity test

Null (H_0)	Delta	P-value
Homogenous slope	13.518	0.000
	16.900	0.000

Table 5: Cross-section dependence tests

Variable	Breusch-Pagan LM test	Pesaran CD test
LHDI	3718.83**	60.268***
	(0.00)	(0.00)
LEDP	1768.89***	16.636***
	(0.00)	(0.00)
LEDK	2429.14***	28.905***
	(0.00)	(0.00)
IE	945.68***	−12338
	(0.00)	(0.2173)
LDC	1789.35**	19.777***
	(0.00)	(0.00)
LPG	1284.78***	14.933***
	(0.00)	(0.00)
LFDI	336.24***	3.715***
	(0.00)	(0.00)

***, ** and * stand for 1%, 5% &10% level of significance, and the values in the parenthesis () contains the p-value

at 1% level. In addition, the null hypothesis of no cointegration was rejected in 8 out of the 11 statistics of Pedroni cointegration test in Table 8. These results confirmed that all the variables have long run relationship. This result validates the choice of MM-QR, FMOLS and DOLS in this study. Although the interest of this study is MM-QR, but the long run coefficients are presented for robustness purposes.

Table 9 present the results of MM-QR models. This study examines the conditional effect of environmental degradation and institutional environmental on the distributions of human development (low, medium, high and very high). The study estimates two different models using two different proxies of environmental degradation. We use co2 emission per capita (LEDP) In model 1 and co2 emission intensity (LEDP) in model 2.

Table 6: Panel unit root tests

Variables	Maddala and Wu test		CIPS test	
	Level	1st difference	Level	1st difference
LHDI	36.155	84.514***	2.581	−3.967***
LEDP	48.154	175.01***	1.473	−5.525***
LEDK	46.181	179.69***	2.094	−5.611***
LDC	48.975	101.05***	−1.110	−1.8950**
IE	51.370	185.14***	−0.639	−6.614***
LPG	85.802***	97.636***	0.051	−0.928
LFDI	62.410**	310.49***	−2.177**	−7.732***

***, ** and * stand for 1%, 5% &10% level of significance

Table 7: Cointegration test

Statistic	Value	Z-value	P-value
Gt	−2.322**	−1.458	0.026
Ga	−3.299	5.660	1.000
Pt	−60.600***	−42.811	0.000
Pa	−15.464***	−2.787	0.003

***, **&* stand for 1%, 5% &10% level of significance

The results in model 1 shows that co2 emission per capita (LEDP) have positive and significant coefficients across all the quantiles (0.25q - 0.95q) at 1% level. These results means that 1% increase in environmental degradation will increase human development by 0.13% in countries with low HDI; by 0.108% in countries with medium HDI; by 0.09% in countries with very high human HDI; 0.06% in countries with very high HDI. The coefficients increase from low quantiles to higher quantiles. The findings also support the "green paradox" assertions and also consistent with previous studies (Sadiq et al., 2022; Steinberger et al., 2012).

The results in Table 9 for model 2 shows that co2 emission intensity (LEDK) has significant negative coefficients in 0.50q, 0.75q and 0.95q at 1% level. These results reveals that a 1% decrease in environmental degradation will promote human development by -0.016% in countries with medium HDI, by -0.015 in countries with high HDI and by 0.014 in countries with very high HDI. These findings are consistent with Asongu and Odhiambo (2019; Omri et al. (2022); Tariq and Xu (2022). On the other hand, LEDK is positive and significant in 0.25q at 1% level, which means that a 1% increase in environmental degradation increases the level of human development by 0.018% in countries with low HDI. These findings are consistent with the findings in FMOLS and DOLS estimators in Table 10.

Also in Table 9, the results of the second variable of interest in model 1, institutional environment (IE) has positive and significant coefficients in 0.50q, 0.75q and 0.95q at 1% except for 0.95q

Table 8: Pedroni Cointegration test

Within-Dimension	Statistics	Weighted Statistics	Between-Dimension	Statistic
Panel v-Statistics	2.2488**	3.3965***	Group rho-Statistic	5.6171
	(0.012)	(0.000)		(1.000)
Panel rho-Statistics	−0.2690	4.1182	Group PP-Statistic	−7.5373***
	(0.394)	(1.000)		(0.000)
Panel PP-Statistics	−12.304***	−3.0716**	Group ADF-Statistic	−2.5421**
	(0.000)	(0.001)		(0.000)
Panel ADF-Statistics	−14.268***	−4.2161***		
	(0.000)	(0.000)		

***, ** and * stand for 1%, 5% and 10% level of significance, and the values in the parenthesis () contains the *P* value

Table 9: Method of the Moment Quantile Regression results

DV: LHDI	Location	Scale	0.25Q	0.50Q	0.75Q	0.95Q
Model 1						
LEDP	0.111***	−0.027***	0.130***	0.108***	0.085***	0.067***
IE	−0.083***	0.045***	−0.114***	0.077***	0.039**	0.011*
LDC	−0.001**	0.003*	0.003	0.017**	0.007*	0.004***
LPG	0.042***	−0.010	0.049***	0.041***	0.032***	0.026**
LFDI	0.048***	−0.000	0.046***	0.039***	0.024***	0.019***
IF	−0.002*	−0.003***	−0.001	−0.003**	−0.005***	−0.007***
_CONS	−0.568***	0.130***	−0.657***	−0.552***	−0.442***	−0.359***
Model 2						
LEDK	0.016***	−0.002	0.018***	-0.016***	-0.015***	−0.014***
IE	0.020**	0.008	0.015	0.023*	0.028**	0.031**
LDC	−0.006	0.013*	0.015	0.002	0.006**	0.012**
LPG	0.040***	−0.017**	0.052***	0.035***	0.024***	0.016*
LFDI	0.071***	−0.032***	0.094***	0.061***	0.042***	0.027***
IF	−0.007***	0.000	−0.007***	−0.007***	−0.007***	−0.007***
_CONS	−0.615***	0.106**	−0.692***	−0.581***	−0.516***	−0.464***

***, ** and * stand for 1%, 5% and 10% level of significance

Table 10: Results of the Cointegrating estimators

Variables	FMOLS		DOLS	
	Model 1	Model 2	Model 1	Model 2
LEDP	0.0664***		0.0458**	
LEDK		−0.0597***		−0.1682***
IE	0.0367**	0.0334**	0.0828**	−0.0477***
LDC	0.0324***	0.0385***	0.0189***	−0.0219**
LPG	−0.0323***	−0.0225**	−0.0219	−0.0318***
IF	−0.0013***	−0.0011**	−0.0001	0.0007
LFDI	0.0011*	0.0009	0.0032**	−0.0006
R-squared	−5.7457	−103.04	−23.738	0.9749

***, ** and * stand for 1%, 5% and 10% level of significance

at 10%. These results mean that a 1% increase in institutional environment (IE), increase human development by 0.077% in countries with medium HDI; by 0.039% in countries with high HDI; and by 0.011% in countries with very high HDI. Similarly, in model 2, the institutional environment (IE) has positive and significant coefficients in 0.50q, 0.75q and 0.95q similar to findings in model 1. These findings are consistent with Aloui (2019); Ejuvbekpokpo (2017); Kamalu and Ibrahim (2022a); Muhanji et al. (2018). However, the negative and significant coefficient 0.25q in model 1, means that strong institutional environment deteriorates human development. These findings are also similar with the findings reported in Table 10 for FMOLS and DOLS.

The results for control variables in Table 9, show that financial development (LDC), is positive and significant at 5% in 0.50q, at 10% in 0.75q and at 1% in 0.95q, while insignificant in 0.25q in model 1. The results are similar to that of DOLS in Table 10. The strength of the coefficients increases with higher quantiles. These results mean that a 1% increase in financial development, will increase human development by 0.017% in countries with medium HDI; by 0.007% in countries with high HD; by 0.004% in countries with very high HDI. These findings are in line with findings of Ababio et al. (2020); Datta and Singh (2019); Lenka and Sharma (2020). The coefficients of population growth (LPG) are positive and significant across all the quantiles in model 1 and 2, and higher in countries with low HDI. Similarly, FDI has positive and significant coefficients across all the quantiles in model 1 and 2, but higher in countries with low human HDI. These findings confirmed the assertion of the school of thought that consider FDI as a good injection in developing countries (Akisik et al., 2020; Gökmenoğlu et al., 2018). Lastly, inflation has negative and significant coefficients across all the quantiles

Table 11: Method of the Moment Quantile Regression results with Interactions

DV: LHDI	Location	Scale	0.25Q	0.50Q	0.75Q	0.95Q
Model 1						
LEDP	0.058***	−0.029***	0.080***	0.054***	0.029***	0.013
IE	−0.039***	0.040***	−0.070***	−0.034**	−0.030	0.024
LDC	0.005	0.009**	−0.003	0.006	0.014**	0.019**
LPG	0.026***	−0.005	0.030***	0.025***	0.021***	0.019**
LFDI	0.024***	−0.005	0.027***	0.023***	0.019***	0.016**
IF	−0.001	−0.001*	−0.000	−0.001	−0.002**	−0.003**
LEDP*IE	−0.013	0.027***	0.008	0.066**	0.061***	0.052***
_CONS	0.570***	0.065***	0.519***	0.577**	0.635***	0.672***
Model 2						
LEDK	0.018***	−0.003**	−0.021***	0.018***	0.015***	0.013***
IE	−0.241***	0.102***	−0.332***	−0.222***	−0.145***	−0.076*
LDC	−0.014*	0.005	−0.018*	−0.013*	−0.009	−0.006
LPG	0.017***	−0.004	0.021***	0.017***	0.014***	0.011*
LFDI	0.043***	−0.016***	0.057***	0.040***	0.028***	0.017***
IF	−0.005***	−0.000	−0.005***	−0.005***	−0.005***	−0.006***
LEDK*IE	0.028***	−0.011***	−0.037***	0.025***	0.017***	0.010**
_CONS	0.506***	0.090***	0.427***	0.524***	0.591***	0.652***

***, ** and * stand for 1%, 5% and 10% level of significance

Table 12: Dumitrescu and Hurlin (2012) Panel Heterogenous non-Causality test

Null (H_0)	W-statistics	Direction	Null (H_0)	W-statistics	Direction
LEDP ≠ LHDI	4.4523***	→	LDC ≠ LEDK	4.4785***	→
LHDI ≠ LEDP	6.4319		LEDK ≠ LDC	6.4737	
LEDK ≠ LHDI	4.5084***	→	LPG ≠ LEDK	4.6528	→
LHDI ≠ LEDK	6.5415		LEDK ≠ LPG	8.7104***	
IE ≠ LHDI	4.4575***	→	IF ≠ LEDK	4.3287***	→
LHDI ≠ IE	5.5462		LEDK ≠ IF	5.2341	
LDC ≠ LHDI	3.7369**	↔	LPG ≠ IE	5.5616	→
LHDI ≠ LDC	7.4108***		IE ≠ LPG	3.9641**	
LPG ≠ LHDI	6.7354	→	IF ≠ IE	3.7268**	→
LHDI ≠ LPG	8.0036***		IE ≠ IF	5.0931	
IF ≠ LHDI	2.8598		LFDI ≠ IE	2.2665	→
LHDI ≠ IF	5.5916		IE ≠ LFDI	3.6902**	
LFDI ≠ LHDI	2.2993	→	LPG ≠ LDC	3.7841**	→
LHDI ≠ LFDI	3.6557**		LDC ≠ LPG	2.4610	
IE ≠ LEDP	3.8233**	↔	IF ≠ LDC	4.6730	→
LEDP ≠ IE	4.4444***		LDC ≠ IF	4.3536***	
LPG ≠ LEDP	4.3729***	↔	LFDI ≠ LPG	2.6172	→
LEDP ≠ LPG	8.4218***		LPG ≠ LFDI	4.2674***	
IF ≠ LEDP	4.0009**	→	LFDI ≠ IF	3.5036**	→
LEDP ≠ IF	5.1339		IF ≠ LFDI	2.0069	
IE ≠ LEDK	3.6689**	↔			
LEDK ≠ IE	4.3867***				

***, ** and *stand for 1%, 5% and 10% level of significance

except in 0.25q which insignificant. The results means that higher inflation decreases the human development, by eroding purchasing power and decreases effective demand (Dabachi et al., 2022).

Table 11 present the MM-QR results that estimate the moderating role of institutional environment in the relationship between environmental degradation and human development. The coefficient of interaction reveals positive and significant coefficients across all the quantiles in model 1 and 2 except in low quantiles. Moreover, the coefficients increase with higher quantiles. These findings mean that quality institutional environment reduces the effect of environmental degradation on human development. These findings support the assertion in the literature that strong institutions promote climate action policies that mitigate environmental degradation and achieve sustainability (Godil et al., 2021; Gunarathne et al., 2021; Orcos et al., 2018). Table 12 present the causality results, and it show that there is unidirectional causality running from environmental degradation, institutional environment and financial development to human development. There is also unidirectional causality from human development to population growth and FDI. It also reveals bidirectional causality between financial development and human development, between institutional environment and environmental degradation, and between population growth and environmental degradation.

5. CONCLUSION

This study examines the conditional effect of environmental degradation and institutional environment on human development in developing countries, from 1996 to 2021. The results from the MM-QR confirmed that the effect of environmental degradation and institutional environment is heterogenous across the developing countries. The study concluded that low environmental degradation promotes human development, but the effect is higher in countries with low HDI. The result also reveals that strong institutional environment promote higher human development, and the effect increase with higher quantiles. Moreover, financial development, population growth and FDI have positive effect on human development across all levels of human development, with higher effect in countries with low HDI. Interestingly, these results are robust to results obtained using FMOLS and DOLS, only that MM-QR results are conditional upon the distribution of HDI. In another important findings, this study found that strong institutional environment when in place, reduces the negative effect of environmental degradation on human development in developing countries. The study also confirmed unidirectional causality running from environmental degradation and institutional environment to human development. Where, bidirectional causality was reported between financial development and human development.

The findings of this study present important policy implications for developing countries. The 17 sustainable development goals (SDGs) are all geared towards achieving sustainable development. Therefore, to promote human development in developing countries, policymakers should devise policies that will reduce carbon emissions, thereby mitigate greenhouse effect, hence, lower environmental degradation, especially in countries with low human development. Progressive environmental tax regime, rigorous and all-encompassing renewable energy policies and environmental adaptation strategies should be the priority of policymakers in developing countries. Moreover, developing strong institutional environment has positive implication for increasing human development in developing countries. Policies and programs to control corruption, protect property right, application of rule of law and effective regulatory framework, should be pursued by the policymakers of developing countries.

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