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Abstract

Climate change is one of the most significant market failures transpiring and hampering human development progress. Government intervention is required to correct this market failure to avoid catastrophic repercussions. The UNDP indicated climate change has become a "defining human development issue of our generation" (United Nations Development Program, 2022). Given the threat that climate change poses to human development, it is imperative to find effective ways to mitigate its targeted effects on human development. The study investigates how institutions might assist in reducing the harmful impacts of emissions on human development. Utilizing panel data analysis as the methodological foundation this study uses 36 countries for the time period 2003 to 2018. The results indicate that institutions can be a robust instrument in modulating climate change effects.

Keywords: Climate Change, Institutions, Emissions, Institutional Quality, Inclusive Human Development, Inequality

1. Introduction

Climate change is threatening the advancements being made with inclusive human development. For many decades, countries have been experiencing the challenge of maintaining sustainable and inclusive human development while mitigating climate change. Human development and climate change issues are so significantly integrated that the United Nations Development Program (2022) indicated climate change has become "the defining human development issue of our generation". Climate change and human development cannot be isolated. Human development assists with the necessary skills and technological advancement to mitigate climate change, yet climate change can stagnate these advancement efforts. To ensure both goals with regards to these issues are met a mediator between them is necessary he institutions' role will be significant in combating these issues as a possible mediator. Therefore it is imperative to understand to what extent institutions can assist in modulating climate change's effect on inclusive human development.

Governments' practical usage of their institutions within the transition to low-carbon economies can significantly assist in accelerating the transition within the economic sectors while sustaining human development. If institutions are effective, climate change policies can provide incentives for collective action against climate change mitigation. These institutions are also responsible for assessing climate effects' risk and sensitivity. Given institutions' power, they can assist with addressing climate change impacts and enhancing the resilience of the country and the most vulnerable in society through development interventions to become more adaptive to severe climate events (Mearns & Norton, 2010). Effective implementation of these policies can directly affect economic growth and development (Martí et al., 2022).

These institutions can significantly impact human development should they be of high quality. They can assist citizens in gaining advancements in education and social norms, assisting with economic welfare gains. These gains also assist with economic growth. Kimenyi (2007) indicated that economic growth can be seen as a necessary condition for improvement in the welfare of citizens; however, this statement is not synonymous with poverty reduction. High levels of income do not imply lower levels of poverty; due to this, institutions have a vital role

in reducing the inequality gap that arises by providing fair economic and social policies that are pro-poor growth and display an equal distribution of human development (Kimenyi, 2007) These policies will assist with reducing inequality condition that affects individuals choices concerning the three measures of the Human Development Index (HDI): education, health standards and income. It is, therefore, essential to account for inequality imperatives when assessing human development.

Discussing nexuses such as climate change- human development or climate change – economic growth will not provide policymakers with enough information to make effective decisions. Asungo et al. (2020) suggest that it is necessary to effectively inform policymakers on how policy variables respectively can assist with moderating policy syndromes. When done, it will assist policymakers in using policy variables to attain targeted outcomes. Given the challenges and policy syndromes the world is facing concerning human development, this study examines how institutional quality can assist in modulating climate change's effect on human development. The study further controls for inequality as this affects individual choices regarding human development. There are 36[1] countries used in this study for the time period 2003 to 2018 in a first difference Generalized Methods of Moments model.

2. Literature Review

Inclusive human development plays a significant role in attaining economic growth. As inclusive human development occurs, human capital increases within the economy. Romer (1990) enhances Solow's endogenous growth theory by adding how innovations and new ideas for goods and services can contribute to economic growth. Romer defines technology as ideas or knowledge in the economy available to produce goods or services (Zhao, 2019). Romer (1990) found that human capital contributed significantly to economic growth and development.

[1] Argentina, Austria, Belgium, Bolivia, Canada, Costa Rica, Czech Republic, Denmark, Dominican Republic, Ecuador, Estonia, Finland, France, Germany, Greece, Honduras, Indonesia, Ireland, Israel, Italy, Kazakhstan, Luxembourg, Moldova, Norway, Panama, Paraguay, Peru, Portugal, Russia, Spain, Thailand, Turkey, United Kingdom, United States, Ukraine, Vietnam

Romer's (1990) study indicated that the level of literacy in a country assisted in explaining levels of investment as well as the rate at which income grows. The literacy level via education can contribute to human development in two ways. First, education directly offers individuals the opportunity to accumulate skills and abilities that affect their productivity. The second is where this attainment of skills and abilities indirectly amplifies individuals' opportunities within the economy, providing the human capital with the ability to enrich their welfare (Lanzi, 2007).

The workforce – a country's human capital- is the economy's driver. Being in good health provides a more productive environment. Loeppke et al. (2009) have argued that if the United States wants to compete within the global economy, it needs a healthy, able and available workforce. Low-quality healthcare programs can cause an increasing burden of workforce disability which can lead to progressive loss from the workforce currently contributing to the economy. Bloom et al. (2004) state that when workers are healthy mentally and physically, they are more energetic and robust in the sense that they will be less absent from work due to illness. This leads to the workforce/human capital being more productive and earning higher wages contributing to human development.

Climate change and its factor are likely to have the most significant impact on poor countries and communities as these countries mainly depend on natural resources directly and have considerably fewer resources than developed countries to adjust to climate change's effects. (Aydinalp et al., 2008; Meadowcroft, 2009). When climate change worsens, it decreases fishing due to rising water temperatures, decreases agricultural output due to drought and floods destroy crop yields and displace individuals. This negatively affects the individual livelihoods and welfare of the country due to lower food security and agricultural income. While climate change may cause food security problems impacting the health of individuals, it also increases the likelihood of diseases spreading (Kumssa & Jones, 2010). Institutions within these countries assist in enabling communities to adapt and become more resilient to these climate change effects.

For these communities to increase their adaptability to climate change events, institutions can assist with shaping policy for ecological and social contexts to communities' specific

conditions. More so, local institutions are important in all adaptation efforts and how these efforts are being practiced. Institutions can have a more significant impact when they work together with civil and public organizations in moderating policy adaption (Mearns & Norton, 2010). Due to existing challenging policy syndromes, low-quality institutions may not have the desired outcome concerning "vulnerability, adaptive capacity and resilience" (Mearns & Norton, 2010) to climate change circumstances.

Institutions can play a profound role in assisting human development and mitigating climate change. These institutions can be defined by North (1990) as "the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction". According to Acemoglu et al. (2012), two categories of institutions exist:

> **Political institutions** determine the direction of a country's economic institutions and therefore have the power and capacity to regulate the society of a country. Inclusive political institutions can have a significant role in the decisions concerning how economic institutions distribute economic benefits, health, and education in a country to reduce inequality.
>
> **Inclusive economic institutions** motivate all people within an economy to provide their skills and abilities to the market, promoting equality. These institutions strive to promote protecting property rights, uphold the Rule of law and provide public services that create an environment which incentivizes the private sector (Acemoglu & Robinson, 2012; Samarasinghe, 2019).

Although communities in the past have adapted to climate change and their resilience, effective institutions can enhance their adaptability and resilience. Institutions are responsible for regulating and distributing resources effectively and fairly. They also assist with public-private partnerships, which have become common in mitigating climate change and assisting with human development by launching development projects and modulating policies that assist with existing inequalities.

If institutions do not modulate policies that assist with inequalities, individuals within the market experience unequal opportunities mainly due to the market's social, political and institutional structures, which then has adverse outcomes related to education and health, leading to sub-optimal levels of human development (Castells-Quintana et al., 2019).

Literature exists on pairwise analysis of climate change and human development, climate change and institution, and human development and democracy/institutions (Martí et al., 2022; Saha & Zhang, 2017). A combination analysis was done by Asongu et al. (2020) for governance, CO2 emissions and human development; however, this study will augment Asongu et al. (2020) study.

3. Methodology

3.1 Theoretical Framework and Data

Various studies exists on climate change – human development and institutional quality nexuses (Martí et al., 2022; Saha & Zhang, 2017). Asongu et al. 2020 investigates how governance can assist with environmental degradations effect on inclusive human development. The authors use the inequality adjusted human development index (IHDI) to represent inclusive human development. They use a first difference GMM system for the time period 2000 to 2012 for 44 sub-Saharan African countries where Equation 1:

Equation 1

$$HD_{i,t} = \sigma_0 + \sigma_1 HD_{i,t-\tau} + \sigma_2 CO_{i,t} + \sigma_3 G_{i,t} + \sigma_4 COG_{i,t} + \sum_{h=1}^{3} \delta_h W_{h,i,t-\tau} + \eta_i + \xi_t + \varepsilon_{i,t}$$

Where HD represents human development, CO represents CO2 emissions and G represents the governance indicators. COG represents the interaction term between CO2 emissions and the respective governance indicators and W represents the control variables: "education quality, credit access and foreign aid". η_i represents country specific effect, ξ_t represents the time-specific constant and $\varepsilon_{i,t}$ is the error terms (Asongu & Odhiambo, 2020). Following the proposed model of Asongu et al. (2020), this study augments the model by using the HDI and accounting for inequality instead as a control variable.

The Human Development Index (HDI) was designed to indicate the large differences a significant part of the population experiences concerning opportunities and resources. More specifically, the HDI is a multidimensional concept that measures human development through three indicators: healthy life, education and standard of living for various countries

(United Nations Development Program, 2022). Equation 2 indicates the theoretical framework for this study, with HDI being the dependent variable:

Equation 2

$$HDI_{i,t} = (CO2_{i,t},\ Inst_{i,t},\ Ineq_{i,t})$$

Where $HDI_{i,t}$ represents human development for i country in time period t, CO2 represents CO2 emissions, and Inst represents the six institutional proxies. Ineq represents inequality. Equation 3 represents the proxies for institutional quality where Corruption control perception (CC), Rule of law perception (RL), Regulatory quality perception (RQ), Government effectiveness perception (GE), Political stability and absence of violence/ terrorism perception (PS), Voice and accountability perception (VA):

Equation 3

$$Inst_{i,t} = (CC_{i,t},\ RL_{i,t},\ RQ_{i,t}, GE_{i,t},\ PS_{i,t}\ VA_{i,t})$$

Table 1: Variable Description

Variable	Definition	Source
Human Development Index (HDI)	The Human Development Index (HDI) was designed to indicate the large differences a significant part of the population experiences with regard to opportunities and resources. The HDI is a multidimensional index measuring human development through healthy life, knowledge and standard of living. For the health section, the HDI created a life expectancy index using life expectancy at birth. To account for knowledge, the HDI created the education index, which consists of expected years of schooling and mean years of schooling—for the standard of living, the HDI created a GNI index which consists of GNI per capita (PPP $).	UNDP (2022)
Climate Change - CO2 Emissions	CO2 Emissions are measured by the amount of emissions emitted from the "burning of fossil fuels and the manufacture of cement" while also accounting for the emissions emitted from solid, liquid, gas fuels and gas flaring. The unit CO2 emissions are measured in kiloton (kt). CO2 emissions is seen as one of the largest contributors to climate change.	World Development Indicators (2021)
Corruption Control	Corruption control measures the ***perception*** of public power used for own private gain.	World Governance Indicators (2021)
Rule of Law	Rule of law measures the ***perception*** of the public's confidence that society will abide by its rules.	World Governance Indicators (2021)
Regulatory Quality	Regulatory quality measures the ***perception*** that the government has ability to formulate and impede given policies and regulations for private sector development.	World Governance Indicators (2021)
Government Effectiveness	Government effectiveness measures the ***perception*** of governments' ability to provide quality services which are able to perform in a degree of independence from political pressure.	World Governance Indicators (2021)
Political Stability and Absence of Violence/ Terrorism	Political Stability and Absence of Violence/ Terrorism measures the ***perception*** of the possible likelihood that political instability, violence or terrorism may occur.	World Governance Indicators (2021)
Voice and Accountability	Voice and accountability measure the ***perception*** of the freedom that citizens have for expression and association along with the freedom of the media.	World Governance Indicators (2021)
Inequality	The Palma ratio measures inequality through " the share of all income received by the 10% people with highest disposable income divided by the share of all income received by the 40% people with the lowest disposable income." By using this definition own calculations were done by dividing the income share held by the highest 10% by (Income share held by the third 20%+Income share held by the fourth 20%) from the World Development Indicators.	World Development Indicators (2021)

3.2 Econometric Framework

This study will use a first difference Generalized Methods of Moments (FD GMM) system. This model has the advantages of addressing endogeneity as well-being robust to weak instruments; FD GMMs also assist with controlling for time-invariant unobserved factors and provide robust inference. FD GMM's work well with short periods, which assists with the 16 years of this study. The examined time period is from 2003 to 2018. The HDI, all institutional proxies, and the inequality index are recalculated[2] to be between 0 and 1, while the natural logarithm of CO2 emissions is used. To ensure results are not inconsistent, unit root tests, cointegration tests, a cross-sectional dependence test and the Hansen test is done (De-Hoyos & Sarafidis, 2006; Im et al., 2003; Kao, 1999; Levin et al., 2002; Phillips & Perron, 1988; Roodman, 2009).

Equation 4

$$HDI_{i,t} = \beta_0 + \beta_1 HDI_{i,t-1} + \beta_2 CO2_{i,t} + \mu_i + \mathcal{E}_t + \eth_{i,t}$$

Equation 5

$$HDI_{i,t} = \beta_0 + \beta_1 HDI_{i,t-1} + \beta_2 CO2_{i,t} + \beta_5 Ineq_{i,t} + \mu_i + \mathcal{E}_t + \eth_{i,t}$$

Equation 6

$$HDI_{i,t} = \beta_0 + \beta_1 HDI_{i,t-1} + \beta_2 CO2_{i,t} + \beta_3 CO2 * Inst_{i,t} + \beta_4 Inst_{i,t} + \beta_5 Ineq_{i,t} + \mu_i + \mathcal{E}_t + \eth_{i,t}$$

Equation 7

$$HDI_{i,t} - HDI_{i,t-1} = \beta_1 (HDI_{i,t-1} - HDI_{i,t-2n}) + \beta_2 (CO2_{i,t} - CO2_{i,t-n}) + \beta_3 (CO2 * Inst_{i,t} - CO2 * Inst_{i,t-n}) + \beta_4 (Inst_{i,t} - Inst_{i,t-n}) + \beta_5 (Ineq_{i,t} - Ineq_{i,t-n}) + (\mathcal{E}_t - \mathcal{E}_{t-n}) + (\eth_{i,t} - \eth_{i,t-n})$$

Where μ_i is the country-specific effect, $\mathcal{E}_t$ is the time-specific constant and $\eth_{i,t}$ is the error term. Equation 6 represents the level equation, while Equation 7 represents the first

[2] Recalculated value for index's $= {(Value - Minimum\ Value)} / {(Maximum\ Value - Minimum\ Value)}$

difference equation of the system GMM. Equation 4 represents a basic equation of lagged human development and CO2 emissions however in equation 5 a control variable is added – inequality; this represented by column 1 and 2 respectively in Table 2. To proceed to the effect this study is examining in Equation six institutions as well as the interaction variable between institutions and CO2 emissions are added which represents column 3 to 9 in Table 2.

Literature has shown that institutions are endogenous and can be highly correlated, creating a risk of multicollinearity (Gwartney et al., 2006; Moers, 1999; Siddiqui & Ahmed, 2013). To avoid multicollinearity, literature uses each institution separately when working with regressions (Acemoglu & Robinson, 2001; Méon & Sekkat, 2005). An index of the six institutional proxies is also created using the Principal Component Analysis (PCA). Using the PCA method to construct an index allows the "extraction of unobserved common factors of different political regime variables". It allows the proxies to gain higher explanatory power(Bittencourt, 2012). "PCA forms factors that are uncorrelated linear combinations of the observed variables" (Siddiqui & Ahmed, 2013). This study will have seven separate regressions – one for each institutional proxy and another for the institutional quality index.

3.3 Prior Expectations

CO2 emissions is expected to negatively influence human development as it can deter educational attainment opportunities and health choices. However, should the institutional proxy cause instantaneous growth in the economy, both CO2 emissions and the activities within the economies will increase, which can lead to the expectation that CO2 emissions positively influence economic growth (Kumssa & Jones, 2010). The positive effect of CO2 emissions can be further explained due to industrialization's ability to increase living standards, economic opportunities and improved health service quality.

As the quality of institutions transitions to a higher degree of quality, there first exists a need for stabilization to occur. As institutions transition and quality increases North (1990) indicates that it can be consider overwhelming. This is because new institutions effectively replace old institutions however the rate at which new institutions are constructed isn't following the same pace as the dismantling of the old institutions. The latter created uncertainty within the economy in the short run. As this occurs New or higher quality

institutions could cause chaos and increased cost while low benefits arise however in the long run an inflection point is reached where the benefits exceed the cost and uncertainty decrease (Oliver, 1992; Peng, 2003). Therefore institutions may have a negative effect in the initial stages of this transition; however, with progress in reforms, the lagged positive effects can, in the long run, outweigh this negative effect. Institutions are therefore expected in the short run to have a negative effect on human development (Havrylyshyn & van Rooden, 2003).

Inequality is expected to impact human development negatively. When inequality increases, it negatively affects individuals access, opportunities and choices regarding jobs and services, which can stagnate possible social and economic advancements (Castells-Quintana et al., 2019; Meadowcroft, 2009).

4. Results

All variable in the model was tested to see if they pass the post-estimation diagnostic test. The Hansen test null hypothesis states that all instruments are valid and the results of the study indicate that for all institutional variables and the institutional index, the variables failed to reject the Hansen null hypothesis. The Hansen test is preferred over the Sargan test since the "Hansen test is robust but weakened by instrument proliferation, whereas the Sargan test is not robust but not weakened by instrument proliferation" (Asongu & Odhiambo, 2020).

Certain institutions have been found to significantly assist in modulating the effect CO2 emissions has on human development as the results indicate. When the institutional quality of Corruption control, Rule of law and Political stability interacts with CO2 emissions the variables are found to significantly improve human development. When the quality of these institutions increases, they assist with the mitigation of CO2 emissions, therefore, leading to a positive impact on human development.

When Regulatory quality is interacted with CO2 emissions the variable is found to have a statistically significant negative effect on human development. This is in line with other literature (Asongu & Odhiambo, 2020). An increase in the quality of Regulatory quality has a

twofold effect. First increased economic activity leads to increased emissions which negatively affects human development as seen in the interaction variable. The second effect is where increased economic activity leads to increased economic opportunities in turn impacting human development positively (Huang et al., 2022). The latter explains how regulatory quality positively impacts human development.

When considering the models using Corruption control, Regulatory quality and Political stability, these institutions affect human development significantly. When Corruption control and Political stability are considered in their respective models, an increase in CO2 emissions leads to a decrease in human development.

Institutional quality in literature is generally seen to have a positive impact on human development by promoting equality through fairness, however, in the short run it can have a negative impact on human development due to the transition occurring in the economy (Havrylyshyn & van Rooden, 2003). When the quality of Rule of law, Corruption control and Voice and accountability increases these institutions are found to have a statistically significant negative effect on human development which is in line with Havrylyshyn et al., (2003) explanation of short run effects.

Inequality is found to have a statically significant and negative impact on human development for all six institutional indicators as well as the institutional index. This is in line with literature that explains as inequality increases individual opportunities for education and health decrease lowering the level of human development (Castells-Quintana et al., 2019; Ferreira et al., 2022).

The net effect of institutional quality modulating CO2 emissions effect on human development can be computed for Corruption control, Regulatory quality and Political stability. The [3]net effect of Corruption control, Regulatory quality and Political stability are -

[3] Net effect of specific institution= (CO2 emissions -CO2emission*institution-Institution)[(CO2 emissions*institution+ mean of institution)+CO2 emissions]
Net effect of corruption control = (-0.009-0.017-(-0.188))[(-0.188x0.518)+(-0.009)]=-0.02
Net effect of regulatory quality = (0.010-(-0.033)-0.378)[(0.378x0.311)+(0.010)]=-0.04

0.02, -0.04 and -0.06 respectively in mitigating CO2 emissions effects on human development. The outcome of Regulatory quality here is in line with what other literature such as Asongu et al.,(2020) found. Asongu et al.,(2020) indicate that Regulatory quality needs to uphold improvement for positive effects to occur. The net effect for the other institutional and index variables is not computed since one or more of the coefficients needed in the net effect estimation is not statistically significant.

Net effect of political stability= (-0.018-0.027-(-0.308))[(-0.308x0.667)+(-0.018)]=-0.06

Table 2: First Difference System GMM Results[4]

	Dependent Variable: Human Development								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	CO2 emissions	Inequality	Corruption control	Rule of Law	Regulatory Quality	Government efficiency	Political stability	Voice and accountability	Index
Lagged Human Development	1.001***	1.017***	0.947***	0.933***	0.972***	0.939***	0.965***	0.973***	0.947***
CO2 emissions	0.000	0.000	-0.009**	-0.008	0.010*	-0.009	-0.018**	-0.010	-8.95e-06
CO2 Emissions * Corruption control Perception			0.017**						
CO2 Emissions *Rule of Law Perception				0.013*					
CO2 Emissions *Regulatory Quality Perception					-0.033*				
CO2 Emissions *Government efficiency Perception						0.015			
CO2 Emissions *Political stability Perception							0.027**		
CO2 Emissions *Voice and accountability Perception								0.014	
CO2 Emissions *Index									0.003*
Corruption control Perception			-0.188*						
Rule of Law Perception				-0.143					
Regulatory Quality Perception					0.378*				
Government efficiency Perception						-0.159			
Political stability Perception							-0.308**		
Voice and accountability Perception								-0.164	
Index									-0.031*
Inequality		0.008	-0.023**	-0.023*	-0.025*	-0.018**	-0.017*	-0.012	-0.030**
Constant	0.005	-0.011	0.149***	0.146	-0.079	0.152**	0.241**	0.144	0.055

[4] *** Variable is statistically significant at 1% level of significance.
** Variable is statistically significant at 5% level of significance.
*Variable is statistically significant at 10% level of significance.

	Dependent Variable: Human Development								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	CO2 emissions	Inequality	Corruption control	Rule of Law	Regulatory Quality	Government efficiency	Political stability	Voice and accountability	Index
AR1	-5.00***	-4.89***	-5.04***	-5.03***	-4.96***	-5.09***	-5.05***	-4.96***	-4.98***
AR2	1.32	1.29	1.35	1.29	1.07	1.37	1.33	1.28	1.27
SarganTest	42.92***	41.35***	41.30*	47.09**	40.40*	44.77**	47.96**	48.14**	39.01
Hansen Test	29.83***	29.46***	32.77	33.94	33.29	34.81	31.93	34.90	32.39
Difference-in-Hansen tests of exogeneity -GMM Instruments									
Hansen test excluding group	25.58**	25.59**	31.59	32.00	30.69	30.30	31.71	32.83	31.37
Difference (null H=exogenous)	4.24**	3.87**	1.18	1.93	2.61	4.51	0	2.08	1.02
Difference-in-Hansen tests of exogeneity - IV									
Hansen test excluding group	25.75***	25.10**	31.85	33.47	30.18	32.63	31.04	33.49	30.85
Difference (null H=exogenous)	4.08**	4.36	0.91	0.47	3.11	2.18	0	1.42	1.53
Net effect	N/A	N/A	0.16	0.12	-0.34	N/A	0.26	NA	NA
Net effect of institutions moderating co2 emissions on human capital	N/A	N/A	-0.02	N/A	-0.04	N/A	-0.06	NA	NA

5. Conclusion

There is a need for countries to sustain human development while mitigating climate change. These two issues are significantly interlinked with each other. Institutions can play a vital part for more inclusive human development along with assisting in the mitigation of climate change.

The results indicate that overall climate change has a significant and negative impact on human development. When institutions are interacted with climate change the results indicate that institutions assist in modulating climate change's effect on human development. While institutions on their own was found to have a short-term negative impact on human

development, this is due to the need for institutions to stabilize after a transition period. As expected inequality also deters human development.

From this study policy makers can observe that specifically enhancing the quality of Corruption control, Regulatory quality and Political stability will assist in modulating CO2 emissions effect on human development. By specifically targeting the enhancement of the quality of these institutions to modulate CO2 emissions impact on human development, this will contribute to climate change target outcomes.

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7. Appendix

Table 3: Model without interaction term

	Dependent Variable: Human Development								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	CO2 emissions	Inequality	Corruption control Perception	Rule of Law Perception	Regulatory Quality Perception	Government efficiency Perception	Political stability Perception	Voice and accountability Perception	Index
Lagged Human Development	1.001***	1.017***	0.949***	0.945***	0.961***	0.951***	0.962***	0.944***	0.944***
CO2 emissions	-0.000	-0.000	0.000	0.000	0.000	0.000	0.000	0.001**	0.000*
Corruption control Perception			0.008**						
Rule of Law Perception				0.010**					
Regulatory Quality Perception					-0.009*				
Government efficiency Perception						0.012**			
Political stability Perception							0.004		
Voice and accountability Perception								0.012**	
Index									0.001***
Inequality		0.008	-0.006**	-0.005**	-0.004	-0.004*	-0.006*	-0.008***	-0.005**
Constant	0.005	-0.011	0.039***	0.040***	0.037***	0.036***	0.030***	0.038***	0.046***
AR1	-5.00***	-4.89***	-5.02***	-5.03***	-5.01***	-5.03***	-5.03***	-5.03***	-5.04***
AR2	1.32	1.29	1.28	1.32	1.37	1.37	1.36	1.29	1.36
Sargan Test	42.92***	41.35***	43.83***	43.30***	44.73***	43.49***	47.94***	42.98***	42.73***
Hansen Test	29.83***	29.46***	29.10**	28.78**	29.31***	28.58**	28.16**	28.85**	28.66**
Difference-in-Hansen tests of exogeneity									
GMM Instruments									
Hansen test excluding group	25.58**	25.59**	26.35**	25.7888	26.33**	25.49**	25.25**	26.53**	25.85**
Difference (null H=exogenous)	4.24**	3.87**	2.75**	3.00*	2.98*	3.09*	2.92*	2.32	2.82*
IV									
Hansen test excluding group	25.75**	25.10**	25.43***	25.21***	20.17**	24.75**	22.05**	25.94***	25.35***
Difference (null H=exogenous)	4.08**	4.36	3.67	3.57	9.14**	3.83	6.12	2.91	3.32

Table 4: Model without control variable – equality

	Dependent Variable: Human Development							
	(1)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	CO2 Emissions	Corruption control Perception	Rule of Law Perception	Regulatory quality Perception	Government efficiency Perception	Political stability Perception	Voice and accountability Perception	Index
Lagged Human Development	1.001***	0.984***	0.969***	1.002***	0.967***	0.992***	0.992***	0.997***
CO2 emissions	-0.000	-0.010**	-0.009*	0.011*	-0.013**	-0.016**	-0.011	0.001
CO2 Emissions * Corruption control Perception		0.021**						
CO2 Emissions *Rule of Law Perception			0.017**					
CO2 Emissions *Regulatory Quality Perception				-0.033*				
CO2 Emissions *Government efficiency Perception					0.022*			
CO2 Emissions *Political stability Perception						0.024**		
CO2 Emissions *Voice and accountability Perception							0.016	
CO2 Emissions *Index								0.003*
Corruption control Perception		-0.024**						
Rule of Law Perception			-0.183**					
Regulatory quality Perception				0.385*				
Government efficiency Perception					-0.240*			
Political stability Perception						-0.278**		
Voice and accountability Perception							-0.190	
Index								-0.035*
Constant	0.005	0.131***	0.127**	-0.120	0.167**	0.192**	0.139	-0.003

	Dependent Variable: Human Development							
	(1)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	CO2 Emissions	Corruption control Perception	Rule of Law Perception	Regulatory quality Perception	Government efficiency Perception	Political stability Perception	Voice and accountability Perception	Index
AR1	-5.00***	-4.98***	-4.98***	-4.91***	-5.05***	-5.04***	-4.98***	-4.90***
AR2	1.32	1.39	1.34	1.13	1.38	1.38	1.29	1.33
Sargan Test	42.92***	33.91	41.11*	37.67	41.26*	45.63**	46.67**	35.73
Hansen Test	29.83***	33.30	33.46	32.53	32.85	33.20	34.24	33.92
Difference-in-Hansen tests of exogeneity GMM Instruments								
Hansen test excluding group	25.58**	32.09	30.45	30.82	30.25	33.06	32.54	33.47
Difference (null H=exogenous)	4.24**	1.21	3.01	1.66	2.60	0.14	1.70	0.45
IV								
Hansen test excluding group	25.75**	32.24	32.93	30.82	31.31	32.21	33.34	33.79
Difference (null H=exogenous)	4.08**	1.06	0.54	1.71	1.54	0.99	0.90	0.13

Table 5: Correlation Matrix

	Human Development	CO2 Emissions	Corruption Control	Rule of Law	Regulatory Quality	Government Efficiency	Political Stability	Voice and Accountability	Inequality
Human Development	1.000								
CO2 Emissions	0.332	1.000							
Corruption Control	0.840	0.153	1.000						
Rule of Law	0.868	0.184	0.972	1.000					
Regulatory Quality	-0.847	-0.170	-0.934	-0.962	1.000				
Government Efficiency	0.875	0.248	0.968	0.974	-0.938	1.000			
Political Stability	0.632	-0.072	0.727	0.746	-0.691	0.701	1.000		
Voice and Accountability	0.794	0.009	0.883	0.882	-0.869	0.851	0.706	1.000	
Inequality	-0.692	-0.410	-0.558	-0.604	0.568	-0.618	-0.469	-0.421	1.000

Table 6: Data Tests and Descriptive Statistics

Unit Root Tests				
		HDI	CO2	Inequality
	No trend	-9.819***	-6.795***	-4.937***
	Include time trend	-9.362***	-6.801***	-5.075***
	Suppress panel specific mean	19.401	2.888	-6.730***
Levin-Lin-Chu (LCC)	Subtract cross-sectional mean	-6.227***	-4.887***	-5.154***
	No trend	1.619	3.475	-2.999***
	Include time trend	-1.808**	-5.990***	-6.866***
Im-Pesaran-Shin (IPS)	Subtract cross-sectional mean	4.615	5.904	-3.329***
	No trend	430.577***	204.195	120.615***
	Include time trend	200.234	241.961**	169.003***
Phillips-Perron (PP)	Subtract cross-sectional mean	182.819	156.908	149.392***

Kao Cointegration and Cross-sectional dependence tests	
Kao -Modified Dickey-Fuller t	2.605***
Friedman's test of cross sectional dependence	123.296**

Descriptive Statistics					
Variable	Observations	Mean	Std. Dev	Min	Max
Human Development	576	0.818	0.096	0.567	0.962
CO2 emissions	576	11.358	1.643	8.216	15.565
corruption Control	576	0.518	0.273	0.059	1
Rule of Law	576	0.585	0.273	0.144	1
Regulatory Quality	576	0.311	0.17	0.062	0.668
Government Efficiency	576	0.61	0.206	0.261	0.983
Political Stability	576	0.667	0.17	0.191	0.986
Voice and Accountability	576	0.696	0.213	0.172	1
Institutional Index	576	2.50E-09	2.30E+00	-3.685	3.716
Inequality	576	0.266	0.216	0	1