Institutions Powers, financial development and environmental factors influence on Carbon emission: Evidence from a Global Perspective

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Institutions powers, financial development and environmental factors influence on Carbon emission: Evidence from a Global Perspective

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Abstract

This study explores the moderating power of institutional quality on carbon emission through renewable energy consumption, foreign direct investment, economic growth and financial development in the globe for the period of 2002 to 2019. By using two Step System Generalized Method of Moments, the results illustrate that renewable energy usage and foreign direct investment inflow enhance environmental quality while financial development and economic growth lowers environmental quality in the panel. The results shows that quality institutions in countries are still not yet adequate to defend the harmful impact of every environmental factor and protect environment however, the interaction term of institutional quality confirms the significant moderating effect of all explanatory variables on environmental quality in the panel. The findings also confirm the existence of Environmental Kuznets Curve and evidence the pollution halo hypothesis. The findings of this paper can be useful for policy makers whereas conducting stricter environmental regulation.

Key words: Quality Institutions; Foreign direct investment inflow; financial development; Economic Growth; Environmental Kuznets Curve

1. Introduction

Ecological economists are recently concerned with the matter of environmental degradation as it is a fundamental issue in the field of economics and received huge consideration recently. Such issue of degradation can be the reason of high amount of carbon emission discharge due to consumption of large amount of natural resources for production such as nonrenewable energy to enhance economic growth. Governmental institutions are trying to manage the usage of natural resources which are harmful for environment however the use of energy is also important for the production of goods and services to achieve higher

economic growth. Renewable energy from renewable sources is a substitutes to be used for production and achieve economic growth as renewable energy is environment friendly and not degrade the quality of environment however its not yet reached the desired level especially in developing economies as developing economies still depend on energy from fossil fuels and it's the cause of low environmental quality in developing countries (H. Khan, Weili, & Khan, 2021). Likewise, most of the studies have indicated that the inflow of foreign direct investment is harmful for environmental quality as most of foreign investors focus on profit maximization and invest in polluted industries which degrade the quality of environment however FDI inflow has shown a positive impact on economic growth in most of the countries that its enhance economic growth. However some researchers argues that the effect of FDI on environment is not the same in every country and FDI can also bring green technology which enhance economic growth, as well protect the quality of environment by using renewable energy and green technology which are not polluted. The question of importance for this paper is whether these economic factors have an impact on the CO2 emission. The impact of economic growth on carbon emission has also been focused in literature which has been considered a major driver of carbon emission. (Shafik & Bandyopadhyay, 1992) studied economic growth and environmental quality by using eight indicates to measure environmental quality. They illustrates that economic growth worsens environmental quality in initial stage however an unceasingly increasing in income, environmental quality keep enhancing. Mixed results on the impact of financial development on environmental quality has also been achieved where policy makers and observes have a keen interest in this association whether financial development is harmful or beneficial for the quality of environment (Shahbaz, Hye, Tiwari, & Leitão, 2013). Some studies indicate that financial development degrades environmental quality (Muhammad, Tiwari, & Muhammad, 2011). These researchers believes that financial development is harmful for environmental quality as financial development facilitate the inflow of foreign direct investment and FDI degrade environmental quality by investing in polluted industries as well its enhance economic growth which effect environment badly. Some financial services tend to increase the energy consumption which in turn increases carbon emission. Financial development help consumers loan through financial intermediation which make consumers able to buy luxurious items such as automobiles, and other products which release harmful gases which are not in favor of environmental quality. However, some other researchers argued that financial development is negatively associated with carbon emission (Komal & Abbas, 2015). These researchers believes that an increase in financial development enhance

the efficiency of energy by converting nonrenewable energy to renewable energy which in turn reduce carbon emission (Gokmenoglu, Ozatac, & Eren, 2015). Financial development also play important role in easing the provision of advance technologies which are helpful in reducing carbon emission and less harmful for environmental quality. Based on the above discussion, quality institutions has been consider that it is important for environmental quality protection and can control such factors which are harmful for environmental quality. This study is ever the first one examining the moderating role of quality institutions by using single proxy as well use the quality institutions index to deeply investigate its impact on carbon emission though foreign direct investment, financial development, renewable energy consumption and economic growth. The study also use single proxy for financial development which is commonly been used as well financial development index to deeply investigate the impact of financial development on environmental quality which is also a robust check. Our study also indicates that institutional quality is important to protect environmental quality concerning foreign direct investment, energy consumption, financial development and economic growth. We believe that good quality institutions can make polices regarding the inflow of foreign direct investment to bring new technology and not to invest in polluted industries. It does also can make policies regarding production and can make policies to adopt and promote the use of renewable energy consumption for production to protect environmental quality. Quality institutions can also influence economic activities positively which are harmful for the quality of environment. According to this dilemma, this study trying to investigate the moderating role of quality institutions on carbon emission through foreign direct investment, renewable energy consumption, financial development and economic growth to know whether quality institutions have any role to keep improving economic growth while controlling the harmful impact of FDI inflow, financial development, adopting the use of renewable energy consumption and avoiding the use of farmer energy from fossil fuels as well the harmful impact of financial development on environmental quality. The remaining parts of the paper are structured in the following sequence. Section 2 present literature reviews, part 3 is composed of research methods, part 4 presents analysis and discussion while the last section gives conclusion of the paper.

2. Literature review

Large number of studies have been conducted on the impact of foreign direct investment on carbon emission, financial development on carbon emission and economic growth on carbon emission and vice versa but with little accord and dissimilar conclusion. Some studies have included other factors such as renewable energy consumption and nonrenewable energy consumption in this association. The role of quality institutions has also been considered in this dilemma whether institutions have any role to defend the harmful impact of these factors on environmental quality. Some studies found the positive while some found the negative impact of these factors on environmental quality. For instance, a study conducted by (Li, Zhang, & Ma, 2015) on the impact of financial development and economic growth on carbon emission in 102 countries and found the significant impact of financial development and environmental quality on economic growth while found a significant inverted U-Shaped between financial development and growth and inverted U-shape association between economic growth and carbon emission. On the other hand, (Bayar & Maxim, 2020) have examined the impact of financial development, energy consumption and economic growth on carbon emission in European countries. They didn't find any significant evidence on the impact of financial development on carbon emission however they found that there is a causal relationship between economic growth and primary energy consumption. However, they found positive impact of energy consumption and financial development on carbon emission in the long run. Opposing to this, (Odhiambo, 2010) examined financial development, carbon emission and income inequality in sub-Saharan African countries. They employed Generalized method of moments where the findings of their study shows that there is a reducing unconditional impact of financial development on carbon emissions. Another study conducted by, (Pavlović et al., 2021) which examines the impact of FDI and economic growth on carbon emission. By using polynomial linear regression model, they found the existence of pollution halo hypothesis however their findings were not successful to confirm the Environmental Kuznets Curve. Likewise, (Qureshi, Qureshi, Vo, & Junejo, 2020) have examined the dynamic relationship of corruption, economic growth and FDI in developed and developing countries. They employed Panel Var and generalized method of moments and found that control of corruption negatively influence FDI inflow and economic development in developing and developed countries. They further indicate that corruption and economic growth have a positive bidirectional relationship for developing countries while negative unidirectional relationship for developed countries. (Alshubiri & Elhaddad, 2019) have studied economic growth and foreign finance and carbon emission to examine the existence of EKC curve in 32 OECD countries. They found that foreign finance and the quality of

environment have an inverted U-shaped relationship. All the three proxies of foreign finance significantly contribute to carbon emission in the initial stage while later these become environmental friendly and reduce carbon emissions. The role of quality institutions in financial development, energy consumption, FDI and economic growth nexus has also been considered and studied widely. (M. M. Khan & Ahmad, 2020) have investigated the moderating role of institutions in environmental degradation and financial development nexus in south Asia. They found the increasing impact of financial development on carbon emission and negative moderating role of institutions quality on financial development and environmental sustainability. Likewise, (Islam, Khan, Popp, Sroka, & Oláh, 2020) have studied the moderating role of institutional quality in the nexus between foreign direct investment and financial development in belt and road initiative countries. Their findings show that financial development significantly attracts foreign direct investment in these countries while institutional quality plays a significant role as a moderator in this association.

3. Methodology

3.1 Econometric Techniques and Empirical models

This study investigates the moderating role of quality institutions in the linkage between financial development, renewable energy consumption, foreign direct investment and carbon emission in the globe. We use panel data for the period of 2002 to 2019. Data for all variables is downloaded from the World Bank world development and world governance indicators. To examine this association, this study uses two system Generalized method of moments and its does not employ OLS, random or fixed effect models because of autocorrelation problem between the error term and the lags of the dependent variables and also the country specific effect and the lags of dependent variables and the problem of endogeneity (Amuakwa-Mensah & Adom, 2017). (Arellano & Bover, 1995) proposed two step system GMM estimators to solve the problem of endogeneity and autocorrelation. Two step system GMM estimator also deals with the problem of weak instruments and that's why it's the most efficient and robust estimators. The instruments use in in two step system GMM is to reduce the endogeneity problem of the independent variables. It reduces over identification of instruments and control for heteroscedasticity. As an efficient estimator, this study finally employs the two step system GMM estimator to investigate the association of the study variables. Our baseline model can be stated as follows on the impact of financial development, renewable energy consumption, foreign direct investment and economic growth on carbon emission.

$$ED = \beta_0 + \beta_1 ED_{it-1} + \beta_2 RE_{it} + \beta_3 FDI_{it} + \beta_4 GDP_{it} + \beta_5 (GDP_{it})^2 + \beta_6 FDI_{it} + \beta_7 POP_{it} + \varepsilon_{it} \dots (1)$$

In equation 1, ED represents environmental degradation which is proxied by per capita CO2 emission. (Jiang & Ma, 2019) and (H. Khan, Weili, & Khan, 2021) have recently used this proxy. The environmental quality will be lower if there is higher per capita of carbon emission in a country. ED_{it-1} is the first lag of left hand side variables which are utilized as explanatory variables in the equation to quantify the anterior years effect on the present year. RE is renewable energy consumption. Studies in preceding literature indicates that its beneficial for reducing carbon emission such as (H. Khan, Weili, & Khan, 2021), (H. Khan, Weili, Khan, & Khamphengxay, 2021) and (Hu, Xie, Fang, & Zhang, 2018). GDP is gross domestic product per capita, GDP^2 is the square of per capita gross domestic product. Several studies have identified the association between pollution and economic growth by following the Environmental Kuznets Curve framework. Pollution increase due to increase in per casita income however its start to decline as continues increase in income and reach the maximum level. (Al-Mulali, Ozturk, & Solarin, 2016) claims the negative impact of economic growth on pollution in the early stage of development. We use per capita GDP as well we take the square of per capita GDP to test the existence of environmental Kuznets Curve. FDI is foreign direct investment in the equation which is proxied as a percentage of GDP (Zhu, Duan, Guo, & Yu, 2016). The impact of FDI on environment varies on condition as mentioned in pollution halo and pollution haven hypothesis. Likewise, FD represent financial development which is proxied by domestic credit to private sector as a percent of GDP (Jian, Fan, He, Xiong, & Shen, 2019), (Jiang & Ma, 2019). However we use Private sector domestic credit as a proxy for financial development as well we use financial development index constructed of different financial development indicator used in previous studies. By using principle components analysis, we use the data of value of stocks traded, credit to private sector, stock market capitalization and broad money to create FDB index. POP represent urban population where the preceding studies indicate that increase in population may increase carbon emission, where i signify country, t time while ε is the error term. In equation 2, we include institutional quality to the model. The empirical model can be expressed as follows;

$$ED = \beta_0 + \beta_1 ED_{it-1} + \beta_2 RE_{it} + \beta_3 FDI_{it} + \beta_4 GDP_{it} + \beta_5 (GDP_{it})^2 + \beta_6 INST_{it} + \beta_7 FDI_{it} + \beta_8 POP_{it} + \varepsilon_{it} \dots (2)$$

We construct institutional quality index by using six blocks of institutional quality indicators such as Rule of Law (ROL), Control of corruption (COC), voice and accountability (VOA), political stability (PS), government effectiveness (GOV) and regulatory quality (RQ). We believe that environmental degradation varies across countries and its not the same as the quality of institutions are not the same in every country. We understand that good quality of institutions such as good governance, control of corruption and stringent regulation in a country are desirable to enhance the quality of environment by controlling polluted FDI inflow and promoting the use of renewable energy sources. Effective and well established mechanism of institutions discourage the polluted inflow of FDI in industrial sectors and encourage the attraction of environment friendly FDI. Effective regulatory framework ensure the efficient use of energy which in turn enhance environmental quality (Claessens & Feijen, 2007).

Beside the index of institutions quality constructed of six indicators, we also use a single variable to proxy for institution quality which is control of corruption. This indicator is recently used by (Hunjra, Tayachi, Chani, Verhoeven, & Mehmood, 2020) and (H. Khan, Weili, & Khan, 2021). We use this indicator separately to deeply know the role of institution quality which as a robust check. Control of corruption is chosen to proxy institutions quality as it has a potential impact on carbon emission. This indicator gives a standardized mean between 0 and a standard deviation which is equal to 1.

Moreover, we are testing the moderating role of quality institutions on carbon emission through renewable energy consumption (RE), economic growth (GDP), foreign direct investment (FDI) and financial development (PVT), we add the following interaction terms to the regression model: $(RE \times INS) + (GDP \times INS) + (FDI \times INS) + (PVT \times INS)$ respectively. After adding interaction term in the model, the model can be stated as follows;

$$ED = \beta_0 + \beta_1 ED_{it-1} + \beta_2 RE_{it} + \beta_3 FDI_{it} + \beta_4 GDP_{it} + \beta_5 (GDP_{it})^2 + \beta_6 INS_{it} + \beta_7 FDI_{it} + \beta_8 POP_{it} + (RE \times INS) + (GDP \times INS) + (FDI \times INS) + (PVT \times INS) + \varepsilon_{it} \dots (3)$$

We expect that the coefficient of each interaction term to be negative significant which confirm the moderating role of institutions quality on carbon emission through these factors.

Figure 1 shows the conceptual framework of the study variables and moderating role of quality institutions, table1 and 2 shows descriptive statistics and correlation matrix of variables respectively.

Figure 1: The moderating role of institutional quality on carbon emission through renewable energy consumption, economic growth, foreign direct investment and financial development

Table#1 Descriptive statistics

Variable	Mean	Std.	Min	Max
CO2	17361.4	7651.5	7.334	1.007
IRE	31.901	30.237	0.001	98.27
GDPPC	2.372	5.039	-62.378	121.78
VOA	-0.014	1.004	-2.313	1.800
ROL	0.008	1.003	-2.606	2.100
RQ	0.005	0.988	-2.645	2.260
COC	-0.001	1.016	-1.868	2.469
PS	-0.027	1.003	-3.314	1.965
GOV	0.016	0.991	-2.445	2.436
PVT	53.576	44.855	0.186	308.97
STRD	48.20	81.793	0.001	1721.54
BM	14.33	14.985	-58.172	249.83
MKT	57.917	52.900	0.001	352.15
FDI	7.991	54.755	-1268.17	1282.63
POP	1.399	1.553	-9.080	17.5109

250 **Table#2 Correlation matrix**

	CO2	RE	GDPPC	VOA	ROL	RQ	COC	PS	GOV	PVT	STRD	BM	MKT	FDI	POP
CO2	1.000														
RE	-0.138	1.000													
GDPPC	0.176	0.132	1.000												
VOA	-0.120	0.005	-0.075	1.000											
ROL	0.021	-0.308	-0.175	0.691	1.000										
RQ	-0.006	-0.322	-0.144	0.703	0.918	1.000									
COC	0.012	-0.282	-0.166	0.670	0.958	0.900	1.000								
PS	-0.021	-0.316	-0.105	0.561	0.768	0.719	0.758	1.000							
GOV	0.076	-0.367	-0.159	0.662	0.948	0.910	0.942	0.730	1.000						
PVT	0.387	-0.324	-0.122	0.400	0.682	0.610	0.658	0.481	0.726	1.000					
STRD	0.557	-0.147	0.029	0.057	0.253	0.192	0.211	0.080	0.289	0.444	1.000				
BM	-0.019	0.209	0.262	-0.322	-0.447	-0.485	-0.402	-0.277	-0.449	-0.408	-0.101	1.000			
MKT	0.081	-0.289	-0.051	0.261	0.538	0.533	0.557	0.354	0.606	0.635	0.127	-0.267	1.000		
FDI	-0.107	-0.150	0.139	0.068	0.157	0.239	0.174	0.208	0.164	0.022	-0.063	0.011	0.208	1.000	
POP	-0.126	-0.040	-0.284	-0.374	-0.047	-0.089	-0.043	-0.121	-0.087	-0.146	-0.097	0.120	0.125	-0.021	1.000

251

252

253 **4. Results and discussion**

254 As discussed above, the dynamic two step system Generalized method of moments is
 255 efficient estimator to examine the relationship of the study variables. GMM estimator is
 256 advantageous because it's deal with endogeneity problems and gives robust results.
 257 (Blundell & Bond, 2000) reveal that first difference GMM is less efficient while system
 258 GMM is more reliable and efficient. Therefore, we employed two step systems GMM to our
 259 data to get more robust results. The Arellano Bond test (AR2) result confirms the model
 260 fitness and the result of sargan test also validate the instrumental variables. We use three
 261 empirical models. The first empirical model is composed on the impact of renewable energy
 262 consumption, financial development, economic growth and FDI on carbon emission. In the
 263 second empirical model, we add institutional quality index while in the third empirical model
 264 we take the interaction terms.

265 In table 3, column 1 shows the list of variables, column 2 represent empirical model 1 which
 266 shows the two step system GMM results on the impact of renewable energy consumption,
 267 financial development index, economic growth and foreign direct investment on carbon
 268 emission. Column 3 represents the result of empirical model 2, we replace the financial
 269 development index with financial development by bank (FD-B) and also include single proxy
 270 of institutional quality which is control of corruption (IQ-CC). While in column 2B, we use
 271 financial development by bank (FD-B) and include the institutional quality index (IQ-IND)
 272 and remove the single proxy of control of corruption (IQ-CC) for representing institution
 273 quality and also exclude financial development index. While in empirical model 3 in table 4,
 274 we exclude the institutional quality index and financial development index (FD-IND) and use

domestic credit to private sector by banks (FD-B) shown in table as financial development-I as a proxy for financial development and single proxy of corruption for institutional quality (IQ-CC) along other variables.

Results for all three empirical models in table 3 and 4 on the impact of renewable energy consumption on carbon emission is significant and negative which imply that the high amount of renewable energy consumption is more likely to reduce carbon emission and safeguard the quality of environment. These findings indicate that renewable energy consumption enhances environmental quality. These findings support the current policies regarding environmental protection which are proposed in (IPCC1996) Kyoto Protocol arrangements and the Intergovernmental Panel on Climate Change (Lee, 2007). The findings suggest countries on the promotion of renewable energy sources and eliminating energy from fossil fuels to achieve high quality of environment. These findings are in line with those of (Apergis & Payne, 2010) ,(H. Khan, Weili, Khan, et al., 2021), (H. Khan, Khan, Kim Oanh, & Lin, 2020) and (Jebli, Youssef, & Ozturk, 2016). These findings evidence that renewable energy consumption is ecofriendly environment and mitigates carbon emission.

Secondly, the estimated coefficient of financial development by bank (FD-B) in model 2a, model 2B and model 3 with all interaction terms are highly significant and positive which indicate that increase in financial development increase carbon emission and it's harmful for environmental quality. As a robust check, the financial development index constructed of different financial development indicators mentioned in methodology section is also highly significant and positive which is shown in empirical model 1 column 2. Our results strongly evidence that financial development lowers environmental quality in the sample countries as predicted by most of the researchers. So our findings are more robust to alternative conclusions of different researchers and in line with the inferences of literature. Our results are in line with the findings of (Zhang, 2011),(H. Khan, Weili, & Khan, 2021),(Shahbaz, Solarin, Mahmood, & Arouri, 2013) however, (Ahmed, Kousar, Pervaiz, & Ramos-Requena, 2020) found the negative impact of financial development on carbon emission in the long run. The reason of positive and increasing impact of financial development on carbon emission maybe that there are including developing countries in the sample which use financial development for capitalization to enhance the small and medium size industries growth which are not in favor of environmental quality protection. It's may also be that the excess financing to individual which are being used for luxuries and increasing consumption of individuals which are not in favor of environmental quality. It's also illustrates that financial development in the sample countries have no focus on green technology

development. Our findings conclude that pollution will increase if there is increase in financial developing.

311

312 **Table#3 Institutional quality, financial development and environmental Degradation**

Results of 2-Step System Generalized Method of Moments	CO2 Emission	CO2 Emission	CO2 Emission
Variables	Model-1	Model-2A	Model-2B
RE	-0.101*** (0.011)	-0.124*** (0.000)	-0.120*** (0.000)
Financial Development-I		FD-B 0.000*** (1.820)	FD -B 0.000*** (2.140)
Financial development-II	FD-IND 0.012*** (0.004)		
EG	0.014*** (0.001)	0.040*** (0.000)	0.040*** (0.000)
EG ²	-0.003*** (0.000)	-0.002*** (4.370)	-0.002*** (4.460)
Institutional Quality-I		IQ-CC 0.122*** (0.002)	
Institutional Quality-II			IQ-IND 0.149*** (0.001)
IFDI	-0.003*** (0.000)	-0.001*** (6.070)	-0.001*** (5.750)
Urbanization	-0.039*** (0.005)	-0.009*** (0.001)	0.001 (0.000)
Co2 _{it-1}	0.961*** (0.002)	0.924*** (0.000)	0.925*** (0.000)
Constant	0.488*** (0.0439)	0.561*** (0.002)	0.497*** (0.002)
Observations	418	1,093	1,093
R-squared			
Number of id	50	119	119
AR2	-1.13(0.260)	-1.21(0.228)	-1.17(0.241)
Sargan test	352.44(0.000)	440.95(0.000)	-1.20(0.231)

313

314 Likewise, economic growth proxy by per capita GDP (EG) is highly significant in all three
315 empirical models along other variables suggesting that economic growth is at the cost of
316 environmental quality in our sample countries, as predicted and confirmed by several
317 researchers. The results confirm the impact of economic growth on carbon emission as
318 expressed in the Environmental Kuznets Curve hypothesis. The findings are in line with (H.
319 Khan, Weili, & Khan, 2021). However the square term of economic growth is highly
320 significant and negative in all models indicates that it's reduce carbon emission thus this
321 results confirms the existence of environmental Kuznets curve in the sample countries which
322 illustrates that its reduce emission when the income reach a certain level.

The estimated coefficient of institutional quality using alternative proxy (control of corruption) in model 2 (Column2) is highly significant and positive which shows that quality institutions increase carbon emission and the level of control of corruption is not adequate yet in some countries of the panel. Similarly, the institutional quality index (IQ-IND) constructed of the six bloc of institutional quality indicators” regulatory quality, control of corruption, voice and accountability, rule of law, government effectiveness and political stability in model 2B is also highly significant and positive which confirm the robustness of the results of model 3 . The results show that the level of institutional factors is not yet adequate and it’s has a harmful impact on the environmental quality protection. Our findings suggest that the level of institutions in the sample is weak as weak level of quality institutions are linked with lower environmental quality while strong institutions are concerned with high level of environmental quality.

Likewise, the estimated coefficient of foreign direct investment mostly in all empirical models is significant and negative which indicate that foreign direct investment enhance environmental quality and these findings support the pollution halo effect of FDI that the inflow of FDI protect environmental quality. The reason can be that foreign direct investment in modern ages may transfer green energy efficientlhy. (Griffin & Enos, 1970) found that the inflow of foreign direct investment is not in favor of environment as foreign investors don’t focus on technology transfer because their primary aim is the maximization of profit however our findings are contradictory with that statement. Likewise, the estimated coefficient of urban population is significant and negative in the first two models and insignificant in the third model. (Mushtaq, Chen, Ud Din, Ahmad, & Zhang, 2020) also found that urban population decrease carbon emission in china.

Table# 4: The Moderating role of institutional quality on carbon emission

Results on the impact of renewable energy, financial development, economic growth, GDP square, and FDI on environmental degradation are equitably similar. The impact of institutional quality on carbon emission is also strongly similar in all empirical models. The study indicates that good level of governance enhance the association between renewable energy consumption and environmental degradation (0.001), economic growth and environmental degradation by 0.02, FDI and environmental degradation by 0.05 and financial development and environmental degradation by 0.001.

Moreover, all the institutional quality interaction terms are negative and significant. Based on the above mentioned findings together, good quality institutions lower the harmful effect of energy consumption, financial development, and economic growth on carbon emission. This

findings support the regulation effect hypothesis which are related to the implementation of standards related to environment. Its indicates that if there is strong quality institutions, the financial markets will more likely to facilitate environment friendly projects and facilitate green investments. In this way, the harmful impact of financial development on environment can be minimized. Our results are in line with those of (Hunjra et al., 2020).

Table# 5: Two step System GMM model results

Results of 2-Step System Generalized Method of Moments	Model-3			
Variables	1	2	3	4
Co2 _{it-1}	0.925*** (0.000)	0.921*** (0.000)	0.925*** (0.000)	0.923*** (0.000)
RE	-0.125*** 0.000***	-0.129*** 0.000***	-0.132*** 0.000***	-0.127*** 0.000***
Financial development-I	(2.990) (0.000)	(3.450) (0.001)	(1.730) (0.000)	(5.430) (0.000)
GDP	0.040*** (0.000)	0.054*** (0.000)	0.040*** (0.000)	0.038*** (0.000)
(GDP) ²	-0.002*** (3.870)	-0.002*** (3.400)	-0.002*** (4.130)	-0.002*** (4.820)
Institutional quality -I	0.152*** (0.007)	0.234*** (0.005)	0.161*** (0.004)	0.069*** (0.004)
FDI	-0.001*** (6.240)	-0.001*** (9.430)	0.004*** (3.030)	-0.001*** (4.180)
urbanization	-0.000 (0.001)	0.004** (0.001)	-0.002*** (0.001)	-0.006*** (0.000)
RE× Inst	RE× IQ-CC -0.001* (0.000)			
GDPPC× Inst.	GDPPC× IQ-CC -0.021*** (0.000)			
FDI ×Inst.	FDI ×IQ-CC -0.005*** (2.480)			
FD ×Inst.	FD-B ×IQ-CC -0.001*** (4.110)			
Constant	0.493*** (0.007)	0.500*** (0.005)	0.515*** (0.005)	0.586*** (0.005)
Observations	1,093	1,093	1,093	1,093
Number of id	119	119	119	119
AR2	-1.20(0.231)	-1.25 (0.213)	-1.16(0.245)	-1.20(0.231)
Sargan test	439.53(0.000)	426.06(0.000)	438.79(0.000)	439.15(0.000)

Likewise, the interaction term of institutional quality and foreign direct investment is also negative which indicates that strong quality of institutions can control the harmful impact of FDI inflow and help reducing carbon emission by implementing rules and regulation for foreign direct investment not to invest in polluted industries while to invest and bring new technologies which are environment friendly. This result is in line with the findings of (Hunjra et al., 2020). We can compare the harmful impact of FDI on environment especially in developing countries are harmful due to poor level of regulatory framework. The

interaction of per capita GDP with quality institution is also significant and negative which indicates that good quality of governance and strong institutions can help lower the positive impact of economic growth as foreign direct investment, financial development and other factors are important for economic growth however these are not favorable for environmental quality can be controlled by quality institutions. Likewise, the results indicate that the favorable negative association between environmental degradation and renewable energy consumption will be strengthen in the presence of better governance. Good governance can help meet the challenges which are badly related to environmental quality with large amount of inflow of funds (Bokpin, 2017). Good governance is agreed factor in mitigating the harmful impact of FDI on environment (Assa, 2018).

5. Conclusion and policy implication

This study explores the moderating effect of institutional quality on carbon emission through foreign direct investment, financial development, economic growth and renewable energy consumption in the globe for the period of 2002 to 2019. The study employed two Step System Generalized Method of Moments as it is an efficient estimator for such kind of studies. The results indicate that renewable energy usage and foreign direct investment inflow enhance environmental quality while financial development and economic growth lowers environmental quality in the panel. However, the interaction term of institutional quality confirms the significant moderating effect of all explanatory variables on environmental quality in the panel. The findings also confirm the existence of Environmental Kuznets Curve and evidence the pollution halo hypothesis. The study indicates that institutional quality index as well the signal proxy of quality institutions positively affect carbon emission which maybe the reason of weak level of institutions in some countries of the panel such as control of corruption, government effectiveness and regulatory quality however the interaction terms of quality institutions through FDI, FD, Economic growth and Renewable energy consumption moderate this association. The policy makers should focus to enhance the quality institutions to protect the quality of environment because institutors provide laws, regulations and control the level of corruptions which reduce carbon emission and improve the quality of environment. Quality institutions can also establish laws for FDI inflow and production to protect environment by implement restriction to stop the inflow of FDI in polluted industries as well to keep the progress of economic growth. The results also indicate that FD increase carbon emission thus indicate that financial development does not facilitate the green energy and technology promotion. However, green technologies which are

beneficial for environmental quality need large amount of investment while due to lack of guarantees, banks don't provide loan for carbon free projects to enhance environment friendly projects. Future studies should use try to investigate the role of environmental innovation in finance, FDI and growth association lodging by institutional quality. Future studies can be conducted for developing and developed countries to differentiate the impact of these variables on carbon emission as our sample is mix and it's include both developed and developing countries. Future studies can use alternative econometric models for such kind of studies to deeply and efficiently understand this association and compare the results.

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Figures

Figure 1

The moderating role of institutional quality on carbon emission through renewable energy consumption, economic growth, foreign direct investment and financial development