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EXPLORING THE INTERMEDIARY ROLE OF INSTITUTIONAL QUALITY AND HUMAN CAPITAL IN THE NEXUS BETWEEN FINANCIAL DEVELOPMENT AND ENVIRONMENTAL DEGRADATION IN PAKISTAN

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ABSTRACT
Pakistan has been facing the problem of increasing environmental degradation over the past a decade or so. Like most of the emerging economies, Pakistan is also on the trajectory of economic growth but this outcome has also increased environmental degradation (ecological footprint) EFP. It is, therefore, imperative to point out factors, which are contributing to environmental degradation. In this regard, the current study explores the effect of financial development, institutional quality, and human development on EFP. In Financial development and EFP nexus, the study finds the mitigating role of institutional quality and human development. The study used time series data ranging from 1980 to 2021 for Pakistan. The research conducted the Autoregressive Distributed lag technique (ARDL) to find out how these variables are econometrically related. The empirical work unearthed that financial development has increased EFP. The study further found the role of, institutional quality, and human development as dampening the effect of financial development on EFP. Based on the findings of the study Pakistan should keep the process of financial development but for the sustainability of the environment, it must also improve both, institutional quality and human development.
Keywords: Financial development, Institutional quality, environmental degradation, human development and ARDL.

INTRODUCTION
Pakistan is a resource rich developing country and it has reserves of crude oil, natural gas, coal, copper, iron, salt, limestone and water resources (Atil et al., 2020). But the country has experienced extreme weather events in recent past i.e. faced several floods since 2010, worst drought during 1998 to 2002, extreme heat wave in the western parts of country especially heat wave of 2015 in Karachi, wind storm of June 2016 in Islamabad and incidents of landslides and Glacial Lake Outburst Floods in northern parts of the country. These extreme weather events caused aggravated losses to the country both economically and resulted in fatalities. German Watch calculates the Global Climate Risk Index (CRI) to quantify the impact of extreme weather events both in terms of fatalities and economic losses occurred for 180 countries of the world. According to the report in 2021, Pakistan is ranked 15th most affected country among 180 countries on CRI by German Watch. While World Bank policy report 2019 warns that more than half of the county's population will be exposed to air pollution in 2050, and the associated cost will also increase which is estimated as varying in range from 2.5 to 6.5 percent of GDP equivalent by (Strukova, 2018). According to (MoCC, 2016) and National disaster management authority (NDMA), the damages of the country caused by disaster related events are about 3.99 Billion US dollar during the period of 1994 to 2013. The estimated annual damages of the country caused by flooding are 0.6 percent of GDP equivalent, (World Bark, 2015). The agriculture sector of the country contributes 18% of the country's GDP and provides employment to the rural population. The agricultural activities in the country are highly dependent on Indus water which provides water supply to 90% of its food production (Qureshi, 2011). The expedite melting of the northern glaciers that are

the prime source of water supply to the river is causing flooding in present and an expected shortage of water in future which is adversely effecting agriculture produces both in present and in future.

The above facts show that environmental degradation is occurring at an increased face and becoming a serious threat to country not only in term of fatality but also economically. The finding from a poll conducted by Gallop and Gilani in (2017), 79 percent of the population considers water quality as a problem and another 75 percent considers air pollution as a problem. Similarly, the poll shows that half of the population believes on immediate policy actions for the prevention of environmental deterioration which was only one third earlier in2015.

A developed and efficient financial sector is inevitable for the smooth functioning of the expanded economic activities of modern world. Economists like (Levine, 1996) think the slow economic development in some developing countries is attributed to inefficient and underdeveloped financial system and suggest systematic reforms in financial sector. Pakistan, a developing country, is facing the issue of fragile and inconsistent economic growth performance, adopted the policy of financial sector liberalization in 1991 after realizing the suppressing impact of nationalization policy of 1970s on the economic performance of the country. The aim of the liberalization was to encourage competition among the financial institutions and enhance the supervisory role of the state bank of Pakistan. Liberalization of financial sector along with other reforms was part of the deliberate efforts by the government to spur economic growth of the country. World Bank considers financial development as a composite term which encompassing the availability and access to financial resources along with the depth, stability and efficiency of the financial market. The advancement of the financial sector enables the countries, especially the developing countries, to expedite the process of industrialization and utilization of natural resources for fulfilment of energy requirement (Frankel and Romer, 1999).

The plethora of studies has investigated the nexus of financial development and economic growth having consensus on the existence of a positive relationship between the two (Bist, 2018, Pan and Yang, 2019). The occurrence of economic growth via consuming of natural resources (Hussain et al 2020b), is also a commonly accepted fact in today's mechanical world. Therefore, the issue of making economic developmental and preserving the environment is being a vital concern (Atl et al, 2020, Hailu and Kipgen, 2017), for the countries. The financial development may help in preserving the environment by attracting the foreign investment into the country which improve the productivity through the influx of advanced technology. Similarly, the financial development also enables the local producers to acquire environment friendly advanced technologies resulting in enhanced environment quality. Parallel to this, financial development also makes it possible to pursue the projects of solid waste management and other measures for prevention of environment degradation. The empirical findings support the view of positive, negative and insignificant impact of financial development on environment. A series of paper found a negative impact of financial development on environmental degradation in different regions and countries across the globe i.e. Tamazian et al, in BRIC countries, Tamazian and Rao in transition countries, Jalil and Feridun for china and Shehbaz with different coauthors in his three paper separately for Malaysia, Indonesia and South Africa. On the other hand, some authors have found negative impact of financial development on environmental degradation i.e. Zhang for China, Al-mulali and Sab for Sub Saharan African countries and, similarly, Boutaba and Shehbaz et,al, for india. While Ozturk and Acaravcihave found in significant impact of financial development on environment in Turkey. Therefore, the question of the sustainability of the growth, i.e. the growth in environmental preserving way, as a result of financial development is still a widely debating issue in the literature and is inconclusive so far.

Despite the tremendous mechanization and automation that has taken place everywhere and in every sphere of life the role of human could not be reduced to zero. Human being is still occupying a significant place in all the activities being performed for ensuring the existence of life and goodness of the mankind. Owing to the perpetuity of the role of humans it has always remained at the center of all the policies made for development and sustaining it. In modern era, the importance of skilled human capital has even increased compared to the role it was playing previously. The skilled human capital is more productive and uses all the inputs among energy very efficiently causing less wastes as well as emitting lower amount of greenhouse gases during production. Therefore, educated and aware human capital can play a vital role and make economic development possible in environment friendly manner. The educated human capital can understand importance of climate change taking place as well as the associated adverse economic and fatal impacts and can help in preventing the climate change and

mitigating the related adversity (Ahmed and Wang, 2019; UNESCO 2010). Chankrajang and Muttarak (2017) has highlighted that gaining awareness and knowledge regarding environment friendly manners leads towards the pro – environment actions.

The objectives of inclusive economic growth and environment sustainability, that are at the core of United Nation's sustainable development goals, are hard to achieve in the absence of properly functioning institutions (Glass and Newig, 2019). The institutional quality of a country can be measured by the size of the government, the efficiency of rules and regulations and the openness of its market (Friedman and Friedman, 1990). The energy consumption alone is responsible for the two third of overall greenhouse gasses emission (IEA world energy outlook 2019), thus the success of achieving the long-term goals for the mitigation of climate changes solely depends on the quality and quantity of energy consumption (Goldthau and Witte, 2010). The efficiency of rules and regulations that determine the level corruption in the country which, in turn, hinders the country from building the capacity needed for the implementation of policies devised for renewable energy and environment sustainability (Sinha et al, 2019). Corruption also allows the misutilization

of subsidy fund for fossil- fuel energy consumption. Hasnisah 2019 emphasized on the necessity of appropriate institutional policies in combination with the financial development and trade policies for the implementation of renewable energy strategies to achieve the sustainable development goals.

The study is a step ahead toward the conclusion of the debate regarding the impact of financial development on the environment in Pakistan because the previous literature is divided and is inconclusive on the point that either financial development is having positive, negative or no relationship with environmental degradation. To best of our knowledge no study has investigated so far, the intermediary role of institutional quality between the relationship of financial development and environmental degradation, especially in case of Pakistan. Similarly, the previous literature does not contain any of the studies that has investigated the intermediary role of human capital between the relationship of the financial development and environmental degradation.

The remaining part of this paper will be presented as: section 2 will discuss literature review while section 3 focuses on methodology. The results are presented in section 4 while conclusion is there in section 5.

REVIEW OF LITERATURE

Financial development has been seen during last few decades almost everywhere on globe though with different degree and intensity. Likewise, its effect on environmental degradation is also noticed but here the effect is in both directions e.g., negative and positive. There are other variables too which over the years have shown some considerable effect on environmental. The following literature is reviewed to understand what the determinants of environmental degradation with a focus on financial development.

Welsch (2002) found corruption to be impeding growth and also increasing pollution. Per capita income has a u-shaped relation with pollution and corruption effecting pollution directly (by increasing pollution at a certain level of income) and indirectly (through reducing income) in developing countries. Gagliardy (2008), better institutions will make sure that policies are devised and implemented for the larger benefit of societies and economies rather than be manipulated by few for personal gain. Tamazian and Rao (2010) attempted to know the nexus of financial development and environmental degradation in presence of institutional quality. The study found role of institutional quality as pivotal for 24 transitional economies in tackling environmental degradation.

Halkoes and Polimes (2014), investigated the relationship between financial development, economic growth and environmental degradation. The study found both financial and economic development affecting environmental degradation negatively, causing increase in co2 emissions in OECD countries. Shehbaz et al. (2014) tried to know how energy consumption affects environmental degradation. The research found that energy affected environmental degradation negatively both at consumption and production level. Financial development is also found to have added to environmental degradation. Al-mulali et al. (2015) suggested firms and countries to invest in projects where more environment friendly technologies are used because the study found financial development to have a desired negative effect on environment degradation. Javid and Fatima (2016) found the existence of environmental Kuznet curve (EKC) exists in case of Pakistan; financial development initially deteriorates environment but after a specific level of income the FD starts improving environment as more environment friendly technology is used. Sharif et al., (2017) found tourism a factor which

increases environment degradation in Pakistan using time series data. The study suggested policies which will increase tourism but curtail environment degradation and improve economic growth.

Zakria and Bibi (2019) proved EKC in south Asian countries and the study also confirmed that financial development was more capitalization rather using it for better technology. The study found institutional quality improves environment. Ahmed and Wang (2019) showed significant effect of human capital on reducing EFP in India while energy consumption added EFP. The relationship between Economic growth and EFP shaped inverted u showing the presence EKC. Human capital is analyzed from different aspects; human capital related to task, to firm and then there is general type of human capital (Au et al., 2008). These divisions of human capital are not only essential but also very effective in dealing with environment related problems. Urbanization can increase the environmental degradation but human capital works in other direction in this case (Danish et al., 2019) Saud et al. (2019), also confirmed the presence of EKC in Venezuela case through time series analysis. The study suggested financial institutions can help the Govt tackle the environmental degradation through more prudent policies.

Atil et al., (2020) found that to know if natural resources are curse or blessing for Pakistan in relation to financial development. The study found natural resource as a blessing for Pakistan, and it has a positive relation with financial development too. Abbas et al. (2020) found socioeconomic factors causing environmental degradation in Pakistan utilizing data from1984 till 2017. The study also found the role of inconsistent and uncertain policies have a negative role in this regard. The sources of environmental degradation in case of Pakistan have been studied by Yousaf et al., (2022) through a time series data. Economic growth affects EFP negatively, the study found EFP affecting arable land too. Azam, Liu and Ahmed (2020) checked the effect of institutional quality on environment for 66 developing countries. The study found institutional quality to be affecting environment and energy consumption positively while globalization was found adding to environmental problems. In nutshell the reviewed literature aptly points out how financial development affects environment. But at the same time the literature leaves a gap of pointing out mitigating factors when it comes to negative effect of financial development on environmental degradation. The current study is an attempt to fill this gap considering the institutional quality and human capital as mitigating factor when analyzing the effect of financial development on environment.

Theoretical Framework and Methodology

The following sub-sections will highlight the theoretical framework and construction of the econometric model.

Theoretical Framework and model construction

Theoretically, the opinion is divided on the effect of FD on environmental degradation as it can increase or decrease ecological quality. The group that considers FD as a positive contributor to curtailing environmental degradation, argues more funds be allocated to projects using clean energy projects. Furthermore, they argue that to prevent environmental degradation, supporting infrastructure is needed which is possible only through prudent investment policies (Tamazian et al., 2009; Shebaz et al., 2021). They also favor FD in controlling environmental degradation because it enables the countries to use advanced technologies, which can help improve ecological quality alongside economic growth (Ahmed et al.,2021).

The group of researchers sees FD as a contributor to environmental degradation. FD makes it easier for people to get credit for the new businesses, which also increases energy consumption hence causing environmental degradation (Acheampong, 2019). Current research constructed the model given below by following Shabaz et al. (2018) and Nasir et al. (2021).

$$lnEF_t = \beta_1 + \beta_2 lnEF_t + \beta_3 lnGDP_t + \beta_4 lnEC_t + \beta_5 lnHC_t + \beta_6 IQ_t + \tau_t (1)$$

Where EF shows Ecological footprint, FD Financial development, GDP Gross Domestic Product, EC Energy Consumption, HC Human Capital, and IQ Institutional Quality. T refers to year and $\tau$is the error term.

Since we hypothesize, that Institutional Quality should minimize the effect of FD on environmental degradation therefore we added the interactive term of FD and Institutional Quality Equation (1) in Equation (2). This term will tell us how the combined effect of FD and Institutional Quality on environmental degradation.

$$lnEF_t = \beta_1 + \beta_2 lnFD_t + \beta_3 lnGDP_t + \beta_4 lnEC_t + \beta_5 lnHC_t + \beta_6 IQ_t + \beta_7 lnFD_t * lnIQ_t + \tau_t (2)$$

In order to check the joint effect of FD and Human Capital on environmental degradation, we have added the interactive term of FD and Human Capital to Equation (1) in Equation (3).

$$lnEF_t = \beta_1 + \beta_2 lnFD_t + \beta_3 lnGDP_t + \beta_4 lnEC_t + \beta_5 lnHC_t + \beta_6 IQ_t + \beta_7 lnFD_t * lnHC_t + \tau_t \quad (3)$$

The research is attempting to check the dynamic linkage between ecological footprint, financial development, institutional quality, and human capital. The study period is from 1980 to 2021. Ecological footprint, which has been extracted from the Global footprint network, is used as a proxy and it is considered to best capture the environmental aspect because it is a composite index (Ahmed et al., 2022). Data of GDP, Human Capital and energy consumption is extracted from World Development Indicators. Credit to private sector has been taken from World Development Indicators as a proxy of financial development. Institutional quality has been taken from World Governance Indicators.

Estimation Technique

This study uses ARDL technique for analysis to achieve the objective of the study. The ARDL is preferred over all the other available cointegration techniques for time series analysis on basis of following reasons. The ARDL is more flexible compared to other techniques because it does not impose the restriction on the variables to be integrated of same order. The ARDL is equally applicable to small and large samples. The ARDL also provides the advantage of testing the long and short run relationship among the parameters simultaneously along with error correction term to capture the rate of convergence towards the equilibrium.

Before applying the ARDL unit root test was applied to ensure that none of the series is integrated of order (2). The Augmented Dicky Fuller technique is consisting on following equation given below:

$\Delta Zt = \alpha 0 + \alpha\ 1Zt\text{-}1 + \sum\pi \quad di\Delta Zt\ j + \mu t \ldots\ldots (4)$

Where Δ is the form of 1st difference operator, Zt shows the time sequence variable, α 0 is a constant and π is the number of lags included in the model. The ADF equation presented that whether estimated variables are equal to zero. Further this test offer t-statics and probs value for talking decision about stationary of series. The above equations contain variables both in level and in first difference. The coefficient in the differenced form shows the short run relationship and the coefficient in the level form shows the long run relationship.

The study uses ARDL bound test to confirm the presence of long run relationship among the variables and validates the inclusion of the variables in level in the model. The null hypothesis of the bound test is that there is no cointegration meaning that the coefficients of all the variables in level are zero. The null hypothesis of no cointegration is accepted if the calculated value of the bound test is less than the lower bound and rejected if the calculated value is greater than the upper bound. The acceptance of the null hypothesis favors the restricted model (model containing the variables only the in differenced form) over the unrestricted (model containing the variables in differenced as well as in level form) whereas rejection of the null hypothesis favors the unrestricted model over the restricted model. The long run equations is presented below.

$$LEF_{it} = \alpha_1 + \sum_{t=1}^{n} \alpha_2\, lnFID_{it-1} + \sum_{t=1}^{n} \alpha_3\, lnFDGDP_{it-1} + \sum_{t=1}^{n} \alpha_4\, lnEC_{it-1} + \sum_{t=1}^{n} \alpha_5\, lnHC_{it-1} + \sum_{t=1}^{n} \alpha_6\, INST_{it-1} + \tau_{it} (5)$$

$$LEF_{it} = \alpha_1 + \sum_{t=1}^{n} \alpha_2\, lnFID_{it-1} + \sum_{t=1}^{n} \alpha_3\, lnFDGDP_{it-1} + \sum_{t=1}^{n} \alpha_4\, lnEC_{it-1} + \sum_{t=1}^{n} \alpha_5\, lnHC_{it-1} + \sum_{t=1}^{n} \alpha_6\, INST_{it-1} + \sum_{t=1}^{n} \alpha_7\, HC * lnFID_{it-1} + \tau_{it} (6)$$

$$LEF_{it} = \alpha_1 + \sum_{t=1}^{n} \alpha_2 \, lnFID_{it-1} + \sum_{t=1}^{n} \alpha_3 \, lnFDGDP_{it-1} + \sum_{t=1}^{n} \alpha_4 \, lnEC_{it-1} + \sum_{t=1}^{n} \alpha_5 \, lnHC_{it-1} + \sum_{t=1}^{n} \alpha_6 \, INST_{it-1} + \sum_{t=1}^{n} \alpha_7 \, FID * lnINST_{it-1} + \tau_{it} (7)$$

The above equations 5,6 and 7 presented the long run equation of Ecological footprint. In the first equation of long run we check the relationship between FID, HC and INST on ecological footprint. In the second equation of long run we find the relationship between interactive term (HC*LnFID) on ecological footprint. In the third equation we explore the relationship among second interactive term (FID*LnINST) on ecological footprint. Moreover, we demonstrate the relationship among all variables used in ARDL long run model. After all this Analysis we created the long run relationship among all variables included in model than we employ short run concept of ARDL Method.

$$\Delta LEF_{it} = \alpha_1 + \sum_{t=1}^{n} \alpha_2 \, \Delta(lnFID)_{it-1} + \sum_{t=1}^{n} \alpha_3 \, ln\Delta(FDGDP)_{it-1} + \sum_{t=1}^{n} \alpha_4 \, ln\Delta(EC)_{it-1} + \sum_{t=1}^{n} \alpha_5 \, ln\Delta(HC)_{it-1} + \sum_{t=1}^{n} \alpha_6 \, \Delta(INST)_{it-1} + \varphi(ECT)_{t-1} + \tau_{it} (8)$$

$$\Delta LEF_{it} = \alpha_1 + \sum_{t=1}^{n} \alpha_2 \, \Delta(lnFID)_{it-1} + \sum_{t=1}^{n} \alpha_3 \, ln\Delta(FDGDP)_{it-1} + \sum_{t=1}^{n} \alpha_4 \, ln\Delta(EC)_{it-1} + \sum_{t=1}^{n} \alpha_5 \, ln\Delta(HC)_{it-1} + \sum_{t=1}^{n} \alpha_6 \, \Delta(INST)_{it-1} + \sum_{t=1}^{n} \alpha_7 \, \Delta(FID * lnINST)_{it-1} + \varphi(ECT)_{t-1} + \tau_{it} (9)$$

$$\Delta LEF_{it} = \alpha_1 + \sum_{t=1}^{n} \alpha_2 \, \Delta(lnFID)_{it-1} + \sum_{t=1}^{n} \alpha_3 \, ln\Delta(FDGDP)_{it-1} + \sum_{t=1}^{n} \alpha_4 \, ln\Delta(EC)_{it-1} + \sum_{t=1}^{n} \alpha_5 \, ln\Delta(HC)_{it-1} + \sum_{t=1}^{n} \alpha_6 \, \Delta(INST)_{it-1} + \sum_{t=1}^{n} \alpha_7 \, \Delta(HC * lnFID)_{it-1} + \varphi(ECT)_{t-1} + \tau_{it} (10$$

The above equations 8, 9 and 10 shows the variables of short run model. This model would be used to estimate the ECM term which confirm about the long run relationship among the variables from the short run to the long run in this model. If the parameter of ECT happen a significant and negative, its demonstrates that there is existence of equilibrium among all variables from short run to the long run in ecological footprint model. Here ECTt-1 represent the value of lag of the error correction term, £ is the coefficient of ECT which clarifies the speed of adjustment to the equilibrium from short run to the long run.

After deciding the variable in the model, next step is the lag selection of the selected variables which is decided on the basis of standard lag selection criteria i.e. Akaik Information Criteria (AIC). After these steps the results are obtained for interpretation using the finally selected model.

After regression analysis post estimation diagnostic tests were performed to check the quality of the findings. These tests include Remsey reset test for functional form accuracy, LM test for autocorrelation, White test for heteroscedasticity and cumulative sum test for stability of the parameters.

RESULTS AND DISCUSSION

The following section presents Correlation Matrix, unit root tests, ARDL and diagnostic tests.

Table No. 1 Correlation Matrix

Correlation Matrix						
	LECOFP	LGDP	LHC	LINSTVE	LENC	LFID
LECOFP	1	0.959	0.940	-0.344	0.844	-0.550
LGDP_PC_CONS	0.959	1	0.879	-0.216	0.718	-0.622
LHUMAN_CAPITAL	0.940	0.879	1	-0.427	0.905	-0.445

LINSTVE	-0.344	-0.216	-0.427	1	-0.444	0.213
LENC	0.844	0.718	0.905	-0.444	1	-0.174
LFID	-0.550	-0.622	-0.445	0.213	-0.17477	1

Source: Author Calculation

Table 1 shows the correlation matrix of the series of the study. The matrix is generated to have some understanding of the data and relationship among the variables which provide beneficial insight for solving problems that may arise at the regression stage. The first column of the matrix shows strong and positive relationship of gross domestic product, human capital, energy consumption with ecological footprint, whereas it has negative weak relationship with institutional quality and negative strong relationship with financial development. The second column depicts that gross domestic product has strong positive correlation with human capital and financial development, whereas a weak negative correlation with institutional quality and negative strong correlation with financial development. The third column of the table shows human capital has negative weak correlation with institutional quality and financial development, whereas a positive strong correlation with energy consumption. The fourth column of the table shows that institutional quality has weak negative correlation with energy consumption and weak but positive correlation with financial development. The fifth column of the table shows that energy consumption has a negative weak correlation with financial development.

Table No. 2 Unit root

Unit root							
Variables	Level			1^{st}Difference			Decision
	None	Intercept	Trend & Intercept	None	Intercept	Trend & Intercept	
ECOFP	3.303 (0.999)	-0.630 (0.849)	-2.976 (0.154)	-4.912 (0.000)	-6.802 (0.000)	-6.680 (0.000)	I(1)
INST	-2.687 (0.008)						I(0)
LHUMAN_CAPITAL		-2.254 (0.192)			-2.435 (0.051)	-5.280 (0.000)	I(1)
LCO2	-2.004 (0.045)						I(0)
LECOFP	4.124 (0.999)	-1.979 (0.294)	-2.970 (0.155)		-6.491 (0.000)		I(1)
LENC	1.667 (0.974)	-2.986 (0.046)	-1.299 (0.870)				I(0)
LFID	-0.955 (0.295)	-1.513 (0.513)	-2.971 (0.156)	-4.233 (0.000)			I(1)
LGDP_PC_CONS	2.718 (0.997)	-0.605 (0.853)	-3.137 (0.115)	-2.350 (0.020)			I(1)
LGDP_PC_CUR	2.518 (0.996)	-0.864 (0.786)	-1.397 (0.842)	-4.131 (0.000)			I(1)
LHCLFID	0.380 (0.787)	-1.942 (0.309)	-1.376 (0.847)	-2.614 (0.010)			I(1)
LINST_LFID	-3.257 (0.001)						I(0)

Source: Author Calculation

Table 2 shows results of unit root test performed to check the stationarity of the log transformed series included in the study. These tests are performed to avoid the possibility of spurious regression which arises if any of the variables included in the regression is nonstationary. The result shows that the institutional quality, carbon emission, energy consumption and the interactive term of institutional quality and financial development are stationary at level, whereas other variables like ecological foot print, human capital, financial development, gross domestic product and the interactive term of financial development and human capital are stationary at first difference. On the basis of these results the study is choosing ARDL test for estimation.

Table No. 3 Results of the ARDL bound test

	Model 1		Model 2		Model 3	
F-stat	7.273		6.808		5.352	
Critical Values of Bound Test	I0 Bound	I1 Bound	I0 Bound	I1 Bound	I0 Bound	I1 Bound
10%	2.75	3.79	2.53	3.59	2.53	3.59
5%	3.12	4.25	2.87	4	2.87	4
1%	3.93	5.23	3.6	4.9	3.6	4.9

Source: Author Calculation

Before proceeding towards regression analysis the ARDL bond test was applied to check the cointegration among the variables. Table 3 presents the results of ARDL bound test which is also known as F-Test. This test is used to check for the existence or absence of long run relationship among the variables. The result shows that the F- statistics of 7.273 of model 1, 6.808 of model 2 and 5.352 of model are greater than their respective upper bound values i.e. 3.79 of model 1, 4.25 of model 2 and5.23 of model 3. Therefore, the null hypothesis of no cointegration cannot be rejected. Therefore, the result confirms the existence of long run relationship among the variables in all the three specification and the ECM term can be included in the ARDL model for analysis.

Table No. 4 Short and Long Run Results of Ecological Footprint Models

	ARDL short Run		
Name of Variables	Model 1	Model 2	Model 3
D(LHUMAN_CAPITAL)	-3.216 (0.000)	-2.698 (0.013)	-3.648 (0.001)
D(LINSTVE)	1.066 (0.298)	3.476 (0.002)	2.773 (0.014)
D(LENC)	4.074 (0.000)	9.030 (0.000)	5.473 (0.000)
D(LFID)	2.421 (0.024)	-2.885 (0.009)	1.676 (0.108)
D(LGDP_PC_CONS)	1.108 (0.280)	0.349 (0.730)	-0.402 (0.691)
D(LHCLFID)		4.575 (0.000)	
D(LINST_LFID)			-2.755 (0.011)
D(@TREND())	6.563 (0.000)	8.392 (0.000)	7.168 (0.000)
CointEq(-1)	-7.390 (0.000)	-17.994 (0.000)	-12.910 (0.000)
LGDP_PC_CONS	-1.871 (0.075)	-2.054 (0.053)	-0.400 (0.692)
LHUMAN_CAPITAL	-3.115 (0.005)	-6.441 (0.000)	-4.057 (0.000)
LINSTVE	-2.241 (0.035)	3.095 (0.005)	3.075 (0.005)
LENC	5.147 (0.000)	8.349 (0.000)	5.833 (0.000)
LFID	4.164 (0.000)	-2.766 (0.019)	4.933 (0.000)
LHCLFID		6.162 (0.000)	
LINST_LFID			-3.095 (0.005)
C	8.724	12.137	10.682

	(0.000)	(0.000)	(0.000)
@TREND	7.310 (0.000)	1.0597 (0.000)	8.741 (0.000)

Source: Author Calculation

Table 4 shows the regression outcome of all the three models of the study. The results show that human capital is negatively associated with ecological footprint both in long run and short run, in all the three models. The results depict that, in the short run, an increase in human capital by 1% significantly decreases pressure on environment by 3.216 %, 2.698% and 3.648% according to model 1, 2 and 3, respectively. Similarly, in the long run, an increase in human capital an increase in human capital by 1% prevents environment significantly from deterioration by 3.115%, 6.441% and 4.057% according to model 1, 2 and 3, respectively. These findings are highly expected as educated masses coordinates for the environment preservation through efficient use of energy and other natural resources. These findings are similar to the findings of Ahmed et al., (2020).

The result also shows that institutional quality is positively associated with ecological footprint in all the three specifications both in long and short run except in model 1 in the long run which shows that the association is negative. The results reveal that, in the short run, a 1 % betterment in quality of institutions in Pakistan spurs environmental degradation by 1.066%, 3.476% and 2.773% according to Model 1, 2 and 3, respectively. Similarly, in the long run, the deteriorating impact of 1% improvement in institutional quality of the country is 3.095 % and 3.075% according to model 2 and 3, respectively. Model 1, on the contrary, shows that an improvement of 1 % in institutional quality will significantly contribute to environmental preservation by 2.241%. The better quality of public institutions is expected to contribute to environment preservation in the country through its effect on social, governance and economic readiness. Contrary to the expectations, the findings of the present study shows that in Pakistan an improvement in quality of public institutions does not contribute to environmental preservation that might be justified on ground of insufficient laws for the protection of environment.

The outcome of the regression shows that energy consumption is positively associated with ecological footprint in all the three specification both in long and short run. The result shows that, in the short run, an increase of 1% in energy consumption creates a significant pressure on environment by 4.074%, 9.03% and 5.473% according to specification 1, 2 and 3, respectively. Similarly, in the long run, a 1% increase in energy consumption in Pakistan deteriorates environment by 5.147%, 8.349% and 5.833% according to Model 1, 2 and 3, respectively. These are expected results as a greater percentage share of energy consumption consists of fossil fuel consumption which emits Co2 and degrades environmental quality. These findings are similar to the findings of Destek and Sarodie (2019), Khan and Hou (2021c) and Desteck and Sinha (2020).

The finding from regression analysis shows that financial development is positively associated with ecological footprint in all the three specification both in the long and short run. The result shows that a 1% financial development increases pressure in short run-on ecological footprint by 2.421%, 2.885% and 1.676% according to specification 1,2 and 3, whereas a similar level of financial development creates a pressure of 4.164%, 2.766% and 4.933% according to model 1,2 and 3 respectively, in the long run. These findings are expected as financial development enhances economic activityandincreasingconsumptionoffossilfuelwhichtranslatesintoapressureonecologicalfootprint of the country. The financial development might be allocating resources to those sectors that are more detrimental to environment.

The result shows that ecological footprint in Pakistan is less responsive to the economic growth in the country. In short run gross domestic product is insignificant in all three specifications whereas in the long run it is significant in model 1 and 2 at 10% and 5%, respectively and insignificant in model 3. In the short run its impact on ecological footprint is positive and in the long run its impact is negative. This can be interpreted that the economic growth builds pressure on ecology in short run, but in the long run, new, energy efficient and environmentally friendly technologies are adopted for the production that reduced the pressure built in the short run.

The result shows that the coefficient of the interactive of financial development and human capital is significant and negative. This is the expected result shows that an increase in human capital mitigates the detrimental impact of financial development on ecological footprints. The partial impact of financial development in model 2 will be 2.885 – 4.575*HC which means that a 1% improvement

in human capital in Pakistan reduces the detrimental impact of financial development on environment by 4.575% in the short run. Similarly, the long run partial impact of financial development is 2.766 – 6.162*HC which shows that an improvement of 1 unit in human capital will reduce the detrimental impact of financial development by 6.162%. The result also indicates the level of human capital that will vanish the deterioration to environment occurred due to financial development. The findings of the current study indicates that Pakistan needs 0.63 of human capital in the short run and 0.45 human capital in the long run to completely swap out the deterioration caused by financial development.

The result shows that the coefficient of the interactive term of institutional quality and financial development in the third model is highly significant and negative both in short and long run. This is quite interesting because it shows that the detrimental effects of financial development on environment can be mitigated through better public institutions. The institutional quality plays a compensatory role for the deterioration to environment due to financial development. In presence of institutions the short run marginal impact of the financial development on environment will be 1.676 – 2.577* I.Q. which means for every unit improvement in institutional quality the detrimental impact of financial development will be mitigated by 2.577%. Similarly the long run marginal impact of financial development on environment will be 4.933 – 3.095*I.Q which means that every improvement in institutional quality will compensate the detrimental impact of financial development on environment by 3.095%. This result has another advantage as well i.e. using this the quality of institution sufficient to nullify all the negative impacts of financial development on environment can be calculated both in short and long run. The current result shows that in short run, the quality of institutions should be 0.6 point and in the long run it should be 1.59 point to nullify the deterioration that may occur due to financial development.

Finally, the table presents the ECM term which shows the stability of the model and measures the speed of convergence towards the equilibrium. The ECM term is negative and significant in all the three specifications indicating that the system is stable and will converge towards equilibrium in the long run. The magnitude of the ECM term, a measure of speed of convergence, is 7.39%, 17.994% and 12.91% in model 1, 2 and 3, respectively. Though the result shows different rate of convergence in different specifications, but it is robust, in the sense, it indicates the stability of the system in all the three specifications.

After regression analysis some post estimation tests of residual diagnostics and coefficient stability were performed to investigate for auto correlation, heteroscedasticity and stability. The following table presents the results of Ramsey reset test used for functional form, ARCH test/ white for heteroscedasticity and LM test for autocorrelation.

Table No. 5 Diagnostic tests of all three models

Model under investigation	**Diagnostic tests statistics**		
	Ramsey RESET test	**ARCH test/ White**	**LM test**
Model:1	2.022 (0.166)	0.652 (0.754)	1.397 (0.271)
Model:2	0.776 (0.389)	0.453 (0.910)	0.318 (0.731)
Model:3	1.269 (0.272)	0.412 (0.924)	0.330 (0.722)

Source: Author Calculation

The second column shows the result of ARCH test/ White test for all the models of the study. The p value of the test is greater than 5% so the null hypothesis of no heteroscedasticity cannot be rejected. Based on the result it is concluded that the models are from heteroscedasticity. The third column of the table shows the result of LM test for all the models. The result shows that the p values are greater than 5% so the null hypothesis of no autocorrelation cannot be rejected. This shows that the models are free from autocorrelation. CUSUM tests are used to check the stability and reliability of parameters. The two red lines are used as benchmark at 5% significance level. In case the blue line crosses these two given red lines then the parameters will not be stable and reliable. Keeping these parameters and given result in all 3 figures confirm that our parameters in all three models for ecological footprint are stable and can be lilied upon for policy recommendations.

CONCLUSION

If we list the current global challenges the world has been facing, then without any hesitation we can single out environmental degradation is the top on the list. It is threatening the tremendous progress made on the economic and social front over the years. Pakistan is not an exemption in this regard, as the environmental degradation is almost obvious by the regular news being reported in media regarding floods through glaciers, fires in different mountains, and water scarcity in different parts of the country. It makes it imperative to find out what is fueling environmental degradation in Pakistan and find out how this process can be stopped or reduced. The financial development over the years in Pakistan has been linked with environmental degradation. The current study is an endeavor which explores the dynamic relationship between financial development (FD) and EFP for Pakistan using a time series data from 1980 to 2021. In addition to FD the research also looks for the combined effect of FD and institutional quality and FD and human capital on EFP while using energy consumption and Economic growth as control variables.

The research found that FD has been increasing EFP which has been causing environmental degradation in Pakistan. To further understand the situation, we tried to find out the indirect effect of FD on EFP in Pakistan by combining FD with institutional quality and human capital separately. Much to our surprise the FD is found to be improving ecological quality but through a channel called institutional quality. The other interesting finding came through another channel called Human development where FD reduced EFP in Pakistan through a statistically positive and significant relationship.

This study suggests the following policy recommendations on the basis of results we have reached Pakistan must realize that financial development is the source of economic growth, but it also deteriorates ecological quality hence structural changes are the need of the hour. Furthermore, funds should be allocated to those projects which use more environment friendly technologies and have the understanding of lowering environmental degradation along with economic growth. The 2nd policy recommendation is regarding Human capital. Pakistan needs to devise strategies which can improve human capital through proper health care, education and skill development. This strategy will result in decreasing environmental degradation. Sustainable economic development can come on the foundation and existence of very strong institutional quality. This will help Pakistan mitigate the negative effect of FD on environment. Presence of strong institutions will also make sure that funds are not allocated towards pollution- increasing projects.

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