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Impacts of urbanization FDI Industrialization and economic growth on carbon emissions in Pakistan

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Abstract

The purpose of this study is to explore the effect of urbanization by adding economic growth on carbon emission and limiting the region of Pakistan. The studied time period of this study is 1990 to 2021. Autoregressive Distributed Lag, bound testing approach has been used to check long run relation between urbanization and carbon emission (CO2). The ARDL co-integration confirmed long run relation in the selected model. Results indicates positive relationship of urbanization, foreign direct investment and population with carbon emission (CO2) in short run, while all other variables gross domestic investment (GDP) and domestic investment (DI) are negatively linked with carbon emission (CO2). On the other hand, in case of long run, all variables are positively linked with carbon emission while domestic investment and GDP are negatively linked. Government should be implementing effective urban planning strategies to promote sustainable development. This includes designating areas for green spaces, implementing mixed land-use zoning to reduce commuting distances, and encouraging compact and walkable communities. By strategically managing urban growth, governments can minimize carbon emissions associated with transportation and energy use.

Keywords: FDI, Economic Growth, Carbon Emission, Pakistan

Introduction

Urbanization, foreign direct investment (FDI), and economic growth have complex and multi-faceted issue carbon emissions. While there is no definitive answer, several factors can influence the relationship between these variables.

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Urban areas tend to have higher population densities and concentrated economic activities, which can lead to increased energy consumption and carbon emissions. As cities expand, there is a greater demand for infrastructure, transportation, and housing, often resulting in increased energy use from fossil fuels. However, urban areas also offer opportunities for more efficient energy use and the adoption of sustainable practices. Well-planned cities with adequate public transportation, efficient buildings, and renewable energy sources can help reduce carbon emissions.

FDI can bring economic growth and development to urban areas, attracting businesses and industries. However, the impact on carbon emissions depends on the nature of the investments. FDI that promotes energy-intensive industries or relies heavily on fossil fuels may contribute to increased emissions. On the other hand, FDI that supports clean technologies, renewable energy, or energy-efficient practices can help reduce carbon emissions. The policies and regulations in place also play a crucial role in shaping the environmental impact of FDI.

Economic growth often leads to increased energy consumption, industrial production, and transportation, which can result in higher carbon emissions. As countries develop and their GDP rises, there is typically a surge in energy demand, often met by burning fossil fuels. However, economic growth can also provide resources for investing in cleaner technologies, environmental regulations, and sustainability initiatives. The decoupling of economic growth from carbon emissions is a significant challenge, but it is possible through sustainable development pathways. Policy interventions, technological advancements, and public awareness are essential in managing the influence of urbanization, FDI, and economic growth on carbon emissions. Some strategies to mitigate carbon emissions in this context include:

Designing cities with a focus on sustainable infrastructure, efficient transportation systems, green spaces, and energy-efficient buildings can help reduce carbon emissions.Encouraging the adoption of solar, wind, and hydropower (sources of renewable energy) are crucial for several reasons, including reducing reliance on fossil fuels and lowering carbon emissions.Implementing energy-efficient practices across industries, buildings, and transportation can lead to significant reductions in carbon emissions. Promoting public transportation, cycling infrastructure, and electric vehicles can help reduce carbon emissions associated with urban transportation. Enforcing regulations that limit emissions, promote cleaner production processes, and offer incentives for sustainable practices can steer FDI and economic growth toward lower carbon intensity.

It's important to note that the impact of these factors can vary across different countries and regions, depending on their specific circumstances, policies, and level of development. Additionally, the long-term effects of urbanization, FDI, and

economic growth on carbon emissions depend on how sustainability and climate change considerations are integrated into decision-making processes at various levels.

From the few decades, the increasing relation of used energy and economic growth is one of the characteristics of industrialization. For instance, during the Industrial Revolution, energy use increased significantly and output increased as a result, despite the fact that energy is already known to be an important variable, along with labor and capital, in order to clarify long-term economic growth (Stern, 1993, 2000; Stern and Kander, 2012; Wrigley 1986).

Therefore, it is without discussion that energy consumption is of greatest importance to the growth of industrialization in Newly Industrialized Countries (NICs; see below). The NICs are newly developed economies working to become industrialized in order to be classified as developedcountries. China, India, Brazil and Mexico are the part of NIC's. These countries are among the top 10 countries, used energy during the year 2018. Meanwhile these highlighted NIC's are also the part of top 20 which produced CO2 with greater ratio in 20192. However, in the context of inevitably expanding industrialization, what are the precise effects of increased wealth and energy consumption on environmental degradation? As urbanization and industrialization establish, energy consumption rises in both the short- and long-term (Sadorsky, 2014), leaving this topic unsolved.

This study's main goal is to analyzing effects of economic development and energy use on carbon emissions, which are used as a proxy for degradation of the environment based on the Environmental Kuznets Curve (EKC) hypothesis, with a particular emphasis on NICs that have adopted a multivariate framework.3 Simon Kuznets' (1955) theory served as the inspiration for Grossman and Krueger's (1991) development and popularization of the EKC concept. Grossman and Krueger (1991) noted that three significant channels: scale effect, composition effect, and technique effect, underlies the relation of economic growth and environmental quality, with scale effect having a negative impact.The composition effect and technique effect of economic growth having a positive impact.

Economic growth caused irresponsive exploitation of environmental resources at the early stages of development by neglecting waste management problems that lead to further environmental degradation, based on the results of scale effect. Economic growth has a composition effect as economic development increases, and as a result, policymakers are more concerned with the introduction of greener technologies and environmental-friendly mechanisms to preserve environmental quality and prevent environmental harm. Later, when the nations are completely established, economic growth shows a technique impact, where the nations have ability and willingness to invest more green energy technology may help to improve the environmental quality.

From the perspective of climate change policy, this study is also timelier because, according to van den and Wouter (2016), the climate policy evaluation plot reflects overall increases in social welfare. Meanwhile, human development is positively correlated with time (Costa et al., 2011). Few studies, however, use data on human capital to proxy human development used to calculate the effect of human development on carbon emissions in nexus contexts as we do.

This study makes four contributions in total: the effects of energy use,economic expansion, human capital, and exports on carbon emissions are all included in this study for the first time as a nexus. In addition, pool of nations added in this analysis is being used as there is no previous research has looked at these nations did not used panel data approachto measure naturally rising industrialization. Third, given the paradigm shift in how climate policy is assessed, the addition of the human capital dimension as a second variable examined the effects on carbon emissions, both novel and timely. Effects of energy consumption, economic growth, and human population are all studied variables.Results are pertinent and important for forming global climate policy due to inspirational CO2 reduction targets, such limiting global warming to 2°C, as stated in the accord reached at the. The 2015 Paris Agreement (COP 21) mandates that large polluters throughout the world, like the NICs, first comprehend connections between "energy consumption", "economic growth", "human capital", "exports", and "CO2 emissions". As a result, they may create effective CO2 emissions mitigation and reduction programs to combat negative effects of climate change, ultimately promoting global sustainability.

Objectives

This study aims to address a gap in perspective of urbanization, FDI industrialization and economic growth on carbon emission in case of Pakistan by covering time period of 1990 to 2021.

1. To investigates the impacts of urbanization on carbon emission whether urbanization is the cause of increasing carbon emissions or not.
2. To investigates the impact of total population on carbon emission in positive or negative way.
3. To investigate the effects of FDI on carbon emission in case of Pakistan as FDI is the most important factor for development.
4. To investigates the effects of domestic investment on carbon emission in the developing country like Pakistan.
5. To investigates the impact of economic growth on carbon emission. Economic growth is the key indicator of development of a country. We are interested to check the effects of economic growth on carbon emissions.

GAP OF STUDY

This is complex and multi-faceted issue to examine the influences of urbanization, FDI, and economic growth on carbon emissions. While there is no definitive answer, several factors can influence the relationship between these variables. Urban areas tend to have higher population densities and concentrated economic activities, which can lead to increased energy consumption and carbon emissions. As cities expand, there is a greater demand for infrastructure, transportation, and housing, often resulting in increased energy use from fossil fuels. However, urban areas also offer opportunities for more efficient energy use and the adoption of sustainable practices. Well-planned cities with adequate public transportation, efficient buildings, and renewable energy sources can help reduce carbon emissions.

Some studies check the effect of economic growth on carbon emission. This study examine the influence of urbanization on carbon emissions being the subject of several investigations.Improvement in such work, effect of urbanization on carbon emission and growth may be investigated in a different angle "The effect of economic growth and urbanization on CO2 emissions for the case of Pakistan". So, this main contribution of my study.

Literature Review

Saini et al. (2017) indicates that studied topic is becoming increasingly relevant, particularly due to the rapid pace of development in developing countries. The paper explored the concept of the environmental Kuznets curve hypothesis, which suggests an inverted U-shaped relationship between economic development and environmental degradation. This hypothesis posits that as countries develop economically, environmental degradation initially increases but eventually starts to decline after a certain level of economic growth is achieved. The findings of the paper reveal that a majority of reviewed literature supported environmental Kuznets curve hypothesis. Results evidence suggested that relationship of economic growth and carbon emission followed inverted U-shaped pattern. As economies continue to develop, there is potential for environmental improvements and reduced carbon emissions.

Muneer et al. (2018) found non-linear relation of carbon emission by applying nonlinear ARDL method of analysis in Pakistan since 1975 to 2016. The study also employed a Granger causality test for the determination of direction of the causality. According to their research analysis, results confirmed an increase in FDI showed positive and significant impact on carbon emission in Pakistan. Further they implies that higher levels of foreign direct investment are associated with increased carbon dioxide emissions in the country.

Shaheen et al. (2018) mentioned the focus to examine the relation of income, energy consumption, urbanization, and carbon emissions in Pakistan. The study aimed to understand the effects of selected independent variables on carbon emissions in the country. ARDL approach was applied to conduct empirical estimations for the selected model. According to the research findings, energy consumption and GDP are identified as the main drivers of environmental pollution, specifically carbon emissions. This implies that higher levels of energy consumption and economic activity, represented by GDP, are associated with increased carbon emissions in Pakistan. However, the study suggests that industrialization and urbanization do not have a significant influence on carbon emissions in context of Pakistan. These results suggested that relation among industrialization, urbanization and carbon emissions in Pakistan is relatively weak or influenced by other factors that were not considered in the analysis.

Kamran Khan et al. (2019**)** examined the determinants that effect the carbon emissions in Pakistan since 1971 to 2016. Their study utilized a DynamicARDL approach used to analyses the relationship between these variables and their impact on CO2 emissions. Based on their studied model, result implies that higher levels of energy consumption, urbanization, economic growth, and globalization contribute to increased CO2 emissions in the country.

Chang et al. (2019) they depicted the role of urbanization and industrialization on China's ability to decouple economic growth from carbon emissions. Findings of their study suggest that urbanization has a significant impact on carbon emissions in China. As urbanization progresses, carbon emissions tend to rise due to the increased energy consumption and industrial activities associated with urban areas. This indicates that the process of urbanization promotes an increase in carbon emissions. Furthermore, the study highlights that in the early stages of industrialization, decoupling of economic growth from carbon emissions is inhibited. Further implies that during this phase, economic gains are balanced by the environmental harm caused by industrialization. However, as industrialization progresses and environmental regulations and efficiency measures are implemented, there is potential for decoupling to occur, allowing for economic growth without a proportional increase in carbon emissions.

Abbasi et al. (2020) investigated explored the effects of energy consumption, industrial growth, urbanization, and CO2 emissions on economic growth in Pakistan. The study utilizes Dynamic Autoregressive Distributed Lag (ARDL) simulations and FDC (Fully Modified Dynamic OLS) tests to analyze the changes in these variables and their impact on economic growth. According to the evidence presented in the research, it suggests that electricity consumption and industrial value-added have both short- and long-run impacts on economic growth in Pakistan. This implies that

changes in electricity consumption and industrial growth have significant effects on the country's economic performance in both the short and long term.

Salman et al. (2020)examined the relationship between urbanization and carbon emissions, by considering non-linear nature of this link. It also investigates the effects of global commerce on carbon emissions in different income groups of Belt and Road Initiative(BRI) nations. To analyze these relationships, the study utilizes panel quantile regression and 2SLS regression to account for variability and address endogeneity concerns. The data used in the analysis covers the period from 2000 to 2016. The findings of the study reveal interesting patterns. In high-income groups of the BRI nations, urbanization exhibits inverted U-shaped relation with carbon emissions. This suggests as urbanization initially increases, carbon emissions also rise, but beyond a certain point, further urbanization is associated with a decrease in carbon emissions. This could be attributed to the implementation of more efficient technologies and policies that promote sustainability in urban areas.

Khan et al. (2020) analyzed the relation of energy consumption, economic growth, and CO2 emissions in Pakistan. The researchers utilize yearly time series data spanning from 1965 to 2015 to examine this relationship. Based on the projected findings, the study recommends that policymakers in Pakistan promote the adoption and utilization of renewable energy sources to meet the country's growing energy needs. By replacing outdated fossil fuels like coal, gas, and oil with renewable energy sources, Pakistan can not only address its energy requirements but also contribute to lowering CO2 emissions. This, in turn, can support sustainable economic growth in the country.

Farooq et al. (2021)find out the combined effect of urbanization, financial development index, foreign direct investment, and economic growth on the Environmental Kuznets Curve (EKC). They analyzed time series analysis by using unit root test, structural break unit root test, combined co-integration analysis, and ARDL analysis to confirm integration and robustness of the studied model. Based on the presence of inverted U-shaped relation in the studied model helped to make suitable policies for improvement. In this context, the research explores how urbanization, financial development, FDI, and economic growth collectively influence CO2 emissions.

Ullah et al. (2021) analyzed the effects of fossil fuel consumption, industrial growth, and foreign direct investment (FDI) on carbon emissions in Vietnam. It highlights that fossil fuel combustion in the industrial sector shows significant impact on greenhouse gas emissions. Their research employs Autoregressive Distributed Lag (ARDL) model and Bayer-Hanck combined co-integration analysis to examine the relation between industrialization and carbon emissions in Vietnam. Research explored the dynamic relationship between FDI, fossil fuel consumption, industrial

growth, and carbon emissions in Vietnam. Bayer-Hanck joint co-integration analysis and ARDL bound testing are utilized to examine the long-term relationships and short-term dynamics among these variables. The findings of the study contribute to understanding the complex interactions between industrialization, FDI, fossil fuel consumption, and CO_2 emissions in Vietnam. However, without specific details regarding the results, it is difficult to provide a comprehensive analysis of the study's findings and implications.

Sufyanullah et al. (2021**)** used ARDL approach to examine that how urbanization influences CO2 emissions in Pakistan over time. The findings indicate that urbanization showed significant impact on carbon emissions, suggesting as urban areas expand and populations concentrate in cities, there is an associated increase in CO2 emissions. The paper emphasizes the importance of government action to develop to energy efficient and environmental sustainability strategies to mitigate CO2 emissions in order to improve the overall environmental condition. This highlights the role of policy interventions, regulations, and initiatives aimed at reducing the environmental impact of urbanization and promoting sustainable development.

Rehman et al. (2021**)** investigated the effects of human capital, exports, economic growth, and energy consumption on carbon emissions in newly industrialized countries (NICs). The research explores the relationship between these variables and environmental quality, with a specific interest in testing the environmental Kuznets curve (EKC) hypothesis. Results confirmed that as countries develop economically, environmental degradation initially worsens but eventually improves as they reach a certain level of development. To analyze these relationships, the study employs panel co-integration estimation techniques to address the issue of cross-sectional dependence (CSD). Results highlighted the presence of cross-sectional dependence (CSD) among the variables used and a long-run relationship among them. However, the study does not find evidence to support environmental Kuznets curve hypothesis in the context of the newly industrialized countries (NICs) under investigation.

Erum and Rehman (2022) examined environmental degradation by selecting five highly populated regions of Asia: China, India, Indonesia, Pakistan, and Bangladesh. The research aims to understand the integrated impact of CO2 emissions and its associated factors in these regions during the period 2001-2014.The study utilizes a grey relational analysis (GRA) to estimate the integrated impact of CO2 emissions and the various factors considered. GRA is a method used to analyze the relationships between variables and identify their relative influence. Additionally, the study employs the G-TOPSIS technique, which is a variant of "Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)", to prioritize and rank the explanatory factors based on their influence on CO2 emissions. The findings of the

study suggest that India emerges as a major contributor to CO2 emissions due to population growth and economic development. This indicates that the increase in population and economic activities in India has led to higher CO2 emissions. On the other hand, China and Pakistan are driven by energy consumption and urbanization, highlighting the significant role of these factors in their CO2 emissions.

Xiaomin et al. (2022) recognized the concern about rising carbon emissions and their effects on climate change, with urbanization being identified as a major source of carbon emissions. The research emphasizes the importance of understanding how the process of urbanization influences carbon emissions for sustainable development within the framework of carbon neutrality. By examining time series data, the study identifies three transitional periods in 2003, 2006, and 2009, which align with China's social and economic development. The findings indicate a continuous growth in urbanization rates from 1997 to 2019. Additionally, the study observes spatial trends characterized by a "high in the north and low in the south" pattern and a "high in the east and low in the west" pattern. These spatial trends suggest variations in urbanization levels across different regions of China.

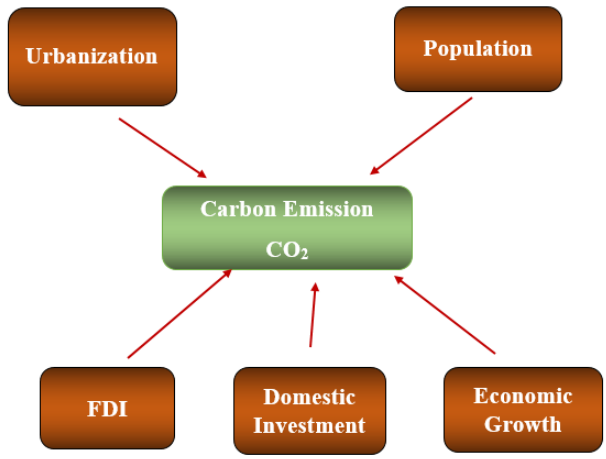
Rehan et al. (2022) examined the relationship between economic growth, energy use, urbanization, and tourism on carbon emissions in Singapore. Singapore, as a popular tourist destination, that caused rapid urbanization and continued economic growth, resulting in increased energy consumption and CO2 emissions. The objective of this study was to examine the dynamic effects of urbanization, energy use, economic growth, and tourism on CO2 emissions in Singapore. To analyze this relationship, the researchers employed the dynamic ordinary least squares (DOLS) approach and suggest, factors contribute to increased carbon emissions as the country experiences urbanization and economic expansion. Furthermore, the study highlights the considerable and positive relation between tourism CO_2 emissions in Singapore.

Theoretical Framework

Simon Kuznets, an economist, indeed described the relationship between per capita income and income inequality as an inverted-U shape, known as the Kuznets curve. He observed that during the early stages of economic development, income inequality tends to increase, but as a country reaches a certain level of development, income inequality starts to decline.Building upon the concept of the Kuznets curve, researchers Grossman and Krueger extended it to study the relation between economic development and environmental quality. This extension is known as the Environmental Kuznets Curve (EKC) that proposed hypothesis of an inverted-U relationship between per capita income and environmental degradation.

According to EKC, in the initial stages of economic development, environmental degradation may worsen as industrialization and economic activities lead to increased pollution and resource depletion. However, as countries achieve

higher income levels and implement environmental regulations, they can invest in cleaner technologies, leading to a decline in environmental degradation.



Methodology

This study investigating the impact of urbanization and economic growth in developing countries, specifically Pakistan. The researchers utilized data from the World Bank, covering the period from 1990 to 2021, to analyze this relationship.

Model

The following is the model of the study

$$CO2=\alpha_O+\alpha_1EG+\alpha_2URBAN+\alpha_3POP+\alpha_4EG+\alpha_5FDI+\alpha_6DI+€o$$

Where:

EG= Economic Growth, gdp (annual%) is used as a proxy for measuring economic growth
POP=Population, it is measured in population growth (annual %)
URBAN= Urbanization measured in Urban population growth (annual %)
FDI= Foreign Direct Investment, it is measured in net inflows (% of GDP)
DI= Domestic Investment (% of GDP)

VARIABLE MEASUREMENTS	
CO2 emissions	Carbon dioxide emissions, often referred to as CO2 emissions, are a type of greenhouse gas emissions that occur due to human activities, particularly the burning of fossil fuels such as coal, oil, and natural gas. These emissions also result from industrial processes like cement manufacturing and gas flaring.
Foreign direct	Foreign direct investment (FDI) refers to the investment made by individuals, companies, or entities from one country (the home country) into another country (the host country) with the objective of establishing a lasting interest or controlling stake in an enterprise in the host country.
Population	The complete set group of individuals, whether it comprises a nation or a group of people with a common characteristic, can be referred to as a population.
Urbanization	Urbanization refers to the process of population shift from rural areas to urban areas, resulting in the growth and expansion of cities and towns. It involves the increase in the proportion of the population living in urban areas and the corresponding decrease in the proportion of people living in rural areas.
Economic Growth	Economic growth refers to the increase or improvement in the value of goods and services produced by an economy over a specific period, typically measured in terms of real gross domestic product (GDP). It is an indicator of the overall health and expansion of an economy.
Domestic Investment	Gross domestic investment refers to the total investment made within a country's domestic economy.

Source: World Bank

Results and Discussion

The analysis of trends and relationships between dependent and independent variables is done using descriptive statistics. It offers average patterns and data distribution, which improves the scope of research and improves behavior estimating in the future.

Table 1						
Descriptive Statistics						
	CO2	**DI**	**FDI**	**GDPPC**	**POP**	**URBAN**
Mean	0.709451	17.04962	1.038958	128114.1	17.20390	4.219957
Median	0.711206	17.06829	0.735837	128441.5	16.68690	4.790000
Maximum	0.918894	20.68500	3.668323	171294.3	20.30362	7.830000
Minimum	0.505941	14.12063	0.375528	98850.19	15.59599	0.400000
Std. Dev.	0.113920	1.834456	0.804722	22687.38	1.441003	2.397156
Skewness	0.176832	0.154612	2.187435	0.533246	0.815195	-0.32754
Kurtosis	2.130646	1.885200	6.870304	1.995607	2.317556	1.861518
Jarque-Bera	1.211175	1.840299	46.91326	2.951042	4.295361	2.372230
Probability	0.545754	0.398459	0.000000	0.228660	0.116755	0.305406
Sum	23.41190	562.6375	34.28562	4227765.	567.7288	139.2586
Sum Sq. Dev.	0.415285	107.6873	20.72250	1.65E+10	66.44768	183.8834
Observations	33	33	33	33	33	33

This descriptive analysis is based on 32 observations, which are sufficient for describing the data's distribution. The data's mean value is the center of it. The mean and median both measure the data's central tendencies. The median expresses the data's middle after analysis. Estimated outcomes are a helpful tool for more research and policy effects. All of the variables included in this study's descriptive statistics were listed in Table 2. 32 observations were used in this descriptive analysis, which is sufficient to depict the data's distribution. The data's mean value is its center.

We used a correlation matrix to determine the statistical link between the variables. Any two variables that are used and either rise or drop together have a positive association or are positively connected. However, if one variable increased while the other fell, the variables will be negatively correlated. The nature of the link is shown by the correlation's negative and positive signs.

Table 2						
Correlation Metrix						
	CO	**DI**	**FDI**	**GDPPC**	**URBAN**	**POP**
CO2	1	-0.58573	0.13191	0.849971	-0.19651	0.816508
DI		1	0.40978	-0.64382	-0.03665	-0.69072
FDI			1	-0.048	-0.44362	-0.1795
GDPP				1	-0.17903	0.885
UNE					1	-0.08685
POP						1

Above correlation matrix show positive relationship with all the variables, like CO2, domestic investment, FDI, GDPPC and URBAN. Carbon emission is strongly and positively correlated with domestic investment (DI), FDI, GDPPC, URBAN and POP respectively.

Table 3		
Unit root testing		
Augmented Dickey Fuller test		
Variables	**t-statistic value**	**Stationarity**
DI	-5.32438 (0.0002)	*1(1)*
FDI	-5.531462 (0.0001)	*1(0)*
POP	-6.693042 (0.0010)	*1(1)*
URBAN	-5.874456 (0.0000)	*1(1)*
GDPPC	-3.368776 (0.0207)	*1(1)*

The unit root results are illustrated in table 3. The findings show that the variables have varied integration orders, which indicates that some of them, like GDPPC, POP, DI, and FDI, are stationary at first difference while others, like FDI and URBAN, are at level. Partnerships with varied levels of integration throughout the long and short terms. They conducted testing ARDL.

The lag length is how many terms back down the AR process you want to test for serial correlation.

Table 4						
Lag length Criteria						
Lag	**logL**	**LR**	**EPE**	**AIC**	**SC**	**HQ**
0	-420.5765	NA	36096.03	24.28012	27.79861	27.61154
1	-250.6623	263.0931	6.697202	18.56397	20.82426*	19.51475
2	-193. 1453	66.79392*	0.113086*	2.218053*	21.10134	18.66939*

Table 5							
ARDL bound testing to co integration							
ARDL Bound Testing					**Diagnostic Tests**		
Estimated model	**Optimal lag length**	**F. stats**	**5 percent**		χ^2 **LM Serial**	χ^2 **BPG Hetro**	χ^2 **Ramse RESE**
			LB	**UB**			
F_{CO2}(Co2/ DI, FDI, POP, URBAN, GDPpc)	2,0,0,0,0,0, 1,1	4.059215**	2.56	3.49	0.8509 (0.44)	0.7716 (0.757	1.1067 (0.3094
**, significant at 5 percent level							

The results of table 5 indicate that long run relationship exist in the selected model. The short and long run analysis is illustrated in the table 6.

Table 6				
Short run Analysis				
Dependent variable ΔCO2				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.35537	0.327513	-1.08507	0.0294**
ΔDI	-0.0124	0.00632	-1.96269	0.0673***
ΔFDI	0.051367	0.016102	3.190139	0.0057*
ΔPOP	0.076295	0.030799	2.477193	0.0248**
ΔURBAN	0.007052	0.003424	2.059737	0.0561***
ΔGDPPC	-1.35E-06	1.12E-06	-1.20586	0.2454
ECT_{t-1}	-0.657612	0.003608	-10.8355	0.0001*
Long Run Analysis				
Dependent variable ΔCO2				
ΔDI	-0.01337	0.006837	-1.95562	0.0682***
ΔFDI	0.055371	0.010029	5.520916	0.0000*
ΔPOP	0.082243	0.020528	4.006419	0.001*
ΔURBAN	0.007602	0.00322	2.360935	0.0313**
ΔGDPPC	-1.04E-05	3.12E-06	-1.03686	0.0454**
C	-0.38308	0.293924	-1.30332	0.0211**

R-squared	0.87898
Adjusted R-squared	-0.854963
Durbin-Watson stat	1.859091
*, **, *** significant at 1, 5 and 10 percent level	

The table 6 shows that results showed all variables DI, URBAN, POP and FDI cause to increase the carbon emissions significantly in the short runs. The ECM's coefficient is -0.657612 and its p-value is 0.0001*, it is significant and require roughly 65% adjustment speed to reach equilibrium in a year. On the other side, the results of long run show that these same variables also reason to raise the pollution in environment. But, this is the situation of developing countries, where the population is high, not well skilled, lack of technologies etc. That's why, carbon emissions is high in the long run. In the developed countries, due to the use of safe technologies, educated population, carbon emissions is low.

Conclusion

The most concerning objective of this research work is related to examine the influence of this study is to investigate the impact of urbanization on carbon emission in Pakistan for the period 1990 to 2022. The study finds that the higher economic growth can lead to greater pollution in the short term, over the long term, it may also lead to greater investment in clean technologies and more efficient production methods. For example, as countries become wealthier, they may invest in cleaner forms of energy, reduce their reliance on fossil fuels, and implement stricter environmental regulations. Economic growth often leads to increased energy consumption, industrial production, and transportation, which can result in higher carbon emissions. As countries develop and their GDP rises, there is typically a surge in energy demand, often met by burning fossil fuels. However, economic growth can also provide resources for investing in cleaner technologies, environmental regulations, and sustainability initiatives. Additionally, rapid economic growth can lead to a focus on short-term gains over long-term sustainability, which may cause of exploitation of natural resources and neglect the environmental concerns.

The findings of the study show that urbanization have positively and significant linked with carbon emission. The result of this study follows the theory "Environmental Kuznets Curve (EKC). The proper arrangement of urban areas can lead to low level of carbon emission.

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