Causal Link between Urbanization, Industrialization, and Carbon Emissions: Empirical evidence from Pakistan

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ABSTRACT

The main aim of the study to examine the causal nexus in industrialization, urbanization and carbon emissions in Pakistan and used the time series data from 1990 to 2019. Based on the data behavior, an ARDL technique is used for estimation. This study originates that the energy consumption, exports, GDP, industrialization has optimistic and noteworthy effect on carbon emission. However, the urbanization has optimistic and noteworthy effect on CO_2 emission. Moreover, there are exist two-way casualty between EC and CO_2 emission, and UP and CO_2 emission, while, One-way causation from GDP to CO_2 emission, energy consumption to exports, urbanization to exports. However, no causality exists between exports and CO2 emission, industrialization and CO_2, GDP and exports, industrialization and exports, Industrialization and GDP, UP and GDP, and UP and industrialization. The study recommended that the minimize energy consumption, control the emission from factories and focused on those industries like tourism which has small effect on the environment degradation. This study also suggests discouraging urbanization and promoting exports of goods which emission free.

Keywords: *Industrialization; Urbanization; Carbon emission; ARDL; Pakistan*

Background of the Study

The primary goal of every economy is to achieve sustainable economic-growth, which means meeting the requirements of the current cohort without depleting the resources available for the following cohort (WCED, 1987). There are various aspects that contribute considerably to maintaining and achieving sustainable economic growth, with energy supply playing a critical role. A green and clean environment is also an important aspect and an unquestionable requirement for long-term growth. Many variables influence environmental quality, including energy usage, industrialization, urbanization, and trade openness, among others. The effective use of energy is beneficial since it reduces manufacturing costs per unit output and pollutants (Dincer & Rosen, 1999). According to Azam and Khan (2016) that modernization, industry, and the rapid development in UP all contributed meaningfully to pollution, which is a major worry for the environment worldwide, but more so in low-income nations.

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CO_2 is the leading cause of world warming and environmental damage. Since the 1990s, there has been an surge in environmental contamination as an outcome of the increasing trend of urbanization and industrialization (Parveen et al., 2019). The world community recognizes a optimistic and significance link between ID and urbanization. This relationship is motivated by a desire to achieve better levels of development (Sadorsky, 2013). This connectivity has two impacts. On the one hand, it promotes the size of construction and stimulates GDP development in all economies. Instead, more energy was utilized at the home and manufacturing levels, which was the major source of smog such as CO_2 emission (Nasreen et al., 2018). Urbanization and industrialization are integral components of contemporary civilization and a high level of living, but they have serious consequences like health issues (Ahmad & Zhao, 2018).

Many previous research empirically studied the connection between urbanization associated with industrial development and increased energy consumption and CO2 emissions (Yazdi & Dariani, 2019), found a constructive association among urbanization and CO2, whereas the other originate a negative connection (Lv & Xu, 2019). Similarly, numerous previous studies have found that increased trade openness has resulted in lower pollution levels (Lv & Xu, 2019). Several other studies, on the other hand, have determined that trade has a harmful impression on the CO_2 emission (Le et al., 2016). Thus, all of these previous research show that the influence of the industrial development, urbanization and trade on environment is still debatable, and more rigorous studies are needed to re-explore the effects of these factors on the CO_2 emission.

Pakistan's environmental crisis is definitely critical, since the country has taken no measures to combat global warming. Pakistan, instead, is publicly acknowledging the worldwide environmental crisis. The Pakistani industry has improved its environmental credentials greatly, both in terms of manufacturing and long-term usage. Pakistan has consistently supported the development of technology to detention carbon emissions and techniques to reduce climate-change. There is no convincing evidence that Pakistan uses fossil fuels and emits CO2.

Existing research shows that urbanization has a harmful influence on CO2 (Liu & Bae, 2018), industrialization (Liu & Bae, 2018), and trade by (Khan & Ozturk, 2020). The experimental outcomes on the link between GDP, industrialization, trade, urbanization and CO_2 are still murky, according to the extant research. Furthermore, unlike the estimation techniques of the past studies whether they rely on one technique or used inappropriate techniques like Munir and Ameer (2020) used NARDL and granger casualty techniques in the case of Pakistan but used data period from 1975-2016, and Jiang et al. (2022) present an enhanced CCD model, spatial autocorrelation, and other approaches for assessing past and future coordination states. Most previous research also overlooked the application of ARDL and granger causality methodologies in the case of Pakistan, as well as key factors. To close the gap, this study employed time series data of Pakistan, the ARDL approach, and Granger causality to produce accurate and more trustworthy conclusions that we could generalize to all developing countries. As a result, in order to achieve sustainable development, this research will look at the impact of industrialization, urbanization, and national wealth on CO_2 in Pakistan from 1975 to 2020.

The impetus for this work stems from Wang et al. (2020) 's investigation of 18 APEC nations; this study covers Pakistan's time series and employs a distinct model, extended data

period, and the most appropriate assessment approach based on order of integration. It is the first research in Pakistan to look at the influence of various variables on the environment. By removing heterogeneity and erogeneity from the data, this study used the most appropriate estimating methodologies to investigate the unknown parameters. Because OPEC nations' CO2 emissions are increasing, this study is necessary to discover and verify the link between these factors. The empirical findings will aid policymakers in minimizing the negative effects of CO2 emissions. This study's range of factors is comprehensive, and it includes significant variables that have yet to be examined in previous research in Pakistan. This study analysis is motivated by the use of standard estimating methods in examining the influence of urban population and industry combined, as well as the inability to address differences in nations based on income levels. The literature on the influence of UP and ID on environmental deterioration yields varied results. This study adds to the current body of knowledge by investigating the nonlinear impacts of urbanization and industrialization on environmental quality in Pakistan. The report offers policymakers and the government with important instructions for developing successful policies regarding urbanization, industrialization, and CO2 emissions. Individuals, corporations, environmentalists, researchers, and government organizations can all benefit from the conclusions of this study. The primary goal of this inquiry is to give critical evidence, information, and a better knowledge of the environment to important stakeholders.

As a result, this research is likely to provide a major contribution to the current literature, variables, and empirical methods, particularly in Pakistan. This study's findings will help us better understand the detrimental impacts of certain repressors on the environment. The findings will aid policymakers in increasing industry and commerce while reducing environmental costs.

Theoretical Framework

The ecological modernization hypothesis (Blowers, 1997) asserts that when nations progress from lower to intermediate developmental stages, they priorities growth above environmental sustainability. Further modernization, it is claimed, would reduce environmental difficulties, and societies will begin to emphasize technical innovation, environmental sustainability, and the transition from a manufacturing to a service-built economy (Hajer, 1995). According to the urban-environmental-transition (UET) hypothesis, pollution grows in tandem with the nation's wealth as cultures develop toward an industrialized economy (Marcotullio & Lee, 2003). According to compact city hypothesis, urbanization has reducing environmental harm and strain. However, development without adequate urban set-up tends to harm the environment (Burgess, 2000).

Pollution-heaven hypothesis and factor-endowment-hypotheses are two contrasting perspectives on the impact of commerce on CO_2. According to the PHH, rich countries and multinational corporations relocate pollution-intensive manufacturing units to developing countries. The world's pollution intensive businesses perceive expanding economies to be utopia. In terms of environmental quality, industrialized economies are expected to benefit, while emerging economies are expected to lose. The PEH contends that international commerce is determined by inequalities in technology or endowments, not by differences in environmental policies (Temurshoev, 2006).

Empirical Literature about urbanization and CO_2 emissions

For 86 economies from 1975 to 1998, Cole and Neumayer (2004) used OLS technique for estimation and found that population growth is matched by proportional surges in CO_2, but higher urbanization rates and smaller normal household size surge CO_2. From 1975-2003, Martínez-Zarzoso and Maruotti (2011) indicate an inverted U-link between UP and CO_2. Indeed, the elasticity of CO_2 and UP is positive at low levels of urbanization, which is consistent with the greater environmental effect reported in less developed countries. Elliott and Clement (2014) perform cross-sectional and panel regression studies of CO_2 at US, while accounting for spatial-autocorrelation. Their findings clearly support and demonstrate how multiple aspects of urbanization interact at the local level to impact CO_2 in significantly more consistent ways than home density and alternative transit use. Their discoveries shed light on the difficulties of urbanization as a regional force of environmental revolution with gradually more global implications.

Wang et al. (2015) use a lately built partial-parametric OLS fixed effect to check the bell shape (EKC) relationship between the UP and CO_2 for OECD nations from 1960-2010. They found the substantial link between UP and CO_2, confirming the EKC concept. According to Wu et al. (2016), urbanization causes a huge economic difference, which has a big influence on CO_2 emissions. According to Zhang et al. (2017), urbanization has a major impact on CO_2 as a key indication of modernity. They empirically assess the influence of UP on CO_2 using panel-data from 141 countries from 1961-2011and use a FE model. Ali et al. (2017) investigate the empirical inspiration of UP on CO_2 in Singapore between 1970 and 2015. Within the analysis, the ARDL method is used. They demonstrate that UP has an adverse and noteworthy influence on CO_2 in Singapore.

Liu et al. (2018), explore the influence of UP on CO_2 efficiency, which is quite complicated. They utilize the model to examine the CO_2 efficiency of ten typical Chinese from 2008-2015. Their findings reveal that the CO_2 efficiency of Chinese urban clusters has not been greatly enhanced, and the proficiency from the' self-evaluation' technique differs notably from IPCE. Hanif (2018) utilized a system GMM on a panel of thirty-four (34) economies from 1995-2015 and found that the use of fuels for cooking, as well as the growth of metropolitan areas, contribute considerably to CO_2 on one end while driving air pollution on the other. In addition, the findings show an inverted U-shape link between GDPpc and CO_2. Lv and Xu (2019) utilized the PMG method and data of 55 economies from 1992-2012. They discover that trade has a positive impact on the environment in the short-period but a harmful impact in the long-period. Meanwhile, the findings indicate that UP has a harmful and substantial influence on CO_2, meaning that urbanization enhances environmental quality.

Yazdi and Dariani (2019) used Asian nations data from 1980-2014 using the PMG technique. They found that urbanization improve EC and CO_2. For a long time, Wang et al. (2021) used ARDL technique for estimation and found that industrialized nations tend to have the same harmful effects of UP on CO_2, notwithstanding disparities in resources. used the data of thirty-seven (37) Sub-Saharan African nations, and demonstrate that the effect coefficients of UP on CO_2 and ecological foot-print are both optimistic, indicating that UP raises environmental. Similarly, Rasool et al. (2022) focus on China from 1991 to 2015 and demonstrate a substantial unfavorable relationship between the Chinese IT industry, energy usage, urbanization, and environmental damage.

Empirical Literature about industrialization and CO_2 emissions

used data of 30 Chinese provinces from 2000-2013 utilizing panel datasets at the provincial level in an LMDI model. Their findings demonstrate that GDP is the most important driver of regional CO_2, followed by EC, and social transformation. Similarly, Pata (2018) used data of Turkey from 1974-2013. According to the results of the ARDL approach, UP and ID has a long-period optimistic effect on CO_2pc. Furthermore, the data verify the EKC hypothesis's validity for Turkey. According to Wang et al. (2018), used data of China and India from 1980 to 2014 and demonstrate that China mostly conducted a poor decoupling of economic development from CO_2, but India's decoupling status was irregular. CO_2 intensity is the most important sponsor to decoupling in China, followed by UP, GDP, and ID. In India, the most important driver of uncoupling is also the intensity of carbon emissions, followed by UP, ID, and GDP. As a result, boosting energy efficiency is the greatest policy for China and India to achieve economic development while reducing emissions. Furthermore, Dong et al. (2019) found that urbanization and income level have a strong influence on CO_2. In terms of UP, there is no link between CO_2 and UP stage. Wang and Su (2019) found that China's CO_2 and GDP appear to be significantly decoupled only in a few years between 1990-2015, with the remainder years being slightly decoupled.

Majeed and Tauqir (2020) used a panel of one hundred and fifty-six (156) nations and income categories from 1990 to 2014. Dynamic GMM, and CCEMG estimation approaches. They found that UP and ID has significant and favorable effects on CO_2 across all panel categories. According to Dong et al. (2021), Using panel data from 2002 to 2017, and found that CO_2 have a long-period negative impact on residents' health a percent increase in CO_2 emissions China. Sikder et al. (2022) examine the combined impacts of EC, ID, GDP, and urbanization on CO_2 for twenty-three (23) developing nations from 1995-2018. They use the Panel-ARDL technique for estimation. According to their findings, a 1% rise in energy usage, GDP, ID, and UP increases CO_2 by 0.230%, 0.170%, 0.540%, and 2.320%, correspondingly.

Summary of Literature and Gap

The existing empirical research on the relationship between CO_2 and other parameters is either inconclusive or mixed. For instance, discovered two paths of causation between income and CO2emissions for 88 nations from 1960 to 1990, confirm EKC. Apergis and Payne (2009), discovered that there were long-term correlations between real production, energy consumption, and CO_2 using panel-data from six (6) Central American countries from 1971-2004. The use of energy has a optimistic impact on CO_2. Shi (2003) discovered a optimistic link between population changes and CO2 emissions for 93 economies from 1975 to 1996. Industrialization and commerce, according to Keho (2015) aided in the deterioration of the CO_2 in Cote d'Ivoire from 1970 to 2010. For 86 economies from 1975 to 1998, Cole and Neumayer (2004) found a promising connection between CO_2 and urbanization rate, inhabitants, family sizes, and energy-intensity. For five ASEAN nations from 1980 to 2006, Lean and Smyth (2010) naked a optimistic relationship between energy usage and CO_2, as well as a non-linear link between actual production and CO2. For 85 economies from 1990 to 2011, Akin (2014) discovered that trade has a undesirable impact on

CO_2, with a unidirectional causation flowing from CO2 to trade and GDP to CO2 and energy-usage in the near term. During the period 1961–2003, Aka (2008) discovered that commerce improved but economic expansion damaged environmental quality in Sub-Saharan Africa.

Lv and Xu (2019) discovered that trade has beneficial effects on the CO_2 in the short-term but has a adverse impact on the CO_2 in the long run for 55 middle-income economies between 1992 and 2012. However, UP has a noteworthy and negative impact on . Yazdi and Dariani (2019) found that relationships between variables in Asian nations from 1980 to 2014. Increased urbanization leads to increased CO2 and then energy usage, as well as a bi-directional causation between CO2, urbanization, and output growth. From 1975 to 2017, Parveen et al. (2019) demonstrated that there is a one-way causation between CO2 to urbanization, as well as CO2 to GDP in Pakistan. The energy growth hypotheses were created by Odugbesan and Rjoub (2020), who found that there was one-way causation going from energy use to growth in Nigeria and Indonesia, but bi-directional causation in Turkey and Mexico. Adebayo et al. (2021) discovered that energy use, CO2, and urbanization all have a favorable impact on output growth in Brazil from 1965 to 2019, but that there is no substantial relationship between trade openness and economic growth. According to Moutinho, Madaleno, and Elheddad (2020) production growth increases CO_2 nations, and energy usage has a negative impact on the environment; nevertheless, trade has better-quality environment in twelve OPEC nations from 1992-2015.

Few studies have been showed to examine the connection between urbanization, output growth, industrialization, trade, and , and most of them used a small sample size or a short time period, such as Saidi and Rahman (2021), who used data for five (5) OPEC countries from 1990-2014, but they overlooked the most central variables, namely trade and industrial development, which are the most noteworthy factors in CO_2. Similarly, Moutinho, Madaleno, and Bento (2020) ignored the most relevant variables, which are the most important contributors in CO2 emissions in 12 OPEC nations from 1992 to 2015. Although there have been several research on the urbanization-environment nexus, only a few have focused on the least developed nations (Wang et al., 2022). Most previous research also overlooked the application of ARDL and granger causality methodologies in the case of Pakistan, as well as key factors. To close the gap, this study employed time series data of Pakistan, the ARDL approach, and Granger causality to produce accurate and more trustworthy conclusions that we could generalize to all developing countries.

Methodology

Model specification

This study uses secondary annually time series data for the period 1990-2020 which was collected from the World Development Indicators (WDI) (2022). This study's model is based on Kaya (1989) empirical model, which was used to investigate the relationship between CO_2 emissions and human activities. Lin et al. (2015) employed the Kaya empirical model to explore the impact of industrialization on CO_2 in Nigeria and China, respectively. This study used the following modified model is as under:

$$CO_{2t} = \alpha_0 + \alpha_1 UP_t + \alpha_2 GDP_t + \alpha_3 EC_t + \alpha_4 EXP_t + \alpha_5 ID_t + \mu_t \quad \text{..... (1)}$$

Whereas are the coefficient.

Table 1: Descriptions of the variables

Variable	Mark	Units
CO_2 (metric tons per capita)	CO_2	Log
Urban population	UP	Percentage
GDP growth (annual %)	GDP	Percentage
Energy consumption	EC	Log
Exports (% of GDP)	EXP	Percentage
Industry	ID	Percentage

Econometric Techniques

ARDL Technique

There are lot of technique for estimating for estimation, but the ARDL techniques developed Pesaran and Shin (1998). The ARDL technique more appropriate than other techniques due to the verity of reasons, like mixed order of integration and overcome on endogeneity. Therefore, the ARDL techniques results are more reliable, and authentic.

$$CO_{2t} = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} CO_{2t-1} + \sum_{i=0}^{n} \alpha_{2i} UP_{t-1} + \sum_{i=1}^{n} \alpha_{3i} GDP_{t-1} + \sum_{i=1}^{n} \alpha_{4i} EC_{t-1} + \sum_{i=1}^{n} \alpha_{5i} EXP_{t-1} + \sum_{i=1}^{n} \alpha_{6i} ID_{t-1} + \mu_t \quad \ldots\ldots (2)$$

$$\Delta CO_{2t} = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta CO_{2t-1} + \sum_{i=0}^{n} \alpha_{2i} \Delta UP_{t-1} + \sum_{i=1}^{n} \alpha_{3i} \Delta GDP_{t-1} + \sum_{i=1}^{n} \alpha_{4i} \Delta EC_{t-1} + \sum_{i=1}^{n} \alpha_{5i} \Delta EXP_{t-1} + \sum_{i=1}^{n} \alpha_{6i} \Delta ID_{t-1} + \gamma_1 UP_t + \gamma_2 GDP_t + \gamma_3 EC_t + \gamma_4 EXP_t + \gamma_5 ID_t + \mu_t \quad \ldots\ldots (3)$$

Results and Discussion

Unit Root Tests Results

Table 2 shows the unit-root tests results, which shows that the energy consumption and GDP are stationary at level and zero (0) degree integration order, while, the series CO2, exports, industrialization, and urbanization are stationary at first difference and has 1st degree integration order. The unit root tests result indicated that the degree integration order of variables is mixed. Therefore, this study used the ARDL technique for estimation which more suitable for mixed order.

Table 2: PP and ADF tests Results

Variables	PP Test		ADF Test		Decision
	At level	1st Difference	At level	1st Difference	

	-1.4407	-1.4407	-4.9628*	1(1)
CO_{2t}	(0.5486)	(0.5486)	(0.0004)	
	-3.2469*	-3.2507*		1(0)
EC_t	(0.0273)	(0.0270)		
	-0.5266	-0.6375	-5.2167*	1(1)
EXP_t	(0.8719)	(0.8470)	(0.0002)	
	-3.7311*	-3.7325*		1(0)
GDP_t	(0.0088)	(0.0088)		
	-2.1767	-2.1767	-5.9360*	1(1)
ID_t	(0.2185)	(0.2185)	(0.0000)	
	-0.7910	-0.8273	-7.2313*	1(1)
UP_t	(0.8068)	(0.7951)	(0.0000)	

*Note: The values inside the parenthesis () are p-values and *, **, & *** indicated the significance level at 1, 5 and 10-percent.*

Regression Results

Table 3 shows the ARDL results, which shows that, in the long-run, the EC has optimistic and noteworthy effect on CO_2. A % raise in the EC will increase the CO_2 on average by 0.3683 percent. The results were matching with the finding of Acaravci and Ozturk (2010), Sharma (2011), Hwang and Yoo (2014) and Franco et al. (2017) , while, the opposite results were given by Alkhathlan and Javid (2013), and Muhammad (2019). Similarly, the exports have optimistic and noteworthy effect on CO_2. A % rise in the exports will boost the carbon emissions on average by 0.0149 percent. The results are parallel with the outcome of Al-mulali and Sheau-Ting (2014), Weber et al. (2008), and Hasanov et al. (2018) , while, dissimilar with the outcome of Stretesky and Lynch (2009), and Weitzel and Ma (2014).

The GDP has optimistic and noteworthy effect on CO_2. A % rise in the GDP will boost the carbon emissions on average by 0.0043 percent. The similar finding were given by Acaravci and Ozturk (2010), Halicioglu (2009), Alkhathlan and Javid (2013), Ahmed and Long (2012), Sharma (2011) and Tang and Tan (2015) , while, different results were given by Liu (2005), and Acheampong (2018). Similarly, the industrialization has optimistic and noteworthy effect on carbon emission. A % increase in the ID will increase the CO_2 on average by 0.0062%. The results are in line with the outcome of Patnaik (2018), Cherniwchan (2012), and Munir and Ameer (2020) , while, dissimilar with the outcome of Opoku and Aluko (2021) and Opoku and Boachie (2020). Moreover, the UP has optimistic and noteworthy effect on CO_2. A % rise in the urbanization will surge the carbon emissions on average by 0.0156 percent. The results are parallel with the outcome of Franco et al. (2017), Uttara et al. (2012), Shahbaz et al. (2014), and Rahman and Alam (2021), while, opposite finding were given by Cui et al. (2019) and Liang et al. (2019).

Similarly, in the short-term, the EC has optimistic and noteworthy effect on carbon emission. A % rise in the energy consumption will boost the CO_2 on average by 0.3204 percent. Correspondingly, the exports have optimistic and noteworthy effect on CO_2. A % raise in the exports will raise the CO_2 on average by 0.0186%. The GDP has optimistic and noteworthy effect on CO_2. A % rise in the GDP will increase the CO_2 on average by 0.0015%. Moreover, the industrialization has optimistic and noteworthy effect on CO_2. A % rise in the industrialization will increase the CO_2 on average by 0.0073%. However, the urbanization

has unimportant effect on CO_2. Furthermore, the ECM worth is found negative (-0.5369) and significant, which shows that there is 54% the speed of convergence and exist co-integration.

Table 3: ARDL Results

Variables	Coefficient	Std Error	t-value	P-value
Long-Run Coefficients				
EC_t	0.3683*	0.1243	2.9638	0.0077
EXP_t	0.0149*	0.0036	4.1879	0.0005
GDP_t	0.0043*	0.0013	3.4142	0.0027
ID_t	0.0062***	0.0034	1.8321	0.0819
UP_t	0.0156**	0.0071	2.2031	0.0395
C	1.2574***	0.6345	1.9816	0.0614
Short-Run Coefficients				
$D(EC_t)$	0.3204***	0.1851	1.7307	0.0982
$D(EXP_t)$	0.0186*	0.0020	9.1772	0.0000
$D(GDP_t)$	0.0015**	0.0006	2.3137	0.0309
$D(ID_t)$	0.0073*	0.0009	7.8884	0.0000
$D(UP_t)$	-0.0018	0.0011	-1.6197	0.1202
$D(ECM_{t-1})$	-0.5369*	0.0084	-63.6486	0.0000
C	0.0117*	0.0038	3.0540	0.0060
F-Bounds Test		H_0: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	5.244579*	10%	2.08	3
K	5	5%	2.39	3.38
		1%	3.06	4.15

Note: *, **, & *** designated the significance level at 1, 5 and 10-percent.

Granger Causality Test Results

Table 4 illustrates that there are exist two-way casualty between EC and CO_2, and UP and CO_2, while, one way causality running from GDP to CO2 emission, EC to exports, UP to exports. However, no causality exists between exports and CO2 emission, industrialization and CO_2, EC and GDP, EC and industrialization, EC and UP, GDP and exports, industrialization and exports, industrialization and GDP, UP and GDP, and UP and industrialization.

Table 4: Granger Causality Test Results

Variables	CO_{2t}	EC_t	EXP_t	GDP_t	ID_t	UP_t
CO_{2t}	----	2.4108*** (0.0895)	1.1985 (0.3474)	1.0029 (0.4332)	0.0882 (0.9849)	2.5349*** (0.0783)
EC_t	4.0174** (0.0179)	----	2.3690*** (0.0936)	0.1349 (0.9673	0.4624 (0.7624)	1.6480 (0.2083)
EXP_t	0.5734 (0.6856)	0.2591 (0.9001)	----	0.1827 (0.9442)	1.9875 (0.1422)	0.4113 (0.7981)
GDP_t	2.4913***	0.9724	0.2841	-----	0.2450	0.9340

	(0.0821)	(0.4482)	(0.8842)		(0.9087)	(0.4677)
				0.5824		
	0.7848	0.0352	0.3789	(0.6796		1.1231
ID_t	(0.5506)	(0.9974)	(0.8206)	)	----	(0.3784)
				2.0265		
	3.5808**	1.8126	2.8908***	(0.1362	0.3743	
UP_t	(0.0271)	(0.1729)	(0.0539)	)	(0.8237)	----

Note: The values inside the parenthesis () are p-values and *, **, & *** indicated the connotation level at 1-, 5- and 10-percent.

Conclusion and Recommendations

The primary goal of every economy is to achieve sustainable economic growth but sustainable development is impossible to achieve without increasing environmental quality. The main aim of the study to investigate the causal nexus in industrialization, urbanization and CO_2 in Pakistan and used the data from 1990-2019. Based on the data behavior, an ARDL technique is used for estimation. This study found that the energy consumption, exports, GDP, industrialization has optimistic and noteworthy effect on CO_2. However, the urbanization has optimistic and noteworthy effect on CO_2, while, and has inconsequential effect in the short-period. Furthermore, there is 54% the speed of convergence and there is long-period cointegration among the variables. Moreover, there are exist two-way casualty between EC and CO2 emission, and UP and CO_2, while, one-way causation from GDP to CO2 emission, EC to exports, UP to exports. However, no causality exists between exports and CO2 emission, industrialization and CO_2, EC and industrialization, EC and UP, GDP and exports, industrialization and exports, industrialization and GDP, UP and GDP, and UP and industrialization.

The study recommended that the minimize energy consumption, control the emission from factories and focused on those industries like tourism which has small effect on the environment degradation. This study also suggests to discourage urbanization and promote exports of goods which emission free.

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