Kayani, Umar Nawaz; Misbah Sadiq; Aysan, Ahmet Faruk et al.

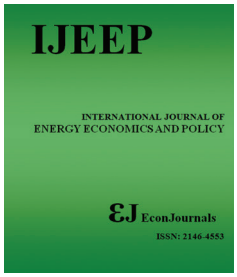
Article

The impact of investment, economic growth, renewable energy, urbanisation, and tourism on carbon emissions : global evidence

International Journal of Energy Economics and Policy

Provided in Cooperation with:
International Journal of Energy Economics and Policy (IJEEP)

Reference: Kayani, Umar Nawaz/Misbah Sadiq et. al. (2023). The impact of investment, economic growth, renewable energy, urbanisation, and tourism on carbon emissions : global evidence. In: International Journal of Energy Economics and Policy 13 (1), S. 403 - 412. https://econjournals.com/index.php/ijeep/article/download/14042/7150/32104. doi:10.32479/ijeep.14042.



International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2023, 13(1), 403-412.

The Impact of Investment, Economic Growth, Renewable Energy, Urbanisation, and Tourism on Carbon Emissions: Global Evidence

Umar Nawaz Kayani[1]*, Misbah Sadiq[2], Ahmet Faruk Aysan[3], Syed Arslan Haider[4], Ismat Nasim[5]

[1]College of Business Administration, Al-Ain University, Abu-Dhabi, United Arab Emirates, [2]College of Business Administration, Umm Al Quwain University, United Arab Emirates, [3]Hamad Bin Khalifa University, College of Islamic Studies, Qatar Foundation, Qatar, [4]Department of Management, Sunway Business School (SBS), Sunway University, No 5, Jalan Universiti, Bandar Sunway, 47500 Selangor Darul Ehsan, Malaysia, [5]Department of Economics, the Government Sadiq College Women University, Bahawalpur, Pakistan. *Email: umar.kayani@aau.ac.ae

Received: 31 October 2022 **Accepted:** 09 January 2023 **DOI:** https://doi.org/10.32479/ijeep.14042

ABSTRACT

Examining urbanisation and tourism from the perspective of global Sustainable Development Goals is essential for achieving a balance between environmental protection and economic growth in the world's most polluted nations. Moreover, most polluted countries pay more attention to the nature of foreign direct investment (FDI) inflows to achieve a sustainable environment. This study intends to explore the impacts of FDI, tourism, urbanization, and economic growth on carbon dioxide emissions using panel data for the top ten most polluted nations for the period from 2000 to 2019. To guide empirical testing, the panel unit root tests LLC and IPS are used. The outcomes of LLC and IPS advise FM-OLS application on how to accomplish the goals. The findings provide proof of how FDI and other factors affect carbon emissions (CE). Particularly, renewable energy consumption (REC) has a detrimental but minor effect on CE. For the panel of developing nations, FDI had a favourable and significant effect on CE along with economic growth, tourism, and urbanization. The expansion of cities is also harming nature and ecological footprints. These findings are alarming as all factors cause CE under consideration that leads to the deterioration of the environment. Therefore, more environmental rules should be put into place to reduce CE, draw in clean FDI, and encourage quality-oriented investment in selected nations. Second, it is important to ensure the deployment of green technology and the upgrading of urbanized structures. The government can take several actions against the use of polluting goods and vehicles in urban areas, and any polluting industries should also be outlawed in such residential areas.

Keywords: Foreign Direct Investment, Carbon Emissions, Renewable Energy Consumption, Urbanization, Tourism, Sustainable Development Goals
JEL Classifications: Q56, Q59, B22

1. INTRODUCTION

The expansion of the global economy has been confronted with a significant challenge, known as climate change, brought on by carbon emissions in the most recent few decades. There are several organisations throughout the globe attempting to assist. In 1992, delegates to the United Nations Conference on Environment and Development (UNCED) ratified the United Nations Framework Convention on Climate Change to reduce greenhouse gas concentrations in the atmosphere (UNFCCC) (Li and Wang, 2021). The Kyoto Protocol, which was agreed upon in 1997 under the UNFCCC framework, is legally binding to reduce greenhouse gas (GHG) emissions into the atmosphere. Carbon emissions have the most significant influence out of the six GHGs that are responsible for climate change and account for 80% of the overall emissions (Caron and Fally, 2022). Since the beginning of Earth's

history, there has been a correlation between average global temperatures and the amount of carbon dioxide and other GHGs in the atmosphere. As a result, reducing carbon emissions has appeared to be one of the most effective strategies for combating climate change (Gillingham et al., 2018).

Before the middle of the 20th century, the carbon emissions increase was relatively gradual, as shown by the statistics from the World in Data project, which was based on information from the Global Carbon Project. Around the same amount of carbon was discharged into the atmosphere by the United States in 1950 as was produced globally, equivalent to around 50% of China's yearly emissions (Wu et al., 2022). By 1990, the total amount of carbon emissions showed an increase by a factor of 4 to 22 billion tonnes. Carbon emissions have continued to rise at a fast pace, and there are currently more than 36 billion tonnes of carbon emitted annually throughout the globe. In addition, there has been a noticeable shift in addition to the significant increase in the overall concentration of CO_2 throughout the world (Fan et al., 2022). European countries and the United States in 1900 were responsible for over 90% of the total yearly carbon levels in the world. In 1950, the share of these two countries decreased a little but was still more than 85% of the total amount. Other parts of the globe, particularly Asia as a whole, and China in particular contributed much more to global carbon emissions in the later part of the 20th century (Koondhar et al., 2021). On the other hand, the United States and Europe only account for about one-third of world emissions in terms of carbon dioxide equivalents. Considering the gravity of the situation, it is widely agreed that identifying the probable sources of carbon emissions and taking effective countermeasures is an urgent need for governments throughout the globe to mitigate the severe effects of climate change (Zhang et al., 2022).

Foreign direct investment (FDI) is a kind of international capital flow that has increased in frequency with the speeding up of economic globalisation; FDI helps host nations' economies thrive, but it also leads to a sharp rise in carbon emissions. FDI is one of the most often discussed topics in academic literature because of its significant impact on a country's economic and environmental growth. FDI inflows may be related to the warming of the planet (Arshad et al., 2020). As a result, much previous research has focused on analysing how FDI flows affect carbon emissions. However, much previous research has drawn divergent conclusions about whether or not FDI flows are related to ecological degradation. As pointed out by the Pollution Haven Hypothesis, FDI may hasten environmental deterioration in certain locations. Companies in sectors that generate a lot of waste are more likely to be located in nations or areas with relaxed environmental regulations (Martins et al., 2022). This might lead to wasteful or inefficient use of resources. Multiple studies demonstrate that FDI increases carbon emissions and hence provides support for the pollution-haven effect (Contractor et al., 2020). However, FDI can be useful for countries that receive it because it can transfer innovative technologies, promote financial development, and improve management, encouraging businesses to use greener products and practices that benefit the environment and reduce carbon emissions (Nisar et al., 2022). Thereby, proof it he s provided for the pollution halo effect. Some studies show that FDI flows, and carbon emissions have a nonlinear connection (Sarkodie et al., 2020). Although a rise in FDI may cause an increase in carbon emissions at first, at a certain point, further FDI will cause a drop in carbon emissions.

However, FDI does not independently impact the amount of carbon emissions. Other factors, like economic growth and the effectiveness of regulatory systems, also have a role in determining carbon emissions. To begin, there has been a significant amount of research devoted to analysing the connection between a growing economy and increased levels of pollution. A number of scholars have cast doubt on the reliability of the Environmental Kuznets Curve (EKC) hypothesis, even though more and more evidence is pointing to an upside-down U-shaped relationship curve between wealth and pollution levels in the environment (Dogan and Inglesi-Lotz, 2020). Second, economies that have a better quality of regulation tend to have more stringent environmental policies and adhere more closely to the rules of relevant international environmental accords. In addition, these economies choose to use coercive measures to compel businesses to comply with the rules for managing pollution emissions. On the contrary, in economies that have less strict regulatory quality, environmental laws are less likely to be rigorous for companies, and governments may make judgments about pollution emissions that are less than ideal. As a consequence of this, the real levels of carbon emissions are more significant than the levels that would be ideal for any given amount of wealth (Ang and Fredriksson, 2021). Foreign direct investment (FDI) inflows are often debated in relation to their potential impact on greenhouse gas emissions. The same holds true for carbon emissions' indirect consequences, like as economic growth and regulator quality. Numerous studies have looked at the link between FDI inflows and emissions of carbon directly, but FDI inflows may also indirectly impact emissions of carbon (Musah et al., 2022; Opoku and Boachie, 2020).

Therefore, the aim of this research revolved around investigating the connection between GDP growth, FDI, and carbon emissions. This research anticipates that economic growth and regulatory quality would moderate the connection between FDI inflows and carbon emissions, based on a review of the relevant literature. This study will be useful in informing policymakers so they can create measures to reduce carbon emissions. The remainder of the paper is as follows; Section 2 discusses the literature review; Section 3 discusses the methodology; Section 4 highlights the results; and finally, the conclusion is presented in Section 5.

2. LITERATURE REVIEW

2.1. Pollution Levels and Economic Stability

There are two lines of evidence connecting pollution to economic development. Pollution of the natural world is now recognised as a global problem with water, air, thermal and visual pollution having emerged as key contributors to environmental degradation in recent years. Pollution may be detrimental to ecosystems, poisonous to soils and streams, and particularly hazardous to human health. Furthermore, environmental deterioration has been linked to cancer and other fatal illnesses if exposed to them over time. Pollution is bad for people and has negative consequences

for the ecosystem, such as a shift in temperature or an increase in sea levels. Protecting the environment and achieving rapid economic growth are two common development objectives. Increases in environmental quality are associated with worse economic growth (Musah et al., 2022). For all of human history, nations have struggled to find a solution that allows for both economic development and environmental protection. Tenaw and Beyene (2021) studied economic development and pollution in Sub-Saharan African nations from 1990 to 2015, finding a correlation between the two. In particular, the vulnerabilities of the majority of economies become more apparent during times of crisis. It might be a fall in the stock market, a dramatic shift in unemployment or inflation, bank failures, or an economic downturn. Particularly in this context, energy has a crucial role in financial development, while the use of conventional energy resources like fossil fuels has degraded environmental conditions. The relationship between health and economic development is causative in both directions. If we consider the "grow now, clean later" approach, Shastri et al. (2022) argue that India is an example where environmental quality is linked to economic development. CO_2 emissions may affect the GDP of the country. Due to its large population, India has struggled to increase economic development and decrease poverty. It has a rising economy, yet poverty remains a serious problem. Furthermore, environmental deterioration has become a significant challenge that makes economic development questionable.

According to Ruan and Yan (2022)'s research on China, the country had a "shock" to its ecological development before 1992, and then an "enhancement" and "peak" between 1990 and 2002. This is in line with the rise of heavy industry in the country. Sun and Huang (2020) propose that the emergence of contemporary ecological development may be traced back to the 1960 s, when economic growth emerged as the primary cause of pollution in developed nations. Additionally, the economic reforms implemented in China throughout the 1970 s contributed significantly to the country's burgeoning economy at this time. Further, fast industrialisation has produced very high levels of pollution, which contribute to critical social, economic, and political issues. Now officially, China's economy is the world's second biggest. Furthermore, global warming and other climatic changes have exacerbated pollution issues. Pollution from industry and domestic energy use has been steadily rising in industrialised nations. In research of G-20 economies, Awan and Azam (2022) discovered an inverted U-shaped association between degradation of the environment and revenue, suggesting that a heightened consciousness about fluctuation in environmental pollution levels has a considerable influence on economic and industrial development rate. The impact that the availability of natural resources has had on the rate of economic expansion has been significant. Increases in both economic activity and pollution were noted by Liu et al. (2022) Sustainable development is linked to better economic and social situations. Additionally, wealthy nations have access to a plethora of cutting-edge technology that may be used to curb environmental pollution and offset the repercussions of climate change. As a result, the United Nations Sustainable Development Goals (SDGs) put a premium on measures that boost soil health, renewable energy sources, and environmentally friendly technology to reduce environmental pollution. Long-term economic success and the health of future generations depend on proactive measures to reduce pollution.

2.2. FDI Inflows and Carbon Emissions

An expanding body of research on the impacts of FDI on GHG emissions has been published during the last decade. However, FDI's effects on GHG emissions have been strongly contested for years. The most up-to-date studies on this subject primarily focus on the following three areas of inquiry.

Initially, the pollution haven hypothesis, proposed that FDI inflows are linked to a greater level of emissions of carbon, has been the subject of various prior research that explored the consequences of FDI inflows on emissions of carbon directly. Developed nations, in search of higher returns, often invest in emerging nations with laxer environmental rules or cheaper environmental levies, resulting in the relocation of polluting companies to the developing world (You and Xiao, 2022). Therefore, a rise in carbon emissions in the nations hosting FDI-led economic development is to be expected. Ulucak (2022) used information on China as a developing nation to argue that FDI considerably boosts carbon emissions in poorer nations. On the other side, developing nations are more likely to relax their rules in order to entice foreign investment and boost their economies (Adeel-Farooq et al., 2021). Ullah et al. (2021) explored the connection between FDI flows and environmental policy rigour and examined the available evidence. Corruption is linked to an increase in local emissions of carbon, as multinational corporations may lobby corrupt government set-ups to weaken environmental regulations.

Second, the Pollution Halo Theory, proposed by a number of earlier studies, argues that FDI inflows may result in bringing clean and more efficient technology to the host nation, which is favourable and can s cut carbon emissions. According to Muhammad et al. (2020), a country's emissions are negatively impacted by FDI at greater quantiles in Indonesia, Malaysia, the Philippines, Singapore, and Thailand. In addition, according to Nepal et al. (2021), in India's case FDI inflows impart a substantial positive influence on carbon emissions through raising production in the long term.

Third, there have been some really conclusive investigations. Caetano et al. (2022) used panel data from 32 OECD nations to argue for a non-linear connection between FDI flows and carbon emissions. FDI inflows have a positive correlation with carbon emissions on the left side of the inflection point, while FDI inflows have a direct relationship with the concentration of carbon-based pollutants on the right side. De Vita et al. (2021) reported that FDI inflows' effects on carbon emissions vary greatly depending on each country's level of per capita income. Moreover, in middle-income nations, the relations between FDI and carbon emissions take the form of an inverted U. However, FDI inflows may help reduce carbon emissions in high-income nations but have the reverse effect in low-income ones. Using time series evidence from 1980 to 2013, Salahuddin et al. (2018) analysed the empirical impacts of macroeconomic development, power usage, and FDI on CO_2 emissions in Kuwait. CO_2 emissions are shown to be boosted

in the short and long terms by economic expansion, increased power use, and FDI.

Many studies have shown a correlation between inward FDI and an increase in carbon dioxide (CO_2) levels. Particularly in the recent decade, this issue has received much-written attention. There is no clear answer to whether or not FDI reduces CO_2 emissions in host nations, and this uncertainty exists at both the local and global levels. In many studies the reliability and credibility of the Pollution Haven Hypothesis has been confirm Since the idea goes, industrialised nations' stronger environmental rules result in greater production costs for companies operating in filthy sectors, hence those companies will move their operations to developing and emerging economies. Numerous international studies support the theoretical prediction that FDI causes emissions of carbon (Adeel-Farooq et al., 2021; Nepal et al., 2021). Cointegration and the VECM method were used for exploring the effects of FDI, exchange rates, GDP, and import-export framework on pollution levels by Zameer et al. (2020). They found that FDI leads to an increase in the emissions of carbon, lending credence to the pollution-haven theory. Though the theory predicts that FDI would reduce carbon emissions, several empirical investigations have found the opposite, concluding that FDI has no substantial effects on emissions of carbon or failing to provide evidence to support the presence of the Pollution Haven Hypothesis. FDI is shown to have a positive correlation with carbon emissions, suggesting that FIs invest in polluting sectors of host economies, particularly those still in development. FDI's impact on GHG emissions varies from one country to another, according to research by Li et al. (2022). Yang et al. (2021) confirm the link among the Pollution Haven Hypothesis and FDI and its adverse effects on the environment. Furthermore, a sizable body of research supports the halo theory, which contends that FDI reduces emissions of carbon or has other beneficial effects on environmental safeguards. This suggests that the conclusions are subject to certain econometric models, model parameters, and choice of nations, as reported by Song and Han (2022), who discovered that FDI has negative impacts on the environment in emerging economies. CO_2 emissions in Turkey were analysed by Mert and Caglar (2020), who showed that the correlations between exports, imports, and FDI were asymmetric. According to these experts, foreign direct investment (FDI) in Turkey does not significantly contribute to the country's per capita emissions since it has no long-term impact on CO_2 growing CO_2 emissions (Oguz et al., 2013). Mohsin et al. (2022) analysed developing nations to determine the causes of their CO_2 emissions, energy demand, GDP, and FDI. The fact that he discovered FDI to have a negative long-run influence on CO_2 emissions disproves the Pollution Haven Hypothesis since it indicates that FDI does not create CO_2 emissions but rather the relatively modest coefficient emissions in emerging nations. For the years 1997-2014, Jiang et al. (2022) used panel quantile regression to look at how FDI and international trade affected the CO_2 emissions of individual Chinese provinces. Except for the fifth and tenth quantiles, they discovered that FDI had a negative and substantial influence on CO_2 emissions (per capita GDP). Hanif et al. (2019) looked studied the impact of FDI, fossil fuel use, and economic development on carbon emissions in emerging economies in Asia. They argued that FDI contributes to pollution because it raises domestic CO_2 emissions, proving the existence of the pollution-development nexus. Increased FDI inflows into China would lead to greater energy consumption and, hence, higher CO_2 emissions, opposing the findings of De Beule et al. (2022), who explored that FDI has a favourable effect on environmental quality. It has been found by De Beule et al. (2022) that shocks to a country's FDI inflows, capital investment numbers, and economic development have asymmetric environmental repercussions. Carbon dioxide emissions are both temporarily and permanently triggered by positive shocks to economic growth, FDI inflows, and capital investments. They found similar support for the pollution haven theory and environmental Kuznets curve as found by Wang et al. (2018).

In accordance with Zandi et al. (2019), both economic development and trade liberalisation have negative and statistically significant impacts on CO_2 emissions. Energy consumption, population increase, and economic expansion are correlated with CO_2 emissions positively, according to a significant body of current research (Tiwari et al., 2013). The period-by-period regression analysis conducted by Wei et al. (2020) in China shows that the beneficial effects of imports have been steadily increasing with time; nevertheless, of the three FDI knock on effects that were modelled, only the backward spill overs have had a positive influence on emissions of carbon. Considering the EKC hypothesis, Wang et al. (2018) examines the impact of earnings and energy use on CO_2 emissions in the United States. When looking at carbon emissions through the lens of the autoregressive- distributed-lag (ARDL) framework, the researcher shows that both incomes and energy use per person lead to a rise in emission. Additionally, use of renewable energy has a short-term moderating influence on carbon emissions, whereas use of nuclear energy has a long-term dominant impact.

2.3. Other Factors Influencing Carbon Emissions

Previous research has shown a wide range of additional factors that influence carbon emissions alongside FDI inflows. Numerous studies, for instance, have looked at how rising prosperity affects carbon dioxide output. A commonly held belief in several of these countries is the EKC hypothesis, which proposes a reverse U-shaped relation between economic prosperity and environmental degradation. If a country's economy is weak, its leaders may decide to put economic development ahead of environmental protection (in terms of higher carbon emissions). However, as the GDP of the country rises, the cost of environmental governance falls, raising public awareness of the issue and encouraging policymakers to prioritise environmental protection (Ngo, 2022). The following is a summary of three effects that economic growth has had on the environment, as provided by (Liu et al., 2022). The first effect is referred to as the scale effect. Therefore, it can be inferred that a rise in economic activity without corresponding increases in technical innovation is linked to an increase in demands placed on natural resources, which in turn contributes to a rise in the amount of waste produced and CO_2 levels. In this situation, the increase in economic activity poses a damaging impact on the surrounding environmental conditions. The second effect is the one caused by composition. As a result, it follows that changes in the organisational framework

of production lead to a corresponding increase in income. In industrial civilizations, environmental deterioration is made worse as the economic structure transitions from rural to urban. However, environmental deterioration is reversed when the economic structure switches from industries requiring high energy input to technologically and knowledge-related services (Rafiq et al., 2022). Finally, we have the impact of technology. This trend indicates that environmental protection will be guaranteed when national economies are strong enough to cover the costs of R&D. In addition, there are various previous studies that provide empirical support. Using panel data for 17 industrialised nations from 1870 to 1994 and time-series data for the UK and the US, Kaika and Zervas (2013) analysed the correlation among emissions of carbon and per capita income. According to them, the environmental Kuznets curve is present in every possible set of data. Additionally, the environmental Kuznets curve persists despite controlling for factors like population density and foreign trade. Although empirical verification of the EKC concept is ongoing, some researchers have produced conflicting findings (Ahmed et al., 2022). An example is the work of Adom et al. (2012), who used a nonparametric panel technique to analyse data on Ghana, Senegal, and Morocco and found that, regardless of wealth, economic development increases emissions of carbon. The environmental Kuznets curve may not be generalizable, according to an argument made by Moosa (2017). An N-shaped curve was generated using data from Australia. Grouping all data for regression, Sarkodie and Strezov (2019) found that low and high-income nations, Africa, Asia, and Oceania do not exhibit an environmental Kuznets curve, whereas middle-income nations, the United States, and Europe show an inverted U-shape.

Additionally, the quality of regulations is seen as a major role in controlling carbon emissions. According to Ahmed et al. (2022) rising economic activity in Asia's low-income nations has been attributed to improvements in institutional quality, which may have unintended consequences for the environment in terms of elevated levels of carbon emissions. In addition, the stringency of a region's environmental regulatory system is based on the quality of the rules. Countries with lax environmental rules owing to international commerce, stated Pata and Caglar (2021), tend to specialise in the manufacturing of pollution-intensive items, which in turn causes the host country to raise emissions of carbon. Low income per person may reduce pollution even more if regulations were of lower quality. In low-income nations, the total impact of government effectiveness on emissions is shown to be positive and small; in high-income economies, the effect is negative and very significant. Nonetheless, better laws may lead to more efficient use of resources, and one of Porter's hypotheses was that doing so would encourage businesses to become more innovative, reduce manufacturing costs, and minimise any negative impacts on the environment (Wei et al., 2022). As a result, the effectiveness of laws has a positive and negative impact on carbon emissions. For a fuller picture, a conclusion based on empirical evidence is available. In one sense, enhanced regulatory quality is associated with more economic activity, which in turn increases carbon emissions. However, if regulatory quality is improved, the mechanism through which FDI inflows effect carbon emissions will change, leading to a large reduction in emissions.

However, there are many other variables than these two that influence the effects that FDI inflows have on emissions of carbon. These include financial growth, urbanisation, and tourism (Tan et al., 2021). In addition, Akram et al. (2021) used a panel quantile regression to examine the impact of BRICS nations' imports and exports on carbon emissions, finding that the former has a favourable influence on the latter while the latter are adversely impacted by population size. In a similar vein, Zhang and Zhang (2018) studied the impact of GDP on CO_2 emissions and found that the proportion of industrial added value to GDP is inversely related to emissions of carbon. This finding supports the hypothesis. Wang and Jiang (2020) conducted research on the impact of the actual output on atmospheric CO_2 levels in Russia, and their findings revealed that the two are negatively correlated. In addition, gross fixed capital creation is recognised as an essential component of a number of variables that contribute to a reduction in carbon emissions.

3. METHODOLOGY

To empirical validate the hypotheses of the study, the researchers chosen the top ten most polluted countries and took the data from 2000 to 2019. As the topic of the study has considered the tourism as an important factor of environmental quality, therefore the data availability for tourism has limitation due to covid-19 and data is limited till 2019 only. The data is taken from world development indicators and selection of most polluted countries is taken from Statista.com and validated it from u-earth.eu and iqair.com. Micrograms per cubic metre (g/m^3) of air is a concentration measurement based on mass per unit volume that is used to rate countries from most polluted to least polluted. One microgram (10-6) of pollutant is present in one cubic metre of air, resulting in a concentration of one milligram per cubic metre. As per the $\mu g/m^3$, Bangladesh is declared as most polluted nation with 76.9 $\mu g/m^3$ and Chad is second most polluted nation with 75.9 $\mu g/m^3$. Pakistan ranked third in the list and Tajikistan fourth with 66.8 $\mu g/m^3$ and 59.4 $\mu g/m^3$ respectively. India followed the ranking at fifth place and having 58.1 $\mu g/m^3$. The list continued with Oman, Kyrgyzstan, Bahrain, Iraq and Nepal.

The authors of the study compiled a panel of top ten most polluted countries and obtain the long run results to depict the relationship of the variables of the study with CO_2 that is explained variable. The variables are following:

- CE = CO_2 emissions (kt)
- FDI = Foreign direct investment, net inflows (% of GDP)
- REC = Renewable energy consumption (% of total final energy consumption)
- GDPG = GDP growth (annual %)
- URBAN = Urban population (% of total population)
- TOUR = International tourism, expenditures (current US$).

4. RESEARCH RESULTS

4.1. Correlation Matrix

The data for the selected countries is forming a balanced panel (Luo and Ma, 2021). The missing values are interpolated by linear

trend. The study obtained the correlation matrix to see the situation of variables interdependence. The correlation matrix is obtained by the help of EVIEWS software (Agung, 2011) and results are presented in Table 1.

4.2. Descriptive Analysis

The descriptive analysis is estimated country-wise for each variable and then as a panel also calculated. For CE, the descriptive analysis is reported in Table 2. The descriptive analysis for each country separately is obvious to see to check the relevant share of each cross section in panel. As the panel consists of ten cross-sections and each cross section is geographically different in size and population therefore country-wise analysis is reported for each variable in separate table. Table 2 is summarizing the carbon dioxide emissions in each area. The values reported show that the Chad is a relatively small country, and its relative carbon dioxide emission is very high that lead it in highly polluted countries.

Keeping in view the data from 2000 to 2019, the trend of FDI is reported in Table 3 that shows the variation in the volume of FDI in different countries. As per the Table 2, Chad is a small country with lower rate CE, but the value of FDI is highest for Chad in the Table 3. This hints towards that higher rate of FDI is major cause of CE for Chad. At the same time, the mean contribution of FDI is negative for Iraq. Iraq is having the maximum value 4.56 but it fluctuates due to the economic and political instability.

Table 4 is showing the picture for the renewable energy consumption that is the best way to decrease the CE in the world. Here again, Chad is showing a contradicting situation, the highest value of mean is 81.39 and lowest value 76.45 is telling a different story about the CE in Chad. The major reason behind can be anticipated that the country is using a high rate of renewable energy but due to geographically small in size the value of relative pollution is high that is clearly pushing Chad in highly polluted countries. Other countries are showing the mix depiction of renewable energy consumption like Pakistan with mean value 47 and low standard deviation 2.69 is also in the list of highly polluted countries due to high CE.

Urbanization means the expansion and formation of cities where number of people become permanently concentrated for residence (Qu et al., 2021). Urban areas can grow naturally as population is growing and more proportion of population is migrating from rural areas (Wang and Zhang, 2021). Urbanization often results in deforestation, habitat loss and the extraction of fresh water from the environment, which decrease the biodiversity and alter the species ranges and interactions (Arshad et al., 2020). The urbanization is clearly decreasing the environmental quality and cause more pollution. Table 5 is reporting the story of urbanization and Bahrain is leading the group with mean value of urban population out of total population 88.71 with standard deviation 0.33. Nepal is showing the lowest value of urban population that is only 4.54 and still Nepal is at the tenth place of most polluted countries. There are numerous reasons of pollution across the country like lack of regulations regarding operations such as factories and construction sites, open burning as well as the fuels use in many vehicles found in Kathmandu and other major cities of Nepal.

The Table 6 is presenting a story of tourism that is highly correlated with CE. Tourism is showing a low trend in the panel as these countries are not attracted for tourists. Various reasons can be seen like natural disasters that were face by Pakistan in 2005 as a massive earthquake, infrastructure issues (Rehman et al., 2022), security and cross boarder regulations problems and travel marketing. India is leading the panel for tourism with average value of 23.14 and 0.63 standard deviation. For tourism, all cross sections are showing almost same picture that can be evident from the average value of tourism expenditures.

According to the environment Kuznet Curve theory (Kaika and Zervas, 2013), in the early stages of economic development, CE will continue to increase with economic development until economic growth reaches a turning point. After the turning point, CE will show a downward trend and environment quality will improve subsequently. This theory is telling about the turning point but unable to identify it. The nations have to fee the need of

Table 1: Correlation matrix

CE	FDI	GDPG	REC	URBAN	TOUR
CE	1.000				
FDI	−0.093	1.000			
GDPG	0.057	0.120	1.000		
REC	−0.042	0.087	0.091	1.000	
URBAN	−0.098	−0.005	−0.094	−0.616	1.000
TOUR	0.619	−0.288	−0.093	−0.357	0.304	1.000

The results of the Table 1 indicating that the variables are not correlated with one another and the severity of Multicollinearity is not serious enough to affects the empirical findings. The direction of estimated relationships will be not reverse for any variable as well

Table 2: Country-wise descriptive analysis for carbon dioxide emissions

Name	Mean	Median	Max.	Min.	SD
Bahrain	24739.00	25365.00	33260.00	15880.00	5555.39
Bangladesh	50723.50	47665.00	90740.00	21650.00	21249.25
Chad	1229.50	945.00	2390.00	290.00	839.04
India	1633979.00	1612430.00	2456300.00	937860.00	537609.70
Iraq	113236.50	103050.00	174560.00	76650.00	30514.96
Kyrgyzstan	7497.00	7135.00	11250.00	3970.00	2277.98
Nepal	5922.50	4260.00	15190.00	2620.00	3932.59
Oman	49995.00	45335.00	76030.00	25110.00	17951.81
Pakistan	143047.00	142985.00	198830.00	98370.00	30316.93
Tajikistan	3870.50	2855.00	9420.00	2130.00	2263.70

Table 2 is presented the descriptive analysis of CE that are obtained country-wise. The mean and median values are projecting the measures of central tendency and standard deviation is measure of dispersion around mean value. The set of selected countries are most polluted countries of world

Table 3: Country-wise descriptive analysis for foreign direct investment

Name	Mean	Median	Max.	Min.	SD
Bahrain	4.39	3.95	15.75	0.21	4.04
Bangladesh	0.88	0.85	1.74	0.10	0.44
Chad	7.35	4.07	46.28	−4.85	12.29
India	1.63	1.60	3.62	0.61	0.72
Iraq	−0.26	0.29	4.56	−4.54	2.30
Kyrgyzstan	5.23	4.57	17.13	−1.39	4.55
Nepal	0.24	0.22	0.68	−0.10	0.23
Oman	2.54	2.01	7.92	−2.76	2.54
Pakistan	1.18	0.75	3.67	0.38	1.00
Tajikistan	4.45	2.97	13.10	0.88	3.57

Table 3 is reporting the descriptive analysis of FDI that are obtained country-wise for a period of 20 years. The mean and median values are measures of central tendency whereas standard deviation is measure of dispersion around mean value. The results indicate that Chad has maximum FDI and Iraq is having a negative value

Table 4: Country-wise descriptive analysis for renewable energy consumption

Name	Mean	Median	Max.	Min.	SD
Bahrain	10.00	8.00	15.00	3.00	0.45
Bangladesh	41.98	41.69	59.06	24.75	10.41
Chad	81.39	80.21	88.70	76.45	4.01
India	38.76	36.79	47.11	32.41	5.50
Iraq	15.00	14.00	20.00	5.00	1.05
Kyrgyzstan	26.55	25.77	36.00	21.92	3.87
Nepal	85.93	87.53	91.31	74.27	5.18
Oman	16.00	15.74	19.00	07.00	1.58
Pakistan	47.00	47.12	51.54	42.09	2.69
Tajikistan	54.93	57.89	64.58	38.56	9.14

Table 4 is reporting the descriptive analysis of REC that are obtained country-wise for a period of 20 years. The mean and median values are measures of central tendency whereas standard deviation is measure of dispersion around mean value. The results indicate that Chad has maximum REC and Bahrain is having lowest value

Table 5: Country-wise descriptive analysis for urbanization

Name	Mean	Median	Max.	Min.	SD
Bahrain	88.71	88.61	89.39	88.37	0.33
Bangladesh	30.22	30.09	37.41	23.59	4.37
Chad	22.15	21.96	23.28	21.64	0.49
India	30.86	30.76	34.47	27.67	2.11
Iraq	69.30	69.04	70.68	68.50	0.69
Kyrgyzstan	35.55	35.30	36.59	35.28	0.40
Nepal	4.54	4.60	8.98	0.12	2.11
Oman	76.55	74.89	85.44	71.51	4.83
Pakistan	34.91	34.90	36.91	32.98	1.21
Tajikistan	26.65	26.52	27.31	26.50	0.24

Table 5 is describing the descriptive analysis of URBAN that are obtained country-wise for the period from 2000 to 2019. The mean and median values are measures of central tendency whereas standard deviation is measure of dispersion around mean value. The results specify that Bahrain has larger proportion of urban population and Nepal is having relatively smaller proportion of urban population

safe environment and start to make regulations for it. However, the economic growth creates long-run waste and toxins, which have obvious consequences (Martins et al., 2022). For a developing country, economic growth is contributing to the more CE and many more activities that cause pollution like the use of plastic, vehicle emissions, by-products of manufacturing and power generation, fuel oils and natural gas to heat homes and fumes from chemical production. Our panel is a panel of developing countries and therefore the more economic growth leads to more CE.

Table 6: Country-wise descriptive analysis for tourism

Name	Mean	Median	Max.	Min.	SD
Bahrain	20.68	20.36	22.32	19.86	0.76
Bangladesh	20.32	20.45	21.05	19.55	0.46
Chad	19.63	19.97	20.90	17.84	1.12
India	23.14	23.33	24.08	22.03	0.63
Iraq	21.39	21.08	23.11	19.94	1.09
Kyrgyzstan	19.09	19.61	20.18	16.86	1.17
Nepal	19.75	20.10	20.63	18.50	0.73
Oman	21.03	20.96	21.95	20.26	0.55
Pakistan	21.22	21.34	21.92	20.01	0.57
Tajikistan	17.50	17.58	17.95	16.53	0.36

Table 6 is delineating the descriptive analysis of tourism expenditures that are obtained country-wise for the period from 2000 to 2019. The mean and median values are measures of central tendency whereas standard deviation is measure of dispersion around mean value. The results specify that more or less same picture of tourism in the panel countries

Table 7: Country-wise descriptive analysis for economic growth

Name	Mean	Median	Max.	Min.	SD
Bahrain	4.46	4.31	8.29	1.98	1.91
Bangladesh	6.08	6.26	7.88	3.83	0.99
Chad	6.52	3.74	33.63	−6.26	8.76
India	6.45	7.10	8.50	3.09	1.79
Iraq	5.43	5.12	53.38	−36.66	15.70
Kyrgyzstan	4.46	4.47	10.92	−0.47	3.10
Nepal	4.54	4.60	8.98	0.12	2.11
Oman	3.29	3.67	8.86	−2.67	3.16
Pakistan	4.29	4.41	7.55	1.61	1.65
Tajikistan	7.69	7.40	11.00	3.90	1.68

Table 7 is revealing the descriptive analysis of economic growth that are obtained country-wise for the period from 2000 to 2019. The mean and median values are measures of central tendency whereas standard deviation is measure of dispersion around mean value. The results specify that Tajikistan possesses the higher growth rate and Oman has its growth rate half of Tajikistan

Table 8: Levin, Lin and Chu and Im, Pesaran and shin tests

Variables	Levin, Lin and Chu (LLC) t*	Im, pesaran and shin (IPS) W-stat		
CE	−6.5330	0.000	−6.1126	0.000
FDI	−2.0012	0.023	−3.6537	0.000
REC	−4.1425	0.000	−7.1505	0.000
GDPG	−6.7319	0.000	−5.7754	0.000
URBAN	−3.1855	0.001	5.9668	0.045
TOUR	−11.199	0.000	−10.479	0.000

Table 8 is reporting the unit root results of the variables of the study and findings of LLC and IPS indicating that all variables are stationary at level

4.3. Panel Unit Root Test

For any empirical testing, any panel series requires the unit root testing, for selected series of our analysis, two panel data unit roots tests are used, Levin, Lin & Chu and Im, Pesaran and Shin. The results of both tests are not only testing the stationary level of the series but also validating the results of other test. All the panel data series are stationer at level and Panel FM-OLS is recommended.

4.4. Panel FM-OLS Test

The results of Table 9 validating the long run relationship among the variable of the study. Long run confirmation also represents the existence of co-integration in our model. The FDI has an estimated value 2.11 that is statistically significant

Table 9: Panel FM-OLS test

Variable	Coefficient	SE	t-statistic	Prob.
FDI	2.1140	0.2708	7.8073	0.0000
GDPG	1.4307	0.3881	3.6867	0.0004
TOUR	4.9795	2.3980	2.0765	0.0000
REC	−0.3041	0.3643	−0.8347	0.4059
URBAN	4.1151	1.1931	3.4492	0.0000

Table 9 is reporting the long run relationship and estimated values are showing the magnitude and direction of the relationship between CE and all independent variables. The results depicting that other than REC, all variables are significantly encouraging the CE

at 1%. The relationship of FDI and CE is positive as expected and as the degree of impact of FDI increases gradually, the CE will also increase, and more degree of CE plays more imperative role in increasing pollution. The cause is more FDI will bring high tech structures and equipment for heavy manufacturing industry. This paper also provides estimated results for the effects of urbanization, renewable energy, tourism spending, and economic growth. The value of REC is negative and insignificant for the panel, which indicates the massive use of energy consumption that is coal-based and undoubtedly deteriorate the quality of environment. The positive and significant value of urbanisation suggests that the increasing urban population has a direct effect on CE, as expected. The fact that the tourism expenditure coefficient is positive and significant also implies that as tourism expenditure increases, more CE will pollute the environment. In the last, economic growth is also having a positive and significant coefficient and causing more CE in the panel countries. As many developing countries are on the path of industrialization to upgrade the lifestyle. More and addition of industrialization will increase the CE and environmental quality decline.

5. CONCLUSIONS AND POLICY IMPLICATIONS

This study aims to analyse the effects of FDI, tourism, urbanisation, and economic growth on carbon dioxide emissions using panel data for the 10 most polluted countries from 2000 to 2019. Researchers use the LLC and IPS panel unit root tests to identify where to start performing experiments. The results of LLC and IPS advise that the applicant panel use FM-OLS to achieve their objectives. The data give evidence for the impact of FDI and other variables on CE. In this instance, REC has a negative but minor impact on CE. FDI's impact on CE is advantageous for developing economies. We provide our empirical findings and explore their policy implications in this section.

First, given the FDI inflows could be a channel for more CE and lower environment quality therefore more stringent environmental regulations should be implemented to lower the CE and to attract the clean FDI inflows and to motivate the quality-oriented mode of investment in selected countries. Second, the upgradation of structure of urbanization, the application of the green technologies should be guaranteed in cities. The government may implement a variety of steps to reduce the incidence of pollutants and vehicles in urban areas, and polluting companies should be prohibited from operating near residential areas. The industries should be shifted towards the areas which are far away from cities and those areas that are not suitable for agricultural production.

Third, it is strongly advised that the panel's developing countries further adjust their economic structures toward a green and circular economy in order to achieve coordination between economy and CE. The more concentration should be on the use of renewable and efficient energy resources. The tourism is also an important factor to increase the economic growth and to increase the global integration. Our panel countries should focus on this part as well. Last but not least, the most important conclusion drawn from the empirical results is that various nations need varying levels of pollution mitigation measures rather than a "one size fits all" strategy.

REFERENCES

Adeel-Farooq, R.M., Riaz, M.F., Ali, T. (2021), Improving the environment begins at home: Revisiting the links between FDI and environment. Energy, 215, 119150.

Adom, P.K., Bekoe, W., Amuakwa-Mensah, F., Mensah, J.T., Botchway, E. (2012), Carbon dioxide emissions, economic growth, industrial structure, and technical efficiency: Empirical evidence from Ghana, Senegal, and Morocco on the causal dynamics. Energy, 47(1), 314-325.

Agung, I.G.N. (2011), Time series data analysis using EViews. New Jersey, United States: John Wiley and Sons.

Ahmed, F., Ali, I., Kousar, S., Ahmed, S. (2022), The environmental impact of industrialization and foreign direct investment: empirical evidence from Asia-Pacific region. Environmental Science and Pollution Research International, 29(20), 29778-29792.

Ahmed, Z., Ahmad, M., Alvarado, R., Sinha, A., Shah, M.I., Abbas, S. (2022), Towards environmental sustainability: Do financial risk and external conflicts matter? Journal of Cleaner Production, 371, 133721.

Akram, R., Chen, F., Khalid, F., Huang, G., Irfan, M. (2021), Heterogeneous effects of energy efficiency and renewable energy on economic growth of BRICS countries: A fixed effect panel quantile regression analysis. Energy, 215, 119019.

Ang, J.B., Fredriksson, P.G. (2021), Does an early start help or hurt? Statehood, institutions and modern climate change policies. Energy Economics, 94, 105075.

Arshad, Z., Robaina, M., Shahbaz, M., Veloso, A.B. (2020), The effects of deforestation and urbanization on sustainable growth in Asian countries. Environmental Science and Pollution Research International, 27(9), 10065-10086.

Awan, A.M., Azam, M. (2022), Evaluating the impact of GDP per capita on environmental degradation for G-20 economies: Does N-shaped environmental Kuznets curve exist? Environment Development and Sustainability, 24(9), 11103-11126.

Caetano, R.V., Marques, A.C., Afonso, T.L., Vieira, I. (2022), A sectoral analysis of the role of foreign direct investment in pollution and energy transition in OECD countries. Journal of Environmental Management, 302(Pt A), 114018.

Caron, J., Fally, T. (2022), Per capita income, consumption patterns, and CO2 emissions. Journal of the Association of Environmental and Resource Economists, 9(2), 235-271.

Contractor, F.J., Dangol, R., Nuruzzaman, N., Raghunath, S. (2020), How do country regulations and business environment impact foreign direct investment (FDI) inflows? International Business Review, 29(2), 101640.

De Beule, F., Dewaelheyns, N., Schoubben, F., Struyfs, K., Van Hulle, C.

(2022), The influence of environmental regulation on the FDI location choice of EU ETS-covered MNEs. Journal of Environmental Management, 321, 115839.
De Vita, G., Li, C., Luo, Y. (2021), The inward FDI-energy intensity nexus in OECD countries: A sectoral R&D threshold analysis. Journal of Environmental Management, 287, 112290.
Dogan, E., Inglesi-Lotz, R. (2020), The impact of economic structure to the environmental Kuznets curve (EKC) hypothesis: Evidence from European countries. Environmental Science and Pollution Research International, 27(11), 12717-12724.
Fan, J., Wang, J., Liu, M., Sun, W., Lan, Z. (2022), Scenario simulations of China's natural gas consumption under the dual-carbon target. Energy, 252, 124106.
Gillingham, K., Nordhaus, W., Anthoff, D., Blanford, G., Bosetti, V., Christensen, P., McJeon, H., Reilly, J. (2018), Modeling uncertainty in integrated assessment of climate change: A multimodel comparison. Journal of the Association of Environmental and Resource Economists, 5(4), 791-826.
Hanif, I., Raza, S.M.F., Gago-de-Santos, P., Abbas, Q. (2019), Fossil fuels, foreign direct investment, and economic growth have triggered CO2 emissions in emerging Asian economies: Some empirical evidence. Energy, 171, 493-501.
Jiang, W., Cole, M., Sun, J., Wang, S. (2022), Innovation, carbon emissions and the pollution haven hypothesis: Climate capitalism and global re-interpretations. Journal of Environmental Management, 307, 114465.
Kaika, D., Zervas, E. (2013), The environmental Kuznets curve (EKC) theory-part A: concept, causes and the CO2 emissions case. Energy Policy, 62, 1392-1402.
Koondhar, M.A., Shahbaz, M., Ozturk, I., Randhawa, A.A., Kong, R. (2021), Revisiting the relationship between carbon emission, renewable energy consumption, forestry, and agricultural financial development for China. Environmental Science and Pollution Research International, 28(33), 45459-45473.
Li, P., Wang, Z.H. (2021), Environmental co-benefits of urban greening for mitigating heat and carbon emissions. Journal of Environmental Management, 293, 112963.
Li, W., Qiao, Y., Li, X., Wang, Y. (2022), Energy consumption, pollution haven hypothesis, and environmental Kuznets curve: Examining the environment-economy link in belt and road initiative countries. Energy, 239, 122559.
Liu, H., Khan, I., Zakari, A., Alharthi, M. (2022), Roles of trilemma in the world energy sector and transition towards sustainable energy: A study of economic growth and the environment. Energy Policy, 170, 113238.
Liu, Y., Sadiq, F., Ali, W., Kumail, T. (2022), Does tourism development, energy consumption, trade openness and economic growth matters for ecological footprint: Testing the environmental Kuznets curve and pollution haven hypothesis for Pakistan. Energy, 245, 123208.
Luo, L., Ma, X. (2021), Research on the Impact of Income Gap on Environmental Pollution Based on Balanced Panel Data of 48 Countries. In: IOP Conference Series: Earth and Environmental Science. Vol. 781. Bristol, United Kingdom: IOP Publishing. p032003.
Martins, J.M., Haider, S.A., Pereira, J.M., Mata, M.N., Abreu, A. (2022), Innovation management on waste biorefineries. In: Handbook of Waste Biorefinery. Cham: Springer. p915-932.
Mert, M., Caglar, A.E. (2020), Testing pollution haven and pollution halo hypotheses for Turkey: A new perspective. Environmental Science and Pollution Research International, 27(26), 32933-32943.
Mohsin, M., Naseem, S., Sarfraz, M., Azam, T. (2022), Assessing the effects of fuel energy consumption, foreign direct investment and GDP on CO2 emission: New data science evidence from Europe and Central Asia. Fuel, 314(1), 123098.
Moosa, I.A. (2017), The econometrics of the environmental Kuznets curve: An illustration using Australian CO2 emissions. Applied Economics, 49(49), 4927-4945.
Muhammad, S., Long, X., Salman, M., Dauda, L. (2020), Effect of urbanization and international trade on CO2 emissions across 65 belt and road initiative countries. Energy, 196, 117102.
Musah, M., Mensah, I.A., Alfred, M., Mahmood, H., Murshed, M., Omari-Sasu, A.Y., Boateng, F., Nyeadi, J.D., Coffie, C.P.K. (2022), Reinvestigating the pollution haven hypothesis: The nexus between foreign direct investments and environmental quality in G-20 countries. Environmental Science and Pollution Research International, 29(21), 31330-31347.
Nepal, R., Paija, N., Tyagi, B., Harvie, C. (2021), Energy security, economic growth and environmental sustainability in India: Does FDI and trade openness play a role? Journal of Environmental Management, 281, 111886.
Ngo, T.Q. (2022), How do environmental regulations affect carbon emission and energy efficiency patterns? A provincial-level analysis of Chinese energy-intensive industries. Environmental Science and Pollution Research, 29(3), 3446-3462.
Nisar, Q.A., Akbar, A., Naz, S., Haider, S.A., Poulova, P., Hai, M.A. (2022), Greening the workforce: A strategic way to spur the environmental performance in the hotel industry. Frontiers in Environmental Science, 10, 841205.
Oguz, O., Ozturk, I., Aslan, A. (2013), Coal consumption and economic growth in Turkey. International Journal of Energy Economics and Policy, 3(2), 193-198.
Opoku, E.E.O., Boachie, M.K. (2020), The environmental impact of industrialization and foreign direct investment. Energy Policy, 137(C), 111178.
Pata, U.K., Caglar, A.E. (2021), Investigating the EKC hypothesis with renewable energy consumption, human capital, globalization and trade openness for China: Evidence from augmented ARDL approach with a structural break. Energy, 216, 119220.
Qu, Y., Zhan, L., Jiang, G., Ma, W., Dong, X. (2021), How to address "population decline and land expansion (PDLE)" of rural residential areas in the process of Urbanization: A comparative regional analysis of human-land interaction in Shandong Province. Habitat International, 117(4), 102441.
Rafiq, M., Akbar, A., Maqbool, S., Sokolová, M., Haider, S.A., Naz, S., Danish, S.M. (2022), Corporate risk tolerance and acceptability towards sustainable energy transition. Energies, 15(2), 459.
Rehman, A., Ma, H., Ozturk, I., Ulucak, R. (2022), Sustainable development and pollution: The effects of CO2 emission on population growth, food production, economic development, and energy consumption in Pakistan. Environmental Science and Pollution Research International, 29(12), 17319-17330.
Ruan, F.L., Yan, L. (2022), Interactions among electricity consumption, disposable income, wastewater discharge, and economic growth: Evidence from megacities in China from 1995 to 2018. Energy, 260, 124910.
Salahuddin, M., Alam, K., Ozturk, I., Sohag, K. (2018), The effects of electricity consumption, economic growth, financial development and foreign direct investment on CO2 emissions in Kuwait. Renewable and Sustainable Energy Reviews, 81, 2002-2010.
Sarkodie, S.A., Adams, S., Leirvik, T. (2020), Foreign direct investment and renewable energy in climate change mitigation: Does governance matter? Journal of Cleaner Production, 263, 121262.
Sarkodie, S.A., Strezov, V. (2019), A review on environmental Kuznets curve hypothesis using bibliometric and meta-analysis. Science of the Total Environment, 649, 128-145.
Shastri, S., Mohapatra, G., Giri, A.K. (2022), The environmental philips curve

from a gender perspective: Empirical evidence from India. Environmental Science and Pollution Research International, 48(12), 1-10.
Song, W., Han, X. (2022), The bilateral effects of foreign direct investment on green innovation efficiency: Evidence from 30 Chinese provinces. Energy, 261, 125332.
Sun, W., Huang, C. (2020), How does urbanization affect carbon emission efficiency? Evidence from China. Journal of Cleaner Production, 272, 122828.
Tan, Z., Koondhar, M.A., Nawaz, K., Malik, M.N., Khan, Z.A., Koondhar, M.A. (2021), Foreign direct investment, financial development, energy consumption, and air quality: A way for carbon neutrality in China. Journal of Environmental Management, 299, 113572.
Tenaw, D., Beyene, A.D. (2021), Environmental sustainability and economic development in Sub-Saharan Africa: A modified EKC hypothesis. Renewable and Sustainable Energy Reviews, 143, 110897.
Tiwari, A.K., Ozturk, I., Aruna, M. (2013), Tourism, energy consumption and climate change in OECD countries. International Journal of Energy Economics and Policy, 3(3), 247-261.
Ullah, S., Adams, K., Adams, D., Attah-Boakye, R. (2021), Multinational corporations and human right violations in emerging economies: Does commitment to social and environmental responsibility matter? Journal of Environmental Management, 280, 111689.
Ulucak, R. (2022), Analyzing energy innovation-emissions nexus in China: A novel dynamic simulation method. Energy, 244, 123010.
Wang, J., Zhang, Y. (2021), Analysis on the evolution of rural settlement pattern and its influencing factors in China from 1995 to 2015. Land, 10(11), 1137.
Wang, Q., Jiang, R. (2020), Is carbon emission growth decoupled from economic growth in emerging countries? New insights from labor and investment effects. Journal of Cleaner Production, 248, 119188.
Wang, Q., Zhao, M., Li, R., Su, M. (2018), Decomposition and decoupling analysis of carbon emissions from economic growth: A comparative study of China and the United States. Journal of Cleaner Production, 197, 178-184.
Wang, Z., Zhang, B., Wang, B. (2018), The moderating role of corruption between economic growth and CO2 emissions: Evidence from BRICS economies. Energy, 148, 506-513.
Wei, Y., Zhu, R., Tan, L. (2022), Emission trading scheme, technological innovation, and competitiveness: Evidence from China's thermal power enterprises. Journal of Environmental Management, 320, 115874.
Wei, Z., Han, B., Pan, X., Shahbaz, M., Zafar, M.W. (2020), Effects of diversified openness channels on the total-factor energy efficiency in China's manufacturing sub-sectors: Evidence from trade and FDI spillovers. Energy Economics, 90(C), 104836.
Wu, Z., Huang, X., Chen, R., Mao, X., Qi, X. (2022), The United States and China on the paths and policies to carbon neutrality. Journal of Environmental Management, 320, 115785.
Yang, T., Dong, Q., Du, Q., Du, M., Dong, R., Chen, M. (2021), Carbon dioxide emissions and Chinese OFDI: From the perspective of carbon neutrality targets and environmental management of home country. Journal of Environmental Management, 295, 113120.
You, J., Xiao, H. (2022). Can FDI facilitate green total factor productivity in China? Evidence from regional diversity. Environmental Science and Pollution Research International, 29(32), 49309-49321.
Zameer, H., Yasmeen, H., Zafar, M.W., Waheed, A., Sinha, A. (2020), Analyzing the association between innovation, economic growth, and environment: Divulging the importance of FDI and trade openness in India. Environmental Science and Pollution Research International, 27(23), 29539-29553.
Zandi, G., Haseeb, M. (2019), The role of trade liberalization in carbon dioxide emission: Evidence from heterogeneous panel estimations. International Journal of Financial Research, 10(5), 228-240.
Zhang, L., Tian, H., Shi, H., Pan, S., Chang, J., Dangal, S.R.S., Qin, X., Wang, S., Tubiello, F.N., Canadell, J.G., Jackson, R.B. (2022), A 130□ year global inventory of methane emissions from livestock: Trends, patterns, and drivers. Global Change Biology, 28(17), 5142-5158.
Zhang, Y., Zhang, S. (2018), The impacts of GDP, trade structure, exchange rate and FDI inflows on China's carbon emissions. Energy Policy, 120, 347-353.