DOI: https://doi.org/10.52131/pjhss.2023.1101.0330

Pakistan Journal of Humanities and Social Sciences

Volume 11, Number 1, 2023, Pages 68–79
Journal Homepage:
https://journals.internationalrasd.org/index.php/pjhss

PAKISTAN JOURNAL OF HUMANITIES AND SOCIAL SCIENCES (PJHSS)
INTERNATIONAL RESEARCH ASSOCIATION FOR SUSTAINABLE DEVELOPMENT

Effect of Financial Development, Economic Growth on Environment Pollution: Evidence from G-7 based ARDL Cointegration Approach

Nabila Shahzadi Hafiza[1], Salman Masood Sheikh[2], Awais Sadiq[3], Saif Ur Rahman[4]

[1] M.Phil. Scholar, Superior University Lahore, Pakistan, pakizashah13@gmail.com
[2] Dean & Professor, Faculty of Economics and Commerce, Superior University Lahore, dean.fec@superior.edu.pk
[3] M.Phil. Scholar, Faculty of Economics and Commerce, Superior University Lahore, awaissadiq9@gmail.com
[4] Assistant Professor, Superior University Lahore, Saifrao12@gmail.com

ARTICLE INFO

Article History:
Received: November 13, 2022
Revised: January 30, 2022
Accepted: January 30, 2022
Available Online: February 13, 2023

Keywords:
Green Investments
Financial Development
Environmental Pollution
G-7 countries

Funding:
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

Several opinions have influence on the factors of environmental pollution in G-7 countries. However, the main objective is to scrutinize the impacts of financial development, green Investment, economic growth, and energy efficiency on environmental pollution in the context of the G-7 nations. In order to fill this gap, this study was carried out using annual penal data from 1997 to 2021. The results of the Panel ARDL model confirm that green Investment, economic growth (GDP), and financial development have a positive and significant relationship with CO2 emissions in long run. However, energy efficiency has a negative impact on CO2 emissions in the G-7 countries. Based on its results, the report advises that expenditures in green investment be increased in order to reduce environmental pollution in the G-7 nations. Enhancing financial sector advancements is a crucial way for the nation to achieve its targets for sustainable development. One method of lowering environmental pollution in society is to make investments in energy efficiency. The G-7 should spend additional funds on energy efficiency measures in light of the aforementioned. Additionally, changes in the banking system have demonstrated a substantial influence on the pollution of the environment. Low levels of environmental pollution are caused by this financial prosperity in the countries.

Corresponding Author's Email: pakizashah13@gmail.com

1. Introduction

The biggest issue facing the globe today and the primary factor in many fatal diseases is environmental degradation. Emerging nations like G-7 are increasingly concerned about global warming and environmental damage, which has been a crucial topic in recent internal and international policy discussions. Global emissions of carbon dioxide (CO_2) have risen quickly. Global carbon emissions increased from 1.6 billion tons in 1990 to 36 billion tons in 2019. A significant contributor to lung issues and other deadly diseases is environmental pollution. Thus, the problem of rising environmental contamination has grown significantly (Ali, ur Rahman, & Anser, 2020; Anjum et al., 2021; Anwar, Nasreen, & Tiwari, 2021; Sarwar, Ali, Bhatti, & ur Rehman, 2021).

Green investments may reduce environmental pollution in a variety of ways, including the effectiveness of energy conservation and emission reduction, the growth of innovation and technology skills, and the upgrading of the industrial structure. The environmental crisis resulting from environmental deterioration/beggar brought on by various forms of pollution, depletion of natural resources due to their rapid rate of exploitation/utilization and growing reliance on energy-intensive and environmentally harmful technologies, reduction and loss of ecological populations due to excessive use of toxic pesticides and herbicides, and loss of several species of plants due to the practice of monoculture, removal of invasive species, and climate change (Appannagari, 2017; Hassan, Sheikh, & Rahman, 2022; S. Rahman & Idrees, 2019; S. U. Rahman, Chaudhry, Meo, Sheikh, & Idrees, 2022; Zaman & Abd-el Moemen, 2017). By emitting a significant amount of carbon dioxide, it may have an impact on Environmental pollution (Danish et al., 2022). Higón, Gholami, and Shirazi (2017), Danish et al. (2022) and Latif et al. (2020) reported that ICT reduces the level of CO_2 emission by introducing smart electrical grids, digital transportation systems, smart cities, efficient use of energy, and industrial processes.

Along with economic growth, reduced energy use creates/creates significant environmental issues Yasmin, Saeed, Pasha, and Zia (2019) Due to their heavy reliance on nonrenewable energy sources, developing nations are experiencing problems with environmental deterioration (Khan et al (2020a, b). Environmental pollution can be significantly reduced by using renewable energy (Muhammad & Khan, 2021). Additionally, economic expansion brought about by globalization policies may result in higher atmospheric CO_2 emissions (Teng & Pan, 2020; Ulucak, 2020; Zhu, Fang, Rahman, & Khan, 2021).

By concentrating on the aspect of financial development, FDI, carbon emission, and technological innovation by using the case of G-7 countries, progress has been made in everything that presents the relationship between CO2, IT, and FDI. This study will also examine the relationship between EKC and economic growth and carbon emissions. The literature evaluations make it obvious that earlier studies largely focused on the relation effect on the dependent variable like GI on EP and FD on EP, without looking at the combined effects of both factors on EP. Additionally, the bulk of previous research modelled the macroeconomic factors that influence EP mostly using traditional econometric techniques. However, it was important for the research to use more contemporary econometric techniques since they could produce solid and trustworthy results. By using the ARDL estimator to assess the impact of financial development and economic growth on environmental pollution in G-7 nations, our investigation filled the aforementioned gap.

2. Literature Review

This section discusses the literature on the relationship between FD and EP. The relationship between the investigated series is described in the final part, which fills a gap in the literature. Environmental pollution and green investment nexus According to (Chen et al., 2019), GI is defined as investment operations focused on projects or businesses dedicated to the preservation of natural resources, the development of alternative energy sources, the protection of the air and water, and other environmentally friendly practices.

Green investments may also be viewed as socially responsible investments due to the great priority put on environmental standards, social responsibility, and benefits Wan and Sheng in 2021. A financial decision should be considered green, in accordance with (Xu et al., 2017), if it would decrease the use of dirty fuels, including coal. As an illustration, Shen et al in 2020 performed research on 30 Chinese provinces and concluded that, according to the study's CS-ARDL estimates, GI decreased ecological pollution in the areas. The study recommended the creation of green investments and environmentally friendly policies to help lower the rate of effusions in the study regions. Rokhmawati (2021) looked at 445 factories in Indonesia between 2016 and 2017. While green investments might reduce GHG emissions, it was found using the mediation regression analysis approach that doing so did not boost competitiveness. Kahia and Ben Jebli (2021) conducted a study on the top 10 industrialized countries in the world.

Shen, Li, Wang, and Liao (2020) investigated Chinese 30 regions and found that, based on estimates of the report's CS-ARDL, GsI significantly reduced environmental pollution in the areas. The research suggests that, in order to slow down the rate of outpourings in the studied regions, investment possibilities in green and ecologically friendly policies be created. Between 2016 and 2017, Rokhmawati (2021) examined 445 industrial facilities in Indonesia. Using the mediated regression method, it was discovered that while green investments might lower Greenhouse gas, their decrease did not result in an increase in competitiveness. The top 10 industrialised nations in the world were the subject of research by (Kahia & Ben Jebli, 2021). Investment in green power decreased contamination rate in Austria, Chile & Australia, according to Residuals, DOLS, and CCR estimations. The study came to the conclusion that green power investments were the key to reducing carbon emissions and promoting expansion in the nations' industrial sectors.

By Gyamfi, Ozturk, Bein, and Bekun (2021) revealed bioenergy for EP. That clarified how the economy's use of biomass resources affects the environment. He and colleagues (2021) analyzed the industrial sector in China and found that efficient energy usage decreased the nation's carbon emissions. According to the research of Dalevska, Khobta, Kwilinski, and Kravchenko (2019), Matuszewska-Janica, Żebrowska-Suchodolska, Ala-Karvia, and Hozer-Koćmiel (2021), Dabyltayeva and Rakhymzhan (2019), GI were considered as the main drivers that gave the financial base for environmental sustainability. (2019. Chang and Shieh (2017), the majority of GI was used to promote and put in place clean energy technologies that might reduce the amount of emissions, according to Almulali et al. (2013), Ocal and Aslan (2013).

In a research on EU nations, (Lyeonov, Pimonenko, Bilan, Štreimikienė, & Mentel, 2019) found that GI increased EP by 3.08%. An insignificant correlation among the investments in green power and EP was found after researching Chinese 30 regions "between" (2003 to 2017). According to the report, China should accelerate its green power investments by building new technological systems to support the improvement of its ecosystem. The report also promoted improvements in energy quality and efficiency as well as the encouragement of energy diversity in the nation to further increase EP. Shen et al. (2020), who conducted their research in China as well, used the cutting-edge CSARDL estimator to evaluate the relationship among investments in green power and EP and determined that low-carbon emissions from green investments serve as a positive driver of EP.

In their research on green investments and EP from 2021, Raghutla et al. According to the research done by Qin et al in 2020 & Masood 2020, Spending on power generation was essential. to boosting EP. A research on 29 Chinese provinces was carried out by Zheng, Wang, Mak, Hsu, and Tsang (2021). The findings indicate that energy service firms have invested (ESCOs). M. T. I. Khan, Ali, and Ashfaq (2018)'s investigation into Pakistan revealed that green energy is safe for the environment. In order to reduce environmental pollution in the country, the report recommended that the government expand its investments in green energy. Imran, Özçatalbaş, and Bashir (2020) investigated the South Punjab cotton producers' energy efficiency. The industry was able to save 23% of the energy it used overall because to investments in energy efficiency, which also dramatically reduced emissions.

In order to support rising energy consumption and promote EP, ASEAN nations should invest in green energy contend of Anwar et al. (2021), S. Rahman and Idrees (2019); Younas, Idrees, and ur Rahman . In agreement with Du et al., Xia et al. (2020) & Zhang et al. (2021) indicated Spending on power generation was essential driving force for EP in China. Jia, Shao, and Yang (2021) looked at how green energy helps reduce emissions throughout the world. According to the findings, worldwide carbon emission change was mitigated to the tune of 11.04 percent overall by investments in clean energy. In a dynamic research on Korea, Adebayo et al. (2021) found that using green energy sources bio mass solar energy, wind and among others nuclear power, is an efficient way to reduce environmental pollution there.

Energy efficiency according to Martínez-Moya, Vazquez-Paja, and Maldonado (2019) increased EP through reducing emissions. From 1995 through 2019, Ponce and Khan (2021), examined nine developed countries. That for increase the energy productive enhanced EP in the countries as a result of the findings. In their research on South Asia, found that using clean energy was the best way to protect the region's environmental wellness, (Murshed, Rahman, Alam, Ahmad, & Dagar, 2021). Yasmeen and Tan (2021), after conducting research on Pakistan, advised governments to encourage investments in non-EP alternative energy sources. In their study of the BRICS countries, Khattak, Ahmad, Khan, and Li (2021) highlighted projects of green enhancing to increase the investment as a top possibility for increasing EP, particularly for power production projects using wind, hydro, solar, and biomass. In order to achieve carbon neutrality, Shao, Zhong, Li, and Altuntaş (2021) examined nation of the US and recommended making investments in the fields of upgrades and renewable energy.

Between 1990 and 2016, Sharma, Shahbaz, Sinha, and Vo (2021) looked into four South Asian countries. Investments in RE technologies as a result of the discovery have reduced the nations' energy-driven coal consumption. Ullah, Ozturk, Majeed, and Ahmad (2021) examined 15 nations that consumed RE between 1996 and 2018 and strongly advised that the countries change their energy usage policies to create more energy by introducing RE technology in order to contribute to growth. The top ten nations according to the RE and ECI rankings were investigated by Wang et al. in 2021. The report emphasised that the most important instrument for raising EP in the nations is investments in renewable energy. Economic experts broadly acknowledge that FD impacts CO2 emissions to lessen air degradation Ahmad, Muslija, and Satrovic (2021); H. Khan, Weili, and Khan (2022); Bilal, Shah, Rahman, and Jehangir (2022); S. Rahman and Idrees (2019). In order to improve economic viability, Guru and Yadav (2019) defined FD as the scope, stability, and predictability of financial markets. And effectiveness in financial sectors, like having improved access to such institutions. Rajan and Zingales (2003) asserts that a robust financial system significantly contributes to economic growth by generating local funds that are subsequently invested in successful local businesses. Additionally, developments in the financial industry support the development of effective financial plans according (Musah et al., 2021); Zulfiqar et al. (2022), Hafiza et al. (2022). It has been extensively studied how FD and EP are related. But the results are inconsistent.

Turkey from 1965 to 2018 show the regression among FD and EP in was investigated by Doğanlar, Mike, Kızılkaya, and Karlılar (2021). The series has a long-run connection, according to the findings of the RALS cointegration test. The DOLS estimations also revealed that FD was detrimental to EP across the nation. European emerging and Central Asian economies the nonlinear relationship between FD and EP was studied by Chunyu, Zain-ul-Abidin, Majeed, Raza, and Ahmad (2021). The findings showed that EP initially got worse with continuing FD. The cube of FD improved EP during the same time periods, supporting the inverted U-shaped theory. According to the report, in order to achieve environmental sustainability, nation should encourage FD promotes Limited renewable energy sources, advancements in greener manufacturing processes, solar power, and electrification.

The relationship between FD and EP in China was investigated by Yao and Zhang (2021) using approach in two-sector of oriented technical change. According to the study's ARDL calculations, FD reduced EP nationwide. In particular, a 1% increase in FD led to a 0.45–0.79% increase in carbon emissivity. M. Khan and Ozturk (2021) investigated in 2021 directional or non-directional effects of EP on FD in 88 underdeveloped countries from 2000 to 2014. Five FD indicators showed an improvement in EP in the nations, according to system GMM econometric estimations. Additionally, the negative impacts of FDI, real exchange rate, and wealth on pollutant emissions were indirectly offset by FD. Additionally, little evidence supported the pollution haven theory (PHH), which was assessed using FDI and trade flexibility financial organization. The PHH for the 2 factors vanished when FD exceeded specific thresholds. The impact of FD and structural reform on Venezuela's transition to a low-carbon economy was studied by Nwani (2021). Results of the analysis confirmed that FD positive shocks and de jure financial integration conditions boosted EP in the nation. Rjoub, Odugbesan, Adebayo, and Wong (2021) concluded the positive effect of FD on environmental pollution in Turkey.

Nassani, Aldakhil, and Zaman (2021) examined in economies top ten mineral-rich from 1990 to 2019. In light of the results, additional funding reduced the environmental pollution metric known as mineral resource rent. The BRICS economies were examined by Ganda (2021) between the years 2000 and 2018, and the study's key conclusions revealed an increase FD benefited EP of the countries by reducing emissions. Nathaniel, Alam, Murshed, Mahmood, and Ahmad (2021) and Shahid, Muhammed, Abbasi, Gurmani, and ur Rahman (2022) examined the 1990–2016 FD–EP relationship in the N–11 nations. According to the study's conclusions using contemporary econometric approaches, FD was bad for EP in the countries. South Asian economies were the subject of research by Murshed, Ahmed, Kumpamool, Bassim, and Elheddad (2021) from 1990 to 2016. The study's findings demonstrated that FD is bad for EP globally. Yang et al in 2021 investigated from 1990 to 2017. Due to revelations, FD decrease EP in air to worsen. From 1980 to 2015, Acheampong, Amponsah, and Boateng (2020) looked at the relationship between FD & EP in economies 83. According to the general projections, changes in sectors of financial had no appreciable impact on EP. Additionally, there were regional differences in the moderating and nonlinear impacts of financial market movements on EP.

3. Methodology

This study use environment pollution as dependent variable and we use CO_2 emissions as proxy for it and its measurement kilo tons (kt), and then we use green investment (GI), financial development (FD) gross domestic product (GDP) energy efficiency (EE) as independent variable. We also use proxies in our independent variables like in green investment we as technological innovations, resident and non-resident as proxy and in financial development (FD) we use domestic credit to private sector domestic credit to private sector by banks as proxy CO2 is in kilo tons (kt).

Accessibility from 1997 to 2021. In Table 1, the variable description, measuring unit, and source of data are portrayed. Here we use the method of panel ARDL which examine the result of different variable in short run and long run on environmental pollution (CO2 emissions). Using the Bai and Perron (1998) approach, multiple points of breaks were practiced. The Schwarz criteria, which Schwarz (1978) recommended, specifies the highest breaking points to be, has been taken into account while determining the breaks points' assurance.

$$EP = f(GI, FD, EE, GDP)$$

Where EP as environment pollution, GI as Green Investment, FD as Financial Development, EE as energy efficiency & GDP individually. We contend that these elements are the key producers and substantial contributors to reducing environmental pollution in the air by using the CO2.

Table 1: Units of measurement

Variable	Measuring Unit	Sources
	Environmental Pollution	
Carbon Dioxide (Co2)	Tones metric per person	WDI-2021 World development indicators-
	Green Investment (GIP)	
Technology Innovations	Patent for Resident and non-Resident	WDI-2021 World development indicators-
	Financial Development (FDP)	
Energy Efficiency	Ratio of energy consumption GDP	WDI-2021 World development indicators-
Domestic Credit to Private Sector	Percentage of GDP	World development indicators-WDI-2021
Gross Domestic Product	GDP growth annual %	World development indicators-WDI-2021

In this study we get the data from 1997 to 2020 of G- 7 countries (United Kingdom, Japan, Italy, United States, Germany, Canada, France) and apply test (Im, Pesaran, & Shin, 2003), the Levin, Lin, and Chu test from the first generation of tests, (Maddala & Wu, 1999) Fisher-type test, and Im, Pesaran, and Choi and Chue (2007) tests are all included (2001). The fundamental drawback of these tests is that they are all built on the presumption that each time series in the panel is cross-sectional independently distributed, despite the fact that a substantial body of work shows that economic variables move together.

$$EP_{it} += \beta 0 + \beta 1 \, GIP_{it} + \beta 2 GDP_{it} + \beta 3 \, FDP_{it} + \beta 4 \, EE_{it} + \mu_{it}$$

Where I denote country and t represents time, whereas EP is environmental pollution, GDP is GDP growth rate, GIP is for Green Investment, EE is energy efficiency and FDP is for financial development, however, to check the hypothesis of the Environmental.

4. Descriptive Analysis

Table 2 shows the result of descriptive analysis of selected variables. In this table values of data mean, median, maximum determined. The statistic test of jarque-bera determine with its probability values also shows in this table. This test uses to check the normality of variables. Jarque-Bera test determine that all the variables are normally distributed and remaining variables are not normally distributed.

Before applying panel ARDL we apply the unit-root test because we check that our all variables are stationary at the level or first difference because if any single variable is stationary at the second difference, then we cannot use the PMG approach. The results show that no variable is stationary at level, so we take the first difference of all variable now stationary at first difference. This part of the empirical investigation shows the results of test unit root by panel. We initially performed a few panels root tests to gauge the degree of stationarity of the model's input variables.

Table 2: Descriptive Testing

	CO2	GIP	GDP	FDP	EE
Mean	10.27	-9.14	1.08	-9.14	10.81
Median	9.073	-0.04	1.47	-0.12	10.54
Maximum	20.46	1.88	7.33	2.341	19.737
Minimum	4.176	-2.63	-8.59	-3.190	4.224

Table 3: Panel Unit Root Analysis

	At Level										
	Individual Intercept					Individual Intercept and Trend					
Variables	Common Unit Root	Individual Unit Root			Hadri	C Unit Root		I Unit Root			Hadri
	LLC	IPS	ADF	PP		LLC	Breitung	IPS	ADF	PP	
CO2	0.99	1.00	1.00	1.00	0.00	0.38	0.86	0.77	0.73	0.41	0.00
GIP	0.24	0.76	0.70	0.42	0.00	0.28	0.51	0.04	0.02	0.02	0.00
FDP	0.01	0.16	0.08	0.54	0.00	0.22	0.49	0.78	0.78	0.97	0.00
GDP Growth	0.14	0.63	0.60	0.43	0.001	0.22	0.43	0.03	0.02	0.03	0.00

The results of a number of panel unit root tests, including the (Hadri, 2000) tests, the Pesaran and Shin W-stat tests, the Lin, Levin, and Chu, PP, ADF, and IPS tests, are shown in Table 3. Table 3's first row displays the names of several unit root tests, while its first column lists the variable names used in the models. For each series, the level and the first difference of the empirical findings for each unit root test are shown. According to the empirical findings, all variables are stationary at the first difference, while some are also becoming stationary at the level. Therefore, panel cointegration empirical analysis is possible. Numerous earlier studies have suggested that if the model variables are stationary at the first difference, the analysis of panel cointegration is helpful for an estimate (Pesaran, Shin, & Smith, 2001).

4.1 Long Run Panel ARDL Estimation

The results of the long-run and short-run estimations of the Panel ARDL model are displayed in Table 4. The primary objective of the study is to confirm the relationship between green investment, environmental pollution, CO_2 emissions, GDP, and financial development.

Table 4: Long Run and Short Run Estimation of Panel ARDL Test

Variable	Coefficient	Std. Error	t-Statistic	Probability
		Long Run		
GIP	0.198792	0.066559	2.986699	0.0034
GDP	0.221036	0.033562	6.585856	0.0000
FDP	-0.148148	0.067302	-2.201233	0.0296
EE	-0.467412	0.095092	-4.915383	0.0000
		Short Run		
ECT	-0.367532	0.068719	-5.348338	0.0000
d(GIP)	-0.069999	0.050700	-1.380656	0.1699
d(GDP)	-0.008159	0.018758	-0.434971	0.6644
d(FDP)	0.115031	0.141425	0.813369	0.4176

d(EE)	-0.321732	0.321128	-1.001878	0.3184

Table 4 displays the Panel ARDL results. At a 5% level of significance, the results demonstrate a positive and significant connection between GIP and environmental pollution. In other words, a 1 unit rise in GIP causes a 0.199-unit increase in environmental pollution. In the empirical economic research, the long-term connection between GIP and environmental pollution is a controversial subject. Additionally, we found that, at a 5% level of significance, there is a positive and significant association between GDP and environmental pollution. The result is a 0.221 units increase in environmental pollution for every unit increase in GDP. However, we also noticed a long-term, significant negative relationship between FDP and environmental pollution at a 5% level of significance. It suggests that a unit increase in FDP causes an environment pollution decrease of 0.148 units. The results also indicate a long-term, negative relationship between EE and environmental pollution at a 5% level of significance. According to this, every unit increase in EE results in a 0.467 units decrease in environmental pollution. These are aligning with previous studies of (Li, Hammer, Zheng, and Cohen (2022); Attahiru et al. (2019); S. Rahman and Idrees (2019)

4.2 Short Run Panel ARDL Estimation

In Table 4, the ECT value is -0.367, indicating that any deviation from equilibrium is adjusted with a 36.7% speed of correction. This finding suggests that environmental pollution is more important to the long-term effects of the variables we selected. The short run dynamics has a significant impact on the computation of the ECT coefficient. The error correction coefficients, or ECT, which are correct in sign and significant, are proof that the variables have co-integrating relationships that have been established. The ECT coefficient illustrates how quickly the long-run equilibrium is restored following a short-term shock. One example is that the ECT coefficient is 0.367. Accordingly, in the current year, approximately 36.7% of the shock-induced disequilibria will have achieved long-term equilibrium.

According to the GIP coefficient, this is -0.699, a short-term increase in GIP receipts results in a short-term decrease in environmental pollution of 0.699 units. The outcome supports the GIP-led growth hypothesis, which states that improvements in incoming GIP activities may lead to a reduction in environmental pollution. According to the GDP coefficient, a 1 unit rise in GDP will cause a 0.008-unit decrease in environmental pollution. According to the coefficient of FDP, a gauge of renewable energy, an increase in the volume of FDP by one unit will result in an increase in environmental pollution of 0.115. In particular, we identify a statistically significant negative sign of magnitude 0.322. The EE coefficient indicates that every unit increase in EE causes a 0.322-unit decrease in environmental pollution. The short run analysis results and the coefficient of the error correction factors are shown in Table 4 below. The short-term results are in line with earlier forecasts and are nearly sign-identical to the long-term outcomes. The magnitudes of the short run estimates, however, are smaller than those of the long run ones.

5. Conclusion

Decisions and analysis recommendations with respect of consequences of climate change Examination of study show the relationship between independent variable effects on independent variable like environmental pollution has been measured very important. Stronger econometric tools were used to examine the connection among independent variable green investment and other variable financial development, show the effect on environmental pollution by using the period from 1997 to 2020 in G-7 nations as evidence. Using the Panel ARDL approach, the finding affirms that a positive and significant associations exist between the green Investment, financial development and economic growth on CO_2 emissions.

Furthermore, the energy efficiency has a negative relationship with CO_2 emissions in in the G-7 countries. Moreover, financial developments which is measure by the proxies of private sector bank and the public sector bank in the declined environmental pollution in G7 countries due to its positive react on CO2 using cleaning the environmental pollution. To aid the nation's declining consumption of clean energy, it is suggested that clean power be included in the nation's different energy blends. Additionally, increasing expenditures in technical advancements is a successful tactic that might encourage environmental degradation in the G-7.

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