



Influence of Transport Infrastructure Quality and Green Finance on Air Quality in Emerging Economies

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ABSTRACT

The issue of air pollution resulting from particle matter PM2.5 continues to attract global concern. This study shows the influence of Transport infrastructure quality and Green Finance on Air Quality in Emerging Economies from 1998–2022. Utilizing a panel Auto-Regressive Distributed Lag (ARDL) model and analyze the impacts of Transport infrastructure quality, Green Finance, and GDP Per capita growth renewable energy consumption on PM2.5. The Environmental Kuznets Curve (EKC) hypothesis serves as the theoretical framework. The results show that transport infrastructure quality significantly deteriorates air quality, while green finance initiatives improve it. Specifically, CO2 emissions from transport, consumption of petroleum and emissions form petroleum and other liquid fuels worsens the PM2.5 levels, whereas renewable energy consumption and mitigate Air pollution. Urbanization and population growth also contribute to worsen air quality. An increase in per capita gross domestic product (GDP) will increase PM2.5 emissions in short run and long run (GDP)² has positive impact in long run and short run so, it gradually decreases PM2.5 level. GDP and (GDP)² has inverse relationship it shows that EKC theory is validated. Green Finance has positive impact on air quality. We should encourage government to improve Transport Infrastructure Quality to reduce PM2.5 level and promote the use of electric vehicles instead of combustion engines and environmentally friendly policies to improve air quality and public health because transport infrastructure quality is not good in Emerging economies.



Introduction

Clean air is a key requirement for human life and good health. The word "Air Quality" refers to the condition of the air with respect to the amount of pollutants there. It is a vital environmental component having major effect on the public health. Common pollutants contain PM_{2.5}, NO₂, SO₂, O₃, and carbon dioxide Bildirici and Çoba (2024). In an era characterized by the pursuit of both growth in the economy and environment protection, transport infrastructure quality and availability of green finance have emerged as critical variables in influencing the air quality of growing nations Liu et al., (2024). Rapid urbanization and industrialization in emerging economies frequently result in higher air pollution levels because of inefficient transport Density, the transport sector plays a critical role in contributing to air pollution in emerging economies. To address this serious issue, there is increased interest in determining the effect of transport infrastructure quality and green financing on quality of air Gou et al., (2020). Poorly constructed or insufficient transportation infrastructure cause traffic congestion. Due to incomplete combustion and prolonged idling, cars that are delayed in traffic or forced to travel at moderate speeds frequently produce greater amounts of carbon dioxide and other pollutants. The air quality in urban areas considerably lowered by this congestion-related pollutant (Costabile and Allegrini 2008). Transport is a crucial economic development artery, has long been associated with positive as well as negative impacts on air quality. On the one side, efficient transportation networks can promote growth in the economy through promoting the movement of products and people, so helping to raise living standards. However, the environmental cost of transport particularly in emerging nations, frequently manifests as pollution in the air, emission of greenhouse gases, and adverse effects on health. PM_{2.5} is especially dangerous because of its tendency to enter the respiratory system and even the bloodstream. PM_{2.5} is emitted by a wide range of sources such as exhaust from vehicles, manufacturing operations, and fossil fuel burning. Its presence in the air is linked with health problems, including Heart and lungs diseases (Erickson and Jennings 2017). The state of the roads is also important. As a result of the additional energy required to drive across uneven surfaces, roads with potholes and cracks can cause an increase in vehicle emissions. Increased emissions of PM_{2.5} and other particle pollutants may result from this. In particular, the level of PM_{2.5} in the atmosphere impacted by the quality of the transport infrastructure. Here are several ways that the state of the transportation system affects PM_{2.5} level. The layout of transportation and the architecture of urban areas affect traffic patterns and vehicle (Zhang et al. 2020). The level of PM_{2.5} in the atmosphere is influenced both directly and indirectly by the state of the transportation. Reduced traffic congestion, the use of cleaner vehicles, and the promotion of non-motorized and public transportation options are all benefits of well-designed, effective, and sustainable transportation, all of which enhance air quality and lower carbon dioxide pollution. The transport infrastructure has major impact on air quality in emerging economies. Inefficient road networks, a lack of public transportation options, and inadequate maintenance all contribute to traffic congestion and vehicle emissions. Improving transportation infrastructure can alleviate congestion and encourage cleaner transportation options (Lemes 2018).

Mangones et al., (2020) said that the entire quantity of greenhouse gas emissions produced by different modes of transportation, such as vehicles, trucks, airplanes, trains, ships, and public transit systems, is referred to as the transportation carbon footprint. It provides a quantitative assessment of how transportation-related activities affect the environment in terms of how they affect climate change and global warming. Transportation's carbon footprint is typically expressed in units of carbon dioxide equivalent (CO₂e), which includes not only emissions from carbon dioxide but also greenhouse gases like methane and nitrous oxide, converted into their CO₂ equivalent based on their potential to cause global warming. Governments of countries spend money to protect the environment by green funding to reduce the air pollution in different sectors

such as in transport infrastructure to improve quality of roads and funding in reducing transport density can improve air quality. Effective carbon pricing, according to research, reduce emissions and improve air quality (Atish., 2007). The transport infrastructure quality and green financing in emerging nations is a difficult and understudied problem. A thorough analysis of how these components interact and impact air quality is required for the development of effective policies and initiatives to address air pollution. Identifying successful policy interventions and financial mechanisms is crucial for directing decision-makers and urban planners toward more sustainable and environmentally friendly transportation solutions. As a result, the research challenge to be addressed in this study is how to leverage improvements in transport infrastructure quality and the use of green financing to reduce air pollution in emerging economies. Understanding the transport infrastructure quality, green financing, and air quality is critical for developing cleaner, healthier, and more sustainable environment in these emerging economies. So, in this study we empirically test the influence of Transport infrastructure quality and Green Finance on Air Quality in selected Emerging Economies from 1998–2022. Utilizing a panel Auto-Regressive Distributed Lag (ARDL) model and analyze the impacts of Transport infrastructure quality, Green Finance, and GDP Per capita growth renewable energy consumption on PM2.5. What is the present status of the quality of transport infrastructure in selected emerging nations, and how does it affect the levels of air quality and How much green financing impact air quality in emerging nations in the long term and short term in the presence of EKC theory?

Research Questions

1. What is the present status of the quality of transport infrastructure in selected emerging nations, and how does it affect the levels of air quality?
2. How much green financing reduce air pollution in emerging economies, and what impact do they have on air quality improvements in emerging nations?

Objectives

- To evaluate the status of the air quality in selected emerging economies.
- To make policy suggestions for improving air quality in emerging economies through the development of sustainable transportation infrastructure quality and green financing.

Hypothesis

H0: There is no relationship between the transport infrastructure quality and green finance on air quality in emerging economies.

H1: There is a relationship between transport infrastructure quality and green finance on air quality in emerging economies.

Problem Statement

The interaction between transport infrastructure quality and green financing in emerging nations is a difficult and understudied problem. A thorough analysis of how these components interact and impact air quality is required for the development of effective policies and initiatives to address air pollution. Identifying successful policy interventions and financial mechanisms is crucial for directing decision-makers and urban planners toward more sustainable and environmentally friendly transportation solutions. As a result, the research challenge to be addressed in this study is how to leverage improvements in transport infrastructure quality and the efficient use of green financing methods to reduce air pollution in emerging economies. Understanding the transport infrastructure quality, green financing, and air quality is critical for developing cleaner, healthier, and more sustainable environment in these emerging economies.

Significance of the Study

- An in-depth understanding of how transport infrastructure quality affects air quality in emerging economies.
- Insights into how green finance reduce air quality.
- Recommendations for governments, stakeholders, and investors on how to improve transport infrastructure quality and environmental sustainability.

The importance of this research rests in its ability to persuade policymakers, investors, and stakeholders in order to reduce air pollution and can help emerging economies achieve more sustainable urbanization and economic growth.

Literature Review

Sethi et al. (2024) analyzed the impact of green technological innovation, green financing, renewable energy consumption, institutional quality, and agricultural value added on environmental sustainability by analyzing CO₂ emissions in 25 selected developing countries from 1998 to 2019. Using Driscoll-Kraay and two-step SGMM estimators, the research addresses endogeneity issues within the model. The result showed that while green financing, green technological innovation, and institutional quality tend to increase CO₂ emissions, agricultural value added and renewable energy consumption have a negative effect. Additionally, the interaction between green technological innovation, institutional quality, and green financing shows only a minor and negligible impact on CO₂ emissions. The study initiate that developing nations implement policies that promote investment and innovation in the renewable energy sector to achieve sustainable development goals and effectively reduce carbon emissions.

Bildirici and Çoba (2024) applied the Panel Fourier Bootstrapping ARDL (PFBARDL) model and the Panel Fourier causality test were analyzed to investigate and causal the dynamic relationships among economic growth, urbanization, energy intensity and energy consumption, foreign direct investment (FDI), and PM_{2.5} levels from 1995 to 2019. The PFBARDL results indicated a cointegration among the variables, with an error correction coefficient of -0.169. The analysis demonstrated a bidirectional causal link between economic growth, FDI, and PM_{2.5} emissions, as well as between energy intensity and PM_{2.5} release. The findings suggest that increasing economic development, energy consumption trends, and urbanization could negatively affect PM_{2.5} concentrations.

Subramaniam (2024) analyzed relationship between the green economy and carbon dioxide emissions in European nations through the environmental Kuznets curve (EKC) hypothesis, highlighting a notable gap in existing research. Utilizing the generalized method of moments (GMM), the study evaluates annual data from 2012 to 2020. The results indicate that green economies significantly contribute to reducing carbon emissions and enhancing environmental quality across European countries. This impact remains consistent even when considering the interaction between economic development and the green economy within the EKC framework. Economic growth can lead to decreased carbon emissions, supporting the EKC hypothesis in conjunction with the nation's green economy. Therefore, it is recommended that governments enhance their investments in green economy initiatives to facilitate these outcomes.

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Bakry et al. (2023) analyzed the influence of green finance on environment sustainability in developing economies. This research revealed that carbon dioxide (CO₂) emissions has relation with green finance, GDP, Renewable energy and Urbanization in various specifications using panel (VECM) and panel cointegration analysis in a group of 76 emerging nations from 2010 to 2019. Paper findings suggest the existence of an EKC and the increasing effect of urbanization on CO₂ emissions.

İlbasmiş et al. (2023) examined how green investments influence air quality in both developed and emerging European nations, focusing on their short- and long-term effects. Utilizing the panel (GMM) and panel causality techniques, the findings indicated that, in the short term, green investments negative impact on air quality in both types of countries. However, in developed nations, these investments lead to positive long-term outcomes for air quality. Additionally, the panel causality analysis indicated a reciprocal relation among air quality and green investments.

Dai et al. (2023) assessed the effect of transport renewable energy consumption (TRN) in terms of TCO₂, considering factors such as transport fossil fuel consumption (TTF) and road infrastructure (RF) in the United States from 1970 to 2019, with the aim of suggesting effective mitigation strategies. Additionally, it explored the existence of a transport environmental Kuznets curve (EKC) to analyze transport-related growth dynamics. To assess cointegration, the Bayer-Hanck cointegration test was applied, utilizing four different methodologies, along with the Gradual Shift causality test, which accounts for structural shifts and fractional integration in time series data. Long-term findings from the Dynamic Ordinary Least Squares (DOLS) test, which addresses endogeneity and serial correlation, indicated that TRN both mitigates and Granger-causes CO₂ emissions. The analysis revealed that fossil fuel use in transportation and road infrastructure leads to increased CO₂ emissions. Notably, the transport EKC did not hold in the United States, suggesting that further expansion could have negative environmental consequences. The relationship between TCO₂ and economic growth exhibited a U-shaped pattern, while the Spectral Causality test supported the growth hypothesis regarding the connection between fossil fuel consumption in transportation and economic growth.

Liu and Dong (2021) investigated the relationship among urban traffic development and PM_{2.5} pollution in thirty provinces of China, a prominent emerging economy, from 2007 to 2016. Utilizing threshold regression and geographically temporally weighted regression models, the research explored the nonlinear dynamics and spatial-temporal variations of this relationship. The findings revealed a significant threshold effect, indicating that increases in road area can significantly worsen local PM_{2.5} pollution once a certain limit is exceeded. A similar threshold effect was observed in relation to regional economic growth. Additionally, there was considerable geographic variation in how urban traffic development influenced PM_{2.5} levels across different provinces in China.

Data and Methodology

Data

Using panel data, this paper looks at how the Emerging countries, Transport infrastructure quality, Green Finance, economic growth, renewable, Urbanization and Population all affect the PM2.5 emissions. Employing annual panel data gathered from the World Development Indicators database, IMF and international US Energy Agency Data the paper has data from the years 1998-2023.

Model Specification

Economic Function might be as follows:

$$PM2.5 = f(TCF, CPLP, EPLP, EOEP, RGDP, POP, URB, RENEW, (GDP)^2) \dots\dots \text{Equation 1}$$

PM2.5= Air Pollutant

TCF = Transportation carbon footprints

CPLP = Consumption of petroleum and other liquid products

EPLP = Emission from petroleum and other liquids products

EOEP = Expenditure on Environment Protection

POP = Population

URB = Urbanization

RNE = Renewable energy consumption

GDP = Gross domestic product

(GDP)² = Gross domestic product square

Econometric Function might be as follows:

$$PM2.5_{it} = \alpha + \beta_1 TCF_{it} + \beta_2 CPLP_{it} + \beta_3 EPLP_{it} + \beta_4 EOEP_{it} + \beta_5 GDP_{it} + \beta_6 POP_{it} + \beta_7 URB_{it} + \beta_8 RENEW_{it} + \beta_9 (GDP)_{it}^2 + \mu_{it} \dots\dots\dots \text{equation 1.2}$$

Collection of Data:

Data Years

From 1998 to 2022

Data Collection

- WDI, (World Development Indicator)
- IMF, (International Monetary Fund)
- US, (energy information administration)

Empirical Model

To assess the long- and short-run effects of transport infrastructure quality and green finance on PM2.5 emissions, this study utilizes a panel ARDL model. This model offers several advantages, including robustness in scenarios with limited sample sizes, effectively tackling issues related to nonstationary panel data. Moreover, the ARDL model can be linearly transformed into an error correction model, allowing for the integration of both short- and long-term effects while estimating the relationships between variables simultaneously. According to the panel ARDL model, the dependent variable (y) (PM2.5 emissions) can be measured as follows.

$$y_{it} = \sum_{j=1}^p \lambda_{ij} y_{i,t-j} + \sum_{j=0}^q \delta_{ij}' X_{it-j} + \mu_i + \varepsilon_{it}$$

where $i = 1, 2, \dots, N$ show number of countries; $t = 1, 2, \dots, T$ shows number years; X_{it} represents the explanatory variables, namely, Transport infrastructure Quality, Green finance, GDP per capita, μ_i refers to the fixed effect and λ_{ij} represents the coefficient of the lag dependent variable is scalar. δ_{ij} is vector coefficient and ε_{it} represents error term.

Result and Discussion

Descriptive Statistics

This section analyzes the impact of transport infrastructure quality and green finance on PM2.5 utilizing panel ARDL methods, with PM2.5 designated as the dependent variable. Descriptive statistics and correlation coefficients for the variables are presented in Tables 3 and 4.

Table 4.1

Variable	Obs	Mean	Std. Dev.	Min	Max
PM25	450	3.274	.331	2.436	4.363
TCF	450	3.071	.353	2.009	3.862
CPLP	450	2.411	.23	2.16	3.129
EPLP	450	1.638	.486	1.041	3.129
EOEP	450	1.42	1.409	0	3.172
GDP	450	2.845	.293	0	3.355
RNEW	450	2.146	1.527	-2.303	3.912
POP	450	1.818	.213	0	3.148
URB	450	1.908	.237	0	3.168
(GDP) 2	450	8.18149	1.397419	0	11.25621

Table 4.2: Matrix of Correlation

Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) PM2.5	1.000									
(2) TCF	-0.225	1.000								
(3) CPLP	0.142	-0.273	1.000							
(4) EPLP	0.194	-0.263	0.577	1.000						
(5) EOEP	-0.200	-0.076	-0.042	-0.098	1.000					
(6) GDP	0.178	-0.118	0.113	0.090	0.024	1.000				
(7) RNEW	-0.250	0.279	-0.112	-0.158	0.437	-0.038	1.000			
(8) POP	0.307	0.147	-0.001	0.034	-0.560	-0.027	-0.298	1.000		
(9) URB	0.437	0.035	0.225	0.240	-0.487	0.026	-0.147	0.474	1.000	
(10) (GDP)2	0.195	-0.136	0.140	0.113	0.002	0.675	-0.028	-0.025	0.051	1.000

Table 4 shows the correlation between variables has mix trend of correlation there is weak positive as well as negative and positive correlation among the variables.

Panel Unit Root Test

Table 5 shows the findings of the Im Pesaran Shin and Levin Lin Chu unit root tests for the variables. PM2.5, CPLP, EPLP, and GDP and (GDP)2 were found to be stationary at both the level and first difference, whereas TCF, EOEP, RNEW, POP, and Urbanization were non-stationary at

the level but stationary at the first difference. The stationary tests aimed to make sure there was no integration in second order. among the series. Given the mixed levels of integration across the variables, the panel ARDL approach was employed instead of the conventional static panel model.

Table 4.3: Unit ROOT TEST

Variables	IPS		LLC	
	At Levels (0)	At First Difference (1)	At level (0)	At First Difference (1)
PM2.5	-2.5367***	-6.1733***	-1.6508***	-8.1933***
TCF	-1.6899	-4.9656***	-16.2168***	-13.7103***
CPLP	-4.4889***	-5.3714***	-3.2102***	-3.9202***
EPLP	-3.9146***	-5.3818***	-1.5303***	-1.0203***
EOEP	-1.4826	-3.9470***	-3.6374	-4.3868***
GDP	-5.7411***	-7.7854***	-1.6408***	-4.8097***
RNEW	-0.4390	-2.9163***	-9.6078	-12.0760***
POP	-1.7132	-3.6752***	-0.0021	-4.3055***
URB	-2.3044	-4.1489***	-3.7891***	-3.7768***
(GDP)2	-3.6135***	-2.3742***	-5.1496***	- 2.6813***

Note: Unit Root test estimated by author in Stata. *,**,*** shows the significance at 10%, 5% and 1%.

Panel Cointegration Test:

Before conducting the panel ARDL estimation and panel causality tests, panel cointegration tests were employed to determine whether there is cointegration in the variables. Two tests were utilized for this purpose, and the finding showed that there was cointegration between the variables in the model.

Table 4.4: Cointegration Test

Pedroni		Westerlund	
Statistics	Value	Statistics	Value
v	1.284	Gt	0.032
rho	1.818	Ga	0.002
t	3.583	Pt	0.005
adf	1.604	Pa	0.022

Panel ARDL Estimation

Table 7 presents the results of the Hausman test were used for comparison of the PMG and MG models, where the p-value (indicated in parentheses) was 0.0248, falling below the 0.05 threshold. This led to the rejection of the null hypothesis is that PMG is more effective, indicating that MG provides a more effective estimation than PMG. In the second Hausman test, which compared PMG with DFE, the p-value was 0.000, suggesting that DFE is a superior estimation compared to PMG.

Table 4.5: Panel ARDL Estimation (1, 1, 1, 1, 1, 1, 1, 1, 1, 1)

DPM2.5	PMG		MG		DFE	
	Coefficient	St. Error	Coefficient	St. Error	Coefficient	St. Error
LR						
TCF	0.103**	0.057	-0.850***	0.476	0.100**	0.098
CPLP	1.763*	0.892	-2.599***	0.722	0.043**	0.647
EPLP	0.881**	0.424	8.742	0.524	0.021**	0.798
EOEP	0.041**	0.012	0.170*	0.206	- 0.037***	0.022
GDP	0.579***	0.085	-0.955***	0.576	-0.279***	0.120
RNEW	-0.450***	0.066	-0.354*	0.259	-0.224***	0.081
POP	0.450**	0.352	-1.318**	0.121	0.104*	0.611
URB	-0.036***	0.306	1.279	0.693	0.254*	0.590
(GDP)2	-0.169***	0.038	-0.169***	0.038	-0.295***	0.121
SR						
ECT	-0.423**	0.059	-1.012**	0.100	-0.480***	0.044
TCF	-0.253*	0.155	0.336***	0.621	0.029**	0.076
CPLP	0.616	1.603	0.784*	0.002	0.288**	0.542
EPLP	-0.258***	0.777	-1.896*	0.932	0.619**	0.741
EOEP	0.005	0.031	-0.213**	0.196	-0.017***	0.013
GDP	0.214 **	0.181	0.465	0.289	0.007***	0.038
RNEW	0.184*	0.082*	0.666**	0.559	- 0.095*	0.056
POP	-9.466	0.239	0.302***	0.673	0.469	0.525
URB	1.200	0.586	-20.62	0.752	0.426*	0.523
GDP)2	-0.099***	0.070	-0.063***	0.107	-1.000**	0.005
C	1.294*	0.213	0.217*	0.120	1.594*	0.339

Hausman test

PMG, MG >> MG	5.541 (0.0248)
PMG, DFE >> DFE	37.211 (0.0000)
MG, DFE >> DFE	0.532 (0.6193)

Given the null hypothesis that PMG is more suitable. In other Hausman test, which assessed MG against DFE, the p-value was 0.6138, resulting in the failure to reject the null hypothesis. This indicates that DFE is indeed a more accurate estimation than MG, based on the premise that DFE is more effective. Therefore, DFE stands out as the best estimation among the three models. Additionally, the error correction term (ECT), which reflects the speed of convergence to equilibrium, was significant at the five percent level, signifying long-run cointegration between the panel's variables, with variations from the long-run equilibrium being measured at a rate of 4.80%. The DFE estimation imposes constraints on the coefficients of the cointegrating vector, requiring them to be uniform in the panels. It also mandates that the speed of adjustment coefficients and the short-run coefficients remain the same in countries. In the long term, TCF is positive in the long run and in the short run also positive. SO, it means when TCF increase it has negative impact on pm2.5. PM2.5 concentration also increase in the long run as well as in the short run. CPLP and EPLP also is positive in the long run and in the short run so both these variables have negative impact on pm2.5 it will increase the PM2.5 level in air pollution in the long run and short run. So, consumption of petroleum and other liquid products increase it will worsen the air quality EOEP and RNEW is negative in the long and short so it means both have positive influence when they increase on the PM2.5 level if they increase pm2.5 level will decrease, GDP had positive value in short run and in the long run. SO, it prove the hypothesis of EKC theory at first when GDP increase it worsens the air quality but in the long run it have negative impact on air quality. At first Emerging economies focus on their boost in economy not in infrastructure and air quality. But when their GDP increase in the long term they pay attention to air quality. POP and URB also has positive value in the long term and in the short term their is negative value. So, in short, they do not influence air quality but in the long run they impact pm2.5 level in the air in short run when they increase pm2.5 level will also increase and worsen the air quality.

Panel Granger Causality Test:

To check the causality of dependent variable and independent variable, Dumitrescu and Hurlin (2012) Granger's non-causality test was use that is shown in table 4.6 in panel data. There is bidirectional causality between the variables so we rejected the Null hypothesis because p value is less than 0.05 so there is causality in the variables.

Table 4.6 Dumitrescu & Hurlin (2012) Granger non-causality test results:

Null Hypothesis	Statistics	P value
PM2.5 does not Granger-cause TCF	W-bar = 2.0828	
	Z-bar = 3.2485	0.0212
	Z-bar tilde = 2.4463	0.0144
TCF does not Granger-cause PM2.5	W-bar = 0.7959	
	Z-bar = -0.6122	0.054
	Z-bar tilde = -0.7741	0.038
PM25 does not Granger-cause CPLP	W-bar = 0.0169	
	Z-bar = -2.9492	0.0232
	Z-bar tilde = -2.7235	0.0465
CPLP does not Granger-cause PM25	W-bar = 0.6159	
	Z-bar = -1.1522	0.049
	Z-bar tilde = -1.2246	0.020
PM25 does not Granger-cause EPLP	W-bar = 0.0201	
	Z-bar = -2.9397	0.033
	Z-bar tilde = -2.7156	0.016
EPLP does not Granger-cause PM25	W-bar = 0.5630	

	Z-bar =	-1.3111	0.019
	Z-bar tilde =	-1.3571	0.004
PM25 does not Granger-cause EOEP	W-bar =	2.7238	
	Z-bar =	5.1714	0.010
	Z-bar tilde =	4.0503	0.043
EOEP does not Granger-cause PM25	W-bar =	0.8856	
	Z-bar =	-0.3433	0.031
	Z-bar tilde =	-0.5498	0.002
PM25 does not Granger-cause GDP growth	W-bar =	1.7832	
	Z-bar =	2.3496	0.018
	Z-bar tilde =	1.6965	0.089
GDP growth does not Granger-cause PM25	W-bar =	0.6504	
	Z-bar =	-1.0488	0.051
	Z-bar tilde =	-1.1383	0.055
PM25 does not Granger-cause RNEW	W-bar =	1.3000	
	Z-bar =	0.9001	0.308
	Z-bar tilde =	0.4874	0.226
RNEW does not Granger-cause PM25	W-bar =	0.9341	
	Z-bar =	-0.1978	0.043
	Z-bar tilde =	-0.4284	0.038
PM25 does not Granger-cause POP	W-bar =	1.3086	
	Z-bar =	0.9259	0.004
	Z-bar tilde =	0.5089	0.010
POP does not Granger-cause PM25	W-bar =	1.3502	
	Z-bar =	1.0506	0.293
	Z-bar tilde =	0.6129	0.039
PM25 does not Granger-cause URB	W-bar =	1.3421	
	Z-bar =	1.0264	0.004
	Z-bar tilde =	0.5927	0.053
URB does not Granger-cause PM25	W-bar =	0.7770	
	Z-bar =	-0.6689	0.003
	Z-bar tilde =	-0.8214	0.011
PM2.5 does not Granger cause (GDP)2	W-bar =	1.5759	
	Z-bar =	1.7278	0.040
	Z-bar tilde =	1.1778	0.023
(GDP)2 does not Granger cause PM2.5	W-bar =	0.6722	
	Z-bar =	0.9834	0.054
	Z-bar tilde =	1.0837	0.05

Conclusions

This paper examines the effects of Transport infrastructure, Green finance, GDP growth Population, Renewable energy and Urbanization on PM2.5 emissions in Emerging nations. We utilized the panel Auto Regressive Distributed Lag Model, DFE technique as an economic instrument, including yearly panel data for emerging nations from 1998 to 2022. The basic purpose is to investigate the effect of transportation infrastructure, green financing, GDP growth, renewable energy, population, and urbanization on PM2.5 emissions. Initially to test the panel data stationarity tests (Livin Lin Chu and IPS) was used to confirm if the variables chosen are stationary on level or first difference. Depending on the findings of the stationarity tests, the variables in this research are stable at the level of first difference, indicating that Panel ARDL is

acceptable for use in our analysis. Following that, panel cointegration tests are used to confirm the cointegrated link between variables. Panel cointegration testing shows that there is cointegration. After assessing cointegration and stationarity, the Hausman test is used to determine which technique from the panel ARDL, namely PMG, MG, and DFE, is most suited for the purpose of our study. The findings of the Hausman test show that DFE is more suited than the other two. In this work, the DFE approach is used to investigate the impact of IV on DV. Empirical results of the paper indicate that transportation infrastructure, green financing, GDP growth, renewable energy, population, and urbanization all have a long- and short-term association with the release of PM_{2.5} in emerging economies. Findings revealed that transport infrastructure quality significantly deteriorates air quality, while green finance initiatives improve it. Specifically, CO₂ emissions from transport, consumption of petroleum and emissions from petroleum and other liquid fuels worsen the PM_{2.5} levels, whereas renewable energy consumption mitigates air pollution. Urbanization and population also contribute to worsen air quality. When GDP increases, PM_{2.5} level will also increase emissions in short term and long term. (GDP)² has positive impact in long run and short run so, it gradually decreases PM_{2.5} level in long run. THE EKC hypothesis is validated, indicating an inverted U-shaped relationship because GDP and (GDP)² has inverse relationship. Green Finance has positive impact in long run. Transport Infrastructure Quality is not good in Emerging economies so due to this air quality is worsening in emerging economies. We should encourage government to improve Transport Infrastructure Quality to reduce PM_{2.5} level and promote the use of electric vehicles instead of combustion engines and environmentally friendly policies to improve air quality and public health. Governments should invest more to reduce air pollution and promote renewable energy consumption to reduce dependence on fossil fuels.

Practical & Academics Contributions

- This research helped us to understand how the transport Infrastructure quality, green finance and air quality are interrelated in emerging economies.
- This document will Provide a complete picture of air quality problems and their sources in rapidly growing economies.
- Added clarity to the literature by empirically establishing the influence of transport density on air quality.
- Evaluated success of green finance is promoting Air quality an important issue that is sometimes overlooked.
- Provide evidence-based policy proposals to stakeholders to help them improve air quality and urban growth.
- In conclusion this study adds to knowledge and informs approaches to addressing major environmental issues in emerging economies.

Policy Recommendations

- Emerging economies should promote Investments in Transportation Infrastructure and prioritize electric vehicles and public Transportation system.
- Governments should promote renewable energy consumption and reduce dependence on fossil fuels.
- Implementing Sustainable urban planning strategies that mitigate air pollution.

Economic growth should be balanced with environmental considerations to avoid environmental degradation.

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