



# The influence of electricity production, permanent cropland, high technology exports, and health expenditures on air pollution in Latin America and the Caribbean Countries



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## ARTICLE INFO

### Keywords:

Electricity production  
High technology exports  
Health expenditures  
Carbon dioxide emission  
Panel techniques  
Latin America and the Caribbean countries

## ABSTRACT

The objective of the study is to examine the dynamic linkages among electricity production from renewable sources, permanent cropland, high technology exports, health expenditures, and carbon dioxide (CO<sub>2</sub>) emissions in the panel of 14 selected Latin America and the Caribbean countries, over the period of 1980–2013. The study employed panel unit root test, panel cointegration, panel least square, panel fixed effect model, panel random effect model, and panel two stage least square (2SLS) instrumental variables technique for robust inferences. The results confirmed the long-run relationship between the variables. The panel results indicate the effectiveness of high-technology exports that decreases the CO<sub>2</sub> emissions, while electricity production, permanent cropland and health expenditures increase CO<sub>2</sub> emissions, which deteriorates the environment. The study concludes with the support of long-term sustainable policies, which is imperative for sound growth in a panel of countries.

## 1. Introduction

Environment and air pollution are the two major challenges that globally recognized to control by sustainable consumption and production. The Latin America and the Caribbean countries are no exception that severally affected by air pollution and environmental hazards, however, these countries strive hard to follow the principles of ‘green growth’ to foster economic growth, agricultural value added, green infrastructure and cheap renewable energy sources. IDB [15] report indicates the vulnerable situation related with air pollution hazards in Latin American and Caribbean countries where around 100 million people are exposed to air pollution levels exceeding the suggested guideline of World Health Organization (WHO). IDB [16] discussed the environment report for this region and emphasized the need of climate protection policy by sustainable policy instruments to manage the economic and natural resources, and protects the natural habitats and ecosystem. Climate Policy Observer [6] report shows the greater tendency to address climate change issues in the Latin America and Caribbean countries, which is one of the recent commitment been made in the 20th forum of the environmental ministries in this region that held in March 2016. This region strives hard to maintain the environmental issues by regional climate cooperation among the

member countries and give weight to the national priorities. The region further protected the biodiversity and ecosystem, optimizing the resources to manage chemical and waste, and reinforce the sustainable production and consumption patterns, which in line with the regional 2030 vision of sustainable development.

There are number of studies presented about the environmental hazards and air pollution in developed and developing countries. This study strives to quest for the relationship between air pollution and the number of environmental factors in the panel of Latin America and the Caribbean countries. Some notable studies indicate the environment-pollution nexus across the globe i.e., Torras and Boyce [40] concluded that education, political stability and civil reforms are the strong predictors to affect environmental quality in the low income countries. McLeod et al. [26] examined the relationship between air pollution and economic factors in England and Wales. The results confirmed the strong nexus between pollution and growth factors including ethnicity and population density, however, exposure of air pollution with growth factors varied across the regions. Welsch [43] examined the inter-relationship between air pollution and happiness in the 10 European countries and found that air pollution is accountable to create differences among inter-country and inter-temporal in subjective well-being. According to D’Amato et al. [7, p. 17]

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*“Due to climate change, air pollution patterns are changing in several urbanized areas of the world with a significant effect on respiratory health. The underlying mechanisms of all these interactions are not well known yet”.*

Khan et al. [19] investigated the association between greenhouse gas (GHG) emissions and energy demand across the globe, over the period of 1975–2011. The results confirmed the energy conservation hypothesis i.e., there is unidirectional causality running from energy to GHG emissions but not vice versa. Huang et al. [14] discussed the importance of home based energy system which saved the energy costs, therefore, the smart grid is one of the improved option for managing the demand response of the customers. Brei et al. [5] investigated the impact of air pollution on biodiversity in the Caribbean. The results found that cost of environmental pollution was associated with species extinction in the region. Salvo et al. [37] identified potential challenges to conducting high quality physical activity and build environment in Latin America. The study is focused on the challenges to carry out research on physical activity and built environment research. According to De Andrade et al. [8, p. 1]

*“Many Latin American countries have introduced public policies that integrate health, social, and economic actions, and have sought to develop health systems that incorporate multisectoral interventions when introducing universal health coverage to improve health and its upstream determinants”.*

Miyama and Managi [28] forecast the inter-temporal relationship between CO<sub>2</sub> emissions and global emissions trend and found that East Asia and South Asia is the major contributor of global emissions. Al Mamun et al. [1] examined the relationship between economic growth and CO<sub>2</sub> emissions across the globe, by using the data from 1980 to 2009. The results confirmed the environmental Kuznets curve (EKC) except high income countries, where the relationship is no longer supported the EKC hypothesis in the region. Ozturk [29] investigated the long-run association between energy demand, air pollutants and GHG emissions in six UNFCC classified countries, during the period of 1990–2012. The results show that energy demand, CO<sub>2</sub> emissions, methane emissions and nitrous oxide emission increases GHG emissions in the region. Ozturk [30] further examined the possible relationship between biofuel energy, air pollution, energy efficiency, renewable energy and population growth across developed and developing countries, by using the annual time series data of 2000–2012. The results show that air pollution, energy efficiency and renewable energy generation were significantly associated with the increase biofuels production, while population growth decreased biofuels production in the region. Qureshi et al. [36] emphasized the need of sustainable natural environment which is associated with the sound health in Asian countries. The results conclude that environmental factors significantly associated with the per capita health expenditures in selected Asian countries. Wei et al. [42] examined the energy embodied carbon emissions generated by Beijing industries, during the period of 2000–2010 and found the following key players, which are the serious threat to the Chinese sustainable agenda including mining and construction industries, energy sector, and water, while economic restructuring and rapid economic growth further contributed to escalates carbon emissions in a country. Asumadu-Sarkodie and Owusu [3] considered the case study of Ghana and examined the impact of energy, income, and population on carbon emissions for the period of 1971–2013 and supported the energy led emissions and income led emissions, while population growth is significantly associated with higher carbon emissions in a country. Asumadu-Sarkodie and Owusu [4] further added carbon emissions in agricultural ecosystem in the context of Ghana and found that area of rice paddy harvested, biomass burned crops residues, and cereal production increases carbon emissions, while agricultural machinery as a source of agricultural input substantially decline carbon emissions in the long-

run. Qureshi et al. [34] investigated the impact of energy demand and air pollutants on Pakistan's agricultural production and found that GHG emissions deteriorates the production of rice, cotton, and wheat, while energy demand substantially increases agricultural production in a country. Gao et al. [10] concluded that energy efficiency will played an enormous role to reduce carbon emissions in China, while economic restructuring does not have any visible sign to lessen carbon emissions that would helpful to achieve sustainable policy agenda in a country. The study suggested the need of dual action plans regarding increasing energy efficiency and stabilizes economic restructuring to reduce global emissions. Al-mulali et al. [2] investigated the causal relationships between agricultural investment, agricultural value added, and GHG emissions and confirmed the growth led investment in agriculture sector, while the feedback relationship was found in between GHG emissions and agricultural output across countries. Lee et al. [21] provided the list of key factors that will helpful to address the climatic variations in Asia, i.e., improvement in the energy efficiency system, green vehicles, cleaner production technologies; improvement in water resources, energy conservation, etc., all these factors will facilitate to support the sustainable growth agenda in a region. Khan et al. [20] emphasized the need of green policy agenda that provoked the sustainability in the energy-resource depletion model, climate change model, and health based resource model for broad-based growth.

The above studies strongly indicate the need for further exploration in environment-pollution nexus, therefore, the present study explores this relationship in a some new innovative ways i.e., this is the first ever study, as authors' knowledge, to quest for environmental factors and air pollution in panel of Latin America and the Caribbean countries by handling the sophisticated annual data of respective countries. Further, the study used number of panel techniques to confirm the results for generalization. Finally, this study does not examine the environmental Kuznets curve (EKC) hypothesis; as many previous studies investigated the EKC hypothesis on the study region, therefore, this study directly explore the impact of electricity production from renewable sources, permanent crop land, high technology exports, and health expenditures on CO<sub>2</sub> emissions that filled the existing gap in the literature review by including national scale indicators in sustainable environmental agenda across countries. The more specific objectives are:

- i) To examine the long-run relationships among energy demand, permanent cropland, high-technology exports, health expenditures and carbon emissions in a panel of selected Latin America and the Caribbean countries, and
- ii) To estimate whether this relationship is apparently influenced by country specific effects/time specific shocks or both?

## 2. Data source and methodology

The data for environmental variables includes electricity production from renewable sources (kWh), permanent cropland (% of land area), health expenditure per capita (current US\$), and high-technology exports (current US\$), whereas, the data for CO<sub>2</sub> emissions from transport (% of total fuel combustion) is taken from World Development Indicators published by World Bank [45]. The study used interpolation technique to fill the gap between the variables series where required. The air pollution variable is served as a “response” variable and environmental factors are served as “regressors” for the study. The study used panel data of 14 Latin America and the Caribbean (LCA) countries namely Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Jamaica, Mexico, Panama, Paraguay, Peru, Uruguay, and Venezuela, for the period of 1980–2013. The study estimated the following non-linear regression equation to explore the relationship between environmental factors and air pollution in LCA countries, i.e.,

$$\ln(AIRPOL)_{it} = \beta_0 + \beta_1(ENVIR)_{it} + \varepsilon_{it} \quad (1)$$

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