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Role of EKC and PHH in Determining Environment Quality and their Relation to Economic Growth of a Country

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Abstract

Globalization, liberalization of international trade and recent economic developments have resulted in widespread pollution and therefore degrading environment quality in many countries over the world. This study tries to examine the role of Environmental Kuznets Curve (EKC) and Pollution Haven Hypothesis (PHH) in shaping the relationship between environmental quality and the economic growth of a country. To this end, a comparative overview of developing and developed countries across the world have been evaluated for their economic growth and the resultant impact on environmental quality, and their use of EKC and PHH to determine it. Descriptive analysis is used in the estimation. Results have shown that no clear conclusion can be determined as the role of EKC and PHH varies across economies, however both the theories are evident more in case of developing countries. The environmental quality depends on whether the country is developed or developing along with the imposition of stringent regulations as well as the propensity to act on the regulations effectively.

Contents

1. Introduction

An inverted U-shaped relationship between environmental quality and per capita income, commonly known as Environmental Kuznets Curve (EKC) and Pollution Haven Hypothesis (PHH) have gained much attention in the past due to its crucial role in determining environmental quality (Dietzenbacher and Mukhopadhyay, 2007; Antonio, 2013). The quality of the environment initially worsens with the economic development or growth and increases at the later stage due to increase in income levels and firms tend to use more environment friendly technologies. However, evidences have shown that inverted U-shaped phenomenon is not true when applied universally and N-shaped and constantly increasing EKC scenarios also prevailed (Dinda, 2004). The developing economies lack proper environmental regulations which attract huge foreign investments in setting up of polluting industries. As a result, the developed countries may rely on developing countries to supply them pollution intensive goods. The growth of international trade lead to increase in pollution as the country ultimately leading to the occurrence of Pollution Haven hypothesis (Antonio, 2013). So, in case PHH holds true, then EKC implies a shift of pollution from developed to developing economies rather than reducing the overall pollution level (Cole, 2004). Such trade patterns are generated by PHH while EKC explains the reason of reduction in pollution in high income economies.

With the advent of Liberalization, Privatization and Globalization (LPG), most countries of the world have witnessed an overall economic growth but this growth comes at a cost i.e. increased pollution deteriorating environmental quality. According to the report published by World Health Organization (2016) people living in low-income cities are more prone to rising pollution and more than 80% of the people in urban areas are exposed to air quality that exceeds the WHO limit. During 2008-2013, overall global urban emissions increased by 8%, mostly affecting developing economies. The American economy has shown a different scenario where air quality has improved with the growth in the economy reducing the concentration level of major air pollutions. With the increase in income levels, people are increasingly concerned about the environmental issues, thus improving the air quality of a handful of countries like the USA (Environmental Protection Agency (EPA), 2016). Developing economies lack proper environment protection rules and regulations which result in huge pollution levels. Unregulated industries and rapid industrialization has increased the exploitation of natural resources. For example, India has to bear $80 billion a year pollution and environmental degradation cost attributed to contaminated water and hazardous air quality (NDTV, 2013). So, industrial growth is resulting in environmental quality degradation.

The contribution of this study lies in studying the role of Environmental Kuznets Curve and Pollution Haven Hypothesis (PHH) by empirically analyzing the contributions made by various researches till date. The research also tries to establish the link between the economic growth and quality by citing examples of various nations, developing and developed.

1.1. Aims and Objective of the Study

The aim of the study is to identify the role of Environmental Kuznets Curve (EKC) and Pollution Haven Hypothesis (PHH) in determining environment quality and their relation to investment or economic growth of a country. To this end, countries under 'developing' and 'developed' categories have been considered with various 'growth' parameters such as GDP (Gross Domestic Product), FDI (Foreign Direct Investment), per capita income, etc.

2. Literature Review
2.1. Pollution Haven Hypothesis

The pollution haven hypothesis was first proposed and identified by Copeland and Tylor in 1994 and argued that with increase in the trade liberalization the pollutant industries will move to the poor countries which have less regulated environment policy from the rich countries. According to the pollution haven hypothesis the inflow of the foreign direct investment will increase in those countries where the rules and regulation related to environmental are more liberal. Eskeland and Harrison (2003) defines pollution haven hypothesis as : " *pollution haven hypothesis is, perhaps, best seen as a corollary to the theory of comparative advantage, as pollution control costs begins to matter for some industries in some countries , other countries should gain comparatively advantages in those industries , if pollution control costs are lower there (for whatever reason)"* (Eskeland and Harrison, 2003).

According to the study of Aliyu (2005) the pollution haven hypothesis has three main dimensions. Relocation of the pollution industries to the developing countries from the developed countries is the first one and the increasing in the globalization has help to move the polluting industries to the poor countries. The second dimension of the pollution haven hypothesis is related to the dumping of the hazardous and perilous products generated during the production process in the poorer countries. The last dimension is related the exploitation of the non- renewal resources from the developing countries which can have impact on the sustainable development agenda of the developed countries

2.2. Environmental Kuznets Curve

In recent years, the Environmental Kuznets Curve (EKC) hypothesis has received much attention and consideration in the environmental economics literature. The literature in 1995 builds on the seminal article by Kuznets in which he derived a hump-shaped relationship between per capita income and pollution in 1965. The hypothesis of the Environmental Kuznets Curve contends that as an economy develops, environmental problems will get more serious initially, but will decline eventually.

It has been observed that for high incomes the relationship between pollution and income is positive again, or maybe even that the environmental Kuznets curve is U-shaped. One underlying idea is the following. Environmental deterioration can be split and divided into two parts: pollution and the reduction of natural resources (land, forest, grass and mineral resources). The U-curve reflects the fact that environmental degradation in underdeveloped

countries is related to population pressure, extensive production modes, and the overexploitation and overusing of natural resources.

Similarly arguments have been put forward that, as people become wealthier, they tend to push for stricter Environmental policies, this may give rise to a relationship between per capita income and emissions along the effects of per capita income on, for example, taxes on pollution or environmental standards. Third, one has to consider the *structural* effect. A typical time path of the sectorial composition of an economy is one in which countries are initially characterized by a large agricultural sector, followed by a period of industrialization and subsequently followed by de-industrialization and a rising service sector

3. Discussion

Cole (2004) examined the linkages between trade, EKC and PHH. According to the researcher, pollution havens are limited and are confined to certain sectors and regions. Trade openness has negatively impacted the air quality because of the ease in getting "greener" production technologies. Similarly research conducted by Poon *et al.* (2006) examines the relationship between China's economic development and its environment by modeling the effects of energy, transport, and trade on local air pollution emissions using the Environmental Kuznets model. The findings showed that soot levels have not declined with increase in income because of lack of government policies whereas SO_2 levels have decreased due to adoption of cleaner technologies and stringent regulations on polluting industries.

Kubatko (2008) studied the impact of per capita income on the pollution levels using the EKC model in Ukraine. The dependent variables considered in the study were concentration of pollution and emissions and per capita income, atmospheric precipitation, wind speed, average temperatures and % of precipitations as the independent variables. The author applied model of EKC using pooled data. He concluded an inverted U-shaped relationship between pollution and income, suggesting that Ukraine follows the EKC for certain pollutants only. There is an increase in pollution levels of dust and carbon dioxide in Ukraine.

Jula (2015) studied the impact of long term impact of economic growth (using GDP) on CO_2 emissions of Romania during the period 1960-2010 and did not use any other variables and used the NG-Perron test with optimal point. They found a significant relationship between the two variables in the form of an N-shaped curve, supporting the EKC theory for Romania.

He *et al.* (2009) investigated the applicability of the EKC theory for studying the impact of economic growth (using GDP as indicator) on CO_2 emissions of Canada. They studied the CO_2 emissions and GDP data of Canada for the period 1948-2004 using time series method. Cubic parametric model of EKC was applied to this effect, and the results showed limited presence of the inverted U-shaped curve between GDP and CO2, following which they applied more flexible methods such as Hamilton's model. This test too showed similar results, i.e. no presence of Kuznets curve.

Rashid (2009) tested the relationship between CO_2 emissions and GDP growth in USA and the BRIC nations for the period 1981-2006. While the author finds mixed but probable evidence of the existence of a Kuznets curve in USA, the evidence was strong in case of BRIC. However he also found a contradicting result in the analysis, i.e. the threshold for improvement in air quality was higher in case of the USA as compared to BRIC. The author also found evident presence of PHH in case of BRIC countries where investment was increasing rapidly since they are developing countries, thus enjoying the benefits of cheaper labor.

Recent study by Apergis and Ozturk (2015) test the Environmental Kuznets Curve over a period 1990-2011 for 14 Asian Economies. Another study by Al-mulali (2015) examined the EKC hypothesis for ninety-three countries using ecological footprints as an indicator of environmental degradation. The findings of both the research show that EKC model is not true for low and middle income countries as they are in the initial stage of development and is relevant only for high-income economies.

In the table below, a brief overview of recent studies conducted on the applicability of the Kuznets curve in various countries and regions in provided. The findings of each of the studies indicate that while the curve is definitely present in case of developing countries, especially those which are becoming a global hub for production such as Mexico, India, China and Brazil, the curve is not so evident in developed economies such as USA and Canada.

As it can be seen in the table above, most studies have confirmed the validity of EKC in their respective study regions. Only in case of He *et al.* (2009)'s study, the EKC was not evident in Canada.

On the other hand, the Pollution Haven Hypothesis (PHH) too has been studied extensively by many researchers, in some cases together with EKC. As mentioned before, the PHH postulates that so called 'dirty goods' will be moved to poor countries for manufacturing purpose, because of the lack of environmental regulations in these countries, whereas the 'clean goods' will remain in developed countries. Therefore most studies on PHH take into consideration only developing countries from Asia Africa and South America.

Pollution haven hypothesis has also comes under criticism because of lacking credible and use of traditional instrumental variables (Taylor, 2005; Millimet and Roy, 2011). Doytch and Uctum (2011) examine the impact of globalization and sectorial foreign direct investment (FDI) on the environment conducting a multi country analysis from 1970 – 2000. The main findings and results of the study were that the inflow of FDI in manufacturing sector shows the evidence for the pollution haven hypothesis while the inflow of FDI in service sector supports the halo effect hypothesis. Similarly the inflow of FDI in the poor countries shows more harmful effect on the environment as compared to rich countries.

Dietzenbacher and Mukhopadhyay (2007) conducted empirical analysis of pollution haven hypothesis for India taking into account Heckscher-Ohlin Theory. The findings of the research showed that India is no longer a pollution haven and has gained from international trade. According to HO theory, it will be in the interest of capital abundant country to produce pollution intensive goods. Since Indian economy is labor abundant, the pollution haven hypothesis did not apply.

Table-1. Recent studies conducted on Kuznets curve Theory

Author name and Year	Country/ Region	Emissions or concentrations	Aim and methodology	Variables	Time period	Findings
Taguchi (2012)	East and South-East Asian economies (19 countries)	Emissions		GDP (independent); carbon and sulphur (dependent)	1950-2009	Definitive presence of Kuznets curve regarding sulphur emissions
Sayed and Sek (2013)	40 countries (developed and developing)	Emissions	To detect the existence of EKC using 5 pollutants (CO2, sulphur, GHG, SPM10 and BOD) by applying panel data analysis; using Hausman test and redundant tests	GDP (independent); CO2, sulphur, GHG, SPM10 and BOD (dependent)	1961-2009	Presence of EKC in developed countries for CO2 and BOD; while it is SO2 in case of developing
Figueroa and Pastén (2009)	73 high and low income countries	Emissions	To estimate EKC to analyze the relationship between income and pollution. Random Coefficient Model was used to test EKC hypothesis for each country	Pollution (dependent) and income (independent)	1960-1990	EKC hypothesis is strongly present in case of high-income countries.
Lipford and Yandle (2014)	Mexico	Emissions	Examining the effect of economic growth on Mexico's environmental quality for pre- and post- NAFTA period	CO2 (dependent); RGDP per capital (independent)	1950-2004	Kuznets curve is present in pre and post-NAFTA period, but the emissions are growing at a slower pace after NAFTA
Sunday (2015)	Sub-Saharan African region	Emissions	The paper examines the presence of EKC for SSAR using panel data analysis.	GDP (independent); CO2, CLQ, CSF, CIN (independent variables)	1980-2012	Different pollutants produce different EKC results.
Bibi (2014)	Pakistan	Emissions	To find out the presence of EKC in Pakistan using ARDL model	GDP (independent); CO2 per capita (dependent)	1972-2011	The EKC is valid in case of Pakistan with tipping point of EKC at 338.34
Lim (1997)	South Korea	Emissions	To explore the presence of EKC in South Korea	GDP (independent); SO2, NO2, TSP, BOD (dependent)	1960-1995	Inverted U-shape curve, i.e. EKC. while CO2 emission and deforestation have worsened, SP2, O2, TSP and BOD have improved with economic growth
Ivanova and Vertkina (2015)	Russia	Emissions	To assess the impact of economic growth on environmental degradation and to check the validity of EKC in Russia using OLS estimates.	Average monthly wages (independent); air pollution (dependent)	2011	EKC is present in case of Russia

Given below is a table on various authors who have empirically studied the PHH in the context of developing and developed economies throughout the world to determine if the hypothesis is applicable or not.

Thus, it can be seen from the above table that all the studies validate the presence of PHH in case of developing countries. However, contrary to studies reviewed in the literature, PHH is also evident in case of semi-developed countries in Europe, establishing the fact that any country with growing manufacturing activities is likely to witness a rise in dirty emissions.

Table-2. Recent studies conducted on Pollution heaven hypothesis

Author name and Year	Country/ Region	Aim and methodology	Variables	Time period	Findings
Kheder and Zugravu (2008)	Central & Eastern Europe; emerging and developed countries in OECD	To study the presence of PHH comparatively in developed & developing economies in Europe	TFP, Corruption, Political Stability, Market Potential (dependent variables); air pollution (independent variable)	1996-2002	PHH is present in the strongest manner in emerging countries. FDI inflow in emerging countries is more due laxity rather than severity of regulations.
Aliyu (2005)	14 developing countries	To detect the impact of environmental policy on location of production for the outflow of FDI into "dirty goods".	Environmental tax (independent) Carbon emissions (dependent)	1990-2000	FDI is responsible for the growth in pollution levels i.e. CO_2 emissions in a number of developing countries, validating the presence of PHH.
Mukhopadhyay (2006)	Thailand	To test the validity of PHH and Factor Endowment Hypothesis (FEH) in the case of Thailand.	Carbon Emissions (dependent); consumption, trade with OECD, import-export price indexes, exchange rate, labor and capital stock, FDI (independent)	1980, 1990 and 2000	PHH matters for Thailand but FEH does not with FDI being one of the major contributors to this occurrence.
Wu (2013)	European Union	To examine the presence of PHH in European Union caused by the EU Trading Scheme using cross section and cross-time bilateral trade flow data	CO_2 (dependent); import-export (independent)	2000-2011	PHH is present in case of middle and upper middle income counties.
Akbostanci et al. (2004)	Turkey	To validate the presence of PHH in case of Turkey using panel data approach.	Total manufacturing activity (independent); industrial waste output dependent	1994-1997	the demand for Turkish products too increased, validating the presence of PHH in Turkey

4. Conclusion

In this study, the research has addressed the problem of the environmental Kuznets curve and pollution haven hypothesis in determining the environmental quality. The empirical studies show that pollution haven holds true in case of developing economies due to transfer of pollution intensive industries from developed to developing countries. Developing countries are becoming pollution havens because of imposition of less stringent regulations. However, these economies have lower standards because of high costs involved in imposing pollution standards. Next, these economies lack trained personnel to impose such standards. Corruption is deeply rooted in such economies which again possess the problem. Finally, the pollution intensity increases due to the shift from agricultural to manufacturing sector on account of rapid urbanization and population growth. Environmental Kuznets model when applied globally show evidences that only high-income countries have benefitted from increase in economic standards resulting in better environment standards. Other middle and low income economies are still in the clutches of poor air quality affecting the lives of millions of people.

The research finds that many developing economies like China, India and Brazil do not follow the principles of Environment Kuznets Curve hypothesis (EKC) and have become a pollution haven due to its high carbon dioxide emissions. India has moved away from being pollution haven because of the comparative advantage in the production of labor intensive goods. The economy of United States has been benefitted with the rise in per capita income. With the growth in technology and standard of living, people become more focused on environmental problems which helped U.S. in achieving better environmental quality along with economic growth. The Turkish economy is also benefitted from rising income levels and its environmental quality has improved in recent past. To conclude, the validity of EKC hypothesis increases with increase in income levels, as seen in case of high income economies. Low income economies are still not able to adopt cleaner technologies and renewable resources because of huge costs involved in such applications.

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