



The linkages between deforestation, energy and growth for environmental degradation in Pakistan



Khalid Ahmed^{*}, Muhammad Shahbaz, Ahmer Qasim, Wei Long

^a Sukkur Institute of Business Administration, Sukkur 65200, Pakistan

^b Department of Management Sciences, COMSATS Institute of Information Technology, Lahore, Pakistan

^c Shaheed Benazir Bhutto University, Department of Business Administration, Lyari, Pakistan

^d School of Economics Wuhan University of Technology, Wuhan 430070, PR China

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ABSTRACT

This study explores the validation of the Environmental Kuznets Curve (EKC) hypothesis for Pakistan using time series data from 1980–2013 with deforestation as an indicator (dependent variable) for environmental degradation, and four independent variables (economic growth, energy consumption, trade openness, and population) were also examined. The Autoregressive Distributed Lag (ARDL) bounds testing approach to cointegration and the VECM–Granger causality test were applied. The results confirmed the existence of cointegration among the variables both in long- and short-run paths. However, the diminishing negative impact of economic growth on deforestation in the long-run confirms the EKC hypothesis for deforestation in Pakistan. Moreover, economic growth and energy consumption Granger cause deforestation. A bidirectional causal effect is detected between economic growth and energy consumption, however, in the long-run, economic growth and trade openness Granger cause energy consumption. This study was designed with several significant tests to ensure the reliability of results for policy use and to contribute to future studies on the environment-growth-energy nexus.

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1. Introduction

Climate change has emerged as a global threat and its increasing negative impacts on humans are intimidating (Stern, 2006). The economies of the world unanimously acknowledge that if timely drastic measures are not taken, the cost of the resulting damage would exceed current projections. The rapid occurrence of natural calamities i.e., floods, hurricanes, earthquakes, tsunamis, etc., further deteriorate the environment and cause widespread destruction. This rapidly changing global environmental trend has also captured the attention of the international research community (Ahmed and Long, 2013b). In recent years, environmental research is one of the most discussed topics among both physical and social scientists. As a consequence, economists in addition to professionals of other disciplines have developed a research group working extensively on the energy and growth nexus and its adverse environmental repercussions. Among the indicators that simultaneously effect environmental quality, deforestation is also a

growing concern for energy economists in regard to the use of energy resources to attain growth targets. The linkage between deforestation and the energy-growth nexus has been ignored because studies have been focused on advanced economies rather than in developing countries where there is strong evidence of this link. Therefore, this study aims to enhance existing literature on the environment, energy and growth networks and to empirically investigate the linkage between growth, trade and deforestation to assess the environmental degradation of Pakistan.

During last few decades, Pakistan's economy has shown enormous growth and future growth potential, it has continuously benefited from globalization with the opening of trade, resulting in a higher energy demand. However, this economic progression has many challenges, one of these challenges is the negative environmental impacts of growth. Pakistan's economy relies heavily on agriculture, and increasing urbanization, the increasing need for agriculture land and a higher population rate are causing deforestation in the country. For this reason, Pakistan has a high rate of deforestation. Currently, Pakistan has forests over 2.5% of its land area, with a 2.1% annual rate of deforestation. Pakistan has the highest deforestation rate in Asia (WWF, 2010). This deforestation may prevent Pakistan from complying with one of the World Bank's Millennium Development Goals that requires an increase in forest area from 2.5% to 6% by 2015. Pakistan has also faced extreme

^{*} Corresponding author. Tel.: +92 715630272; fax: +92 715632465.

E-mail addresses: khalid.ahmed@iba-suk.edu.pk (K. Ahmed), shahbazmohd@live.com (M. Shahbaz), QaziAhmer_qazi@yahoo.com (A. Qasim), longwei@whut.edu.cn (W. Long).

natural disasters in recent years due to environmental degradation. There were consecutive floods observed in 2010 and 2011, and it is projected that such natural calamities will be more frequent in coming years. The severity of these flood disasters was illustrated when the UN Secretary General expressed deep concerns over the consecutive disasters and the lack of disaster management systems after his visit to flood-affected areas and after meeting with internally displaced people (IDPs). The changing environmental conditions due to industrialization, urbanization, population increase and an increase in agriculture land have consequently increased the risk to the natural environment and the biodiversity of Pakistan. If extensive research is not conducted, the key factors will not be identified for the restoration of environmental quality. Forests are a key source of biodiversity, and controlling the negative impacts of climate change helps protect their livelihood and reduce flood damage. Pakistan has a high deforestation rate. According to the Federal Bureau of Statistics, there was a 3% decline in forest area between 2000 and 2005. The proposed causes are urbanization, over grazing, farming methods, global warming, and the use of wood as a major source of energy in rural areas. The increasing rate of deforestation is also considered to be the primary source of a temperature increase in the northern areas of Pakistan, subsequently causing the fast melting of glaciers¹ in the summer and, consequently, flooding. Thus, these factors necessitate the inclusion of deforestation as an environmental degradation indicator in this study.

This study investigates the linkages between energy consumption, economic growth, trade openness, and population density with deforestation, which is an important environmental indicator in Pakistan. This study utilizes the most appropriate econometric tools: the ARDL bounds testing approach to cointegration and Granger causality tests. The inverted-U shaped hypothesis of the Environmental Kuznets Curve (EKC) is analyzed with respect to economic growth. Our empirical findings confirm the presence of an EKC effect between economic growth and deforestation. Energy consumption positively affects deforestation, but trade openness negatively affects it. This study offers new insights into energy and growth literature, and the results provide key policy control tools for government, international agencies and research organization towards an energy, growth and environmental quality nexus.

2. Review of literature

In 1955, Simon Kuznets studied the relationship between long-run income growth and income inequality. He proposed that at the early stage of income growth, inequality rises but after a certain threshold, income inequality starts to diminish, producing an inverted U-shaped curve. Later in the 1990s, a similar relationship was established between income and environmental degradation, known as the EKC hypothesis. Since that time, many prominent economists, such as Grossman and Krueger (1991, 1995), Grossman and Krueger, 1991, 1995; Shafik and Bandyopadhyay, 1992; Lucas et al. 1992; Panayotou, 1993, 1997; Selden and Song, 1994 and Vincent, 1997, have utilized the EKC hypothesis and found an inverted U-shaped relationship between income and pollution for various pollutants. For more than two decades, the EKC hypothesis has been used in empirical studies, and various statistical tests have been applied on panel and time series data. Techniques related to groups of countries, single countries and cross-country data have been explored as well Altinaya and Karagol, 2004; Frankel and Rose, 2005; Johansson and Kriström, 2007; Kaplan et al., 2011; Shahbaz et al., 2013a,b,c,d ; Shahbaz et al., 2012b;

Onafowora and Owoye, 2014. Most previous studies have focused on the income-CO₂ emissions nexus to the exclusion of some potential environmental degradation indicators.

Growing global environmental concerns have focused the attention of scholarly communities in both the natural and social sciences, and they have conducted impact assessments of several indicators on environmental quality. Deforestation, an indicator of environmental degradation, has been studied in different ways. Initially, the focus was on the Amazon forests, which currently represent half of the planet's remaining rain forests. The initial study of the Food and Agriculture Organization (FAO) in 1954 summarized the increasing exploitation of wood and its potential threats. Consequently, the research community began to investigate this phenomenon with respect to environmental impacts FAO, 1954. The first comprehensive climatic effect of Amazon deforestation was assessed by Molion (1975). Then, another study by Lettau et al. (1979) calculated the deforestation effect in the Amazon region using the hydrologic cycle and atmospheric recycling. Both studies concluded that the construction of dams, urbanization, increasing irrigation system capacity and energy demands were causing deforestation, which was ultimately influencing climatic change in the Amazonia region. Similar studies followed that mainly emphasized tropical deforestation (the notable similar studies on impact analysis are, Heinrichs and Mayer, 1980; Henderson-Sellers and Gornitz, 1984; Mayer, 1984; Hassan and Hertzler, 1988; Nobre 1991. Following the Earth Summit 1992, extensive research on the environment and climate change resulted in a higher number of studies and an increased quality of research output. In addition to other indicators, deforestation has been used to determine environmental impacts. Studies showing the negative impact of deforestation in conjunction with an increase in temperature, extreme weather occurrences, loss of bio-diversity, land erosion, infectious diseases and increasing greenhouse gases emissions are by Shukla and Parikh, 1992; Fearnside, 1992; Dickinson, 2003; Hinderson et al., 1993; Shafiq, 1994; Henderson and Venkatraman, 1993; Zeng et al., 1996; Fearnside, 1997; Laurence, 1999 ; Rustad et al., 2000, respectively.

Research on environmental degradation has also focused on the growth-trade liberalization nexus as a primary indicator contributing to climate change. In the same period, environmental economics researchers adopted different hypotheses and estimations to explain the growth-environmental degradation nexus. This work received rapid attention and was alarming because the results were mixed. The initial work was conducted by the Grossman and Krueger (1995), who investigated the environmental impacts of trade openness on NAFTA. Their study received more attention and increased in importance when environmental quality was considered essential for sustainable development in the background study of 'World Bank Report, 1992' contributed by Shafik and Bandyopadhyay, 1992. In 1995, the study of Goklany (1995) found that developing countries are more sensitive to deforestation due to growth and trade liberalization. This notion was further analyzed by Suri and Chapman (1998a,b); Suri and Chapman (1998a,b) over pooled cross-country and time-series data using the EKC hypothesis. Their results showed that growth and trade initiated environmental degradation. A similar study was undertaken by Bhattarai and Hammig, (2001), who used data from 66 countries from Asia, Africa and Latin America and found strong evidence of a relationship between deforestation and income across the three continents. Further studies on this topic include Panayotou, 2003; Taylor and Copeland, 2004; Culas, 2007, DeFries et al. (2010), Rudel (2013), Shahbaz et al. (2013b), Shahbaz et al. (2013c), and Ahmed (2014). However, studies that investigated the causal relationship between various environmental and growth indicators for Pakistan, including (Chiou-Wei et al., 2008; Zaman

¹ Pakistan's major source of irrigation comes from glacier melt and the remainder comes from monsoon rains, approximately 70% and 19%, respectively.

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