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Economic growth and environmental impacts: An analysis based on a composite index of environmental damage

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ABSTRACT

The conflict between economic growth and the environment is complex and sharper today than ever before. Indeed, the relationship between economic growth and the sustainability of ecosystems has been extensively discussed in the literature, but the results remain controversial.

This paper reviews the use of single and composite indicators of environmental damage and questions whether the Environmental Kuznets Curve (EKC) hypothesis sufficiently mirrors the relationship between economic growth and ecological damage. Ecological Indicators are relevant when they potentially inform society about ecological developments in a reliable way. We use the modified composite index of environmental performance (*mCIEP*) to measure environmental damage, and GDP per capita to represent economic growth. The econometric model is developed using panel data composed of 152 countries and a period of 6 years. The model is estimated for the full sample, for three different sets of countries, by level of development, and a decomposition analysis is carried out, which corresponds to the study of the CIEP individual dimensions.

Our results reveal that, at present, the EKC hypothesis is not proved. We conclude that it is critical to be clear that economic growth alone is not enough to improve environmental quality. Therefore, creating a consistent, coherent and effective environmental policy framework is essential in order to improve environmental quality that supports wellbeing and enables long-term economic development.

1. Introduction

There is the need to balance economic growth and the sustainability of ecosystems. For a long time, scholars have been considering the trade-offs between economic growth and its impact(s) on the ecosystem, and the "Environmental Kuznets Curve Hypothesis" (EKC hypothesis) is one of the most important theories surrounding this relationship.

The EKC hypothesis suggests that the relationship between economic growth and its environmental impacts is not linear; rather, it may be represented by an inverted U-shaped curve. The idea is that economic growth causes negative ecological impacts that initially tend to increase as the economy grows, until they reach a turning point, where the environmental damage stabilizes and begins to fall while economic growth continues. This theory is based on an original principle developed by Kuznets (1955) regarding the relationship between economic growth and income inequality. However, since then, significant progress has been made with regard to testing this hypothesis, mainly in the field of environmental sciences.

The most common econometric models used to analyse the EKC hypothesis are constructed with single variables to represent the (negative) impacts on ecosystems (Xiaoyu et al., 2011). The most commonly used variables to measure environmental damage are: carbon dioxide (CO_2), sulfur dioxide (SO_2) and nitrogen oxide (NO_x) emissions (Babu and Datta, 2013; Buehn and Farzanegan, 2013). However, these only measure the effects on air, which represents just one facet of pollution and thus they ignore other relevant dimensions of environmental impacts (Al-Mulali et al., 2015; Jha and Murthy, 2003). But, overall, conclusions on the EKC hypothesis are still unclear and there is a need for additional research

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that crosses the boundaries of these traditional studies, which use a single environmental variable.

Alternatively, some authors are using composite indicators to measure the environmental impacts, so that they are able to address broader features of ecosystems. However, none of these proposed indexes covers a wide range of ecosystem dimensions. Just as an example, to the best of our knowledge, none of these composite indexes has considered the consequences on human health of environmental damage(s). Furthermore, the amount of research that has used an environmental composite index is still too small to provide consistent conclusions on the actual relationship between economic growth and ecological damage.

Summing up, the vast literature on the EKC hypothesis still presents unclear results. Jha and Murthy (2003) argue that there is no consensus regarding the level of global environmental impacts caused by economic activities. Dinda (2005) affirms that the question of the reliability of the EKC hypothesis has not been completely solved yet. Bo (2011) calls it a "controversial issue". Thus, we have a puzzle that requires further investigation to obtain more congruent and accurate results to support policy makers.

Policy makers are immersed in these confusing and controversial conclusions regarding the relationship between economic growth and environmental impact(s). Ecological indicators become relevant only when they potentially inform society about ecological developments in a reliable and consistent way. Accordingly, there is a need to improve knowledge on the real impacts of economic development on our ecosystem(s) and citizens' wellbeing to support (local, regional and national) policy decision-making and planning processes.

This study aims to fill this research gap and add new viewpoints to the debate on the relationship between economic growth and impacts on the environment, by exploring the use of an environmental variable index that allows for accounting for a wide range of environmental damage. More specifically, this paper focuses on the analysis of the relationship between economic development and ecological damage, based on the EKC hypothesis, using an original environmental composite index. To achieve this purpose, the Composite Index of Environmental Performance (CIEP), proposed by García-Sánchez et al. (2015), is used to represent the environmental variable(s). This indicator was developed for countries, based on the driving force–pressure–state–exposure–effect–action (DPSEA) framework, using a set of 19 variables, which include the various ecosystem dimensions: air, water, flora, fauna and soil. Thus, this adds to the literature by expanding the scope of ecosystems impacts measurement, which is widely recognized as one of the main limitations observed in the studies that have used a composite index to analyse the EKC hypothesis. Furthermore, a better understanding of what the real effects of economic growth on the environment are might bring insights that can aid policy makers in making decisions towards the promotion and better harmonization of economic development and ecological quality.

This paper is organized as follows. In the next section, we provide background information on the EKC hypothesis, identifying the most relevant studies that use a composite index to measure environmental impacts. Section 3 explains the Composite Index of Environmental Performance (CIEP), which is to be used in the empirical application. Section 4 introduces the methodology and data. Section 5 presents the results and a discussion on their policy relevance. Section 6 concludes.

2. The relationship between economic growth and ecological impact(s)

The impact of economic growth on ecosystems has been widely studied through statistical models, using different variables and approaches. But the conclusions continue to resemble a complex black box. Actually, results have shown that the economic system may put the ecological system(s) under pressure and, as a consequence, damage its own sustainability (Machado et al., 2001).

Economic growth was traditionally seen as 'synonymous' with environmental degradation. However, with the introduction of the sustainable development concept, new approaches have emerged. Researchers are finding that economic growth can also be associated with environmental preservation. Sustainable development can be seen as an approach that aims to pacify the relationship between economic development and ecosystem(s).

2.1. The Environmental Kuznets Curve hypothesis

Scholars are observing a non-monotonic behaviour relationship between various pollutants and income (Ahmeda and Long, 2012; Bo, 2011; Jha and Murthy, 2003; Li et al., 2014; Lopez and Mitra, 2000; Mukherjee and Chakraborty, 2013; Zhao et al., 2013). This observation was first made by Grossman and Krueger (1991), while analysing the North American Free Trade Agreement (NAFTA). They concluded that environmental degradation increases with economic growth, but then, environmental quality begins to improve as economic development increases. In others words, there might be a turning point at which the correlation between economic growth and environmental performance changes direction. This theory is widely known as the Environmental Kuznets Curve (EKC) hypothesis.

Under these circumstances some paradoxical insights arise. Generally, economic activities use fossil fuels and other natural resources to produce goods and services. Cracolici et al. (2010) claimed that there is a positive correlation between GDP growth and CO_2 emissions. In addition, they observed that urbanization, which is a typical phenomenon in economically developed countries, causes a substantial increase in city pollution levels, because both transport and the consumption of resources (such as water and energy) affect the environment.

These issues were also investigated by Brock and Taylor (2010), Inglehart (1995) and Kerret and Shvartzvald (2012). They observed that in developed countries, citizens are more concerned with health care, quality of life and welfare; i.e., they are more eco-conscious. Actually, above certain income levels, citizens become more environmentally responsible and change their behaviour, preferring clean products, regardless of the cost (Bo, 2011; Dinda, 2004; Morse, 2008). Furthermore, wealthy countries tend to have more financial resources to invest in environmental policies that address environmental disasters and aim to maintain welfare quality standards (Roca, 2003). Industries begin to use cleaner technologies and governments allocate more resources to implement environmental policies. In this regard, Kaika and Zervas (2013) suggest that in the initial phases of economic development, the primary industry is predominant and causes high levels of pollution and consumption of resources. As the economy grows, the quality of technology, services and information improves; thus, the process reduces environmental damage by becoming more resource efficient. Al-Mulali et al. (2015) also agree that technology influences the turning point where environmental degradation begins to decrease, as it can allow for significant improvements in energy efficiency and renewable energy use. Thus, in this regard, high environmental quality can be considered as having the typical characteristics of a luxury good (Bergh and Jeroen, 2009).

2.2. Testing the EKC hypothesis based on a single environmental variable

There are several proposals in terms of analyzing the relationship between economic growth and its environmental impact(s).