Energy Research & Social Science 39 (2018) 46–54

Contents lists available at ScienceDirect

Energy Research & Social Science

journal homepage: www.elsevier.com/locate/erss

Original research article

Democracy and carbon dioxide emissions: Assessing the interactions of political and economic freedom and the environmental Kuznets curve

Prathibha Joshi[a], Kris Beck[b,*]

[a] Gordon State College, Department of Business and Public Service, 419 College Drive, Barnesville, GA 30204, United States
[b] Gordon State College, Department of History and Political Science, 419 College Drive, Barnesville, GA 30204, United States

ARTICLE INFO

Keywords:
Environmental Kuznets curve
GMM
Political freedom
Economic freedom
OECD
Non-OECD

ABSTRACT

The Environmental Kuznets Curve (EKC) suggests that while early economic development leads to increased pollution, further economic growth results in reduced environmental degradation. Many studies have sought to learn whether carbon dioxide (CO_2) emissions follow such an inverted-U path, with a variety of mixed results. We use economic growth, population growth, urbanization, and energy use variables along with rarely used measures of political and economic freedom to see how they influence carbon emissions and the scope of any potential EKC. We compare a sampling of 22 OECD countries with a selection of 87 non-OECD countries, with the non-OECD countries divided up into the subcategories of free, not free, partially free, and transition. We use an upgraded dataset from the World Bank Development Indicators and the improved econometric technique Arellano-Bover/Blundell-Bond Generalized Method of Moments (GMM) estimator to better evaluate the interactions between these variables and CO_2 emissions. We find no evidence of a CO_2 EKC for the OECD and non-OECD regions, and mixed results for the impact of political and economic freedom, depending on region. CO_2 emissions instead tend to increase monotonically with a rising income, suggesting governments and industry need to do more to curb those emissions as development grows.

1. Introduction

Rising concentrations of carbon dioxide (CO_2) in the atmosphere along with other greenhouse gasses (GHGs) warm the planet, thereby resulting in climate change [1,2]. Industrialization and development have led to this rapid increase in CO_2 emissions, which to a certain extent has justified the concern by Meadows et al. [3] about the negative effects of economic growth. For example, the world has experienced a 30% rise in CO_2 emissions from the 19th century to the 20th century [4,p. 24,5]. Yet some researchers have argued that like with other pollutants, CO_2 emissions will undergo an environmental Kuznets curve (EKC) where those emissions will decrease with further economic development so as to reduce worldwide CO_2 concentrations and therefore slow the warming trend.

Nevertheless, the EKC literature has not yet come to a strong decision about a CO_2 EKC, with some studies showing that it does exist overall [1,6–11] but others discovering different patterns completely [12–18]. Further studies thus are needed to shed more light on this relationship.

A few studies have sought to determine the impact of political and economic freedom on the shape of the EKC, focusing on how these variables might flatten or increase the scope of the curve. However, most studies do not incorporate both variables as part of their equation, generally focusing on one or the other. Part of our contribution to the literature is to further investigate the impact of these two base variables by utilizing *both* a political freedom and an economic freedom index. We therefore seek to discover how increasing or decreasing various measures of freedom can impact carbon emissions.

We also examine other variables of economic growth, population growth, urbanization, and energy use to gauge their influence on carbon emissions as well as to evaluate the potential for a CO_2 EKC that would exhibit the inverted U shape. We have chosen these variables to discover whether the income variables give an indication of the presence of an EKC or other patterns and if the other variables might help explain how those patterns either change or disappear, depending on how these variables affect carbon emissions.

We use an enhanced dataset constructed from the World Bank Development Indicators 2015 and a modified version of the dynamic econometric technique of the Generalized Method of Moments (GMM) estimator [19]. We also contribute to the literature not only by using an updated panel dataset that includes a selection of 22 OECD countries and 87 non-OECD countries, but also by dividing the non-OECD

* Corresponding author.
E-mail addresses: pjoshi@gordonstate.edu (P. Joshi), kbeck@gordonstate.edu (K. Beck).

http://dx.doi.org/10.1016/j.erss.2017.10.020
Received 18 December 2016; Received in revised form 14 September 2017; Accepted 13 October 2017

countries into the categories of politically free, not free, partially free, and those that are in transition to further refine our model. To our knowledge, no other study has divided the non-OECD countries in such ways, making this new treatment of the EKC our innovation to the literature. We hope that by doing so we can enrich the EKC literature for future researchers and gain better insight into how the political character of countries can influence the likelihood of a CO_2 EKC.

The results for OECD countries show that higher levels of income growth, population growth, and increasing energy use all lead to more emissions of CO_2, thereby rejecting the EKC. Urbanization results in fewer emissions even while political freedom and economic freedom both help to increase carbon emissions. For all non-OECD countries combined, income growth as well as political and economic freedom foster higher CO_2 emissions, again failing to confirm an EKC. We find that politically free non-OECD countries experience higher CO_2 emissions due to population growth and greater energy use but that economic freedom helps to diminish the emissions. With the politically not free non-OECD countries, all variables except for political freedom increase carbon emissions. Partially free non-OECD countries have insignificant results for both political freedom and economic freedom, as do the outcomes for transition non-OECD countries. The rest of the paper proceeds as follows: Section 2 offers a selected review of the EKC literature, Section 3 reviews the data, Section 4 presents the empirical model, Section 5 discusses the estimation results, and Section 6 offers some conclusions.

2. Selected literature review

The research on the EKC in general is vast. However, many recent CO_2 studies focus on single country analyses rather than panel data across countries [20–22], but it is difficult to extrapolate from single country studies to general patterns occurring across a wide diversity of countries, data, and time periods. We therefore present a *selected* literature review of the most pertinent studies to our investigation. Grossman and Krueger [23,24] used Kuznets' initial study showing an inverted-U relationship between economic growth and income inequality [25] to posit a similar relationship between economic growth and environmental quality, called then the environmental Kuznets curve (EKC). An EKC for carbon dioxide suggests that after an initial period of low CO_2 concentrations, economic development causes rapidly escalating CO_2 emissions [14] that eventually will bring about the beginnings of climate change and other harmful effects. Continued economic growth, though, should see those CO_2 emissions decline due to a number of reasons, thereby revealing the inverted-U shape and giving the planet the opportunity to recover.

The inverted U pattern of the EKC can emerge through the interactions of three different processes, each of which either increases or decreases the levels of a pollutant. First, rising economic growth and a growing population escalate the discharge of CO_2 emissions as more industries pollute more fully to meet greater consumer demands [26–30]. However, this scale effect can be modified; a better standard of living that comes from that higher economic growth can have a positive influence on the environment since people can better afford and often will demand the luxury good of a clean environment,.

Second, this increased scale of economic activity also can be countered by a change in the economy itself, which occurs when the nature of the economy shifts from a heavily polluting industrialization toward a far less polluting service sector [33,14,28,29]. Third, technology can reduce the environmental impacts of economic growth through the adoption of new methods of production that help industry to pollute less as well as by the discovery of new ways to clean up existing pollution [31,p. 279,34,35,p. 435,36,p. 148]. The inverted U generally emerges when the change to the service sector combines with the development of new technologies to overcome the negative effects of the enhanced scale of the economy; yet should the negative aspects of the scale effect remain dominant, the EKC pattern would not occur.

In general, the literature shows that those pollutants with high visibility and/or direct impacts on people's health are more likely to follow the EKC pattern. CO_2, though, is neither visible nor does it produce any sort of damage that instantly harms health or the environment [13,35,37,38,29,17]. It is an unseen GHG that does cause considerable problems environmentally but indirectly and over time [39,9]. As a result, most people and countries externalize its dangers, making it less likely that they will seek immediate action from governments or polluters. Such an externality, then, can impact the potential EKC pattern (either to flatten or expand it) or replace the EKC with a different curve altogether.

Still, the literature does include some studies that have found an EKC for CO_2 overall, with emissions declining with further economic growth [1,9,10,40]. A few researchers have discovered that such EKCs only occur with high income countries [41–46] while Wood and Herzog [47] revealed an EKC with high turning points. Heil and Selden [5] used a levels model to confirm the EKC for CO_2 while Iwata et al. [48] attributed the increasing use of nuclear energy in France as the cause for its EKC. Ahangari and Moradi [31] found a CO_2 EKC for a few developing countries in Asia, and Aubourg et al. [33] discovered an EKC for various Caribbean and Latin American countries.

Nonetheless, other research has found instead a monotonically increasing pattern where CO_2 emissions either continue to rise with additional economic growth or never form a true EKC pattern [7,14–18,43,44,49–52]. Aslanidis and Iranzo [53] failed to discover a CO_2 EKC using the technique of "smooth transition regression" whereas Dijkgraaf and Vollebergh [13] found mixed results and concluded that the EKC is weak at best. Additional research has been unable to detect an EKC for developing countries as well [54,38,45]. Several studies have revealed an N-shape pattern where emissions once again rise even after a period of decline, mostly due to further economic development [14,55,56]. The EKC literature therefore has produced mixed results for an EKC for carbon dioxide [57].

3. Data

We create improved time series and cross-sectional panel datasets from the World Bank Development Indicators [58], using 1995–2010 as our timeframe. Due to irregular reporting done by many countries, much of the data in earlier years is missing. We purposely did not look at years where data was lacking or where countries reported results sporadically because of the problems inherent with unbalanced datasets, such as incorrect observations, biasness, and inconsistency. Hence the selection of countries and years are based on the availability of data, especially in that the economic freedom index starts from the year 1995. The Development Indicators provide data on the important variables of the model, which include CO_2 emissions,[1] GDP and GDP squared per capita, population growth, urbanization, and energy use. The political freedom data come from Freedom House and the economic freedom data from the Heritage Foundation, for each country. We compare a selection of 22 OECD countries and 87 non-OECD countries, further then dividing the non-OECD countries into the categories of free, not free, partially free, and transitioning based on the political freedom index. Table 1 presents the definitions for the variables in the study and supplies summary statistics for the OECD and non-OECD countries. It also provides the mean and standard deviations of each variable.

The dependent variable is the CO_2 emission rate, CO_2, which the World Bank measures in terms of metric tons per capita. As per World Bank definitions, the majority of carbon dioxide emissions stem from cement manufacturing as well as the use of fossil fuels in consumption and production [58]. The data do not include emissions produced by

[1] The World Bank attains its CO_2 data from the Carbon Dioxide Information and Analysis Center (CDIAC) located at the Oak Ridge National Laboratory.