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On the causal dynamics between CO_2 emissions, health expenditures and economic growth

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ABSTRACT

The objective of the study is to examine the causal relationship between CO_2 emissions, health expenditures and economic growth using dynamic simultaneous-equations models for a global panel of 51 countries over the period 1995–2013. The study also implements these empirical models for three groups: low income group, lower middle income group and upper middle income group countries. Our empirical results show that there is bidirectional causality between CO_2 emissions and economic growth, between health expenditures and economic growth for the global panel, and there is unidirectional causality from CO_2 emissions to health expenditures, except low income group countries. It has also been found that health plays an important role in economic growth it limits its impact on an increasing deterioration of environmental quality. These research findings would certainly serve as usefully effective policies instruments aiming at maximizing both the environmental and health gains highly associated with economic growth and development.

1. Introduction

The topic of causal relationships between environment, health expenditures and economic growth has recently started to be studied in the economics literature for both developing and developed countries. This literature can be categorized into three research strands. The first strand relates to the validity of the environmental Kuznets curve (EKC) hypothesis which postulates that the relationship between economic growth and the environment takes the form of an inverted U-income. This hypothesis, proposed by Grossman and Krueger (1995), states that environmental degradation rises with income increase, then plateaus when income reaches a certain high level, and finally drops. However, empirical studies regarding this inverse U-shaped relationship between CO_2 emissions and per capita income are inconclusive. Although Ang (2008), Coondoo and Dinda (2008), Pao and Tsai (2010), Saboori and Sulaiman (2013), Saboori, Sulaiman, and Mohamed (2012), and Seldon and Song (1994) have found the existence of the EKC hypothesis many other have report evidences against the hypothesis (e.g., Cole, Rayner, & Bates, 1997; Fodha & Zaghdoud, 2010; Holtz-Eakin & Selden, 1995; Roca, Padilla, Farre, & Galletto, 2001).[1]

The second strand focuses on the nexus between health expenditures and economic growth. Most of the earlier studies are interested with the questions of measuring the size of the income elasticity of health care, and on its policy implications for the financing and distribution of health care resources (Baltagi & Moscone, 2010; Bhargava, Dean, Lawrence, & Murray, 2001; Fan & Savedoff, 2014; Funke & Strulik, 2000; Gerdtham and Lôthgren, 2002; Gong et al., 2012; Muysken, Yetkiner, & Ziesemer, 2003; Strauss and Thomas, 1998). Therefore, their results show that there exist two hypotheses regarding the relationship between health expenditures and economic growth: (i) health care is a luxury good, indicating that it is a commodity much like any other and is best left to market forces; (ii) health care is a necessity, often sustain the view of more government intervention in the health care sector.

Finally, the third strand of research on this topic provides empirical evidence on the relationship between health expenditures and CO_2 emissions. Though, much less attention from academic researchers was paid to this strand of research compared with the other two strands. Existing studies including Beatty and Shimshack (2014), Brunekreef and Holgate (2002), Clancy, Goodman, Sinclair, and Dockery (2002), Gerdham and Jonsson (1991), Janke, Propper, and Henderson (2009), Mead and Brajer (2005), Murthy and Okunade (2000), Narayan and Narayan (2008), and Wordley, Walters and Ayres (1997) validated the positive relationship between health expenditures and pollutant emissions. We can see, most of earlier studies have been focused on the cause effect from CO_2 emissions to health expenditures. Only a few empirical

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[1] An extensive review is available in papers of Stern (2004), Dinda (2004), and Kijima et al. (2010).

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studies have focused on the two-way causation between health expenditures and CO_2 emissions.

From the survey of these literatures, it can be concluded that, CO_2 emissions is posing risks to human population health and this can lead to a decrease of the economic growth. The links between these variables are not solely complicate to shape, although they may as interact simultaneously.

This study contributes the following. First, we apply a dynamic simultaneous equation estimation to examine the following combined causality effects: (i) from CO_2 emissions and health expenditures to economic growth; (ii) from economic growth and CO_2 emissions to health expenditures; and (iii) from economic growth and health expenditures to CO_2 emissions. Unlike the single-equation method, the system estimation can bring up the simultaneities among of the endogenous variables specified in the system and identify the likely two-way effects between them. However, to the best of our knowledge, none of the empirical studies have focused to investigating the nexus between environment-health expenditures-growth via the dynamic simultaneous equations models. Second, the current study is different from the previous studies in that is uses system GMM technique to explore the channel variable (economic growth) through which CO_2 emissions may likely affect health expenditures. This channel variable is employed to track down the effect of environmental change on health expenditures, and to allow if increased CO_2 emissions is linked to more health expenditures in three income groups countries or vice versa.

The remainder of this paper is structured as follows. Section 2 presents a brief literature review. Section 3 describes the data and econometric methodology. Section 4 presents the results from empirical analysis. Section 5 concludes the study.

2. Literature review

The causal relationship between environment-health expenditures–economic growth has been synthesized into the following three testable hypotheses: the unidirectional hypothesis, the feedback hypothesis, and the neutrality hypothesis.

2.1. Unidirectional hypothesis

Balaji (2011) and Ayubi (2014) employ different estimation techniques to examine the causal relationships between health expenditures and economic growth for 8 OECD countries and Nigeria, respectively. Their findings show that there is unidirectional causality running economic growth to health expenditures. Hartwig (2010) investigates the effect of health expenditures on economic growth for a sample of 21 OCED countries over the period 1970–2005 and concludes unidirectional Granger causality running health expenditures to economic growth. Mehrara, Sharzei, and Mohaghegh (2014) use adopts a panel cointegration approach to study the relationship between environmental quality, health expenditures, and economic growth for 114 developing countries between 1995 and 2007. The empirical evidence supports the existence of unidirectional causality from CO_2 emissions to economic growth and from economic growth to health expenditures.

2.2. Feedback hypothesis

Amiri and Venetelou (2012) applied a modified version of the Granger causality test proposed by Toda and Yamamoto (1995) to identify the two-way linkages between health expenditures and economic growth for 20 OECD countries over the period 1970–2009. The findings indicate that bidirectional Granger causality is predominant.

Halicioglu (2009) investigates the causal relationship between CO_2 emissions and economic growth for Turkey by employing an ARDL bound approach over the period 1960–2005. Their findings confirm the feedback hypothesis in both the short and the long run. Wang (2011) uses the error correction model to verify the causal relationship between CO_2 emissions and economic growth for 138 countries during 1971–2007, and find evidence to support the feedback hypothesis. Ghosh (2010) in addition documents two-way links between CO_2 emissions and economic growth in India during 1971–2006.

Chaabouni and Abdennadher (2014) look at the causal links between health expenditures, economic growth and environmental quality in Tunisia. The results from their Granger causality tests indicate the existence of strong bidirectional causality between these variables over the period 1960–2008.

2.3. Neutrality hypothesis

Some studies have noted neutral effect between CO_2 emissions, health expenditures and economic growth. For instance, Devlin and Hansen (2001) concluded that there is no significant causality between economic growth and health expenditures. As well, the findings reported by Richmond and Kaufmann (2006) are in favor of the neutrality hypothesis for economic growth and CO_2 emissions interactions, using panel data of 36 developed and developing countries over the period 1973–1997.

2.4. Mixed results

Several studies have noted mixed results about the causal relationship between CO_2 emissions and economic growth (e.g., Apergis & Payne, 2009; Narayan & Narayan, 2010; Zhang, 2011; Omri, 2013) and between health expenditures and economic growth (e.g., Elmi & Sadeghi, 2012; Rao, Jani, & Sanjivee, 2008; Tang, 2011).

Table 1 shows a summary of the selected empirical studies on the CO_2 emissions-health expenditures-growth nexus. The general conclusion that we can draw is that the empirical results of the previous studies are inconclusive, which calls for additional study to elucidate this association. Incidentally, the current investigation gives an empirical analysis of this multivariate causality affiliation by employing dynamic simultaneous-equation models to a panel data set of 51 countries over the period 1995–2013.

3. Data and methodology

3.1. Data

This study uses annual data from 1995 to 2013 for a sample of 51 countries selected on the basis of data availability. According to the World Bank country classification, these countries are divided into three income groups: low income countries (Bangladesh, Benin, Congo, Ghana, Haiti, India, Kenya, Nepal, Nigeria, Pakistan, Sudan, Togo, Zambia and Zimbabwe), lower middle income countries (Algeria, Bolivia, Cameroon, China, Colombia, Congo, Rep., Dominican Republic, Ecuador, Egypt, El Salvador, Guatemala, Honduras, Indonesia, Iran Islamic Rep., Jamaica, Morocco, Nicaragua, Paraguay, Peru, Philippines, Sri Lanka, Syrian Arab Republic, Thailand and Tunisia) and upper middle income countries (Argentina, Chile, Costa Rica, Gabon, Hungary, Malaysia, Mexico, Oman, Panama, South Africa, Turkey, Uruguay and Venezuela). The multivariate framework for the analysis includes Real GDP per capita in constant 2005 US$, CO_2 emissions in per capita metric tons, health expenditures per capita in constant 2005 US $, population aging (% of total population), urbanization (% of total population), labor employed in production, per capita stock