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Are global warming and economic growth compatible? Evidence from five OPEC countries?

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ABSTRACT

In this paper, we investigate the relationship between carbon emissions, income, energy and total employment in selected OPEC countries for the period of 1971–2002. We mainly focus on the link between energy use and income. Employing the autoregressive distributed lag (ARDL) approach, we find that there is a cointegrating relationship between the variables in Saudi Arabia only. The long run forcing variables for income are determined to be employment and energy for Saudi Arabia. In Indonesia, Algeria, Nigeria, and Venezuela, there is no cointegration between income and energy. Secondly we question the long run Granger causality between carbon emissions, energy use, and income. Our results suggest that none of the countries need to sacrifice economic growth to decrease their emission levels. Indonesia and Nigeria may contribute to emissions reduction via energy conservation without negative long run effects on economic growth.

1. Introduction

The main source of global warming is emissions of greenhouse gasses (GHG), and the main source of GHG emissions is believed to be energy consumption. Therefore, reducing energy consumption will also decrease the emission levels. However, it is not a simple matter of applying energy conservation methods, since energy consumption may have important effects on economic growth. Due to these presumed links between GHG, energy consumption and economic growth, it is widely believed that decreasing carbon dioxide (CO_2) emissions to the Kyoto targets would also reduce the growth of GDP. In other words, emission reduction requires energy conservation which hinders economic growth assuming that there is a causal relationship from energy consumption to CO_2 emissions and real income. Because of these presumed links, many countries are hesitant to keep with Kyoto targets. However, there is abundant number of empirical studies, employing diverse methods, conducted in several countries, which point out that the link between energy consumption, income and CO_2 may not be unique. Therefore, investigating the temporal relationship between energy use, CO_2 and income in countries separately may be necessary.

Stern and Cleveland [44] provide an excellent review of the earlier and more recent work on the link between energy consumption and economic growth. Stern [43], Masih and Masih [22–24] are some examples that apply relatively stronger time series techniques than earlier work. Asafu-Adjaye [2], Hondroyiannis, Lolos and Papapetrou [14], Glasure [12], Soytas and Sari [38–40], Sari and Soytas [36,37], Ghali and El-Sakka [10], Lee [18,19], Lee and Chang [20], Huang, Hwang and Yang [15], Narayan and Smyth [27] and Ewing, Sari and Soytas [9] are examples that utilize relatively new time series or panel-data techniques. Even this limited list indicates that the link between energy use and income is a well studied topic. However, despite having many studies employing different techniques, different time periods, and different control variables in different countries, there is a lack of unanimity as to the nature of the relationship between energy use and income. The divergence of results may be indicating that the relationship is too complex and/or its nature differs from country to country.

The recent studies on the other hand improved our understanding in at least two ways. Firstly, the empirical studies may be suffering from omitted variables bias that may yield spurious causality test results. Hence, a multivariate approach should be preferred over bi-variate approaches. Secondly, the temporal relationship between energy use and income may be depending on country specific factors. Furthermore, depending on the nature of the link in concern, alternative policy options may be available to policy makers in different countries. Therefore, studying countries individually may be necessary.

There is an abundance of studies that test the environmental Kuznets curve (EKC) hypothesis (see [6,45] for a review) which relate environmental degradation to economic growth. The hypothesis states that as economies grow pollution also grows, but after an income level is reached economic growth is associated with a decline in pollution. As Rothman and de Bruyn [35] suggest if the

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hypothesis holds economic growth can gradually become a solution to environmental problems and no policy action is necessary. However, a stylized fact has seemed to emerge especially among more recent studies. EKC does not seem to hold when GHG and income *per capita* are considered. Some even suspect a monotonic relationship between carbon emissions and economic growth. Indeed, Coondoo and Dinda [3] suggest that both developing and developed countries should sacrifice economic growth to reduce emission levels. Dinda and Coondoo [7] apply a panel-data cointegration methodology in a bi-variate setting and find mixed results. However, a need for a method that allows for a dynamic relationship seems to have emerged. It also seems that there is a need to combine the two lines of literature both for methodological purposes (i.e. avoiding omitted variables bias) and for the sake of investigating alternative policy options and their affects. Only recently, the long run Granger causality relationship between energy use, output, and emission levels is investigated in a multivariate setting [40,41].

In the light of these suggestions we first investigate the long run relationship between energy consumption and income, and employment in selected OPEC countries. Second we extend the research on the carbon dioxide emissions, energy, and economic growth. Hence, unlike many studies in the literature, this paper focuses on the nature of the environment, energy use, and income relationship in oil rich countries of the OPEC cartel. The income, energy consumption and environmental relationship in OPEC countries are not very well studied. These countries subsidize their oil consumption and thus may encourage waste and more emissions.[2] To decrease global warming, policy suggestions in the light of the uncovered relationship between environment, income, and energy consumption in these major oil producer countries could be insightful. There are a number of studies that investigate the relationship between energy consumption and income in OPEC countries. For instance, Al-Iriani [1] investigates causal relationship between energy consumption and GDP for Kuwait, Qatar, Saudi Arabia, and United Arab Emirates (UAE) in a panel time series framework. Squalli [42] uses all OPEC countries data, except Algeria, to investigate the causal and cointegrating relationships between electricity consumption and economic growth. In a panel time series framework, Mehrara [25] investigates the energy consumption-economic growth relationship in 11 developing countries including seven OPEC countries. Finally, similar relationship is investigated in Zamani [48] for Iran.

Although it may appear that net oil exporting countries would not be cheerful supporters of environmental policies such as energy conservation, all countries are affected from global warming. Indeed the countries studied in this paper may be the most vulnerable ones in the face of rising atmospheric temperature due to relatively low renewable fresh water resources and intense desertification problems (except may be for Indonesia and Venezuela).[3] Furthermore, rising local environmental concerns may force the authorities in these countries to take action in reducing GHG emissions. If energy use is the major source of these emissions, the nature of the relationship between energy use and GDP is essential for devising sustainable growth policies.

The paper can be outlined as follows. We first provide descriptive information about the countries studied. In the following section we describe the data used in this study. Then we discuss the literature on energy–income relationship, and apply bounds testing for cointegration and ARDL modeling. We find that even among the OPEC members the link between energy use and income differs significantly. Hence, the petroleum producing countries may also contribute to the reduction of GHG emissions to fight global warming. Then we introduce some of the empirical work on EKC, and apply the Toda–Yamamoto (TY) procedure [46] in a multivariate setting to test for long run Granger causality. We discovered that the dynamics of the relationships between variables vary across countries. The last section concludes and provides some policy implications.

2. Trends in OPEC countries

OPEC has been an important player in the world energy markets. Although its power has relatively declined due to a rise in non-OPEC oil supply, the cartel continues to hold a high percentage of world proven reserves (OP [30]. Table 1 summarizes some relevant statistics for selected OPEC countries.

According to (Table 1), Saudi Arabia, and Venezuela are the two largest per capita energy consumers among the group, respectively. Saudi Arabia is also the largest carbon dioxide emitter within the group, followed by Algeria and Indonesia. However, they do differ significantly according to their per capita GDPs. Indonesia and Nigeria rank in top two in terms of population sizes, respectively. Partly due to this, they also appear to be the poorest ones in terms of per capita GDP. Both population, economic, and natural resource characteristics seem to be diverse even within these selected members of OPEC. This may also be emphasizing the need to study each country separately in order to understand the specific relationship between energy use and income. Furthermore, as one can observe from the last column of Table 1, Saudi Arabia, Algeria, and Indonesia are the three largest carbon dioxide emitters within the group; although, their population sizes and economic development levels seem to differ significantly. This shows that identifying the most appropriate tools for economic development, energy, and environmental policies in each country separately is rather important. For example, in Saudi Arabia it may be relatively easier to substitute natural gas for oil consumption than in Indonesia, since Saudi Arabia apparently has significantly higher natural gas reserves. In Saudi Arabia, which has high per capita income, it may be easier to focus on policies that promote research and development on environmental friendly energy sources or on energy efficiency improvements. The developed countries may also share their experiences and technology with the relatively poorer countries, such as Nigeria and Indonesia with the lowest GDP per capita and the largest population figures in the group, to promote sustainable growth.

Environmental issues are important for OPEC countries for at least two reasons. First, most of them are probably among the vulnerable countries to global warming. Second, world wide environmental concerns create both responsibilities as well as opportunities for oil exporting countries. Indeed, OPEC officially acknowledges importance of environmental concerns. According to the strategy document of OPEC [31], p. 20 "The oil industry has a long history of successfully improving the environmental credentials of petroleum, both in use and production..." OPEC finds it worthwhile to support development of technologies (i.e. carbon capture and sequestration methods) to mitigate climate change. Furthermore, the organization recognizes that environmental policies may have negative impact on the economic growth in developing countries. However, there are no indications in the strategy document regarding the potential impact of global warming on OPEC countries. Furthermore, there does not seem to be clear arguments realizing that OPEC members are also consuming fossil fuels and emitting carbon dioxide into the atmosphere. In that respect, this paper may have important implications for the member countries individually as well as a group.

[2] We thank an anonymous referee for bringing this issue to our attention.

[3] According to UN Environmental Indicators accessed on April 28, 2006 http://unstats.un.org/unsd/environment/waterresources.htm.