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Economic growth, fossil fuel and non-fossil consumption: A Pooled Mean Group analysis using proxies for capital

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ABSTRACT

This study employs a Pooled Mean Group estimator to examine the nexus between economic growth and fossil and non-fossil fuel consumption for 53 countries between 1990 and 2012. The global sample was divided into four categories: developed exporters, developed importers, developing exporters and developing importers. The purpose of these categories was to observe whether factors unique to these countries influence the relationship between energy consumption and economic growth. With the exception of developing importers, evidence of bi-directional causality between fossil fuel consumption and real GDP across all subsamples is observed. This leads to the conclusion that efforts to directly conserve fossil fuels may harm economic growth. In terms of non-fossil fuel use, the results are more diverse. Bi-directional causality between non-fossil fuel use and real GDP is found in the long and short run for developed importers; bi-directional causality only in the long run for developed exporters; negative long-run causality from real GDP to non-fossil fuels for developing exporters; and long-run causality from non-fossil fuel use to real GDP for developing importers. These results lead to the conclusion that other factors have been responsible for the progress seen in non-fossil fuel use. Thus it is concluded that economic growth on its own is insufficient to promote clean energy development. There is a need for policy makers to create an environment conducive to renewable energy investment.

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1. Introduction

The recent United Nations Climate Change Conference in Paris resulted in a commitment to limit warming to well below 2 °C above pre-industrial levels and pursue efforts to limit the global temperature increase to 1.5 °C (UNFCCC, 2015). While the agreement demonstrates countries' willingness to combat climate change, the implementation of the promised policies will nevertheless pose significant challenges. Primary among them is the trade-off between mitigating climate change while maintaining economic growth. This is of particular significance for developing countries, who will be among the largest contributors to future increases in greenhouse gas (GHG) emissions. Based on current trends, non-OECD emissions are projected to exceed OECD emissions by 127% by 2040 (EIA, 2013). Therefore, it is vital that emerging countries manage their development more sustainably in comparison to countries that developed in previous generations. Unruh (2000, 2002) and Unruh and Carrillo-Hermosilla, 2006 has even described a "carbon lock-in" phenomenon, whereby countries with energy systems based on fossil fuels find it difficult to transition to alternative energy once energy infrastructure and policies are set in place.

Fig. 1 shows per capita carbon dioxide emissions for the countries in this study, categorised according to their level of development and importer or exporter status. It can be seen that in the case of developed countries, carbon dioxide (CO_2) emissions, at least on a per capita basis, slightly decreased between 1990 and 2012, possibly reflecting the ongoing change in the composition of these economies, as well as increases in energy efficiency and non-fossil use. On the other hand, per capita emissions for developing countries are still increasing. Unless this trend can be halted or reversed, the trajectory for global warming will be significantly steeper.

The threats from climate change are well documented and GHG emissions mainly from fossil fuel consumption are a leading cause of this phenomenon. Furthermore, developing countries are considered most vulnerable to these risks because of their dependence on agriculture, the most climate-sensitive production sector. Moreover, developing countries are least able to adapt to climate change due to a combination of underdeveloped infrastructure, weak social safety nets and low personal savings for disaster recovery (Ward and Shively, 2012). The World Health Organisation (WHO) projects 250,000 additional deaths per year from climate change between 2030 and 2050 (WHO, 2015).

At the same time though, it is important to acknowledge the contributions of energy consumption to economic development. To the extent that energy use increases economic growth, raises incomes, raises education levels, and improves health and infrastructure, the responsible use

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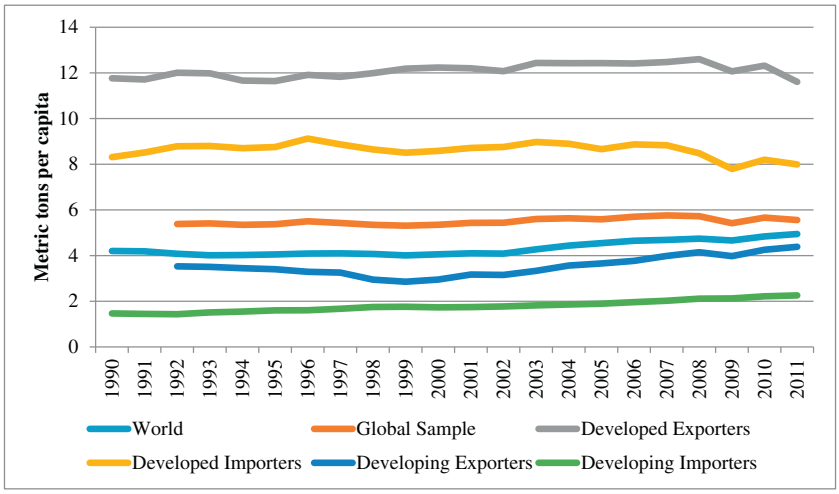


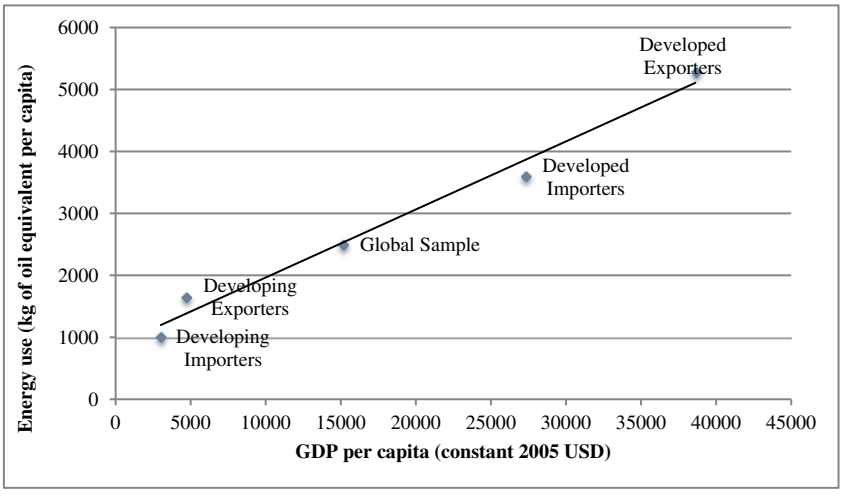
Source: World Bank (2015)
Note: Values represent the average of all the countries within the given category. Data were incomplete for Developing Exporters in 1990 and 1992.

Fig. 1. CO_2 emissions (metric tons per capita), 1990–2012.

of energy can be a positive force for achieving development goals such as poverty reduction. This reasoning, of course, assumes that energy consumption causes economic growth, and therefore efforts to conserve energy would restrain incomes. Fig. 2 shows a clear correlation between energy use and GDP per capita, but causality is less obvious. It could instead be the case that causality runs in the other direction, with incomes being the main driver of energy use. Alternatively, the relationship could be bi-directional or there could be no relationship whatsoever.

Understanding these dynamics is one of the main objectives of the energy-income nexus literature. Recent developments in the literature have been characterised by conflicting results, with no clear consensus on the nature of the causality. Different forms of causality have been observed depending on the countries investigated, the timeframe considered, the variables included and the econometric approach employed This in itself is not completely unreasonable, as the relationship between energy and growth is likely to differ across time and across countries. To contribute to the existing analysis, this study disaggregates energy consumption into fossil and non-fossil fuel sources and divides a global sample of 53 countries into four subsamples: developed exporters, developed importers, developing exports and developing importers. The purpose of this disaggregation is to ascertain what role the level of development and energy importer/exporter status plays in the relationship between energy and income, and also whether these findings differ with respect to the two alternate energy sources — fossil and non-fossil fuels.

In addressing climate change, policymakers are increasingly aware that a 'one-size-fits-all' approach is not always appropriate. Instead, it is more desirable for countries to contribute to the global emissions reduction effort according to their strengths and weaknesses. This will depend on resource endowments, geographical characteristics and the prominence of particular industries in a given economy. This line of reasoning was reflected in the most recent round of UN climate change negotiations, where countries were called upon to publish Intended Nationally Determined Contributions (INDCs), in which countries specify what role they will play in reaching the global temperature target. INDCs foster transparency and disclosure and encourage other nations to increase their efforts, while signalling to businesses and consumers how they can modify their actions accordingly (World Resources



Source: World Bank (2015)

Fig. 2. Correlation between energy use and GDP per capita.

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