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Does energy consumption cause economic growth?: Evidence from a systematic study of over 100 countries

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Abstract

Energy arguably plays a vital role in economic development. Hence many studies have attempted to test for causality between energy and economic growth; however, no consensus has emerged. This paper, therefore, tests for causality between energy and GDP using a consistent data set and methodology for over 100 countries. Causality from energy to GDP is found to be more prevalent in the developed OECD countries compared to the developing non-OECD countries; implying that a policy to reduce energy consumption aimed at reducing emissions is likely to have greater impact on the GDP of the developed rather than the developing world.

JEL classification: O13; Q43

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1. Introduction

The issue of causality between energy and GDP has been a topic concerning energy economists' for a number of years given the results have important implications for policy. Furthermore, this issue is currently of fundamental importance given the very real threat of global warming and

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hence the need to cut energy consumption to reduce emissions to help stem climate change. This paper therefore attempts to address this issue in a global context by consistently and systematically testing whether energy consumption causes economic growth for over 100 countries.

Whether energy consumption is a stimulus for GDP or not has (as pointed out by, amongst others, Ghali & El-Sakka, 2004 and Wolde-Rufael, 2005) been an ongoing debate among energy economists. On one hand, it is argued that energy is a vital and necessary input along with other factors of production (such as labor and capital). Consequently, energy is a necessary requirement for economic and social development so that energy is potentially a "limiting factor to economic growth" (Ghali & El-Sakka, 2004, p.225). On the other hand, it is argued that since the cost of energy is a very small proportion of GDP, it is unlikely to have a significant impact; hence there is a "neutral impact of energy on growth" (Ghali & El-Sakka, 2004, p.225).[1]

In summary, it is crucial that it is determined whether energy consumption is a stimulus to economic growth? (or alternatively from a technical viewpoint, does energy 'cause' GDP?) As illustrated above, the answer to this question has important implications for policy makers. In particular if energy causes GDP then reducing consumption could lead to a fall in income and employment. Whereas, as noted by Masih and Masih (1997) if causality from energy to GDP does not exist then energy conservation policies may be initiated without deleterious side effects on growth and employment. It is important therefore, to ascertain empirically whether there is a causal link from energy consumption to GDP. As also highlighted above, this is particularly true given the current debate about global warming and the need to reduce Greenhouse Gas Emissions by conserving energy consumption, since any constraints put on energy consumption to help reduce emissions will have an effect on growth and development if causality from energy to GDP exists. Moreover, if the causal link is greater for non-OECD/developing countries, then any restraint on energy consumption will have a bigger effect on these countries compared to the more affluent OECD industrialized countries. In this case it could be argued that any reduction in energy consumption should predominantly be undertaken by the developed world so as not to inhibit the development of the less developed nations.

Given the importance of this issue it is not surprising that there have been a number of attempts to quantify the relationship for a number of different countries. A comprehensive list is summarized in Chontanawat, Hunt, and Pierse (2006) and shows that the existence (or otherwise) of causality from energy to GDP has been the subject of some investigation and debate by economists and econometricians. This highlights that the results are very mixed with no clear consensus emerging. Different results for different countries are not necessarily surprising given the "many institutional, structural, and policy differences" (Masih and Masih, 1997, p. 419). However, the lack of consensus for particular countries (and countries with similar characteristics and stage of development) is somewhat surprising, which according to Masih and Masih (1997) is primarily due to methodological differences in terms of definition and specification of variables, the econometric techniques employed, and the lag structures chosen.

This paper therefore attempts to address this issue. A systematic and consistent methodology is adopted to test whether there is evidence of causality from energy to GDP for 30 OECD countries and 78 non-OECD countries and, in particular, test the hypothesis that the link is more prevalent for the non-OECD developing countries. The next section outlines the methodology, followed by Section 3, which presents the results. The final section summarizes and concludes.

[1] See also Toman and Jemelkova (2003) for a more detailed discussion about the effect of energy on economic development.