ENERGY CONSUMPTION AND OUTPUT: TIME SERIES EVIDENCE FROM NON-OECD ASIAN COUNTRIES

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Overview

Statistically significant association between energy consumption and economic growth is now well established in the literature. However, it still remains an unsettled issue whether economic growth is the cause or effect of energy consumption. The importance of identifying the direction of causality emanates from its relevance in national policy-making issues regarding energy conservation. Energy conservation issue is more important when energy acts as a contributing factor in economic growth than when it is used as a result of higher economic growth. In this backdrop, it is justified to search causal relationship between energy consumption and national output (GDP) of those countries that are expected to have higher energy consumption in future. Evidence shows that countries classified as non-OECD Asia will have the highest growth in energy consumption (3.7 percent) over the period 2003-2030. This forecasted energy consumption in these countries will have significant policy implication in the area of energy conservation. Hence, the present paper attempts to identify the direction of causality between energy consumption and output in the context of six major energy dependent non-OECD Asian countries. However, since the traditional bivariate approach suffers from omitted variable problems (Stern 1993, Masih and Masih, 1996 and Asafu-Adjaye, 2000), this paper employs a trivariate *demand side approach* consisting of energy consumption, income and prices. The countries selected for this purpose are Bangladesh, China, India, Malaysia, Pakistan and Thailand. Moreover, according to the Energy Information Administration (EIA) data of 2005, these six countries contribute 81.35% of the energy consumption by all non-OECD Asian countries (aggregate energy consumption of 2005 by all non-OECD Asian countries is 113.60 quadrillion BTU while for these six countries alone the consumption is 92.42 quadrillion BTU).

The rest of the paper is structured as follows. Section two provides a critical review of earlier literature, followed by a description of data sources and methodologies employed in this article. Section 4 examines the time series properties, followed by empirical results from the estimation. Conclusions and policy implications are given in the final section.

Methods

For investigating the time series properties of data this paper employs *ADF* and *PP* unit root testing procedures as well as the test for unknown structural break due to Perron (1997). For the test of cointegration, the study uses the Johansen (1988) and Johansen and Juselius (1990) maximum likelihood estimation procedures.

This article employs a vector error-correction (VEC) model (proposed by Engel and Ganger 1987). Through the error correction term (ECT), the model opens up an additional channel of causality which traditionally ignored by the standard Granger (1969) and Sims (1972) testing procedures. Sources of causality can be identified through three different channels: (i) the lagged ECT's by a t-test; (ii) the significance of the coefficients of each explanatory variable by a joint Wald F or χ^2 test (weak or short-run Ganger causality); (iii) a joint test of the terms in (i) and (ii) by a Wald F or χ^2 test (strong or long-run Granger causality).

Finally to examine the robustness of the causality results this paper employs both generalized variance decompositions and generalized impulse response approaches proposed by Koop et al.(1996) and Pesaran and Shin (1998). The reason behind employing the generalized versions of these two techniques is that the results from these analyses are invariant to the ordering of the variables entering the VAR system.

Results

The empirical results show a bi-directional causal link between energy consumption and income in Bangladesh, Malaysia and Pakistan for both short-and long-run. While there is a unidirectional causality running from income to energy in both short-and long-run for the rest of the countries (China, India and Thailand). Prices seem to be less influential for most of the countries and in the model for India and Malaysia it proves to be an exogenous variable. For all other countries all the variables interact in a dynamic fashion to restore the long-run cointegrating relationship.

Conclusions

For the countries like China, India and Thailand, where unidirectional causality from income to energy is found, they may contribute to the fight against global warming directly implementing energy conservation measures. For Bangladesh, Malaysia and Pakistan, where bi-directional causality is found, a balanced combination of alternative policies seem to be appropriate. Nevertheless, these countries may initiate environmental policies aimed at decreasing energy intensity, increasing energy efficiency, developing a market for emission trading. Moreover, these countries can invest in research and development to innovate technology that makes alternative energy sources more feasible, thus mitigating pressure in environment. They can, furthermore, increase utilization of public transportation and establish a price mechanism which may encourage the use of renewable and environmental friendly energy sources

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