Energy consumption and economic growth in Asian economies: A more comprehensive analysis using panel data

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Abstract

This paper applies the most recently developed panel unit root, heterogeneous panel cointegration and panel-based error correction models to re-investigate co-movement and the causal relationship between energy consumption and real GDP within a multivariate framework that includes capital stock and labor input for 16 Asian countries during the 1971–2002 period. It employs the production side model (aggregate production function). The empirical results fully support a positive long-run cointegrated relationship between real GDP and energy consumption when the heterogeneous country effect is taken into account. It is found that although economic growth and energy consumption lack short-run causality, there is long-run unidirectional causality running from energy consumption to economic growth. This means that reducing energy consumption does not adversely affect GDP in the short-run but would in the long-run; thus, these countries should adopt a more vigorous energy policy. Furthermore, we broaden the investigation by dividing the sample countries into two cross-regional groups, namely the APEC and ASEAN groups, and even more important results and implications emerge.

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1. Introduction

How to reduce carbon dioxide (CO_2) emissions yet, all the while, maintain stable economic growth has not just given rise to heated rhetoric but has also been one of the major concerns of energy and environmental protection policy in every corner of the world. The 1997 Kyoto protocol commits industrialized nations that have ratified the treaty to reducing their emissions of greenhouse gases, principally CO_2, by around 5.2% below their 1990 levels over the next decade. Proponents have reached a consensus that this is a necessary step, not least because high-growth, industrialized economies produce nearly 40% of the world's human-generated CO_2, a figure that has accelerated in recent years. But, opponents contest such a policy out of fear that the imposition of a set of such so-called 'unrealistic' goals would be detrimental to the global economy, not to mention economic development at home, and subsequently lead to serious unemployment. By extension, many argue that even a shortage of energy would adversely affect income (Masih and Masih, 1998).

Following the work of Stern (1993, 2000), Oh and Lee (2004a,b), Ghali and El-Sakka (2004) and Beaudreau (2005) who argue that energy is an essential factor in production, this paper makes it mark in the extant literature by empirically examining long-run co-movement and the causal relationship between energy consumption and real GDP. It does so based on the aggregate production function. And, rather than the bivariate model attempted in numerous earlier studies, the present research employs a multivariate model with energy consumption (EC henceforth), real GDP (GDP henceforth), labor force (LB henceforth) and real capital stock (*K* henceforth) for 16 Asian economies from 1971 to 2002. This study includes Iran, Jordan and Syria which have not been investigated in most, if not all, recent studies (see Table 1). We also determine the relationship between EC and GDP within a multivariate framework when capital stock and labor input are controlled for; this relationship could feasibly run in either or both directions regardless of whether it is transitory or permanent. For our panel of sample countries, we use a cointegration test which,[1] when compared to the cross-section approach, is more powerful and allows us to increase the degrees of freedom. We then use the fully modified OLS (FMOLS henceforth) technique to estimate the cointegration vector for heterogeneous cointegrated panels. This enables us to correct the standard OLS for bias induced by endogeneity and serial correlation of the regressors. Furthermore, we specify and estimate a dynamic vector error correction model (VECM) that is appropriate for heterogeneous panels and that distinguishes between short-run and long-run causality. Finally, we explore different group issues that are of concern to the Asia Pacific Economic Cooperation (APEC) and the Association of Southeast Asian Nations (ASEAN), and with the results of this study, we are able to examine the deeper characteristics that determine the most efficient policies with respect to energy use.

Most earlier studies have investigated the energy—income/output relationship from one of two perspectives: the demand side (or energy demand function) and the production side (or the aggregate production function). On the demand side, Oh and Lee (2004b) emphasize that this model should be used with three variables, namely energy, GDP and energy price proxied by the consumer price index (CPI). The production side model, however, includes energy, GDP, capital

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[1] Panel cointegration techniques provide new evidence in many areas of economic research, such as economic growth, international finance and macroeconomic issues (e.g., Kao et al., 1999 and Pedroni, 2004). The objective of this paper is to determine if these powerful tools are applicable to energy economic research involving pooled cross-section and time-series datasets.