



# Causal relationship between coal consumption and economic growth in Korea

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## Abstract

This paper investigates the short- and long-run causality issues between coal consumption and economic growth in Korea by applying modern time-series techniques. It employs annual data covering the period 1968–2002. Tests for unit roots, co-integration, and Granger-causality based on error-correction model are presented. The overall results show that there exists bi-directional causality running from coal consumption to economic growth with feedback. This means that an increase in coal consumption directly affects economic growth. Thus, in order not to adversely affect economic growth, Korea should endeavor to overcome the constraints on coal consumption. Moreover, the study lends support to the argument that an increase in real income gives rise to increased coal consumption. © 2006 Elsevier Ltd. All rights reserved.

*Keywords:* Coal consumption; Economic growth; Granger-causality; Unit root; Co-integration; Error-correction model

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## 1. Introduction

In the past two decades, numerous studies have been conducted to examine the relationship between energy consumption and economic growth. The overall findings show that there is a strong relationship between energy consumption and economic growth.<sup>1</sup> However, the fact that there exists a strong relationship between energy consumption

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<sup>1</sup> For example, Ferguson et al. [1] has studied the issue in over 100 countries and found that as a whole there is a strong correlation between electricity consumption and economic growth.

and economic growth does not necessarily imply a “causal” relationship. The relationship may very well run from energy consumption to economic growth, and/or from economic growth to energy consumption. Thus, there have been a number of studies to deal with causality tests between energy consumption and economic growth.<sup>2</sup>

In a summary of the literature on the causal relationship between the consumption of energy, including coal, and economic growth, there are a number of evidences to support bidirectional or unidirectional causality between energy consumption and economic growth. Despite the expanding literature on the study of causal relationships between energy consumption and economic growth, to the best of the author’s knowledge, there have been few studies specifically addressing the causal relationship between coal consumption and economic growth. Recently, Yang [3] found unidirectional causality running from economic growth to coal consumption in Taiwan.

In the course of last three decades, Korea has undergone dramatic economic growth. Real GDP (Gross Domestic Product) has grown at an average annual rate of 7.4% between 1968 and 2002. The manufacturing sector, in particular, has expanded at a high speed. This fast economic growth has boosted the consumption of energy, including coal, rising at an annual rate of about 8.8% during the same period, which implies that energy consumption has been doubled in every 8 years. The figure far exceeds the annual growth rate of real GDP. Korea does not export coal but import 92.1% of coal consumed in 2002.

Korea, dependent on the importation of 97% of its total energy demand due to a shortage of domestic natural resources, has extended coal supply as a reliable energy source and various projects were initiated for stockpiling energy reserves against national emergencies. Multilateral efforts aimed at alleviating the dependence on oil were made, especially after experiencing the oil shocks of the 1970s. Beginning with the cement industry, industries started to replace oil with coal as much as possible, thereby increasing the share of coal in overall energy consumption. Overall, coal consumption has grown by about 3.9% per annum for the period of 1968–2002. According to BP [4], the growth rate is the second largest in the world.

In addition, Korea’s coal consumption level in 2002 was ranked at ninth highest in the world [4]. Thus, the coal supply infrastructure of Korea, a newly industrializing and energy-importing country, is an important ingredient of the economy. In particular, meeting the challenge of climate change in connection with the greenhouse effect may profoundly affect coal consumption [5]. This is because the country’s growth rate of CO<sub>2</sub> emissions is now the highest in the world (an annual average of 10% over the period 1990–1995), Korea will have to deal with the climate change problem within the context of international discussions, and any international agreements that are reached will surely have repercussions in Korea itself.

Therefore, public policy makers in Korea have shown a great deal of interest in uncovering the causal relationship between coal consumption and economic growth. This task has become one of the most important ones for Korea in the present and in the near future. However, there has been no empirical work on the causal relationship between coal consumption and economic growth in Korea. Therefore, the investigation of the causality issue needs to be carried out. A major question concerning this issue is which variable

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<sup>2</sup> For example, an overview of the empirical results for Asian countries or economies is found in Table 1 given in [2].

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