

The causal relationship between electricity consumption and economic growth in the ASEAN countries

S.-H. Yoo*

School of Business and Economics, Hoseo University, 268 Anseo-Dong, Cheonan, Chungnam 330-713, Republic of Korea

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Abstract

This paper investigates the causal relationship between electricity consumption and economic growth among the Association of South East Asian Nations (ASEAN) 4 members, namely Indonesia, Malaysia, Singapore, and Thailand, using modern time-series techniques for the period 1971–2002. The results indicate that there is a bi-directional causality between electricity consumption and economic growth in Malaysia and Singapore. This means that an increase in electricity consumption directly affects economic growth and that economic growth also stimulates further electricity consumption in the two countries. However, uni-directional causality runs from economic growth to electricity consumption in Indonesia and Thailand without any feedback effect. Thus, electricity conservation policies can be initiated without deteriorating economic side effects in the two countries.

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1. Introduction

In the past two decades, numerous studies have been conducted to examine the relationship between electricity consumption and economic growth. The overall findings show that there is a strong relationship between electricity consumption and economic growth. For example, Ferguson et al. (2000) 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.

However, the fact that there exists a strong relationship between electricity consumption and economic growth does not necessarily imply a causal relationship. The relationship may very well run from electricity consumption to economic growth, and/or from economic growth to electricity consumption. These causality issues, therefore, suggest the need to carry out further investigations. A major question concerning this issue is which variable should take precedence over the other—

is electricity consumption a stimulus for economic growth or does economic growth lead to electricity consumption?

Public policy makers in the Association of South East Asian Nations (ASEAN) countries have shown a great deal of interest in the role that electricity consumption plays in economic growth. The electricity infrastructure of the countries is becoming an increasingly important component of the economy. According to the ASEAN Center for Energy, energy consumption in ASEAN would rise to about 583 million tons of oil equivalent (MTOE) in 2020 from 280 MTOE in 2000. Thus, the ASEAN need as much as 461 billion US dollars in investments in the energy sector from 2001 to 2020 to sustain economic growth, and about 323 billion dollars of this, would be needed in the electricity sector.

In particular, greater use of information and communications technologies (ICTs) marks a worldwide transition toward a digital society that may profoundly affect electricity consumption.¹ A digital society implies

*Tel.: +82 41 560 8344; fax: +82 41 563 0135.

E-mail address: shyoo@office.hoseo.ac.kr.

¹For example, Baer et al. (2002) found some interesting points as follows. Telework and ICT-facilitated energy management systems

growing reliance on networked ICTs, with more and more people using the Internet and such other ICTs as cell phones, digital video recorders, digital music players, personal computers, and so on. In addition, as commonly known, electricity has become the preferred and dominant form of energy over expanding portion of economic life in industrial economies, has been a major source of betterment of the standard of living, and has played a crucial role in the technological and scientific advancement (Rosenberg, 1998). To proactively cope with increasing electricity demand accompanying rapid economic growth, the ASEAN should endeavor to uncover the causal relationship between electricity consumption and economic growth and to make appropriate electricity policy. This task has become one of the most important ones for the ASEAN in the present and in the near future (Yong, 2004; Karki et al., 2005).

The purpose of this paper is, therefore, to investigate causality between electricity consumption and economic growth in the ASEAN countries, and to obtain policy implications from the results. To this end, we attempt to provide more careful consideration of the causality issues by applying rigorous techniques of Granger-causality to the ASEAN data. The methods adopted here are in the following fashion. First, stationarity and co-integration are tested; second, error-correction models are estimated if co-integration is detected and the standard Granger-causality method is performed otherwise; finally, the *F*-test is performed to gauge the joint significance levels of causality between electricity consumption and economic growth. Through the analysis, instead of arbitrarily choosing a lag length, suitable information criteria are employed to select the optimum lag.

The remainder of the paper is organized as follows. Literature review on causality studies of electricity consumption and economic growth is provided in Section 2. An overview of the methodology adopted here is presented in Section 3. Section 4 explains the data employed and reports the empirical findings. Some concluding remarks are made in the final section.

(footnote continued)

(EMSs) can have large effects on electricity consumption. Expanded use of both digital process controls in manufacturing and business-to-business e-commerce brings power savings, which is not as large as those for telework and EMS. Business-to-consumer e-commerce has effects on electricity consumption. The power-saving effects of EMSs in the residential sector depend less on ICT advances than on consumers' behavioral response to time-of-use or real time pricing. Telework increases electricity consumption in the residential sector while lowering it in the commercial and industrial sectors, the net effect depending both on the number of teleworkers and the average number of days spent on teleworking.

2. Literature review on the causal relationship between electricity consumption and economic growth

The empirical findings of the causality tests between electricity consumption and economic growth are summarized in Table 1. Interestingly, case studies for European and Latin-American countries cannot be found. Most studies focus on Asian and African nations. Fatai et al. (2004) and Narayan and Smyth (2005) dealt with the causality issue for Australia. Thoma (2004) looked into the causality issue for the United States. In a summary of the literature on the causal relationship between electricity consumption and economic growth, there are a number of evidences to support bi-directional or uni-directional causality, or no causality between electricity consumption to economic growth. In other words, the empirical studies present a different evidence about the causality issues.

Evidence on either direction shall have a significant bearing upon policy. If, for example, there is uni-directional causality running from electricity consumption to economic growth, reducing electricity consumption could lead to a fall in economic growth. Uni-directional causality running from electricity consumption to economic growth was detected by Shiu and Lam (2004) for China, Wolde-Rufael (2004) for Shanghai, China, and Wolde-Rufael (in press) for Benin, Congo, DR., Egypt, Gabon, Morocco, and Tunisia. In addition, Yoo (2005b) found that unidirectional causality runs from nuclear power consumption to economic growth in Korea.

On the other hand, if a uni-directional causality runs from economic growth to electricity consumption, it could imply that policies for reducing electricity consumption may be implemented with little or no adverse effects on economic growth. Uni-directional causality running from economic growth to electricity consumption was revealed by Ghosh (2002) for India, Wolde-Rufael (in press) for Cameroon, Ghana, Nigeria, Senegal, Zambia, and Zimbabwe, and Fatai et al. (2004) and Narayan and Smyth (2005) for Australia.

In contrast, if a bi-directional causality is found, economic growth may demand more electricity whereas more electricity consumption may induce economic growth. Electricity consumption and economic growth complement each other and energy conservation measures may negatively affect economic growth. Yoo (2005a), Jumbe (2004), Morimoto and Hope (2004), and Yang (2000) found bi-directional causality between electricity consumption and economic growth in Korea, Malawi, Sri Lanka, and Taiwan, respectively.

And lastly, no causality in either direction would indicate that policies for increasing or reducing electricity consumption do not affect economic growth, and rise in real income may not affect electricity consumption. No causality between electricity consumption and

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