

A re-examination of the relationship between electricity consumption and economic growth in Malaysia

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ABSTRACT

The purpose of this study is to re-investigate the relationship between electricity consumption and economic growth in Malaysia from 1972:1 to 2003:4. This study adopted the newly developed ECM-based *F*-test [Kanioura, A., Turner, P., 2005. Critical values for an *F*-test for cointegration in the multivariate model. *Applied Economics* 37(3), 265–270] for cointegration to examine the presence of long run equilibrium relationship through the autoregressive distributed lag (ARDL) model. The empirical evidence suggests that electricity consumption and economic growth are not cointegrated in Malaysia. However, the standard Granger's test and MWALD test suggest that electricity consumption and economic growth in Malaysia Granger causes each other. This finding provides policymakers with a better understanding of electricity consumption and allows them to formulate electricity consumption policy to support the economic development and to enhance the productivity of capital, labour and other factors of production for future economic growth in Malaysia.

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1. Introduction

The issue of economic prosperities have always been linked to the international trade and the inflow of foreign direct investment. However, these were the age-old issues in the economic literature. Over the past decades, one of the most debated topic abroad is the relationship between electricity consumption and economic growth. Ferguson et al. (2000) found that there is a strong correlation between electricity consumption and economic growth. This is consistent with Keynes's economic framework where consumption and income are significantly correlated. In the earlier studies, cointegration and Granger causality tests have been extensively used to examine the presence of long run equilibrium and the direction of causality between electricity consumption and economic growth. Unfortunately, the existing empirical studies failed to provide a consensus causality results. Some empirical studies claimed that economic growth induces electricity consumption to change (Chen et al., 2007), while others defended the view that electricity consumption leads to economic growth through the Keynesian multiplier effect (Shiu and Lam, 2004). Jumbe (2004) noted that the causal link between electricity consumption and economic growth is of concern because it has a significant policy implication in a country's economic development. For instance, if electricity consumption

Granger causes economic growth, the goal of development policy should encourage electricity consumption. However, if economic growth is not the result of electricity consumption, policy initiatives that encourage electricity consumption could be detrimental to the economy. Therefore, it is of paramount importance for this study to affirm the causal relationship between electricity consumption and economic growth. The major contribution of this study is to apply the newly developed cointegration and Granger causality tests to re-investigate the existence of long run equilibrium relationship and causality direction between electricity consumption and economic growth in Malaysia. The electricity consumption in Malaysia is of interest because of the following: first, Malaysia's electricity consumption is the second highest among the five ASEAN founding economies.¹ The electricity consumption per capita grows rapidly since 1971 and this may be one of the important factors leading Malaysia's economic growth. The plots of the electricity consumption per capita in kilowatt hours (kWh) and the real Gross National Product (GNP) are depicted in Fig. 1.

From the visual inspection, we observed that both series are moving smoothly with an upward trend over the period of 1972–2003. During the period of 1990–2000, electricity consumption per capita in Malaysia has increased from 1194.26 kWh

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¹ ASEAN refers to Association of Southeast Asian Nations and the five ASEAN founding economies are Indonesia, Malaysia, the Philippines, Singapore and Thailand.

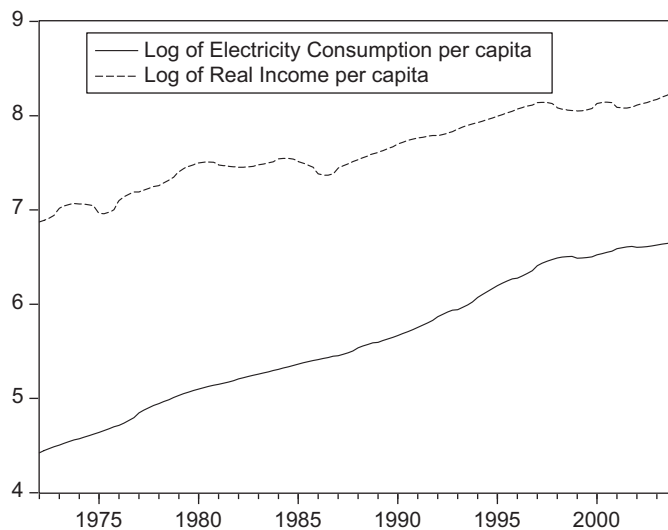


Fig. 1. The plots of log of electricity consumption (kWh) per capita and real gross national products per capita.

per capita to 2774.07 kWh per capita. This may be due to the rapid development of information and communication technologies (ICTs), and other infrastructures that consume high power electricity in Malaysia. Thus, electricity is a vital input of power for Malaysia's economic growth and development, and her vision to become a developed country in year 2020.

Second, to the best of our knowledge, the study on electricity consumption in Malaysia is relatively few, and limited to Yoo (2006) and Chen et al. (2007). Both studies consistently suggested that the variables are not cointegrated using the conventional tests (Engle and Granger, 1987; Johansen and Juselius, 1990). Therefore, these studies employed Granger causality test based on first difference vector autoregressive (VAR) model to determine the direction of causality between electricity consumption and economic growth in Malaysia. In this respect, those existing studies only provide information on short run causality.

Third, Johansen cointegration technique was widely used in examining the long run equilibrium relationship between electricity consumption and economic growth. Nevertheless, couple studies (e.g. Reimers, 1992; Cheung and Lai, 1993) have conducted Monte Carlo experiment to examine the finite sample performance of Johansen cointegration test. These studies found that in finite samples Johansen's cointegration test is bias toward rejecting the null hypothesis of no cointegration. Besides that, Huang and Yang (1996) noted that the Johansen procedure is very sensitive to the assumption that the errors are independent normal. When the errors are not independent normal, the Johansen test has a tendency to find spurious cointegration. Moreover, the Gonzalo and Lee's (1998) simulation results indicate that Johansen's likelihood ratio (LR) test tend to find spurious cointegration with probability approaching to one when the order of integration of the estimated series are not purely $I(1)$ process. Abeyasinghe and Tan (1999) demonstrated that Johansen estimator was the worst among six cointegrating estimators (e.g. Engle and Granger, 1987; Bardsen, 1989; Johansen and Juselius, 1990; Phillips and Hansen, 1990; Engle and Yoo, 1991; Stock and Watson, 1993). In addition, they noted that Johansen estimator is highly sensitive to the lag length of the VAR and the deterministic components (i.e. constant and trend) included into the cointegrating equations. In line to that, Ahking (2002) and Hjelm and Johansson (2005) showed that the results of Johansen tests are highly sensitive to the choice of deterministic components. In practice, Johansen (1992) recommended Pantula procedure to

select a proper model for cointegration test, however, Hjelm and Johansson (2005) argued that this procedure cannot overcome the problem effectively as the procedure tend to select Model 3 (i.e. an unrestricted constant). Therefore, the Johansen's cointegration test results provided by the earlier studies may be biased due to the aforementioned shortcomings.

In this study, we attempt to re-investigate the relationship between electricity consumption and economic growth in Malaysia to fill the detected gaps mentioned above. This study differs from the existing studies in at least three dimensions: First, we employ the Gandolfo (1981) annual to quarterly data interpolation technique to overcome the finite sample size problem. Zhou's (2001) Monte Carlo evidence shows that increasing the data frequency will improve the statistical test properties. Thus, the use of high-frequency data through the interpolation technique may improve the power of the statistical test used in this study.

Second, to ascertain the long run equilibrium relationship between electricity consumption and economic growth in Malaysia we employ the newly developed error-correction model (ECM)-based F -test procedure (Kanioura and Turner, 2005), within an autoregressive distributed lag (ARDL) framework. If the variables are cointegrated, Bardsen's (1989) method will be used to derive the short and long run coefficients from the estimated ARDL model. Third, the earlier studies on electricity consumption and economic growth in Malaysia only provide the short run causality with the VAR model because the variables are not cointegrated. In this study, we will perform the modified Wald (MWALD) test through the augmented VAR model (Toda and Yamamoto, 1995) to determine the long run causality direction between electricity consumption and economic growth in Malaysia. One of the most important features of this test is that without knowing the information of the order of integration or cointegration, the test remains valid in examining the long run causality with data at the level (see Bhattacharya and Mukherjee, 2002a, b; Lau and Chan, 2003). Furthermore, the use of MWALD test may reduce the likelihood of making wrong decision on the orders of integration and cointegration. Another advantage of using MWALD test is because of its simplicity. On the other hand, the Granger's test with VAR model will be used to determine the direction of short run causality.

The remainder of this paper is organised in the following manner. A brief literature reviews will be presented in Section 2. The discussion on the data and econometric techniques used in this study are demonstrated in Section 3. Lastly, Sections 4 and 5 report the empirical results and conclusion, respectively.

2. Literature reviews

The relationship between energy consumption and economic growth was first discussed by Kraft and Kraft (1978) with the United States data from 1947 to 1974. They found that the causality runs from economic growth to energy consumption. Over the past decades, researchers have extended their idea to examine the relationship between electricity consumption and economic growth. The earlier empirical findings of the causality direction between electricity consumption and economic growth can be summarised in Table 1. A conclusion that we can drawn from Table 1 is that the causal link between electricity consumption and economic growth remains controversial.

Altinay and Karagol (2005) employed the MWALD test to examine the causality direction between electricity consumption and economic growth in Turkey over the period of 1950–2000. The MWALD test evidence showed that electricity consumption Granger causes economic growth in Turkey, but there is no

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