



Electricity consumption–growth nexus: The case of Malaysia

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ABSTRACT

The goal of this paper is to model the relationship between electricity consumption and real gross domestic product (GDP) for Malaysia in a bivariate and multivariate framework. We use time series data for the period 1971–2003 and apply the bounds testing approach to search for a long-run relationship. Our results reveal that electricity consumption, real GDP and price share a long-run relationship. The results of the autoregressive distributed lag (ARDL) estimates of long-run elasticity of electricity consumption on GDP are found to be around 0.7 and statistically significant. Finally, in the short-run, the results of the causality test show that there is a unidirectional causal flow from electricity consumption to economic growth in Malaysia. From these findings we conclude that Malaysia is an energy-dependent country, leading us to draw some policy implications. This paper adds support and validity, thus reducing the policy makers concern on the ambiguity of the electricity and growth nexus in Malaysia.

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1. Introduction

Over the past three decades the relationship between energy consumption and economic growth has been a major issue of debate among economists and policy makers. Currently, in Malaysia, the increasing cost of energy has set the pace for conservation policies. The government is also continuously reviewing its energy policy to ensure sustainability of the energy resources (Mohamed and Lee, 2006). Although Malaysia has been fortunate to be relatively well endowed with fossil sources of energy and managed to meet the energy demand, however, in recent years significant growth in the energy demand is recorded. In 2004, the growth in electricity demand was 9.1% and, it is way above the gross domestic product (GDP) growth of 7.5% (Pusat Tenaga Malaysia, 2004). Projection by Gan and Li (2008) shows that total primary energy consumption would triple by 2030 while the final energy demand is projected to reach 116 mega ton of oil equivalent (Mtoe) by 2020 based on 8.1% annual growth rate (Keong, 2005). In addition, the estimated average annual electricity demand is expected to grow by 8.87% (Keong, 2005) and among the ASEAN countries, Malaysia is one of the countries that recorded high energy per capita and electricity intensity over the years (Pusat Tenaga Malaysia, 2004; Shrestha et al., 2009). Besides, the industrial sectors are projected to absorb 50% of the projected energy

demand of 116 Mtoe (Keong, 2005). The growing energy demand and high dependency on electricity demand by the manufacturing sectors warrant attention since formulation of wrong energy policies would adversely affect the sectors and consequently the country's growth.

In this literature on applied energy economics, for one to provide reliable results one should be certain that regardless of models and estimation techniques used, the results are robust. In this study, we use a recent dataset and two different model specifications (bivariate and trivariate) that are commonly used in the literature of energy and growth to reduce the gap of ambiguity in research findings on Malaysia. This approach allows us to check the robustness of the empirical outcome of the causal relationships. Owing to the use of single country as a case, this study overcomes the country-specific differences present in studies using pooled data and allows the interpretation of the result to take into account the institutional, structural and policy reforms of that country more precisely. It also leaves more room for the study to draw better policy implications pertaining to the country under study.

Another issue that we address is the one that relates to small sample sizes. In this regard, Lee (2005) and Mah (2000) have cautioned researchers on the use of short data spans, which eventually lower the power of the cointegration analysis. Mah (2000) stated that the error correction model (Engle and Granger, 1987), Johansen (1988) and Johansen and Juselius (1990) methods are unreliable for studies that have small sample.² To remedy these

² Reinsel and Ahn (1992) and Reimers (1992) suggest the correction of trace statistics to remedy the small sample biasness in Johansen cointegration.

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Table 1
Summary of the literature review.

Authors	Time period	Countries	Methods and tests used	Major findings (causality)
Altınay and Karagol (2005)	1950–2000	Turkey	Toda and Yamamoto (1995)—MWALD	Energy → GDP
Ang (2008)	1971–1999	Malaysia	Johansen; Granger causality—VECM	GDP → energy
Chen et al. (2007)	1971–2001	10 developing Asian countries	Pedroni (1999, 2004) test; ECM	Energy ↔ GDP
Tang (2008)	1972:1–2003:4	Malaysia	Kanioura and Turner's ECM-based <i>F</i> -test; Granger and MWALD causality	Electricity ↔ GDP
Ghosh (2009)	1970–2006	India	ARDL bounds testing approach	Short-run: GDP → electricity
Halicioglu (2009)	1960–2005	Turkey	Bounds testing; Granger causality	Energy → GDP
Lee and Chang (2008)	1971–2002	16 Asian countries	Panel cointegration techniques	Energy → GDP
Masih and Masih (1996)	1955–1990	India, Pakistan, Malaysia, Singapore, Indonesia and the Philippines	Johansen and Juselius (1990); VECM	No relationship
Mehrara (2007)	1971–2002	Iran, Kuwait and Saudi Arabia	Toda and Yamamoto (1995); ECM	GDP → energy
Mozumder and Marathe (2007)	1971–1999	Bangladesh	Johansen (1988) and Johansen and Juselius (1990); VECM	GDP → electricity
Narayan and Smyth (2009)	1974–2002	6 Middle Eastern countries	Panel cointegration test; panel Granger causality test	Electricity ↔ GDP
Odhiambo (2009)	1971–2006	Tanzania	ARDL-bounds testing	Energy → GDP
Payne (2009)	1949–2006	United States	Toda and Yamamoto (1995)	Electricity → GDP
Squalli (2006)	1980–2003	OPEC members	Toda and Yamamoto (1995)—MWALD	No relationship
Yoo (2006)	1971–2002	Indonesia and Thailand	Johansen and Juselius (1990)	Energy → GDP
		Malaysia and Singapore	Granger—VAR	GDP → electricity
Yuan et al. (2007)	1978–2004	China	Johansen and Juselius (1990); Hodrick–Prescott filter	GDP ↔ electricity
				Energy → GDP

econometric issues in estimation, a relatively recent technique known as the bounds testing approach to a long-run relationship has become popular. Several recent studies have applied the bounds test in sample sizes of around 30 observations (see, for instance, Narayan and Narayan, 2005a, b). The popularity of this test is also due to the availability of small sample size critical values, which are now available in Narayan (2005).

Against this background, the goal of this paper is to examine the relationship between real income, electricity consumption and price using annual data for the period 1971–2003. This study makes two contributions to the literature. First, this study uses the bounds testing approach shown to have better statistical properties compared with existing tests. This will add precision and reliability to our results and hence will give credence to policy implications derived from our work. Second, while a number of studies have been done that include Malaysia, these studies use either panel data or bivariate framework that ignores country specific effects and omitted variables biasness, respectively (Sari and Soytas, 2009; Chang et al., 2001; Stern, 2000). Therefore, it is necessary to study countries individually using a multivariate framework. To the best of our knowledge, this will be the first single-country study on Malaysia, modeling electricity consumption, electricity price and GDP in a multivariate framework.

The other sections of the paper are organized in the following way. In Section 2, we provide a brief overview of the related literature on the causal relationship between energy consumption and economic growth. The empirical model is described in Section 3. Section 4 reports the empirical evidence and, finally, the policy implications and concluding remarks are provided in Section 5.

2. Brief literature review on the energy–growth nexus

It is important for policy makers in Malaysia to understand the relationship between energy consumption, particularly the electricity demand and economic growth. The debate focuses on whether energy causes economic growth or economic growth causes energy consumption or a bi-directional relationship exists.

The direction of causality between these variables is important to policy makers in order to implement the energy conservation policy (Jumbe, 2004). For example, if we find evidence of a positive unidirectional causality running from income to energy consumption, it implies that the country does not depend on energy for economic development. Therefore, the country can adopt energy conservation policies without any detrimental effect on economic growth. If, however, there is a unidirectional causality running from energy consumption to income, it indicates that the country is dependent on energy consumption for economic growth. As a result, energy conservation policies may harm economic growth (Narayan and Singh, 2007).

However, the results pertaining to the causal relationship between economic growth and energy consumption have been mixed and remain ambiguous. A summary of the literature review is provided in Table 1. Some recent studies have found that causality runs from economic growth to energy consumption (Ghosh, 2009; Mozumder and Marathe, 2007; Mehrara, 2007) while other studies have found that causality runs from energy consumption to economic growth (Odhiambo, 2009; Halicioglu, 2009; Yuan et al., 2007; Squalli, 2006; Altınay and Karagol, 2005). There are also some studies that found no causal (Payne, 2009; Masih and Masih, 1996) and bilateral causality (Chen et al., 2007; Narayan and Smyth, 2009) relationship between economic growth and energy consumption. According to Masih and Masih (1998) and Hondroyannis et al. (2002) the main reason for these conflicting empirical results is due to differences in institutions, structural reforms and policies adopted by different countries. In addition, the use of different econometric estimation techniques and sample periods also influences the results.

It is evident that in case of Malaysia, two of the studies established a bi-directional causality (Tang, 2008; Yoo, 2006), two found unidirectional (Ang, 2008; Lee, 2005), while the other (Masih and Masih, 1996) found no causality. On the whole, the literature seems to show mixed evidence of energy–income causality in Malaysia depending on data, period of study and methodology employed. This has motivated the need to reinvestigate the notion of causality between energy consumption and