DO ENERGY-ENVIRONMENTAL KUZNETS CURVE HYPOTHESIS SUSTAIN IN THE ASIAN REGION?

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Keywords

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Overview

As of 2016, Asian region holds more than half of the world's population and how the economy of this region develops will have huge impact on the climate change problem. Most climate scientists suggest that the main cause of climate change is due to increased greenhouse gas emissions from economic activities. It is known that the use of fossil fuels is the major source of greenhouse gas emission from economic activities. However, energy consumption continues to increase as the world's economy grows. Thus, it is becoming more imperative to understand how economic development is related to energy consumption.

Recently, many studies are investigating the relationship between energy consumption and economic growth under the Energy-Environmental Kuznets curve (EEKC) hypothesis (Pablo-Romero and Jesus 2016; Luzzati and Orsini 2009; Suri and Chapman 1998). Like the environmental Kuznets curve, EEKC hypothesizes an inverted-U shape relation between energy consumption and income per capita. It states that as GDP per capita of one country increases the level of energy consumption also increases to a certain level, but beyond some level of GDP per capita this trend reverses, which is related to improvement in energy efficiency.

Investigating the EEKC provides an important information for understanding the relationship between economic development and energy consumption. Such information is very valuable for policy makers of the Asian region because this region is one of the fastest-growing economies in the world. However, there are still a few empirical studies that tests the EEKC hypothesis for the Asian region. Hence, the purpose of this study is to investigate whether this hypothesis sustains in the Asian region.

Methods

The standard model we used for testing the EEKC hypothesis is:

$$\ln(\mathrm{EC})_{it} = \alpha_i + \gamma_t + \beta_1 \ln(\mathrm{GDP})_{it} + \beta_2 \ln(\mathrm{GDP})_{it}^2 + \varepsilon_{it} \quad (1)$$

where EC is the total energy consumption per capita, α_i is an intercept parameter that vary across countries or region, γ_t is a parameter that vary by years, and GDP is the GDP per capita. We hypothesized that the EEKC hypothesis will hold if $\beta_1 > 0$ and $\beta_2 < 0$ holds in equation (1).

We estimated the model with panel data. First, we performed a panel data regression analysis. We analyzed the pooled OLS, fixed effects model, and random effects model and configured which model is the statistically appropriate model by performing the Hausman (1978) and F tests.

Second, we conducted panel cointegration tests among EC, GDP, and squared-GDP. We first performed the panel unit root tests with intercept and trend. The Levin-Lin-Chu (2000) , Breitung (2000), Im-Pesaran-Shin (2003) tests are used for this purpose. Once the order of integration for the time series data are configured, we performed the Pedroni (1999, 2004) and Kao (1999) panel cointegration tests. Finally, when cointegration tests revealed cointegrating relationships, the Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS) models are applied to estimate equation (1).

The energy consumption and GDP per capita data are obtained from the World Bank collection of development indicators. We used the yearly data for the 1984-2013 period. The countries and regions of Asian region we used for the panael data are Australia, Bangladesh, Brunei Darussalam, China, Hong Kong, India, Indonesia, Japan, Nepal, Malaysia, Mongolia, New Zealand, Pakistan, Philippines, Singapore, South Korea, Sri Lanka, Thailand, and Vietnam.

Results

The Hausman (1978) and F tests suggested that the fixed effects model (FEM) is the most appropriate model for the panel regression analysis. The first column of Table 1 shows the result of the FEM. The GDP per capita has a

positive effect on the energy consumption per capita while the squared-GDP per capita has a negative influence. This suggests that the coefficients of this FEM is consistent with the EEKC hypothesis.

The conditions for estimating the FMOLS and DOLS was satisfied after performing the panel unit root tests and panel cointegration tests. Thus we applied the FMOLS and DOLS models for investigating the EEKC hypothesis. The results of these models are shown in the second and third columns of Table 1. As seen in the table, both models reveal that the coefficients are consistent with the EEKC hypothesis.

Table 1 Energy-environmental Kuznets curve estimation results

	Fixed effects model		FMOL		DOLS	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Intercept	3.92	27.82	na		na	
Ln(GDP)	0.49 ***	12.84	0.36 ***	53.15	0.82 ***	4.33
$Ln(GDP)^2$	-0.01 ***	-4.50	-0.05 ***	-3.55	-0.04 **	-2.41

Note: ***, and ** denotes significance at 1% and 5%.

Conclusions

We investigated whether the EEKC hypothesis sustains in the Asian region for the 1984-2013 period using a panal data including 19 countries and regions of the Asian region. Both the panel regression and panel cointegration models indicated that the EEKC hypothesis holds in the Asian region.

This result imply that as countries and regions of the Asian regions achieve economic development the energy consumption per capita increases to a certain level, but there is a turning point where economic growth leads to decrease in the energy consumption. This result might be indicating that there is a point where economic development contributes to the spread of energy efficient techonology within the country or region which eventually reduces its energy consumption per capita.

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