DETERMINANTS OF RENEWABLE ENERGY DEVELOPMENT IN CHINA

Oluwasola E. Omoju, China Center for Energy Economics Research (CCEER), Xiamen University, China +8618559654314, shollcy@yahoo.co.uk

Overview

China's impressive economic performance in the past decades has resulted in increased energy consumption and carbon intensity. Over the past few years, China's economy has grown at an average of about 7%, exceeding that of the United States and the European Union combined. However, this impressive economic performance has led to increase in energy consumption and carbon (co_2) emission. According to the United States Energy Information Administration (EIA), China's primary energy consumption increased from 18.122 Quad BTU in 1980 to 97.8328 Quad BTU in 2011, an increase of over 400%. Similarly, her electricity net consumption increased form 261.492 billion kilowatthours in 1980 to 571.543 billion kilowatthours in 2012. With the increase in total primary energy and electricity consumption, energy-related carbon emission also increased significantly. As at 2011, China's fossil fuel-related co_2 emission stands at 8715.3072 million metric tons compared to 1448.464 million metric tons in 1980, which makes it the largest co_2 emitting in the world. The current emission in China is almost that of Africa (1152.221), Europe (4305.170), Middle East (1951.808) and Central and South America (1339.470) combined. The current trend of high resource intensity, energy consumption and emission is not sustainable. If current trend continues, China's emission level will undermine global effort to stem climate change and global warming.

The high level of energy intensity and co_2 emission in China has attracted local and international attention, and has called for significant changes to the country's energy strategy and policy. In response to this, measures are being put in place to address the situation. One of the key measures aimed at addresing energy-related co_2 emission in China is increasing the share of renewable energy in the total energy mix. Reducing fossil energy consumption and the resulting co_2 emission in China will to a large extent facilitate the achievement of global target for co_2 emissions and climate change mitigation. Despite the obvious importance of promoting renewable energy adoption in China, there are still significant gaps and limited studies on the factors influencing renewable energy adoption in the country. Against this background, this paper examines the influencing factors of renewable energy consumption in China using data from 1980 to 2011.

Methods

To capture the long run relationship between renewable energy and its influencing factors in China, the Johansen-Juselius cointegration technique is employed. The co-integration analysis which is a property of long run equilibrium provides information about the long run relationship among the variables. The Johansen-Juselius multivariate cointegration model can be expressed as follows:

$$\Delta X_t = \sum_{I=1}^{\gamma-1} \Gamma_i \Delta X_{t-1} + \Pi X_{t-1} + \varepsilon_t$$

Where X_t is the matrix vector respectively, Δ is a symbol of difference operator, ε_t is a matrix vector of residuals. The VECM model has information about the short and long run adjustment to changes in X_t via the estimated parameters Γ_i and Π respectively. Here, the expression ΠX_{t-1} is the error correction term and Π can be factored into two separate matrices α and β, such that $\Pi = \alpha\beta'$, where β' denotes the vector of cointegrating parameters while α is the vector of error correction coefficients measuring the speed of convergence to the long-run steady state. The Augmented Dickey Fuller (ADF) test is employed to test the stationarity of the time series data used in the paper.

To investigate the long run relationship between renewable energy and its influencing factors in China, this study specifies the following model:

$$RE_t = \beta_0 + \beta_1 RGDPG_t + \beta_2 OPEN_t + \beta_3 FDIGt + \beta_4 FIN_t + \beta_5 FUEL_t + \varepsilon_t$$

where RE_t is the share of renewable electricity in total electricity consumption; $RGDPG_t$ is real GDP growth; $OPEN_t$ is trade openness and is depicted by trade as a % of GDP; $FDIG_t$ is foreign direct investment and proxied by the ratio of foreign direct investment to GDP; FIN_t is financial development and is indicated by domestic credit to the private sector as a % of GDP; $FUEL_t$ is the share of fossil fuel in energy consumption; β_0 is the constant and $\beta_1, \beta_2, \ldots, \beta_5$ are the coefficient of the corresponding variables; and ε_t is the error terms.

The data used in the paper are obtained from various sources. RE_t is obtained from the database of the United States Energy Information Administration (EIA). $RGDPG_t$, $OPEN_t$, $FDIG_t$, FIN_t and $FUEL_t$ are obtained from the World Development Indicator of the World Bank. STATA software is used to run the analysis.

Results

Based on the result of the ADF test, all the variables are stationary at first difference, which meets the condition for Johansen cointegration test. After conducting the Johansen cointegration test, it is found that there exists at least one cointegration equation between renewable energy and real GDP growth, trade openness, financial development, foreign direct investment and share of fossil fuel in total energy consumption in China. This indicates that there is a long run relationship between renewable energy and these factors in China. The long run cointegration equation between renewable energy and the determinants in China is expressed below:

$$RE_t = 14.80 - 0.34RGDPG_t + 0.21OPEN_t + 0.73FDIG_t + 0.1FIN_t - 0.64FUEL_t + \varepsilon_t$$
$$\text{Std. Err} \quad (0.0766) \quad (0.0384) \quad (0.1527) \quad (0.0221) \quad (0.1475)$$

The result of the cointegration equation shows that all the variables are significant at 1% significance level, and only the coefficient of real GDP growth does not meet apriori expectation. The result shows that a 1% in real GDP growth leads to a 0.34% reduction in renewable energy adoption. This could be because economic growth increase energy consumption in a proportion that is higher than the increase in renewable consumption. In other words, economic growth may not increase renewable energy consumption in the same proportion as total energy consumption. The result could also be as a result of the economic growth model that China has followed over the years, which is fuelled by fossil fuel consumption and has no regard for environmental protection. Trade openness and foreign direct investment have positive significant impact on renewable energy in China. According to the result, a 1% increase in trade openness and foreign direct investment leads to 0.21% and 0.73% respectively in increase in renewable energy consumption. Trade and foreign direct investment open up the opportunities for the agglomeration of talents and technology transfer, including clean technology. Furthermore, the activities of foreign firms help to develop local capacity in terms of skills development and technological development. Financial development has a significant positive impact on renewable energy in China. A 1% increase in financial development leads to 0.1% increase in renewable energy adoption. As the financial sector develops, the capacity to provide credit facilities to finance major projects such as clean energy technological development and other forms of renewable energy technologies increases. The share of fossil fuel in total energy consumption has a negative significant impact on renewable energy adoption in China. A 1% increase in the share of fossil fuel in energy consumption leads to a 0.64% reduction in renewable energy consumption in China. This explains the power of the lobby of conventional energy in underming renewable energy. China is the largest primary energy consumer in the world, and over 50% of energy consumption in the country is sourced from fossil fuel. There is high possisbility that investors in the fossil fuel sector would enhance efforts to undermine renewable energy policies.

Conclusions

This study examines the long term determinants of renewable energy in China using Johansen cointegration technique. The study finds that real GDP growth undermine renewable energy in China. This could be because the size of renewable energy does not increase in the same proportion as the size of total energy consumption. Also, foreign diret investment and trade openness significant promote renewable energy in China. Both engender talent agglomeration, human capital development and technology transfer, which are conducive for the development and dissemination of renewable energy. Financial development also has a positive significant impact on renewable energy. As the financial sector develops, it develops the capacity to finance clean energy technology projects. However, the risks involved in financing renewable energy projects due to uncertainties in future climate policies and long payback period undermine the impact of the sector on renewable energy development. Fourth, conventional fossil fuel have significant negative impact on renewable energy.

Based on the findings of the study, the following policy suggestions are recommended to promote renewable energy adoption in China. First, the Chinese government need to reduce obsession with economic growth and give priority to renewable energy in order to ensure a low-carbon and sustainable economic development. Second, there should be continuous efforts to open-up the economy and attract foreign direct investment in order to enhance import of advanced technologies, talents and skills. Third, the financial sector should be strengthened and supported to improve their capability to finance clean energy technology investments. This could be done by providing government guarantees for projects that promotes renwable energy development and dissesmination. Fourth, the Chinese government should decisively deal with the lobby influence of the fossil fuel industry on renewable energy development. Thus, deliberate measures should be taken to significantly reduce fossil fuel consumption.