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What is the relationship between energy consumption and economic development? New evidence from a rapidly growing economic development region

Mengmeng Hu[1] · Yafei Wang[2] · Beicheng Xia[2] · Guohe Huang[3]

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Abstract
Experiences worldwide indicate that the relationship between energy consumption and economic development is complex. Guangdong Province has experienced a more than threefold increase in GDP since 2005, but it is not clear whether rapid economic growth is at the cost of a large amount of energy consumption. In this study, we employ spatial autocorrelation and hotspot analysis to discover the spatial agglomeration of GDP per capita and energy intensity in Guangdong, China, from 2005 to 2018. Furthermore, panel vector autoregression coupled with a system generalized method of moments is performed to examine the dynamic causal relationship between energy consumption and economic growth under the framework of the Cobb–Douglas production function. We used a multivariate model and grouped studies based on the differences in regional economic development and the results with similar research. The results show that the GDP per capita of the Pearl River Delta (PRD) is significantly higher than that of the peripheral municipalities. However, energy intensity shows an entirely different spatial distribution. The development of the regional economy depends on its own "assembling effect". In regions with significant differences in economic development, it is necessary to conduct grouping studies; otherwise, the overall results will not represent partial results. GDP explains approximately 68.3% of the total variation in energy consumption in the PRD but only approximately 34.5% of that in the peripheral municipalities. We do not confirm Granger causality between energy consumption and economic development. Guangdong can decrease its energy consumption growth without substantially sacrificing its economic growth. The contribution of this study is to propose an analytical framework of the relationship between energy consumption and economic development that integrates time and space perspectives to account for spatial effects in panel analysis.

Keywords Economic development · Energy consumption · PVAR model · Spatial statistics · Guangdong

✉ Beicheng Xia
xiabch@mail.sysu.edu.cn

Extended author information available on the last page of the article