

Heterogeneous Impact of Low Carbon Regulations on Provincial Carbon Efficiency in China

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Abstract

Under the framework of the Paris Agreement, China has put forward independent contribution commitments including "dual carbon targets", improving carbon efficiency, and adjusting energy structure. This article divides 30 provinces in China into three categories based on the annual growth rates of CO₂ emissions, GDP, and GTFP: sustainable, relatively sustainable, and unsustainable. Using the year 2016, when the Paris Agreement came into effect, as a time node, the article explores the heterogeneous impact of low-carbon regulations on inter provincial carbon efficiency in China using the mixed radial data envelopment analysis (DEA-EBM) method, econometric models, and structural equation modeling (SEM). The main conclusion is that: (1) From 2010 to 2016, China's carbon efficiency grew at an average annual rate of 1%, and the growth rate increased to 2% after 2016, indicating that low-carbon regulations have a promoting effect on the development of low-carbon economy; (2) Technological change is the core driving force for carbon efficiency improvement, mainly derived from magnitude technological change, while input biased and output biased technological changes generally show a regression trend, indicating that energy-saving and low-carbon policies generally lack incentives for technological progress; (3) The impact of low-carbon regulations has inter provincial heterogeneity. Low carbon regulations have improved carbon efficiency in sustainable provinces (accounting for 33.3%) by promoting the joint progress of resource allocation efficiency (51.3%) and technological change (48.7%). Although relatively sustainable provinces (accounting for 30.0%) have made progress in both technology and efficiency, the "compliance cost" effect has suppressed their ability to promote efficiency through scale optimization. In unsustainable provinces (accounting for 36.7%), the impact of low-carbon regulations on resource allocation efficiency and technological progress is not significant. Based on the above research results, it is proposed that incentivizing biased green technology progress through energy-saving and low-carbon regulations is a key path to promote low-carbon development in China.

Keywords

Paris Agreement, Low-Carbon Regulation, Carbon Efficiency, Heterogeneity