

Assessing City-level Carbon Reduction Performance Under China's Emissions Trading Scheme: A Rank Confidence Set Approach

Min Zhu*

School of Economics and Management, China University of Petroleum (East China), Qingdao, China

Email address:

zhumin_512@163.com (Min Zhu)

*Corresponding author

Abstract

Under China's "Dual-Carbon" goals, scientifically evaluating the effectiveness of carbon emissions trading (ETS) pilot policies is crucial for the development of a unified national carbon market. Existing studies typically rank pilot cities based on point estimates of policy effects, often overlooking the uncertainty arising from estimation errors and multiple comparisons, which can lead to biased policy evaluations. To quantify this statistical uncertainty in city ranking, this study utilizes panel data from 282 prefecture-level cities in China. First, the city-level policy effects of ETS pilots are estimated using a multi-period difference-in-differences model, along with the corresponding standard errors for each pilot city. Building on these estimates, we apply the Rank Confidence Set methodology to construct 95% confidence sets for both individual cities and the full sample, enabling rigorous statistical inference of ranking uncertainty. The results indicate that joint confidence sets adjusted for multiple testing effectively control the overall error rate in rank inference and substantially enhance the statistical reliability of city rankings. Furthermore, the stepwise procedure used to construct refined confidence sets narrows the ranking intervals, improving the precision of rank identification. Notably, several pilot cities that appear at the top in point-estimate rankings exhibit confidence intervals spanning multiple ranking tiers, suggesting that differences in emission reduction performance between cities are not statistically significant. These findings demonstrate that reliance on point estimates alone may exaggerate perceived differences among cities, whereas the Rank Confidence Set approach provides a statistically robust measure of uncertainty in policy evaluation. This methodology offers a valuable tool for assessing ETS pilot performance and supports evidence-based design of regional carbon reduction policies.

Keywords

Emissions Trading Scheme, Rank Confidence Set, Statistical Uncertainty, Ranking Inference