Impacts of investing renewable energy on human capital and future sustainability:

A framework of inclusive wealth analysis at province-level in China

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１．はじめに

The Inclusive Wealth (IW) Index, which combines economic, environmental and social factors, provides a tool for assessing sustainability but lacks the ability to predict future scenarios. Renewable energy (RE) provides a pathway to reduce emissions, but also poses economic and infrastructural challenges. This study proposes a new framework combining computable general equilibrium (CGE) and Greenhouse Gas-Air Pollution Interactions and Synergies (GAINS) models to estimate future IW, focusing on RE development, technological innovation and carbon tax. Using Shandong Province as a case study, the framework provides a comprehensive assessment of the impacts of RE development on the economy, carbon damage and health capital.

２．分析方法

The basic production, marketing, income and expenditure is simulated by Computable General Equilibrium (CGE) model with LBD module in RE power sector. To incorporate health impact brought by RE development, this paper combines CGE model with GAINS-China model. The GAINS-China model can calculate annual average $PM_{2.5}$ concentration data at province level.

３．分析結果

Unit:	2025	2030	2035	2040	2045	2050
Health						
BaU	15066586	15066599	15066603	15066601	15066607	15066614
CT	15066598	15066614	15066620	15066625	15066629	15066637
Change	11.73	14.6	16.9	23.98	22.09	22.67

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Produced						
BaU	626257	640976	673318	671569	631532	570961
CT	626387	641585	674288	672602	632554	571896
Change	130	609	970	1033	1022	935
Carbon						
BaU	-49957	-51203	-53784	-53207	-49193	-43385
CT	-47915	-46475	-45811	-44203	-39383	-32497
Change	2042	4728	7973	9004	9810	10888
Total						
Change	2184	5351	8960	10061	10854	11845

Overall, the carbon tax imposes positive impact on future sustainability as the sum of health, produced capital and carbon damage is positive and the higher carbon tax leads to more sustainability in the long term. However, over 90% of the values change of the IW is contributed by reduction of carbon damage or, the direct carbon abatement that the less carbon emission induced by carbon tax is not significant to improve health and produced capital. In addition, we find that health and produced capital increased less after 2040. While health capital illustrates a rebound due to improved RE, the shifts in produced capital from dirty to clean declines caused by marginal effect of carbon tax.

４．結論

This research successfully establishes a framework to analyze future sustainability based on a numerical framework for economic and policy evaluation and a framework for assessment on impacts on human health through future potentials and costs for air pollution reduction, referring to CGE and GAINS model, respectively. By combining these two models, this study firstly proposes a method to estimate future sustainability via IW index, dividing into health capital, produced capital and carbon damage.

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