Will low-carbon transformation cause income inequality? Empirical evidence from the low-carbon city pilot policy

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Abstract

The deepening of China's low-carbon transformation will inevitably have a remarkable impact on social issues such as income and equity.

This study calculates the **income inequality index** of cities in China using district- and county-level nighttime light data, and empirically estimates the impact of China's **pilot policy for low-carbon city (LCPP)** on income inequality.

The study shows that the LCPP can substantially alleviate income inequality in cities. The mechanism analysis illustrates that the mitigating effect of the pilot policy on income inequality is mainly due to its enhancing effect on the upgrading of labor skill structure. Further research demonstrates that the impact of pilot policy on income inequality is significantly different.

Introduction

In September 2020, the Chinese government announced at the United Nations that it would endeavor to peak carbon dioxide (CO_2) emissions before 2030 and attain carbon neutrality before 2060.

As a profound economic and social systemic transformation, the deepening of the low-carbon transition will remarkably impact social issues. Meanwhile, the United Nations SDGs emphasize the reduction of internal inequality in countries. Hence, it is important to determine whether the low-carbon transition of the Chinese economy and society will lead to income inequality in cities. **The Chinese government introduced the LCPP in 2010 to limit GHG emissions.** As a comprehensive environmental regulation policy that provides a "quasi-natural experiment", this study investigates the effect of policies on income inequality among cities using China's LCPP.

The possible **marginal contributions** of this study are as follows: **First**, it explores the effect of low-carbon transformation on income inequality, which broadens the research scope of LCPP. **Second**, using nighttime light data at the district-and county-level in China, this study constructs the Gini coefficient of cities. **Third**, this study discusses in depth the theoretical mechanism of the impact of LCPP on income inequality from two perspectives: demand-side skill-biased technological progress and supply-side upgrading of labor skill structure.

Theoretical Analysis and Research Hypothesis

By decomposing the Gini coefficient, which measures income inequality, and combining it with the research of Aghion (2002), the following formula is obtained:

$$Gini_t = \mu + \delta LCPP = 1 - \left(\frac{1}{1 + \frac{\beta}{1-\beta}\theta^\gamma (\frac{H_t}{L_t})^\gamma} + \frac{1}{1 + (\frac{H_t}{L_t})^{-1}} \right)$$

Therefore, LCPP can affect income inequality by influencing skill-biased technological progress (θ) on the demand side and upgrading the skill structure of the labor force ($\frac{H_t}{L_t}$) on the supply side. From the above equation, the impact of θ on income inequality is positive, the $\frac{H_t}{L_t}$ will reduce the degree of income inequality.

This study proposes that:

Hypothesis 1a. The LCPP reduces θ and alleviate income inequality.

Hypothesis 1b. The LCPP increases income inequality by θ.

Hypothesis 2. LCPP reduces income inequality by promoting the $\frac{H_t}{L_t}$.

Hypothesis 3a. LCPP may exacerbate income inequality in cities.

Hypothesis 3b. LCPP may alleviate income inequality in cities.

Research Design

This study uses a difference-in-differences (DID) model and the specific model was set:

$$Gini_{it} = \alpha + \beta policy_{it} + \rho X_{it} + \mu_i + \lambda_t + \xi_{it}$$

This study uses nighttime light data from counties and districts in China and constructs the following Gini coefficient indicator to measure income inequality:

$$Gini_{i,t} = \frac{S_1}{S_1 + S_2} = 1 - 2S_2 = 1 - \frac{1}{p_{i,t}l_{i,t}} \sum_{j=1}^{n} (l_{j-1,t} + l_{j,t}) \times p_{j,t}$$

Empirical Analyses

The regression results indicate that implementation of LCPP has reduced income inequality in cities and the LCPP led to an average reduction of approximately 2.7% (0.0098/0.363) in the income inequality index of the pilot cities. Thus supporting **Hypothesis 3a**.

LCPP regresses the mechanism variables including θ and $\frac{H_t}{L_t}$ in turn. The model results show that the LCPP increased income inequality by promoting urban θ, the LCPP reduced income inequality through the $\frac{H_t}{L_t}$. **Hypothesis 1b and Hypothesis 2 is supported.** Moreover, the comparison of the regression coefficients of the two channels indicates the dominant position of the $\frac{H_t}{L_t}$.

The impact of the LCPP on cities' income inequality has heterogeneities in terms of the eastern region, the southern region, the resource-based region, the rate of technological progress with high and low skill bias, and the rate of upgrading of high and low labor skill structure.

Table 1. The baseline regression results of LCPP on income inequality

Variable	gini		gini2		gini (Policy time lag)	
	M 1	M 2	M 3	M 4	M 5	M 6
policy	−0.0098**	−0.0098**	−0.0124***	−0.0122***	−0.0088**	−0.0085**
	(0.0043)	(0.0043)	(0.0033)	(0.0033)	(0.0041)	(0.0042)
Controls	N	Y	N	Y	N	Y
City FE				Y		
Year FE				Y		
Cons	0.3907***	0.5628***	0.4717***	0.4385***	0.3840***	0.5643***
	(0.0082)	(0.1725)	(0.0082)	(0.1348)	(0.0082)	(0.1730)
N	3906	3906	3906	3906	3906	3906
R^2	0.8146	0.8166	0.9462	0.9466	0.8146	0.8165

Conclusions and Policy Implications

This study shows that the LCPP has a significant impact in mitigating income inequality within the city. Moreover, skill-biased technological progress and labor skill upgrading are channels through which the LCPP affects income inequality. The policy mitigates income inequality through the upgrading of labor skill structure channel. Furthermore, the impact of the LCPP on cities' income inequality is heterogeneous.

This provides the following policy implications for boosting low-carbon transformation in cities and mitigating income inequality. First, it is recommended to enhance the regulation of carbon emissions and further expanded the scope of pilot cities. **Second,** we should pay more attention to upgrading the skill structure of the labor force in reducing the income gap of residents. **Third,** continuously improve the LCPP and promote the construction of pilot cities according to local conditions.

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