Public Concern over Carbon Emissions and Its Impact on Government Environmental Governance-A Study Based on the Provincial Baidu-Index in China

Yanyi Li[1], Abdul Rais Abdul Latiff[2*]

{liyanyi@student.usm.my[1], abdulrais@usm.my[2*]}

School of Social Sciences, Universiti Sains Malaysia, 11800 USM, Penang, Malaysia

Abstract. Based on the panel data of 30 Chinese provinces from 2015 to 2021, and using Baidu-index to measure provincial public concern over carbon emissions, this study uses the Fixed Effects Model and Two-Stage Least Squares (2SLS) Regression Model to explore the factors influencing public concern about carbon emissions and their effects on the environmental governance of each provincial government. The results show that public concern for carbon emissions is positively related to the Internet penetration rate, age structure, industrial structure, education level, urban environmental pollution status and economic development level of provinces and that an increase in public concern for carbon emissions has a positive impact on the environmental governance of local governments.

Keywords: Carbon Emissions; Public Concern; Environmental Governance; Baidu-Index

1 Introduction

With the impact of global climate change becoming increasingly prominent, the issue of carbon emission has become a hotspot of concern for governments and the public. In China, the government attaches great importance to the issue of carbon emissions and has made reducing carbon emissions an important strategic goal for national development. To achieve this goal, our Government has formulated a series of national policies, including improving energy efficiency, optimizing the energy structure, promoting the development of clean energy, and strengthening the construction of the carbon emissions trading market. Implementing these policies aims to guide the whole society to participate in carbon emission reduction actions, promote green development, and realize a low-carbon economy.

According to Shen & Wang.(2023)[6] and Han et al.(2022)[9], as the direct beneficiary and participant of carbon emission governance, the public's concern over carbon emissions plays an important role in environmental improvement and green government governance. Therefore, it is of great significance to understand how public concern over carbon emissions affects government governance. The purpose of this study is to reveal the public's concern for carbon emissions and its influencing factors through empirical research, to explore the impact of public concern over carbon emissions on the environmental governance of provincial

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governments, and to provide a basis for the government of China to formulate a more effective carbon emissions policy.

2 Theoretical analysis and research hypothesis

2.1 The effect of public concern over carbon emissions will have on the environment

According to Liu et al.(2023)[1], there is a significant correlation between the increase in public environmental concern and the decrease in the level of environmental pollution. Buntaine, M. T et al.(2024)[2] found that public participation can significantly reduce air and water pollution levels. This suggests that public concern can be an important force in pushing the government to strengthen environmental governance. Therefore, this study proposes hypothesis 1:

Hypothesis 1: The increase in public concern over carbon emissions will have a promoting effect on environmental improvement.

2.2 The effect of public concern over carbon emissions on local government environmental governance

The study by Chen et al.(2022)[10] found that there is a synergistic effect between government environmental governance and public participation. According to Zheng et al.(2013)[3], the increase in public environmental concern can strengthen the degree of government financial intervention, thus promoting green development. Therefore, this study proposes hypothesis 2:

Hypothesis 2: The increase in public concern over carbon emissions will significantly increase the local government's policy formulation and implementation in environmental governance.

3 Research design and statistical analysis

3.1 Data description

In this study, the carbon emission Baidu-index, carbon emissions, and economic data at the provincial level of 30 provinces in China from 2015-2021 are selected to empirically test the factors influencing the public's concern about carbon emissions, and the influence of the public's concern about carbon emissions on the environmental governance behaviors of the provincial governments. The data from 2015-2021 are selected mainly due to the consistency of statistical caliber and data availability. Among them, the data on public concern for carbon emissions come from Baidu-index; the data on carbon emissions in each province come from China Carbon Accounting Database (CEADs); the data on control variables at the city level and the data on environmental pollution and governance and other parts of the data come from China Environmental Yearbook, China Urban Yearbook, China Energy Statistics Yearbook, etc., respectively; and the data on local governments' concern for carbon emissions in the indicators of environmental pollution and governance are collected by hand. The data are collected manually. The text analysis method utilized in this study was informed by the research conducted by Hügel & Davies. (2020)[8] and Wang et al. (2023)[11].

3.2 Definition of variables

3.2.1 Public concern over carbon emissions

This study refers to the research of Zheng, S. Q et al.(2013)[3]and Zhou, K et al.(2024)[4], based on the Baidu-index platform, using the term carbon emission to search, to obtain the Baidu-index of 30 prefecture-level cities from 2015 to 2021, which is used to measure the degree of public attention to carbon emissions. The keyword of carbon emission is selected, and following the processing method of previous literature, the annual total value of the Baidu-index for this term "PC + mobile" is logarithmically processed, to construct the index of the public's concern about carbon emission.

3.2.2 Carbon Emission

Based on the China Carbon Accounting Databases (CEADs), this study obtains data on carbon emissions from 2015-2021 from all provinces in China, which are processed to take logarithms and are used to measure the level of carbon emissions in each province in China.

3.2.3 Provincial governments' environmental governance (Action)

Referring to the studies of Zheng, S. Q et al.(2013)[3] and Ahmad, M et al.(2023)[5], this study uses three data, namely, energy consumption intensity (EI), local government's concern for carbon emissions (GCI), and local financial expenditure on environmental protection (Investment), to measure the environmental governance of each provincial government. The larger the value of GCI and Investment, the higher the level of environmental pollution and governance of the provincial government. The smaller the value of EI, the higher the level of environmental pollution and governance of the provincial government.

3.2.4 Control variables

To control the influence of other factors on the public's concern about carbon emissions, and concerning the practice of important literature in the same field, this study chooses a series of control variables: (1) the level of economic development (GDP) and the regional gross domestic product per capita (GDPPC); (2) industrial structure: the proportion of the secondary industry's output to the city's GDP (INDUSTRIAL); (3) education level: the proportion of students enrolled in ordinary higher education institutions to the total urban population (EDU); (4) the proportion of young people: the proportion of young people (15-64 years old) in the urban population (YOUNG); (5) Urbanisation rate (URBAN); (6) Internet penetration rate(INTERNET); (7) Population (POPU).

3.3 Descriptive statistics

Table 1 shows the definition of the variables and their descriptive statistics.

Table 1 Variable Definitions and Descriptive Statistics

Variable	Definition	Sample size	Mean	Standard deviation
Baidu-Index	Public Attention to Carbon Emissions, the "Carbon Emissions"'s Baidu-Index	210	21180.42	17237.02
Carbon Emission	Provincial apparent CO2 emissions (Metric Tons)	210	399.78	351.69

EI	Energy Intensity: energy consumption per Unit of GDP (tons of standard coal per 10,000 yuan)	210	0.74	0.55
GCI	Attention of local governments to carbon emissions: number of searches for the keyword "carbon emissions" on the official websites of provincial governments	210	101.31	309.24
Investment	Local financial expenditure on environmental protection (RMB billion)	210	180.43	108.36
GDP	Provincial GDP (RMB billion)	210	30070.24	24163.34
GDPPC	GDP per capita per year (10,000 RMB)	210	6.42	3.05
INDUSTRIAL	Share of secondary sector output in provincial GDP (%)	210	0.38	0.08
EDU	Number of students enrolled in general higher education institutions as a proportion of the total urban population (%)	210	0.02	0.01
YOUNG	Share of young people (15-64 years) in the population (%)	210	0.72	0.04
URBAN	Urbanisation rate: share of urban population in total population (%)	210	0.62	0.11
INTERNET	Internet penetration rate(%)	210	60.22	11.10
POPU	Total population of provinces (10,000 persons)	210	4655.24	2908.25

3.4 Model Construction

3.4.1 Influence factor model of public carbon emission concern degree

According to the results of the Hausman test, $p<0.01$, this study selects the individual fixed effects model to test the analysis of the influence factors of public carbon emission concern, also known as the model (1), see equation (1):

$$\begin{aligned}\log(\text{Baidu}-\text{Index}_{it}) = \alpha_0 + \alpha_1 \times \log(\text{Carbon Emission}_{\text{it}}) + \\ \alpha_2 \times \log(\text{GDPPC}_{\text{it}}) + \alpha_3 \times \text{EDU}_{\text{it}} + \alpha_4 \times \text{YOUNG}_{\text{it}} + \alpha_5 \times \text{INDUSTRIAL}_{\text{it}} + \\ \alpha_6 \times \text{URBAN}_{\text{it}} + \alpha_7 \times \text{INTERNET}_{\text{it}} + \text{individual fixed effects} + \varepsilon_{\text{it}}\end{aligned} \quad (1)$$

In this context, "i" represents a city, and "t" represents a year. Baidu-Index is an indicator of public concern for carbon emissions, Carbon Emission refers to the carbon emissions of each province, GDPPC stands for GDP per capita, EDU represents the proportion of students enrolled in regular higher education institutions as a percentage of the total urban population, YOUNG is the proportion of young people aged 15 to 64 in the urban population, INDUSTRY is the proportion of the secondary industry's output value in the city's GDP, and URBAN is the proportion of the urban population in the total population. INTERNET is the Internet penetration rate. "individual fixed effect" stands for fixed effect on individuals. ε_{it} represents the random perturbation term.

3.4.2 Modelling the influence of public concern over carbon emissions on the environmental governance of provincial governments

In order to test the impact of public concern about carbon emissions on the provincial government's environmental governance, we constructed a two-way fixed effects model, also known as model (2), see equation (2):

$$\begin{aligned}\log(\text{Action}_{it}) = \beta_0 + \beta_1 \times \log(\text{Baidu}-\text{Index}_{it})_{\text{lag}} + \sum_{n=1}^{N} \beta_{2n} \times X_{itn} + \\ \text{region fixed effects} + \text{year fixed effects} + \xi_{\text{it}}\end{aligned} \quad (2)$$

In this context, "i" represents a city, and "t" represents a year. n is the provincial government environmental governance variable, and X is other control variable. The term "region fixed effects" refers to the implementation of fixed effects for regions, while "year fixed effects" refers to the implementation of fixed effects for the time, ε_{it} represents the random perturbation term. In this study, three indicators are selected to measure n from three different perspectives: the first indicator is the local financial expenditure on environmental protection (Investment), the second is the local government's concern for carbon emissions (GCI), and the third is the energy intensity (EI).

4 Empirical results and analyses

4.1 Regression results of the model (1)

This study examines the factors affecting the public's concern for carbon emissions based on model (1), and the regression results are shown in Table 2.

The coefficients of $\log(\text{Carbon Emission})$ and $\log(\text{GDPPC})$ are significantly positive at the 5% confidence level, the coefficient of EDU is significantly positive at the 1% confidence level, the coefficients of YOUNG and INTERNET are also positive but not significant, and the coefficient of INDUSTRIAL is significantly positive at the 10% confidence level. positive, and the coefficient for URBAN is negative and insignificant.

This suggests that public concern about carbon emissions is higher in provinces with more carbon emissions, which is similar to the findings of Zheng, S.Q et al.(2013)[3]. In addition, provinces that are wealthier, have higher levels of education, a larger proportion of young people, and higher Internet penetration have higher levels of public concern about carbon emissions, which is also consistent with expectations.

Table 2 Regression Results for Model 1

VARIABLES	$\log(\text{Baidu}-\text{Index})$
$\log(\text{Carbon Emission})$	3.829**(1.599)
$\log(\text{GDPPC})$	1.062**(0.522)
EDU	125.3***(27.28)
YOUNG	0.384(2.568)
INDUSTRIAL	1.310*(0.684)
URBAN	-6.009*(3.380)
INTERNET	0.0106(0.00712)
Constant	-12.24**(5.160)
Individual fixed effects	Yes
Observations	210
R-squared	0.552

Standard errors in parentheses;*** p<0.01, ** p<0.05, * p<0.1

4.2 Regression results of the model (2)

Based on model (2), this study examines the influence of public concern over carbon emissions on the environmental governance of provincial governments, and the regression results are shown in Table 3. Table 3 gives the regression results of the model of the influence

of public concern over carbon emissions on the environmental governance of provincial governments.

The explanatory variable in column 1 is local fiscal spending on environmental protection, and the coefficient of $\log(\text{Baidu}-\text{Index})$ (1st order lag) is positive at the 10% significance level after controlling for population size (POPU), industrial structure (INDUSTRY), and regional and year fixed effects. The explanatory variable in column 2 is the local government's concern over carbon emissions, and the coefficient on $\log(\text{Baidu}-\text{Index})$ (1st order lag) is positive at the 5% significance level after controlling for other influences and fixed effects. The explanatory variable in column 3 is energy intensity, and the coefficient on $\log(\text{Baidu}-\text{Index})$ (1st order lag) is negative at the 1 percent significance level after controlling for other influences and fixed effects.

Model 2 shows that in the provinces where the public concern over carbon emissions is higher (or the concern increases faster), the local government will spend more on environmental protection in the next period of local finance and that the increase in public concern over carbon emissions can promote the local government's concern for carbon emissions to a certain extent, the findings are consistent with those of Liu et al. (2023)[7], and in addition, it can also effectively bring about a reduction in energy consumption at the provincial level, the research hypotheses were tested.

Table 3 Regression Results for Model 2

VARIABLES	log(Investment)	log(GCI)	EI
$\log(\text{Baidu}-\text{Index})\_\text{lag}$	0.00126*(0.000642)	0.414**(0.172)	-0.130***(0.0452)
log(GDP)	-	0.755**(0.335)	-
log(POPU)	0.128***(0.000637)	-0.690*(0.387)	-0.385***(0.0449)
INDUSTRIAL	-0.0121**(0.00589)	1.515(1.355)	2.123***(0.415)
Constant	1.055***(0.00556)	0.445(1.230)	3.237***(0.391)
region fixed effects	Yes	Yes	Yes
year fixed effects	Yes	Yes	Yes
Observations	210	208	210
R-squared	0.997	0.283	0.486

Standard errors in parentheses;*** p<0.01, ** p<0.05, * p<0.1

4.3 Robust Test

To verify the robustness of the results of the regression model, we replaced the explanatory variable of public concern about carbon emissions in the original model with the Baidu-index of the Carbon Neutral and conducted three regression analyses of the model (2) respectively. This study found that the robustness test results still support the regression conclusion of 3.2, the coefficients all passed the significance test, and the original hypothesis still holds.

5 Conclusion

This study has the following main conclusions: (1) public concern over carbon emissions is positively related to the age structure, industrial structure, urban environmental pollution

situation, and economic development level of the province, while the improvement of the public's education level will also make them pay more attention to environmental problems; (2) the improvement of the public concern over carbon emissions can effectively push the local government to pay attention to the environmental problems and increase financial expenditures through the increase of financial expenditures, improving industrial structure, improving technology, etc. to improve the regional environmental pollution situation.

Based on the above conclusions, this study proposes the following research insights: First, the government should open up the channels of public participation in environmental governance, make full use of the environmental information fed back by public concern, and make up for the information asymmetry. Second, deepen the reform of the media industry, give full play to the role of media supervision, promote the development of high-quality media reports, and better play the supervisory role and public opinion guidance function of the news media. Thirdly, timely adjustments should be made based on public feedback to improve environmental regulation policies and enforce the law impartially. The government should increase financial expenditure on environmental protection to prevent and control environmental pollution at source.

References

[1] Liu, N., Liu, Y., & Yu, X. (2023). The impact of public environmental concern on environmental pollution: The moderating effect of government environmental regulation. Plos one, 18(8), e0290255.

[2] Buntaine, M. T., Greenstone, M., He, G., Liu, M., Wang, S., & Zhang, B. (2024). Does the Squeaky Wheel Get More Grease? The Direct and Indirect Effects of Citizen Participation on Environmental Governance in China. American Economic Review, 114(3), 815-850.

[3] Zheng, S. Q., Wan, G. H., Sun, W. Z., & Luo, D. L. (2013). Public demands and urban environmental governance. Management world, 6(72), r84.

[4] Zhou, K., Zhang L.R., Tao Y.Q.,&Wang Y.X.(2024).Public Environmental Concerns and Corporate Green Governance - A Study Based on the Urban Baidu-Index.R&D MANAGEMENT,(01),1-13.

[5] Ahmad, M., & Satrovic, E. (2023). Role of economic complexity and government intervention in environmental sustainability: Is decentralization critical?. Journal of Cleaner Production, 418, 138000.

[6] Shen, C., & Wang, Y. (2023). How does public concern about climate change affect carbon emissions? Evidence from large-scale online content and provincial-level data in China. Journal of Cleaner Production, 426, 139137.

[7] Liu, Z., Tang, Y., Wilson, J., Tao, X., Lv, B., Wang, Z., ... & Zhao, W. (2023). Influence of government attention on environmental quality: an analysis of 30 provinces in China. Environmental Impact Assessment Review, 100, 107084.

[8] Hügel, S., & Davies, A. R. (2020). Public participation, engagement, and climate change adaptation: A review of the research literature. Wiley Interdisciplinary Reviews: Climate Change, 11(4), e645.

[9] Han, Y., Kou, P., & Jiao, Y. (2022). How does public participation in environmental protection affect air pollution in China? a perspective of local government intervention. Polish Journal of Environmental Studies, 31(2), 1095-1107.

[10] Chen, S., & Liu, N. (2022). Research on citizen participation in government ecological environment governance based on the research perspective of “dual carbon target”. Journal of Environmental and Public Health, 2022.
[11] Wang, B., Jiang, Z., Cheng, D., & Wang, Z. (2023). Exploring public attention and sentiment toward carbon neutrality: evidence from Chinese social media Sina Weibo. Frontiers in Psychology, 14, 1200824.