Examining Public Concern about Global Warming and Climate Change in China

Xinsheng Liu*, Feng Hao†, Kent Portney‡ and Yinxi Liu§

Abstract

To what degree are Chinese citizens concerned about the seriousness of global warming and climate change (GWCC) and what are the key factors that shape their concern? Drawing theoretical insights from extant literature and using recent data from a national representative public survey (N = 3,748) and provincial environmental and economic statistics, this study, the first of its kind, examines the variations and determinants of Chinese GWCC concern. Our data show that in China, compared to other countries, average public concern about GWCC is relatively low, and concern varies greatly among Chinese citizens, across different provinces and between coastal and inland areas. Statistical analyses reveal that the levels of Chinese GWCC concern are significantly influenced by individual sociodemographic characteristics, personal post-materialist values, and regional economic dependency on carbon-intensive industries. Specifically, women and younger Chinese with greater post-materialist values are more concerned about GWCC than their counterparts, and citizens from provinces with higher economic dependency on carbon-intensive industries tend to be less concerned about GWCC than people from provinces with lower carbon dependency. We discuss key policy implications and make suggestions for future research in the conclusion.

Keywords: China; public concern; global warming and climate change; survey analysis; policy

The issue of global warming and climate change (GWCC) is one of the most complicated and challenging facing the world today. Mostly driven by greenhouse gas (GHG) emissions from the combustion of fossil fuels, GWCC are having a growing detrimental impact on the environment and society.[1] China,

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1 IPCC 2014.

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the world's largest GHG emitter since 2006, has pledged to reduce its GHG emissions and increase non-fossil energy sources under the 2009 Copenhagen Accord and the 2016 Paris Agreement.[2] In recent years, the Chinese government has passed strategic plans and specific policies to address GWCC through national programmes aimed at climate change mitigation and adaptation.[3] Policy implementation and success largely depend on public support. Studies have shown that public perception and concern about GWCC risk are strong predictors of citizens' willingness to support climate policies.[4]

Despite the importance of the link between public opinion and policy outcomes, only a limited number of studies have explored Chinese citizens' attitudes towards GWCC. These studies are primarily area-specific and non-representative, based on data collected from a self-administered survey of tourists in Beijing, Fuzhou and Hangzhou;[5] face-to-face interviews conducted in Chengdu and Xi'an;[6] an online survey of residents in Beijing;[7] and a field study conducted in Beijing.[8] In another study, a national sample of 516 respondents was analysed, but the survey was conducted online with a nonprobability-based sample "skewed toward higher education, younger generations, and people with an above-median income."[9] While these studies have improved our understanding of the complexity of GWCC concern, they are non-representative and thus difficult to generalize across China.

In this study, we utilize data from a national representative public opinion survey conducted in 2016 as well as regional statistics collected from *China Statistical Yearbooks* to investigate the variations and determinants of the Chinese public's GWCC concern. Drawing insights from extant literature, we develop theoretical expectations and employ both descriptive statistics and regression models for data analysis. Our descriptive statistics show that the average GWCC concern in China, compared to other countries, is relatively low, and that the levels of GWCC concern vary greatly among Chinese citizens, across different provinces and between coastal and inland areas. Our regression models reveal that the varying levels of individual Chinese GWCC concern are significantly driven by certain individual-level characteristics and regional-level variables. More specifically, we find that women and younger people with higher post-materialist values are more concerned about GWCC than their counterparts. We also find some evidence linking regional carbon economic dependency to people's GWCC concern, as our data show that people from provinces with a higher economic dependency on carbon-intensive industries tend to be less

2 Liu, Zhu, et al. 2013.
3 Wang, Pu, Liu and Wu 2018.
4 Wood and Vedlitz 2007; Tjernström and Tietenberg 2008; Mumpower, Liu and Vedlitz 2016; Drews and van den Bergh 2016.
5 Qiao and Gao 2017.
6 Tvinnereim, Liu and Jamelske 2017.
7 Xue et al. 2018.
8 Yu et al. 2013.
9 Wang, Xiao 2017, 298.

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concerned about GWCC than people from provinces with a lower carbon economic dependency.

Our study makes several contributions to the literature. First, to our knowledge, this is the first study to examine public concern about GWCC in China based on a national representative survey. Our data from the 2016 public survey reflect the recent state of how Chinese citizens perceive the seriousness of GWCC, and our findings are expected to be more generalizable than those based on non-representative and area-specific data. Second, we further examine how the variations of individual Chinese GWCC concern are shaped by several key individual-level variables such as respondents' social characteristics and personal post-materialist values. Third, in modelling the determinants of GWCC concern, we expand on extant literature and incorporate several regional-level variables (such as local vulnerability to climate change and regional carbon economic dependency) that are thought to be potentially important predictors for individual GWCC concern.

In what follows, we first provide a brief review of the relevant literature to identify the key factors in explaining individual citizens' concern about GWCC. We then discuss the data sources, data collection procedures and variable measures. Next, we show the distributions of Chinese GWCC concern and analyse the data using correlation and regression methods. In conclusion, we summarize our findings, discuss policy implications and make suggestions for future research.

Literature Review and Theoretical Expectation

Public concern about GWCC is an important force shaping social and policy responses to climate change. Widespread and strong concern typically corresponds to people's decisions and their willingness to support climate change mitigation and adaptation policies.[10] GWCC have had a huge impact and inflicted much damage to China,[11] especially in coastal areas vulnerable to sea-level rises and storm surges.[12] In recent years, the Chinese government has passed various climate mitigation and adaptation policies to reduce GHG emissions and encourage a low-carbon economy and lifestyle. Successful policy implementation not only requires consensus from the public in perceiving the dangerousness of climate change but also depends on people's voluntary choice. Thus, studying GWCC concern is important in the China case. While there are extensive studies on the general environmental concerns of the Chinese public,[13] and a few insightful but non-random sampling-based studies on Chinese climate change

10 Wood and Vedlitz 2007; Tjernström and Tietenberg 2008; Mumpower, Liu and Vedlitz 2016.
11 Qian and Zhu 2001.
12 "China blames climate change for record sea levels." *Reuters*, 23 March 2017, http://www.reuters.com/article/us-china-climatechange-sealevel/china-blames-climate-change-for-record-sea-levels-idUSKBN16U0DR. Accessed 18 May 2017.
13 Xiao, Dunlap and Hong 2013; Hao 2014; Liu, Xinsheng, and Mu 2016; Hao, Michaels and Bell 2019.

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attitudes,[14] research using a national representative survey to systematically probe Chinese citizens' concern about GWCC has been lacking.

In contrast to the scant research on this topic in China, the literature on public GWCC concern in Western countries has grown rapidly in recent years. For example, there are numerous studies on public GWCC concern in countries such as the United States,[15] United Kingdom,[16] Germany[17] and Australia.[18] There are also studies that compare climate change and related views cross-nationally.[19] Generally, the extant literature suggests that variations in public GWCC concern are associated with two groups of variables: individual-level factors, such as socio-economic status and personal beliefs or values;[20] and regional-level place-based characteristics, such as local physical vulnerability to climate change.[21]

Research on the relationship between individual-level factors and GWCC concern usually focuses on standard socio-economic characteristics (such as gender, age, education, income, place of residence, race, etc.). While some personal-level variables such as household income and place of residence (for example, urban versus rural) are found to be not regularly associated with the variation in citizens' GWCC concern,[22] several other individual-level social characteristics, discussed below, have a consistent effect on individuals' GWCC concern in existing studies.

Among the individual-level social variables, past research reveals that the most consistent predictor for citizens' GWCC concern is gender: women tend to have greater GWCC concern than do men.[23] Based on a review of more than 100 studies, Aaron McCright and his colleagues report that "in no reviewed study did we find that men report stronger pro-climate views than do women."[24] Theoretical reasons for this gender gap in GWCC concern (and other environmental concerns) can be found in the literature that explains how individuals in any society learn about gender-based expectations, division of labour and value-formation processes.[25]

The next most consistent social predictor for GWCC concern seems to be the age of the respondent. Much past research finds that younger adults usually

14 Carlsson et al. 2012; Yu et al. 2013; Wang, Xiao 2017.
15 Wood and Vedlitz 2007; McCright and Dunlap 2011; Liu, Xinsheng, Vedlitz and Shi 2014; Stoutenborough, Liu and Vedlitz 2014; Mumpower, Liu and Vedlitz 2016.
16 Clements 2012; Poortinga et al. 2011.
17 Engels et al. 2013.
18 Tranter 2013.
19 Kvaløy, Finseraas and Listhaug 2012; Carlsson et al. 2012; Lee et al. 2015; Tranter and Booth 2015; McCright, Dunlap and Marquart-Pyatt 2016.
20 Wood and Vedlitz 2007; McCright and Dunlap 2011; Liu, Xinsheng, Vedlitz and Shi 2014; Mumpower, Liu and Vedlitz 2016.
21 Brody et al. 2008; Hornsey et al. 2016; McCright et al. 2016; Drews and van den Bergh 2016.
22 O'Connor, Bard and Fisher 1999; Savage 1993.
23 Liu, Xinsheng, Vedlitz and Shi 2014; McCright and Dunlap 2011; McCright 2010; Semenza et al. 2008; Brody et al. 2008; Leiserowitz 2006.
24 McCright et al. 2016, 182.
25 Brody et al. 2008; Kvaløy, Finseraas and Listhaug 2012; McCright 2010.

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report higher GWCC concern and tend to support GWCC policies more than do older adults.[26] A theoretical explanation for this age effect is that as countries make the transition to postmodern nations, a growing cohort of citizens will experience shifts in personal values, have more educational opportunities, and then develop greater concern for environmental and ecological issues such as climate change.[27] Robert Jones and Riley Dunlap analysed 11 sociodemographic and sociopolitical factors and found that age was the best predictor of environmental concern, with younger people expressing greater concern than older people about the environment.[28] Nevertheless, there are a few studies that find that age has mixed effects on GWCC concern.[29]

Past studies also find that education often exhibits a positive effect on GWCC concern, since a higher level of education facilitates the understanding of the phenomenon and enhances the likelihood of believing that global warming has already begun.[30] Although a few studies find an inverse association between education and GWCC concern in the United States,[31] evidence from many other studies seems to suggest a positive relationship between education and GWCC concern.[32] For example, using an extensive dataset, gathered from 26 countries, on topics surrounding environmental concern, Emilia Tjernström and Thomas Tietenberg find that a higher level of education is associated with a higher likelihood of expressing GWCC concern.[33] Similarly, in another study, which was based on data gathered from 119 countries, Tien Ming Lee and colleagues find that educational attainment is the single strongest predictor of climate change awareness worldwide.[34]

In addition to the three social base variables (gender, age and education), the extant literature finds that personal post-materialist values are another important individual-level predictor for citizens' GWCC concern. Starting with the theory of a hierarchy of human needs,[35] scholars contend that humans begin to emphasize and pursue higher needs once they are satisfied with basic physiological and security needs (such as food, shelter and safety). In a series of influential studies, Ronald Inglehart described this shift as a pursuit of "post-materialist" values.[36] Emphasizing a greater desire for quality of life, civil rights, autonomy and self-expression, instead of economic gains and material possessions, post-materialist values have been credited with the rise in environmentalism and individuals' concern about non-material objects.[37] Recent empirical studies find that post-

26 Tjernström and Tietenberg 2008; McCright 2010; Aldy, Kotchen and Leiserowitz 2012.
27 McCright, Dunlap and Marquart-Pyatt 2016; Poortinga et al. 2011.
28 Jones and Dunlop 1992.
29 Liu, Xinsheng, Vedlitz and Shi 2014.
30 Clements 2012; Tranter 2013.
31 McCright and Dunlap 2011; Wood and Vedlitz 2007.
32 Tjernström and Tietenberg 2008; Lee et al. 2015.
33 Tjernström and Tietenberg 2008.
34 Lee et al. 2015.
35 Maslow 1954.
36 Inglehart 1990; 1997.
37 Ibid.; Hao and Wang 2018.

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materialist values exert a positive impact on citizens' GWCC concern. Thomas Dietz, Amy Dan and Rachael Shwom together report that individuals with stronger post-materialist values (i.e. placing democracy and freedom of speech above maintaining order and fighting rising prices) tend to exhibit a higher GWCC concern.[38] Similarly, Berit Kvaløy, Henning Finseraas and Ola Listhaug, using data from the 2005–2009 World Values Survey across 47 countries, also demonstrate that perception of the seriousness of the GWCC problem is positively correlated with post-materialism.[39]

While most of the studies on public concern about GWCC discussed above tend to focus on individual-level social base and personal value factors, there are a few exceptions that show that regional context characteristics (for example, environmental pollution) can also affect citizens' environmental concern.[40] To explain citizens' GWCC concern, scholars contend that regional factors such as local climate vulnerability and exposure to climate-related physical risks should be taken into account.[41] As people exposed to climate change stressors are more likely to experience and understand climate change consequences, or know someone who has personal experience of the consequences of global warming, they are more likely to be concerned about GWCC.[42] Similarly, So Kim and Yael Wolinsky-Nahmias find that a general measure of climate vulnerability correlates with higher commitment to climate policies, including greater willingness to pay and stronger support for pro-climate energy polices.[43] Patrick Egan and Megan Mullin find that heatwave exposure has a positive effect on GWCC concern because it increases the likelihood of believing that there is solid evidence that the earth is getting warmer.[44] Samuel Brody and his colleagues find that public perceptions of the potential negative impacts of climate change increase when the threat or sense of climate vulnerability is most overt.[45]

In addition to climate vulnerability, we extend the current literature to consider another regional-level factor that may potentially condition individual citizens' GWCC concern – regional economic dependency on carbon-intensive industries. Theoretically, it is reasonable to expect that people from regions where the local economy is more dependent on carbon-intensive and fuel-burning industries would be less likely to care about GWCC owing to their strong carbon-based economic self-interests. Empirically, past studies have presented some evidence that economic conditions shape public environmental attitudes[46] and climate change concern.[47] A recent piece of research on the geographic variation in public

38 Dietz, Dan and Shwom 2007.
39 Kvaløy, Finseraas and Listhaug 2012.
40 Liu, Xinsheng, and Mu 2016; Hannibal, Liu and Vedlitz 2016.
41 Brody et al. 2008; Grover, Brody and Vedlitz 2017.
42 Grover, Brody and Vedlitz 2017.
43 Kim and Wolinsky-Nahmias 2014.
44 Egan and Mullin 2012.
45 Brody et al. 2008.
46 Conroy and Emerson 2014.
47 Shum 2012; Stoutenborough, Liu and Vedlitz 2014; Benegal 2017.

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GWCC opinions in the United States finds "lower levels of belief that global warming is happening in some Midwestern and Western counties with large greenhouse-gas-producing industries, such as coal-fired power plants."[48] Studies on Appalachia also find that coal miners tend to support the mining industry while caring less about the impact of coal production on the climate.[49] However, how regional economic factors such as carbon economic dependency affect public GWCC concern has not been systematically examined, and this is one of the contributions of this study.

Informed by these theoretical explanations and past empirical studies, we investigate how Chinese GWCC concern is affected by both individual-level variables and regional-level characteristics. Specifically, for individual-level characteristics, we expect that in China, based on the best available empirical evidence from past research, women, younger people, the better educated and those with stronger post-materialist values will be more likely to express greater GWCC concern compared to their counterparts. For regional-level factors, we expect that Chinese citizens who are located adjacent to the coastline, where climate risk is relatively higher than for non-coastal areas, will have higher GWCC concern than people living in inland areas. We also expect that Chinese citizens living in higher carbon economic dependency regions will exhibit less GWCC concern than their counterparts, owing to their carbon-vested interests.

Data Sources and Variable Measures

To examine Chinese public GWCC concern and its determinants, we use data from two sources: the China Governance and Public Policy Survey (CGPPS) and the official *China Statistical Yearbook*.

All individual-level data (such as respondents' GWCC concern and socio-economic status information) are drawn from the CGPPS, which is a research project of the Bush School of Government and Public Service at Texas A&M University. The CGPPS consists of multiple surveys conducted during the second half of 2016. In this paper, we use the data from a survey carried out between 28 October and 5 December 2016. All of the CGPPS surveys were conducted by the Survey and Research Center for China Households at the Southwestern University of Finance and Economics in China using its random-dialling computer-aided telephone interviewing system. The surveyors employed a stratified, three-stage probability proportion-to-size random sample design to draw a representative sample of Chinese adults aged 18 and older in mainland China (excluding Tibet, Xinjiang, Hong Kong and Macau).

As of 2016, China administers 33 provincial-level regions (called province, autonomous region, municipality or special administrative region) and 2,854

48 Howe et al. 2015, 600.
49 Bell 2016; Hao 2015.

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county-level divisions (called county/autonomous county, district, county-level city, or banner/autonomous banner). The GCPPS survey covered 29 provincial-level regions and 353 county-level divisions. For this survey, a total of 7,298 respondents were sampled and 3,972 interviews were completed, yielding a response rate of 54.43 per cent. After data cleaning, the final survey dataset includes 3,748 valid cases. All interviews were conducted in Chinese, with the median survey completion time of 14.5 minutes.

All regional provincial-level data are drawn from the *China Statistical Yearbook*, which is published annually by the National Bureau of Statistics of China. From the year books, we collected the past five years' data (2011–2015) on each province's GDP, population, land size and the share of carbon-intensive industries in the province's GDP. In the statistical yearbooks, China's GDP is contributed by three broad sectors or industries – primary industry (agriculture), secondary industry (construction and manufacturing), and tertiary industry (the service sector). Since the primary and secondary industries depend heavily on fossil fuel burning and produce a great amount of GHG emissions, together they are considered as carbon-intensive industries. The data from the five years prior to the 2016 CGPPS survey were averaged and merged with the CGPPS opinion survey data.

The dependent variable in this study is *GWCC concern*, which is measured by a survey participant's perception of the seriousness of this issue in China. In the GCPPS survey, respondents were asked, "on a 0–10 scale, with 0 being not serious at all and 10 being very serious, how serious do you think the problem of global warming and climate change is in China?" Participants' responses to this question are coded accordingly, so the higher score indicates a higher level of GWCC concern.

Through the GCPPS survey, we collected respondents' sociodemographic background and economic status information, including the three individual-level variables that we are mainly interested in when explaining Chinese citizens' GWCC concern: gender, age and education. *Gender_female* is measured as 1 for female and 0 for male. *Age* is the respondent's actual age in 2016. *Education* is coded with 9 levels (1 = no schooling; 2 = elementary school; 3 = middle school; 4 = high school; 5 = vocational school; 6 = advanced vocational school; 7 = college; 8 = masters; 9 = doctoral).

As discussed in the literature review, another important individual-level predictor for GWCC concern is expected to be the extent to which people hold personal post-materialist values. A standard way of measuring post-materialist values in the extant literature is to construct a post-materialism index based on respondents' answers to a relatively large number of questions regarding the issues they are most concerned about or what they perceive to be the top priorities facing the country.[50] Some studies suggest a simplified, but still valid, approach

50 Inglehart 1990; Kvaløy, Finseraas and Listhaug 2012.

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to measure post-materialism: those respondents who put democracy (for example, giving people more say in government decisions) and civil liberty (for example, protecting freedom of speech) above maintaining order in the nation and fighting rising prices are considered to have stronger post-materialist values.[51] In this study, we follow this approach and use participants' responses to a question that measures the extent to which people hold post-materialist values with respect to political democracy and civil liberty in China. The question asks respondents to indicate how serious they think the issues of political democracy and civil liberty are in China, ranging from 0 to 10, with 0 being not serious at all and 10 being extremely serious. The variable of *post-materialist values* is thus measured on a 0–10 scale, with a higher score indicating a stronger need for political democracy and civil liberty and thereby stronger post-materialist values.

Additional individual-level social background information was also collected in the survey. *Income* is measured as logged household per capita income in 2016. The type of residence, *Urban residence*, is measured as 1 for urbanite and 0 for rural resident. As past research indicates that political orientations can shape individual GWCC concern, we also collected the respondent's political party membership information in the survey.[52] Although the left–right or liberal–conservative political ideology division does not apply to China, one previous study found that being a Chinese Communist Party (CCP) member positively affects one's concern about the environment.[53] In this study, *CCP member* is measured as 1 for being a CCP member and 0 being otherwise. These variables are used as control variables in our regression analysis later.

At the regional level, we are interested in how different contextual conditions, particularly regional climate vulnerability and carbon economic dependency, affect respondents' GWCC concern. We measure climate vulnerability based on a province's geographical location. We create a dummy variable, *Coastal region*, to indicate whether the province is located in a coastal region. Because these areas are low in elevation and more likely to be stressed by rises in sea level and storm surges, they are more vulnerable to GWCC. We use *Carbon-intensive industries' share of GDP* in each province to measure provincial economic dependency on fossil fuel-burning, greenhouse gas-producing industries. A higher percentage of the share indicates that the province's economy relies more on carbon-intensive industries. We also use the province's *GDP per capita* (log) to reflect the variations in regional economic affluence, and *Population density* (measured by 10,000 people per square kilometre) to capture different demographic concentrations across provinces. These two regional-level variables are used as control variables in later regression models. Summary statistics of all the variables at both individual level and province level are reported in Table 1.

51 Dietz, Dan and Shwom 2007; Xiao and Hong 2018.
52 McCright and Dunlap 2011; Liu, Vedlitz and Shi 2014; Tranter 2013.
53 Xiao, Dunlap and Hong 2013.

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Table 1: **Summary Statistics**

Variables	N	Mean	S.D.	Min	Max
GWCC concern	3,412	6.215	2.326	0	10
Gender_female	3,748	0.402	0.490	0	1
Age	3,748	50.60	13.47	18	92
Education	3,748	3.396	1.564	1	9
Income (log)	3,745	9.377	1.361	−0.693	16.44
Urban residence	3,580	0.378	0.485	0	1
CCP member	3,744	0.087	0.282	0	1
Post-materialist values	3,184	4.980	2.624	0	10
Coastal region	3,748	0.439	0.496	0	1
Carbon-intensive industries' share of GDP (%)	3,748	59.36	6.663	23.64	67.93
GDP per capita (log)	3,748	1.327	0.378	0.619	2.144
Population density	3,748	0.045	0.060	0.001	0.367

Data Analyses and Results

We conduct data analysis in three steps. First, we begin with descriptive statistics and distribution graphs to show the general patterns and variations of Chinese GWCC concern. Second, we compute bivariate correlations between GWCC concern and each of the individual-level and regional-level variables to examine the possible associations between them. Third, we further employ multiple regressions with different specifications to estimate the conditional and overall effects of these variables on Chinese GWCC concern.

Descriptive statistics and distributions

We begin with descriptive statistics and basic distributions. As reported in Table 1, the mean *GWCC concern* for the Chinese respondents is 6.215. Recall that GWCC concern is measured on a 0–10 scale, with 0 being completely unconcerned and 10 being extremely concerned. This average concern of 6.215 is just moderately above the mid-point 5 (neither unconcerned nor concerned) – a level similar to that which has been found in the United States in a study using the same 0–10 scale to gauge the American public's GWCC concern.[54] We consider this level of average GWCC concern in China to be relatively low because the intensity of public GWCC concern in many other countries around the world appears to be much greater.[55] Recent public opinion polls across multiple nations show that China, along with several other countries including the United States, is among the least GWCC-concerned countries in the world, and our data here provide corroborating evidence supportive of these studies.[56]

The relatively low intensity of Chinese GWCC concern is even more evident in Figure 1, which reports the distribution of the survey participants' GWCC

54 Liu, Vedlitz and Shi (2014) found that the average American GWCC concern score was 6.24 in 2004, 6.97 in 2007, and 5.81 in 2013.

55 PEW 2009; Lee et al. 2015.

56 Stokes, Wike and Carle 2015; Wike 2016.

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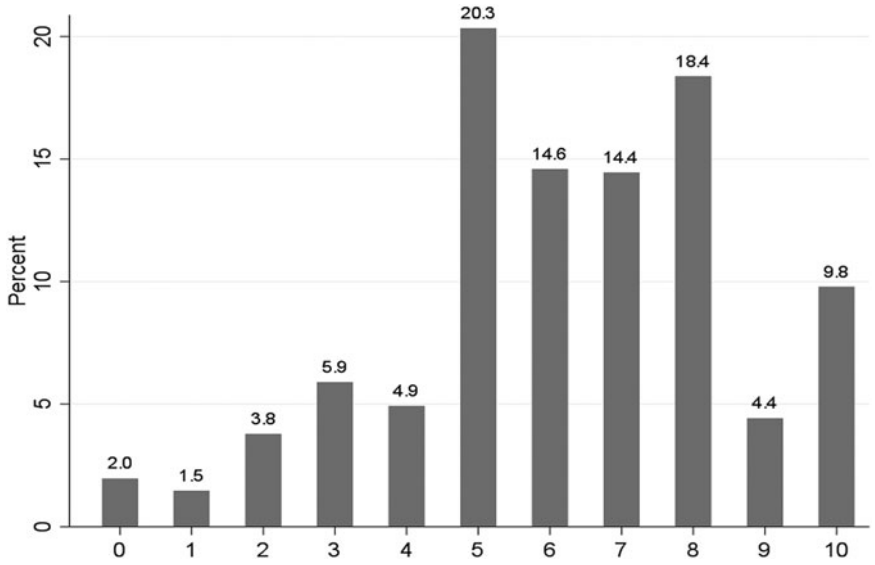
Figure 1: **Distribution of Chinese Citizens' GWCC Concern**



concern levels across the 0–10 scales. As shown in Figure 1, only 14.2 per cent (aggregated percentage from scales 9 and 10) of Chinese respondents report that they are very seriously concerned about GWCC, compared to the global median of 54 per cent who believe that GWCC is a very serious problem.[57] Given the fact that China is the top GHG emitter in the world, this relatively low level of Chinese GWCC concern is alarming, suggesting there is substantial room for China to improve citizens' awareness and enhance their understanding of the risks associated with GWCC.

The distribution of the survey participants' GWCC concern in Figure 1 also indicates a substantial variation in Chinese citizens' GWCC concern. While over half of the respondents (61.6 per cent, aggregated percentage from scales 6 to 10) expressed that they were concerned about GWCC, a significant percentage of the respondents (20.3 per cent) reported their concern level at the mid-point 5, yet the remaining portion (18.1 per cent, aggregated from scales 0 to 4) showed little or no concern at all about GWCC.

Still, the intensity of Chinese GWCC concern varies greatly across regions. Figure 2 displays the average GWCC concern of citizens in each province. Hubei (6.714), Beijing (6.680), Tianjin (6.613), Shaanxi (6.521) and Hebei (6.494) ranked at the top of the list, while Heilongjiang (5.848), Henan (5.850), Guangxi (5.942), Anhui (5.952) and Jiangxi (6.027) showed the lowest average GWCC concern among all provinces.

57 Stokes, Wike and Carle 2015.

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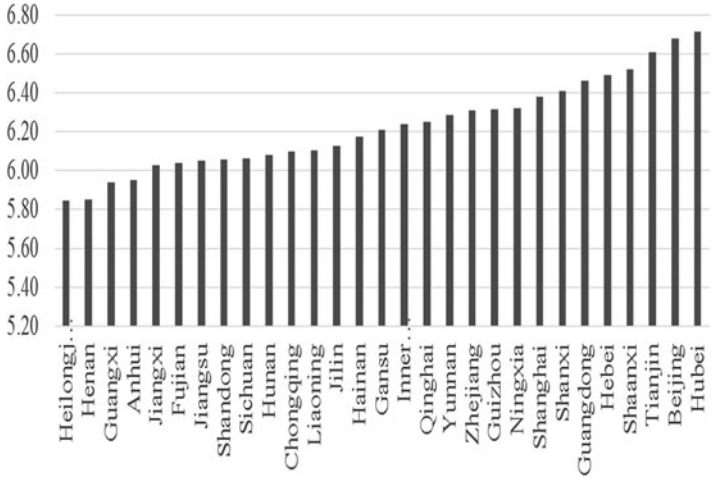
Figure 2: **GWCC Concern across Provinces**



In addition to the variations in GWCC concern among Chinese citizens and across provinces, there also appears to be a difference in the average GWCC concern between coastal provinces and inland provinces. Figure 3 presents the average GWCC concern scores for coastal provinces (dark grey area) and inland provinces (light grey area).[58] The average GWCC concern score for respondents from coastal provinces (6.255) is slightly higher than that for respondents from inland provinces (6.183). This difference might be attributed to two factors. First, as the coastal provinces have advanced levels of economic development, respondents from these areas tend to have less economic pressure and more environmental concern, including concern about GWCC. Second, this difference might also be attributed to different levels of vulnerability to climate change, as the coastal provinces, owing to their lower elevations, are more vulnerable and prone to GWCC risks (sea-level rises, storm surges, etc.) than inland provinces.

Bivariate correlations

To show the relationship between GWCC concern and each of the explanatory variables, we first report the bivariate correlations between GWCC concern and each of the individual-level factors. As shown in Table 2, four individual characteristics are significantly correlated with GWCC concern. *GWCC concern* is positively associated with *Gender_female* ($r = 0.070$, $p < 0.01$) and *Education* ($r = 0.035$, $p < 0.05$), indicating that Chinese women and better-educated Chinese tend to express higher GWCC concern than do their counterparts. *Age* is

58 Owing to their remote location and population size, Xinjiang and Tibet (white coloured areas in the map) are typically not included in national public surveys in China, including the CGPPS project.

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Figure 3: **Average GWCC Concern between Coastal and Inland Provinces**

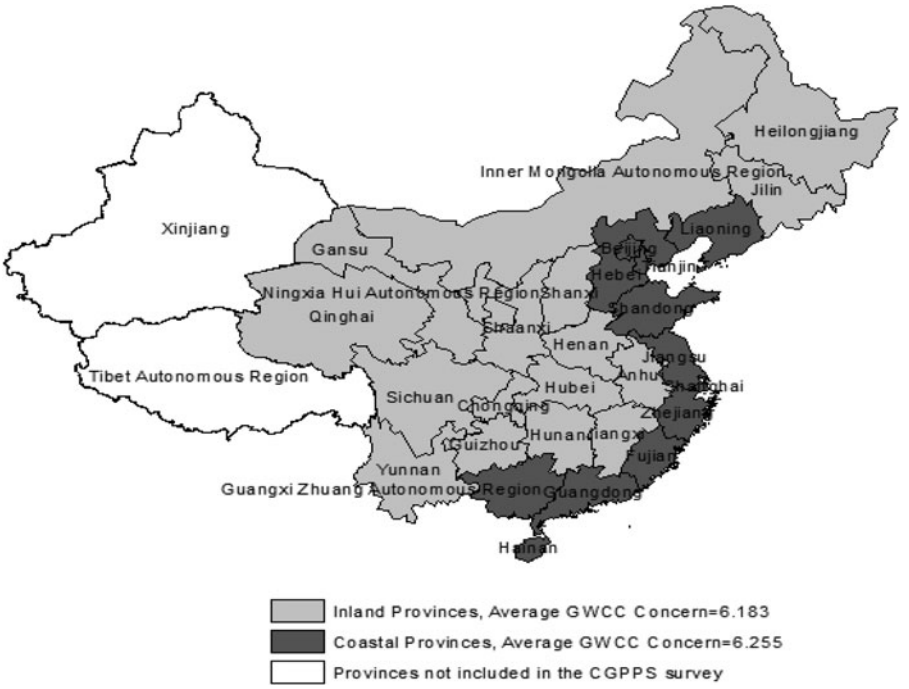

Table 2: **Correlations of Individuals' GWCC Concern with Individual Characteristics**

Variables	Observations	Coefficient	p-value
Gender_female	3,412	0.070	0.000***
Age	3,412	−0.090	0.000***
Education	3,412	0.035	0.041**
Income (log)	3,409	0.019	0.267
Urban residence	3,255	0.022	0.209
CCP member	3,408	−0.008	0.630
Post-materialist values	3,039	0.300	0.000***

Notes:
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

negatively correlated with *GWCC concern* ($r = 0.090$, $p < 0.01$), suggesting that younger Chinese are more concerned about GWCC than are older Chinese citizens. *GWCC concern* is also positively correlated with personal *Post-materialist values* ($r = 0.300$, $p < 0.01$). In comparison with the coefficients between *GWCC concern* and *Gender_female*, *Age* and *Education*, the coefficient between *GWCC concern* and *Post-materialist values* is much higher, suggesting that post-materialism is a relatively stronger predictor for individual citizens' GWCC concern in China. In addition, *GWCC concern* appears to be positively related to

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Table 3: **Correlations of Respondents' GWCC Concern with Regional Characteristics**

Variable	Observations	Coefficient	p-value
Coastal region	3,412	0.010	0.561
Carbon-intensive industries' share of GDP	3,412	−0.042	0.013**
GDP per capita (log)	3,412	0.009	0.628
Population density	3,412	0.014	0.426

Notes:
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Income and *Urban residence*, and negatively associated with *CCP Membership*, but the effects are not statistically significant.

The bivariate correlations between *GWCC concern* and regional-level variables, including *Coastal region*, *Carbon-intensive industries' share of GDP*, *GDP per capita* and *Population density* are reported in Table 3. Respondents located in coastal provinces (*Coastal region*) with better economic affluence (*GDP per capita*) and higher population density (*Population density*) seem to have higher GWCC concern than do their counterparts, but none of the correlations are statistically significant. Nevertheless, the bivariate correlation between *GWCC concern* and *Carbon-intensive industries' share of GDP* shows a significantly negative relationship ($r = -0.042$, $p < 0.05$), suggesting that people located in provinces with higher dependency on a carbon-intensive economy are less concerned about GWCC. This significant and negative correlation between regional carbon economic dependency and individual *GWCC concern* seems to be consistent with our expectation.

To visually illustrate the negative correlation between regional carbon economic dependency and respondents' GWCC concern, we use scatter plots in Figure 4 in which each spot represents a province (or a province-level administrative unit). The vertical axis is the average provincial GWCC concern, which is the mean of all respondents' GWCC concern scores in a province. The horizontal axis is the carbon-intensive industries' share of GDP in a province. Despite the two outliers in the data (Beijing and Shanghai), the fitted value (dotted line) in Figure 4 clearly shows a downward trend, suggesting that when the degree of a province's carbon-intensive industries' share of GDP increases, the average GWCC concern decreases. After the two outliers (Beijing and Shanghai) are removed from the data, the scatterplot with the linear trend line, as shown Figure 5, still displays a negative relationship between regional economic dependency on carbon-intensive industries and a province's average GWCC concern.

Multivariate regressions and results

The bivariate analyses above suggest that *GWCC concern* is significantly correlated with individual respondents' gender, age, education level and post-materialist values, as well as a province's carbon economic dependency.

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Figure 4: **Provincial Average GWCC Concern and Carbon-intensive Industries' Share of GDP**

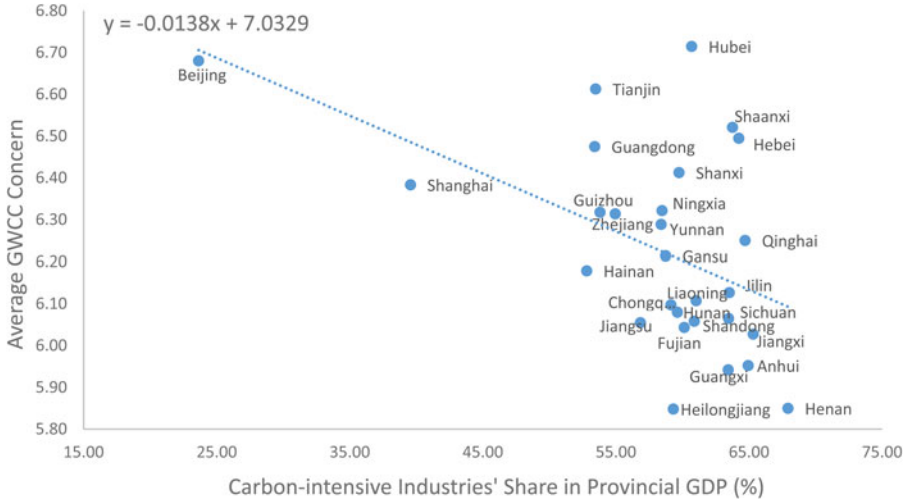
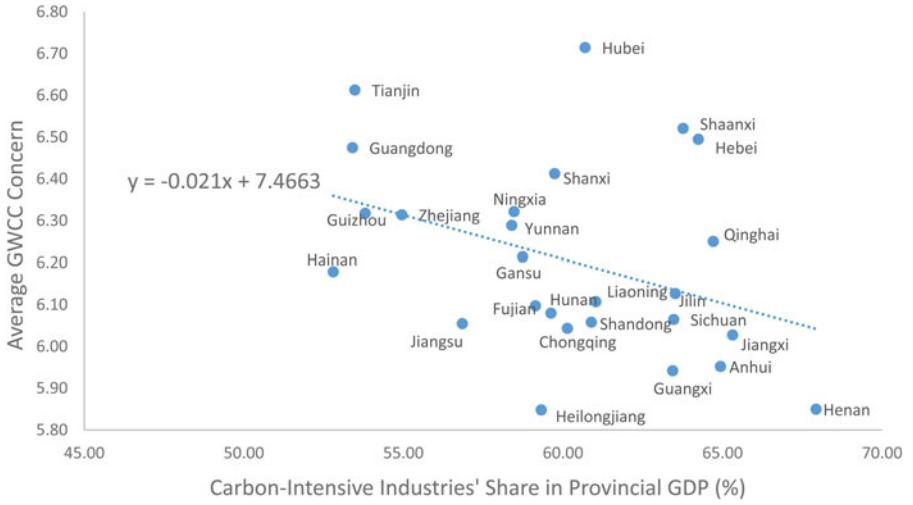


Figure 5: **Provincial Average GWCC Concern and Carbon-intensive Industries' Share of GDP (excluding Beijing and Shanghai)**



However, these relationships need to be further assessed with rigorous methods. In this section, we conduct multivariate regression analysis to model the conditional and overall effects of the individual-level factors and provincial-level variables on individual Chinese GWCC concern.

Based on the discussions in the literature review and theoretical expectation section, we first propose the following equation to assess the explaining power

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of individual-level variables and provincial-level characteristics for respondents' GWCC concern:

$$\mathrm{GWCC}_{ijk} = \beta_0 + \beta_1 \mathrm{IC}'_{ijk} + \beta_2 \mathrm{PC}'_k + \varepsilon_{ijk} \quad (1)$$

In Equation 1, GWCC_{ijk} denotes the GWCC concern of respondent i in county j of province k. The vector $\mathrm{IC'}_{ijk}$ stands for individual-level characteristics, which include the social base variables (i.e. gender, age, education, household income, urban residence status and CCP membership) and the social values variable (i.e. post-materialism score). The vector $\mathrm{PC'}_k$ represents the provincial-level characteristics, which contain the four regional variables discussed earlier (province's physical vulnerability, carbon economic dependency, economic affluence and population density).

Since estimations of individual-level variables may be biased by omitted local variables (for example, local policies and regulations) that could affect both individual characteristics and GWCC concern, we further consider location-fixed effects and perform county-fixed effects estimates to assess the impacts of individual characteristics on respondents' GWCC concern with the following equation:

$$\mathrm{GWCC}_{ijk} = \beta_0 + \beta_1 \mathrm{IC}'_{ijk} + \beta_2 \mathrm{County}_{jk} + \mathrm{e}_{ijk} \quad (2)$$

As discussed above, the CGPPS survey interviewed representative respondents from 353 counties across China. By including location-fixed effects, defined by the county dummies County_{jk}, Equation 2 directly controls for the average differences across these counties, reduces the threat of omitted variable bias, and therefore can obtain better estimations of the impacts of individual characteristics on GWCC concern.

Based on Equations 1 and 2, we perform four separate regressions with different model specifications. In Model 1, *GWCC concern* is regressed only on respondents' individual-level social base variables – i.e. *Gender_female*, *Age*, *Education, Income*, *Urban residence* and *CCP membership*. In Model 2, we add the *Post-materialist values* variable to Model 1 to examine how personal post-materialism conditions respondents' concern about GWCC. In Model 3, we introduce the regional-level variables to Model 2. The four provincial-level variables include physical vulnerability (*Coastal region*), carbon economic dependency (*Carbon-intensive industries' share of GDP*), economic affluence (*GDP per capita*) and population concentration (*Population density*). In Model 4, we perform county-fixed effects estimates.

Since *GWCC concern* was recorded in 11 scales running from 0 to 10, we consider the dependent variable as a continuous variable and thus opt for OLS regression. The results of the four OLS models are reported in Table 4. We include all the models in a single table to allow comparison across different specifications. As survey data tend to have heteroscedasticity issues, we use a robust estimation of the standard errors in all regressions. Post-estimation diagnostic

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Table 4: **Determinants of GWCC Concern**

Variable	Model 1	Model 2	Model 3	Model 4
Gender_female	0.280***	0.255***	0.249***	0.178*
	(0.083)	(0.085)	(0.085)	(0.093)
Age	−0.015***	−0.010***	−0.010***	−0.014***
	(0.003)	(0.003)	(0.003)	(0.004)
Education	0.004	−0.006	−0.009	−0.021
	(0.032)	(0.033)	(0.033)	(0.036)
Income (log)	0.006	0.039	0.031	0.040
	(0.036)	(0.035)	(0.035)	(0.038)
Urban residence	0.095	0.081	0.079	0.113
	(0.098)	(0.097)	(0.098)	(0.116)
CCP member	−0.045	0.027	0.024	−0.064
	(0.144)	(0.145)	(0.145)	(0.156)
Post-materialist values		0.254***	0.254***	0.248***
		(0.019)	(0.019)	(0.017)
Coastal region			0.019	
			(0.117)	
Carbon-intensive industries' share of GDP			−0.015*	
			(0.009)	
GDP per capita (log)			−0.026	
			(0.184)	
Population density			−0.531	
			(0.917)	
Observations	3,251	2,887	2,887	2,887
Prob > F	0.000***	0.000***	0.000***	0.000***
R-squared	0.013	0.096	0.097	0.210
County-fixed effects included	No	No	No	Yes

Notes:
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Robust standard errors in parentheses.

tests for multicollinearity indicate few multicollinearities among the independent variables (all VIFs < 3[59]).

In Model 1, the results show that two social base variables, *Gender_female* and *Age*, are significantly correlated with individuals' GWCC concern: *Gender-female* shows a positive effect, indicating that women tend to have higher GWCC concern than men ($\beta = 0.280$, $p < 0.01$). *Age* shows a negative association with GWCC concern, suggesting that relative to older people, younger Chinese citizens are more concerned about GWCC ($\beta = -0.015$, $p < 0.01$). Both effects are consistent with our expectations. However, *Education* does not have a significant influence on individuals' GWCC concern. With respect to other social base variables, *Income* (household per capita income), *Urban residence* (urban resident status), and *CCP membership* do not exert significant effect on Chinese GWCC concern.

In Model 2, we add the variable of *Post-materialist values* to the first model. Consistent with our expectation, the level of GWCC concern is positively

59 See Fox 1991.

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correlated with post-materialism ($\beta = 0.254$, $p < 0.01$), indicating that Chinese citizens with stronger *Post-materialist values* are more concerned about GWCC. More importantly, adding *Post-materialist values* substantially increases the R-square from 0.013 in Model 1 to 0.096 in Model 2. This suggests that post-materialist values are an important driver for Chinese people's GWCC concern and far more influential than sociodemographic variables. The effects of *Gender_female* and *Age* remain statistically significant in the model, while all other social base variables do not show significant influence on respondents' GWCC concern.

In Model 3, we add the regional-level characteristics and regress respondents' *GWCC concern* with all individual-level and regional-level variables. Consistent with the bivariate correlation analysis earlier, the results show that individual GWCC concern is negatively and significantly shaped by regional *Carbon-intensive industries' share of GDP* ($\beta = -0.015$, $p < 0.1$). This finding is supportive of our expectation, suggesting that residents located in provinces with more economic dependency on fossil fuel-burning and greenhouse gas-producing industries tend to have less GWCC concern than residents in provinces with lower carbon economic dependency. While the results show that other regional-level variables, including *Coastal region*, *GDP per capita* and *Population density*, have non-significant impacts on GWCC concern, the three individual-level variables, *Gender_female*, *Age* and *Post-materialist values*, which were found to be significant predictors for GWCC concern in previous models, remain statistically significant and influential in Model 3.

In Model 4, the county-fixed effects estimates of individual characteristics demonstrate very similar results to previous estimations. The R-squared statistic substantially increases from 0.096 in Model 2 to 0.210 in Model 4, suggesting that the location-fixed effects account for more than half (54.29 per cent) of the explained variations in Chinese citizens' GWCC concern. Consistent with previous estimations without the county-fixed effects, the three individual-level variables – *Gender_female*, *Age* and *Post-materialist values*, maintain statistically significant effects on Chinese GWCC concern.

Taken all together, the regression results with different specifications shown in Table 4 indicate that Chinese *GWCC concern* is affected by both individual-level and regional-level variables. Across the models, three individual-level variables, *Gender_female*, *Age* and *Post-materialist values*, are significantly and consistently correlated with individual *Chinese GWCC concern*. Under the four different specifications, the coefficients of these three variables are all statistically significant, and the signs all point in the same direction. This pattern indicates that there is a common social base and a post-materialist values base underlying the Chinese public's GWCC concern: compared to their counterparts, Chinese women and younger people with stronger post-materialism tend to be more concerned about GWCC. In addition, the regression results also suggest that regional economic dependency on carbon-intensive industries exerts an inhibiting effect on local residents' GWCC concerns – that is, residents in provinces that depend

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more on carbon-intensive and fuel-burning industries tend to be less concerned about GWCC than residents in provinces where carbon-intensive industries account for a smaller percentage of the province's GDP. We discuss the key implications of our findings in the next section.

Conclusion and Discussion

Along with other environmental and ecological problems such as pollution, biodiversity loss and human-induced natural disasters, China faces the great challenges of global warming and climate change. While the Chinese government has formulated numerous climate mitigation and adaptation polices in recent years, it is not clear in the extant literature how Chinese citizens perceive the threat of GWCC and what factors shape the Chinese public's GWCC concern.

This study is the first of its kind to examine the variations and determinants of Chinese GWCC concern through an analysis of both nationally representative survey data and data collected from China's official statistical yearbooks. Our data reflect the recent state of Chinese GWCC concern and our study contributes to the scholarship on this topic. Since our survey is based on a nationwide representative sample, the findings presented in this study are more generalizable than previous studies that either use non-representative data or focus on Chinese climate change attitudes in selected areas.[60]

Our data indicate that in China, compared to other countries, overall average public concern for GWCC is relatively low, and the levels of GWCC concern vary greatly among Chinese citizens, across different provinces and between coastal and inland areas. With regard to the individual-level determinants of GWCC concern, similar to the findings of most studies in Western countries, we find a gender gap and an age gap in China: Chinese females care more about GWCC than Chinese males, and younger Chinese are more concerned about GWCC than older Chinese. Also consistent with previous findings in a non-Chinese context, our data demonstrate that people with greater post-materialist values tend to express a higher concern for GWCC in China. More importantly, our data show that post-materialist values exert substantially greater impact in shaping Chinese GWCC concern than any other individual-level variables.

One unique contribution of our study is that we incorporate several regional-level factors in our analysis. In both correlation and regression analyses, we find that carbon-intensive industries' share of provincial GDP has a significant inhibiting impact on Chinese citizens' GWCC concern – a finding consistent with our expectation on the negative effect of regional carbon economic dependency. Most existing studies on Chinese environmental concern focus on analysing individual-level influential factors such as income, education and gender.[61] One

60 Qiao and Gao 2017; Tvinnereim, Liu and Jamelske 2017; Wang, Xiao 2017; Xue et al. 2018; Yu et al. 2013.

61 Hao 2014; Xiao, Dunlap and Hong 2013.

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exception is Xinsheng Liu and Ren Mu's 2016 study, which finds that provincial-level economic development and environmental risk can affect public environment concern.[62] Thus, our finding about the impact of carbon-intensive industries' share of provincial GDP contributes to the literature of Chinese environmental concern research. We complement previous studies by showing that differences in GWCC concern may stem not only from variations in personal characteristics but also from variations in context at the aggregate level, such as a province's dependency on carbon-intensive industries. Future research should continue to examine the influence of regional context factors, as their community's circumstances may affect people's concern just as much as their personal circumstances do.[63]

While the findings contribute to the accumulation of scholarly knowledge about Chinese citizens' GWCC concern, this study also has some important policy implications. First, we find that the overall level of Chinese citizens' GWCC concern is relatively low, thus large-scale and nationwide awareness-raising efforts are needed to elevate Chinese citizens' understanding about the risks, causes and consequences of GWCC. It is true that many political actions, particularly in an authoritarian regime like China, can be taken without strong public support. It is also true that the Chinese government has passed a number of strategic plans and policies to address GWCC in recent years without much popular input. But successful implementation of these plans and policies still largely depends on the public's attention to GWCC issues and how people perceive the seriousness of the GWCC problem. Existing studies in other countries indicate that successful implementation of environmental policies largely depends on people's willingness to make sacrifices for the environment.[64] For the GWCC issue, intense public concern and strong support are essential for climate policies.[65] Research in China also suggests that higher concern about the environment leads to pro-environmental behaviour (for example, joining environmental NGOs, participating in protests and expressing grievances about environmental problems), which in turn has an impact on government decision making.[66] Recent studies also show that Chinese governmental behaviour and policies, although authoritarian in nature, at least partly respond to public concerns about the environment.[67] More importantly, research on China's environmental civil society organizations demonstrates that public concern can promote the development of civil environmental organizations, and that these organizations and their activities in turn can facilitate and reshape governmental environmental policies.[68] Certainly, there are many other factors that can foster China's

62 Liu, Xinsheng, and Mu 2016.
63 Liu, Xinsheng, Vedlitz and Shi 2014.
64 Wood and Vedlitz 2007; Mumpower, Liu and Vedlitz 2016.
65 Drews and van den Bergh 2016.
66 Duan and Sheng 2018.
67 Tang, Chen and Wu 2018; Zhang et al. 2018.
68 Yang 2005; Stalley and Yang 2006; Ru and Ortolano 2009; Zhan and Tang 2013; Bernauer et al. 2016; Teets 2018.

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climate plans and programmes, but one important driver for the effectiveness of China's climate policies is Chinese citizens' GWCC concern. For these reasons, it is important for China to develop more awareness-raising programmes and allocate more resources to enhance the public's understanding of GWCC risks and hazards. While a high level of public attention to GWCC is critical to policy success, growing GWCC concern is also helpful and often accompanied by subtle changes in personal attitudes and behaviour, which in turn can have long-term environmental benefits.

Second, the variations and gaps in Chinese GWCC concern across provinces and between coastal and inland provinces suggest that in addition to nationwide programmes to promote GWCC concern, some specialized local awareness efforts, particularly in provinces with lower GWCC concern and in inland areas, also need to be coordinated and promoted. Recent empirical studies show that information exposure can significantly raise public awareness and concern about GWCC and other environmental issues, thus one way to effectively enhance public awareness is to increase local media coverage on climate change risks and global warming consequences.[69] In addition, other types of information campaigns (such as the documentary *Under the Dome*) depicting the severity of environmental problems and their causes and consequences can also appeal to citizens, both raising concerns and promoting responsive behaviour.[70]

Third, we find that education attainment exerts no statistically significant impact on Chinese individuals' GWCC concern in our regression models. This is surprising, and in contrast to findings in many other countries where a positive education–GWCC concern link has been found.[71] However, despite the insignificant regression coefficient, a positive association between education and GWCC concern is revealed in our bivariate correlations analysis ($r = 0.035$, $p < 0.05$), showing a potential of increased education level in raising individual's GWCC concern. Moreover, some recent empirical studies demonstrate that the overall intensity of Chinese environmental concern is increased along with education attainment.[72] Considering the potential (albeit not definitive) influence of education in promoting Chinese environmental concern, we suggest that China should incorporate more environmental knowledge and GWCC information into schools' curriculum design and other educational activities to strengthen the links between education level and GWCC-related environmental concern.

Fourth, the gender gap and age gap found in our study suggest that environmental awareness campaigns and GWCC education programmes should give more attention to the groups of people who are less concerned about GWCC, such as Chinese men and older citizens. Moreover, our findings indicate that post-materialist values substantially promote citizens' GWCC concern,

69 Zhao 2009; Sampei and Aoyagi-Usui 2009; Qin et al. 2018.
70 Qin et al. 2018.
71 Clements 2012; Tranter 2013; Lee et al. 2015.
72 Xiao, Dunlap and Hong 2013; Hao 2014; Xiao and Hong 2018; Hao, Huang and Sloan 2018.

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suggesting that development of post-materialism will contribute to a higher level of public concern about GWCC. At present, economic development in China is conducive to promoting the dissemination of post-materialist values, and as long as China maintains its rapid development, Chinese citizens are expected to experience a shift in values from materialism to post-materialism.[73] However, the relationship between the growth of the economy and the development of post-materialism is not always automatic and linear; the changing pattern of post-materialist values may also start to decline after China's development reaches a cut-off point.[74] Thus, actively promoting post-materialist values such as environmentalism and civic engagement is not only beneficial for China's future development but also helpful in enhancing Chinese citizens' GWCC concern.

Fifth, China needs to direct more efforts to restructuring its economy so it is less dependent on carbon-intensive industries. This is good for China's economic transition and sustainable growth in the long term,[75] and can be achieved through local efforts with carbon emission reduction policies and technological innovations.[76] It is also helpful in raising Chinese citizens' GWCC concern, as our study finds that people living in provinces with less economic dependency on carbon-intensive and GHG-producing industries tend to express more concern about GWCC. Currently, carbon-intensive industries account for 59 per cent of China's GDP. A more balanced economic structure and increased share of tertiary industry in GDP will allow citizens to be less carbon-vested and more willing to pay attention to environmental quality and protection.

Sixth, while many studies on other countries have found a clear link between climate vulnerability and citizens' GWCC concern, we did not find this to be the case in China. The coastal region in China is crucial because of its contribution to the national GDP and its large share of the population. Most financial, high-tech and information industries are located in coastal cities such as Shanghai, Tianjin and Shenzhen. However, the coastal region is exposed to severe climate change risks such as inundation from rises in sea level. Our findings indicate that, compared to people living in inland provinces, people living in coastal regions do not have a significantly higher recognition of the potential dangers of GWCC that could affect them. Thus, it is our recommendation that the communities and local governments along the coastline work together to start educational campaigns and programmes that highlight the region's GWCC vulnerability in order to raise awareness and concern about GWCC among its populations.

As one of the first of its kind, the present study can serve as a starting point for subsequent research to expand the literature on the Chinese public's GWCC concern. We recommend some directions for future research. First, we used a single

73 Inglehart 1997.
74 Franzen and Meyer 2010.
75 Liu, Zhu, et al. 2013.
76 Shan et al. 2018.

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question to gauge respondents' general GWCC concern, which may or may not be an adequate measure. While using a single item to measure people's perceived seriousness of climate change is a common approach to operationalize GWCC concern,[77] future research may consider to explore more specific aspects of GWCC (for example, temperature increase, rising sea levels, climate-induced flooding and drought) to complement the current measurement. Second, although we included several regional-level variables in our analysis and conducted location-fixed effects estimates, subsequent studies should consider additional regional factors when data are available. Those factors might include physical environmental and climate conditions, local media coverage of GWCC, the strength and influence of citizen environmental groups and organizations, and government regulations related to carbon-intensive industries and alternative energies. Third, scholars should continue to conduct public surveys on a regular basis and examine the changes and determinants of Chinese citizens' GWCC concern over time. This is important because tracing public attitudes over time with up-to-date data will help scholars improve their theories and models, and with trending patterns detected from multiple surveys over time, policymakers can also make adjustments to existing GWCC policies.

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77 McCright et al. 2016.

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摘要: 中国公众对全球变暖和气候变化的严重性的关注度如何？影响他们关注度的关键因素是什么？本文从现有文献中汲取理论见解，首次运用最新全国代表性公众调查数据（N = 3,748）和省级环境及经济统计指标，分析中国公众对全球变暖和气候变化问题关注度的差异及其决定因素。数据显示，中国公众对全球变暖和气候变化的平均关注度相对其它国家较低，公众对这一问题的关注程度存在很大不同，各个省份之间以及沿海和内陆地区居民的关注度也有差异。统计分析表明，中国公众对全球变暖和气候变化的关注度，受到个体社会人口特征、个人后物质主义价值观、以及所在区域经济对碳密集型产业的依赖性的显著影响。具体而言，女性、年纪较轻、和具有较强后物质主义价值观的中国公民，对全球变暖和气候变化更为关注，而来自于经济上对碳密集型产业依赖度较高的省份的居民，对全球变暖和气候变化的关注程度则较低。在结论部分，我们讨论本研究的政策含义，并为未来的研究提出建议。

关键词: 中国; 公众关注度; 全球变暖与气候变化; 调查分析; 政策

References

Aldy, Joseph E., Matthew J. Kotchen and Anthony A. Leiserowitz. 2012. "Willingness to pay and political support for a US national clean energy standard." *Nature Climate Change* 2, 596–599.

Bell, Shannon E. 2016. *Fighting King Coal: The Challenges to Micromobilization in Central Appalachia*. Cambridge, MA: The MIT Press.

Benegal, Salil D. 2017. "The impact of unemployment and economic risk perceptions on attitudes towards anthropogenic climate change." *Journal of Environmental Studies and Sciences* 8(3), 300–311.

Bernauer, Thomas, Robert Gampfer, Tianguang Meng and Yu-Sung Su. 2016. "Could more civil society involvement increase public support for climate policy-making? Evidence from a survey experiment in China." *Global Environmental Change*, 1–12.

Brody, Samuel D., Sammy Zahran, Arnold Vedlitz and Himanshu Grover. 2008. "Examining the relationship between physical vulnerability and public perceptions of global climate change in the United States." *Environment and Behavior* 40(1), 72–95.

Carlsson, Fredrik, Mitesh Kataria, Alan Krupnick, Elina Lampi, Asa Löfgren, Ping Qin, Susie Chung and Thomas Sterner. 2012. "Paying for mitigation: a multiple country study." *Land Economics* 88(2), 326–340.

Clements, Ben. 2012. "The sociological and attitudinal bases of environmentally related beliefs and behaviors in Britain." *Environmental Politics* 21(6), 901–921.

Conroy, Stephen J., and Tisha L.N. Emerson. 2014. "A tale of trade-offs: the impact of macroeconomic factors on environmental concern." *Journal of Environmental Management* 145, 88–93.

Dietz, Thomas, Amy Dan and Rachael Shwom. 2007. "Support for climate change policy: social psychological and social structural influences." *Rural Sociology* 72(2), 185–214.

Drews, Stefan, and Jeroen C.J.M. van den Bergh. 2016. "What explains public support for climate policies? A review of empirical and experimental studies." *Climate Policy* 16(7), 855–876.

https://doi.org/10.1017/S0305741019000845 Published online by Cambridge University Press

Duan, Wenjie, and Junrong Sheng. 2018. "How can environmental knowledge transfer into pro-environmental behavior among Chinese individuals? Environmental pollution perception matters." *Journal of Public Health* 26(3), 289–300.

Egan, Patrick J., and Megan Mullin. 2012. "Turning personal experience into political attitudes: the effect of local weather on Americans' perceptions about global warming." *Journal of Politics* 74(3), 796–809.

Engels, Anita, Otto Hüther, Mike Schäfer and Hermann Held. 2013. "Public climate-change skepticism, energy preferences and political participation." *Global Environmental Change* 23(5), 1018–27.

Fox, John. 1991. *Regression Diagnostics*. Newbury Park, CA: Sage University Paper Publications.

Franzen, Axel, and Reto Meyer. 2010. "Environmental attitudes in cross-national perspective: a multilevel analysis of the ISSP 1993 and 2000." *European Sociological Review* 26(2), 219–234.

Grover, Himanshu, Samuel D. Brody and Arnold Vedlitz. 2017. "Understanding climate change risk perception in the USA." *International Journal of Global Warming* 13(2), 113–137.

Hannibal, Bryce, Xinsheng Liu and Arnold Vedlitz. 2016. "Personal characteristics, local environmental conditions, and individual environmental concern: a multilevel analysis." *Environmental Sociology* 2(3), 286–297.

Hao, Feng. 2014. "The effect of economic affluence and ecological degradation on Chinese environmental concern: a multilevel analysis." *Journal of Environmental Studies and Sciences* 4(2), 123–131.

Hao, Feng. 2015. "An analysis of social capital generation among coalfield residents at Harlan county, Kentucky." *The International Journal of Social Quality* 5(1), 67–83.

Hao, Feng, Weiwei Huang and Melissa M. Sloan. 2018. "Environmental concern in the United States and China: the influence of measurement in national context." *Social Currents* 5(5), 479–493.

Hao, Feng, Jay L. Michaels and Shannon E. Bell. 2019. "Social capital's influence on environmental concern in China: an analysis of the 2010 Chinese General Social Survey." *Sociological Perspectives*. doi:10.1177%2F0731121419835504.

Hao, Feng, and Yan Wang. 2018. "Acceptance of higher taxes for the environment: a cross-national and multilevel study based on seven years data from ISSP and WVS surveys." *International Journal of Sociology* 48(4), 340–365.

Hornsey, Matthew J., Emily A. Harris, Paul G. Bain and Kelly S. Fielding. 2016. "Meta-analyses of the determinants and outcomes of belief in climate change." *Nature Climate Change* 6, 622–626.

Howe, Peter D., Matto Mildenberger, Jennifer R. Marlon and Anthony Leiserowitz. 2015. "Geographic variation in opinions on climate change at state and local scales in the USA." *Nature Climate Change* 5, 596–603.

Inglehart, Ronald. 1990. *Culture Shift in Advanced Industrial Society*. Princeton, NJ: Princeton University Press.

Inglehart, Ronald. 1997. *Modernization and Postmodernization: Cultural, Economic, and Political Change in 43 Societies*. Princeton, NJ: Princeton University Press.

IPCC (Intergovernmental Panel on Climate Change). 2014. *Climate Change 2014: Synthesis Report*. New York: United Nations.

Jones, Robert E., and Riley E. Dunlap. 1992. "The social bases of environmental concern: have they changed over time?" *Rural Sociology* 57(1), 28–47.

Kim, So Y., and Yael Wolinsky-Nahmias. 2014. "Cross-national public opinion on climate change: the effects of affluence and vulnerability." *Global Environmental Politics* 14(1), 79–106.

Kvaløy, Berit, Henning Finseraas and Ola Listhaug. 2012. "The public's concern for global warming: a cross-national study of 47 countries." *Journal of Peace Research* 49(1), 11–22.

Lee, Tien Ming, Ezra M. Markowitz, Peter D. Howe, Chia-Ying Ko and Anthony A. Leiserowitz. 2015. "Predictors of public climate change awareness and risk perception around the world." *Nature Climate Change* 5(11), 1014–20.

Leiserowitz, Anthony. 2006. "Climate change risk perception and policy preferences: the role of affect, imagery, and values." *Climatic Change* 77(1–2), 45–72.

Liu, Xinsheng, and Ren Mu. 2016. "Public environmental concern in China: determinants and variations." *Global Environmental Change* 37, 116–127.
Liu, Xinsheng, Arnold Vedlitz and Liu Shi. 2014. "Examining the determinants of public environmental concern: evidence from national public surveys." *Environmental Science and Policy* 39, 77–94.
Liu, Zhu, Dabo Guan, Douglas Crawford-Brown, Qiang Zhang, Kebin He and Jianguo Liu. 2013. "Energy policy: a low carbon road map for China." *Nature* 500(7461), 143–45.
Maslow, Abraham H. 1954. *Motivation and Personality*. New York: Harper & Row.
McCright, Aaron M. 2010. "The effects of gender on climate change knowledge and concern in the American public." *Population and Environment* 32(1), 66–87.
McCright, Aaron M., and Riley E. Dunlap. 2011. "The politicization of climate change and polarization in the American public's views of global warming, 2001–2010." *The Sociological Quarterly* 52(2), 155–194.
McCright, Aaron M., Riley E. Dunlap and Sandra T. Marquart-Pyatt. 2016. "Political ideology and views about climate change in the European Union." *Environmental Politics* 25(2), 338–358.
McCright, Aaron M., Sandra T. Marquart-Pyatt, Rachael L. Shwom, Steve R. Brechin and Summer Allen. 2016. "Ideology, capitalism, and climate: explaining public views about climate change in the United States." *Energy Research and Social Science* 21, 180–189.
Mumpower, Jerry L., Xinsheng Liu and Arnold Vedlitz. 2016. "Predictors of the perceived risk of climate change and preferred resource levels for climate change management programs." *Journal of Risk Research* 19(6), 798–809.
O'Connor, Robert E., Richard J. Bard and Ann Fisher. 1999. "Risk perceptions, general environmental beliefs, and willingness to address climate change." *Risk Analysis* 19, 461–471.
PEW (Pew Research Center). 2009. "Global warming seen as a major problem around the world; less concern in the US, China and Russia," 2 December, http://www.pewglobal.org/2009/12/02/global-warming-seen-as-a-major-problem-around-the-world-less-concern-in-the-us-china-and-russia/. Accessed 10 March 2017.
Poortinga, Wouter, Alexa Spence, Lorraine Whitmarsh, Stuart Capstick and Nick F. Pidgeon. 2011. "Uncertain climate: an investigation into public scepticism about anthropogenic climate change." *Global Environmental Change* 21(3), 1015–24.
Qian, Weihong, and Yafen Zhu. 2001. "Climate change in China from 1880 to 1998 and its impact on the environmental condition." *Climatic Change* 50(4), 419–444.
Qiao, Guiqiang, and Jun Gao. 2017. "Chinese tourists' perceptions of climate change and mitigation behavior: an application of norm activation theory." *Sustainability* 9(8), 1–13.
Qin, Chuanshen, Jianhua Xu, Gabrielle Wong-Parodi and Lan Xue. 2018. "Change in public concern and responsive behaviors toward air pollution *under the dome*." *Risk Analysis*. doi: https://doi.org/10.1111/risa.13177.
Ru, Jiang, and Leonard Ortolano. 2009. "Development of citizen-organized environmental NGOs in China." *Voluntas: International Journal of Voluntary and Nonprofit Organizations* 20(2), 141–168.
Sampei, Yuki, and Midori Aoyagi-Usui. 2009. "Mass-media coverage, its influence on public awareness of climate-change issues, and implications for Japan's national campaign to reduce greenhouse gas emissions." *Global Environmental Change* 19(2), 203–212.
Savage, Ian. 1993. "Demographic influences on risk perceptions." *Risk Analysis* 13(4), 313–420.
Semenza, Jan C., David E. Hall, Daniel J. Wilson, Brian D. Bontempo, David J. Sailor and Linda A. George. 2008. "Public perception of climate change voluntary mitigation and barriers to behaviour change." *American Journal of Preventive Medicine* 35, 479–487.
Shan, Yuli, Dabo Guan, Klaus Hubacek, Bo Zheng, Steven J. Davis, Lichao Jia, Jianghua Liu et al. 2018. "City-level climate change mitigation in China." *Science Advances* 4(6), 1–15.
Shum, Robert Y. 2012. "Effects of economic recession and local weather on climate change attitudes." *Climate Policy* 12, 38–49.
Stalley, Phillip, and Dongning Yang. 2006. "An emerging environmental movement in China?" *The China Quarterly* 186, 333–356.

Stokes, Bruce, Richard Wike and Jill Carle. 2015. "Global concern about climate change, broad support for limiting emissions: US, China less worried; partisan divides in key countries." Pew Research Center Research Report, 5 November, http://www.pewglobal.org/2015/11/05/global-concern-about-climate-change-broad-support-for-limiting-emissions/. Accessed 4 April 2017.

Stoutenborough, James W., Xinsheng Liu and Arnold Vedlitz. 2014. "Trends in public attitudes toward climate change: the influence of the economy and climategate on risk, information, and public policy." *Risk, Hazards & Crisis in Public Policy* 5(1), 22–37.

Tang, Xiao, Weiwei Chen and Tian Wu. 2018. "Do authoritarian governments respond to public opinion on the environment? Evidence from China." *International Journal of Environmental Research and Public Health* 15(2), 1–15.

Teets, Jessica. 2018. "The power of policy networks in authoritarian regimes: changing environmental policy in China." *Governance* 31(1), 125–141.

Tjernström, Emilia, and Thomas Tietenberg. 2008. "Do differences in attitudes explain differences in national climate change policies?" *Ecological Economics* 65(2), 315–324.

Tranter, Bruce. 2013. "The great divide: political candidate and voter polarization over global warming in Australia." *Australian Journal of Politics and History* 59, 397–413.

Tranter, Bruce, and Kate Booth. 2015. "Scepticism in a changing climate: a cross-national study." *Global Environmental Change* 33, 154–164.

Tvinnereim, Endre, Xiaozi Liu and Eric M. Jamelske. 2017. "Public perceptions of air pollution and climate change: different manifestations, similar causes, and concerns." *Climatic Change* 140(3–4), 399–412.

Wang, Pu, Lei Liu and Tong Wu. 2018. "A review of China's climate governance: state, market and civil society." *Climate Policy* 18(5), 664–679.

Wang, Xiao. 2017. "Understanding climate change risk perceptions in China: media use, personal experience, and cultural worldviews." *Science Communication* 39(3), 291–312.

Wike, Richard. 2016. "What the world thinks about climate change in 7 charts." Pew Research Center, 18 April, http://www.pewresearch.org/fact-tank/2016/04/18/what-the-world-thinks-about-climate-change-in-7-charts/. Accessed 12 November 2017.

Wood, B. Dan., and Arnold Vedlitz. 2007. "Issue definition, information processing, and the politics of global warming." *American Journal of Political Science* 51(3), 552–568.

Xiao, Chenyang, Riley E. Dunlap and Dayong Hong. 2013. "The nature and bases of environmental concern among Chinese citizens." *Social Science Quarterly* 94(3), 672–690.

Xiao, Chenyang, and Dayong Hong. 2018. "Gender differences in environmental behaviors among the Chinese Public: model of mediation and moderation." *Environment and Behavior* 50(9), 975–996.

Xue, Wen, Anthony D. G. Marks, Donald W. Hine, Wendy J. Phillips and Shouying Zhao. 2018. "The new ecological paradigm and responses to climate change in China." *Journal of Risk Research* 21(3), 323–339.

Yang, Guobin. 2005. "Environmental NGOs and institutional dynamics in China." *The China Quarterly* 181, 46–66.

Yu, Hao, Bing Wang, Yue-Jun Zhang, Shouyang Wang and Yi-Ming Wei. 2013. "Public perception of climate change in China: results from the questionnaire survey." *Natural Hazards* 69(1), 459–472.

Zhan, Xueyong, and Shui-Yan Tang. 2013. "Political opportunities, resource constraints and policy advocacy of environmental NGOs in China." *Public Administration* 91(2), 381–399.

Zhang, Shengling, Yue Li, Yu Hao and Yipeng Zhang. 2018. "Does public opinion affect air quality? Evidence based on the monthly data of 109 prefecture-level cities in China." *Energy Policy* 116, 299–311.

Zhao, Xiaoquan. 2009. "Media use and global warming perceptions a snapshot of the reinforcing spirals." *Communication Research* 36(5), 698–723.