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# What Drives Policy Attention to Climate Change in China? An Empirical Analysis through the Lens of *People's Daily*

**Shiwei Fan [1], Lan Xue [2] and Jianhua Xu [3,*]**

[1] School of Government, Central University of Finance and Economics, Beijing 100081, China; shiwei.fan@outlook.com
[2] School of Public Policy and Management, Tsinghua University, Beijing 100084, China; xuelan@tsinghua.edu.cn
[3] Department of Environmental Management, College of Environmental Sciences and Engineering, Peking University, Beijing 100871, China
* Correspondence: jianhua.xu@pku.edu.cn; Tel.: +86-185-0018-3373

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**Abstract:** Addressing climate change requires sustained effort from all levels of society. Garnering and maintaining the attention of policy elites can be optimized through understanding what drives their attention to climate change. This study goes beyond the focus on democratic regimes to unravel the dynamics of attention to climate change in China. To do this, this study analyzed the content of articles published in *People's Daily* from 1985 to 2013. Drawing upon the information processing theory of policy dynamics, we used the time-series regression to examine the effects of information flows of different types on attention to climate change. We found that events such as important international conferences on climate change, domestic attention to environmental issues other than climate change, and pressure from abroad have a significant influence on attention to climate change in China. In addition, these factors were found to have different effects over time, which has received little attention to date.

**Keywords:** climate change; policy attention; attention drivers; time-series analysis; China

## 1. Introduction

Climate change poses unprecedented challenges to human society at a number of levels. It exerts huge pressure on the natural environment, brings numerous social and political problems, and requires tremendous efforts to cope with [1,2]. Climate change was not "built" in one day and will not vanish in one day either. Addressing climate change requires sustained efforts in the long run.

In the policy arena, for an issue to be seriously considered, it has to grab the attention of the policy elites who are at the central stage of policymaking [3–6]. However, attention to an issue could easily fade away as there are many issues competing for it [3,7,8].

So, there is a tension between the need for sustained attention to address climate change and the risk of attention waning. This leads us to study what drives attention to climate change and thus to guide where efforts can be exerted to maintain such attention. With this question in mind, we conducted our study in a Chinese setting.

We chose China for two reasons. First, China is among the leading greenhouse gas emitters in the world. Substantive mitigation and adaptation efforts from China are indispensable for coping with global climate change. It is thus desirable to decipher China's policy process. This renders studying factors driving issue attention, which is at the front-end of a policy cycle, significant. Second, issue attention has rarely been studied in China, although other components of a policy cycle such as

policymaking and policy implementation have been extensively explored [9–11]. Existing research on the dynamics of issue attention is largely confined to democratic regimes [5,8,12–15], the results of which cannot be directly borrowed to explain the drivers of the dynamics of issue attention in authoritarian regimes. Our study is designed to bridge this gap.

On balance, this study has multiple goals. Theoretically, it intends to enrich our understanding of issue attention with regard to such wicked problems as climate change and in settings other than democratic regimes. Practically, it intends to identify driving forces of issue attention in China such that precise measures can be taken to sustain attention to climate change.

The paper is structured as follows. Section 2 reviews the existent literature relevant to issue attention, from which hypotheses are deduced. Section 3 describes methods for collecting and analyzing data. Sections 4 and 5 present and discuss the empirical results. Section 6 concludes the article.

## 2. Theoretical Framework and Hypotheses

Our analysis of the dynamics of attention to climate change draws upon the information processing theory of policy dynamics [16]. Information processing theory has its root in the behavioral theory of choice and underscores the scarcity of attention and the oversupply of information [5,16–18].

Attention is a scarce resource. Faced with numerous issues, decision-makers have to make prioritization as to which ones are to be taken care of and which ones are to be shelved. Attention has inertia, though, which originates from the relative stability of individual preferences and their resistance to change [5,15,19]. Their resistance is attributable to the cognitive and institutional frictions inherent in policy processes [5,15]. This makes attention shift a dynamic process in which attention experiences lulls interrupted by lurches [3,5]. Major shift in attention may happen when new information indicating changes in social conditions emerges [16,20,21]. When new information intrudes into a policy system, it carries with it the potential "to shock, to disrupt, and to destabilize" policy agendas, thereby engenders attention punctuation and making policy change possible [5,8].

Decision-makers live in a world rich in information [18]. The information includes signals of various types, with some defining problems, some indicating or reminding the existence or severity of problems, and some suggesting potential policy solutions [5,6,16,20,22]. Entities in the policy system collect, assemble, interpret, and prioritize these signals from the environment [5]. In this process, some signals are blocked or dismissed, while others are capable of triggering attention to the policy problem [8].

In addition, for those information signals to be capable of trigging attention, they may function differently in the policy process [6]. Some may have effects at the moment of their intrusion into the policy process [23], while others may be effective over a longer period of time [12]. So, disentangling the short-term from the long-term effects of information flows is necessary, which raises the issue of the choice of time basis for analyzing the effects of the different information flows on attention.

Four types of information flows are examined to understand the drivers of the dynamics of the attention of policy elites to climate change, as follows.

### *2.1. Problem Indicators*

Problem indictors refer to the objective indicators of social problems [6], which are critical in demonstrating the existence of social problems and bringing them to the attention of policy elites [3,6,24,25]. Problem indicators are usually presented in an abstract form and of an index type [6,26]. For instance, the indicators of climate change may include global average temperature, the concentrations of greenhouse gases in the atmosphere, and extreme meteorological disasters, among others.

There is empirical evidence showing that attention to climate change is associated with these indicators [26–29]. Among them, extreme weather is the most salient one for the general public and policy elites [29]. These tangible extreme weather events are obvious cues reminding people

of the severity of climate change, as has been shown in previous studies [26,27,29,30]. Thus, we argue that problem indicators characterized by extreme weather, together with the damage incurred, drive attention to climate change.

**Hypothesis 1 (H1).** *Attention to climate change is positively associated with problem indicators signifying the severity of extreme weather.*

### *2.2. Focusing Events*

Focusing events refer to those incidents that propel a cascade of attention of the public or policymakers to a social problem [6]. Focusing events can be disasters or crises that reveal the severity of a policy problem and are capable of catching people's attention, such as the Three Mile Island event and the 9/11 terrorist attack [6,23,31–33]. Focus events could also be political events, policy alternatives, or social problems that can act as a major lever for moving an issue to the forefront for people in and around governments [6].

Focusing events can enable hidden issues to emerge, helping us to redefine policy problems, bring new dimensions to policy debates, and reframe policy networks or change policymaking structures [3,5,6,32]. With regard to climate change, big news such as the release of a significant report (e.g., the IPCC report) may facilitate the re-emergency of climate issues in people's sight [34]. Moreover, given that climate change is a global issue, global policy agendas such as major international conferences (e.g., Climate Summits), in which important topics are debated, significant agreements are reached, and profound institutions are established, may serve as a catalyst to attract the attention of the public and policy elites to climate change [26]. We hypothesize that these focusing events have impacts on the dynamics of attention to climate change.

**Hypothesis 2 (H2).** *Attention to climate change is positively associated with the occurrence of focusing events.*

### *2.3. Policy Knowledge*

Policy knowledge is an important information input in a policy process, for it helps identify problems, clarify targets or objectives, formulate alternatives, and evaluate performance [35]. Policy knowledge, which involves experience and predictive scientific information, can help facilitate effective and forward-looking decision-making [36,37]. Although the importance of policy knowledge in decision-making has been stressed enough, its effect on agenda setting and attention dynamics has not been studied yet. Through discovering potential risks, generating new knowledge, and advocating, manipulating, and pushing policy issues, policy knowledge may also help attract attention to a certain issue [38].

Climate change is full of complexity and uncertainty. Policy knowledge relevant to climate change covers biophysical data and science with regard to the behavior of ecosystems as well as its impacts on human health, ecosystem health, and natural resources [35,39,40]. Scientific discoveries may play the role of mind changers, thereby bringing climate change into public or political discourses [34]. We argue that policy knowledge on climate change has impacts on attention to it.

**Hypothesis 3 (H3).** *Attention to climate change is positively associated with the increase in policy knowledge.*

### *2.4. Spillovers*

Studies on policy dynamics are often focused on one particular policy issue in a single policy subsystem and have been inattentive to the boundary-spanning nature of many issues [41]. As a result, the trans-subsystem dynamics of the policy process remains unclear. Climate change is a typical

boundary-spanning policy issue, which crosscuts several areas and spans multiple policy subsystems. Therefore, spillovers from other policy domains need to be considered while examining the drivers of attention to climate change [22,41].

#### 2.4.1. Spillover from Attention to Environmental Subsystems Other than Climate Change

Policy issues do not exist in isolation. The conventional wisdom is that attention is scarce [4,42] and there is always competition for attention among issues. This suggests that attention to one policy issue can be crowded out by other issues [43,44]. However, policy subsystems are often interconnected through various linkages that induce trans-subsystem dynamics [22]. These linkages between subsystems could be policy entrepreneurs' collaboration, a policy dimension shift, salience borrowing, and other mechanisms, which enable deep and complex interactions between policy subsystems [22,45]. Thus, there are possibilities that attention to one policy issue can be "crowed in" by other issues. Actually, some studies have provided evidence that there indeed exist crowd-in effects between climate change and other environmental issues [46]. Thus, we argue that attention to climate change in China can be enhanced by trans-subsystem effects from attention to environmental issues other than climate change.

**Hypothesis 4a (H4a).** *Attention to climate change is positively associated with attention to environmental issues other than climate change.*

#### 2.4.2. Spillover from Abroad

Climate politics is global in nature and thus domestic climate policies are prone to be affected by international politics [47,48]. There are studies showing that legislation and policy on climate change are influenced by the passage and enforcement of similar laws elsewhere [49]. This demonstrates the propensity of cross-border policy spillover in addressing climate change. In terms of climate policy in China, there have been studies arguing that several international factors may conspire to shape the policymaking process [50,51]. International pressure is usually recognized as a key factor in shaping China's policy agenda on climate change [52–54]. This argument is also supported by studies claiming that China cares about its international image, prestige, and self-identity of playing a leading role among developing nations [51,55,56]. Therefore, we argue that the boundary-spanning effect due to pressure from abroad may exert a significant influence on China's attention to climate change.

**Hypothesis 4b (H4b).** *Attention to climate change in China is positively associated with pressure from abroad.*

## 3. Data and Methodology

We use time series data and an Auto Regressive Integrated Moving Average (ARIMA) regression model to identify drivers of attention to climate change in China. The timeframe is set to be from 1985 to 2013, which is chosen for two reasons: first, a long series with more observations helps mitigate the impact of noise; second, the accessibility of data made us choose 1985 as the beginning year and 2013 as the ending year when we started working on this project.

### *3.1. Measuring Attention to Climate Change*

We used *People's Daily*, an official newspaper, as a source to derive the level of attention to climate change in China. In the following, we elaborate why and how.

#### 3.1.1. Why?

*People's Daily* is the most pivotal channel for information release in China. As the mouthpiece of the central government, *People's Daily* wields considerable influence on China's political and social

life [57]. The information released by *People's Daily* is guided and vetted by authorities to ensure its consistency with the agendas and positions of the central government [58,59]. Since *People's Daily* provides direct information about the policies and viewpoints of the central government, its content reflects the policy attention and agenda in China [58,60,61].

There have been studies using the content of *People's Daily* and other official newspapers as a proxy for policy elites' attention to a variety of issues in China. For example, Shi and Lou used the content in *People's Daily* to evaluate the changes in civil liberty and political rights in China [61]; Mei et al. studied the articles in *People's Daily* and unveiled the shift in patterns of policy experimentation and policy innovation in China [62].

Although *People's Daily* provides an accessible source to study policy attention in China, academically, using it as a source is prone to the suspicion of providing censored and thus biased information. This concern might be legitimate on other topics; in our study, this would not be an issue. Environment-related problems are not considered to pose a direct threat to China's regime stability [57]. The central government opens up this policy area to allow and even encourage the media to act as a watchdog so as to expose pollution and improve policy implementation [9,57]. Therefore, the media coverage from *People's Daily* in our study can be considered to reasonably reflect the attention of policy elites to climate change.

#### 3.1.2. How?

We followed Schmidt's criteria to retrieve articles from *People's Daily* [63]. When the keyword 'climate' appears in connection with words indicating 'change' or words synonymous to climate change are included in an article, the article is considered to be relevant to climate change. The search string is shown in Appendix A. A full-text search was conducted in China National Knowledge Internet (CNKI: http://www.cnki.net/) Newspapers Library. A total of 3722 articles were obtained.

The prevailing method for measuring the strength of issue attention is a 'count-based' method, which calculates the number or frequency of articles or keywords mentioned in a given time unit [12,63–68]. We followed suit, but used the natural language processing technique to estimate the attention to climate change in China [12,69,70]. This technique can mitigate individual biases and improve coding efficiency.

Specifically, we used the TextRank technique to measure attention to climate change. The TextRank technique is a graph-based natural language processing technique, put forward by Mihalcea and Tarau for extracting keywords from texts [71]. The advantage of TextRank is that the results extracted hinge on the relative importance of information within articles. Moreover, it is an unsupervised method and requires no training sets.

As one of the most popular techniques for keyword spotting in natural language processing [72], it is widely used not only in the field of computer engineering but also in the social sciences. It has been used to perform content analysis and thus to analyze policy narratives [73], study knowledge networks [74], and examine social media [75].

The TextRank technique extracts keywords in three steps: word segmentation, word relations identification, and iterative computation. Specifically, each article is segmented into words or phrases that are treated as vertices in a graph. The edge is defined as the co-occurrence of the words or phrases within a prescribed word distance. The basic idea of the graph-based ranking model is that the more edges are connected to a word or phrase, the more important the word or phrase is.

Rada and Paul proposed a graph-based ranking formula to compute the score associated with a vertex in the graph, which takes into account the edge weights [71]. The equation to estimate the scores of the keywords is as follows (see Equation (1)):

$$WS(V_i) = (1-d) + d \times \sum_{V_i \in In(V_i)} \frac{w_{ji}}{\sum_{V_k \in Out(V_j)} w_{jk}} WS(V_j), \quad (1)$$

where $WS(V_i)$ denotes the score of vertex $i$, $d$ is the damping factor, usually set to be 0.85, and $w_{ji}$ indicates the strength of connections between two vertices, i.e., keywords $i$ and $j$.

Through iterative calculation until the convergence is reached, the scores indicating the relative importance of the vertices can be estimated. One hundred key vertices (i.e., keywords) per article were extracted. Each article is then transformed into a vector of 100 keywords with scores. Finally, climate-related words are screened out from each article, and the scores of these keywords are summed up as the article's score, indicating the level of its relevance to climate change. By using this technique, all 3722 articles retrieved from *People's Daily* were processed.

The lengths of articles are assumed to be associated with their prominence [76]. Articles with more words are assumed to be more important, but the marginal effect is diminishing [77]. The weight of article length is estimated with a logarithmic function, as follows (see Equation (2)):

$$W_{length} = \log(\text{length of article}), \tag{2}$$

where $W_{length}$ denotes the weight of article length and article length is measured as the total number of words in the article.

In addition, the position where an article is located is able to reflect its importance as well [78]. Thus, we measured the relative importance of an article's position through a discounted cumulative gain method, which is usually used to measure the ranking quality in information retrieval (see Equation (3)).

$$W_{page} = \frac{1}{\log_2(page + 1)}, \tag{3}$$

where $W_{page}$ denotes the weight of article position and $page$ is the position number of an article in the newspaper.

Attention is then estimated by multiplying the sum of scores of keywords related to climate change with the weights of article length and article position.

### *3.2. Measuring the Independent Variables*

#### 3.2.1. Problem Indicators

Problem indicators are measured with a composite index reflecting the impacts of extreme meteorological disasters, which include mortality, the size of the population affected, and economic damage. Information on meteorological disasters and their associated impacts were obtained from the International Disaster Database EM-DAT (https://www.emdat.be/). The statistics of the disasters from EM-DAT come from various sources including United Nation agencies, non-governmental organizations, insurance companies, research institutes, and press agencies. This dataset is widely used to study public health, environmental policy, and crisis management.

The meteorological disasters and their associated impacts in China from 1985 to 2013 were retrieved from EM-DAT. The Disaster Extreme Index (DEI) is calculated using the following formula (Equation (4)):

$$\text{Disaster Extreme Index} = \ln(Mortality \times Total\ Affected \times Total\ Damage), \tag{4}$$

where *mortality*, *total affected*, and *total damage* refer to the death toll, the total number of people impacted, and the economic loss due to extreme weather.

#### 3.2.2. Focusing Events

Focusing events in our study refer to the major events related to climate change such as the release of IPCC report, the convening of Conferences of Parties (COP) under the United Nations Framework Convention on Climate Change (UNFCCC), and other important multilateral negotiations pertaining to climate issues. According to previous studies, international focusing events should meet such

criteria as the creation of vital agreement in coping with climate change, the occurrence of high-profile worldwide conferences, and the release of landmark-type scientific discoveries or assessments [26,27].

Judged on these criteria, six types of events were selected, as listed in Table 1. All these focusing events are coded as dummy variables. Since these events do not take place often, we code each type of event as one dummy variable. Thus, the individual effect of these focusing events can be tested.

**Table 1.** List of focusing events.

| Focusing Events | Content |
| --- | --- |
| COP | Conferences of Parties of UNFCCC, 20 in total (1995–2013) |
| Rio+ [1] | United Nations Conferences on Sustainable Development, 3 in total |
| APP | Asia Pacific Partnership on Clean Development and Climate Summit, 3 in total |
| G20 [2] | G20 Summits, 19 in total (1999–2013) |
| BRICS [3] | BRICS Summits, 10 in total (2008–2013) |
| IPCC [4] | Release of IPCC Assessment Reports |

[1] Rio+ refer to United Nations Conferences on Sustainable Development. [2] G20 is the abbreviation of Group of Twenty. [3] BRICS is the acronym five major emerging economies: Brazil, Russia, India, China and South Africa. [4] IPCC (Intergovernmental Panel on Climate Change) is a scientific and intergovernmental body under the auspices of the United Nations, dedicated to the task of providing the world with an objective, scientific view of climate change and its political and economic impacts.

#### 3.2.3. Policy Knowledge

Policy knowledge is measured with a proxy, which is the number of academic publications with a focus on climate change. All the climate-related research papers published in journals recognized as the core journals by CNKI were retrieved. These papers, written mainly in Chinese, are supposed to represent all the climate-related policy knowledge. The search string is the same as the one used to collect climate-related papers from *People's Daily* (see the search string in Appendix A). All publications in core journals with the keywords in the search string were finally retrieved and counted. The number of climate-related research articles in a given time period is taken as a measure of policy knowledge.

#### 3.2.4. Attention to Environmental Issues Other than Climate Change

Attention to environmental issues other than climate change is measured in a similar way. All the articles related to air pollution and environmental protection were retrieved from *People's Daily*. In order to eliminate the confounding effect caused by the co-occurrence of the keywords, namely climate change and environment, in the same article, the articles including the keywords "climate change" and "global warming" were removed from the dataset (see the search string in Appendix A). To test the trans-subsystem effect, the issue competing hypothesis originating from the scarcity of the attention for decision-makers should be controlled for. Extracting the trans-subsystem variables from the same data source as the explained variable renders this controlling strategy possible, because they are under the same upper limit of attention.

#### 3.2.5. Pressure from Abroad

Pressure from abroad is difficult to measure because it cannot be observed directly. The aforementioned literature review illustrated that international pressures shaped China's attitudes and policies in addressing climate change. These pressures may be attributable to concern about national image and prestige as well as the requirement on China to make binding commitments [51,54–56]. Following previous studies, we use the coverage of the influential mass media from major powers as a proxy to measure international pressure [79].

Specifically, we use the frequencies of articles mentioning climate change and China at the same time from *The New York Times* and *The Times* (London) to measure international pressure. These two newspapers are chosen because they are domiciled in the USA and the UK. The USA is the biggest economy and a leading greenhouse gas emitter, and wields tremendous influences on issues related to climate change [80]. It also has significant impacts on the strategies and policies of China in the climate

policy arena [81]. The UK actively advocates for addressing climate change worldwide and sought to take a leading role in coping with global warming [34,82]. It mainly represents the viewpoints of the developed nations in the EU and tries to defend their interests and push developing countries to join in the climate campaign [82]. Another reason why we chose these two newspapers is that they are both well-known worldwide and are regarded as significant players in agenda-setting [3,5,83,84]. They have been widely used as an important data source in studying mass media and communications as well as policy process and agenda politics [29,63,80,85–87].

### *3.3. Auto Regressive Integrated Moving Average Model*

Auto Regressive Integrated Moving Average (ARIMA) is used in our study. This method for performing time series analysis starts with building a model based on the series' own past. Accounting for the past of the dependent variable offers a design analogous to the control group (without intervention) and treatment group (with intervention), which enhances the reliability of the causal inference [88].

## 4. Analysis

In conducting time series regressions, we used both a monthly basis and a quarterly basis. This is different from previous studies on the dynamics of issue attention, which often prescribe one time basis, for instance, a yearly basis [12,26] or a monthly basis [27]. Using a different time basis allows us to identify the time effect of the influence of different information flows on the attention to climate change.

### *4.1. Monthly-Based Regression*

The attention paid to climate change in China on a monthly basis from 1985 to 2013 is depicted in Figure 1, from which no obvious trends but violent fluctuations in the few years around 2007 are observed. To avoid estimation error caused by serious heteroscedasticity, we transformed the dependent variable by taking the cube root of the monthly attention. Such a transformation flattens the peaks, but still allows us to assess the effects of the independent variables on the dependent variable [78].

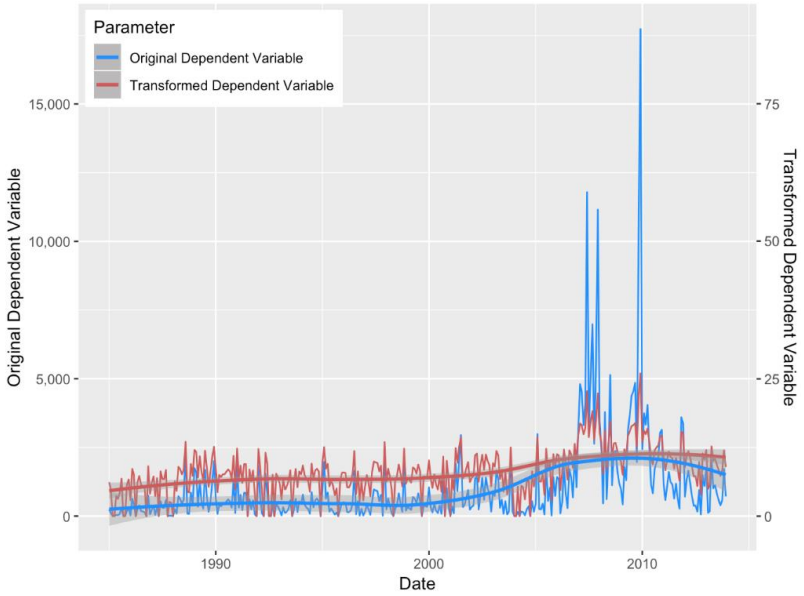


**Figure 1.** Attention to climate change in China (monthly basis). Note: The blue and red lines indicate the original and transformed dependent variable. The smoothed lines with confidence intervals exhibit the general trends of the dependent variable.

Auto Regressive Integrated Moving Average requires an absence of trends in all the variables. Thus, we used the augmented Dickey–Fuller (ADF) test to examine the stationarity of all of them. The statistic of ADF test for the dependent variable is −10.620, which is much smaller than the 1% critical value (−3.452), indicating that it is stationary. Among all the independent variables, only policy knowledge is not stationary. We square-rooted all the independent variables to ensure their stationarity at a confidence level of 95%.

Then, the autoregressive term (AR) and moving average term (MA) were added to form a complete ARIMA model. Figure 2a,b exhibited a declining pattern as the lag length becomes larger, suggesting that AR and MA terms at lag 1 need to be added. We tested whether autocorrelation in the residuals is absent using the Ljung–Box Q statistic after conducting ARIMA (1,0,1), which is a prerequisite for adding explanatory variables to the model. The Q statistic is 46.0894 with a p-value of 0.2349, suggesting that there is no serial correlation. Furthermore, we applied a Lagrange Multiplier to test autocorrelation in the squared residuals. The Ljung–Box Q test suggests an absence of autoregressive conditional heteroscedasticity. Therefore, the results of the tests indicate that the ARIMA model was well specified.

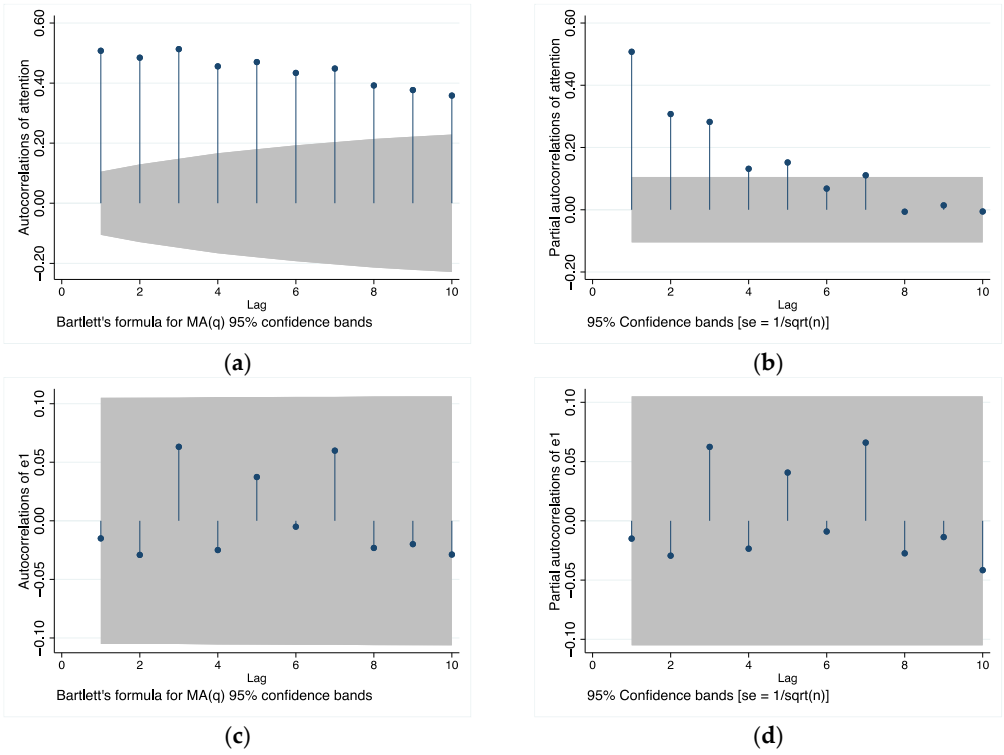


**Figure 2.** Autocorrelation and partial autocorrelation of dependent variable (monthly basis). (**a**,**b**) are autocorrelogram (ac) and partial correlogram (pac) of dependent variable before AR and MA terms are well specified; (**c**,**d**) are autocorrelogram and partial correlogram of residuals after regressing ARIMA model on AR (1) and MA (1).

After establishing the correct univariate specification, we added exogenous variables to the ARIMA (1,0,1) to test our hypotheses. The regression results are shown in Table 2. The different models in Table 2 tested the influence of different information flows on attention to climate change in China.

Model 1 examines the influence of problem indicators on attention to climate change in China. The results show that the index of problem indicators has no significant influence on attention to climate change.

Model 2 examines the influence of focusing events on attention to climate change in China. The results show that some focusing events have a significant influence on attention to climate change,

while others do not. Specifically, Conferences of Parties of UNFCCC and United Nations Conferences on Sustainable Development are the two focusing events that are significant predictors even after controlling for all the other variables (see Models 5 and 6).

Model 3 examines the influence of policy knowledge on attention to climate change in China. The results show that the first lag of policy knowledge has significant influence on attention to climate change. However, after controlling for all the other variables, this influence vanishes (see Models 5 and 6).

Model 4a examines the crowd-in effect of attention to environmental issues other than climate change on attention to climate change. The results indicate a significant crowd-in effect. However, after controlling for all the other variables, this effect disappears (see Models 5 and 6).

Model 4b estimates the boundary-spanning influence from abroad on attention to climate change in China. The regression model included a one-month lag of these pressures variables. The results show that the shift of China's policy attention to climate change is associated with the coverage of *The New York Times* and *The Times*. It is worth noting the influence of the lag of *The Times* remained significant after controlling for all the other variables (see Models 5 and 6).

**Table 2.** Results of the time series regression model (monthly basis).

| | | Base ARMA [1] | Model 1 | Model 2 | Model 3 | Model 4a | Model 4b | Model 5 | Model 6 |
|---|---|---|---|---|---|---|---|---|---|
| Attention | _cons | 7.94 *** | 7.88 *** | 7.73 *** | 6.06 *** | 6.25 *** | 6.23 *** | 5.14 *** | 5.28 *** |
| | | (1.26) [3] | (1.36) | (1.24) | (1.23) | (1.34) | (0.56) | (0.92) | (0.79) |
| ARMA | L.ar | 0.97 *** | 0.97 *** | 0.97 *** | 0.95 *** | 0.96 *** | 0.93 *** | 0.94 *** | 0.93 *** |
| | | (0.02) | (0.02) | (0.02) | (0.03) | (0.02) | (0.04) | (0.03) | (0.03) |
| | L.ma | −0.77 *** | −0.77 *** | −0.75 *** | −0.75 *** | −0.77 *** | −0.81 *** | −0.81 *** | −0.80 *** |
| | | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) |
| H1 [2] | disaster | | −0.00 | | | | | 0.00 | |
| | | | (0.01) | | | | | (0.01) | |
| | L.disaster | | 0.00 | | | | | 0.00 | |
| | | | (0.01) | | | | | (0.00) | |
| H2 | cop | | | 0.32 *** | | | | 0.17 *** | 0.18 *** |
| | | | | (0.07) | | | | (0.06) | (0.06) |
| | rio | | | 0.35 * | | | | 0.28 ** | 0.32 ** |
| | | | | (0.18) | | | | (0.14) | (0.13) |
| | app | | | −0.64 | | | | −0.68 | |
| | | | | (0.41) | | | | (0.42) | |
| | g20 | | | −0.38 | | | | −0.19 | |
| | | | | (0.36) | | | | (0.34) | |
| | brics | | | 0.55 | | | | 1.22 | |
| | | | | (0.84) | | | | (0.93) | |
| | ipcc | | | 0.51 | | | | 0.44 | |
| | | | | (0.42) | | | | (0.37) | |
| H3 | knowledge | | | | 0.05 | | | −0.18 | |
| | | | | | (0.14) | | | (0.12) | |
| | L.knowledge | | | | 0.32 ** | | | 0.16 | 0.11 |
| | | | | | (0.16) | | | (0.12) | (0.11) |
| H4a | envi | | | | | 0.02 | | 0.01 | |
| | | | | | | (0.01) | | (0.01) | |
| | L.envi | | | | | 0.02 * | | 0.02 | 0.02 |
| | | | | | | (0.01) | | (0.01) | (0.01) |
| H4b | pressure_us | | | | | | 0.09 ** | 0.08 ** | 0.08 ** |
| | | | | | | | (0.04) | (0.04) | (0.04) |
| | L.pressure_us | | | | | | 0.01 | 0.01 | |
| | | | | | | | (0.03) | (0.02) | |
| | pressure_uk | | | | | | 0.25 *** | 0.23 *** | 0.22 *** |
| | | | | | | | (0.05) | (0.05) | (0.05) |
| | L.pressure_uk | | | | | | 0.07 * | 0.07 * | 0.07 * |
| | | | | | | | (0.04) | (0.04) | (0.04) |
| sigma | _cons | 3.25 *** | 3.25 *** | 3.10 *** | 3.24 *** | 3.23 *** | 3.01 *** | 2.91 *** | 2.95 *** |
| | | (0.13) | (0.13) | (0.12) | (0.13) | (0.13) | (0.11) | (0.11) | (0.11) |
| Log Likelihood | | −904.86 | −902.39 | −888.13 | −900.45 | −899.89 | −874.33 | −863.47 | −867.54 |
| AIC [4] | | 1817.72 | 1816.78 | 1796.25 | 1812.91 | 1811.78 | 1764.66 | 1766.94 | 1757.08 |
| BIC [5] | | 1833.13 | 1839.88 | 1834.77 | 1836.00 | 1834.88 | 1795.45 | 1843.93 | 1799.42 |

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. [1] The Base ARMA (Auto Regressive Moving Average) model has no exogenous variables added in. [2] H1 indicates that the rows present the statistical results for testing hypothesis 1. So do H2, H3, H4a and H4b. [3] Robust standard errors are presented in parentheses. [4] AIC is the acronym of Akaike Information criterion. [5] BIC is the acronym of Bayesian information criterion.

### 4.2. Quarterly-Based Regression

The attention paid to climate change on a quarterly basis in China from 1985 to 2013 is depicted in Figure 3, in which obvious fluctuation is observed. Similar transformations and tests were conducted before performing the time-series regression. The dependent variable was square-rooted to eliminate the possible heteroscedasticity. The independent variables were square-rooted then differenced ($\Delta x_t = x_t - x_{t-1}$) to ensure stationarity (see Table 3). ADF tests were conducted to all the variables to examine stationarity and no trends were found. According to the autocorrelogram and partial correlogram (See Figure 4a,b), the final ARIMA is well specified with terms including AR(3), AR(7), MA(1), and MA(7). The Q statistic of residuals is 32.2611 with the p-value of 0.8030, suggesting an absence of the serial correlation.

**Table 3.** Transformation of non-stationary variables (quarterly basis).

| Explanatory Variables | ADF Test | Transforming Method | ADF Test |
|---|---|---|---|
| Policy knowledge | $Z(t) = -0.486$<br>$p$-value = 0.8948 | Square root/difference | $Z(t) = -14.948$<br>$p$-value = 0.0000 |
| Trans-subsystem effect | $Z(t) = -2.856$<br>$p$-value = 0.0507 | Square root/difference | $Z(t) = -13.846$<br>$p$-value = 0.0000 |
| Boundary-spanning effect | $Z(t) = -2.253$<br>$p$-value = 0.1875 | Square root/difference | $Z(t) = -17.447$<br>$p$-value = 0.0000 |

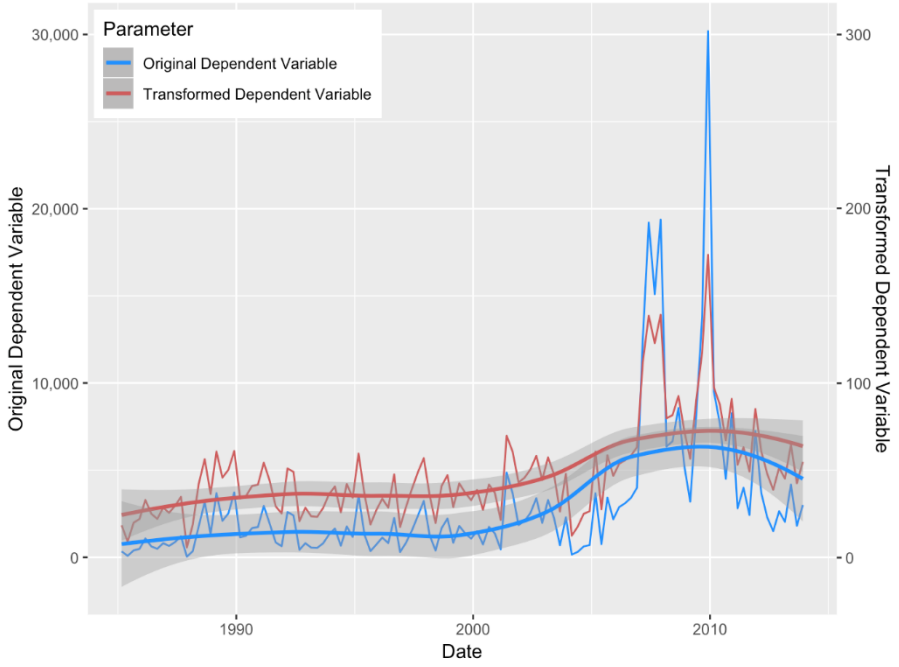


**Figure 3.** Attention to climate change in China (quarterly basis). *Note*: The blue and red lines indicate the original and transformed dependent variable. The smoothed lines with confidence intervals exhibit the general trends of the dependent variable.

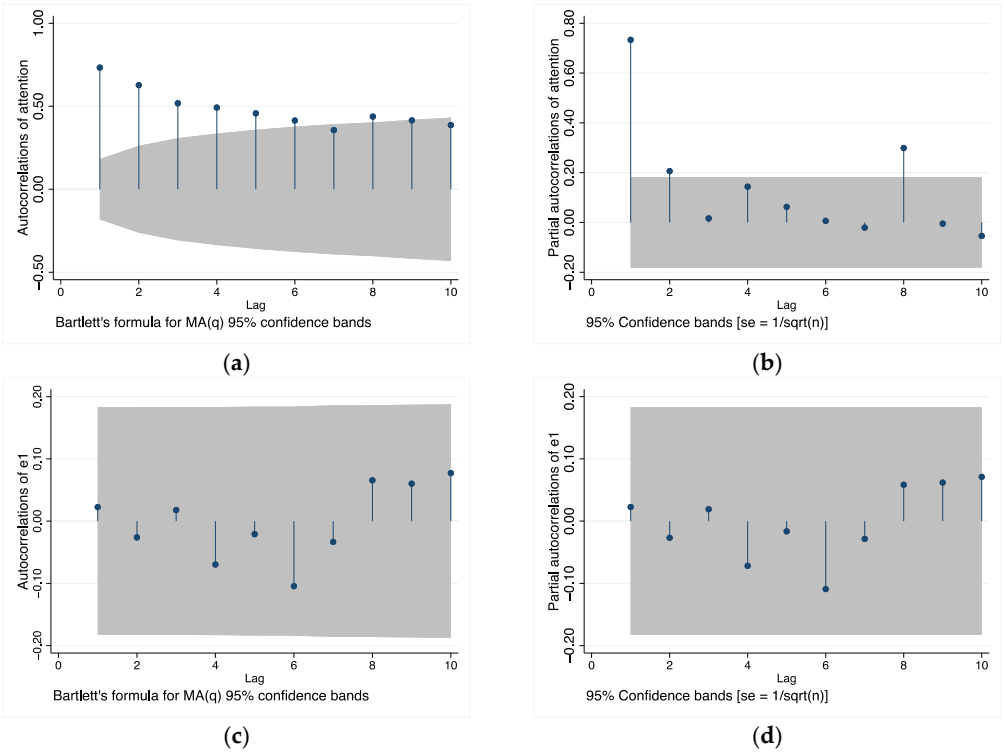


**Figure 4.** Autocorrelation and partial autocorrelation of dependent variable (quarterly basis). (**a**,**b**) are autocorrelogram (ac) and partial correlogram (pac) of dependent variable before AR and MA terms are well specified; (**c**,**d**) are autocorrelogram and partial correlogram of residuals after regressing ARIMA model on AR(3), AR(7), MA(1) and MA(7).

After establishing the correct univariate specification, we added exogenous variables to the model to test our hypotheses. The regression results are shown in Table 4. The different models in Table 4 tested the influence of different information flows on attention to climate change in China.

Model 1 examines the influence of problem indicators on attention to climate change in China. The results show that the index of problem indicators has no significant influence on attention to climate change.

Model 2 examines the influence of focusing events on attention to climate change in China. The results show that some of the focusing events are associated with attention to climate change while others are not. Specifically, Conferences of Parties of UNFCCC and G20 Summits are the two focusing events that are not significant predictors after controlling for all the other variables (see Models 5 and 6).

Model 3 examines the influence of policy knowledge on attention to climate change in China. The results show that policy knowledge has no significant influence on attention to climate change.

Model 4a examines the crowd-in effect of attention to environmental issues other than climate change on attention to climate change. The results show a significant crowd-in effect. Model 4b estimates the boundary-spanning influence from abroad on attention to climate change in China. The results show that the shift of China's policy attention to climate change is associated with the coverage of *The New York Times* and *The Times*. In the full model (Model 5) and combined model (Model 6), the trans-subsystem crowd-in effect and the boundary-spanning effect were both robust even after all other variables were controlled for.

**Table 4.** Results of the time series regression model (quarterly basis).

| | | Base ARMA [1] | Model 1 | Model 2 | Model 3 | Model 4a | Model 4b | Model 5 | Model 6 |
|---|---|---|---|---|---|---|---|---|---|
| attention | _cons | 0.27 | 0.22 | 0.23 | 0.34 | 0.13 | −0.38 | −0.63 | −0.45 |
| | | (0.88) [3] | (0.91) | (0.87) | (0.80) | (0.85) | (0.65) | (0.63) | (0.59) |
| ARMA | L3.ar | −0.19 ** | −0.19 ** | −0.20 * | −0.17 | −0.19 ** | −0.23 ** | −0.24 *** | −0.21 ** |
| | | (0.09) | (0.09) | (0.10) | (0.10) | (0.09) | (0.09) | (0.09) | (0.09) |
| | L7.ar | −0.48 *** | −0.50 *** | −0.48 *** | −0.50 *** | −0.55 *** | −0.38 ** | −0.48 *** | −0.43 *** |
| | | (0.13) | (0.13) | (0.13) | (0.12) | (0.11) | (0.16) | (0.12) | (0.12) |
| | L.ma | −0.42 *** | −0.41 *** | −0.40 *** | −0.43 *** | −0.45 *** | −0.38 *** | −0.43 *** | −0.46 *** |
| | | (0.11) | (0.11) | (0.14) | (0.10) | (0.11) | (0.13) | (0.16) | (0.12) |
| | L7.ma | 0.30 ** | 0.32 ** | 0.32 ** | 0.28 ** | 0.36 *** | 0.15 | 0.23 ** | 0.21 * |
| | | (0.13) | (0.13) | (0.13) | (0.13) | (0.12) | (0.14) | (0.12) | (0.12) |
| H1 [2] | D.disaster | | 0.01 | | | | | 0.01 | |
| | | | (0.01) | | | | | (0.01) | |
| | LD.disaster | | 0.02 | | | | | −0.00 | |
| | | | (0.02) | | | | | (0.02) | |
| H2 | D.cop | | | 1.01 *** | | | | 0.00 | −0.06 |
| | | | | (0.37) | | | | (0.43) | (0.41) |
| | D.rio | | | 0.95 | | | | −1.52 * | |
| | | | | (0.77) | | | | (0.79) | |
| | D.app | | | −0.90 | | | | −1.57 | |
| | | | | (3.74) | | | | (2.94) | |
| | D.g20 | | | −4.12 * | | | | 0.32 | 0.11 |
| | | | | (2.40) | | | | (2.38) | (2.35) |
| | D.brics | | | −0.51 | | | | 1.52 | |
| | | | | (5.23) | | | | (4.73) | |
| | D.ipcc | | | 1.71 | | | | 1.12 | |
| | | | | (2.11) | | | | (1.81) | |
| H3 | D.knowledge | | | | 2.02 | | | 0.47 | |
| | | | | | (1.96) | | | (1.52) | |
| | LD.knowledge | | | | −2.29 | | | 0.28 | |
| | | | | | (1.79) | | | (1.15) | |
| H4a | D.envi | | | | | 3.43 *** | | 2.61 ** | 2.36 ** |
| | | | | | | (1.17) | | (1.24) | (0.98) |
| | LD.envi | | | | | −0.79 | | 0.26 | |
| | | | | | | (0.94) | | (1.18) | |
| H4b | D.pressure_us | | | | | | 8.37 *** | 7.93 *** | 7.20 *** |
| | | | | | | | (1.63) | (1.90) | (1.75) |
| | LD.pressure_us | | | | | | 0.84 | 0.76 | |
| | | | | | | | (1.41) | (1.47) | |
| | D.pressure_uk | | | | | | 9.12 *** | 9.95 *** | 9.99 *** |
| | | | | | | | (2.31) | (3.14) | (2.58) |
| | LD.pressure_uk | | | | | | −3.58 | −3.31 | |
| | | | | | | | (2.49) | (2.60) | |
| sigma | _cons | 17.56 *** | 17.45 *** | 16.74 *** | 17.33 *** | 17.00 *** | 14.18 *** | 13.70 *** | 13.97 *** |
| | | (1.35) | (1.34) | (1.24) | (1.34) | (1.36) | (0.94) | (0.91) | (0.93) |
| Log Likelihood | | −493.25 | −488.28 | −487.72 | −487.54 | −485.51 | −464.56 | −460.80 | −466.94 |
| AIC [4] | | 998.49 | 992.56 | 999.45 | 991.09 | 987.01 | 949.11 | 963.60 | 955.88 |
| BIC [5] | | 1014.96 | 1014.45 | 1032.39 | 1012.98 | 1008.90 | 976.47 | 1021.06 | 986.08 |

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. [1] The Base ARMA (Auto Regressive Moving Average) model has no exogenous variables added in. [2] H1 indicates that the row presents the statistical results for testing hypothesis 1. So do H2, H3, H4a and H4b. [3] Robust standard errors are presented in parentheses. [4] AIC is the acronym of Akaike Information criterion. [5] BIC is the acronym of Bayesian information criterion.

## 5. Discussion

### *5.1. Attention and the Time Effect*

Our findings show that "time" is important in understanding the dynamics of issue attention. The mechanisms for driving attention to climate change are sensitive to the choice of time basis, which reflects the different roles information flows play in the policy process. In the case of the short time basis, which is the monthly basis, some focusing events have a significant influence on attention to climate change in China. This demonstrates that attention to climate change in China is characterized by instant responsiveness to shocking information. In the case of the long-time basis, which is the quarterly basis, attention to climate change is more responsive to the more durative information flows, like the trans-subsystem effect caused by attention to environmental issues other than climate

change. Therefore, we should attach importance to the interaction of information streams and the time dimension in studying policy attention in the future.

### *5.2. Attention and Problem Indicators*

Our hypothesis that attention to climate change is positively associated with problem indicators is supported. Though climate change is usually believed to lead to more natural disasters than ever, it may be difficult to attribute the cause of certain natural disasters to climate change. As a result of this complexity, it is reasonable to conclude that problem indicators do not exert a significant influence on attention to climate change [89].

### *5.3. Attention and Focusing Events*

Focusing events, defined as landmark international events in the climate domain, have a significant influence on attention to climate change in China. Among the focusing events that are included in our study, the Conferences of the Parties of UNFCCC significantly triggered attention to climate change, while other multilateral events such as BRICS did not play a significant role in triggering such attention. The plausible reason is that Conferences of the Parties are specifically focused on climate change, while other multilateral events such as BRICS have multiple issues including climate change in their agenda, which may dilute the focus on climate change.

Compared with the monthly basis results, the focusing effects on a quarterly basis were attenuated after controlling for other factors. This indicated that the stimulus brought by focusing events was not durable in sustaining attention to climate change.

Moreover, violent fluctuations in attention to climate change were observed in the Decembers of 2007 and 2009, when the Conference of Parties (COPs) were held. The COPs in 2007 and 2009 attracted more attention than many others in the post-Kyoto age. As the responsibilities to mitigate climate change were to be reassigned, these two conferences attracted widespread attention, in China too. These spikes also manifest the heterogeneity of focusing effects, which can be further examined in the future.

### *5.4. Attention and Policy Knowledge*

Our hypothesis that attention to climate change is positively associated with an increase in policy knowledge cannot be supported either. This result is inconsistent with the findings on China's policy process that experts and think tanks have exerted more influence on the policy process through various channels [90]. Intellectuals are supposed to impart knowledge to decision-makers. However, the validity of this depends on the institutional setting. In China, a formal advisory committee on climate change was only established in 2005 and officially set up under the National Leading Group in 2007. Notwithstanding, the community of influential experts was very small and only a very few think tanks or universities have access to climate leadership or bureaucrats [91]. This bottleneck for transmitting knowledge into the policy process may attenuate the impact of knowledge in arousing policy attention to climate change.

### *5.5. Attention and the Trans-Subsystem Effect*

We provide evidence that attention to environmental issues other than climate change does have a crowd-in effect on attention to climate change, which enriches our understanding on the allocation of attention. Competition among issues for attention as a scarce resource is often stressed. However, we found that competition may not be the only story. Attention to issues may reinforce each other. In our case, China is experiencing serious environmental pollution as its economy develops [92,93]. Environmental pollution, especially air pollution and climate change, share many polluting sources, which makes these two issues interlinked.

Environmental issues in general are gaining attention in China. Regarded as an authoritarian state, China is often taken as the epitome of the top-down policy process pattern. However, some studies

found that the party-state control had begun to atrophy, as the public gains more freedom to express and thus exert more influence on the policy process through making comments and complaints on social media or acting as a policy entrepreneur [9,61,94,95]. Voices for a cleaner environment have been aired frequently and loudly, which facilitates the promotion of environmental issues to the priority list of China's policy agenda. This may have a ripple effect on climate change.

However, the development period during recent decades in China happened to provide a context to evaluate the interactive dynamics between climate change and other environmental issues. Whether this pattern featuring the trans-subsystem effect can only be found significant in countries experiencing an increasing pollution level and environmental awareness deserves further comparative investigation, especially between developed and developing economies.

### *5.6. Attention and the Boundary-Spanning Effect*

We also provide evidence that attention to climate change is influenced by pressure from abroad. Climate change is a global issue and global efforts are needed to tackle the problem. However, this problem is getting more and more politicized. Similar to many other countries, the attention dynamics in China behaved more like responses to politics rather than responses to problems [26]. Problem streams of climate change failed to act as an effective catalyst in pushing this issue into the purview of the public and the policy elites. Political drivers either resulted from the focusing effects of landmark political events or from boundary-spanning political pressures, underscoring the fact that the jurisdictional boundaries for policymaking have become blurred when addressing climate change. Though authoritarian regimes are free from the pressures of elections, the goal of sustaining regime stability and garnering universal public supports make them more sensitive to international pressure [96].

This finding might not be unique in China, but neither is it valid in all other settings. An extreme case is the USA, which withdrew from the Kyoto Protocol and the Paris Agreement even under fierce criticism from the global society. It seems that the basic dynamics for climate agenda in the USA would be the disparity of preferences between political groups rather than international pressure [97]. This demonstrated that the institutional settings determined how inputs of information would be processed, thereby generating different patterns of attention dynamics [5,15].

## 6. Conclusions

In this paper, we studied the drivers of attention to climate change in China and found that major international events such as the Conference of the Parties under UNFCCC, attention to environmental issues other than climate change, and pressure from abroad have significant influence on such attention. Understanding the attention dynamics of climate change in China is of importance both academically and policy-wise.

Major policy changes are always preceded by an attention shift. Thus, demystifying what drives attention shift and how attention shifts over time is important for understanding policy process. Over the decades, studies on attention dynamics have mostly been in the setting of liberal democracies. Our study focuses on the attention dynamics in China, an authoritarian state. We examined the roles of information flows in shaping China's climate politics. This helps us unveil this black box of policy process in China. Our findings enrich the existing literature in terms of how the different information flows functioned differently in the policy process.

Moreover, our study has another academic contribution, which is the broadening of our knowledge of how the decision-making body responds to climate change, characterized by complexities and uncertainties in a globalized world.

Practically, addressing climate change needs sustained global efforts. Understanding the attention dynamics of climate change in China may help garner sustained attention from China, one of the leading greenhouse gas emitters. Multilateral platforms such as major international conferences on climate change encourage China to pay more attention to climate change. Domestic voices on

environmental protection also help China pay more attention to climate change. External pressures are important in pushing China to pay attention to climate change as well. These channels may be effective at nudging China into addressing climate change.

Finally, our study suffers from a few limitations. First, given that we utilized a proxy variable to represent issue attention in China, the measurement validity of issue attention hinges on the consistency between this proxy and the policy system. Thus, the measurement of issue attention needs to be further developed, especially for a unitary system like China. Second, there might still be an endogeneity issue that we did not address methodologically in the research design, even though we have allowed for the possible endogeneity problems in measuring variables and empirical analysis. These limitations open up new opportunities to conduct more rigorous research on issue attention dynamics in China.

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## Appendix A

Attention to climate change in China is extracted and measured from *People's Daily*. All climate-related articles published in *People's Daily* are retrieved using the following search string: *气候变化 + 气候变暖 + 温室效应 + 温室气体 + 全球变暖 + 地球温度 + 气候变迁 + 气候变动 + 气候转变 + 全球环境变化 + 气候环境变化 + 年平均气温 (in English: climate change + climate warming + greenhouse effect + greenhouse gas + global warming + earth temperature + climate shift + climate fluctuation + climate transformation + global environmental change + climate environmental change + average temperature)*.

When measuring policy knowledge, we also use the same search string above as the keyword search strategy to obtain all the climate-related academic papers from the CNKI database.

The spillover from environmental subsystems is measured by the environment-related articles in *People's Daily*. The search string is as follows: *(环境污染 + 环境保护 + 环境质量 + 空气质量 + 空气污染 + 大气污染 + 大气质量) − 气候变化 − 全球变暖 (in English: (environmental pollution + environmental protection + environmental quality + air quality + air pollution + atmosphere pollution + atmosphere quality) − climate change − global warming)*.

The spillover from abroad is measured by the climate-related articles with the focus on China in New York Times. To search these articles from LexisNexis Academic news archives of New York Times, we use the following search string: *BODY((climat! W/5 (chang! OR catastroph! OR disaster! OR transform! OR adjust! OR trend! OR warm! OR heat! OR cool! OR variab!)) OR (greenhouse! W/3 effect!) OR ((global! OR earth! OR world! OR international! OR hemisphere!) W/5 (warm! OR heat! OR cool! OR chill!)) OR ((temperature! W/5 (global! OR earth! OR world! OR international! OR hemisphere!) W/8 (increas! OR rising! OR rise! OR decreas!)) OR UNFCCC OR Tokyo Protocol) AND BODY(China OR Chinese)*.

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