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RESEARCH ARTICLE

Public Acceptance of Policy Instruments: Evidence from Traffic-Related Smog Control Policies in Beijing

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Abstract

In 2008, approximately one third of Beijing's severe smog pollution stemmed from its traffic sector. The local government addressed this problem by adopting a city-wide driving restriction policy. Starting from 2010, a congestion charge policy has been under discussion. While Beijing's municipality has tried to bring traffic-related smog under control with these regulatory and market-based policies, there has been significant public opposition to both policies. Public acceptance is critical to successful policy making and implementation; however, the literature offers little insight into the key elements influencing public acceptance in the context of multiple policy choices. Based on a questionnaire survey of 285 respondents in Beijing, this paper adopts ordered logistic regression to explore the key factors influencing public acceptance of driving restriction and congestion charge policies. The results show that the public in Beijing prefers the driving restriction policy to the congestion charge policy. Political concerns, such as concerns relating to policy making transparency and perceived fairness, as well as economic concerns, such as concerns relating to car ownership and extra traffic cost, are essential determinants of public acceptance of such policies. Specifically, citizens who are more concerned about equity hold stronger negative opinions on the congestion charge policy.

Keywords Public acceptance · Policy instrument · Smog control · Driving restriction · Congestion charge

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Introduction

With the emergence of civil society and the adoption of Internet technologies, Chinese citizens are now actively expressing their opinions on public policies through multiple channels. Public opinions can have dramatic effects on legislative processes [63] and sometimes lead to real policy changes [39, 45]. In recent years, China has seen delayed adoption and even retraction of public policies as a result of citizens' opposition to, for instance, the construction of a nuclear reactor and solid waste treatment centers. Public opinion and acceptance are critical to the legitimacy and successful implementation of policy [71]. Therefore, the Chinese government is paying increasing attention to residents' opinions and has become more responsive to their preferences during the policy making process. Both China's central and local governments make concerted efforts to include not only elites but also the public in the policy making process [4, 7, 39]. Indeed, public opinion has become a competitive agenda-setting force [47]. Scholars have found that local governments in China tend to be responsive to citizens' opinions and emotions [12, 48, 59]. Therefore, public opinion on air pollution in China may affect the government's environmental policies, thereby affecting air quality [78].

Studies have explored key factors, including trust in government agencies, perceived fairness, perception of costs, perceived risk, and knowledge, contributing to public opinion on a single policy [17, 35, 77, 81]. In practice, however, local governments generally adopt a combination of policy instruments to fulfill multiple policy goals when dealing with a complex issue. Such policy instruments include command and control tools (i.e., laws and regulations) and market-based instruments (i.e., quota trading, taxation and fees). For example, the government may adopt various instruments to tackle climate change, including imposing industry taxes, offering market incentives, developing renewable energy sources, increasing fossil fuel prices and mandating the use of fuel-efficient vehicles [58]. The literature has paid less attention to the key elements of public acceptance in contexts involving multiple policy choices. Our study seeks to fill this gap by comparing the factors influencing public acceptance of multiple policy options, including both regulatory and market-based policies.

Approximately 25–30% of the particulate matter ($PM_{2.5}$) of smog pollution in Beijing is attributable to the road transportation system [13]; therefore, the municipal government has designed both regulatory and economic policy instruments to alleviate the city's severe smog pollution problem. In 2008, Beijing instituted an "odd–even number driving restriction" regulation, that uses the odd and even number of the date to determine the plate number of the vehicle allowed to be driven on that day, to reduce traffic jams and maintain air quality during the Olympic games. The effect of this policy was significant; Cai and Xie showed that the daily average concentrations of PM_{10}, CO, and NO_2 decreased significantly in the traffic restriction period during and after the Olympics [10]. Since October 11, 2008, Beijing has maintained a one-day-a-week driving restriction scheme inside but excluding the

fifth ring road.[1] Additionally, the Beijing government attempted to impose a congestion charge on motor vehicles operating within Beijing's low-emission zone around 2010.[2]

Many cities have similarly tried to adopt combined policies to achieve air quality improvement goals. For example, congestion charges were officially introduced in Stockholm in 2007. Stockholm has also adopted a combination of other regulations to control traffic congestion and air pollution, such as regulating trucks over a certain length, width and weight and a nighttime ban of trucks on certain streets. As the literature has found, adopting a proper mix of policy tools allows a government to combine the advantages and increase the effectiveness of these tools, which appeals to the public [24, 31, 55]. However, both driving restrictions and congestion charge policies have encountered high levels of public opposition during the policy making or implementation process. A survey in Beijing showed that 45.18% of non–car owners and 60.98% of car owners opposed the odd–even number driving restriction scheme.[3] In an online opinion poll in Beijing, 61.4% of the respondents disagreed with the congestion charge policy.[4] Moreover, the driving restriction policy has encountered compliance problems. Wang et al. pointed out that rule-breaking behaviors (i.e., driving on plate-restricted days) were constant and pervasive, and the Beijing Municipal Commission of Transport reported 85,000 cases of restricted cars' being operated during a severe smog period between December 16 and 18, 2016 [70]. Other rule breaking behaviors include purchasing multiple cars with different license plates, covering plates to avoid punishment and borrowing license plates from others [70].

In both democratic and authoritarian systems, a high level of public acceptance is a prerequisite for successful policy implementation, as stronger public support correlates with a higher policy compliance rate [58, 81]. This research seeks to identify the key elements influencing public acceptance of traffic-related smog control policies in Beijing, specifically in the context of multiple simultaneous policies. Accordingly, the key research questions in this paper are as follows. In China, what are the essential factors encouraging the public to accept traffic-related smog control policies? Does the general public react differently to regulatory and market policies?

This paper compares public acceptance of two types of traffic-related smog control policies, namely driving restriction regulations and congestion charges, in six dimensions: policy type, trust in government agencies, perceived fairness, perceived

[1] The driving restriction policy is renewed every year, although the policy content remains largely unchanged. A detailed policy description can be found in Appendix 2.

[2] "2013–2017 Beijing Clear Air Action Plan": http://www.zhb.gov.cn/gzfw_13107/zcfg/hjjzc/dfhjjzc/201605/t20160525_346665.shtml (in Chinese) and http://www.sustainabletransport.org/archives/1543 (in English).

A congestion charge is imposed on most motor vehicles operating within the low-emission zone in Beijing. Additionally, the city government has set up charging hours during which the amount charged varies by time period. However, the congestion charge policy has not been implemented at the time of writing and is still under policy discussion. A detailed policy description can be found in Appendix 2.

[3] Source: http://auto.sina.com.cn/news/2008-09-04/2241407437.shtml.

[4] Source: http://finance.qq.com/a/20160603/012060.htm.

cost, perceived risk and knowledge. The rest of this paper is organized as follows. "Literature Review and Hypotheses" presents the literature review and hypotheses. "Research Design and Data Source" describes the data selection process and sampling strategy, while "Data Analysis Process" introduces the data analysis methodology. "Findings and Discussion" provides the findings and discussion. Finally, "Conclusions and Policy Implications" presents the major conclusions and the policy implications thereof.

Literature Review and Hypotheses

Policy Type and Public Acceptance

This paper first tries to pin down the causal relationships between policy type and public acceptance of policies. Policy tools, or policy instruments, can be categorized as regulatory instruments with higher levels of government enforcement (i.e., laws and regulations) or market-based instruments with lower levels of government enforcement (i.e., quota trading, taxation and fees) [9, 24, 30, 44, 53, 66, 67]. In the area of environmental policy, the literature has shown that people have different preferences regarding regulatory instruments and market-based instruments [23, 24, 44, 57]. In Sweden, for example, Loukopoulos et al. revealed that public acceptance of different types of traffic demand control policies (i.e., prohibiting vehicular traffic in the city center, road pricing and individualized marketing) varied significantly [46]. Through a systematic study of policy designs in the U.S., Hahn and Stavins concluded that policy makers originally had a strong preference for regulatory tools, with which they could ensure policy implementation [25]. However, as they gained knowledge of market-based instruments, many bureaucrats realized their advantages in efficiently achieving certain policy goals, especially young staff members who were influenced by the "law and economics" movement [25]. Studies have also found that economists strongly advocate market-based instruments for environmental policy, owing to the associated minimization of aggregate costs, whereas environmental groups typically support regulations and disfavor market-based instruments because of the highly visible environmental protection costs to the industry [25, 49, 54]. It is worth noting that stakeholders' preferences for policy instruments vary according to the specific contexts and changing effects of the instruments [11, 25].

Although the literature has discussed public acceptance of driving restriction and congestion charge policies separately, no comparative studies have been conducted on these two instruments. The current paper fills this gap by examining two traffic-related smog control policies simultaneously, testing the logic of accepting the policies. Based on the literature, this paper provides a pair of competing hypotheses:

> Hypothesis 1a: Public acceptance of policy instruments varies by the type of instrument. In terms of traffic-related smog control policy, the public prefers a regulation (i.e., a driving restriction policy) to a market-based policy (i.e., a congestion charge policy)

Hypothesis 2a: Public acceptance of policy instruments varies by the type of instrument. For traffic-related smog control policy, the public prefers a market-based policy (i.e., a congestion charge policy) to a regulation (i.e., a driving restriction policy).

Political Trust and Public Acceptance

"Political trust" refers to an individual's basic evaluative orientation regarding the government, based on how well the government is operating in relation to the individual's normative expectations [34, 77]. Such trust in the government influences people's acceptance of public policy in general [36, 41]. In most cases, political trust has a positive relationship with public acceptance. Simply put, people are more willing to comply with government regulations and laws if they have a high level of trust in the legislative authorities [36, 41, 77].

Zannakis et al. tested public acceptance of on-site sewage systems in Sweden and found that political trust was indeed an important factor explaining homeowners' acceptance of government regulation [77]. Tyler and Huo found that citizens were more likely to abide by the decisions of political agencies if they perceived these agencies to be legitimate [65]. In contrast, citizens with low political trust tend to calculate the costs and benefits of compliance and non-compliance [64]. Similar conclusions have been drawn regarding taxation policy and individual carbon allowance policies: when citizens trust that government agencies will use tax or fee revenues in a judicious way, they are more likely to accept the policies [15, 37].

This paper argues that citizens' political trust can be further elaborated by separating it into two concepts: trust in capacity and trust in the policy making process. First, some citizens tend to depend on the government or experts to make judgments (e.g., on whether to accept a certain technology or a certain policy). In this sense, their trust in the government sector, particularly in the government's capacity to deal with possible risk emergencies, may serve as a substitute for individual judgment [18]. The literature has argued that when citizens trust in the management capability of institutions (i.e. governments or NGOs) and believe that these institutions perform their functions and responsibilities appropriately and effectively, they tend to accept public projects or programs with certainty [19, 56]. Similar results have been found in China [42, 84]. Second, political trust also contains democratic meanings. In Western countries, the policy making process has also been emphasized in public acceptance studies. Studies have found that citizens tend to be more likely to accept a policy when they feel that their voice will be heard by the policy makers, either through their direct participation in the policy making process or by being represented by social organizations, such as environmental NGOs, that participate in the policy making process [61]. With regard to China, the literature has suggested that the policy making process is still controlled by the "iron triangle" of the Chinese government, state-owned firms and research institutes, and that it usually ignores the general public [27]. However, with the development of civil society and improvement of citizens' political efficacy, the public is increasingly able to access information from various resources, which increases citizens' capability to participate in the

policy making process, especially via social media and other online communities [79]. This paper tests both concepts of political trust with the following hypothesis:

> Hypothesis 2.1: Political trust, both in government capacity and in the policy making process, has a positive influence on public acceptance of traffic-related smog control policies.

Additionally, the effects of political trust on public acceptance might vary with different policy instruments. Hetherington [28] found that political trust had a larger impact on public acceptance of policies when individuals were asked to sacrifice material interests to support policies. It is natural to assume that political trust matters more in forming public acceptance of a market-based policy than a regulatory policy.

> Hypothesis 2.2: The effect of political trust on public acceptance of a congestion charge policy is stronger than that on public acceptance of a driving restriction policy.

Perceived Fairness and Policy Acceptance

Studies have agreed that perceived policy fairness is a crucial factor affecting people's support for policies [35, 37, 77]. For example, the public show acceptance of carbon taxation policy when they perceive it to be fair in its procedure and outcome [36]. Some scholars, such as Jagers et al., have elaborated on policy fairness in two ways: in terms of equality, in which everyone is given the same policy treatments such as degree of obligations, and in terms of equity, in which policies treat the public to reach an equal outcome according to their different status [37].

The principle of policy equality emphasizes equal treatment, in which the general public perceives an equal distribution of instrument costs and benefits. In the context of a driving restriction policy, for example, the equality principle refers to a policy design that makes all drivers, no matter what type of car they drive, where they live and what their income levels are, subject to the same legal restrictions. The principle of equity, on the other hand, is to impose penalties according to the specific circumstances of the emitters, which should vary from subject to subject [36]. For example, if the driving restriction policy is designed according to the principle of equity, residents living within the low emission zone should pay less. By the same token, under a congestion charge policy, larger emitters should also pay more as well.

In the practice of policy design, a sense of (un)fairness may relate to both the equality and the equity of a policy. For example, a carbon tax policy embedded in petrol price is designed as an equitable policy in the sense that drivers who drive more pay more tax for environmental degradation. However, a taxation increase affects poor people and citizens who live in remote areas (who were car dependent) a lot more than it affects rich people and citizens who live in the same areas. Therefore, citizens are still likely to perceive the distributional consequences of this policy as unfair in terms of equity, leading to low public acceptance [36, 62]. For a more

comprehensive conceptualization, this paper adopts both illustrations of fairness in its theoretical framework and assumes as follows:

Hypothesis 3.1: Perceived policy fairness (i.e. equality and equity) has a significant positive impact on public acceptance of traffic-related smog control policies.

Policy type may also moderate the impact of perceived fairness on policy acceptance, as people tend to value equality fairness in regulations and equity fairness in market-based instruments [36]. This leads to the following hypothesis.

Hypothesis 3.2: The effect of equality fairness on public acceptance of driving restriction policy is stronger than that on public acceptance of congestion charge policy, while the effect of equity fairness has a more significant impact on public acceptance of congestion charge policy than driving restriction policy.

Other Key Elements Influence Policy Acceptance

Besides these main hypotheses, this study also follows the literature and controls for other key elements that may influence policy acceptance, including perceived cost, knowledge and risk perception.

Driving restriction and congestion charge policies could infringe on people's freedom to travel and generate inconveniences in their daily lives. Many scholars have revealed that people's attitudes toward transportation choice heavily depend on perceived cost, convenience and comfort [3, 4, 43]. However, both driving restriction and congestion charge policies pose a social dilemma in which individuals' self-interests, such as driving conveniently without date restriction, conflict with the collective interest, namely of abating the congestion problem [16, 17]. Thus, the perceived cost, inconvenience and restriction associated with these policies might influence people's acceptance level [17, 35, 46]. Therefore, both driving restriction and congestion charge policies might influence people's perceived cost and decrease their acceptance of these policies.

Studies started to consider the effect of knowledge on public acceptance when nuclear technology was introduced to civil usage in the 1960s. Similar theories have been introduced to research on climate change, environmental protection and renewable energy development [22, 72], which has tended to reveal that knowledge level is related to the public's acceptance of local projects [20, 33, 38, 83]. Lack of knowledge or disinformation, for example, is a major factor in public opposition to new technology or pro-environmental behavior [51, 85], while accurate knowledge of the causes of climate change is the strongest single predictor of behavioral intention to support climate policy (e.g., to use public transportation rather than driving) [1, 8, 52, 73]. Thus, this paper defines knowledge as individual knowledge of smog and smog control policies and assumes that this knowledge affects individual acceptance of policies.

Risk perception is defined as an individual's subjective judgment of the adverse consequences of a particular hazard and threats to environment or health [2]. Studies

have stated that risk perception is negatively related to the public's acceptance of local deployment of nuclear station. For instance, citizens show less acceptance of nuclear projects when they perceive higher levels of risk to their health, the environment, and societal stability [20, 33, 38]. As for smog, exposure to $PM_{2.5}$ can cause chronic respiratory and cardiovascular diseases, alter host defenses, and damage lung tissue [75]. A survey conducted in 2013 revealed citizens' risk perception regarding smog: 82% of them stated that smog pollution might cause respiratory or other diseases, besides other hazards such as global warming (54.9%), oxygen layer destruction (49.1%) and acid rain (37.8%).[5] Therefore, we assume that if people perceive smog to pose a greater risk, they will be more willing to accept driving restriction and congestion charge policies designed for smog control.

Research Design and Data Source

Measurement Design

We adopted survey method to test what are essential elements influencing the public's attitude towards different types of policy tools. Based on existing studies, we designed survey questions in seven parts, measuring political trust, perceived fairness and individual knowledge of traffic-related smog control policies, perceived risk of air pollution, perceived cost of policy tools and public acceptance of policies, along with socio-demographic characteristics. Except for the socio-demographic variables and knowledge of traffic-related smog control policies, we used a 5-point Likert scale to measure all of the variables.

We directly measured the dependent variable, policy acceptance, by asking the respondents to what extent they accepted the local deployment of two traffic-related smog control policies, a driving restriction policy and a congestion fee policy, respectively.

For the independent variables, we improved on existing measures in the following ways. To measure political trust, we did not use a single question, such as "how much do you trust in the government generally?" or "how much do you trust in an institution?" Instead, we tried to refine the concept to reflect its complexity. The concept of trust can be expressed as "A believes that B has the ability to do X". However, dominant measures of political trust pay more attention to object B and ask overall questions such as "to what extent do you trust the government sector, judiciary, army or other entities?" Such measures often ignore the context of X [42]. Following Wang [68], Tao et al. [60] and Wu and Wilkes [74], this study designed nine questions to assess different types of political trust from the perspective of smog control. These questions covered trust in the democratic policy process (i.e. "I think that the process of making traffic-related smog control policy is open"; "I think that the process of making traffic-related smog control policy is transparent") and trust in government institution and political actors (i.e. "I think that the local government

[5] Data source: http://news.xinhuanet.com/legal/2013-04/07/c_124545386.htm.

is capable of solving the smog problem in the near future", "I think that the local government has a strong will for smog control").[6] A full list of the questions can be found in Appendix 1.

Second, "perceived fairness" refers to outcome fairness in this research and is measured in terms of both equality and equity. For driving restriction and congestion charge policies, the principle of equality implies that each car owner has the same obligation to obey the driving restriction rule or pay the same fee, whereas the principle of equity implies that drivers who pollute more in certain regions should be charged more. Following Jagers et al. [37] and Zannakis et al. [77], we asked the respondents to indicate their perceptions of the fairness (in terms of equality and equity) of a driving restriction policy and a congestion charge policy, respectively.

Additionally, we used an objective knowledge assessment scale to test the respondents' knowledge of smog pollution and knowledge of policies, rather than using a self-reported measure, because people are highly likely to overestimate their capacity in self-reported assessment, posing threats to validity and reliability [40]. Our objective knowledge scale contained six items to test the public's knowledge in different areas, including the formation and prevention of smog (e.g., circling the main pollutants in smog) and the severity of the smog crisis (e.g., circling the correct average annual concentration of $PM_{2.5}$ in Beijing). We also asked two objective questions about the policy content of the driving restriction and congestion charge, respectively (e.g., "Please circle the correct driving restriction policy content"). All of the measurements were set to 1 when the public correctly identified the policy content and 0 when they failed to correctly identify the policy content. We then added up the scores for above-mentioned six measurements as the final score of the variable of knowledge of smog.

With regard to risk perception of air pollution, health risk is one of the largest sources of public concern and uncertainty [6, 80, 82]. This has been confirmed by several public polls revealing people's concern about smog in China.[7] Therefore, the first risk perception measure used in this study was perceived health risk. Second, there are other concerns associated with the smog crisis, such as risk to transportation safety and risk to social security.[8] Since none study has verified the causal relationship between these concerns and public attitudes, this paper classifies them as other uncertain risks perceived by the general public. Following Jakobsson et al. [35], we measured perceived travel cost in terms of the respondents' level of agreement with the statement that "a driving restriction/congestion charge will bring travel inconvenience to people's daily lives."

Along with age, gender, education, and income, we tested whether the respondents were car owners (i.e., "how many cars do you have?"), their pro-environmental

[6] Self-reported assessment of political trust has been widely adopted in Chinese studies [60, 74]. However, the use of a self-reported measure of political trust may encourage Chinese respondents to give biased answers. We will try to improve the measurement in future studies by employing benchmarking questions.

[7] Data source: Public Opinion Research Laboratory of Shanghai Jiao Tong University, Study on the Smog Perception in China, 2013, http://www.doc88.com/p-9935368235717.html.

[8] *Ibid*.

attitude (i.e., "I regard environmental protection as an important issue") and their willingness to pay for smog control as control variables.

Data Source and Sampling Strategy

The aim of this research was to compare public acceptance of driving restrictions and congestion charge policies. We conducted an online survey with residents who had lived in Beijing for at least 12 months in August 2016 to ascertain their level of acceptance of these traffic-related smog control policies. During the survey period of August 2016, the average $PM_{2.5}$ concentration in Beijing ranged from 37 to 65 $\mu g/m^3$, which is categorized as "good air quality" according to the $PM_{2.5}$ concentration standard of the National Environmental Protection Bureau.[9] We double-checked the data against $PM_{2.5}$ data provided by the Embassy of the United States in Beijing[10] to ensure the data accuracy. Therefore, no significant weather influence needed to be considered during the data analysis.

Following Yan [76], we developed an online survey to assess public acceptance. There are three obvious advantages to an online survey: it provides easy access to respondents quickly and at a relatively low cost. Of all possible ways of conducting an online survey, social media are the best option. Users normally spend a large proportion of their time on social media, which allows researchers to conduct surveys with a high response rate. By the end of 2016, 1.12 billion users in China were accessing the Internet via their cellphones, and 0.889 billion of them used a free social media application called WeChat.[11] This makes WeChat a good online platform for conducting surveys in China.[12]

One of the useful features of WeChat is the "Group" function (*WeChat Qun* in Chinese), which allows users to form groups according to their interests, hobbies and professions. There are special groups for classmates, colleagues, friends, customers and people with similar hobbies or other identities. We conducted snowball sampling and set up our survey outreach strategy based on the WeChat Group feature. First, we developed our survey on WeChat and passed the link to 20 mid-career students majoring in public administration at Tsinghua University. Second, we asked them to pass the link to different WeChat groups

[9] Data source: Data Center of National Environmental Protection Bureau. http://datacenter.mep.gov.cn. A day is defined as a "smog day" if the average $PM_{2.5}$ concentration over 24 h is more than 75 $\mu g/m^3$. Source: http://kjs.mep.gov.cn/hjbhbz/bzwb/dqhjbh/dqhjzlbz/201203/t20120302_224165.htm.

Although the upper limit of the 24 h average $PM_{2.5}$ concentration is 25 $\mu g/m^3$, according to the standard of the WHO, we adopted the standard of the National Environmental Protection Bureau, considering the severe air pollution in China. Source: http://apps.who.int/iris/bitstream/10665/69477/3/WHO_SDE_PHE_OEH_06.02_chi.pdf.

[10] Historical $PM_{2.5}$ data in Beijing obtained from http://www.stateair.net/web/historical/1/1.html.

[11] Data source: http://www.sohu.com/a/158951937_361701. (In Chinese).

[12] We also realized that the use of an online survey might cause a certain level of sampling bias. For example, the online survey method excludes people who do not have access to the Internet via computer or cellphone.

to which they belonged. According to our follow-up checks with these students, the link was sent to eight groups, starting with their friends and colleagues. The first round of sharing covered governmental official groups, financial institute groups, information technology company groups, and manufacturing company groups. Each WeChat group included 100 to 500 members with different job titles, from administrator to cleaning person. Members who completed the survey were given a small monetary reward of a random amount as an incentive.

As Huang [32] posited, online surveys have become increasingly important in social science. Our sampling strategy admittedly led to a high representation of people who were younger and better educated and had a higher monthly income, which might have constituted a certain bias in the sample selection. However, given that younger, better educated people with a higher monthly income tend to be more politically active and involved in the policy making process, we believe that this group merited particular attention.

To make sure that the respondents paid sufficient attention to the questions, we double-checked how much time each respondent spent on the questionnaire as a proxy for the data quality [32]. We dropped a respondent's survey data if the respondent had spent much less than 3 min completing the questionnaire.[13] After this, we had 285 valid questionnaires. Additionally, we interviewed 12 car owners who had lived in Beijing for more than a year to better understand why they supported or opposed these two policy instruments, and what they regarded as the difference between these instruments.[14]

As Table 1 shows, 56.49% of the respondents were male ($N = 161$) and 43.51% ($N = 124$) were female. The average age in our sample ranged from 14 to 69, with a mean age of 30. One hundred and twenty-eight of the respondents (48.42%) held college degrees and 117 (41.05%) held postgraduate degrees or higher. Monthly income, measured in yuan (RMB), ranged from 7,001 to 10,000, which was higher than the average monthly income of 6,906 yuan (RMB) in Beijing[15]. Compared with the population distribution of Beijing, our respondents were younger and had higher education levels. The survey included car owners as well as people who did not have cars. Nearly half of the respondents ($N = 143$, 50.18%) had no car in their family; 114 (40%) had one car; and only 28 (9.82%) had two cars or more.

[13] According to the pilot survey, the time taken to complete the online survey was normally more than 3 min. Thus, we dropped the subjects if they took less than 3 min to complete the online survey. In the pilot survey, we also checked the respondents' understanding of each question to ensure that each question had been asked in a way that accurately expressed the original meaning of the question and was accurately understood by the respondents.

[14] From August to September 2016, 12 car owners were interviewed, including 7 men and 5 women aged from 28 to 45. They were working at government agencies, financial enterprises, middle schools or universities, Internet companies and others. Their homes and jobs were located at different distance away from the downtown of Beijing. Each interview lasted 45 to 60 min, mainly to understand their level of acceptance of driving restriction and congestion charge policies and the reasons for their responses.

[15] Source: http://www.cngold.com.cn/newtopic/20160727/2016nbjpjgzsds.html.

Table 1 Summary of sample sociodemographic characteristics ($N = 285$)

Background		Frequency	Percentage (%)
Gender	Male	161	56.49
	Female	124	43.51
Age	14–19	6	2.11
	20–29	142	49.82
	30–39	101	35.44
	40–49	23	8.07
	50–69	13	4.56
Monthly Income	< 2,000	10	3.51
	2,000–4,000	23	8.07
	4,001–7,000	72	25.26
	7,001–10,000	70	24.56
	10,001–20,000	78	27.37
	> 20,000	32	11.12
Education	Middle school or below	10	3.51
	High school	20	7.2
	College	138	48.42
	Masters or above	117	41.05
Car	None	143	50.18
	1	114	40.00
	> 1	28	9.82

Reliability and Validity Tests

We tested Cronbach's α, which is the average linear correlation among questions belonging to the same scale, to determine scale reliability (as shown in Table 2). Nunnally stated that a commonly accepted rule of thumb for describing internal consistency is that Cronbach's α should be 0.7 or greater [50]. However, as a larger number of items could artificially inflate the α value, this rule may be most suitable for scales with more than 14 items [14]. With a smaller number of items, there are no agreed upon standards for Cronbach's α; this depends on the specific field of study. According to Hinton et al. [29], a Cronbach's α value from "0.5 to 0.75 is generally accepted as indicating a moderately reliable scale, while a figure below this generally indicates a scale of low reliability." In our study, as there were only four items for the variable of perceived fairness, we followed Hinton et al. [29] and regarded 0.5786 as acceptable. Construct validity was guaranteed by precise concept definition and variable measurements designed following the literature. Additionally, we used the survey data to assess the construct validity of our questionnaire by undertaking confirmatory factor analysis (CFA). Hair et al. [26] stated that the construction of a measure is valid if the CFA loadings are more than 0.5. As shown in Table 3, all of the scores for CFA loading were higher than 0.5; thus our scale can be considered valid.

Table 2 Reliability test of the measures

Variable	Cronbach's α	Number of items
Public acceptance	0.5862	2
Political trust	0.8744	9
Perceived fairness	0.5786	4
Risk perception	0.9256	2

Table 3 Construct validity test of the measures

Variables	Measures	λ (CFA Loading)
Political trust in capacity	Commitment	0.7390
	Advice	0.6782
	Impact	0.5985
	Instruments	0.7888
	Effectiveness	0.8460
	Capacity_short	0.6918
	Capacity_long	0.5946
Political trust in process	Openness	0.8672
	Transparency	0.8672
Risk perception towards healthy	Perceived health risk	0.8955
	Perceived other uncertain risks	0.8955
Equality fairness	Equality fairness of driving restriction	0.5210
	Equality fairness of congestion charge	0.5210
Equity fairness	Equity fairness of driving restriction	0.6930
	Equity fairness of congestion charge	0.6930

Data Analysis Process

First, we conducted descriptive analysis and a *t*-test to compare citizens' level of acceptance of driving restriction and congestion charge policies to illustrate the differences as well as the similarities between the two policy instruments. We also compared how people differently perceived the risk and fairness of the two policies.

Second, the dependent variable ("policy acceptance") in this study was ordinal, which describes a clear order with the absolute distances between levels unknown. We thus used an ordered logistic regression model to investigate the effects of factors influencing policy acceptance of driving restriction and congestion charge policies separately. The regression can be characterized as follows (as shown in Eq. 1):

$$Acceptance = \alpha + \beta X_i + u \tag{1}$$

This model had two dependent variables measuring the respondents' acceptance of driving restriction and congestion charge policies, respectively, which was indicated

on a 5-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Additionally, the vector X contained influencing factors such as political trust, perceived risk, perceived fairness, knowledge, car ownership, personal environmental attitude, and sociodemographic factors.

Third, to further explore the direct causality between public acceptance level and policy instrument type, we combined the acceptance level of the two policies and added a dummy variable of policy type to the model (driving restriction policy marked as 0 and congestion charge policy marked as 1). This combined model (shown in Eq. 2) was used to investigate the moderating effect of policy instruments on public acceptance level. It encompassed all of the variables listed in Table 3 and the interaction term ($X_i * type$).

$$Acceptance = \alpha + \beta type + \gamma X_i + \delta(X_i * type) + u \quad (2)$$

Findings and Discussion

General Perceptions of Two Policy Types

This paper finds several sets of differences between the two policies. First, the general public in our sample reacted differently to the driving restriction policy and the congestion charge policy. As shown in Fig. 1, public acceptance of these two policies was significantly different: people tended to support the driving restriction policy more than they did the congestion charge policy (0.55 higher on average; t-statistic = 5.7682***).

Second, the public showed different perceptions of the fairness of these two policies. As shown in Fig. 2, the respondents evaluated the driving restriction policy and congestion charge policy with different scores for equity, emphasizing the principle of equity more for the driving restriction policy than for the congestion charge policy (mean for driving restriction policy = 3.85,[16] mean for congestion charge policy = 3.58, t-statistic = 3.0596***). In addition, the respondents felt that they were more likely to be treated equally in terms of the distribution of burdens and costs by the driving restriction policy than the congestion charge policy (mean for driving restriction policy = 3.93, mean for congestion charge policy = 2.70, t-statistic = 13.0095***).

Third, unexpectedly, we found a relatively low level of political trust in Beijing. As shown in Table 4, all of the measurements of political trust were below the neutral value of 3, except for trust in the government's long-term capacity to fix the smog control problem.[17] This result could be explained by Wang's [68] finding that Chinese citizens may have relatively low levels of trust in government services or government institutions but relatively high levels of trust in the "imagined state."

[16] We used a 5-point Likert scale to measure fairness, with 1 representing "not fair at all" and 5 representing "totally fair."

[17] The negative spectrum indicates that the mean of a certain variable is less than 3.

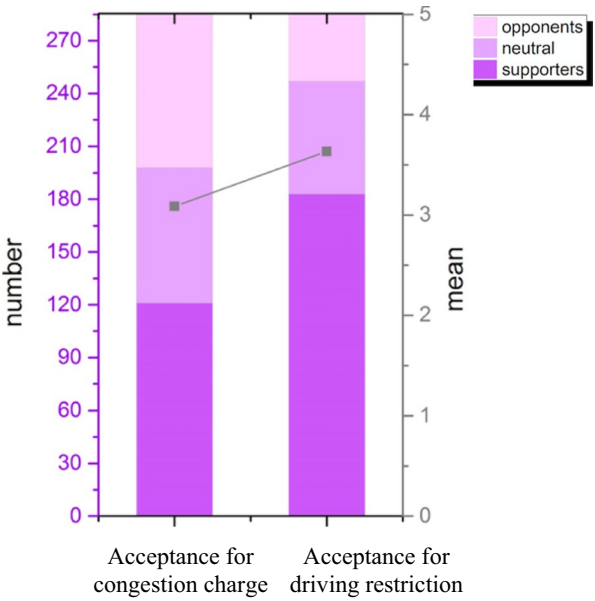

Fig. 1 Distribution of acceptance of two policies

Especially when using self-reported measures, local citizens tend to lack confidence in their power to influence government decisions and the government's effectiveness in controlling smog.

We also found that the majority of the respondents were highly concerned about potential risks associated with smog (as shown in Table 4; Fig. 3; mean = 4.27[18]). Compared with non-car owners, car owners perceived more traffic inconvenience associated with traffic-related smog control policies (mean for non-car owners = 2.32, mean for car owners = 2.54, *t*-statistic = 2.4711***). Although our respondents had little scientific knowledge of smog (average score 3.03 in 6 objective questions), they reported fairly accurate knowledge of traffic-related smog control policies: over half of them (52%) had accurate knowledge of the congestion charge policy, 77.9% of them understood the exact content of the driving restriction policy, and 43.9% of them had an accurate understanding of both traffic-related smog control policies.

Another set of contradictions emerged between the respondents' willingness to pay for smog control and their degree of environmental concern. Table 4 shows that almost all of the respondents held a pro-environmental attitude (mean = 4.17[19]), but that they showed low willingness to pay for smog control (mean = 1.01[20]). This "attitude–behavior gap" is consistent with the literature, suggesting that people with stronger pro-environmental attitudes might not necessarily engage in more pro-environmental behaviors [5, 21] .

[18] In our risk measurement, 1 meant "not risky at all" and 5 meant "extremely risky."

[19] In our environmental attitude measurement, 1 represented "not important at all" and 5 represented "extremely important."

[20] Willingness to pay was measured from 0, "not willing to pay at all," to 5, "willing to pay more than 300 yuan per month for smog control."

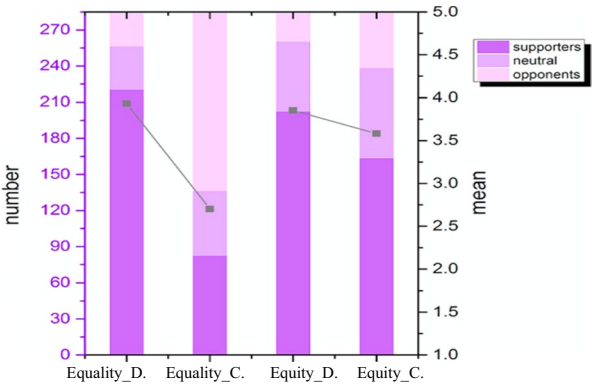

Fig. 2 Distribution of perceived fairness of two policies ("Equality_D" means "equality fairness of driving restriction," "Equality_C." means "equality fairness of congestion charge," "Equity_D." means "equity fairness of driving restriction," and "Equity_C." means "equity fairness of congestion charge")

Regression Results and Discussion

In the regression analysis stage, we first ran Eq. (1) (Table 5) to investigate the effects of influencing factors on the level of acceptance of driving restriction and congestion charge policies separately. Next, controlling for policy type (with driving restriction policy marked as 0 and congestion charge policy marked as 1), we ran Eqs. (2) to check how policy type and interactions between factors (especially with policy type) influenced public acceptance (Table 6). The parallel trends test was passed for all the models.

Overall, most of our hypotheses were verified. First, our respondents in Beijing treated regulatory and market-based policies differently: consistent with the descriptive statistics, they preferred the regulatory (driving restriction) policy to the market-based (congestion charge) policy. Secondly, the regression results revealed that political trust, perceived fairness, WTP and environmental attitude had direct positive and significant effects on public acceptance, while concerns about traffic inconvenience and car ownership influenced public acceptance negatively and significantly. However, the result does not show any significant impact from perceived risk and knowledge about the smog. Third, the results verified the indirect impact of policy type on perceived fairness, which reflects the fact that individuals' major concerns may change when they evaluate different types of policies.

Preference for Driving Restriction Policy over Congestion Charge Policy

Both the descriptive statistics and the regression results showed that the type of policy instrument mattered: the respondents reported significantly higher levels of acceptance of the driving restriction policy than the congestion charge policy (Table 6: Coef. = -0.54, $p < 0.01$), which supported Hypothesis 1. Taking the driving restriction policy as a regulatory policy and the congestion charge policy as a market-based policy, this conclusion is similar to the finding in Western literature that citizens have more concerns about market-related than regulatory policies [46].

Table 4 Variables and descriptive statistics

Variable			Mean	Std. dev.	Scale
Dependent variables	Public acceptance of driving restriction policy		3.64	1.05	1–5
	Public acceptance of congestion charge policy		3.09	1.21	1–5
Independent variables	Political trust in capacity (index)[a]		-1.01e-09	0.90	-2.48-2.61
		Commitment	2.98	1.20	1–5
		Advice	2.94	1.12	1–5
		Impact	2.57	1.10	1–5
		Instruments	2.74	1.11	1–5
		Effectiveness	2.56	1.03	1–5
		Capacity_short	2.92	1.04	1–5
		Capacity_long	3.32	1.07	1–5
	Political trust in process (index)		-1.38e-09	0.90	-1.74-2.32
		Openness	2.83	1.12	1–5
		Transparency	2.71	1.07	1–5
	Risk perception (index)[b]		4.27	0.82	1–5
		Perceived health risk	4.28	0.85	1–5
		Perceived other uncertain risks	4.26	0.85	1–5
	Traffic inconvenience		2.43	1.07	1–5
	Equality fairness of driving restriction		3.93	1.00	1–5
	Equality fairness of congestion charge		2.70	1.24	1–5
	Equity fairness of driving restriction		3.85	1.00	1–5
	Equity fairness of congestion charge		3.58	1.11	1–5
	Knowledge of smog		3.03	1.08	0–6
	Knowledge of driving restriction		0.78	0.42	0 or 1
	Knowledge of congestion charge		0.52	0.50	0 or 1

Table 4 (continued)

Variable		Mean	Std. dev.	Scale
Control variables	Car ownership	0.61	0.69	0–3
	Pro-environmental attitude	4.17	0.99	1–5
	Willingness to Pay (WTP) for smog control	1.01	1.13	0–5
	Age	31.18	7.67	14–69
	Female	0.44	0.50	0 or 1
	Education	3.27	0.74	1–4
	Income	3.99	1.29	1–7

[a]With nine measurements of political trust, we further adopted factor analysis to categorize them into two dimensions, with one representing trust in the openness and transparency of the policy making process ("political trust in process") and the other representing political trust in governmental capability. KMO = 0.8429

[b]The index of risk perception was the average value of the perceived risk of health hazards and perceived risk of other uncertain hazards from smog

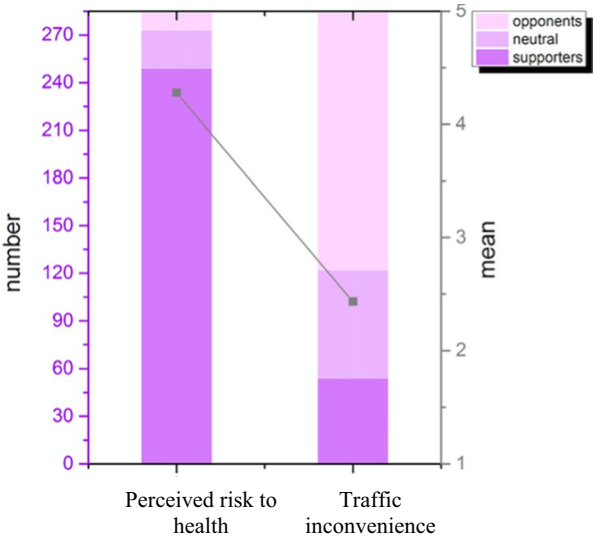

Fig. 3 Distribution of overall perceived risk and benefits

Citizens may associate a direct and visible monetary cost with a congestion charge policy, which might lead them to perceive a greater loss under this policy compared with the hidden cost incurred by a driving restriction policy.

To explore in detail the reasons for the respondents' preference for the regulatory policy, we conducted semi-structured interviews with 12 Beijing residents randomly selected from the survey respondents from August to September 2016. The respondents expressed three concerns that led them to prefer the driving restriction policy. First, they believed that the congestion charge policy placed an extra burden on the public. Although the driving restriction policy also increased commuting costs for people who had to pay for taxis or other forms of transportation as alternatives, the respondents regarded these as indirect costs and sometimes ignored them. Second, the respondents expressed distrust in the implementation capacity of government agencies, worrying about the fee collection and usage processes. The lack of transparency of fee collection and doubts about the use of the fees after collection led the respondents to distrust the congestion charge policy. Additionally, car owners who lived or worked within the low-emission zone were strongly against the congestion charge policy, stating that it was unreasonable and unfair for them to pay for a routine commute that they could not avoid.

All Trust Formats Matter, but Trust in Policy Process is More Important

Hypothesis 2 was verified by the regression results: political trust in the policy making process positively influenced public acceptance of both policies (Table 5: driving restriction—Coef.=0.29, $p<0.05$, congestion charge—Coef.=0.56, $p<0.01$; Table 6: Coef.=0.42, $p<0.01$), whereas political trust in government capacity only mattered to the level of acceptance of the congestion charge, but the statistical

Table 5 Regression results: individual models of public acceptance of driving restriction and congestion charge respectively

	Driving restriction model		Congestion charge model	
	Coef.	*t*	Coef.	*t*
Car owner	-0.15	-0.82	-0.55***	-3.16
Risk perception	0.14	0.88	-0.00	-0.01
Worry about traffic inconvenience	-0.12	-1.06	-0.18	-1.57
Political trust in Govt. capacity	0.13	0.88	0.32**	2.20
Political trust in policy process	0.29**	1.99	0.56***	3.92
Perceived fairness of equality	0.40***	3.07	0.40***	3.88
Perceived fairness of equity	0.44***	3.44	0.03	0.30
Knowledge of smog	0.03	0.29	0.05	0.44
Knowledge of policies[a]	0.22	0.75	0.29	1.22
Pro-environmental attitude	0.34**	2.42	0.18	1.43
Willingness to pay for smog control (WTP)	0.91***	3.97	1.45***	5.76
Age_group				
20-40yr	0.64	0.65	0.50	0.48
41-69yf	0.28	0.26	0.78	0.70
Female	-0.17	-0.73	-0.61***	-2.64
Education				
Middle school and lower	-0.10	-0.13	-0.88	-1.23
College degree	-0.33	-0.47	-0.94	-1.46
Graduate school and higher	-0.58	-0.81	-0.41	-0.62
R^2	0.0989		0.1449	
N	285		285	

[a]We controlled for the variable measuring knowledge of driving restriction in the driving restriction model and the variable measuring knowledge of congestion charge in the congestion charge model

Note: *$p<0.1$, **$p<0.05$, ***$p<0.01$

significance is at a lower level (Table 5: Coef. = 0.32, $p<0.05$). This result supported our hypothesis that the public does not have unified trust in the government but, rather, has different trust attitudes toward different government functions. Trust in policy making process and trust in government capacity reflect different attitudes that lead to different levels of public acceptance of the same policy. Therefore, multi-index measurement is needed for further study with regard to government trust.

The impact of trust in government capacity was not consistently important to the level of acceptance of the two policies, while the influence of trust in the policy making process was consistent and robust throughout all of the models. Although this finding diverges from the literature, it is not surprising. This finding supports Wang's [69] argument that with the rise of self-expression values in China, the importance of trust in government capacity may decrease and democratic preferences, such as an emphasis on policy making participation, may increase. Thus, the consistent importance of trust in the policy making process reflects the fact that the general public in China begin to attach importance to openness and transparency in

Table 6 Regression results: combined model of public acceptance of driving restriction and congestion charge

	Model 1		Model 2	
	Coef.	T	Coef.	T
Car owner	-0.35***	-2.87	-0.35***	-2.78
Risk perception	0.07	0.65	0.06	0.60
Concern about traffic inconvenience	-0.14*	-1.73	-0.15*	-1.80
Political trust in govt. capacity	0.19*	1.90	0.22**	2.12
Political trust in policy process	0.40***	4.00	0.42***	4.11
Perceived equality fairness	0.45***	5.69	0.41***	4.97
Perceived equality fairness	0.22**	2.67	0.24***	2.91
Knowledge of smog	0.04	0.58	0.04	0.46
Knowledge of policies	0.20*	1.66	0.18	1.51
Policy type	-0.44**	-2.44	-0.54***	-2.89
Pro-environmental attitude	0.27***	2.72	0.25***	2.70
Willingness to pay (WTP)	1.14***	6.62	1.17***	6.78
Policy type * Trust in govt. capacity	-	-	0.09	0.47
Policy type * Trust in policy process	-	-	0.23	1.21
Policy type * Perceived equality fairness	-	-	-0.02	-0.16
Policy type * Perceived equality fairness	-	-	-0.37**	-2.28
Age_group				
20–40	0.56	0.79	0.51	0.71
41–69	0.51	0.69	0.47	0.61
Female	-0.37**	-2.29	-0.38**	-2.33
Education				
Middle school and lower	-0.46	-0.87	-0.46	-0.88
College degree	-0.61	-1.30	-0.62	-1.30
Graduate school and higher	-0.50	-1.04	-0.49	-1.02
R^2	0.1263		0.1350	
N[a]	570		570	

[a]As each respondent was asked for his/her level of acceptance of the driving restriction and the congestion charge, the number of observations was doubled in our regression

Note: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

the policy making process, which has become the new institutional setting for study of public acceptance of traffic-related smog control policies.

Perceived Fairness Shows Positive Influence While the Standard of Equity is Moderated to Be Negative

The results provided strong support for Hypothesis 3, indicating that fairness had a significant positive relationship with public acceptance in terms of both equality

and equity (Table 5: equality of driving restriction—Coef. = 0.40, $p < 0.01$; equity of driving restriction—Coef. = 0.44, $p < 0.01$; equality of congestion charge—Coef. = 0.40, $p < 0.01$; Table 6: equality—Coef. = 0.41, $p < 0.01$; equity—Coef. = 0.24, $p < 0.01$). Echoing the literature, we found that individuals who preferred to be treated equally in terms of the distribution of burdens and costs (e.g., every car owner has to obey the same driving restrictions or pay the same congestion charges) were more likely to accept these policies. The degree of emphasis on equality fairness did not differ between the two policy types. However, the respondents' emphasis on equity fairness differed between the driving restriction policy and the congestion charge policy: in the driving restriction policy setting, citizens who preferred equity fairness were more likely to accept the policy, but in the congestion charge policy setting, citizens who preferred equity fairness were less likely to accept the policy.

Public opposition to congestion charges came from the mismatch between residents' diverse contexts and the policy requirements. In our follow-up interviews, residents expressed their concerns about status differences at the individual level. For example, if a Beijing resident lives or works in the low-emission zone, they inevitably need to commute through the zone on a daily basis. Unlike the driving restriction policy, which affects all car owners once a week, the congestion charge policy affects only a small portion of the population, but to a greater extent. Besides, the congestion charge policy requires direct payment from the public, making it easier for the public to identify the compliance cost and develop a sense of unfairness (compared with the traffic restriction policy). Although the driving restriction policy and the congestion charge policy are designed to attain similar policy goals, the use of different policy instruments makes people care more about compensatory fairness for the congestion charge policy. This result suggests that the public opposes the two differently designed policies for different reasons: equality is important in both policy designs, while equity is essential for the congestion charge policy.

Other Determinants of Public Acceptance of Traffic-Related Smog Control Policy

Perceived traffic inconvenience had statistically significant negative effects on public acceptance of traffic-related smog control policy (Table 6: Coef. = -0.15, $p < 0.1$). The general public is more likely to oppose a policy when they notice a higher level of infringement on driving freedom [35].

The regression results showed that environmental factors matter, as pro-environmental attitude had a significant positive influence on policy acceptance (Table 5: Coef. = 0.34, $p < 0.05$). By the same token, WTP had a statistically significant positive influence on public acceptance (Table 5: driving restriction—Coef. = 0.91, $p < 0.01$, congestion charge—Coef. = 1.45, $p < 0.01$; Table 6: Coef. = 1.17, $p < 0.01$). In particular, the influence of WTP on public acceptance was greater for the congestion charge policy, suggesting that people

with higher levels of WTP are more willing to accept a congestion charge policy than a driving restriction policy.

Car ownership had a significant negative influence on traffic policy acceptance, and the degree of opposition to the congestion charge policy was much higher than the degree of opposition to the driving restriction policy. This could be because car owners could avoid a driving restriction policy more easily by having a second car or borrowing someone else's car, yet it is harder for them to escape a congestion charge.

Conclusions and Policy Implications

Taking driving restriction and congestion charge policies in Beijing as the study objects, this paper reveals the difference in public acceptance of policies between regulatory and economic tools. It reveals the key factors determining public acceptance and draws three key conclusions.

First, the general public in Beijing differs in level of acceptance of different traffic-related smog control policies. In this research, the respondents were more willing to accept a driving restriction policy than a congestion charge policy. Unlike traditional regulatory policies, which clearly define legal and illegal actions, a congestion charge policy does not set clear legal boundaries; rather, it discourages the public from entering a low-emission zone by setting the economic disincentive of a congestion charge. Chinese citizens may need a mindset transition to get used to these market-based policy instruments. In addition, with increasing concerns about fairness, the congestion policy may seem to favor higher income people, which can easily arouse opposition among the public. Therefore, how to successfully introduce a mixed set of policy tools still needs a learning-by-doing process in China. This paper suggests several key factors that may help the government increase policy acceptance, such as honing policy makers' skills in market-based instrument design, enhancing public communication capacity and making policy procedure changes to increase political trust.

Second, the findings answer the initial research question: what are the essential factors that influence public acceptance of traffic-related smog control policies in Beijing? Echoing previous research, the results of this study indicate that smog knowledge, environmental attitude and willingness to pay are the major factors affecting public acceptance of such policies. In particular, the study refines measurements of two variables, political trust and perceived fairness, to further understand their mechanisms of influence. The results reported in this paper suggest that the Beijing public understands political trust and perceived policy fairness in multiple dimensions. For example, different mechanisms underlie individuals' trust in the public sector's capacity and policy process. In terms of individuals' trust in government capacity, when people believe

that the government performs its functions and responsibilities appropriately and effectively, they tend to be more likely to accept public projects or policies [18, 56, 84]. Additionally, regarding individuals' trust in the policy process, citizens are more willing to accept a policy when they can participate in the policy making process and feel that their voice will be heard by the policy makers [61]. The results show that the public's trust in the policy process matters more for their acceptance of both driving restriction and congestion charge policies, indicating that the Chinese public has begun to attach importance to the openness and transparency of the policy making process. Meanwhile, perceived fairness is positively related to policy acceptance in that people who prefer equality fairness (procedural justice in which everyone has the same policy obligations) are more likely to accept both driving restriction and congestion charge policies. However, people who prefer equity fairness (distributive justice in which policies treat the public according to their status) are less likely to accept a congestion charge policy. Congestion fee policy, which is designed to reduce unnecessary mobility within a special zone, wrongly punishes people who live or work within that special zone. Thus, citizens tend to regard existing congestion charge policy design as lacking equity fairness, which generates opposition towards this policy type. The results of this research call for further exploration of the relationship between policy design and individual reflections on them: do different policy tools stimulate different values among the public? If so, how could policy instrument design be adjusted to better fulfill policy goals?

Third, turning to policy design, this research answers several questions regarding policy making and implementation in Beijing. For example, when the city tries to adopt different traffic-related smog control policies, why does a congestion charge policy encounter more public opposition than a driving restriction policy? What makes the public accept one policy while opposing another? Based on this analysis, the paper recommends two changes to policy design in the future. First, regulatory policy design should be more transparent. The government should try to increase the public's involvement in the policy making process, which, compared with increasing government capacity, would do more to increase political trust in the policy making process and increase public acceptance more broadly. Second, congestion charge policy design arouses new discussion about distributional standards such as equity fairness. This discussion reflects citizens' increasing concern about the transparency of the policy making process.

This paper undoubtedly has its limitation. It may not be sufficient to compare the two policy options without considering how they interact and influence each other when multiple constraints and externalities exist. In the future, researchers should further explore how different instruments might generate joint externalities at the individual level. This would guide design of policy mix in Beijing.

Appendix 1 Variables definitions and measurements

Variables		Questions
Dependent variables	Public acceptance of driving restriction policy	I support the driving restriction policy in Beijing.
	Public acceptance of congestion charge policy	I support the congestion charge policy in Beijing to alleviate air pollution.
Independent variables	Political trust	I think the process of making traffic-related smog control policy is open.
		I think the process of making traffic-related smog control policy is transparent.
		I think local government has strong will for smog control.
		I think local government would like to consider opinions and suggestions from the public, the expert and the media.
		I think my opinion is influential to local government's traffic-related smog control policy design.
		I think local government has enough instruments for smog control.
		I think smog control instruments adopted by local government are effective.
		I think local government is capable to solve smog problem in the near future.
		I think local government has the capacity to improve its policy design in the long run for smog control.
	Perceived fairness	I think each car owner should have the same obligation to obey driving restriction policy.
		I think each car owner should pay the same amount of congestion charge.
		I think cars with higher emissions should be restricted more.
		I think cars with higher emissions should pay more congestion charge.
	Knowledge of smog	Objective assessment on knowledge level, such as: "which pollutants is the main component of smog?"
	Knowledge of smog control policy	Objective assessment on knowledge level of traffic-related smog control policies in Beijing, such as: "What are the days of the week to implement driving restriction?"
	Perceived risk	Smog may create health hazards.
		Smog may create other uncertain hazards.
	Concern about traffic inconvenience	Traffic control will bring travel inconvenience to people's daily life.

Variables		Questions
Control variables	Pro-environmental attitude	I take environment protection as an important issue.
	WTP	How much money are you willing to pay for smog control per month?

Appendix 2 Policy characteristics of driving restriction and congestion charge instruments

Policy instrument	Policy type	Launch date (year)	Initiated agency	Policy Goal/Content
Driving restriction	Regulation	2008, renewed every year	People's Government of Beijing Municipality	*Policy goal*: Alleviate air pollution *Policy content*: One-day-a-week driving licensing scheme from 7:00 a.m. to 8:00 p.m. inside but excluding the 5th ring road; odd-even number driving restriction scheme that uses the odd and even number of the date to determine the plate number of the vehicle allowed to be driven on that day is adopted on severe smog days.
Congestion charge	Market-based	Proposed in 2013, still under policy discussion	People's Government of Beijing Municipality Beijing Municipal Commission of Transportation, Beijing Municipal Commission of Development and Reform Beijing Municipal Environmental Protection Bureau	*Policy goal*: Alleviate traffic congestion and air pollution *Policy content*: A fee charged on most motor vehicles operating within the Low Emission Area in central Beijing. Operating hours as well as charging amount are still under discussion.

Source: "2016 Beijing Driving Restriction on the Peak Hours during Weekdays" and "the 2013–2017 Beijing Clear Air Action Plan"

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Data Availability The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Declarations

Conflict of interest The authors listed above certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; or expert testimony or patent-licensing arrangements) or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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