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## Will a driving restriction policy reduce car trips?—The case study of Beijing, China

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### ABSTRACT

A driving restriction policy, as one of the control-and-command rationing measures, is a politically acceptable policy tool to address traffic congestion and air pollution in some countries and cities in the world. Beijing is the first city in China to implement this policy. A one-day-a-week driving restriction scheme was expected to take 20% of cars off the road every week day. Using household survey and travel diary data, we analyze the short-term effect of this driving restriction policy on individual travel mode choice. The data also allow us to identify which demographic groups are more likely to break the restriction rule. The estimates reveal that the restriction policy in Beijing does not have significant influence on individuals' decisions to drive, as compared with the policy's influence on public transit. The rule-breaking behavior is constant and pervasive. We found that 47.8% of the regulated car owners didn't follow the restriction rules, and drove "illegally" to their destination places. On average, car owners who traveled during peak hours and/or for work trips, and whose destinations were farther away from the city center or subway stations, were more likely to break the driving restriction rules. Therefore, Beijing is probably in need of more comprehensive and palatable policy instruments (e.g., a combination of congestion tolls, parking fees, fuel taxes, and high-speed transit facilities) to effectively alleviate traffic congestion and air pollution.

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## 1. Introduction

Beijing is the first city in China to implement a driving restriction policy in order to control traffic volume and air pollution. But this policy is not new in the world. Early in the 1970s, Buenos Aires, the capital and largest city of Argentina, banned one-half of automobiles from entering the city center on a given day based on odd or even last digit of the plate number. A similar restriction program was also used in the 1980s in Caracas, the capital and largest city in Venezuela, and then in Athens between 1985 and 1991 (de Grange and Troncoso, 2011, p. 863). In Mexico City, a one-day-per-week driving restriction from 5:00 a.m. to 10:00 p.m. every weekday was introduced in 1989. Sao Paulo in Brazil, Bogota and Medellin in Colombia, and Santiago in Chile all joined Mexico in introducing driving restriction to reduce automobile use. More recently, several Chinese cities from north to south, including Changchun, Lanzhou, Hangzhou, Guiyang, and Chengdu, began to rely on

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driving restrictions to alleviate traffic congestion.<sup>1</sup> This study uses micro level data to evaluate the impact of Beijing's driving restriction policy on individual travel mode choices and on rule breaking behavior.

The efficiency of driving restrictions is controversial. Economists generally believe that congestion pricing is an effective strategy to reduce car-related problems (e.g., [Small and Gomez-Ibanez, 1998](#); [Small and Verhoef, 2007](#)). However, in practice, the public is not willing to pay a higher price to use public roads, even if they would benefit both from reduced congestion and from transportation-related public goods and services provided with the corresponding revenues ([Rouwendaal and Verhoef, 2006, p. 106](#)). Meanwhile, the rationing policy is also regarded as a more equitable way to reduce traffic congestion than road pricing ([Rouwendaal and Verhoef, 2006](#); [de Grange and Troncoso, 2011](#)), as every automobile owner is required to follow the same restriction rule. As a consequence, congestion pricing is not readily accepted by the public ([Schade and Schlag, 2003](#); [Schuitema et al, 2010](#)). Instead, rationing, such as driving restriction measures, becomes a more politically acceptable policy tool to address congestion problems, and is in particular favored by policy makers in developing countries. In 2007 and 2008, Beijing joined these cities and introduced odd-even license plate restriction policies to support international sporting events, especially the 2008 Olympics. Evidence of reduction of congestion and mobile source pollution was confirmed during this period (e.g., [Wang et al., 2009](#)). The benefits of such a restriction seemed so attractive that Beijing soon decided to resume with a similar, but less restrictive, one-day-a-week licensing scheme ([Wang, 2010](#)). This policy was generally supported by the local residents as well.<sup>2</sup>

However, some theoretical and empirical research has argued against the driving restriction policy, "calling it unjust and inefficient" ([de Grange and Troncoso, 2011](#)). These criticisms are due to either non-compliance or compensating responses, such as inter-temporal substitution of driving or adding a second vehicle. For instance, driving restrictions do not take into account willingness to pay, which depends on the importance of different trips to different drivers ([de Grange and Troncoso, 2011](#)). Residents who live far away from subway stations or bus stops have less chance than others to find substitutes for car trips. As a result, it is more likely that they might break the rules to make certain trips. In most developing countries, the public transport system is a very imperfect substitute for cars. This might induce the drivers to adjust to the restriction by purchasing additional cars ([Goddard, 1997, 1999](#)). Evidence from Mexico City has shown that wealthy people are able to buy second cars with a different license plate to circumvent the ban, and, therefore, total car use in Mexico City has in fact increased ([Eskeland and Feyzioglu, 1997](#)). These additional cars were typically older and generate more pollution, which in turn made the air pollution even worse ([Eskeland and Feyzioglu, 1997, p. 399–400](#)). Their study also illustrated that "rationing entails welfare costs at least as high as those of a market-based mechanism producing the same reduction in trips" (p. 384). [Gallego et al. \(2012\)](#) found similar results in Mexico and Santiago. Based on hourly concentration records of carbon monoxide, their results "show that policies that may appear effective in the short run can be highly detrimental in the long run, i.e., after households have adjusted their stock of vehicle" (p. 1). Even if no one bought extra cars and everyone fully abided by the license plate restriction, the reduced traffic in the short run would increase travel speeds, thus encouraging more travel by those who are legally allowed to drive on a particular day.<sup>3</sup> The principle of "triple convergence" would then guarantee that any such strategy not based on pricing will eventually lead to the same congestion levels as before and thus be quite ineffective ([Downs, 2004](#)).

Beijing is not an exception to the unintended consequences of a driving restriction policy. People have a natural preference for fast and convenient transportation and will find ways to circumvent rationing programs of this sort ([Davis, 2008](#)). In Beijing, people have invented "surprising" ways to circumvent the driving restriction program. For example, they covered plates or borrowed plates or cars from others on the day when their cars were prohibited. Some of them set out earlier in the morning to beat the 7:00 a.m. cutoff. Or they simply ignored the restriction rules. In a cross-country comparative study including Beijing, [Lin et al. \(2011\)](#) found that temporal shifting of driving is likely to appear when the restrictions are only effective during certain hours on weekdays. According to the Beijing Transportation Research Center, the congestion index in Beijing decreased from 7.95 in 2007 to 5.93 in 2009, after the driving restriction policy was formally implemented in 2008. However, this index value quickly jumped back to 7.80 in 2010.<sup>4</sup> The possible reasons might be both non-compliance behavior and the addition of more vehicles on the road. One survey<sup>5</sup> found that 50% of families with one car planned to purchase a second car to circumvent this policy. The data<sup>6</sup> from the second-hand car market also shows that sales of the cheap used cars valued at less than 80,000 RMB doubled after the restriction policy, and the price increased at least by 15%. Nevertheless, it has been

<sup>1</sup> Hangzhou, Lanzhou, Guiyang, Changchun and Chengdu followed Beijing to use a one-day-a-week driving licensing scheme to control car trips. They differ only in the hours that driving is restricted, the restricted driving zone and the violation penalty. For example, the driving restriction policy in Changchun (Northeast China) uses a three-day-per-month driving license scheme to alleviate traffic congestion in the city center. Driving is not allowed in designated areas in Changchun if the last digit of the car's plate number is same as the last digit of the date.

<sup>2</sup> For instance, one survey, which was designed to ask the public's attitudes toward the driving restriction policy, revealed that nearly 70% of local residents in Beijing supported this policy after the Olympics ([http://www.qzwb.com/gb/content/2008-09/02/content\\_2917790.htm](http://www.qzwb.com/gb/content/2008-09/02/content_2917790.htm)).

<sup>3</sup> This is pointed out by one of reviewers.

<sup>4</sup> Sources: Beijing Transportation Research Center. When the congestion index is between 4 and 6, it means light congestion, in which some of the ring roads (loop routes that encircle the city center) or major arterials are jammed, and travelers need 1.5 to 1.8 times the average travel time to finish their trips. When the congestion index is between 6 and 8, it refers to moderate congestion, in which most of the ring roads and major arterials are congested, and travelers have to spend 1.8 to 2 times the average travel time to get to their destinations. When the congestion index is between 8 and 10, most of the roads in the city are severely congested, and travelers need to spend more than 2 times the average travel time to complete their trips.

<sup>5</sup> <http://auto.sina.com.cn/news/2009-04-08/1115479818.shtml>.

<sup>6</sup> <http://auto.qq.com/a/20090418/000017.htm>.

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