Transport Policy 58 (2017) 62–71

Contents lists available at ScienceDirect

Transport Policy

journal homepage: www.elsevier.com/locate/tranpol

Car ownership policies in China: Preferences of residents and influence on the choice of electric cars

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ARTICLE INFO

Keywords:
Car ownership policy
License plate auction
License plate lottery
Electric car
Policy preference

ABSTRACT

To alleviate congestion, many Chinese cities have adopted either one of the two car ownership policies, namely, license plate auction or license plate lottery, to limit the number of cars on the road. In an effort to address the criticism associated with administering a single car ownership policy, cities are considering the possibility of carrying out both policies simultaneously, so that residents can choose whether to pay for the license plate through an auction or get it for free from a lottery but with a longer wait time. We study residents' preferences toward the two car ownership policies when both are administered at the same time, a problem that has not been investigated in the literature. We then examine the influence of car ownership policies on the choice of electric cars, which is also new to the literature. Using data collected from a stated preference survey, we estimate mixed logit models using the hierarchical Bayes approach based on the Markov Chain Monte Carlo method. Results show that strong preference heterogeneity exists in respondents' policy choice. We proceed to conduct regression analysis to explain the variations in the preferences toward license plate auction and electric cars. Our main results include: (1) We find that prospective car buyers in Beijing and Shanghai are willing to bid 27,000 yuan and 49,000 yuan to shorten their wait time to get car license plates by one year, respectively; (2) The subsidy to electric cars can be reduced by 102,000 yuan in Beijing and 85,000 yuan in Shanghai if the wait time for an electric car license plate is shortened by one year; (3) Car buyers in favor of license plate auction are those who are from high-income households, who are not buying their first cars, and who are below 30 or above 40 years old; and (4) When promoting the adoption of electric cars, policy incentives, such as making it easier to obtain an electric car license plate and providing attractive subsidies, are as important as the technological advancement electric car manufacturers strive to make, such as improving the driving range of electric cars.

1. Introduction

In the past two decades, the significant economic development in China has created a rapid growth in car ownership. However, the glut of cars has resulted in severe congestion and pollution in cities throughout the country. Faced with the problems brought on by the growing number of cars, many Chinese cities have taken actions and adopted either one of the two car ownership policies, namely, license plate lottery or license plate auction, to limit the number of cars on the road. Both policies require a resident to first get a license plate from the government before he or she can actually buy a car. In license plate lottery, residents must take part in a monthly draw to get the license plate and there is no additional cost involved with getting one. Beijing started this policy since 2011 and the chance to get a license plate has decreased to less than 0.5% in the lottery held in August 2016, that is, only 13,674 license plates were handed out although there were 2,684,759 individuals in the lottery (Beijing Municipal Commission of Transport, 2016). The ferocious competition for license plates has stirred up a lot of complaints from the residents because owning a car has already been a way of life for middle-class citizens (Guo, 2016). Unlike Beijing, Shanghai administers the second type of policy, that is, license plate auction, and the license plates are distributed to residents through auctions, where residents need to bid and pay for the license plates. In the recent auction that took place in January 2017, there were 232,101 residents bidding for 12,215 license plates and the price for a license plate hit an all-time high of 87,685 Chinese yuan, or 12,761 US dollars (China News Network, 2017). The auction policy is not immune to criticism, either.

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http://dx.doi.org/10.1016/j.tranpol.2017.04.010
Received 9 July 2016; Received in revised form 19 February 2017; Accepted 24 April 2017
Available online 19 May 2017
0967-070X/

Many blame that the outrageously high price makes it a privilege of the rich to own a car. Although both types of car ownership policies put annual quotas on the number of license plates for gasoline cars, they impose little or no restrictions on that for electric, or new energy, cars. The cities even provide incentives to promote the purchase of electric cars among residents. For example, Beijing conducts a separate license plate lottery for electric cars and the number of license plates is more than the number of buyers requesting such license plates. As a result, it is very easy to obtain license plates for electric cars. In Shanghai, residents can get license plates for free if they buy electric cars. Moreover, the government provides generous subsidies to electric car buyers. For example, one can get a subsidy of 110,000 yuan, or 16,923 dollars when buying an electric car with a driving range of 250 km or more in 2016 (Xinhua News Agency, 2017). Besides Beijing and Shanghai, a handful of other cities, including Guangzhou, Tianjin, Hangzhou, and Shenzhen, limit car license plates by official decree.

To address the criticism associated administering a single car ownership policy, cities are considering the possibility of carrying out both policies at the same time, so that residents can choose whether to pay for the license plate through the auction or get it for free through the lottery but with a longer wait time (China Business Journal, 2016). In this case, prospective car buyers have the following four options to get their license plates: (a) Getting a license plate for a gasoline car via lottery, (b) Getting a license plate for a gasoline car via auction, (c) Getting a license plate for an electric car via lottery, and (d) Getting a non-local license plate for a gasoline car, which means that the buyer does not register the car using a local license plate from his or her city, but rather using a non-local license plate, that is, a license plate from other cities. Although cars with non-local license plates can still be driven in the city, they are rather inconvenient due to driving restrictions imposed during rush hours. For example, in Beijing they are not allowed to enter the urban area within the Fifth Ring Road and in Shanghai they cannot run on the elevated urban freeways during rush hours (China Daily, 2011).

In this research, we are interested in investigating prospective car buyers' preferences toward the two car ownership policies when they are administered simultaneously, a problem that has not been studied in the literature. This lays a solid foundation for policy makers to decide the optimal allocation of license plates between lottery and auction and also between gasoline and electric cars, so as to maximize, say, equity or residents' satisfaction. Most, if not all, existing studies on car ownership policies focus on the analysis of a single policy or the comparison between the different policies across cities. None of them examined residents' preferences in a scenario when both policies are administered in the same city. For example, Song and Zhou (2010) perform statistical analysis to analyze the minimal bid price in Shanghai's license plate auction. Chen and Zhao (2013) investigate the policy acceptance of Shanghai's license plate auction using Likert-scale statements method from factors including perceived policy effectiveness, affordability, equity concerns, and implementation. Liao and Holt (2013) and Feng and Li (2015) evaluate the revenue and efficiency consequences of Shanghai's license plate auction using a laboratory experiment method and a structural vector autoregression approach, respectively. Wang (2010) qualitatively analyzes the effectiveness of Shanghai's license plate auction. Phang et al. (1996); Chin and Smith (1997), and Koh (2003) focus on the experience and economics of Singapore's vehicle quota scheme. For studies on the comparison of car ownership policies, Chu (2012) analyzes the allocation flexibility and price efficiency within Singapore's vehicle quota system and compares with the car ownership policies in Beijing and Shanghai. Zhu et al. (2013) build an economic model to quantify the benefits and measure the net social impact of license plate lottery and auction in China.

We are also interested in the influence of car ownership policies on the choice of electric cars, which is again new to the literature. Specifically, we want to know if it really matters to make it easier to obtain the license plates for electric cars? Or, how do residents trade the subsidy with the wait time to get the license plates for electric cars? To the best of the authors' knowledge, this kind of studies is very scarce in the literature. Existing research mostly focuses on the influence of vehicle attributes and consumer characteristics, rather than that of car ownership policies, on the choice of electric cars. Beggs et al. (1981) and Calfee (1985) aim at multicar households and find that the driving range of the electric car is the primary concern for consumers. Bunch et al. (1993), Brownstone et al. (1999); Ewing (2000), and Dagsvik et al. (2002) find that limited driving range, high purchase price, and long charging time are the main concerns for consumers. Hidrue et al. (2011) use a latent class model to estimate the willingness-to-pay (WTP) for various attributes of electric cars and identify the target customer segments using their socioeconomic characteristics. More recently, there are a few studies looking at the impact of subsidy on electric car choice. For example, Han et al. (2014) focus on the ownership cost analysis of battery electric cars to estimate the impact of electric car subsidy scheme in China on the market penetration of electric cars. Helveston et al. (2015) measure the influence of subsidies on the market share of electric cars in the U.S. and China through market simulation.

To answer the aforementioned two research questions, we conduct a stated preference survey and apply the two-step method introduced in Campbell (2007), and later used by Hoshino (2010) and Jiang and Chen (2015), that combines the mixed logit model and the regression model to investigate individuals' preferences. We design the choice tasks and ask respondents in Beijing and Shanghai to choose their preferred way to get a license plate from Options (a) through (d) described in the second paragraph of this section. The attributes we consider include the bid price in the auction, the wait time to get the license plate, and the amount of the subsidy for electric cars. We introduce alternative-specific constants to capture residents' preferences and estimate the mixed logit models using the hierarchical Bayes approach based on the Markov Chain Monte Carlo (MCMC) method. Results suggest that strong preference heterogeneity exists among prospective car buyers in their policy choice behavior. We derive the individual-specific WTP and individual-specific coefficients for the alternative-specific constants from the mixed logit models. In order to elucidate the determinants of preference heterogeneity, we conduct regression analysis to explain the differences in the coefficients of alternative-specific constants across respondents by their socioeconomic and attitudinal characteristics.

We summarize the contributions of this study as follows:

- To the best of the authors' knowledge, this study is the first of its kind to study residents' preferences when both license plate lottery and license plate auction are administered at the same time in a city. The preference model we develop lays a solid foundation for policy makers to decide the optimal allocation of the license plates between lottery and auction and also between gasoline and electric cars. By estimating residents' WTP for shortening their wait time to get the license plates, we provide guidance to policy makers when setting the minimum bid prices; and
- We are the first to investigate the influence of car ownership policies on the choice of electric cars in the literature. We show that car ownership policies play an role as important as the advancement in vehicle technology in convincing people to buy electric cars. By understanding how residents trade between their wait time to get a license plate and the subsidy for electric cars, we also help policy makers set the appropriate amount of the subsidy.

The rest of the paper is organized as follows. Section 2 details the design of the stated preference survey and the data obtained for this research. Section 3 provides a detailed description of the mixed logit model, the hierarchical Bayes estimation approach, and the regression analysis. Section 4 presents the empirical results and analyzes respondents' behavioral heterogeneity. Section 5 concludes the discussion and outlines future research directions.