Transportation Research Part D 55 (2017) 113–126

Contents lists available at ScienceDirect

Transportation Research Part D

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

Getting around a license-plate ban: Behavioral responses to Mexico City's driving restriction

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ARTICLE INFO

Article history:

Keywords:
Car restrictions
Driving ban
Hoy No Circula
Travel behavior
Policy avoidance
Mexico City

ABSTRACT

License-plate-based driving restrictions are among the highest profile policies for local governments to address congestion and air pollution. Cities as varied as Sao Paulo, Paris, Tianjin, and New Delhi have enacted temporary or permanent restrictions to improve local air quality. Using household travel survey data and a research design based on the abrupt shift in how the policy applies to 10-year-old vs. 9-year-old vehicles, we evaluate the impact of *Hoy No Circula*, one of the earliest and most studied driving restrictions, in Mexico City. In line with previous studies, we find that *Hoy No Circula* has done little to reduce overall vehicle travel, but we reject the prevailing theory that its lack of success is due to perverse incentives for households to buy second cars. Instead, we highlight the range of other, less costly ways that people adjust behavior to avoid the restrictions. Although no single behavior dominates, most households — particularly those that own older, higher-polluting vehicles — do not use their car every weekday regardless of the restriction. As a result, it is relatively easy to shuffle travel from restricted days to unrestricted days and thus avoid the ban. Shuffling travel days is less costly, more immediately available, and far simpler for most households than buying a second car.

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1. Introduction

Faced with some of the worst pollution in any city in the 1980s, the Mexican government instituted a policy to restrict car use in the Mexico City Metropolitan Area. The policy *Hoy No Circula*, roughly translated as "Don't Drive Today," began in 1989, and restricted private cars from driving one weekday per week based on the last digit of the license plate. Mexico City recently doubled down on its policy. *Doble Hoy No Circula* — enacted temporarily due to a recent surge in local pollution — applied to more of the vehicle fleet and banned cars as many as three days out of the week.

Other Latin American cities like Buenos Aires, Bogota, Cartagena, Lima, Sao Paolo, and Santiago de Chile have enacted similar policies (Onursal and Gautam, 1997; de Grange and Troncoso, 2011; Gallego et al., 2013). More recently, the policy has expanded in other parts of the world. After successfully reducing local pollution ahead of the 2008 Summer Olympics, Beijing became the first Chinese city to enact a license-plate-based car restriction (Viard and Fu, 2015; Sun et al., 2014; Wang et al., 2014; Gu et al., 2017). Cities as varied as Paris, Tianjin, and New Delhi have also enacted temporary or permanent restrictions

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http://dx.doi.org/10.1016/j.trd.2017.06.027
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to improve local air quality. Throughout the paper, we refer to these policies interchangeably as car bans, driving restrictions, or car restrictions.

Driving restrictions tend to be politically more palatable than congestion charging and other pricing-based policies to reduce road congestion and pollution (e.g. Mahendra, 2008). Wirth (1997), Mahendra (2008), and Wang et al. (2014) cite surveys that indicate high public approval for the policy in Mexico City, Sao Paulo, and Beijing. Yet *Hoy No Circula* in Mexico City and its counterparts elsewhere in the world are economically costly (Blackman et al., 2015; Davis, 2008; Cantillo and Ortúzar, 2014; Nie, 2017) and may have done little-to-nothing to improve congestion or local air quality. Three empirical studies of *Hoy No Circula* suggest that because the policy encourages households to purchase second cars to avoid the restrictions, there may be no effect or even an increase in driving (Eskeland and Feyzioglu, 1997; Davis, 2008; Gallego et al., 2013).

That so many households respond to a car ban by purchasing a second vehicle is surprising. There are many other ways — such as shuffling trips to a different day — for households to avoid a ban, most of them more immediate and less expensive than purchasing an additional vehicle. However, many of these behavioral responses cannot be examined using aggregate emissions, travel, or vehicle purchase data. Two studies to date have examined household-level responses to a car ban using disaggregate data from Beijing. Wang et al. (2014) focus entirely on just one avoidance mechanism: non-compliance with the restriction. Gu et al. (2017) examine non-compliance and whether households shift car travel to unrestricted hours, weekdays, or second vehicles.

This study is the first to present a systematic analysis of the various ways that individuals and households — the correct unit of analysis to study behavioral adjustments to a policy — might have responded to Mexico City's travel ban. Our contribution is thus both theoretical and empirical. Relying on household-level data from the Mexico City Metropolitan Area's (MCMA) 2007 household travel survey, we present a half-dozen hypotheses about how households might adapt to a license-plate-based car restriction program like *Hoy No Circula*. We then explore each hypothesis using a research design based on the abrupt shift in how the policy applies to 10-year-old and 9-year-old vehicles. By examining a single day of travel after the policy has been in effect for several years, our research design also has the advantage of providing insight into the long-run behavioral equilibrium, rather than the short-run aggregate responses as in Davis (2008).

The *Hoy No Circula* policy has undergone numerous changes since the survey was conducted. Thus, our primary contribution is to analyze the underlying household responses to a driving restriction, rather than to assess the Mexico City policy as it currently stands. Moreover, the diversity in how ostensibly similar car bans are implemented across the world – geographic and temporal scope, exempted vehicles, and the number of days that a car is banned – mean that parsing the underlying mechanisms may prove more fruitful than seeking a universal answer to the effectiveness of such policies. In Beijing, for example, strict limits on vehicle licenses make it difficult to avoid the restriction through second car purchases.

Understanding how households respond to *Hoy No Circula* and similar policies can help policymakers improve the design of car bans or at least temper expectations about the impacts on pollution. For example, if second car purchases indeed limited the effectiveness of license-plate car restrictions, then varying which days are associated with which plates would reduce the incentive to purchase a second car since it would sometimes be banned on the same day as the first car. More broadly, better understanding behavioral responses to license-plate-based car bans is increasingly important as these policies proliferate and increase in intensity.

The remainder of this paper is organized as follows. Section 2 provides an overview of the literature on behavioral responses to driving restrictions with an emphasis on policy avoidance. Section 3 describes the policy context, research design, and data. Section 4 discusses the findings in relationship to our hypotheses about how households might avoid a travel ban. Section 5 concludes with an overview of the paper's implications for public policy and describes areas for future study.

2. Behavioral responses to a driving restriction

Throughout Asia and Latin America, researchers have generally found that car bans have no effect (de Grange and Troncoso, 2011; Davis, 2008; Sun et al., 2014; Lin Lawell et al., 2015), a small positive effect (de Grange and Troncoso, 2011), or even a negative effect (Eskeland and Feyzioglu, 1997; Lin Lawell et al., 2015; Gallego et al., 2013) on local pollution or car use.[2] Sun et al. (2014) estimate that the Beijing car ban reduced congestion but did not affect pollution, perhaps because reduced congestion led to greater traffic flow and its associated pollution. Few independent academic assessments come close to finding the 20% reduction in emissions that policy makers hoped would come from banning one-fifth of cars from the road each day. Two notable exceptions suggest that the policy may be substantially more effective in Beijing. Viard and Fu's (2015) regression discontinuity analysis attributes a 21% reduction in air pollution to Beijing's one-day-per-week ban, though the graphical evidence in the paper suggests that the results are highly dependent on the regression specification. Supporting this finding, however, Gu et al. (2017) find that car-owning households reduce weekday car trips by 15.8%–18.6% on restricted days. Carrillo et al. (2014) observe a 10% reduction in Quito's local pollution relative to areas and times just outside the ban, but Quito's policy only affects peak hours and the central part of the metropolis.

[2] Some papers are listed more than once as they have different findings depending on the type of effect (one or more pollutants, vehicle travel, etc.) or the time period analyzed.

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