Transportation Research Part A 69 (2014) 165–182

Contents lists available at ScienceDirect

Transportation Research Part A

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

Lights, camera, legal action! The effectiveness of red light cameras on collisions in Los Angeles

Timothy Wong *

Department of Economics, University of California, Irvine, 3151 Social Sciences Plaza, Irvine, CA 92697, United States

ARTICLE INFO

Article history:
Received 22 August 2014
Accepted 22 August 2014

Keywords:
Red-light cameras
Intersection crashes
Red-light running collisions
Bayesian inference
Correlated count data
Poisson regression

ABSTRACT

This study estimates the effect of red light cameras (henceforth cameras) on collisions under the Los Angeles Automated Photo Enforcement Program that ran from 2006 to 2011. To control for selection bias and unobservables, a data set is constructed such that intersections with cameras are compared to control groups of nearby intersections without cameras, matched on observable characteristics. To capture potential spillover effects of cameras, control groups at various distances from the intersections with cameras are considered. A Poisson panel data model with random coefficients is applied to these data and estimated using Bayesian methods. The program suffered from weaknesses in enforcement. The city's courts did not uphold citations and this dampened the effect cameras had on drivers. These problems are accounted for in modeling. Controlling for these concerns, results indicate that the cameras decreased red light running related collisions, but increased right-angle and injury collisions, as well as collisions overall.

1. Introduction

In 2009, road collisions at intersections killed 7043 people in the United States, of which 676 were attributed to drivers failing to stop at red lights (Federal Highway Administration, 2010a,b). Tangible economic costs of collisions alone are estimated at about 313.6 billion dollars a year, in 2013 prices, primarily because of losses due to injury, death, property damage, travel delay, and insurance administration. If one utilizes value of statistical life estimates rather than just productivity loss estimates, these costs rise by over 70% (Small and Verhoef, 2007). Such large figures warrant that road safety policies be studied carefully in order that resources are best used to reduce collisions and their associated costs.

Red light cameras (henceforth cameras) have been introduced in cities across the United States since the 1990s to increase enforcement of traffic laws in the hope of increasing safety. These camera systems are triggered to capture an image of the intersection if a vehicle crosses the stopping line after a specified time, once the light has turned red. License plate information from the photographs is then used to issue a ticket to the vehicle owner. Evidence on the effectiveness of cameras in increasing safety at intersections remains inconclusive. While past research indicates that cameras decrease the number of right-angle collisions, some findings suggest that cameras also increase rear-end collisions significantly, because road users brake more suddenly in the presence of these cameras (Erke, 2009).

This paper studies the City of Los Angeles Automated Photo Red Light Enforcement Program which was in effect from April 2006 to July 2011 and estimates the effect these cameras had on collisions. Leveraging on the city's size and abundance of available potential control intersections, intersections with cameras (henceforth treated intersections) are compared

* Tel.: +1 (660) 238 2401.
E-mail address: tcwong1@uci.edu

http://dx.doi.org/10.1016/j.tra.2014.08.023
0965-8564/

against nearby intersections without cameras, matched on observable characteristics. The spatial correlation that arises from this design is incorporated into the study through the use of a random coefficient specification within a Poisson regression model. Similar methods are adopted by Hallmark et al. (2010) in their study of cameras in Davenport, Iowa. The estimation design in this paper also attempts to capture potential spillover effects that cameras may have on neighboring intersections by considering three sets of control groups with varying distances from the treated intersections.

The Los Angeles camera program suffered from legal setbacks that dampened the effectiveness of the program over time. Because the Los Angeles Superior Courts began rejecting citations issued from cameras, citations issued later in the program were more frequently ignored. In addition, the installation of cameras at intersections was accompanied by increases in amber and all-red phase signal timings at the same intersections, complicating the ability to uncover the effectiveness of cameras alone on collisions. However, by assuming that the effect of cameras on collisions decayed over time, due to enforcement weaknesses, while the effect of traffic light phase timings did not, it is possible to separate the effect of cameras on collisions from the effect of traffic light phase timings on collisions. This is done by estimating the yearly effect of the program on collisions for each of the five years of the program. The assumption just stated suggests that any reversal in trends of the yearly effects must be assigned to the decay in the effectiveness of camera enforcement over time.

Controlling for the decay in enforcement, this study finds that cameras decrease red-light-running collisions. Nevertheless, cameras also increase right-angle, rear-end, and injury-related collisions. As a result, cameras cause a net increase in collisions overall. The paper is organized as follows: Section 2 presents a summary of existing findings and estimation concerns on the effectiveness of cameras. Section 3 provides an overview of camera programs in Los Angeles. Sections 4 and 5 provide details on the data used and estimation strategy employed. In Section 6, the results from estimation are presented and discussed, while Section 7 summarizes and concludes the study.

2. Literature review

There is a well-developed existing literature on the effect of cameras on road safety. Retting et al. (2003) and Aeron-Thomas and Hess (2005) provide summaries of the existing work on the issue. In addition, Høye (2013) conducts a meta-analysis of the camera literature, which provides a comprehensive index of academic papers that address the effect of cameras on collisions and other safety indicators.

Past research indicate that cameras reduce red-light-running violations. Studies of Oxnard, California (Retting et al., 1999a), Fairfax County, Virginia (Retting et al., 1999b), Salem, Oregon (Ross and Sperley, 2011), and Virginia Beach, Virginia (Martinez and Porter, 2006) find that cameras decrease violations when cameras were installed. Porter et al. (2013) find that when the same cameras in Virginia Beach were turned off, red light running rose dramatically, by almost 300% in the subsequent month, and by 400%, one year later.

The effectiveness of cameras at reducing collisions, however, is more ambiguous. Retting and Kyrychenko (2002) and Hallmark et al. (2010) find that cameras reduce the overall number of collisions. Retting and Kyrychenko (2002) find that cameras decrease injury related collisions. Hu et al. (2011) study a cross section of 99 cities and find that cameras decrease fatal collisions while Haque et al. (2010) find that cameras in Singapore decrease motorcycle collisions. Other studies find less encouraging results in support of cameras. Some find that, at best, cameras have no effect on collisions overall (Chin and Quddus, 2003; Burkey and Obeng, 2004; Garber et al., 2007). Many studies also find that cameras increase rear-end collisions (Burkey and Obeng, 2004; Council et al., 2005a; Garber et al., 2007; Shin and Washington, 2007). These increases suggest that, in the presence of cameras, drivers brake more abruptly to avoid citations, causing such collisions to occur.

Høye (2013) provides some rationale for the lack of cohesive results. In her meta-analysis, she highlights two primary concerns when studying camera programs that cause heterogeneity in results: selection bias and spillover effects. Studies that do not control for selection bias find reductions in right angle collisions that are twice as large as studies that do not. She also finds evidence that publication bias accounts for heterogeneity in results across studies. Across studies, Høye reports that on average, cameras increase all collisions by 6%, decrease right-angle collisions by 13%, and increase rear end collisions by 40%. Right-angle injury collisions decrease by 33% and rear end injury collisions increase by 19%.

Selection bias arises because the placement of cameras at intersections is, in most cases, non-random. Cameras are generally placed at intersections where more collisions occur. Unobservable characteristics of these intersections that make them particularly dangerous (for example, high traffic volume) are hence correlated with the presence of cameras. Unless this correlation is addressed, any estimate of the effect of cameras on collisions will also capture some of the effect of these unobservable characteristics, creating bias (Rubin, 1974).

Spillover effects arise because the presence of cameras at certain signalized intersections within a city may cause drivers to behave differently at signalized intersections without cameras. The traditional thought is that the spillover effect is positive (Retting et al., 1999a,b; Shin and Washington, 2007). Cameras help drivers develop better driving habits, making them less likely to run red lights at all intersections. However, it is also conceivable that the spillover effect is negative. A driver who wants to shorten travel time could run more red lights at intersections without cameras knowing he is more likely to receive a citation for such an offence at an intersection with cameras.

These concerns have been addressed previously in different ways. One way to control for selection bias is by conditioning on an extensive set of variables that affect safety at intersections. This strategy is employed by Burkey and Obeng (2004), Chin and Quddus (2003), and Haque et al. (2010), among others. Generally, the set of control variables includes data on