Red-Light and Speed Cameras: Analyzing the Equity and Efficacy of Chicago's Automated Camera Enforcement Program

Executive Summary

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EXECUTIVE SUMMARY

01 INTRODUCTION

We are at a watershed moment in which public concern for roadway safety intersects with public scrutiny of municipal fines and fees.[1] This is evident in the unprecedented alliance between the national Vision Zero Network, principally concerned with improving road safety and eliminating traffic fatalities, and the Fines and Fees Justice Center, a national advocacy organization that aims to eliminate unjust monetary sanctions and punitive practices for all manner of infractions and code violations because they distort the justice system, thwart regulatory compliance, and disproportionately harm poor people, particularly communities of color.

Prior studies of red-light and speed camera enforcement are generally positive. Despite some ambiguous findings, the evidence suggests that roadways are typically safer once cameras are installed. The overall number of collisions is reduced as well as the severity of vehicular injuries.[2] Despite the safety profile of traffic cameras, as of July 2021, 11 states prohibited the use of either red-light cameras, speed cameras, or both.[3] At the local level, red-light camera use declined from 533 municipalities in 2012 to 345 by 2020.[4] Generally speaking, public sentiment is more favorable toward speed cameras, however, the rate of implementation has declined or speed camera use is restricted to specific zones. For example, Pennsylvania allows speed enforcement cameras in work zones on the Pennsylvania Turnpike, interstates, and federal aid highways in the state.[5] Increasingly, the constitutionality of automated enforcement laws are being challenged. Jurisdictions that abandon camera enforcement programs cite dubious efficacy of automated enforcement, challenges enforcing violations, the expense of maintaining the program, and, most frequently, community opposition to inadequate transparency in the system.[6]

Numerous studies examine racially disparate impacts of municipal ticketing and the regressivity of monetary sanctions.[7] They typically exclude camera enforcement technologies although automated enforcement cameras typically yield the largest volume of tickets annually. Automated traffic enforcement has attracted unlikely support from advocates of police reform. Proponents contend that cameras offer a race-neutral alternative to police enforcement of traffic infractions, emphasizing dual concerns of racially disproportionate stops and the risk of violent encounters with police particularly for Black drivers.[8] Though automation may provide apparent advantages to agent enforcement, they may not eliminate racial and economic inequities. The volume of automated tickets issued, the spatial location of cameras, and the structure of fines, fees and forfeitures may in fact reinforce racial and economic inequities.

The purpose of this study is to analyze the City of Chicago's automated red-light and speed camera enforcement program (2016-2019) given the dual concerns of traffic camera effectiveness for improving roadway safety and social equity impacts.

This study contributes to the Chicago Department of Transportation's (CDOT) effort to routinely evaluate the efficacy, functionality and city policies pertaining to the red-light and speed cameras, known as the City of Chicago Automated Enforcement Program. One portion of this study analyzes roadway safety attributable to traffic cameras, specifically, the incidence and severity of crashes at more than 100 speed cameras across the city. The other portion of this study focuses on critical equity concerns by analyzing the social and spatial distribution of camera tickets and economic impacts of camera-ticket fines and fees for communities. Findings from the speed camera-level safety analysis, as well as the camera-level and neighborhood-level of ticket distribution, and the community economic burden of fines and fees inform our recommendations to the City of Chicago Mayor's Office and City Departments responsible for administering automated enforcement policies, monitoring camera effectiveness, and structuring penalties.

02 DATA & APPROACH

This study draws on red-light and speed camera tickets issued to Chicago drivers between 2016 and 2019 obtained from the Chicago Department of Finance. We focus on 438 cameras (289 red-light cameras and 149 speed cameras) operational throughout the study period. These cameras issued approximately 5.7 million citations, over 4.8 million of these records were geocoded to vehicle registration addresses in the state of Illinois. We focus on roughly 2.7 million red-light and speeding tickets issued to Chicago residents, which corresponds to 1.1 million vehicles registered to Chicago addresses.[9] We excluded from the analysis 14,000 red-light and speed camera tickets issued vehicles registered to forty institutions across the city, such as police stations, public facilities, airports, and car dealerships.

To assess the distributional effects of Chicago's red-light and speed camera tickets fines and fees, we spatially joined the red-light and speed camera violations dataset to Chicago census tract shapefiles, along with demographic and socioeconomic data from the U.S. Census, American Community Survey 5-year estimates (2015-2019), employment data from the Longitudinal Employer-Household Dynamics dataset, ride-hailing trip data, and other data sources.

We use linear regression models to explain the number of red-light and speed camera tickets household receive per year. We also use linear probability models to determine the likelihood that drivers receive more than one ticket and the probability of paying a ticket once drivers receive multiple tickets or accrue penalties. Additionally, we ran hazard models to estimate time to pay a ticket, controlling for salient neighborhood characteristics.

To assess absolute and relative economic burden of ticket fines and fees across the city we parse monetized tickets into total payment per tract, total fines paid, total fees paid, and citywide aggregate payments.

The *absolute economic burden* is the share of tract-level aggregate household income that goes to camera ticket fines and fees. Across the city, *absolute burden* by tract ranges from .024 to 1.49, with a mean =.368 and standard deviation = .239. 1sd ($\mu \pm \sigma$): (.368 + .239) to (.368 - .239) or .607 to .129. In other words, households spent, on average, .36% on camera ticket fines and fees over the study period. Census tracts with a burden score >.607, one standard deviation above the mean, allocated a significantly large share of aggregate household income to pay camera-ticket fines and fees. Conversely, census tracts with a burden score < .129, one standard deviation below the mean, are not considered economically burdened by camera ticket fines and fees as they paid significantly lower than the city average.

To estimate *relative income burden*, we compute tract-level aggregate payments as a share of income, (or absolute burden) relative to citywide aggregate payments and aggregate income. We would expect the amount that any neighborhood pays toward ticket fines and fees to approximate citywide allocation. Generally, scores >1.0 are considered economically burdened, meaning they paid a larger share of household income toward ticket fines and fees. Conversely, scores <1.0 were not burdened by camera ticket fines and fees. However, given the wide dispersion in the relative economic burden, one standard deviation above the mean [1sd ($\mu + \sigma$)] is used to identify areas of significant burden.

To examine safety impacts of Chicago's speed cameras, we obtained road crash data and road density data from the Illinois Department of Transportation (IDOT). We use the Empirical Bayes (EB) method to analyze 101 speed camera instrumented locations. Changes in the count of crash incidents within 250 meters on either side of the camera on instrumented roads over a three-year period are used as a basis for evaluating safety. The analysis uses a before-after approach and estimates safety on the basis of comparing the after-period crash counts against what would have happened if cameras were not installed at the treated sites. Since most speed cameras in Chicago were installed in 2013 and 2014, the 2010-2012 period is taken as the before treatment period and the 2015-2017 period is used as the post treatment period to evaluate safety.

We have organized our recommendations to align with our three primary research questions. First, the current location of red-light and speed camera and attendant factors that may contribute to heightened exposure to cameras for proximate Chicago residents. The second set of recommendations addresses the regressive structure of ticket fines and fees found to unduly burden low-income residents, who are disproportionately Black and Latino. Our third set of recommendations are derived from the safety profile of speed cameras which shows a net positive safety impact but is not consistent across camera locations.[10]

03 KEY FINDINGS

a) Spatial and Social Distribution of Tickets

We examine rates of ticketing per household at the census tract level as well as rates of ticketing per vehicle at the camera level for both red-light and speed cameras. Each is summarized below:

The spatial distribution of tickets per household shows predominantly Black and Latino areas receive a higher number of tickets per household as compared to other parts of the city. Rates of ticketing can depend on exposure to cameras, travel patterns of residents and amount of travel, infrastructure and built environment factors, and household structure. However, not all these variables are readily observable at the census tract level. Our analysis examines the rate of ticketing experienced in neighborhoods, or census tracts, per household while controlling for camera exposure; type of camera to which drivers are exposed; road density and other built environment factors; accessibility to essential amenities such as groceries stores; various household and socio-demographic characteristics (e.g., jobs per household, proportion with children, race and median income); and the number of rideshare trips by driver residence. Active rideshare drivers are likely more exposed to cameras.

Tickets per household increase as the number of nearby cameras increases.
We find that majority Black census tracts have the highest rates of tickets per household, followed by majority Latino census tracts as compared to majority White or other tracts. The number of cameras in close proximity to majority Black or majority Latino neighborhoods is not significantly greater than other neighborhoods. As we explain below, ticketing depends not only on the number of cameras but also on the built environment and other variables near the cameras.

Ticketing levels are highest among red-light cameras located within 350 feet of freeways. As a camera's distance from a freeway increases, tickets issued after controlling for traffic volume declines. It is important to note that red-light cameras within 350 feet of freeways comprise approximately 13% of all cameras city wide and issue 31% of all red-light tickets. Cameras within 350 feet of freeways account for 21% of the cameras in majority Black neighborhoods.

The number of red-light tickets issued declines as road density near the camera increases. Conversely, ticketing increases with crime levels proximate to cameras.

Speeding tickets issued per vehicle is lower in majority Latino neighborhoods relative to other areas. Unlike red-light cameras, speed cameras only operate in safety zones and when the school or park is open. School safety zone speed cameras comprise 41% of the speed cameras city wide and issue 20% of the speed camera tickets. In majority Latino areas, school safety zone cameras comprise 71% of the speed cameras. Because school safety zone cameras operate fewer hours than park cameras, it is expected that rates of ticketing at the camera level would be lower in such areas.

b) Economic Impact of Paid Ticket Fines and Fees

We investigate the distribution of camera-ticket fines and fees to assess disparate economic burdens across Chicago neighborhoods and households.

Ticket fines and fees do not affect drivers equally. The absolute economic burden associated with camera tickets is disproportionately borne by low-income Black and Latino residents. Over four years, more than 1% of annual aggregate household income is going to paying camera ticket fines and fees in some areas of the city. Economic burden follows a stark racial pattern, even after accounting for household income and number of tickets issued.

Residents in low-income neighborhoods are paying a higher share of ticket fees relative to their income but also relative to the number of tickets received. Black, Latino and low-income residents pay a disproportionate share of both fines and fees relative to income. Fees alone are particularly harmful for low-income residents. Low-income residents incurred fees on 46% of all tickets received compared to just 17% for upper-income residents. For tickets that were paid, fees incurred declined substantially to 34% for low-income residents and declined marginally for upper-income residents to 16%.

Residents in majority Black and low–income neighborhoods have a much higher likelihood of accruing fees on a ticket and a much lower likelihood of paying a ticket, once they have accumulated fees or more than one ticket. People who resided in majority Black neighborhoods and low–income neighborhoods have a higher probability of getting >1 ticket over the 4-year period.

c) Speed Camera Safety Analysis

Speeding was a factor in over a quarter of crash fatalities annually in the U.S. from 2009 to 2018. We evaluate the safety impact of 101 speed-camera locations, from 2015-2017, by examining changes in the incidence of injury and fatal crashes within 250 meters of the cameras. The period from 2010-2012 is used to estimate the safety profile at camera locations before cameras were installed.

The deployment of cameras reduced the expected number of fatal and severe injury crashes by 15%. It reduced moderate injury crashes by 9% and minor injury crashes by 14%. These reductions translate into 36 fewer fatal and severe-injury crashes, 68 fewer moderate-injury crashes, and 100 fewer minor-injury crashes. Overall, injury and fatal crashes fell by 12% (204 fewer crashes) when compared to what would have been expected in the absence of cameras.

The camera-level safety analysis identifies camera locations where crash records were significantly improved, unaffected, or worsened. About 70% of the 101 sites had an estimated positive safety improvement. There was little relationship between the number of tickets issued and the safety impact of cameras.

While on aggregate the cameras are improving roadway safety, the City can enhance overall effectiveness by reviewing camera locations where safety improvements were not made or where the crash record has worsened. More transparency on the models used to rank safety zones and on follow-up speed studies that lead to camera installation would also be useful to ensure that public safety is enhanced by installed cameras.

04 RECOMMENDATION SUMMARY

Regarding Camera Locations

- Analyze red-light cameras proximate to freeways. Particularly examine the types of movements generating tickets in these locations and set fines to reflect severity/risk of harm from movement.
- Examine processes that led to differences in the choice to install school or park safety zone speed cameras given the apparent differences in majority Latino vs other areas across Chicago.

Regarding Fines and Fees

- Reduce base fines commensurate with risk of harm.
- Introduce late fee caps, stop doubling of fines as penalty for late payment.
- Implement a statute of limitations for non-payment.
- Scale fines and fees by ability to pay.
- Scale fines and fees based on number of infractions.
- Introduce a graduated pricing structure for red-light violations, comparable to speed violations.

Regarding Safety Impacts

- Reevaluate methodology for camera placement, make the process transparent.
- Justify placement of cameras with local speed study.
- Reassess camera locations that are not improving safety outcomes or where worsening crash records have been observed.
- Decommission or relocate cameras when not found effective.

Endnotes

[1] We define Fines and Fees as separate dimensions of monetary sanctions. A Fine is the fixed monetary charge as sociated with a red-light or speeding infraction determined by an automated enforcement camera, which is currently $100 for red-light camera violations and either $35 or $100 for speeding camera violations, determined based on the

driving speed above regulation. Whereas Fees are monetary penalties added to Fines. They may include late or unpaid ticket fees, vehicle immobilization or boot fees, towing and impoundment fees. In this analysis, Fees do not include indirect costs that drivers with numerous unpaid tickets might incur such as license suspension, attorney fees, bankruptcy, and employment disruption.

[2] Pilkington, P. and S. Kinra, Effectiveness of speed cameras in preventing road traffic collisions and related casualties: systematic review. Vol. 330, No. 7487, 2005, pp. 331–24334. Li, H., D. J. Graham, and A. Majumdar, The impacts of speed cameras on road accidents: An application of propensity score matching methods. Accident Analysis & Prevention, Vol. 60, 2013, pp. 148–157. Mountain, L., W. Hirst, and M. Maher, Costing lives or saving lives: a detailed evaluation12of the impact of speed cameras. Traffic, Engineering and Control, Vol. 45, No. 8, 2004,13pp. 280–287.146. Hess, S., Analysis of the effects of speed limit enforcement cameras: Differentiation by road type and catchment area. Transportation research record, Vol. 1865, No. 1, 2004, pp.1628–34.177. Elvik, R., Effects on accidents of automatic speed enforcement in Norway. Transportation Research Record, Vol. 1595, No. 1, 1997, pp. 14–19.198. Thomas, L. J., R. Srinivasan, L. E. Decina, and L. Staplin, Safety effects of automated speed enforcement programs: critical review of international literature. Transportation 21Research Record, Vol. 2078, No. 1, 2008, pp. 117–126.229. Gains, A., B. Heydecker, J. Shrewsbury, and S. Robertson, The national safety camera programme-three year evaluation report, 2004. Wong, Timothy. (2014) "Lights, camera, legal action! The effectiveness of red-light cameras on collisions in Los Angeles." Transportation Research Part A: Policy and Practice, 69: 165-182; Gallagher, J. and Fisher P. (2017) "Criminal Deterrence when there are Offsetting Risks: Traffic Cameras, Vehicular Accidents, and Public Safety." Vehicular Accidents, and Public Safety (November 17)

[3] Maine, Mississippi, New Hampshire, South Carolina, Texas and West Virginia prohibit both red-light and speed cameras. Montana and South Dakota prohibit red-light cameras, and New Jersey and Wisconsin do not allow speed cameras. Nevada prohibits the use of cameras unless operated by an officer or installed in a law enforcement vehicle or facility. National Conference of State Legislatures, Automated Enforcement Overview, https://www.ncsl.org/research/transportation/automated-enforcement-overview.aspx

[4] Insurance Institute for Highway Safety https://www.iihs.org/topics/red-light-running; automated enforcement cameras

[5] National Conference of State Legislatures, Automated Enforcement Overview, https://www.ncsl.org/research/transportation/automated-enforcement-overview.aspx

[6] Lee R. Wickert (June 19, 2019) The Red Light Traffic Camera Controversy https://www.mwl-law.com/the-red-light-traffic-camera-controversy/

[7] Barajas, J. (2020) "Biking While Black: How Planning Contributes to Unjust Policing," TREC Friday Seminar Series. 194. https://archives.pdx.edu/ds/psu/33270; Brazil, N. (2018), "The Unequal Spatial Distribution of City Government Fines: The Case of Parking Tickets in Los Angeles." Urban Review; Chicago Metropolitan Agency for Planning (April 2021) Improving equity in transportation fees, fines, and fares Findings and recommendations for northeastern Illinois; Pattillo, M. and Kirk, G. (2020) Pay Unto Caesar: Breaches of Justice in the Monetary Sanctions Regime. UCLA Criminal Justice Law Review, 4(1), 49–77; Sanchez, M. (2018) ProPublica Illinois and WBEZ Driven into Debt series; The Chicago Fines, Fees & Access Collaborative; Woodstock Institute (June 2018) The Debt Spiral: How Chicago's Vehicle Ticketing Practices Unfairly Burden Low-Income and Minority Communities.

[8] Vera Institute (August 2021) Investing in Evidence-Based Alternatives to Policing: Non-Police Responses to Traffic Safety https://www.vera.org/downloads/publications/alternatives-to-policing-traffic-enforcement-fact-sheet.pdf; Justin Fox. One tool to cut racism in policing: Traffic cameras. Bloomberg Opinion, July 2020.

[9] We use notice number and address to approximate a unique identifier for vehicles

[10] Our analysis of the safety impacts only examines speed cameras. A 2017 study examined the safety impact of red-light cameras. See: Mahmassani, H. S., Schofer, J. L., Johnson, B. L., Verbas, O., Elfar, A., Mittal, A., & Ostojic, M. (2017). Chicago Red-light Camera Enforcement.