The Effect of Red-Light Cameras on Vehicle Collisions in Fort Worth

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Abstract

Texas enacted a ban on red-light cameras in 2019. This study investigates the effect of removing red-light cameras in Fort Worth by examining the rate of total collisions. The location of crash sites and the intersections in our study will be mapped using ArcGIS Pro to compare the frequency and density of these crashes. Analysis between treatment and control sites will determine the impact of removing cameras on collision rates.

Background

Red-light cameras were designed to deter drivers from running red traffic lights and causing vehicle collisions. They allow law enforcement to safely monitor intersections without being resource-intensive or physically engaging. Prior to 2019, Texas installed and utilized these cameras before Governor Abbott signed a law to 'outlaw cameras that take pictures of vehicles that enter intersections while the traffic signal is red.' The main reasoning behind the ban cited a study that found drivers were more likely to cause rear-end collisions from sudden braking to avoid red-light camera fines. This study argues that red-light cameras do not reduce the rate of collisions at intersections, but rather change the type of collision.

Objective

To quantify the impact of removing red-light cameras on the rate of total intersection collisions in Fort Worth through a comparative analysis of treatment and control groups.

Data/Methodology

Collision Frequency Data:

TxDOT Crash Records Information System (2015-2023)

Red-Light Camera Intersections Data:

TxDOT Red-light Camera Post Activation Annual Report (2019)

Non Red-Light Camera Intersection Data:

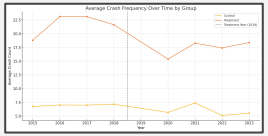
Used the Collision Frequency Data to locate Non Red-Light Camera intersections

Data Organization

1. Geocoded intersection names from the Post Activation Report using the 'Geocode Addresses' tool in ArcGIS
2. Used the Buffer tool in ARCGIS to create a 100-yard buffer around intersection points. Calculated annual crash frequency within each intersection buffer.
3. Calculated the annual average of collisions before and after the ban (sum of annual collisions / 4 years).
4. Calculated the mean change for each intersection by subtracting the mean before the ban from the mean after.

Paired T-test Analysis

Performed this test once on each group in our study. Used to compare the means before and after the ban within their respective groups.



Difference in Differences (DiD) Analysis

Conducted to compare the difference in means before and after the ban between the control and treatment sites. This tells us how the treatment group changed compared to the control group.

Results/Discussion

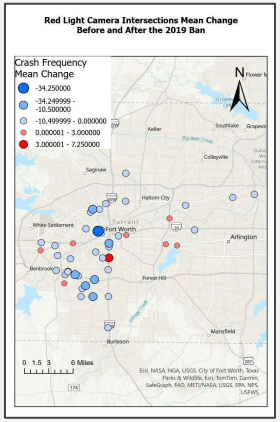


Figure 1. Crash frequency of treatment group intersections.

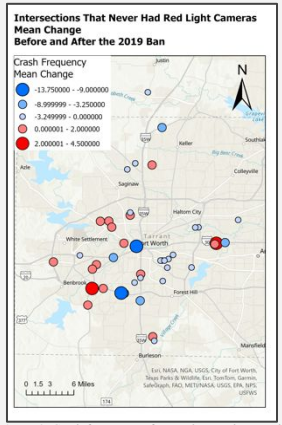


Figure 2. Crash frequency of control group intersections.

Group	Before Mean	After Mean	Change	DiD Estimate
Treatment	21.67	17.36	-4.31	-3.25
Control	6.99	5.93	-1.06	

Figure 3. Difference in Difference estimation between treatment and control.

1. Sites within the treatment group saw a significant decrease ($P < .01$) in vehicle collisions overall. The group had a significant quantity of blue, representing a negative frequency value that decreased after 2019 (fig 1). This is consistent with the T-test results, which highlighted a significant change between collision rates before and after camera removal.
2. Conversely, the control group had a larger quantity of red points, representing a positive frequency value that increased after 2019 (fig 2). However, the T-test results contradict the visual, showing a significant change after the ban. More intersections saw an increase in collisions, but the average was skewed by negative outliers, causing an overall decrease in collisions.
3. While both variables saw reduced collisions, treatment intersections had a more significant change compared to the control. The collision rate decreased by an estimated effect of 3.25 crashes (fig 3).

Conclusion

After the ban, crash rates declined significantly in the treatment group with the control group showing a weaker and less statistically significant reduction than the treatment group. Citywide crash rates also fell after the ban. This suggests that red-light cameras may not be as essential for public safety as commonly believed. This study highlights the complexity of red-light camera effectiveness and emphasizes the need for data-driven evaluations before implementing any traffic control program.