Traffic Cameras Fail To Prevent Moral Hazard

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Abstract

Traffic Cameras were installed at several traffic intersections in Chapel Hill North Carolina in 2003 in an attempt to reduce red light running violations. Motivations for the camera installation included reducing the costs of as well as the number of injuries and deaths from red light running-related accidents. Even if the installation of the cameras cut such accidents in half, the installation and operation of the cameras vastly outweighs the sum of increased citation revenues and the reduction in injury and death-related costs. Red light running-related accidents increased dramatically during the period the cameras were in place; their presence alone appears to encourage more accidents due to fears of "getting caught." Further, the cameras alter cultural norms of law enforcement and due process while privileging a private interest to make decisions about community legal matters. More importantly, reduced penalties and costs associated with the cameras reduces the deterrence power of the cameras even if enforcement is perfect; revision of the contract between society and driver before society can estimate driver effort in response to the new system is ill-advised. Systems put in place to prevent moral hazard must be based both on sufficient due diligence and on metrics defined and gathered before implementation so that goals can be defined and progress can be measured. Increasing supervision is justified in the context of a contract between a principal and an agent only if evidence suggests that the current social contract is suboptimal. A contract between individual and society based on society's increased knowledge of an individual's effort should revised only after the individual has had time to revise his/her effort in light of the increased supervision.

Introduction

Controversy hit Chapel Hill, North Carolina, when cameras designed to help enforce red lights were installed at three traffic light intersections. The cameras, part of a comprehensive traffic system that takes pictures of cars driving through red lights and issues citations to the offending drivers, were taken down after a number of complaints only after four months of operation.

The motivations behind installing the camera system seemed straightforward at the outset: drivers who run red lights cause needless accidents leading to injury or death, and those accidents cost the residents of Chapel Hill a great deal of money. An electronic system, proponents claimed, would do a better job of enforcing the rules than the police force, and would therefore make the three intersections safer.

From 09 October 2003, the first day the camera-based system was enabled, until 31 December, the red light enforcement system placed at three of the town's red lights issued 401 citations. The town previously averaged 300 citations per year for all 40-odd red lights in the town (approximately 40 in number). The number of citations issued, then,

> 83 days/365.25 days per year * 300 citations per year * 3 traffic lights/40 = 5 citations
> (number of citations likely to have been issued at three lights before cameras during the same period of time)

effectively increased nearly 80-fold.

If accidents can be prevented by an increase in light enforcement, then we should expect to see some decrease in the number of accidents caused by red light running.

Discussion

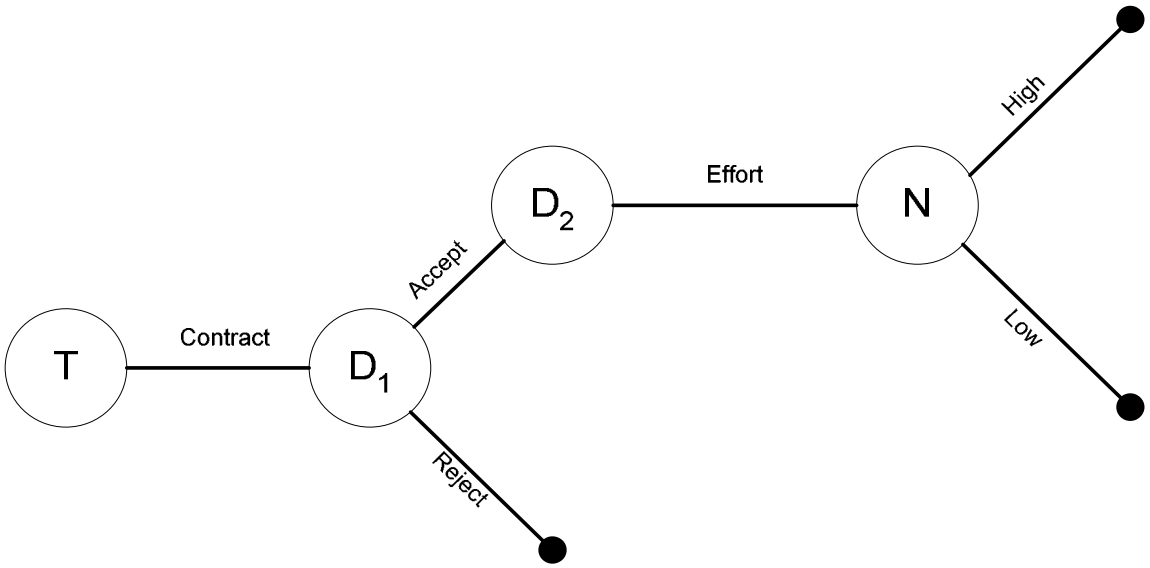
Red light violation-based accidents predominately involve "t-bone" accidents: when the front end of one car hits the side of another. Read-end accidents make up a smaller but significant proportion of red light accidents, caused either when a driver in front of another one slams on his/her breaks in order to prevent a red light violation, when a driver behind another one incorrectly judges the car in front to accelerate through the light, or when a car "hung" at a light waiting to make a left turn completes the turn just before traffic comes across the intersection. A very rough but reasonable estimate of the proportion of t-bone to rear-end is 3 or 4 to 1.

The total number of accidents at the intersections during the surveillance period is unavailable. The total number of rear end accidents, however, before and during the surveillance period are known for two of the three monitored intersections (Airport Road and US Hwy 15-501, and Airport Road and Estes Road). Based on the NC-DOT information previously published at the now-defunct safelight.townofchapelhill.org website (http://safelight.townofchapelhill.org), 48 rear-end accidents occurred in the five years leading up to Dec. 31, 2002 at the two intersections. During the 83 day period with the cameras, the number of rear-end accidents climbed to 19.

Even if we assume that 5 times more t-bone accidents have occurred during the 5 years leading up to 2003 at the two intersection, and even if we make the assumption that the camera system perfectly prevented all t-bone accidents during the period of operation, the number of accidents at the intersections appear to have increased.

> 48 rear-end * 5 = inflated estimate of t-bone accidents, 1998-2003 = 240
> 240/5 years = 48 t-bone accidents per year
> expected t-bone accidents in 83 days, assuming no cameras = 83/365.25 * 48 = 11
> expected total accidents = 11 t-bones + 5 other types = 16 total accidents
> actual accidents, rear-end only: 19

We may be served to begin understanding the problem at hand by using the game theoretic concept of moral hazard with hidden action. Rasmusen defines moral hazard with hidden actions in the following way: an agent ("informed player") and a principal ("uninformed player") begin with complete information and agree to a contract; agent then takes action hidden from principal, after some state of nature intervenes, a payoff for the principal is produced. Translating this into the terminology of the present problem, the Town of Chapel Hill and a driver start out with complete information; the drivers license comes with a number of agreements between driver and state. After accepting the contract by virtue of receipt of a drivers license takes some action with regard to red traffic lights and obeys them as measured by effort; a state of nature intervenes on a driver's effort and if the driver either is caught running a red light or causes an accident by driving through a red light, the Town either receives funds from the citation or bears the financial burden of the accident See Figure 1 below for an illustration.



Contract: Cost of violating red light

Effort: Driver running a red light

Figure 1 - Moral Hazard With Hidden Action[1]

We expect that in a moral hazard with hidden action game that the principal's (town) improved ability to estimate effort of the agents (drivers) as a result of the information provided by traffic cameras.

We may be assisted in understanding the concept of moral hazard with hidden action and any increase on surveillance by the following:

> Principal-agent models of hierarchical control[2,3] emphasize the coercive elements of supervision as the means for inducing subordinate compliance. In this view, supervisors extract work from subordinates by rewarding good workers, i.e., those who comply with the supervisor's preferences, and punishing inadequate performers.[4] The principal's job is to anticipate the rational responses of agents and to design a set of incentives such that the agents and it in their own interest (given the incentive system) to take the best possible set of actions (from the principal's perspective). These models assume that the principal's ability to induce compliance is constrained by asymmetric information regarding the agent's effort (moral hazard) or ability (adverse selection).[5]

The town should therefore be less constrained in formulating the right contract after introduction of the camera system given that information asymmetry is reduced by the cameras. That is to say, a revised contract as a result of introducing the cameras *should* be more optimal than the previous contract because the town knows more, much more, about the effort of the driver.

We are confronted with two crucial questions in light of the principal-agent model of moral hazard with hidden action. The first is, was the first contract actually suboptimal to begin with? If it were suboptimal, then it would merit a change in the system, in the contract, a change towards greater optimization that only could be made after enough information about effort was produced by the camera enforcement system. Some common sense needs to be at work; the degree of change in the current system should be in proportion to the degree to which the current contract is suboptimal. Another way to ask this question is to use hindsight and ask whether the observed outcome of the original model (before cameras) was somehow bad, at least bad enough to merit policy change. If the contract was already optimal, then there was no reason to change the contract. The second question is, if the contract is indeed suboptimal, is the new contract in the context of the new system more optimal than the previous one?

Beginning with the latter question: the original contract between the town and its drivers stipulated that each violation was a criminal offense. A local newspaper contained a brief description of the penalties:

> Mayor Kevin Foy, who cast the final vote to end the program, spoke harshly about what he sees as the system's flaws. "This system creates perverse incentives," Foy said, pointing out that a red light camera violation amounts to a civil offense and a $50 fine, whereas a ticket for running a red light at any of the town's other intersections is a criminal offense and costs nearly $120 in both the ticket and court costs. For every $50 ticket generated by the camera system, $48 goes to the multi-billion dollar Dallas-based company ACS; $2 goes to the town.[6]

The driver was subject to a visit to court but maintained the right of due process. If convicted the driver faced criminal penalties and costs associated with the criminal conviction including possible jail time and a $120 fine. The town agreed to enforce the law with human beings who would make judgments that gave a minimum of 1 second leeway (written into the law as “by feet not inches”) plus made exceptions for extenuating circumstances. The requirement for human agency on the enforcement end of the contract implied that the town would not always be there to catch offenders but would make its own effort as best as possible.

The new contract was radically different from the old. After just 0.3 seconds in the red zone a driver was assessed a penalty. It appears that this penalty assessment is perfect (in practice the camera succeeded in getting a readable image 36% of the time). No extenuating circumstances were taken into account when violations were issued, but the offense was dropped from a criminal one to a civil one. The fine was also dropped to $50. No court appearance would be necessary.

Given that people knew about the cameras, under the new system they made a significantly greater effort to avoid breaking the law at all costs. Drivers assumed that every time they broke the law they would be assessed a violation and face paying the $50 fine. Their effort needed to reflect the fact that they believed they could no longer “get away with anything.” Sufficient effort to avoid violations under the new method required They were 80 times more likely to get caught but drivers possibly perceived their chances to be as high as (80/.36 =) 220 times higher than before the cameras.

Let us assume that the total cost in dollars of a criminal violation was approximately $400: in addition to the $120 fine, wages were lost due to a visit in court; risk of jail time times the cost of jail time added to the total. If we are to assume that $400 is the current cost, then the right price range for the new contract would be between $400/220 and $400/80, or roughly between $2 and $5, an order of magnitude smaller than the $50 fine. It appears that given the cameras the new contract was indeed suboptimal.

Back to the first of the two questions about the contract between a driver and the town: was the first contract actually suboptimal to begin with? Was the state of affairs bad enough to convince town officials that improvements could, should, and would be made?

The "grassroots" organization run by a large DC PR firm that fronts for ACS, the subsidiary of Lockheed Martin that makes the camera systems, regularly cites the following statistics as reason for needing their system: 800 people in the US die and 200,000 more are injured each year in red light running-related accidents, and those accidents cost us billions upon billions of dollars.

How do those figures translate down to a Chapel Hill scale?

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rate of red-light-running-related deaths
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800 deaths per year @ red lights and 40,000 accident deaths overall across US
800/40000 = 8/400 = 2% of all traffic fatalities caused by red light running

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# of red light running fatalities per year in Chapel Hill

# of fatalities in north carolina = 1575
1575 * rate of deaths by red light running = 32 across the entire state

$$\frac{32 * \#\text{ of chapel hill drivers}}{\#\text{ of nc drivers}} = \frac{32 * 35000}{5{,}800{,}000} = 0.2 \text{ deaths per year}$$

# of injuries per year, Chapel Hill

# of injuries per year, US
# of injuries per year @ red lights, per year 178,000
# of injuries per year, north carolina

$$\frac{178{,}000 \text{ injuries in red light accidents in US}}{3{,}000{,}000 \text{ total injuries in US each year}} = 7\% \text{ of all injuries}$$

$$\text{number of injuries per driver} = \frac{3 \text{ million injuries}}{200 \text{ million drivers}} = 1.5\%$$

1.5% * 7% = rate of injuries per driver due to red light accidents

rate * number of chapel hill drivers = 0.105% * 35,000 = projected 37 red light-related injuries per year in Chapel Hill

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Cost of red light injuries & deaths to Chapel Hill per year

NC cost of deaths & injuries per year = $8.270 billion cost across NC
http://www.nhtsa.dot.gov/STSI/State_Info.cfm?Year=2002&State=NC&Accessible=0

$8.27 billion * 2% = $165 million (cost to NC in deaths per year from red light running)

total cost of deaths & injuries per year in chapel hill due to red light running

$165,000,000 * 35,000
---------- = $1 million per year ($5,000,000 every 5 years)
5,800,000

Chapel Hillians bear approximately 9% of this cost per year or $90,000
(http://www.nhtsa.dot.gov/people/economic/econimpact2000/tech_doc.htm)

It appears there wasn't much of a problem to begin with. The loose projections of 0.2 deaths and 37 injuries every year in Chapel Hill (estimates that very close to the true mark) are caused by traffic light violations that come at a cost of approximately $90,000 to Chapel Hill taxpayers. Chapel Hill is home to one of the largest hospitals in the state that handles 30,000 patient admissions per year; it has 50,000 residents, where thousands of whom move away, move in, are born, or die every year. At less than $2 per person the cost to each Chapel Hillian is less than a Happy Meal in Mexico City. The statistics quotes as compelling reaons, when placed into the context of Chapel Hill, do not seem to reflect some crisis of safety in the Chapel Hill community.

Conclusion

The traffic cameras never needed to be installed in the first place. Sufficient due diligence would have shown that the cameras would not work if they required changing the entire nature of the contract between the town and its citizens.

The increase in accidents resulting from the new red light enforcement system was likely the result of a new contract less optimal than the last, a new contract that was too harsh and led drivers to make too much effort to comply with traffic signals.

If the cameras are to be put in place in a place that does need them, the new contract between a municipality and its drivers that comes with the cameras should be loosened even more than it is. The cost of the penalty could be reduced even further, or the camera timings could be adjusted in a more reasonable way. It might help if the judgment of the camera system approximated the discretion of a police officer as best as possible. Penalty timers should be highly dynamic; for example, the timers should become less "hardline" in rainy weather where slamming on one's brakes to stop at a red, and maybe more strict than usual; during certain times of the day or days of the week. The cameras should be run by the town itself so as to ensure that conflicts of interest do not violate the trust required for maintenance of the contract between the driver and society.

Further, the loosening of penalties need to be communicated to the public. The only form of communication for most drivers through Chapel Hill is visual: they see the cameras and they adjust their effort as a result of their very appearance. Reliable and convincing evidence would have to be provided to residents so that they know the lights are not so "Big Brother." Ultimately, I predict that cameras will serve to reduce accidents only if the original contract, the drivers license contract, requires a shared understanding at the time the drivers license is issued. An imperfect contract to prevent moral hazard can't work if the terms are changed and no one knows about the changes. Such a shared understanding requires implementation and standards in practices at the state level before a camera is introduced in any of its municipalities.

References

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