Do Traffic Tickets Increase Road Safety? Evidence From Two New Sources *

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Abstract

One role of police officers is to increase road safety. Police officers can administer traffic citations in hopes that they will deter speeding and reduce reckless driving on the road. This article uses two sets of data for Florida counties to ascertain whether police officers can increase public safety by writing traffic tickets. In contrast to previous studies, only some evidence is found to support this hypothesis; Monthly crash data for Florida counties during the years 2010-2011 finds a statistically and economically significant effect of tickets on crashes. However, the annual data comprised of Florida counties spanning the years 1999-2010 provides no evidence to suggest traffic tickets increase road safety.

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1 Introduction

In 2011, 34,677 deaths occurred due to motor vehicle accidents. (Center for Disease Control Table 2, 2011) Police officers serve citizens in their role as public officials, and it is their duty to serve and protect. They prevent crime, seize illegal narcotics, and promote public safety, all of which serve their roles as public officials. Of particular interest, one role police officers serve is to increase public safety on the road. This is evident by campaigns such as click it or ticket, which serve to promote public safety by educating citizens on the benefits of wearing seat belts.

Traffic citations are also administered in order to increase public safety on the road. Police officers administer traffic tickets in an attempt to deter reckless driving practices by citizens. Thus, traffic citations are given to drivers who break the law while driving motor vehicles. This paper tests the hypothesis that police officers can effectively increase road safety by administering traffic tickets.

Banning certain practices while driving may yield some benefits. Abouk & Adams (2013) find that making texting while driving subject to fines is associated with a reduction in traffic crashes in the short run, but it has little benefits in the long term. The authors suggest drivers merely react to announcements of bans on texting while driving such that driving behavior changes, but it only changes temporarily.

Regulation may also exert a reduction in traffic crashes. Carpenter &

Stehr (2008) find that traffic fatalities and injuries were significantly reduced due to mandatory seat belt laws, and Dee et al. (2005) suggest that graduated license restrictions among teenagers are associated with a reduction in traffic fatalities among 15 to 17 year old drivers by 5.6%. On the other hand, Levitt (2008) finds that replacing child safety seats with seat belts would not result in reductions in traffic fatalities among 2 to 6 year old children.

There is some recent evidence that police officers can increase safety on the road. Lee (2011) uses the click-it-or-ticket campaign to isolate an increase in police officers and finds that traffic tickets reduce motor vehicle accidents, especially for female drivers and during the night. However, no evidence is found to suggest that police officers can successfully reduce traffic fatalities in the study.

Peltzman (1975) finds mandating seat belts actually has the perverse effect of increasing traffic crashes. This "Peltzman effect" suggests that making roads safer with devices such as seat belts and air bags invokes drivers to take more risks when driving which neutralizes any safety benefits from mandating seat belts. While drivers may not be any worse off, pedestrians appear to be placed in more danger. Similarly, this Peltzman effect may apply to traffic tickets given by police officers. If citizens feel that the roads are made any safer by police officers, they may take risks they otherwise would not choose.

Estimating the effects of ticketing practices on traffic crashes is subject to reverse causality similar to estimating the effect of police on crime. **?**

uses electoral cycles and Levitt (2002) updates his study to use firefighting expenditures as instruments to control for the fact that police may reduce crime, but increases in crime may cause more police to be hired. The relationship between traffic tickets and traffic crashes is also likely endogenous for very similar reasons; traffic tickets may reduce motor vehicle crashes, but a city or county with increases in traffic crashes may employ more police or allocate their efforts more towards road safety. Taking this endogenous relationship into account, Makowsky & Stratmann (2011) use a two stage least squares (2SLS) specification that utilizes fiscal revenues for the county as an instrument and provides evidence to suggest that traffic tickets reduce motor vehicle crashes and fatalities.

Both Makowsky & Stratmann (2011) and Lee (2011) use Massachusetts data on monthly traffic crashes and tickets. This study complements the literature by looking at the efficacy of traffic tickets in more detail. More specifically, this study uses two sets of data to provide additional evidence towards the efficacy of traffic tickets in road safety. The first source of data is very similar in structure to the recent literature because it uses monthly, county level data during a two year span from 2010 to 2011. However, the second source of data spans over a much longer time frame. It analyzes the relationship between traffic tickets and traffic crashes in a 12 year span from 1999 to 2010 using Florida county level data. The goal of this chapter is to analyze the robustness of the previous results using one set of data that is similar and another that is different.

This chapter proceeds as follows: Section II describes both sources of data, Section III tests the hypothesis that traffic tickets increase road safety, Section IV reports the results, and Section V discusses the importance of the findings and draws a conclusion of the literature.

2 Background & Data

2.1 Background

Traffic citations are administered by police officers in response to violations of traffic law. One of the most common traffic citations is due to speeding or exceeding the posted speed limit, usually by at least five miles per hour.

An interesting note is that the ticket distribution in Table 1 follows a step-wise punishment system, which targets marginal benefits and marginal costs of illegal behavior. It serves as an additional deterrent to speeding too excessively because violators are fined by larger amounts the more they speed. This is likely to be more effective than a binary punishment system where all speeds in excess of the posted limit are subject to the same fine and punishment. These fines have been established by Florida law since 1998 for all jurisdictions in the State of Florida. Prior to 1998, the categories of 1-5 mph and 6-9 mph were lumped into a $25 fine.

Other common traffic violations include failure to wear seat belts, running through a red traffic light or stop sign, reckless driving, improper license tags and registration, and inoperative vehicle parts, among many others. Police officers have a duty to enforce these laws by either writing a traffic citation in response to these violations or giving a warning.

Using an expected utility approach, Becker (1968) finds that risk averse individuals are deterred from crimes to a greater degree due to increases in punishment from fines rather than a greater probability of punishment. This finding has a similar application for traffic behavior. Rational individuals are expected to respond to traffic tickets by driving more safely if they feel they are more likely to get caught breaking a traffic violation or if fines are increased. Therefore, one public policy strategy to increase road safety is to employ more police officers in traffic enforcement. These law enforcement officers are expected to write more traffic tickets which is expected to increase road safety by reducing motor vehicle crashes and fatalities. This study addresses the topic of the efficacy of traffic enforcement using two sources of data comprised of Florida counties.

2.2 Data

This chapter uses two unique sources of data to test the hypothesis that traffic tickets increase public safety by reducing traffic crashes. The first source is comprised of annual crash data for the 67 Florida counties during the 12 years from 1999-2010. Crash statistics and traffic data are gathered from the Florida Department of Highway and Safety Motor Vehicles (FLHSMV), and they are collected for a county i during a given year t. Economic data such as the unemployment rate is gathered from the Bureau of Labor Statistics (BLS). Median income and demographic data including the percentage of the male population, population ages 15 to 24, population density, and general population are found from the United States Census Bureau's "USA Counties" report. Police officer data are found from the Federal Bureau of Investigation's (FBI) full time employment Table 80 data. The data on highway mileage are found from the FLHSMV's Public Road Mileage and daily miles traveled form. This variable is computed as the ratio of interstate, freeway, and turnpike daily miles as a percentage of total daily miles traveled. All variables utilized in this data are collected annually. In contrast, the second data source gathers some variables in annual and monthly form.

The second source of data is comprised of monthly crash statistics for the 67 Florida counties during the months in the years 2010 and 2011 for a total of 24 months. These data are also gathered from the FLHSMV. Traffic tickets issued by local police officers are used in all specifications for both data sets in order to maintain consistency with the empirical specifications that control for the likelihood that the relationship between traffic tickets and traffic crashes is endogenous; traffic tickets may reduce traffic crashes, but areas with more traffic crashes may employ additional police officers to focus their efforts on traffic safety. Because only tickets administered by local police officers are analyzed, only 61 of the 67 counties are included in the analysis. The direction of causality very likely runs in both directions. These data are summarized in Table 2 below. Data on gender and age for the year 2011 is provided by the U.S. Census' Current Estimates Data, and they are collected annually.

3 Empirical Model

The hypothesis that traffic tickets can effectively reduce traffic crashes and increase road safety is testable, and the base regressions follow the linear regression model, Ordinary Least Squares (OLS):

$$C_{it} = \alpha + \beta T_{it} + X_{it}^{'}\Gamma + \lambda_i + \theta_t + u_{it}, \tag{1}$$

for county i in time t where time is either month or year depending on the data used. T is the number of per capita traffic tickets written by local police officers in a given time period. As previously mentioned, traffic tickets are the amount written by local police officers in order to incorporate the fiscal relationship between traffic tickets and revenue changes (Makowsky & Stratmann, 2011). $\mathbf{X_{it}}'$ is a vector of controls which may influence traffic crashes. These covariates include: the population density, percentage male, the unemployment rate, median income, the percentage of the population between ages 15 and 24, and highway mileage. λ_i is the county fixed effect which controls for idiosyncrasies between counties, and θ_t controls for month and year effects such as seasonal and business cycles which may influence results.

In order to control for the possibility that β is biased due to the endogenous relationship between traffic tickets and traffic crashes, an additional reduce form equation is modeled:

$$T_{it} = \Pi \Delta R_{it} + \epsilon_{it}, \tag{2}$$

where R is the change in revenues from the previous year and ϵ is the error term. The population density is a proxy for urban areas, and it takes into consideration the impact of crowded traffic conditions on motor vehicle crashes. Rowe (2008) finds discretion based on gender in ticketing practices; men are more likely to be ticketed than women. If traffic tickets can increase road safety, this may reduce traffic crashes for the male population. However, it is more likely there is a positive relationship between the percentage of a population that is male and traffic crashes, which supports the rates charged by the motor vehicle insurance industry. Similarly, young drivers are more likely to be involved in traffic crashes due to their inexperience in driving, which is also supported by insurance rates. Economic conditions such as the unemployment rate may adversely effect traffic crashes (Ruhm, 2000; Boudreaux, 2013). The road system may also influence traffic crashes. Counties comprised of more highway miles as a percentage of total miles are expected to have less traffic crashes.

4 Results

As previously mentioned, β is likely to be biased under OLS in equation (1). This is due to the likely endogenous relationship between traffic crashes and traffic tickets. Traffic tickets are hypothesized to reduce traffic crashes, but it is also possible that areas with more traffic crashes may hire additional police officers to assist in traffic enforcement. Therefore, following the work of Makowsky & Stratmann (2011), changes in revenues are used as an instrument to correct for this reverse causality issue. Theory suggests that changes in revenue will influence traffic tickets. Garrett & Wagner (2009) find evidence to suggest that traffic tickets are administered more heavily following declines in local government revenue. In contrast, there is little reason to expect that traffic crashes are related to fiscal conditions.

Table 3 presents the first stage results from the instrumental variable (IV) estimates for both sets of data. The first point to notice is that the instrument, Δ *Revenue per capita*, is only statistically valid for the monthly data from 2010-2011; Staiger & Stock (1997) suggest the following rule of thumb: In the case when there is only one instrument, the instrument is considered to be weak if the first-stage F-statistic is less than ten. The first stage F-statistic reported in Table 3 suggests the instrument, the percentage change in revenue, is not weak under this definition because its value of 18.07 exceeds the threshold of 10. However, the same instrument is not robust to the alternative annual data for the 12 years from 1999-2010. The first-stage F-statistic is only 0.43, which suggest that the instrument is weak. Moreover, there is no statistical evidence that traffic tickets can effectively reduce traffic crashes under the annual data specifications. Other variations of revenue changes were tested for their validity as a relevant instrument, but none of those combinations yielded a large enough F-statistic to render them anything other than a weak instrument.

Interestingly enough, none of the covariates that are statistically significant across data sets maintain the same sign; both the unemployment rate and the percentage of the population that is male report a negative and statistically significant relationship with traffic tickets per capita for the data during the years 1999 through 2010. However, both of these variables switch sign and report a positive and statistically significant relationship with traffic tickets per capita for the monthly data in 2010 and 2011. The other covariates are equally fragile between the two sets of data. Overall, this suggests that the findings from previous literature may be contingent on the data sources. This is explored more in Tables 4 and 5.

The second stage regression results are reported in Table 4, and these estimates use the monthly data from 2010 and 2011. Similar to a previous finding (Makowsky & Stratmann, 2011), Pooled OLS and IV estimates that exclude individual fixed effects report a positive and statistically significant relationship between local traffic tickets and crashes per capita. This relationship flips signs and becomes negative and retains statistical significance after the idiosyncratic errors are taken into consideration. Monthly fixed effects are taken into consideration in all specifications because both the quantity and quality of driving may vary depending on the season or time of year. An F-test for the joint significance of month fixed effects supports the inclusion of these variables. Moreover, the inverse relationship between traffic tickets and crashes in the IV estimate with fixed effects is also statistically valid as the instrument in Table 2 is appropriate. The same cannot be said for this relationship for the data from 1999 to 2010.

While there is some evidence that traffic tickets reduce crashes using monthly data in Table 4, annual data for the 12 years between 1999 and 2010 does not support this finding. This data is reported in Table 5 below. At first glance, it appears the data confirms previous results from the other data source due to the positive and statistically significant relationship between traffic tickets and crashes per capita. However, controlling for the endogenous relationship and unobserved heterogeneity does not reveal the statistically significant and inverse relationship between traffic tickets and crashes per capita from the other data source and previous findings (Makowsky & Stratmann, 2011; Lee, 2011).

One explanation is that these findings in the literature are highly contingent on the data. Both Makowsky & Stratmann (2011) and Lee (2011) use monthly data for a short duration of time, and the 2010 through 2011 data supports these findings in Table 4. In contrast, data in a longer time series from 1999 through 2010 do not support these findings.

Even if traffic tickets are shown to have a statistically significant relationship, the magnitude of the effects have yet to be discussed. The marginal effects from the instrumental variable model in Table 4 suggest that an increase in one traffic ticket per capita results in a decrease of about three traffic crashes per 100 residents per month. For instance, the average population in Florida's 67 counties during 2010 and 2011 was 281,000 or about the size of Leon County. Therefore, an increase in traffic tickets equal to the population of 281,000 would result in a reduction of 8400 crashes per month. To state this effect differently, an increase of 33 traffic tickets would be associated with a reduction of one crash per month. Therefore, there is some evidence that individuals may respond to an increase in the presence of law enforcement in traffic safety.

Median income exhibits a statistically significant and inverse relationship with traffic crashes. To the extent that traffic tickets increase road safety, this finding may suggest that road safety is a normal good. Recent literature suggests that fatalities from motor vehicle crashes are inversely related to the unemployment rate (Ruhm, 2000; Boudreaux, 2013). This result is found in the pooled OLS and IV estimates, but it is not robust to the specification that controls for the idiosyncratic error. The percentage of a population that is male has a positive and statistically relationship with traffic crashes in the fixed effects model. This supports the vehicle insurance industry's practice of discriminating insurance rates based on gender.

5 Conclusion

Traffic safety is a major concern with nearly 35,000 fatalities resulting from motor vehicle accidents annually. Recent literature has found that law enforcement is a viable tool for enforcing road safety. Makowsky & Stratmann

(2011) find that traffic tickets successfully reduce traffic crashes, injuries, and to a lesser extent fatalities. Lee (2011) uses the click-it-or-ticket campaigns as a natural experiment and also finds that traffic tickets reduce traffic crashes. However, both of these studies use the same data. These studies focus on the efficacy of traffic enforcement in Massachusetts over the span of two years using monthly data. In order for a general conclusion to be drawn, these results must be able to be replicated with other data using similar and different techniques.

This study contributes to the literature by estimating the impact of traffic enforcement on traffic safety using two different sources of data. First, I use data in a form similar to the previous literature with Massachusetts data, but its sample is comprised of monthly data for Florida counties during the years 2010 to 2011. The appropriate identification technique which controls for both the endogenous relationship between traffic tickets and traffic crashes and the unobserved heterogeneity found in panel data provides some evidence that traffic tickets can effectively reduce motor vehicle crashes. This is an important finding because this result supports the previous literature (Makowsky & Stratmann, 2011; Lee, 2011).

The second source of data spans a much greater length of time. It is comprised of Florida counties during the 12 years from 1999 to 2010, and it uses annual crash and ticket data. In contrast to the above finding and literature, the results from this empirical estimation do not support the previous literature. In part, this is due to a weak instrument which finds no relationship between traffic tickets administered by local police officers and revenues by the local government. The lack of a finding here fails to support the previous study by Garrett & Wagner (2009). However, various attempts were made to find a strong instrument to support the identification strategy, and none of these instruments supported the hypothesis that traffic tickets can reduce motor vehicle crashes. Future analyses should ascertain the fragility of these results to various instruments and data in order to provide a more complete picture of traffic enforcement. This is an important step to analyze the public policy implications of traffic tickets. Because of scarcity, police officers have significant opportunity costs when focusing on one activity. More research needs to be completed in order to isolate the relative efficacy of traffic enforcement.

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Table 1: Ticket Fines for Speeding

For speed exceeding the limit by:	Fine:
1-5 mph	Warning
6-9 mph	$25
10-14 mph	$100
15-19 mph	$150
20-29 mph	$175
30 mph and above	$250

Table 2: Descriptive Statistics

Monthly Data (2010-2011)	count	mean	min	max
Crashes	1608	364	0	6844
Local Tickets	1464	30332	45	713625
Unemployment rate	1608	11	6	19
% Male	1608	52	48	65
% Pop 15-24	1608	13	3	28
Police Officers	1584	321	9	3024
Highway Miles	1608	0	0	1
Density	1608	336	10	3355
Annual Data (1999-2010)	**count**	**mean**	**min**	**max**
Crashes	804	3669	36	54519
Local Tickets	724	29974	26	968164
Unemployment	804	5.56	2.1	15.1
% Male	804	50.94	47.37	64.67
% Pop 15-24	804	12.88	5.35	33.91
Police Officers	779	298	7	3158
Highway Miles	804	0.17	0	0.73
Density	804	310.25	0	4058

Table 3: First Stage IV (1999-2010 & 2010-2011)

	Tickets	
	1999-2010	2010-2011
Unemployment Rate	-0.002***	0.001**
	(0.00)	(0.0004)
% Male	-0.00**	0.0004***
	(0.00)	(0.00004)
% Pop 15-24	-0.002	-0.002
	(0.00)	(0.001)
Highway Miles	-0.000	-0.011*
	(0.02)	(0.006)
Police per capita	-0.486	4.68***
	(1.13)	(1.53)
Density	0.00001	-0.0001***
	(0.00001)	(0.00)
Median Income ‡	-0.000001	
	(0.0002)	
ΔRevenue capita	-0.023	0.000002***
	(0.034)	(0.000001)
F-Test of Excluded Instruments	0.43	18.07***
N	700	1416

White's standard errors in parenthesis.

Instrument = Δ Revenue per capita

$^{*}p < .10, ^{**}p < .05, ^{***}p < .01$

Table 4: Do Traffic Tickets Increase Public Safety? 2010-2011

	OLS	OLS	IV	IV
Local Tickets	0.00***	-0.0064	0.00**	-0.027**
	(0.00)	(0.001)	(0.00)	(0.013)
Unemployment rate	-0.00***	-0.0004**	-0.00***	-0.00001
	(0.00)	(0.0001)	(0.00)	(0.00001)
% Male	-0.00***	-0.0009**	-0.00***	0.000001
	(0.00)	(0.0004)	(0.00)	(0.000008)
% Pop 15-24	0.00***	0.00009**	0.00***	0.00002
	(0.00)	(0.00002)	(0.00)	(0.0001)
Police officers	0.12***	-0.142	0.14***	0.007
	(0.12)	(0.12)	(0.02)	(0.093)
Highway Miles	0.00***	0.0002	0.00***	0.0001
	(0.00)	(0.0003)	(0.00)	(0.001)
Density	0.00***	-0.000002	0.00***	-0.000003
	(0.00)	(0.000003)	(0.00)	(0.000002)
County FE?	No	Yes	No	Yes
N	1508	1416	1416	1416

Month Fixed Effects Included in All Models and are jointly statistically significant. Correction for Endogeneity, Instrument = Δ Revenue per capita. $^{*}p < .10,^{**} p < .05,^{***} p < .01$

Table 5: Do Traffic Tickets Increase Public Safety? 1999-2010.

	Crashes		
	OLS	IV	IV
Local Tickets	0.01***	0.01	-0.10
	(0.00)	(0.04)	(1.79)
Unemployment Rate	-0.00***	-0.00**	-0.00
	(0.00)	(0.00)	(0.00)
% Male	-0.00**	-0.00**	0.01***
	(0.00)	(0.00)	(0.00)
% Pop 15-24	0.00***	0.00*	0.00
	(0.00)	(0.00)	(0.00)
Highway Miles	0.01***	0.01***	-0.11*
	(0.00)	(0.00)	(0.01)
Police per capita	1.14***	1.05	0.30
	(0.22)	(1.22)	(0.24)
Density	0.00**	0.00	0.00*
	(0.00)	(0.00)	(0.00)
Median Income ‡	-0.00**	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)
County FE?	No	No	Yes

White's standard errors in parenthesis.

Correction for Endogeneity, Instrument = Δ Revenue per capita

$^{*}p < .10, ^{**}p < .05, ^{***}p < .01$