

An Econometric Analysis of Parking Citation Payment in Eugene, Oregon

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Abstract: Since July of 2006, the City of Eugene has received payment of only 85.2 percent of issued parking citations, resulting in a substantial loss of potential revenue each year. Using data on every parking citation issued by the City of Eugene over this period, we use probit analysis to estimate the determinants of whether or not parking citations get paid. Based on our analysis, we suggest changes in parking policy with the objective of increasing the rate of citation payment and thereby increasing revenue.

1. Introduction

Public parking is a highly demanded yet relatively scarce resource that is depended on by many individuals living in all types of locations, from small towns to large cities. Given high demand coupled with limited supply, municipal governments have often priced parking – through meters, permits, and levying off-street parking – in order to ration the service toward those who are willing and able to pay for it and thereby avoid gross disorder and inefficiency. A necessary accompanying effect of putting a price on parking is that the same municipalities must then police the behavior of the people they serve, who may not comply with the implied usage agreement.

While the fundamental purpose of issuing parking fines may be to better achieve compliance with the regulations, budgetary concerns have resulted in municipalities depending on revenues arising from non-compliance. For example, the City of Eugene collected approximately \$868,051 in revenue from paid fines in 2007, yet in the same year, \$150,464 in potential revenue went uncollected, as this revenue source requires that offending drivers submit payment according to regulations. Even with the threat of

state prosecution, many offenders simply never pay their citations and suffer no repercussions. The failure of complete fine payment enforcement is an inevitable result of the high volume of parking citations issued each day, which makes it extremely difficult for government agencies to follow-up on every offender's citation. However, even if 100 percent of citation payment in practice is impossible, the rate of citation payment – whether it is 70 percent, 85 percent, 99 percent, or any other rate – is fundamentally determined by how various economic and governmental policy incentives influence individuals' decision making.

The purpose of this paper is to analyze and understand what parker attributes determine the rate of payment of citations issued by the City of Eugene, and then subsequently based on our analysis suggest changes in parking policy that we believe will raise the overall rate of citation payment. Understanding what determines the rate of citation payment – and thereby implementing more efficient policy – is an important issue for the City of Eugene, because all unpaid citations represent a substantial loss of potential revenue.

We will analyze data provided to us by Jeff Petry, the Parking Services Manager of the City of Eugene, consisting of a record of every parking citation written by the City of Eugene from July 2006 through February 2010. Using these data, our econometric analysis will provide estimates of the determinants of one's propensity to submit payment, conditional on receiving a citation within the city of Eugene. We will consider the influence of a large set of variables on propensity of fine payment and discuss how to interpret the empirical results we uncover in the data.

In Section 2, we summarize the related literature on the subject in order to provide some additional context for the analysis. In Section 3, we discuss the data to be used in our analysis and provide a descriptive analysis of parking citations in the City of Eugene. In Section 4, we describe our statistical methodology. In Section 5, we describe and discuss our variables, which we then consider empirically in Section 6. In Section 7, we discuss the importance of the “Failure-To-Pay” (FTP) citation category and suggest a change in policy. In concluding remarks, we summarize reasonable actions that could be supported by the empirical analysis we have performed, with the objective of increasing revenue.

2. Literature Review

Broadly speaking, the decision of an individual to pay or not to pay a parking citation is analogous to the decision of whether an individual chooses to commit any crime. For the purposes of this paper this analogy will be well exploited, because while there is limited academic literature concerning specifically what determines the payment of fines, there is an existing literature that focuses on understanding the economic incentives that lead to crime (whether in petty forms such as not paying a parking violation or serious forms such as robbery). While authors may allow that not all crimes are the result of rational cost-benefit calculus by the offender, their theories concerning how economic incentive structures determine many crimes are nevertheless important because they are often validated by the empirically observable phenomena of deterrence.

Below, we survey some articles in the economics of crime that are relevant to our project. These include the seminal paper, Becker (1968), and several studies that extend the initial Becker analysis. We survey a range of articles that validate the Becker (1968) framework in various circumstances, and Saha and Poole (1999), which attempts to rebut the policy prescriptions of Becker (1968) by recognizing the multiple and often competing social objective constraints that enforcement agencies face.

Building on the ideas of famous 18th century philosophers and economists Cesare Beccaria and Jeremy Bentham, Becker (1968) is considered a “pioneering work” and the “first sophisticated economic analysis” of crime (Miceli 2009). While Becker (1968) has an enormous range of important contributions to the area, the most fundamental, important and relevant contribution to our paper of Becker (1968) is that, to a significant degree, crime (including minor violations) can be theoretically modeled in terms of economic incentives. That is, Becker (1968) posits that a person commits an offense if the expected utility of committing the crime is greater than the expected utility of any other opportunity cost.

For analytical convenience, the benefit of committing a crime can be thought of as a monetary equivalent to the utility gained (g), and the cost of committing a crime is the probability of getting caught (p) multiplied by the fine or punishment to be imposed (f). Therefore, in this “rational criminal” model, a crime will be committed if $g > pf$. While this identity may not be reasonable to apply to all types of crimes, the decision of whether or not individuals pay their parking citations seems like an appropriate application because we believe minor “crimes” like not paying a parking fine are

reasonably responsive to the incentives established by p and f . That is, we believe it is reasonable to assume that if there were dramatic changes in parking policy, such as changes in p or f , there would be an observable change in the behavior of parkers. Moreover, a wide body of research in various scenarios has demonstrated that p and f are indeed inversely related with offenses. For example, Smigel (1965) and Ehrlich (1967) demonstrated that seven felonies reported by the Federal Bureau of Investigation exhibit a stable inverse relationship with p and f . Ander (2006) demonstrated that an increase in parking fines, f , lead to a decrease in parking violations at the University of Virginia. Kessler and Levitt (1999) demonstrated that immediately after an increase in criminal sanctions, f , in California the rate of the specifically targeted crimes decreased substantially.

Therefore, throughout our analysis it will be assumed that when individuals choose whether or not to pay their parking citations, a meaningful portion of them respond to policy incentives. For example, if the probability of conviction increased, or if the magnitude of a fine increased, the number of offenses (i.e., the number of non-paid citations) will decrease because the expected disutility of a violation will be greater than the utility of the violation. More broadly than just the variables p and f , Becker (1968) will inform our analysis of all relevant variables – for example, location of city, time of year, type of vehicle, and more – as deriving from the economic theory of individuals responding to incentives and applying cost-benefit considerations when making choices.

Seeking to understand how legal enforcement and social norms influence

parking behavior, Fisman and Miguel (2007) addresses a topic very similar to our investigation and confirms the general crime-decision framework Becker (1968) established. Fisman and Miguel (2007) analyzes the parking behavior of United Nations diplomats across time, given a significant change in parking enforcement policy for United Nations diplomats. Prior to 2002, United Nations diplomats had the privilege of parking-citation immunity, meaning that although they still received tickets for parking infractions, they were completely free of liability to pay the associated fines. In 2002, diplomats were stripped of this immunity and were required to pay citations like all other parkers, under the threat of escalating penalties or the eventual removal of their license plate.

This created a natural experiment in which parking behavior before and after immunity was compared, allowing for an investigation of how a substantial increase in parking citation enforcement level changed citation payment behavior, as well as how the diplomats' home-country social norms involving corruption affected their behavior. After the parking citation policy change, a spectacular 98 percent decline of tickets issued to United Nation diplomats occurred, which confirms the proposition of Becker (1968) that if the probability of enforcement increases, offenses (e.g., nonpayment of fine) will decrease. Also, Fisman and Miguel (2007) found that during the zero-enforcement immunity regime, the corruption (a cultural norm of sorts) in a diplomat's home country was positively correlated with the number of parking citations issued to them, suggesting that social norms are a meaningful determinant of how one might "abuse" parking-citation immunity. Of these two determinants of parking behavior,

Fisman and Miguel (2007) found that the certainty of legal enforcement had a larger effect on parking behavior than the cultural norms of the diplomats' home countries. In terms of our project, the most salient finding of Fisman and Miguel (2007) was that there was a 98 percent decrease in issued tickets when the immunity regime was stopped, which suggests that an increase in enforcement levels can significantly increase individuals' propensity to comply with parking rules.

Saha and Poole (1999) uses a game theoretic structure to determine the optimal levels of fine and probability of enforcement, given various social objectives of the enforcing agency. First, Saha and Poole (1999) consider two extreme and distinct goals of an enforcement agency: 1) to maximize compliance with the law without regard for the agency's revenue; and oppositely, 2) to maximize the agency's revenue without regard for the level of compliance with the law. To single-mindedly maximize compliance with the law, Saha and Poole (1999) argues that an infinitely large fine is the best deterrent of transgression. Oppositely, to single-mindedly maximize agency revenue, Saha and Poole (1999) argues that the probability of enforcement should be maximized, along with a relatively low penalty. With these two extremes established, Saha and Poole (1999) next analyze the more realistic and common goals of a social agency: to maximize the probability of enforcement, while at the same time minimizing the probability of the transgression in the first place. Under these social objectives, Saha and Poole (1999) finds that a higher, "non-maximal" penalty should be leveled. By analyzing these more realistic social objectives of a monitoring agency, the results are contrary to a proposition in Becker (1968) that social welfare always increases with

the increase of the penalty level, even to maximal levels. For our project, the strength of Saha and Poole (1999) lies in its willingness to consider the real-world dual constraints that social objectives impose on an enforcement agency – to minimize transgression while maximizing enforcement probability. Rather than narrowly focusing on one goal, this paper acknowledges the dual and sometimes conflicting constraints imposed on an enforcement agency, and accordingly offers a useful penalty and enforcement strategy.

3. Data and Descriptive Analysis

3.1 Data

Our primary data source includes information about every parking citation issued by the City of Eugene between July 2006 and February 2010. Within each of the 228,890 citations written over this time period, the data set includes the date of the offense, the identity-coded license plate number and state (ensuring complete protection of individuals' privacy), and the make and color of the vehicle. Also, the data provides an identification of the issuing officer, the type of violation, the location of the violation, an identification of the specific meter head (when applicable), and the total fine amount outstanding at the time the data presented to us. Due to several minor issues with the data, we did not use all original observations. We will discuss each source of data alternation below.

We restrict our analysis to tickets issued prior to 2010, as nonpayment is observed at an artificially high rate for those tickets issued in early 2010 because

individuals did not have adequate time to pay their citation when our data was collected. Including these tickets would therefore bias our analysis of propensity to pay. To verify this potential bias that we are trying to avoid, we can consult the historical rate of nonpayment for an indication of a relatively “normal” rate of nonpayment. In the years between 2006 and 2009, the rate of nonpayment was 14.8 percent, but in the year of 2010 the rate of nonpayment “jumped” to 38 percent. This high nonpayment rate in 2010 is consistent with drivers not having had sufficient time to pay their fines, and motivates our decision to delete the 11,226 observations from 2010 from our analysis.

Due to the fact that officers manually entered information on each ticket, we encountered a certain degree of noise and varied written recording that was identifiable and therefore amendable. For example, it was clear that some observations were simple misspellings, or that a vehicle’s model was recorded in place of vehicle make. To fix these problems, we manually renamed any misspecifications that still conveyed the intent. This was a limited process, and we made changes only if they were reasonably clear. As such, we did not rename all misspecifications. Where we could not determine what a written observation was communicating, we did not use that observation for our analysis.

For our econometric analysis, we excluded 3,135 observations where FTP citations were issued. These citations are issued to a vehicle if an officer encounters the vehicle and identifies that the vehicle has a previous fine that has been unpaid over a significant time scale. While these are an interesting type of citation, we cannot

include them in our econometric model because they have essentially no variation in respect to fine payment (98.4 percent have been paid since July 2006) and because other observations are endogenous to them.¹ However, even though we cannot include FTP citations in our econometric model, we will discuss them separately in Section 7 because we believe they could play a role in fulfilling our objective to increase the rate of citation payment and revenue.

Also, due to what appeared to be a data collection error or highly irregular driver behavior, we discarded a relatively small number of observations that did not make logical sense. In these flawed observations, multiple tickets were cited on the same date to the same license plate but different makes of car. We speculate that these observations were the result of simple data entry error, or were the result of a car dealership plate being used on multiple cars. Given the relatively small number of observations in which this occurred, we felt it would be safest to delete these anomalies from our data set. After these minor data modifications, we ultimately run our econometric analysis on 204,465 observations from July 2006 through December 2009.

In addition to the above primary data source, we employed several secondary sources. From the Bureau of Labor Statistics, we obtained monthly unemployment rates for the Eugene/Springfield area and the consumer price index of an “average US city.” From the historical weather cite weatherunderground.com, we obtained daily data on the weather conditions at the Eugene Airport. From the City of Eugene’s publicly

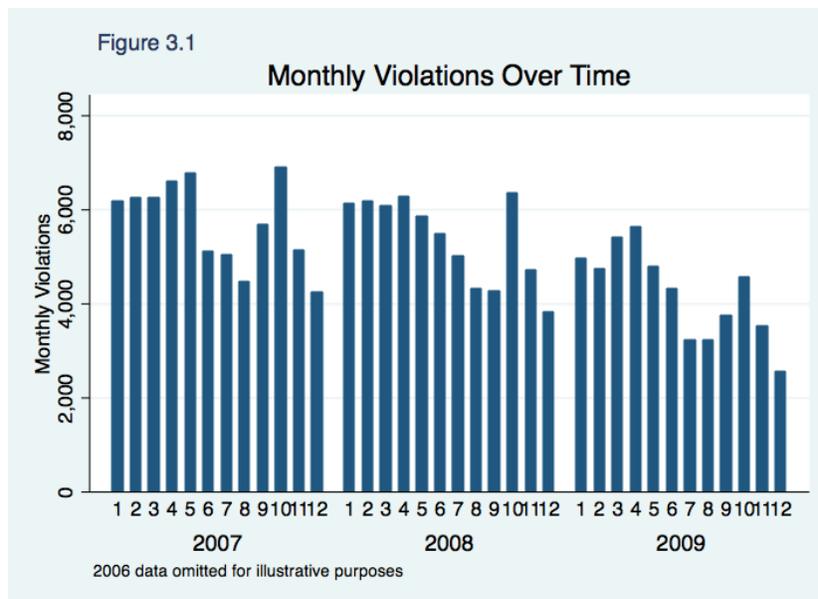
¹ That is, when a FTP citation is issued, it usually results in a previously unpaid citation to be also paid. Therefore, all FTP citations are directly correlated with another (unknowable to us) observation, which violates regression assumptions that the independent variables are exogenous.

available administrative orders, we obtained information about fine and meter prices. From the University of Oregon’s Officer of the Registrar we obtained information about student enrollment by term, and from the University of Oregon’s Department of Public Safety we obtained information about the price of meters and parking permits on campus.

3.2 Descriptive Analysis

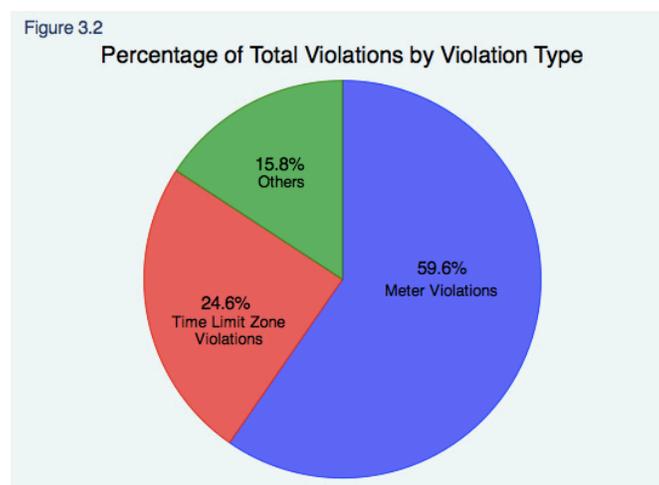
In order to provide a general orientation to broad trends and facts about Eugene parking citations, we will survey some descriptive statistics. While our actual analysis section will go into deeper detail, this section is designed only to give a general feel for the makeup of parking citations in Eugene from July 2006 through December 2009.

The average number of citations per month is 5,395, but, as is shown below in Figure 3.1, there is significant monthly variation.



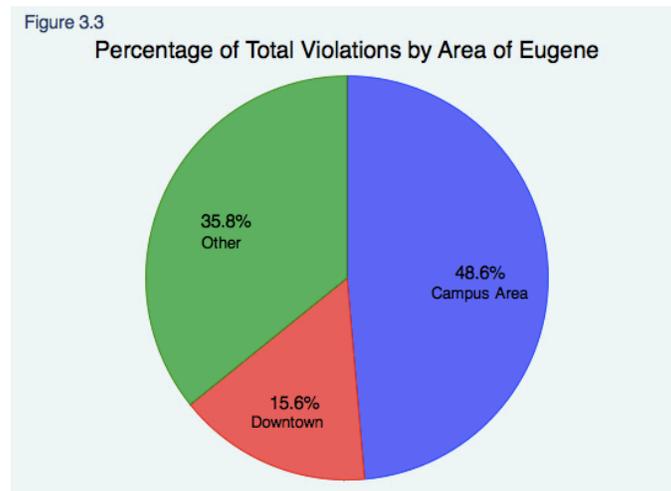
This illustrates a repeating trend of high levels of parking citations during the winter and spring, a drop during the summer, high levels again during the fall, and a reduced level during the holidays, which suggests correlation with the University of Oregon school year. Also noteworthy, there is a general downward trend from 2007 to 2009, which may be explained due to the current recession causing heightened City budget constraints and decreased economic activity.

In the City of Eugene over our adjusted timeframe there were 217,664 parking citations issued. Of these citations, two types of infractions were much more prevalent than others. Together, meter citations (129,800) and time limit zone citations (53,510) accounted for 84.2 percent of citations. Meter citations are issued when a car is parked at an unpaid meter, which can be found throughout the city. Time limit zone citations are issued when a car is parked in a free parking zone – such as the neighborhood immediately to the west of the University of Oregon – for longer than the permitted time. In addition to meter and time-limit citations, the City of Eugene issues 52 other types of parking citations, which totaled 34,353 citations and accounted for the remaining 15.8 percent of citations issued over our time frame. Figure 3.2 illustrates this breakdown.



In addition to understanding how the different types of infractions comprise the total number citations in Eugene, it is important to have an idea of where the citations were written. Eugene is a relatively large city that spans roughly 40.5 square miles, and two of its focal points are the University of Oregon and the downtown area. Using Eugene’s official parking district definition, we will define the university area as approximately the area inside Ferry Street on the West, Broadway Boulevard on the North, Fairmount Boulevard on the East, and 24th Avenue on the South. While there is no official “downtown” parking district, we used our best judgment and defined downtown as the area inside 5th Avenue on the North, High Street on the East, 13th Avenue on the South, and Lawrence Street on the West (see Appendix B for maps).

Parking tickets are written throughout the entire city, but a large proportion and high concentration of them occur downtown and in the university area. The percentage of citations written in each area is displayed below in Figure 3.3.



This shows that the campus area has the most significant citation activity in Eugene. Together, downtown (.32 square miles) and the campus area (1.06 square miles) have a total size of just 1.38 square miles, while the remainder of the city has an

area of approximately 39 square miles. In terms of citations per square miles, the campus area and the downtown area are similar, while elsewhere in Eugene is much lower.²

The City of Eugene has an escalating mechanism for prosecuting those who fail to pay their fine. First, the original fine price automatically doubles after 30 days of delinquency. Next, if an officer encounters a vehicle with a long-term outstanding citation, the officer can issue a FTP citation which, depending on the quantity or severity of previously unpaid citations, range from \$30 to \$75. If the individual still does not pay, an officer can administer an immobilizing steel “boot” that can be placed on a vehicle’s tire. Nevertheless, due to the fact that approximately 200 citations are issued everyday, it is inevitable that some percentage of parking citations remain permanently unpaid. By year, the percentage of citations that were never paid were:

Table 3.1: Statistics on Fine Payment

Year	Percent of Citations Unpaid	Unpaid Citations	Paid Citations
2006 (July – Dec)	14.0%	4,742	29,042
2007	13.8%	9,438	59,200
2008	14.5%	9,278	55,255
2009	17.4%	8,831	41,878
Overall	14.8%	32,289	185,375

Over our time period, between 14 and 17 percent of parking citations were never paid in Eugene each year, implying an average of roughly 85 percent of citations being paid.

² The number of citations written per square mile per year in downtown is 29,973, in campus is 28,521, and elsewhere in Eugene is 569.

Below in Table 3.2, we illustrate how much revenue has remained uncollected by the City of Eugene at the original fine price, before it doubled due to delinquency.³

Year	Revenue lost to unpaid citations	Average fine per unpaid citation	Unpaid citations
2006 (July - Dec)	\$68,712	\$14.49	4,742
2007	\$150,442	\$15.94	9,438
2008	\$135,366	\$14.59	9,278
2009	\$127,696	\$14.46	8,831
Total	\$482,216		
Yearly Average	\$138,347		

This shows that on average, Eugene foregoes at least \$138,000 in citation revenue each year, excluding the additional revenue from fines doubling after 30 days of delinquency.

Given the significant amount of revenue being uncollected each year, an analysis of the determinants of whether or not individuals pay their fines is valuable. In our analysis section, we will look at how various attributes affect propensity of fine payment and thereby affect revenue. We will then use our findings to strategize ways in which Eugene could better use parking policy and allocate resources to increase the rate of fine payment and thereby capture previously lost revenue.

³ Another approach is to show how much money is currently owed to Eugene, but we will not outline “total dollars owed” here because it accounts for the doubling of delinquent fines that will likely never get paid in the future (See Table 1 in Appendix A for amount of money currently owed to the City of Eugene from parking citations).

4. Methodology

The purpose of our analysis is to understand how various variables correlate with individuals' decisions to pay or not to pay parking citations. Given the discrete variable we are attempting to explain – whether or not the fine was paid – probit analysis is the appropriate econometric methodology. With a binominal dependent variable, the standard Ordinary Least Squares method is not appropriate because it may estimate coefficients on the independent variables in such a way that suggests the dependent variable is greater than one or less than zero, which is by definition impossible. Probit analysis is specifically designed for models with a binominal dependent variable, and enforces that any predictions based on the model are bound between zero and one by scaling down the effects of independent variables when their estimated influence on the dependent variable puts the probability of success close to zero or one.⁴

When analyzing a probit regression, the estimated coefficient on each of the independent variables represents the variable's marginal effect on a standard normal cumulative distribution function of the probabilities of "success" the dependant variable. Therefore, the coefficients are in terms of a z-distribution. For example, if the estimated coefficient on an independent variable is 0.15, that indicates that for each additional unit of that variable, the z-score of the dependent variable's "success" is 0.15 higher. The coefficients do not directly indicate probability, and are only directly useful for

⁴ There are two similar options that are available for models with binomial dependent variables: probit and logit methodologies. Indirectly, probit charts probability that some behavior (e.g. payment or nonpayment of fine) is a "success" or "failure" (i.e., a "1" or a "0") over a cumulative distribution function using a standard normal distribution, while the logit model uses a logistic distribution. We choose to use probit, and after checking we can confirm that all of our results are qualitatively robust to logit specifications as well.

determining the direction of correlation and for significance testing. However, it is possible to indirectly derive the predicted probability associated with an independent variable, which is more useful and intuitive than discussing changes in z-distributions.

Using a table of standard normal distribution, the change in the predicted probability of the dependent variable being affirmative (i.e., the fine was paid) given a change in an independent variable can be attained. While we will report the estimated coefficients of our model, we will discuss them in terms of predicted probability, with all other variables in the model set equal to their mean values. This isolates the predicted probability associated with each variable.

At this point we will introduce our basic model, for citation i in month t :

Equation 4.1

$$\Pr(\text{FinePaid}_{it} = 1) = \Phi(\beta_1 + \beta_2\text{distant_plate}_{it} + \beta_3\text{campus}_{it} + \beta_4\text{downtown}_{it} + \beta_5\text{fine}_{it} + \beta_6\text{finals}_{it} + \beta_7\text{football}_{it} + \beta_8\text{officers_day}_{it} + \beta_9X_{it} + \varepsilon_{it})$$

Note that Φ indicates that the model is over a standard normal cumulative distribution function, the variable X_{it} denotes the inclusion of control variables, and ε_{it} denotes the disturbance term corrected for month-level clustering. In the next section, we will define each variable and discuss the potential relationships they may have with the propensity for drivers to submit payment for fines acquired. Also, note that this is just the “basic” model, which will be manipulated during our analysis section, such as by taking the square of a variable to look for a non-linear relationship.

5. Variable Descriptions

This section will describe the meaning, source, assumptions, and, if applicable, suggest potential relationships that variables may have with propensity to pay. We will discuss our dependent variable, fine payment, in Section 5.1, and we will discuss our independent variables in Section 5.2.

5.1 Dependent Variable: Fine Paid

Our dependent variable fine payment is a dummy variable, where “1” signifies that the offender paid their fine in full and “0” signifies the offender has not paid their fine in full. Our data do not contain information about the date of citation payment, so we cannot give any insight about how long it takes individuals to pay their citations. Regardless of the duration of the outstanding ticket, what is most relevant to the City of Eugene is whether the tickets do or do not get paid eventually. Approximately 15 percent of parking citations have not been paid, resulting in over \$100,000 in lost potential annual revenue (without counting the doubling of fine price after 30 days of delinquency). Based on this, we believe that understanding what determines fine payment is a worthy and important investigation for the City of Eugene.

5.2 Independent Variables

To explain what determines individuals’ decisions to pay or not pay their parking citations, we will analyze a wide range of independent variables. While we are constrained by availability of potentially useful data on characteristics of individual

citation recipients (e.g., income, gender, education level, etc.), we believe that the independent variables detailed below constitute a complete enough model to improve the understanding of the factors that determine fine payment with unbiased estimations. That is, where possible, we have attempted to avoid omitted variable bias by including all variables that could potentially affect parking behavior, so as not to neglect any potential influence of seemingly improbable factors determining payment decisions. Also, it is important to make clear that we are solely estimating the determinants of fine payment, and thus are taking the number of citations as given. A description of each variable follows.

Individual Characteristics

From our primary data source, we constructed dummy variable lists to identify the make, color, and state of license plate of the vehicle that was given a citation. For the license plate, we constructed two groups, “near” and “distant.” The near group includes vehicles with an Oregon, Washington, or California license plate and the distant group includes vehicles with a license plate from any other location. To look for variation of fine payment across makes, we created a dummy variable list of 64 makes.⁵ Also, to control for variation in color of vehicle, we constructed two dummy variable categories. The common color group contains all color types with more than 1,300 observations (beige, black, blue, brown, gold, gray, green, maroon, red, silver and white), and the

⁵ We attempted to systematize the relationship between make and fine payment by constructing a “price of make” variable, based on the average price of all 2010 models within a make. Unfortunately, this construction yielded statistically insignificant results. This is likely due to the fact that we did not have data concerning the year and model of the vehicle that was cited. We ultimately did not include this variable in our model.

uncommon color group contains all color types with less than 1,300 observations (bronze, orange, pink and yellow). The dummy variable lists for make and color categories are included in our control variable X_{it} .

Of these individual characteristics, we suspect the most determinative of fine payment will be the state of license plate. Our expectation is that those in the distant group will have a negative relationship with propensity to pay because those who have a license plate not from Oregon, Washington or California are less likely to reside permanently in Eugene and therefore may perceive a lower likelihood of citation payment prosecution and enforcement, which, in accordance with Becker (1968), should result in a higher number of non-payments.

Area

From our primary data, we created dummy variables that signify if the citation was issued in the University of Oregon “campus area,” the downtown area, or elsewhere. These areas were defined in Section 3.2, and are also located in Appendix B. If these areas are significantly determinative of propensity of fines to be paid, these variables will be instructive to where Eugene should be focusing its parking enforcement resources.

Citation Price

From publicly available administrative orders from the City of Eugene, we obtained data on the fine price of each type of citation. Depending on the type of citation, the least expensive fine the City of Eugene issues is \$10, the median fine is

\$12, and the maximum fine is \$450. The relation between fine price and fine payment is of special interest because it will indicate how individuals respond to prices, which is one of the major enforcement policy tools available.

Number of Officers on Duty per Day

We created a variable that indicates for each day how many officers wrote at least one citation. This variable is included in our model because the number of officers on duty is one of the primary policy options available to the City of Eugene, and if we find there is a relationship between number of officers on duty and fine payment then that will be a key factor in policy suggestions. To see if there is a nonlinear relationship between number of officers on duty and fine payment, we will also include a square of the officers on duty variable.

Finals Week

From publicly available information from the Registrar at the University of Oregon, we obtained the dates of every week when final examinations were administered since 2006. We made a dummy variable that indicates that it was the Sunday, Monday, Tuesday, or Wednesday of any finals week over our time span. We excluded the later portion of the week – Thursday, Friday and Saturday – from the variable to achieve what we believed was the most accurate time frame where student behavior may potentially be altered. This variable is interesting because if there is a significant relationship between finals week and fine payment, Eugene parking officers

could predict future changes in citation payment behavior and adjust enforcement accordingly.

University of Oregon Football Games

Based on publicly available information from the Oregon Athletic Department, we obtained the dates of all Oregon Duck football games played at Autzen Stadium in Eugene since 2006 and we created a dummy variable to signify those days. We suspect that football and propensity to pay will be negatively correlated, because many who attend football games at Autzen stadium are in town temporarily and may therefore perceive that there is not a high probability of enforcement for non-payment of citation. Again, this expectation comports with the theory established in Becker (1968) that the probability of enforcement and offenses (i.e., non-payment) are inversely related. If there is a relationship of a considerable magnitude between football game days and fine payment, Eugene parking officers may want to adjust enforcement accordingly.

Control Variables

In our model specified in Equation 4.1, the variable X_{it} denotes a group of control variables. These variables are included primarily as controls to avoid any potential omitted variable bias, but are not expected to have a significant determinative effect on fine payment. To account for factors associated with time, we included dummy variable lists to indicate the season (based on official season dates), the day of the week of the offense, and an overall trend through our timeframe (which we also squared to detect a

potential nonlinear relationship). We include three groupings of citation types – meter citations, time limit citations, and other citations – to control for variation in fine payment across the most common types of citations. Price controls include the real prices of City of Eugene parking meters, UO parking meters, and UO parking permits over our time span. Demographic controls include UO enrollment by term, Lane Transit District ridership by month, and Lane County vehicle registration by year. Additional control variables include the Eugene/Springfield unemployment rate, the number of parking citations in Eugene per day, and daily weather variables (high and low temperature, and precipitation level).

6. Econometric Analysis and Policy Suggestions

In this section we will use the discrete-choice model probit to run a regression on fine payment to determine the influence of a variety of driver attributes on the propensity to pay citations. In Section 6.1, we will analyze the results of our primary model (which includes all variables outlined in Section 5) in order to investigate potential topics for policy suggestions and to otherwise provide generally useful knowledge about the determinants of propensity of fine payment. Also, we will consider how the estimated results relate to revenue equivalencies. Based on the most policy-actionable and revenue enhancing finding from Section 6.1, in Section 6.2 we outline what we believe are the most salient relationships that officers and policy makers should consider.

6.1 Results and Analysis of the Primary Model

We will demonstrate the results of our primary model, which includes all variables and all controls. That is, for citation i in month t , we estimate

$$\Pr(\text{FinePaid}_{it} = 1) = \Phi(\beta_1 + \beta_2\text{distant_plate}_{it} + \beta_3\text{campus}_{it} + \beta_4\text{downtown}_{it} + \beta_5\text{fine}_{it} + \beta_6\text{finals}_{it} + \beta_7\text{football}_{it} + \beta_8\text{officers_day}_{it} + \beta_9X_{it} + \varepsilon_{it})$$

where Φ indicates that the model is over a standard normal cumulative distribution function, the variable X_{it} denotes the inclusion of control variables, and ε_{it} denotes the disturbance term corrected for month-level clustering. In Table 6.1, we report the estimated probit coefficients for each variable that was significant at better than the five percent level. Again, probit estimates are the marginal change in the z-score over a standard normal cumulative distribution, but in the analyses of the individual variables that follow, we will convert the estimated probit coefficients into predicted probability of fine payment, holding all other variables constant at their mean value. Also, even though they were included in the full regression, the results of the make of vehicle dummy variable list are not in Table 6.1, and will be relegated to their own Table 6.2 to be discussed separately.

Table 6.1: Results of Complete Model

Independent Variable	Estimated Coefficient
All Plates Other Than Oregon, Washington, and California	-0.573*** (0.019)
Campus Area	0.102***

	(0.010)
Uncommon Colors (Bronze, Orange, Pink and Yellow)	-0.083**
	(0.037)
Meter Citation	0.187***
	(0.013)
Time Limit Citation	0.223***
	(0.012)
Fine Price	0.002***
	(0.000)
Winter	0.072***
	(0.015)
Spring	-0.029**
	(0.014)
Summer	-0.044**
	(0.018)
Tuesday	0.066***
	(0.013)
Wednesday	0.075***
	(0.013)
Thursday	0.061***
	(0.012)
Time Trend	-0.007**
	(0.003)
University of Oregon Home Football Game Day	-0.081***
	(0.028)
LTD Ridership (millions)	0.0018***
	(0.000)
Constant	-2.771
	(3.379)
Observations	204,456

Standard errors in parentheses corrected for clustering at the month level. *** 1 percent, ** 5 percent. Also included in model but found insignificant: indicator for the downtown location, officers on duty per day, the day of week Friday, Saturday and Sunday, the finals week variable, the real meter price controls, UO enrollment, Lane County vehicle registration, the weather variables, the number of citations per day, and the unemployment rate.

Excluding non-significant variables and the purely control variables vehicle color and LTD ridership, we will devote the following subsections to interpreting the results of each of the remaining independent variables and discussing their impact on revenue. The purpose of this is twofold: first, to look for a policy-actionable variables that we can expand on in Section 6.2 concerning policy suggestions, and second to generally provide a better understanding of the qualities that determine propensity of fine

payment even if they are not directly policy-actionable. If officers better understand how driver attributes relate to propensity of fine payment there may be potential for an increase in revenue even without policy changes.

State of License Plate

The estimated coefficient on the distant state license plate dummy variable – citations written to those without Oregon, Washington or California plates – is negative and estimated precisely. Holding all other variables in the model constant at their mean, individuals with license plates from outside of the Western states have a predicted probability of 70.0 percent to pay their citations, compared to a predicted probability of those with Western state plates of roughly 86.2 percent. Based on the payment behavior of individuals with distant license plates, we estimate a loss of \$6,811 per year in revenue, compared to the behavior of individuals with plates from Oregon, Washington, or California.⁶ Or put another way, if Eugene officers could have issued the same number of citations, but only cited individuals with Western plates, Eugene would have received an average of \$6,811 per year in additional revenue. In the future, assuming the propensity of fine payment for the groups of plates does not change, this knowledge could earn Eugene thousands of dollars per year. While parking policy cannot be set only to issue citations against individuals with near plates, officers should be aware that individuals with plates from Oregon, Washington, and

⁶ This estimate is found by multiplying the difference of predicted propensity to pay (0.862 - 0.700) by the mean price of fine (\$14.66) and the number of tickets cited to individuals with “distant” plates (10,037), equaling \$23,837. To annualize this number, we divide by the total months in our data (42) and then multiply by the number of months in a year (12), to get \$6,811 per year.

California have a 16.2 percentage points higher predicted probability of fine payment than individuals with other plates. On an individual level, this discrepancy results on average in \$2.38 of more revenue per citation if the fine is given to an individual from the Western states, before any potential doubling of fines due to delinquency.

Make of Vehicle

The dummy variable list of every make in the dataset was included in our full regression above, but we decided to present the results in a separate table simply to avoid cluttering Table 6.1 with the results of 36 different types of makes. Table 6.2 lists only the make dummy variables that were significant at the five percent level, and the make Honda is the omitted dummy variable.

Table 6.2: Results of Make Dummy Variable List, in respect to Honda

Independent Variable	Estimated Coefficient	Independent Variable	Estimated Coefficient	Independent Variable	Estimated Coefficient
Ferrari	-1.967***	Buick	-0.377***	Kia	-0.160***
	-0.676		-0.034		-0.035
Motor Home	-0.891***	Pontiac	-0.362***	Hyundai	-0.152***
	-0.256		-0.029		-0.035
Fiat	-0.835***	Oldsmobile	-0.337***	Audi	-0.143***
	-0.269		-0.042		-0.047
Daewoo	-0.594***	Cadillac	-0.319***	Saab	-0.141**
	-0.168		-0.045		-0.059
Yamaha	-0.549***	Isuzu	-0.297***	Mercury	-0.140***
	-0.18		-0.046		-0.031
Hummer	-0.519***	Dodge	-0.259***	Mazda	-0.137***
	-0.196		-0.021		-0.029
Eagle	-0.445***	Chrysler	-0.240***	Nissan	-0.131***
	-0.126		-0.043		-0.023
Lincoln	-0.444***	Ford	-0.230***	Suzuki	-0.127**
	(0.061)		-0.016		-0.058
Datsun	-0.410***	Chevrolet	-0.208***	Volkswagen	-0.061***
	(0.096)		(0.017)		(0.023)
Kawasaki	-0.407**	Saturn	-0.184***	Toyota	0.048***

Plymouth	(0.182) -0.396*** -0.041	Mitsubishi	(0.039) -0.167*** -0.046	Lexus	-0.015 0.182*** -0.041
Geo	-0.390*** -0.049	Jeep	-0.160*** -0.022	Mini Cooper	0.327*** -0.11
				Observations	204,465
Standard errors in parentheses corrected for clustering at the month level. *** 1 percent, ** 5 percent.					

The list is arranged from lowest to highest of estimated coefficients. The majority of the coefficients are negative, which indicates that individuals who drive the omitted variable, Honda, have among the highest propensity to pay their fines. For an example, we will analyze the behavior of Toyota drivers and Ford drivers because they are similar makes, but have significantly different predicted probabilities of fine payment. When given a citation, the predicted probability of Toyota drivers to pay their citation is 86.4 percent, while the predicted probability of Ford drivers to pay their citation is 80.5 percent. Given this wide disparity, if every ticket that was written to a Ford driver was instead written to a Toyota driver, Eugene would have received \$6,541 more in revenue per year.⁷ While discriminating against certain types of makes is not possible, the general knowledge of what types of makes correspond to different propensities of fine payment could result in gains in revenue in situations where an officer must decide which type of car to issue a citation to first.

⁷ This estimate is found by multiplying the difference of predicted propensity to pay (0.864 - 0.805) by the mean price of fine (\$14.66) and the number of tickets cited to individuals with a Toyota plate (26,467), equaling \$22,892. To annualize this number, we divide by the total months in our data (42) and then multiply by the number of months in a year (12), to get \$6,541 per year.

Campus

The estimated coefficient on the campus area is positive and is statistically significant at better than the one percent level. Holding all other variables in the model constant at their mean, individuals who receive a citation in the campus area are predicted to pay their citations 86.7 percent of the time, 2.3 percentage points higher than individuals who receive citations not on campus. This indicates that over our time frame Eugene has forgone a total of \$41,763 – or \$11,932 per year on average – due to the payment behavior of parking offenders not in the campus area.⁸ Framed another way, this indicates how much more revenue Eugene would have received if individuals in non-campus areas behaved the same as individuals in the campus area.

The fact that the predicted probability of fine payment on campus is 2.3 percentage points higher than elsewhere in the city may suggest that officers should patrol the campus area more than they currently do in order to capitalize on higher returns per ticket. However, it should be noted that in the summer season, the propensity of fines to be paid on campus is lower than elsewhere in Eugene.

Citation Type

The estimated coefficients on meter citations and time limit citations are both positive and significant at better than the one percent level. Even though they are comparable citations (e.g., they are the two most common fines issued with an equal price of \$12) individuals who get a meter citation have a predicted probability of fine

⁸ This is calculated by multiplying the number of fines that occur not in the campus area (110,785) by the average fine off campus (\$16.39) and by the difference in predicted probability to pay between non-campus and campus (0.023).

payment of 87.2 percent, while individuals who get a time limit citation have a predicted probability of fine payment of 89.0 percent. To illustrate this discrepancy in terms of revenue, we estimate that Eugene has forgone \$8,011 in annual revenue due to the payment behavior of individuals who get a meter citation (as compared to the payment behavior of individuals who get time limit citation).⁹ While areas with time limit zones and parking meters must both be policed, this suggests that returns on time limit zones are higher and should be marginally emphasized.

Fine Price

The estimated coefficient of the price of fine variable is positive and is significant at better than the one percent level. Table 6.3 demonstrates the predicted probability of fine payment for each level of fine price.

Fine Price	Predicted Probability of Payment
\$10	85.4%
\$12	85.4%
\$15	85.6%
\$20	85.8%
\$25	85.9%
\$40	86.5%
\$50	86.9%
\$90	88.2%
\$190	91.2%
\$450	96.3%

⁹ This estimate is found by multiplying the difference of predicted propensity to pay (0.89 - 0.872) by the mean price of meter fine (\$12) and the number of tickets cited to individuals with meter violation recipients (129,800), equaling \$28,037, which annualizes to \$8,011.

While this shows that fine price and predicted likelihood of payment is positively related, this should be cautiously interpreted and not be generalized into a blanket assumption that raising citation prices will always increase individuals' propensity to pay. For example, one explanation for this is that when very high price citations are issued (\$40 or higher), individuals expect that the probability of payment enforcement is higher. With an expectation that there is a higher probability of enforcement, individuals may be more likely to comply with payment rules. This is based on the theory established in Becker (1968), which posited an inverse relationship between perceived probability of enforcement and offenses (in our case non-payment). Based on this relationship, there may be room for Eugene to marginally increase the fine price level without seeing a decrease in fine payment. However, a fine price increase may entail a large political cost. In Section 7, we will discuss a different strategy to increase the expectation of fine payment enforcement without changing fine prices.

Time Controls

We included three time control variables – day of week, time of season, and overall trend over our time frame – primarily to avoid omitted variable bias, but we have found several interesting relationships with propensity of fine payment. Unless noted otherwise, all our time variable estimates are significant at better than the one percent level.

There is seasonality in the probability of fine payment: citations issued in the winter have the highest likelihood of payment, followed by the fall and then the spring,

with citations issued in the summer having the lowest likelihood of payment. Holding all other variables in the model constant their mean, Table 6.5 demonstrates the predicted probability of payment by season.

Season	Predicted Probability of Payment
Fall	85.6 %
Winter	86.8 %
Spring	85.0 %
Summer	84.8 %

For a revenue equivalency example, we estimate that if parkers had behaved in the spring the way they did in the winter, Eugene would have collected \$3,824 more revenue each spring season, on average.¹⁰ Although seasonal variation in fine payment is slight, the fact that there is seasonality in fine payment is important to understand and could imply the need for marginal changes of policy or enforcement by seasons.

In terms of how the day of the week affects propensity of fine payment, our results (not including Friday, Saturday or Sunday, which were statistically insignificant) indicate that, holding all other variables in the model constant their mean, citations issued on Monday have a predicted probability of payment of 2.04 percentage points lower than citations issued on Tuesday, Wednesday, and Thursday (which are all similar).

¹⁰ To calculate this, we multiply number of spring tickets (50,715) by the overall average fine (\$14.66) by the difference of predicted probability of payment between winter and spring (1.3 percent). This equals \$13,383, which is then annualized to equal \$3,824 in lost revenue.

Lastly for time controls, the estimated coefficient on the monthly trend over time is negative and significant at better than the five percent level. This indicates that holding all else in the model constant, the propensity of fine payment has slightly decreased over our time frame. This variable was also important for our model for the objective of avoiding omitted variable bias.¹¹

University of Oregon Football Game Days

The estimated coefficient on the home football game day dummy variable is negative and significant at better than the one percent level. Holding all else in the model constant, for citations issued on days when there is a home University of Oregon football game, the predicted probability of fine payment is 83.7 percent, and for citations issued on days when there is not a football game, the predicted probability of fine payment is 85.6 percent. This change in fine payment behavior corresponds to \$1,567 of lost total revenue since 2006, as compared to the probability of fine payment for citations issued on all other non-football game days.¹²

We suggest that on home football game days, officers should concentrate on the campus area. The predicted probability of payment of citations issued on campus during a football game day is 85.0 percent, while the predicted probability of payment of citations issued off campus during a football game day is 82.4 percent, a difference of

¹¹ For example, before we included the time trend variable, we had found that the unemployment rate was statistically significant with respect to fine payment. However, including the time trend variable diluted that relationship. Therefore, had we not included the time trend variable we would have suffered from omitted variable bias and attributed a relationship to the unemployment rate that was not actually true.

¹² To demonstrate how much Eugene has lost in citation revenue during football game days, we multiply the number of game day tickets written (5,627) by the overall average fine price (\$14.66) by the difference in the predicted probability of payment of game days compared to non-game days (-.019).

2.6 percentage points. Theoretically, if all tickets on football game days were written on campus and not elsewhere, Eugene would have received \$1,162 more in game day revenue.¹³ Divided by the number of home football games over our time frame, this equals \$47 per game. Although this amount of potential revenue is low, the relationship between fine payment and football games may also be applicable to other public events, such as University of Oregon basketball games or the Bach Festival, which could result in additional revenue.

6.2 Summary of Most Salient Findings for Officers and Policy Makers

Of all the variables we have analyzed in our econometric model, the findings concerning the state of the license plate, the area of the town, type of citation, and the fine price are the most important determinants of fine payment in terms of potentially adjusting officer behavior or even parking policy to increase fine payment and revenue.

We found that individuals who have a license plate from Oregon, Washington, or California have a predicted probability of payment of 16.2 percentage points higher than those who do not have a license plate issued from such states. By being aware of this relationship, officers can allocate their time to concentrate on areas and vehicles with West coast plates, and could thereby increase revenue at the margin. We found that when a citation is issued in the campus area, it has a predicted probability of being paid of 1.71 percentage points higher than if it was issued elsewhere in the city. The campus area is the most concentrated area of citation activity in the city, so it may be worth

¹³ Found by multiplying the number of off campus game day tickets (3,049) by the average fine (\$14.66) by difference in probability of payment of non-campus versus campus (0.026).

considering reallocation of more officer patrol hours to the campus area. We cannot speak to the exact optimal patrol hour allocation because we do not know how patrol hours are currently allocated, but our findings suggest that patrolling the campus area may yield higher returns in fine payment than elsewhere in the city.

We found that individuals who received time limit citations are 1.8 percentage points more likely to pay their fine than individuals who received a meter citation, holding all other variables constant at their mean. Given that these two citations are similar in nature and identical in fine price, this suggests that it may be beneficial to patrol time limit zone areas to a greater proportion than meter areas. This would entail only a marginal change in officer behavior, but could also increase fine payment and revenue at the margin. Lastly, we found that the relationship between fine price and fine payment is positive, with an especially large magnitude for fine prices that are exceptionally high. When an individual receives an expensive citation, it is likely that they perceive a higher likelihood of payment enforcement, which makes them more likely to abide by fine payment rules. If this is true, this suggests that Eugene would benefit from anything that increases the credibility of fine payment enforcement. Strategies to accomplish this may include increases in the fine price itself, or other approaches that lead parking violators to believe that their penalties will be enforced. However, increasing the fine price may entail too high of a social cost in terms of parker discontent with prices that are perceived to be unfair. This leads us into Section 7, which considers a different strategy for increasing the credibility of fine payment

enforcement (and thus increasing the payment rate and revenue) without changing the current citation price schedule and causing political dissatisfaction.

7. The Role of “Failure-To-Pay” Citations

The role of FTP citations has been ignored in the above econometric analysis that is targeted toward understanding what marginal adjustments in officer behavior or policy would mean for fine payment. This is a reasonable omission from an econometric analysis due to the endogenous nature of FTP citations with other observations, and the lack of variation in fine payment in FTP citations.¹⁴ That said, considering the role of FTP citations in encouraging fine payment is still possible.

In terms of altering parking policy to increase fine payment and revenue, *our most important suggestion is to enhance the role of FTP citations*. If an officer finds a vehicle (usually in the process of writing a new ticket) that has a long-term outstanding fine due, the officer can write a FTP citation. Failure-To-Pay citations impose fines between \$30 and \$75, depending on the quantity and severity of previously unpaid citations.

Over our time frame, 98.4 percent of individuals who were issued a FTP citation ultimately paid them. Compared to the overall payment rate of 85.2 percent, the higher probability that a FTP citation will be paid is remarkable. Additionally, the virtue of FTP

¹⁴ FTP citations only result from a previous citation being issued (e.g., unpaid meter violations) and are currently issued only upon a second citation being imposed (e.g., another meter violation), which raises concerns of endogeneity with other observations. Moreover, that FTP fines are paid with such regularity (e.g., in 2009, 98.4 percent of FTP citations were paid) makes econometric analysis of these fine payments uninformative.

citations is threefold. The first benefit of FTP citations is that they are paid at an eye-catching rate, and the second implicit benefit is that they result in the payment of all previously delinquent fines that an individual has accumulated. Third, the usage of FTP citations is an important tool for increasing the perception of payment enforcement. If FTP usage were expanded, parkers' expectations would eventually become modified by the perceived increase in payment enforcement and would have a greater incentive to pay their initial citation. While we cannot analyze the third benefit of FTP citations because it is unquantifiable at this time, it should be recognized as an important benefit that an expansion of FTP citations would offer in the future.

Over our time frame, 3,135 FTP citations were issued, at any average price of \$39.99, which has equated to approximately \$35,260 in revenue per year from FTP citations alone. Yet that is just the first benefit of FTP citations. In addition, they require individuals to pay all previous delinquent fines. The mean citation price is \$14.66, which by being delinquent would have doubled to \$29.32 outstanding. Multiplying \$29.32 by the number of FTP citations (3,135) by the propensity of fine payment (0.984) yields at very least \$90,048 overall, or \$25,842 per year that without the FTP citation would not have been received.¹⁵ Summing the two sources of revenue that FTP citations have generated, Eugene has received on average \$61,089 in annual revenue due to FTP citations. There are on average approximately 900 FTP citations issued each year, so this indicates that each FTP citation leads to about \$68 in revenue at the margin. Given that overall only 85.2 percent of citations are ultimately paid to the City of Eugene, and that FTP citations have a 98.4 percent probability of payment and result on average in

¹⁵ This conservatively assumes that all FTP recipients only had one previous outstanding citation.

approximately \$68 in revenue per ticket, we believe that the FTP citations are being grossly underused.

We will identify where FTP citations are most often written and where they are most often paid. Using this information, we will estimate the consequences of the City of Eugene hiring one or more individuals for the sole purpose of processing license plates of parkers and administering FTP citations when appropriate. As we will demonstrate below, we believe that the City of Eugene should hire an individual with this task because it will result in significant revenue for the City of Eugene.

The area with the highest ratio of FTP citations to overall citations is the campus area. On campus, FTP citations account for 2.87 percent of citations, while elsewhere in the city they account for 1.47 percent of citations.¹⁶ The campus area also has a higher probability of payment of FTP citations than average, at 99.5 percent. Together, these facts suggest that an officer searching for vehicles that are eligible for a FTP citation should patrol the campus area.

Theoretically, we will demonstrate the effect of hiring one person (we will call the officer “Rita”) to patrol the campus area looking for vehicles that have fines delinquent over a long-term scale and are thus deserving of a FTP citation. If Rita were to scan through 25 plates per hour – less than one every two minutes on average – she would search 200 plates each day. If Rita scanned cars at this rate, and discovered FTP

¹⁶ These proportions are calculated by dividing FTP citations by non-FTP citations. Notably, we exclude all observations from Friday, Saturday, and Sunday, because (for reasons unknown to us) FTP citations have only been issued on Monday through Thursday over our time frame. Therefore, including observations from Friday through Sunday would bias this estimate. This will be discussed in more depth below.

candidates at an assumed rate of 2.87 percent, she would issue 5.74 FTP citations per day.¹⁷

Extrapolating to an annual rate, 1,653 FTP citations in a year, we can predict how much revenue that would produce. Again, the total revenue from each FTP ticket includes the FTP citation itself added to the payment of all previously delinquent tickets the individual has accumulated. The mean fine for FTP citations on campus is \$39.55, which multiplied by the propensity of FTP to be paid on campus (0.995) by the tickets Rita will write (1,653) results in \$65,049 in revenue directly from the FTP citation. Next, we need to calculate how much revenue these FTP citations will earn from back payments. The mean citation fine on campus is \$12.85, which when doubled due to delinquency, results in \$25.70 outstanding. That multiplied by the number of tickets Rita wrote (1,653) and the propensity of FTP to be paid on campus (0.995) the City of Eugene will make \$42,270 in a year from back payments.¹⁸ Adding together the direct FTP payments and the back payments of previously delinquent fines, the new employee will have raised approximately \$107,319 in revenue for her one year of work. This suggests it is worth hiring a new employee if total costs per year – including salary,

¹⁷ We assume the ticketing rate of 2.87 percent is accurate because presumably in the past officers were not seeking out vehicles eligible for FTP citations, but discovered them by only when issuing a new citation. Based on this, we can take the 2.87 percent ratio of FTP citations over non-FTP citations in the campus area as a random sample of how many vehicles there are in the campus area eligible for a FTP citation. To the extent that those who are parking illegally at the time of ticketing may be more likely to have parked illegally in the past, meaning they may have an inflated chance of being eligible for an FTP and thus are not a representative sample of all campus area parkers, this rate will be biased upwards. If this bias were a concern, it would be relatively simple to check for. An officer could take a random survey of license plates on campus for FTP eligibility and find the proportion of FTP-eligible over non-FTP-eligible. If this was significantly different than our estimation of 2.87 percent, our revenue projections could be easily modified accordingly.

¹⁸ On average, this is the most conservative estimate because it assumes that all FTP recipients only have one previously outstanding citation. In reality, the amount earned on back payments would be higher than this.

benefits, capital, etc. – are less than the \$107,319 in revenue generated. These projections are based on patrolling the campus area because that is currently where the most FTP citations are given, but the results are comparable in other areas of the city.¹⁹

There is one important anomaly in the FTP citation data. Out of the 3,135 FTP citations over the time frame of our data, only two of them occurred on a Friday, Saturday, or Sunday. While the reason for this is unknown to us, it is most likely due to either a technological and budgetary constraint, or a misallocation of resources. It is possible that there is a limited number of patrolling vehicles with technology to search a citation database for the past parking citation history of an individual plate, and that these vehicles are not used on Fridays, Saturdays, and Sundays. It is also possible that officers who work on the weekend neglect to use their technology to check for potential FTP citation recipients. If the cause of this disparity is due to a technological constraint from a lack of funds, we recommend that the City of Eugene reassess the costs of the technology in light of our outlined benefits of FTP citations. If this disparity is due to an allocation of plate-scanning technology away from Fridays, Saturdays, and Sundays, we recommend that they be employed all days of the week in light of our demonstrated benefits of FTP citations.

In conclusion, given the fact that FTP citations have been paid 98.5 percent of the time and are the most lucrative citation the city regularly issues (averaging approximately \$68 in revenue per ticket at the margin), we believe FTP citations are too important of an enforcement mechanism to be underused. Our primary policy

¹⁹ See Tables 2 and 3 of Appendix A for the rate of FTP citation payment by area and the proportion of FTP citations relative to other citations by area.

suggestion is the hiring of an officer who has the sole responsibility of checking license plates for the eligibility for FTP citations, which we have estimated result in over \$100,000 in revenue per year. If our first option of hiring an officer is unfeasible for reasons that we have neglected, then we have additional recommendations that may be easier to implement. First, FTP citations should be written every day of the week, not just Monday through Thursday. If this requires an expenditure on capital, we recommend it be considered in light of the described benefits of FTP citations. Second, all officers should be made aware of the importance of FTP citations – 98.5 percent payment at an average revenue of approximately \$68 per ticket at the margin – and should check every license plate they cite to determine if it is also eligible for a FTP citation. To incentivize this, a direct financial reward to officers could be given for each FTP citation issued. Given that FTP citations earn approximately \$68 in revenue per ticket at the margin, there would be considerable room to determine an appropriate reward and still increase net revenue. Whatever the method that is practically feasible (we recommend all of the above), we strongly believe that enhancing the number of FTP citations issued will significantly increase the citation payment rate and notably increase City of Eugene revenue.

8. Conclusion

Permanently unpaid parking citations are a significant problem for the City of Eugene, which on average has received payment of only 85.2 percent of citations at a cost of more than \$100,000 in forgone annual revenue. Using probit analysis, we have

analyzed data on every parking citation the City of Eugene has issued since July of 2006 to better understand the determinants of whether or not a fine gets paid. We hope to increase revenue in two ways: by informing officers of the attributes that determine fine payment, and by expanding FTP citation usage with a policy change. If officers are aware of what attributes lead to higher propensities of citation payment, they may alter their behavior accordingly at the margins to potentially earn more revenue for the city. Second, we recommend the City of Eugene attempt to utilize the FTP citations more than they currently do. We demonstrated that the hiring of an officer for the sole purpose of distributing FTP citations would produce significant revenue and increase the rate of fine payment. If this policy change is not feasible, we recommend expanding FTP citations through other ways, such as capital investments for technology needed to administer FTP citations, issuing FTP citations all days of the week, ensuring officer awareness, or setting up a financial incentive for officers to cite FTP citations. Together, by utilizing our general analysis of determinants of fine payment and by implementing policy changes to expand FTP citations, we believe the City of Eugene will increase the rate of fine payment and in the process increase revenue.

Appendix A: Tables

Table 1: Dollars currently owed from unpaid parking citations

Year	Revenue lost to unpaid citations	Average amount due per unpaid citation	Unpaid citations
2006 (July - Dec)	\$128,641	\$27.13	4,742
2007	\$281,256	\$29.80	9,438
2008	\$254,148	\$27.39	9,278
2009	\$244,251	\$27.66	8,831
Total	\$908,296		

Table 2: Number of “Failure-To-Pay” citations and percentage that have been paid, per area of town

	Campus Area	Downtown	Not Campus Area	Central Campus	Non-Central Campus	West Campus Area
Tickets	2,068	156	1065	375	1693	1280
Payment Rate	99.52%	97.44%	96.34%	100%	99.41%	99.53%

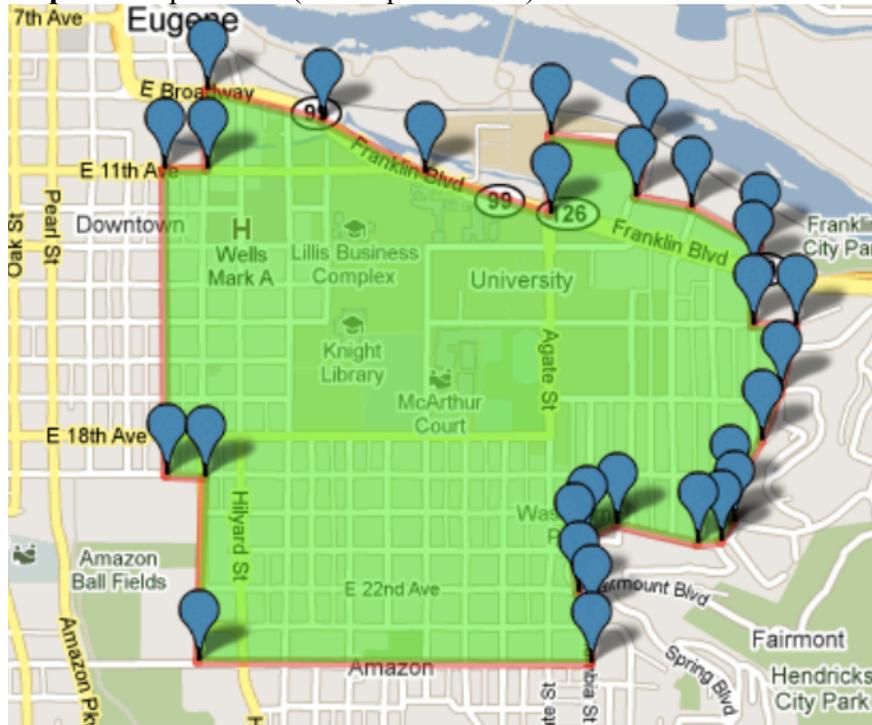
Location Definitions: Non Campus Area: all of Eugene, not including Downtown or Campus Areas; Central Campus: 12th to 18th, Harris to Agate; Non-Central Campus: Campus Area, not including 12th to 18th, Harris to Agate; West Campus Area: 11th to 18th, Patterson to Kincaid.

Table 3: Percentage of “Failure-To-Pay” citations written out of non-FTP citations, per area of town

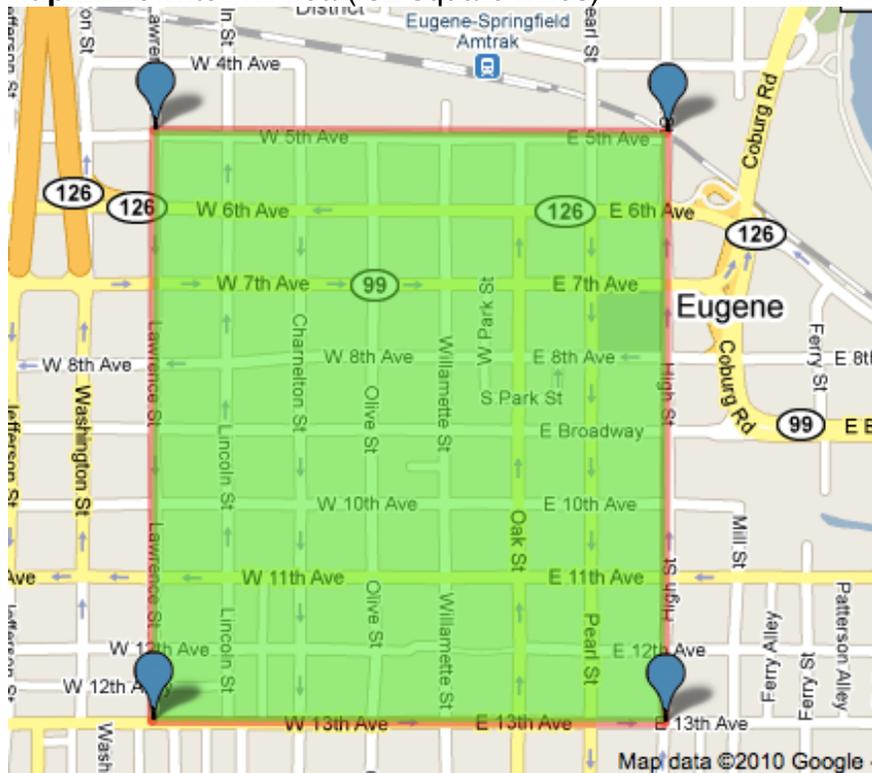
Campus Area	Downtown	Not Campus Area	Central Campus	Non- Central Campus	West Campus
2.87%	0.73%	0.87%	3.47%	2.76%	2.75%

Appendix B: Maps

Map 1: Campus Area (1.06 square miles)



Map 2: Downtown Area (.32 square miles)



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