NBER WORKING PAPER SERIES

PUNISHMENT AND DETERRENCE:
EVIDENCE FROM DRUNK DRIVING

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Working Paper 20243
http://www.nber.org/papers/w20243

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
June 2014

Special thanks to Jason Lindo, Glen Waddell, Phil Cook, Tom Dee, Ben Cowan, Brigham Frandsen, Lars Lefgren, Daniel Rees, Emily Owens, Devin Pope, Kevin Schnepel, and Peter Siminski for helpful insights. I also thank participants at the IZA Risky Behaviors Conference, Conference on Empirical Legal Studies, NBER Summer Institute and Trans-Atlantic Economics of Crime Conferences, and to participants at seminars at BYU, Cornell, the University of Hawaii, and WSU for valuable comments which improved the quality of the paper. I am also grateful to Lucy Hackett and Cole Sutera who provided outstanding research assistance. The views expressed herein are those of the author and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 20243
June 2014
JEL No. I18,I28,K14,K42

ABSTRACT

Traditional economic models of criminal behavior have straightforward predictions: raising the expected cost of crime via apprehension probabilities or punishments decreases crime. I test the effect of harsher punishments on deterring driving under the influence (DUI). In this setting, punishments are determined by strict rules on Blood Alcohol Content (BAC) and previous offenses. Regression discontinuity derived estimates suggest that having a BAC above the DUI threshold reduces recidivism by up to 2 percentage points (17 percent). Likewise having a BAC over the aggravated DUI threshold reduces recidivism by an additional percentage point (9 percent). The results suggest that recent recommendations to lower the BAC limit to .05 would save relatively few lives, while increasing marginal punishments and sanctions monotonically along the BAC distribution would more effectively deter the drunk drivers most likely to be involved in fatal crashes.

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1 Introduction

Since the National Highway Traffic and Safety Administrative began recording fatal traffic accident data in 1975, drunk driving was a factor in 585,136 traffic fatalities.[1] Over a similar time period, 725,347 murders occurred in the United States. The similarity of the magnitudes of both of these causes of death suggests that drunk driving's external costs may actually be close to those associated with murder.[2] However, given that drunk driving is a very different crime than murder and often closely linked with addiction and substance abuse, what we know about the deterability of murderers may not apply for drunk drivers. So while many states have passed laws punishing drunk driving, understanding the deterability of drunk drivers is crucial in determining the appropriate combination of enforcement and punishment that can maximize social welfare.

In his seminal work that modeled criminal behavior, Becker (1968) suggests that criminals commit crimes rationally when the expected benefits of the crime outweigh the expected costs. Moreover, he also concluded that they may be deterred from criminality with the appropriate mixture of punishments and enforcement. Along those lines, recent evidence suggests that individuals who break the law, ranging from violent and property crime offenders (Levitt, 1997; McCrary, 2005; Evans and Owens, 2007; and Chalfin and McCrary, 2011) to drivers exceeding the speed limit (DeAngelo and Hansen, 2014), respond to increased enforcement by committing fewer crimes. However, several factors complicate testing the effect of punishment severity on crime. First and foremost, the severity of punishment is normally determined, at least in part, by the severity of the offense. Thus naive comparisons of of-

[1] Through the end of 2012.

[2] Futhermore, for every fatal accident, dozens of non-fatal accidents occur with substantial injuries and property damage.

fenders with harsh and mild punishments would arrive at biased estimates due to omitted variables.

This paper offers quasi-experimental evidence concerning the effects that punishment severity has on the commission of future crimes. Taking advantage of administrative records on 512,964 DUI stops from the state of Washington (WA), I exploit discrete thresholds that determine both the current as well as potential future punishments for drunk drivers. Specifically, in WA a blood alcohol content (BAC) measured above 0.08 is considered a DUI while a BAC above 0.15 is considered an aggravated DUI, or a DUI that results in higher fines, increased jail time, and a longer license suspension period. Importantly, the statutory future penalties increase for each DUI received, regardless of whether the previous offense was an ordinary DUI or aggravated DUI. The quantifiable nature of BAC, use of thresholds to determine punishment severity, and the inability of either drivers or police to manipulate BAC allows for a unique quasi-experiment to test whether harsher punishments and sanctions deter drunk driving.

The estimated effects suggest that having BAC above either the DUI or aggravated DUI threshold reduces recidivism. I also further investigate several competing mechanisms including deterrence, incapacitation, and rehabilitation. Broadly, the results suggest that harsher punishments and sanctions reduce future drunk driving. As the National Traffic Safety Board (NTSB) recently recommended lowering the BAC limit from .08 to .05, the estimated deterrence elasticities from this paper have strong implications for the potential merits of such a change, in addition to other alternative policy changes such as increasing punishments more steeply or continuously along the BAC distribution.

The paper proceeds as follows. Section 2 provides background on drunk driving and recidivism. Section 3 reviews the econometric methods and data sources used in the estimation. Section 4 presents the main estimates and discusses competing mechanisms which may explain the results. Section 5 concludes.

2 Background

2.1 Drunk Driving

Shortly after the introduction of automobiles, drunk driving emerged as a serious public health issue. In efforts to combat drunk driving, states introduced laws criminalizing driving under the influence (DUI).[3] Identifying the impairment of drivers was initially difficult, as police officers relied mainly on field sobriety tests and their own personal experience. In 1956, the first breathalyzers were created, establishing an objective and reasonably accurate method of measuring BAC in a relatively noninvasive manner. Their relatively low cost and objective nature took the burden off of police in proving a driver was under the influence of alcohol, and instead placed the burden on the accused to establish their innocence.

Because of the relative ease of measuring BAC through breathalyzers, many states adopted laws stipulating strict thresholds for DUI. Initially the thresholds were generous by today's standards, with a BAC level of at least 0.15 needed to establish impairment. Gradually states tightened the standards, with 0.10 becoming a focal point for DUI during the 1980's, until 0.08 became the quasi-uniform standard in the late 1990's and early 2000's. Prior research investigating the adoption of lower BAC limits suggests that lowering the BAC

[3] Some states use terminology other than DUI which has nearly identical legal interpretations including DWI (driving while intoxicated), OUI (operating under the influence), OMVI (operating a motor vehicle while intoxicated), DUII (driving under the influence of intoxicants), or DWUI (driving while under the influence).

limit from .10 to .08 has reduced traffic fatalities by up to 7.2 percent, typically via panel data models or event studies (Apsler et al. 1999; Dee, 2001). At the same time, more severe restrictions were placed on underage drinkers, with many states adopting "Zero-Tolerance" laws that automatically stripped the license of any underage driver with BAC exceeding low thresholds normally ranging from 0.00 to 0.02.[4] Given the different threshold relevant for young drivers, this paper restricts attention to those above the legal drinking age.

At the same time that states were lowering the BAC level needed for a DUI, most states also instituted "Aggravated DUI's" with additional punishments given to individuals with BAC at extremely dangerous levels. As of today, 42 of the 50 states maintain enhanced or aggravated DUI penalties for BAC above thresholds ranging from 0.15 to 0.20.[5] In addition, most states maintain "Implied Consent" laws which stipulate that the refusal to take a BAC test is punished identically to those found guilty of drunk driving. These laws motivate the majority of drivers to admit to BAC tests when asked.[6]

Washington's laws are similar to those enacted in the rest of the United States. Since January 1, 1999, for individuals above the legal drinking age, a BAC over 0.08 has been considered a DUI while a BAC above a 0.15 has been an aggravated DUI.[7] The average

[4]See Carpenter (2003) for a thorough review of zero-tolerance laws and their effects on youth risky behavior.

[5]Some states including Washington also enforce enhanced or aggravated penalties if children are present in the car. Based on calculations from the FARS from 1999-2007, 5.6 percent of drunk drivers in fatal accidents also have children in their car. Given this, any reduced form estimates I obtain examining the .15 threshold could be inflated by dividing by .944.

[6]In WA, 16.7 percent of drivers refuse to take a BAC test. Given there is no measurement of BAC, these refusals are not part of the estimation sample, but I do allow being pulled over and refusing to take a test to be included in recidivism. Additionally in examining the histogram and density of BAC no discontinuities are evident, suggesting that drivers are not able to perfectly predict their BAC prior to refusing a test.

[7]In addition, the presence of a minor in the car increases the offense to aggravated DUI even if the BAC is betwen 0.08 and 0.15. The zero-tolerance policy in Washington considers a BAC of 0.02 to be sufficient for DUI for individuals under the legal drinking age. Commercial drivers also face stricter standards, with a BAC of 0.04 being sufficient to indicate impairment.

penalties from today based on previous offenses and BAC are laid out in Table 1. As noted earlier, those found guilty face more severe expected punishments if convicted again in the future. However, the punishments for repeat offenses are identical for offenders who initially had a regular or aggravated DUI. Holding the number of repeat offenses constant, having a BAC over either .08 or .15 increases current punishments. In addition, Washington's drunk drivers share similar demographics with the rest of the United States. Based on demographics from the FARS for Washington, 75.3 of drunk drivers are male, are on average 40.2 years old, and have a BAC of 16.4. For the rest of the United States, 73.8 percent of drunk drivers are male, are on average 40.8 years old, and have a BAC of 16.2.

2.2 Criminal Activity and Punishment Severity

Many criminals return to committing crimes again within a few years of being released from incarceration for their original crime. For this reason, criminologists and economists alike have long studied the determinants of recidivism in addition to overall rates of criminal activity. Some studies have found results consistent with traditional Beckerian models of crime such as Helland and Tabarrok (2007), who find lower recidivism rates among convicts facing life in prison if convicted of a third strike in California, or Abrams (2011), who finds lower crime rates in states which enhanced punishments for committing crimes with a firearm. Additionally, Drago et. al (2009) utilize an exogenous shock in expected time in prison to study the deterrent effect of prison sentence length on crime. However in some situations criminals seem undeterred by higher punishments, with Lee and McCrary (2009) finding that youth respond little to the large change in penalties which occurs upon reaching

18 years of age. Lastly, greater punishments in the form of harsher imprisonment conditions lead to increases in recidivism rather than decreasing it (Chen and Shapiro, 2007; Drago et. al, 2011). Given that the deterrent effect of punishments and sanctions has varied in the previous literature across different populations or measures of punishment, previous estimates of the deterability of offenders may not inform the deterability of drunk drivers. This is particularly true given the "blue collar" nature of drunk driving.

The variety of estimates linking punishment severity and criminal activity, ranging from negative to null to positive, could arise for several reasons. For instance, more severe conditions or time in prison may have criminogenic effects either through peer effects or the depreciation rate of human capital. Furthermore, for most crimes increased punishments translate into longer prison sentences which mechanically change the age of an individual at the time of release. As such, the age of an individual may directly affect the trade-offs an individual faces when choosing between crime and traditional labor supply. These complications prevent the separation of deterrent and demographic effects in nearly all criminal justice settings.[8]

Punishments and sanctions for drunk driving lack many of the challenges normally present in testing the deterrent effect of punishments. First and foremost, being stopped for drunk driving is a purely reactive process wherein a police officer notices suspicious behavior (weaving, slow or exceptionally fast driving, driving with the lights off, etc.) and stops the potential offender. In other circumstances, police often choose who to investigate based on previous offenses or convictions. In addition, by using DUI tests (and refusals) to measure recidivism,

[8]Even if a study were to randomnly assign sentence length to offenders; this will by definition cause criminals to be older at the time of release. In order to identify the specific deterrent effect of a punishment, the punishment would have to leave age, among other factors, unchanged.

other issues or biases concerning the point at which one should measure recidivism (arrest, charge, or conviction) are avoided. Lastly, the punishments for a DUI are largely fines, short spells in jail or other restrictions on driving, which allows the identification of the deterrent effects of more severe punishments without all of the demographic complications which normally accompany a longer prison sentences for other crimes.

As outlined in Table 1, the statutory punishments for DUI are based primarily on two factors: BAC and prior offenses. For each subsequent DUI expected punishments for future crimes increase. In addition, a sufficiently high BAC results in enhanced punishments for the current offense. These discrete changes in punishments which arise based on BAC are what I use to test the degree to which punishments and sanctions deter drunk driving.

3 Data and Methods

In this study, I take advantage of administrative records on 512,964 DUI BAC tests in the state of Washington from 1995 to 2011. After January 1, 1999, Washington applied a .08 threshold for determining a DUI, and a .15 threshold for an aggravated DUI. Given the BAC thresholds are constant after 1999, I utilize data from 1999-2007 to analyze the causal effect of having a BAC above either the .08 or .15 threshold on recidivism within four years of the original BAC test. For a suspected offender tested on 1/1/1999, the period from 1/2/1999 to 1/1/2003 is used to identify recidivism, while an offender tested on 12/31/2007 could potentially recidivate in the 1/1/2008 to 12/31/2011 window.[9] Several examples of

[9] Later on in this paper we also considering varying windows which range from 10 days to 2,200 days. It also includes additional years of drunk driving tests from 2012 and 2013 for offenders stopped in 2006 and 2007.

the timing of testing and recidivism are outlined in Figure 1. As noted earlier, this paper restricts attention to those above the legal drinking age given that different cutoffs apply to those under 21. The specific cutoffs for DUI and Aggravated DUI allow the usage of a regression discontinuity design (Thistlethwaite and Campbell, 1960; Hahn, Todd, and Van der Klaauw, 2002) to test the effect of punishment severity on recidivism.

In order for a regression discontinuity approach to deliver consistent estimates several assumptions must be met. Sufficient conditions include the continuity of the underlying conditional regression and distribution functions (Imbens and Lemieux, 2008). In short, these assumptions imply that both the unobservables and observables are expected to remain unchanged across the threshold with only treatment status (or the probability of treatment) changing.

The ability of drunk drivers to accurately discern their level of impairment prior to driving or being pulled over is of principal concern, because in that case they would be able to manipulate which side of a threshold their BAC would fall (McCrary, 2008).[10] Indeed both the decision of how much to drink and the subsequent decision to drive drunk are endogenous. To establish identification in this case, it must be assumed that it is locally random if a driver has a BAC either just below or just above the BAC thresholds. In other words, the underlying assumption is that some drunk drivers are randomly lucky, having a BAC barely below one the threshold, while other drunk drivers are randomly unlucky and have a BAC barely above the threshold.

There are a number of reasons why this assumption is likely reasonable. The first is

[10]Indeed, websites such as http://bloodalcoholcalculator.org/ attempt to help potential drunk drivers estimate their level of impairment based upon their gender, height, weight, alcohol consumed, and time spent drinking. Also several apps are available for various smart phones.

the level of accuracy to which the BAC is recorded in WA state; 3 digits on a scale from 0 to 1. Second, many factors such as the speed of alcohol consumption, food intake, hydration, activity, and metabolism are difficult to measure, making any BAC calculation based on consumption and physical characteristics a rough approximation. Third, although personal breathalyzers have recently become available for individuals to purchase, they utilize a portable technology which is far more volatile than the official breathalyzers used to assess guilt.[11] Fourth, even though the breathalyzers measure BAC with a high degree of precision, randomness does occur in the measurement of BAC, with each stop requiring two measures of BAC be taken independently of one another. The correlation between the two measures is .99, and on average the difference is 0.0008, with the inter-quartile range of differences ranging from -.003 to .004.[12] I utilize the minimum of the two variables as the running variable in the analysis, as the minimum determines guilt regarding DUI or aggravated DUI.

Figure 2 contains a histogram displaying the number of observations in each measured BAC level from 1999-2007.[13] While McCrary (2008) suggests several methods to determine the optimal bin width for analysis (which would be necessary if BAC was reported in a truly continuous manner), in this scenario I instead rely on the original BAC bins determined by the implicit rounding from the breathalyzer. Indeed, the distribution of BAC shows little evidence of endogenous sorting to one side of either of the thresholds studied. The McCrary test implies p-values of .59 and .38 respectively at the .08 and .15 thresholds.

[11] The breathalyzers used to assess guilt in WA utilize a combination of infra-red spectroscopy and an electro-chemical cell technology while portable breath test utilize only fuel-cell based technology which trades accuracy in exchange for portability. The various portable breathalyzers available for individual purchase contain several warning labels outlining their relative volatility.

[12] The histogram of distribution of the difference between the two variables is presented in Appendix Figure 1.

[13] Appendix Figure 2 presents a histogram zoomed at the .08 and .15 thresholds, also showing little evidence of any sorting at either threshold.

Frandsen (2013) recently offered an alternative density test based on a local approximation to a binomial distribution. He suggests his test may offer improvements both in consistency and finite sample performance when the data are discrete or rounded. That test estimates a p-value of .795 at.08, and .886 at .15, again revealing no evidence of manipulation. Likewise, the histogram also shows little evidence of non-random heaping, which can also create bias in regression discontinuity designs (Barreca et. al, 2011).

For the regression models, I utilize a local linear regression discontinuity design to estimate the effect of having a BAC above the DUI or aggravated DUI threshold on recidivism, with the slopes allowed to change at the discontinuities, as shown in Equation 1. The main results are based on a local-linear regression discontinuity design with a rectangular kernel, while the sensitivity of the results are tested (finding little to no major differences) using local linear models with other kernels or higher order polynomials.[14] An indicator for either a DUI or aggravated DUI indicates respectively whether the BAC falls above the .08 or .15 thresholds. In the regression models the BAC variable is rescaled around the relevant threshold, either .08 or .15, X_i is a vector of controls, and y_i is a measure of recidivism.

$$y_i = X_i'\gamma + \alpha_1 DUI_i + \alpha_2 BAC_i + \alpha_3 BAC_i * DUI_i + u_i \tag{1}$$

In the regression discontinuity models, all observations are clustered at the finest bin at which BAC is measured, .001.[15] This captures potential autocorrelation between individuals

[14] The higher order polynomials offer little improvement in model fit, and there is relatively little empirical value to expanding to larger bandwidths due to primarily two issues. First, a larger bandwidth eventually would result in the joint modeling of both punishment regimes overlapping in the regressions. Second, the vast majority (around 90 percent) of the observations fall in the BAC range of .03 to .20, and expanding the bandwidth to include observations from greater BAC ranges does relatively little to increase the sample size.

[15] I also employed clusters at several other levels, including the individual level, the police jurisdiction level,

which have similar BAC levels. The standard errors also implicitly adjust for heteroskedasticity which is important because the regression models estimated are linear probability models because of the discrete nature of recidivism, and therefore by construction suffer from heteroskedasticity.

Further evidence of the legitimacy of the assumptions underlying regression discontinuity in this context is outlined in Table 2. The columns of Table 2 contain summary statistics for various segments of the BAC distribution. These include driver characteristics which are predictive of drunk driving including age, gender, and race. Furthermore, a BAC test is the joint intersection of behavior arousing the suspicion of a police officer and the officer choosing to act on the suspicion. Given I have the universe of official breath tests conducted by the Washington State Police, the data include cases where the police officer notices a suspect's driving, cases where officers stop someone for a broken taillight and smell alcohol, randomized stops and cases involving traffic accidents. To determine whether police endogenously test people around the thresholds, I also examine the three primary signals police have ex-ante to assess an individual's potential guilt: prior BAC tests, the portable breath test value, and the presence of an accident. Furthermore, if accidents changed discontinuously at the threshold, we might also be concerned that the recidivism rates might change due to other punishments not related to drunk driving, or non-random attrition from the sample.[16]

Those with higher BAC levels are more likely to recidivate, face higher chances of being involved in accident at the time of the BAC exam, and are more likely to have prior DUI's. However, when comparing individuals within relatively small distances to the thresholds

county and year level,and county-year and month level, and obtained results which were in essence almost numerically indistinguishable from clustering at the BAC level, and were also significant at the 1 percent level.

[16] An example being if the driver dies or is impaired from future driving due to incapacitating injuries.

for DUI and aggravated DUI the differences diminish substantially and all but disappear if we compare only .001 to each side of the thresholds. The only difference evident in simple summary statistics is a slight difference in age at the .15 threshold, and age is a trait with a substantial gradient over the BAC distribution. This initial evidence based on summary statistics provides evidence supporting the legitimacy of the RD design. The stratified summary statistics also suggest the advantage the regression discontinuity design brings to this setting, as it offers substantial power by allowing the inclusion of observations reasonably close to the thresholds even if such observation are not exactly on each side of the threshold.[17] By estimating local linear models that control for the relationship between BAC and recidivism, unbiased estimates can be obtained even in the presence of characteristics which have a substantial gradient, which is the case for age, prior drunk driving, and the presence of an accident.

Table 3 contains estimates of the effect of having a BAC over the DUI and aggravated DUI thresholds on predetermined characteristics which should be unaffected by BAC thresholds, employing the same regression model as equation 1, with the control variables utilized as the dependent variable. The regression models estimated are local linear models as described above, and employ a bandwidth of .05 and a rectangular kernel for weighting. That bandwidth is sufficiently large to offer considerable power without the two thresholds overlapping. It also utilizes roughly 90 percent of the available sample. For each of the driver demographic demographics and the sources of police ex-ante information I fail to reject the null that the predetermined characteristics are unrelated to the BAC cutoffs for DUI and

[17] For instance, going to the bin to the right of .151 to .152, the recidivism rate falls to .11. For any bin, there is a chance of finite sample anomolies, and the RD smoothes out any such differences.

aggravated DUI. The lack of significance in the regression coefficients is also supported by graphical scatterplots in Figure 3.

Figure 3 presents scatterplots of predetermined characteristics and corresponding fitted regression lines (in black) which should remain unchanged across the punishment thresholds if offenders or police are unable to manipulate the running variable. Demographic factors such as age, race (defined by white vs. non-white) and gender are stable across the DUI punishment thresholds. Likewise key sources of information that could drive the police to administer a breath test including the BAC measured at a portable breath-test (if taken), the presence of an accident at the scene, and the number of prior stops (occasions which resulted in a breath test or test refusal) are also unchanged. The stability of predetermined characteristics gives additional credibility that the regression discontinuity can deliver unbiased estimates in this scenario as it suggests neither the impaired driver or police officer is able to manipulate testing on either side of the .08 or .15 thresholds.

4 Results

Having a BAC above the either .08 or .15 thresholds is associated with a combination of different treatments. This includes potentially higher fines, more time in jail, a longer license suspension, home monitoring and/or probation (see Table 1). In addition, judges may mandate other sanctions including receiving an alcohol addiction assessment, receiving treatment for alcohol abuse, attending a victims panel, or attending Alcoholics Anonymous. Separate from the courts, the Department of Licensing in WA takes administrative action to automatically suspend or revoke the license of an individual, adhering strictly to BAC in their initial suspension or revocation decision. The suspension begins automatically.[18] For an individual to prematurely end a license suspension they must obtain an ignition interlock license, which requires that the person pay to install and maintain an ignition interlock device on their car throughout their suspension or revocation period.[19] It would be empirically impossible to separate this combination of treatments all of which potentially shift when a BAC is over either threshold. Instead, I first examine the reduced form effect of having a BAC over the .08 and .15 thresholds on future drunk driving, and later I explore the degree to which these other potential mechanisms shift at both the .08 and .15 thresholds. As such, this approach answers a fundamental policy question: do BAC limits as currently administered reduce future drunk driving?

Initially, I estimate the effect of having a BAC over the DUI or aggravated DUI threshold on recidivism within four years of the initial traffic stop, capturing the medium run effect of punishment on the likelihood of recidivism. This window was chosen as it allows a sufficient time period for an individual to potentially recidivate after their license suspension or revocation has ended (although recidivism during a suspension is both possible and empirically quite common). The window is later varied to examine recidivism rates within windows ranging from 10 days to 2,200 days in order to verify if punishment leads to long run changes in behavior or incapacitation – potentially because of license suspension or revocation (Owens, 2009; Buonanno and Raphael, 2011).[20] Recidivism is an indicator which takes on the value

[18]The only exceptions to this automatic process are allowed if an individual pays $375 for a hearing, temporarily delaying the suspension. http://www.dol.wa.gov/driverslicense/hearingsrequest.html

[19]It costs roughly $100 obtain the ignition interlock license and $20 a month to maintain the ignition interlock device. In addition, they also have to pay additional SR-22 insurance while utilizing the ignition interlock license. http://www.dol.wa.gov/driverslicense/iil.html

[20]For these expanded recidivism windows I also include additional BAC test records from 2012 and 2013 to allow for drunk drivers in 2006 and 2007 to have a 6 year recidivism window.

of 0 if they are not pulled over under suspicion of drunk driving, and takes on a value of 1 if they are subjected to a test or refuse a test by a police officer within 4 years of the original offense.

In Figure 4, a scatterplot of recidivism rates for all offenders highlights the stark changes in recidivism which occur at the .08 and .15 thresholds. The black lines represent the fitted regressions in the intervals .03 to .079, .08 to .15 and .15 to .20. There is a notable drop in recidivism at both the .08 and .15 thresholds. The substantial decrease in recidivism is initial evidence that the increase in punishments and sanctions at the thresholds is effective in reducing future drunk driving. The first panel contains the recidivism rates for all suspected drunk drivers. The second panel contains recidivism rates for the suspected offenders which have no prior tests. These suspected offenders have less experience and face lower expected punishments. The third panel contains recidivism rates for suspected offenders with at least one prior test, a subset that have both more experience and face higher expected punishments. Across each panel, having a BAC over the .08 and .15 legal limits is associated with lower recidivism rates.

4.1 Punishment and Recidivism

Table 4 reports the estimated effect of having BAC over the DUI threshold for all drivers, those with no prior tests, as well as those with at least one prior test.[21] The estimates are presented both with and without additional controls, which consist of indicators for gender, race, age fixed effects, prior offenses, county fixed effects, and year fixed effects. Panel A

[21] Those with a prior breath test refusal are also included in the group with a prior breath test as legally they are guilty based on refusing the breath test, and theoretically, those who refuse a breath test are disproportionately likely to have higher BAC.

includes estimates with a bandwidth of .05, while Panel B presents estimates derived with a smaller bandwidth of .025, both using a rectangular kernel for weighting.[22] Having a BAC above the .08 threshold decreases recidivism by 2 percentage points during a four year follow-up window and is statistically significant at the 1 percent level. This effect is consistent across both bandwidths and with the presence or omission of controls. Those with no prior tests are also less likely to recidivate when they have a BAC over the DUI threshold, as are those with prior tests. Importantly, those with prior tests are estimated to reduce their recidivism by a larger margin. This could be because the expected penalties are much higher if they are caught drunk driving again, or because their baseline recidivism rates are higher. If the two sets of estimates from Panel A and Panel B are averaged and divided by the relevant average recidivism rate to the left of the threshold, all suspects, those with no prior tests and those with at least one prior test have recidivism rates which fall respectively by 17.0, 15.5, and 25.2 percent.[23]

Table 5 presents the estimated effect of having a BAC above the aggravated DUI threshold on recidivism within 4 years of the initial stop. Once again, estimates are presented both with and without controls. Likewise, Panel A utilizes a bandwidth of .05 while Panel B uses a bandwidth of .025, and all regressions using a rectangular kernel for weighting. Having a BAC above the aggravated DUI threshold reduces recidivism for all potential offenders by 1.1 percentage points, for those with no prior tests by 0.9 percentage points, and those with prior tests by 1.9 percentage points. Given the baseline recidivism rates, these point estimates respectively translate into 8.9, 8.2, and 10.6 percent decreases in recidivism. Once

[22] Institutional constraints prevent the examination of a larger bandwidth as it would include the aggravated DUI cutoff.

[23] This assumes equal weighting of the estimates.

again, the estimates are robust to the inclusion or exclusion of additional controls, and the choice of bandwidth has little effect on the magnitude of the estimates. Smaller bandwidths decrease precision slightly, which is to be expected given the decrease in the sample size.

The issue of bandwidth choice is explored more fully in Figure 5. For every possible bandwidth from .005 to .068, the estimated effect of having a BAC above the DUI or aggravated DUI threshold is presented along with the 95% confidence interval. Controls are utilized in each regression and a rectangular kernel is used for weighting. The point estimates are relatively stable across nearly all bandwidths. Except for particularly small bandwidths, generally those less .02, the estimates are also statistically significant (at least at the 95% level). The stability of the estimates across various bandwidths suggests that the linear specification is a reasonable choice for modeling the effect of BAC on recidivism.

4.2 Heterogeneity of Recidivism

In the previous estimates, recidivism is defined rather simply as whether a driver submits to or refuses a test within 4 years. The rich nature of the administrative records on the DUI stops allows a more detailed analysis of the behavioral changes. Most importantly, recidivating at higher BAC levels is far more dangerous than at lower levels. In addition, recidivating at lower levels of BAC could be evidence that police are more stringently testing those that previously had a BAC above .08 or .15. In addition, more severe punishments can have unintended consequences such as increasing the severity of offenses committed for particular subgroups, as illustrated by three strikes laws (Iyengar, 2007). To address these concerns, the previous indicator for recidivism is split into four mutually exclusive categories:

if the BAC falls in [0,.079], the BAC is in [.080,.15], the BAC is [.151,1], or if the driver refuses the BAC test. These separate indicators offer an approach to measure the severity of the offense. An alternative fifth indicator that also represents the severity of the offense indicates whether or not a subsequent accident occurred (which also involved BAC testing).

Table 6 presents the effects of having BAC above the DUI threshold on the more disaggregated definitions of recidivism. Panels A, B, and C present results respectively for all potential offenders, those with no prior tests, and those with at least 1 prior test. All regressions are weighted using a rectangular kernel and have a bandwidth of .05. For the entire population of suspected drunk drivers, having a BAC above the .08 threshold results in a decreased likelihood of being stopped and having a BAC in any of the recidivism categories. The probability effects are largest for the BAC range from .08 to .15. This is also the range with the largest probability mass (see Figure 2). In addition, having a BAC over the DUI threshold reduces the likelihood of being involved in a future accident. The results suggest having a BAC over the DUI threshold results in either less drunk driving or more attentive drunk driving, to the point that they are not getting in accidents or exhibiting the normal signs of impairment, either of which is consistent with deterrence.

In Panels B and C, subtle differences emerge in the estimates for those with no prior tests and those with at least 1 prior test. First and foremost, those with at least 1 prior test have a large and significant reduction in the probability of being in a subsequent accident involving alcohol. This speaks to the public health benefits offered by increased punishments. Both groups consistently show reductions in recidivating at all BAC levels although a few of the estimates are not statistically significant. Also, the point estimates suggest those with at least 1 prior test are less likely be pulled over and refuse a breath test, although these estimates are borderline insignificant. This could be because the more experienced offenders are aware of the higher punishments associated with refusing a BAC test.

Table 7 presents estimates for the effect of having a BAC above the aggravated DUI thresholds on the probability of specific recidivism outcomes, similar to Table 6. Once again the regressions are weighted using a rectangular kernel and bandwidth of .05. The estimates suggest that having a BAC above the aggravated DUI threshold decreases the likelihood of recidivating in all of the BAC content categories. When comparing the effects of having a BAC above the aggravated DUI threshold for those with no prior tests and those with at least 1 previous test, the main difference in the effects lies with refusals. Drivers with prior DUI stops are less likely to be pulled over again and refuse to take a BAC test while those with no prior DUI stops experience no change in their probability of refusing a test. This again could be due to differences in the experience of offenders, with offenders with prior DUI stops having better information about the higher punishments associated with refusing a BAC test.

In summary, the estimates indicate that drivers with BAC over the .08 recidivate less, as do drivers with BAC over the .15 threshold. Having a BAC over either the .08 or .15 thresholds is associated with a decrease in future accidents particularly among offenders with prior DUI stops. In the subsequent section I discuss potential first-stages and three possible mechanisms: incapacitation, rehabilitation, and deterrence.

4.3 Mechanisms

4.3.1 Potential First Stages

As discussed earlier, numerous potential first stages exist due to the myriad of sanctions and punishments potential offenders can receive both in court and out of court. I linked the breath test data with a centrally maintained registry of WA courts which account for over 95 percent of the jurisdictions in WA. These data contain information on fines paid, jail-time served, parole, home monitoring, court-ordered license suspensions, alcohol screenings and other treatments mandated by the court.

Table 8 contains estimates of the effect of having a BAC over the legal limits on court punishments, sanctions and treatments. All regression models are local linear regressions using a rectangular kernel, include the same previous controls and use a bandwidth of .05. Panel A reports estimates for the .08 threshold while Panel B reports estimates for the .15 threshold. Having a BAC over the .08 threshold is associated with an increase in essentially all of the potential sanctions an individual could receive. The table also contains relevant means and medians for the sanctions to allow easy calculations of elasticities. The plot of the sanctions is presented in Figure 6, as is the estimated percentage change for each sanction at both the .08 and .15 thresholds. At the .08 threshold jail time increases by roughly 44 percent while fines increase by 32 percent. Additionally, other sanctions such as alcohol addiction assessment, attending a victims panel, and alcohol treatment all increase significantly. At the .15 threshold jail time increases by 8 percent and fines increase 9 percent, while court ordered license suspension length increase by 35 percent.[24] Interestingly, alcohol

[24] Both jail time and fines exhibit significant skewness, evident by the differences in the means and medians. Utilizing a Quantile RD Treatment Effects estimator, I estimate that jail-time increases by 65 percent at the

assessments decreases by roughly 1 percentage point, while alcohol abuse treatment increases by an essentially offsetting amount.

It's worth noting that despite the intricate data maintained by the courts in WA, certain aspects of the sanctions at the .08 and .15 thresholds cannot be empirically analyzed. For instance, at either threshold, the original charges likely reflected higher fines or time in jail according to WA statutes and BAC that prosecuting attorneys may have held or reduced in order to motivate the dependent to plead guilty. Even the threat of higher punishments is a treatment individuals received upon having a BAC over either of the legal thresholds. Likewise, the WA Department of Licensing operates independently of the courts and automatically suspends or revokes the license of an individual after the original breath test. Furthermore, the Department of Licensing imposes their sanctions even if the court finds a reason to dismiss the underlying charges. Notably the license suspension is 90 days with a breath test over .08 (for an individual's first offense) and an individual receives a revocation of 365 days with a BAC over .15 (resulting in a 400 percent increase in the licensure removal period), as laid out in Table 1.

4.3.2 Incapacitation

Given that license suspension and revocation are fundamental sanctions associated with the two BAC limits, I explore recidivism windows in a more granular basis. This addresses several fundamental issues. First, it allows a more detailed inspection of the effect of punishments on the hazard function of reoffending. Second, it provides evidence on whether

median and 80 at the 75 percentile, both significant at the 1 percent level, while the estimate effect shrinks to essentially zero and is statistically insignificant at higher quantiles. This suggests that for the majority of offenders punishments are increasing even more substantially than mean comparisons reveal.

the previous estimates concerning the effectiveness of punishment are driven by long run changes in behavior, or short-run changes due to incapacitation (see Donohue and Levitt, 2001; Owens, 2009; Buonanno and Raphael, 2013). Lastly, it provides additional sensitivity analyses regarding the magnitude and statistical significance of the effects estimated in the previous section. All regressions are estimated using local linear regressions with a bandwidth of .05 and rectangular kernel weighting.

Identification of incapacitation effects are somewhat different in the context of drunk driving. Normally, incapacitation is defined by the complete inability to commit crimes due to serving time in prison. Drunk drivers receive relatively short incarceration sentences, with jail-time ranging from 24 hours to at most a few months depending on BAC and previous offenses, which results in little pure incapacitation. In addition, licenses are either suspended or revoked for a period of time following the offense.[25] Whether this constitutes incapacitation is debatable. Individuals may opt for a restricted license with an ignition interlock license. In that sense, suspended or restricted licenses are more similar to being on parole because recidivism is still possible even if licenses are suspended or revoked. Importantly and regardless, this analysis will also allow the detection of any abrupt changes that result because of license suspension or revocation.

Figure 7 presents the estimated probability effects (with confidence intervals) and semi-elasticities for every potential time window from 10 days to 2200 days, both for drivers with no prior-tests and those with at least one prior test. Consistently, the effect of having a BAC above the DUI threshold grows in absolute magnitude as the window increases in size for both

[25] The difference between suspension and revocation lies in whether the individual needs to pass a license exam to have their license reinstated.

types of offenders. Scaling the point estimates by the baseline probability of recidivism yields a semi-elasticity, or a percentage measure that refers how a discrete change in a regressor relates to a percentage change in an outcome variable.[26] Over the first two years having a BAC above the DUI threshold decreases recidivism by 30 percent for all potential offenders. As the recidivism window expands to 2200 days (6 years), the long-run effects of having a BAC over the DUI threshold decreases in absolute magnitude to 10 percent for those with no prior tests and to 20 percent for those with at least one prior test. This more intricate analysis of recidivism suggests that the punishment associated with DUI's leads to both short-term and long-term reductions in recidivism, and more accurately reveals the changes in the cumulative hazard function of recidivism.

The effects of having a BAC above the aggravated DUI threshold in recidivism windows ranging from 10 to 2200 days are explored in Figure 8. Similar regressions are employed, once again using rectangular kernels for weighting. For aggravated DUI's, point estimates are initially close to zero before growing consistently negative as the recidivism window expands. In the longer windows (those over 1200 days) the estimates become statistically significant. Likewise, the semi-elasticities hover around zero, but in the long term the semi-elasticities for both groups converge towards -.1. This suggests that enhanced punishments from aggravated DUI's do not appear to offer strong additional deterrence in the short run above ordinary DUI punishments and sanctions. However, in the long run, having a BAC above the aggravated DUI threshold decreases recidivism by an additional 10 percent. This is consistent with drunk drivers exhibiting long-run changes in their behavior, rather than

[26] Appendix Figure 3 presents the baseline probability across windows for first-time and repeat offenders.

changes related to incapacitation due to a suspended license or time in jail.[27]

4.3.3 Rehabilitation

Another important channel that might reduce future drunk driving is rehabilitation. Indeed many sanctions imposed by the court relate to alcohol increase considerably at the .08 threshold, including attending a victims panel, taking an alcohol abuse assessment, and receiving alcohol treatment.[28] These requirements might reduce drunk driving solely by reducing future alcohol consumption or altering the preferences or beliefs of drunk drivers, causing them to consider the external cost of drunk driving. Notably at the .15 threshold court-ordered treatments do not change significantly, with the exception being a slight increase in alcohol treatment which offsets a decline in alcohol abuse assessments.

To further test if alcohol abuse is shifting at either threshold I estimate whether future incidents of domestic violence, assaults, and other crimes in which the suspect is tested for alcohol decrease at the .08 and .15 thresholds. I utilize econometric models identical to those in the previous sections, with the point estimates reported in Table 9.[29] Overall, the results do not provide strong evidence that these other crimes decrease in response to having a BAC over either the .08 or .15 thresholds. While this does completely rule out rehabilitation, it

[27] An alternative approach would be to consider the effect of having a BAC over the thresholds on recidivism in adjacent time periods, better capturing the effect on the hazard function, rather than examining the cumulative hazard function. In appendix Table 1, I investigate this alternative approach, focusing on the probability of recidivating in the first 90 days, 91 to 365 days, 366 to 730 days, and 731 to 1460 days. The first panel reports estimates of the effect of having a BAC over the .08 threshold. The results largely correspond with Figure 7 and Figure 8. Although the hazard is estimated to decline everywhere, it declines the most in the first year. Likewise, while the hazard function is estimated to decline everywhere for those with a BAC over the .15 threshold, the decline is the largest and most statistically significant for the latest period.

[28] In addition, the slope of recidivism kinks at .08 which could be due to the change in the slope of the prescription of these court order prescriptions at .08. See Card, etc.

[29] The Washington breath test registry also contains tests from other arrests in which suspects were tested for alcohol.

also fails to provide evidence supporting that potential mechanism.

4.3.4 Deterrence and Specific Deterrence

The approach in this paper utilizes individuals who happen to have the bad luck of having a BAC just barely over either the DUI or aggravated DUI threshold. As such, it offers a method of assessing the deterrent effect of DUI punishments and sanctions, given that statutory punishments increase with each offense, as shown in Table 1. If we give equal weight to all sanctions, on average future punishments increase by roughly 97 percent (based on mid-point measures of percentage changes). If drunk drivers made their drunk driving decisions in a purely Beckerian fashion, then this would imply a deterrence elasticity of -.22.

Having a BAC over the .15 threshold increases current punishments and sanctions, but doesn't have an effect on statutory sanctions. Therefore a reduction in recidivism could be consistent with what criminologists call "specific deterrence", or the deterrent effect of receiving a punishment. In economics, this type of behavior could be consistent with models of bounded rationality, learning due to incomplete information, or perhaps salience (see Akerlof and Yeller, 1985; Tversky and Kahneman, 1986; Sargent, 1993; and Chetty et al. 2009). Given that fines, jail-time, alcohol treatments, and license suspension increase by 74 percent on average at the .15 threshold, this would suggest a specific deterrence elasticity of -.12.

Furthermore, having a BAC over the .08 threshold potentially has its own specific deterrent effect in addition to increasing expected future punishments. Average punishments and sanctions increase by 71 percent at .08. Due to the combination of treatments received by those with BACs over the .08 threshold, we can't empirically separate if specific deterrence or deterrence is driving the reduction in criminality. If we were to assume drivers at the .08 threshold have the same specific deterrence elasticity as those at the .15 threshold, then the deterrence elasticity at .08 diminishes to -.11.

4.4 Robustness

In this section I investigate a series of robustness tests including alternative methods of defining prior drunk driving experience, tests on the sensitivity of the estimates to excluding observations near the thresholds (also referred to a "donut RD"), and testing the stability of conviction probabilities at the .15 threshold.

Figure 9 presents estimated coefficients across three different ways of defining prior experience with drunk driving. The first is whether an individual has a prior test, the approach used throughout the previous analyses. This approach may be reasonable as even being tested by the police could result in minor fines (for reckless driving or negligent driving) even if the BAC does not exceed the .08 level, and police officers may inform suspected drunk drivers of potential punishments and sanctions regardless of their measured BAC. The second approach measures whether an individual has a prior BAC over .08 (or a refusal). This might also be seen as reasonable as it measures whether an individual previously exceeded the legal threshold, which determines both court and licensing sanctions and punishments. The final measures whether an individual has a prior conviction based on the WA court records. This approach could also be seen as reasonable as it measures prior convictions rather than prior BAC, and also can extended further back, as the breath test records begin in 1995 while the court data begin in 1989. All of these approaches of defining prior drunk driving behavior can be seen as reasonable, and they all produce point estimates and confidence intervals which are nearly indistinguishable from each other.[30]

Another concern could be that police or judges treat suspected offenders differently near the threshold. If that is the case, the previous estimates may understate the true reductions in repeat drunk driving associated with having a BAC over the punishment and sanction thresholds. One approach to deal with this sort of concern is to estimate BAC with a kernel that drops the observations near the threshold entirely, also called a "donut RD" (Barreca et al. 2011). I estimate identical models to those in Table 4, excluding observations near the thresholds. To fully investigate the sensitivity of the results, I drop first the observation at the threshold and expand the observations dropped .001 BAC in each direction until I drop observations from -.005 to .005 relative to the threshold in question. The estimates and confidence intervals are plotted in Figure 10. The point estimates and confidence intervals are essentially identical to the main specifications. This gives additional evidence supporting the locally random nature of BAC near the threshold and of the discrete change in sanctions and punishments that suspected drunk drivers experience at the threshold.[31]

In Figure 11, I investigate the effect of having a BAC above the aggravated DUI threshold

[30] The structure of punishments of in Washington also suggest 3rd time and 4th offenders would face even higher punishments when having BAC over the legal thresholds. There are only 1,359 offenders with 2 BAC tests in my sample, and 273 offenders with 3 or more. While the main results hold up for those sub-groups, the sample sizes are too small to have sufficient power for examining heterogeneous reductions in the hazard functions.

[31] Another potential concern could be non-random attrition from the sample due to moving out of state. Incentives for this are minimized as WA and 44 other states (including CA, ID, OR and nearly all states in the West) participate in the the Interstate Driver's License Consortium of 45. This group of states share information on drunk driving records across geographic boundaries which reduces incentives to move out of state due to having BAC over a legal threshold. Likewise, I reestimated the models for both interior counties and border counties (where moving might be easier), and I found the point estimates were respectively -.024 and -.014 at the DUI threshold, and -.0103, and -.0101 at the aggravated DUI threshold. If the results were driven by out-of-state movers, the point estimates should be larger in absolute value for border counties, which is not the case. This gives additional credibility to the integrity of the research design.

on eventual court outcomes. If more severe charges associated with aggravated DUI increase the likelihood that an individual is convicted, then the reductions in recidivism for having a BAC above the aggravated DUI threshold could be due to a rational economic response (as expected future punishment would be shifting, as punishments depend on the number of previous convictions). To investigate this, I link the BAC results with the centralized database of court records in WA that account for over 95 percent of court cases. As shown in Figure 11, the probability of dismissal, a not guilty verdict, or the sum the two, is essentially unchanged across the threshold (with regression discontinuity estimated point estimates (standard errors) that are respectively .006 (.018), -.014. (.017) and -.009 (.020). This is evidence that changes in conviction probabilities at the .15 threshold are not driving the reduction in recidivism.[32]

5 Conclusion

Alcohol abuse continues to be a major public health problem in the United States (Carpenter and Dobkin, 2010). In dollar values, the externality associated with each incident of drunk driving may be as high as $8,000 (Levitt and Porter, 2001). This paper offers evidence concerning the effectiveness of punishments and sanctions as deterrents to recidivism among drunk drivers, finding evidence that having a BAC above either .08 DUI threshold or the .15 aggravated DUI is associated with reduced recidivism both in the short and long term. This would suggest that the sanctions and fines imposed at current BAC thresholds are effective

[32] The fact that not everyone charged with drunk driving is convicted could imply that we should inflate the point estimates by the fraction convicted. However, simply being charged with a crime also conveys information about the potential penalties, and to inflate the reduced form by the first stage would assume that only the conviction deters drunk driving. Furthermore, license suspension and revocation occur administratively and automatically independent of the courts.

in reducing future drunk driving. The estimates imply deterrence elasticities around -.23 and specific deterrence elasticities as large as -.12. Importantly, the identification strategy does not estimate the full deterring effect of the laws, as the presence of more severe punishments may also deter those who would have otherwise been first-time drunk drivers from ever being tested.

More broadly, the findings of this paper also contribute to understanding the foresight – and hindsight – of criminals. Having a BAC above the DUI threshold decreases the likelihood of recidivism, consistent with the predictions of a rational model of criminality as a DUI increases the expected cost of future criminality. However, having a BAC over the aggravated DUI threshold also decreases the likelihood of recidivism. In neoclassical models, he or she would consider the marginal BAC over the aggravated BAC threshold bad luck and realize that the higher penalty on this occasion is a sunk cost. However, the significant decrease in recidivism evident in drunk drivers with BAC over the .15 threshold which is consistent with a range of models in economics including punishment salience, incomplete information and learning, bounded rationality, and rehabilitation (which can be thought of altering preferences or information). Notably, this finding is consistent with other recent research in criminology (Anwar and Loughran, 2011) and business management (Haselhun, Pope and Schweitzer, forthcoming). For instance, while substantial resources are spent informing the public of the .08 threshold, information regarding the higher .15 threshold could have additional deterrent effects and the drivers with highest BAC's are those responsible for the greatest number of fatalities.

Lastly, given the recent recommendations of the NTSB to lower the BAC threshold from .05 to .08, the estimates from this paper suggest that such a change would save at most

120 to 200 lives. This would amount to roughly a 1 percent reduction in the number of fatal accidents involving alcohol, and notably would be 1/4 of the estimates advanced by the NTSB in their recommendation. The NTSB suggested fatalities would fall by 500-800, and there are roughly 800 fatalities per year with BAC from .05 to .07.

There are other viable policies in addition to lowering the BAC limit. Increasing marginal punishments more sharply along the BAC distribution would cause potential drunk drivers to internalize the external costs of drunk driving especially at higher levels of BAC where the external risks are the greatest, which has the potential to save many more lives than lowering the current BAC limit. Figure 12 plots average statutory fines in the United States across the BAC distribution.[33] While current sanctions impose a myriad of punishments, fines are the sanction easiest to compare across jurisdictions and in constructing optimal punishments, fines are also preferred to sanctions which drain public resources (Becker,1968). The statutory minimum fines increase, due to the jumps in punishments at different thresholds across the various states, but not at the compounding rate at which fatality risks increase. Optimal sanctions would utilize punishments and sanctions whose distribution mirrored the increase in fatality risks and social costs evident across the BAC distribution. If setting punishments continuously along the BAC distribution is politically infeasible, numerous thresholds could be used similar to sanction structures for speeding (10 MPH, 20 MPH, 30 MPH, 40 MPH, etc.) – rather than only two. Furthermore, public safety officials could also potentially deter more drunk driving by better informing drunk drivers of the increased punishments that already exists at higher BAC thresholds with targeted advertisements regarding the aggravated DUI threshold.

[33] Based on Zador et al. (2000) and the author's calculations.

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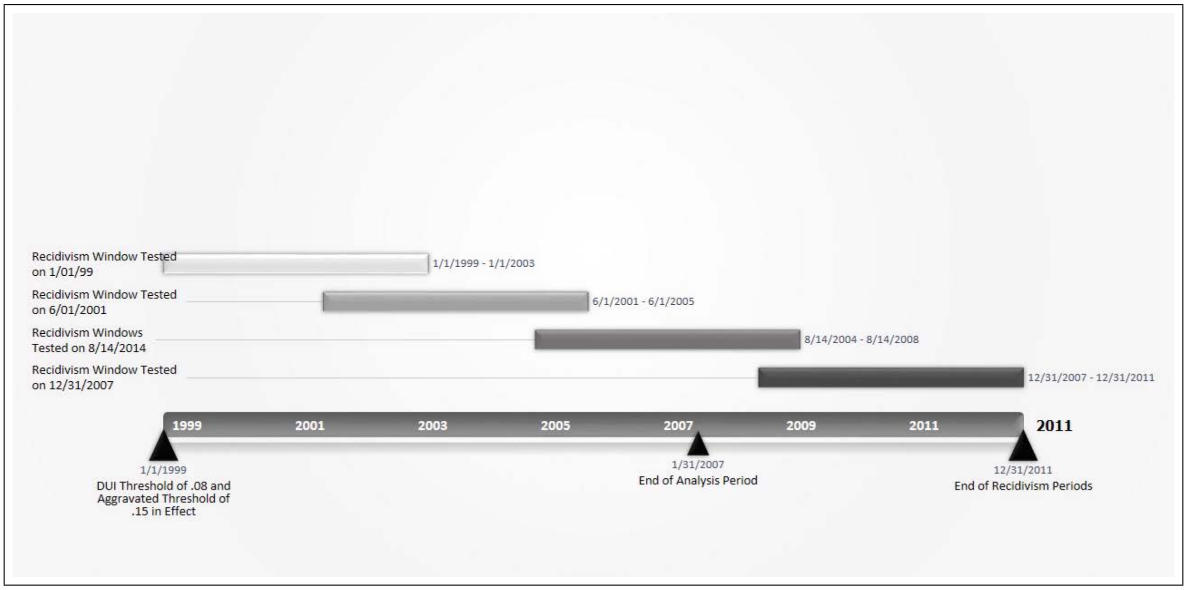
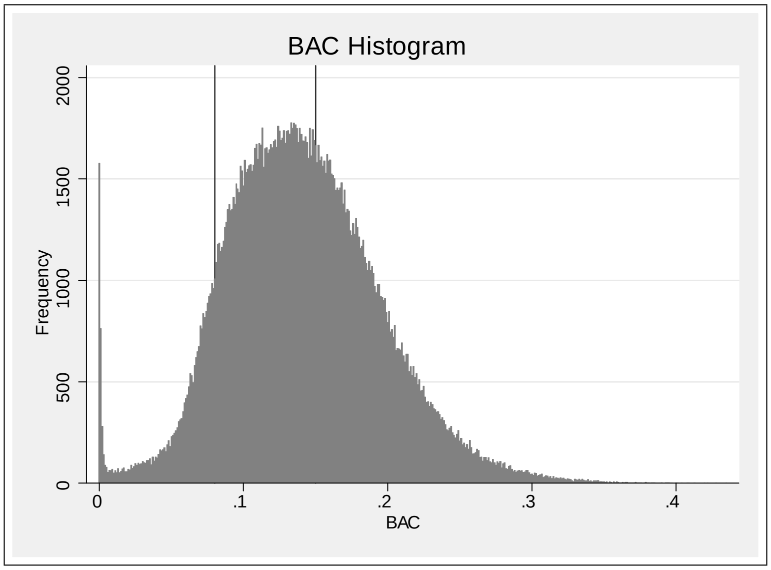
6 Figures and Tables

Figure 1: Timeline of BAC Measurement and Recidivism Window



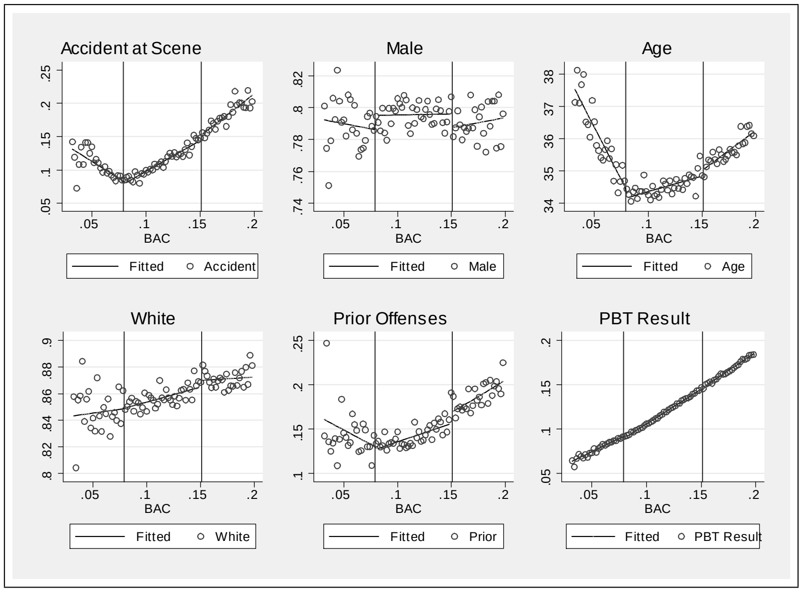
This figure contains a timeline illustrating the sample construction and examples of test dates and potential recidivism windows.

Figure 2: BAC Distribution



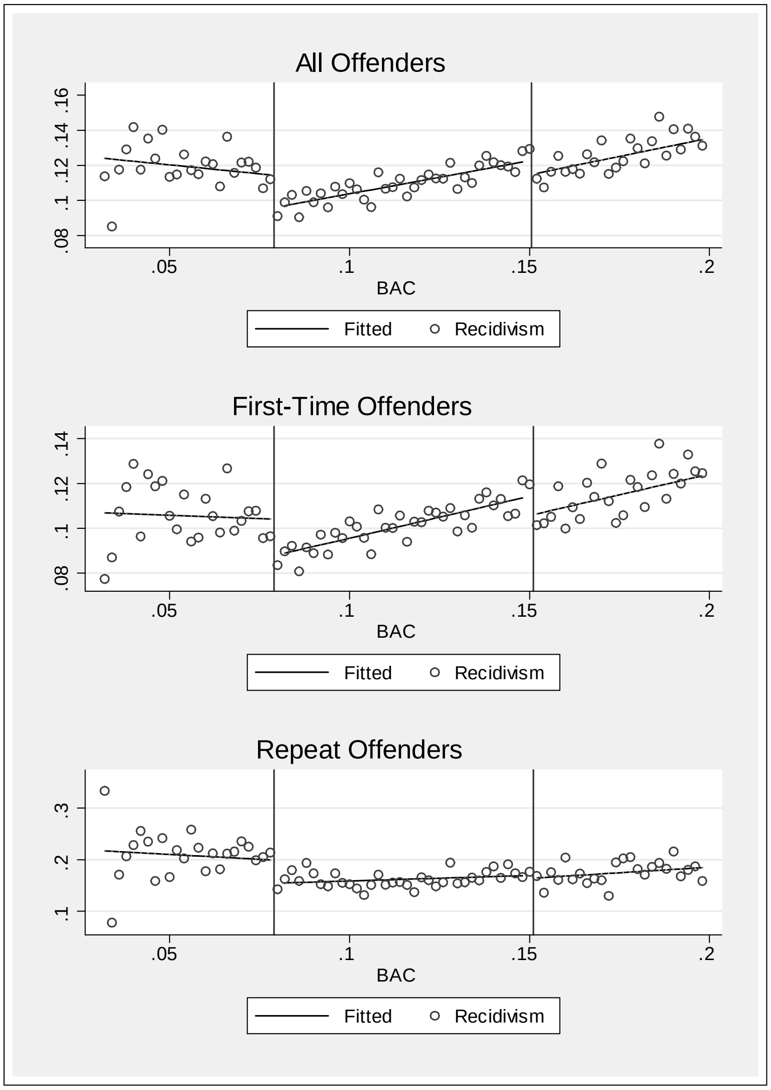
This figure contains the histogram of the BAC distribution. Bin width is .001. The black lines are thresholds at .08 and .15 No manipulation is evident at either threshold.

Figure 3: BAC and Characteristics



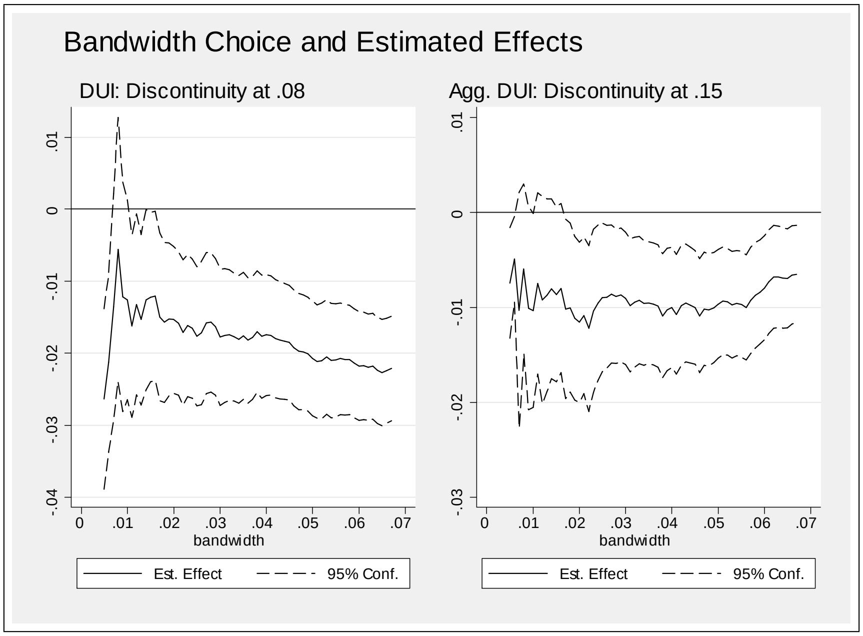
This figure contains scatterplots of BAC demonstrating the stability of the predetermined characteristics along the BAC distribution.
Bin width is .002.

Figure 4: BAC and Recidivism



This figure contains a scatterplots of BAC distribution and recidivism. At both the thresholds a notable decline in reoffending is evident. Bin width is .002.

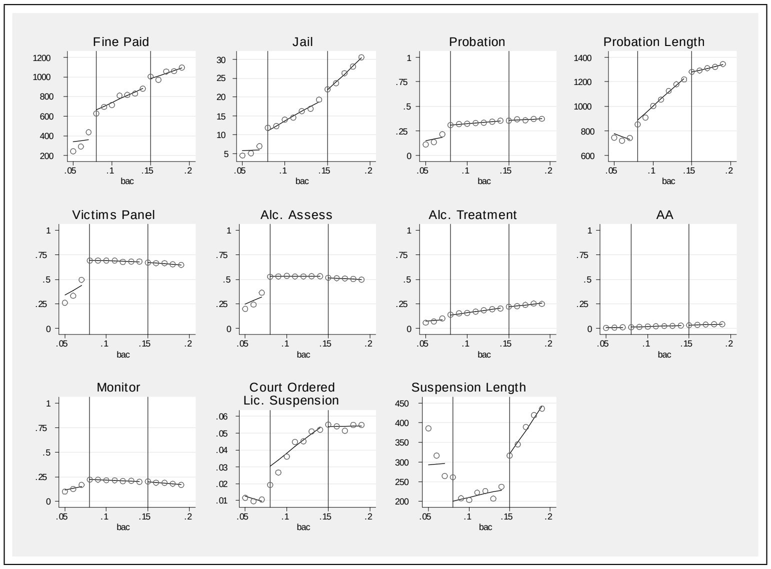
Figure 5: Bandwidth Choice Sensitivity



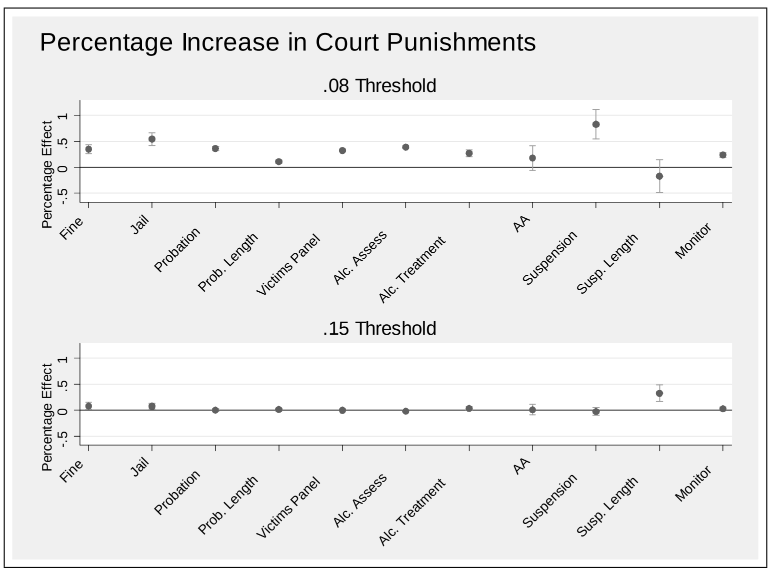
This figures presents the main estimates across variety bandwidths, demonstrating their robustness.

Figure 6: Potential First Stages

Panel A

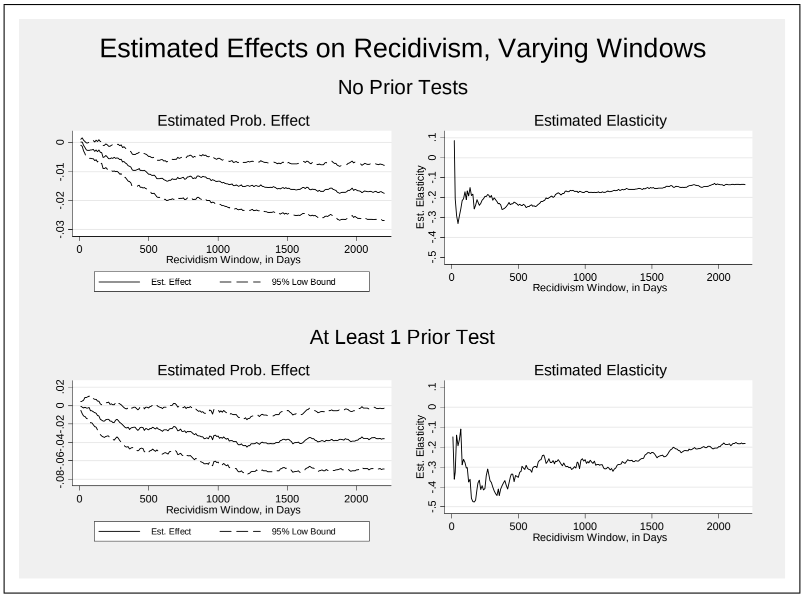


Panel B



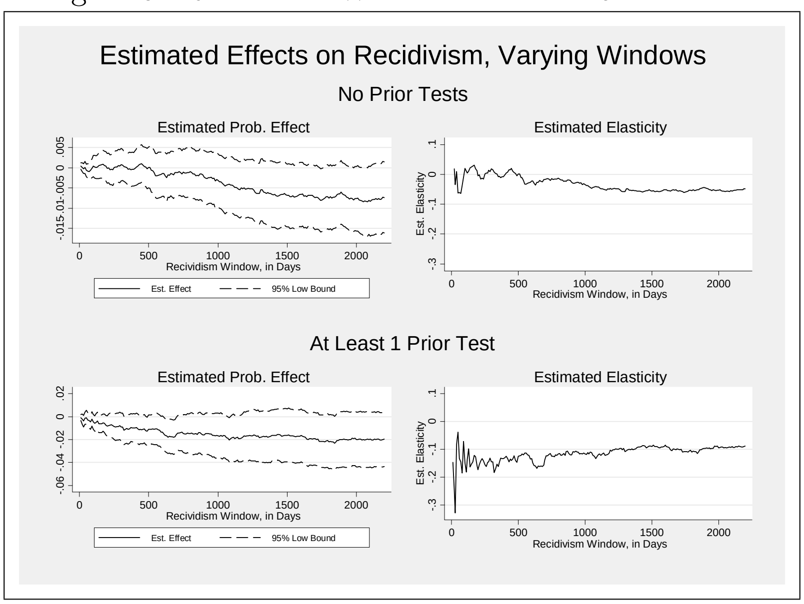
This figure displays potential first stages driven by changes in sanctions and punishments at the .08 and .15 thresholds.

Figure 7: Recidivism Windows for .08 Threshold



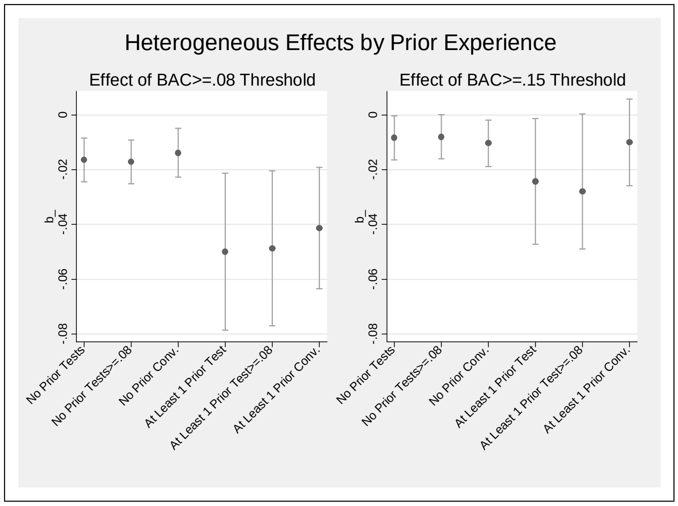
This figure presents the estimated effect of having BAC over the .08 limit across various time windows ranging from 10 days to 2200 days.

Figure 8: Recidivism Windows for the .15 Threshold



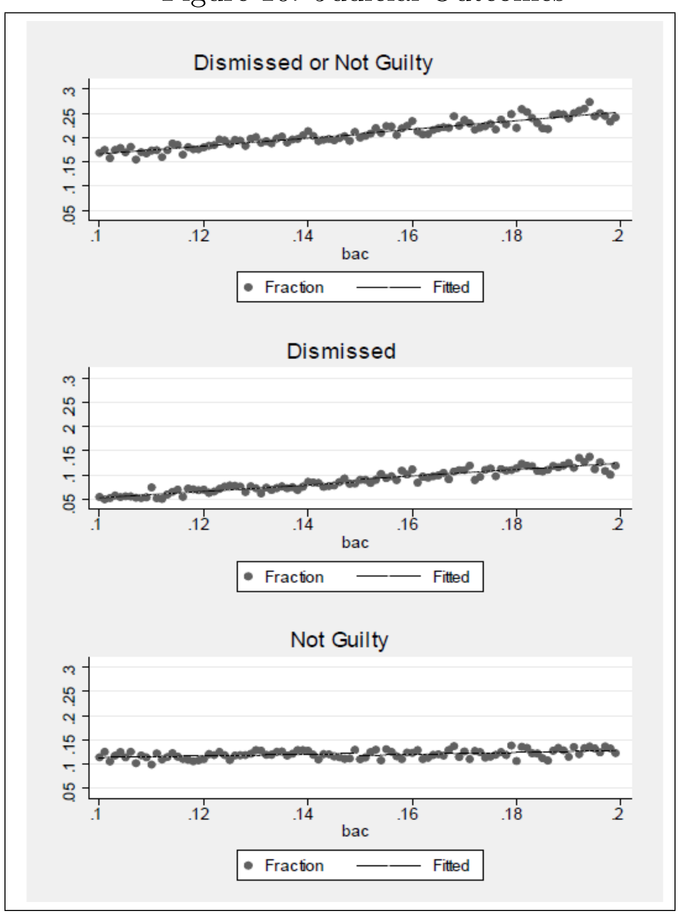
This figures presents the estimated effect of having BAC over the .15 limit across various time windows ranging from 10 days to 2200 days.

Figure 9: Robustness of Prior Experience Measures



This figure demonstrates the stability of the main findings across various definitions of prior offender experience.

Figure 10: Judicial Outcomes



This figure highlights the stability of conviction and dismissal probabilities at the .15 threshold.

Figure 11

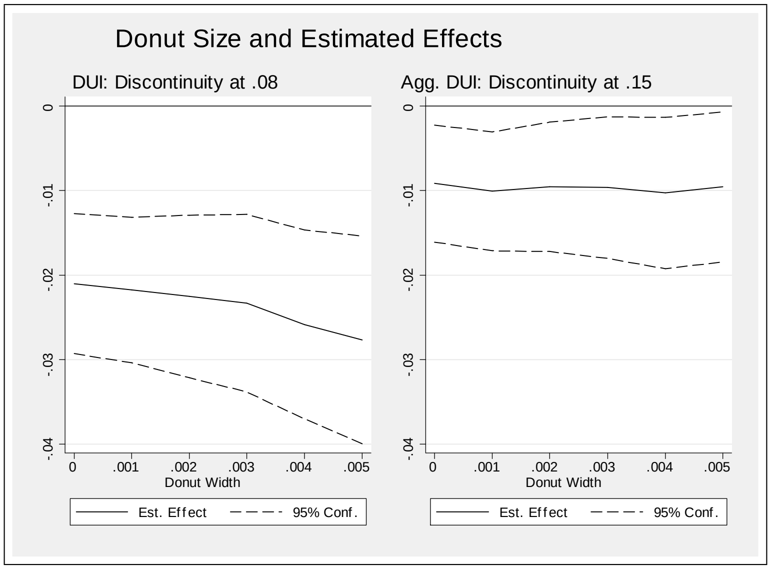
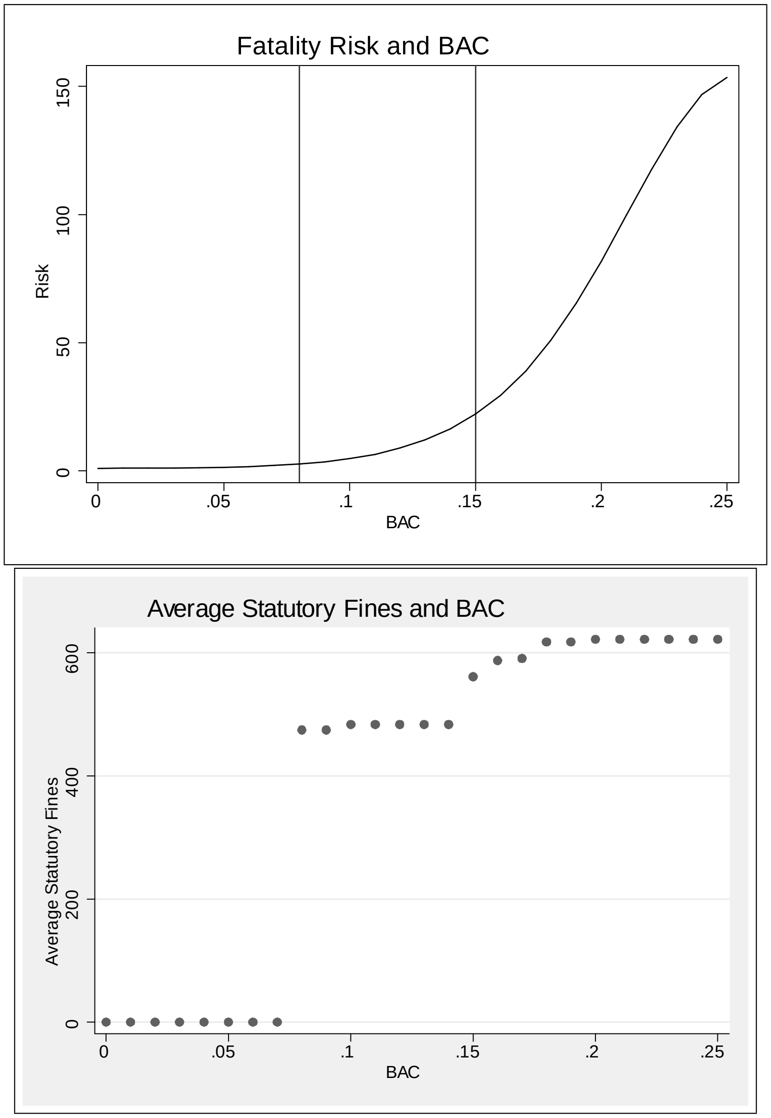


Figure 11 explores the sensitivity of the results to excluding observations near the thresholds via a "donut" RD. Exclusion of observations near the threshold has practically no effect on the precision or magnitude of the estimates.

Figure 12
Punishments vs. Risks Across BAC Distribution



This figure illustrates the estimated fatality risk across the BAC distribution vs. the expected statutory fine in the United States.

Table 1: Punishments for DUI Conviction Based on BAC

	1st Offense		2nd Offense		>=3rd Offense	
	DUI	Agg. DUI	DUI	Agg. DUI	DUI	Agg. DUI
BAC	[.08,.15]	(.15,1]	>=0.08	>.15	>=0.08	>.15
Min. Penalty	$865.50	$1,120.50	$1,120.50	$1,545.50	$1,970.50	$2,820.50
Max. Penalty	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Min. Jail Time	24 Hours	48 Hours	30 Days	45 Days	90 Days	150 Days
Min. Home Release	14 Days*	28 Days*	60 Days**	90 Days**	120 Days**	150 Days
License Susp./Revok. Period	90 Days^{+}	365 Days^{++}	2 Years^{++}	900 Days^{++}	3 Years^{++}	4 Years^{++}
SR-22 Insurance	Yes	Yes	Yes	Yes	Yes	Yes

This table outlines the Washington statutes on sanctions and punishments depending on the BAC measured.
* In lieu of Jail Time. ** Mandatory. $^{+}$.Suspension. $^{++}$ Revocation.

Table 2: Summary Statistics

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
BAC Range	[0,1]	[0,.08)	[.08,.15]	(.15,1]	[.074,.079]	[.080,.085]	[.145,.150]	[.151,.156]	[.079]	[.081]	[.149]	[.151]
Driver Demographics												
Age	35.5	36.0	34.5	36.4	34.9	34.3	35.3	34.9	34.3	33.8	35.2	34.4
[t-test]	N/A	[-18.4]		[37.7]	[-2.4]		[-1.5]		[-1.11]		[-2.04]	
Male	.792	.785	.796	.788	.792	.788	.785	.776	.781	.796	.809	.806
[t-test]	N/A	[3.6]		[4.6]	[-0.4]		[-1.4]		[0.88]		[0.26]	
White	.862	.843	.857	.872	.852	.850	.866	.878	.852	.866	.868	.867
[t-test]	N/A	[5.6]		[10.0]	[0.3]		[2.0]		[-1.2]		[0.13]	
Police Ex-Ante Information												
Accident	.149	.115	.112	.199	.089	.088	.145	.151	.088	.086	.146	.136
[t-test]	N/A	[-2.0]		[56.6]	[-0.2]		[0.6]		[-0.18]		[-0.94]	
Prior Tests	.190	.188	.161	.223	.139	.148	.170	.193	.143	.132	.171	.184
[t-test]	N/A	[-8.61]		[30.6]	[0.74]		[2.76]		[-.74]		[0.88]	
PBT Test	.132	.081	.118		.090	.092	.143	.147	.091	.093	.146	.147
[t-test]		[104.2]		[183.2]	[4.29]		[4.15]		[0.74]		[.55]	
Outcomes												
Recidivism	.120	.117	.110	.132	.113	.097	.122	.109	.103	.084	.125	.125
[t-test]		[-3.2]		[15.6]	[-2.8]		[-2.0]		[-1.45]		[0.22]	
Obs.	229,400	25,515	108,690	95,195	4,572	4,596	6,798	6,431	959	1,089	1,687	1,575

This table contains summary statistics for various BAC ranges. t-statistics testing for the differences of means are reported in [].

Table 3
DUI/AGG DUI and Characteristics

Characteristics	Driver Demographic Characteristics: Male	White	Age	Acc.	Police Ex-Ante Information: Prior	PBT
Panel A : DUI Threshold						
DUI	.007	.002	−.165	-.004	0.039	-.0007
	[1.33]	[0.39]	[-.99]	[-1.08]	[0.55]	[-1.26]
Mean (at .079)	.79					
Controls	No	No	No	No	No	No
Obs.	95,111	95,111	95,111	95,111	95,111	60,485
Panel B : Agg DUI Threshold						
AGG DUI	-.001	0.003	.049	.003	0.008	.0002
	[-1.23]	[0.99]	[0.40]	[0.71]	[1.31]	[.20]
Mean (at .149)						
Controls	No	No	No	No	No	No
Obs.	146,626	146,626	146,626	146,626	146,626	76,153

This table contains estimates of the effect of having BAC above the legal thresholds on predetermined characteristics. Panel A focuses on the estimated effect of BAC above the DUI threshold, while Panel B focuses the Aggravated DUI threshold. All regressions have a bandwidth of .05 and use a rectangular kernel for weighting.
*, **, and *** indicate significance at the 10, 5, and 1 % levels, [] contains estimated t-statistics.

Table 4: BAC Over DUI Threshold and Recidivism

	I	II	III	IV	V	VI
	All Suspected Offenders		No Prior Tests		At Least One Prior Stop	
Panel A : $BAC \in [.03, .13]$						
DUI	-.020***	-.021***	-.016***	-.017***	-.053***	-.053***
	[-4.68]	[-5.00]	[-3.92]	[-4.21]	[-3.48]	[-3.50]
Mean	.103		.093		.172	
Controls	No	Yes	No	Yes	No	Yes
Obs.	95,111	95,111	82,626	82,626	12,485	12,485
Panel B : $BAC \in [.055, .105]$						
DUI	-.019***	-.019***	-.017***	-.018***	-.037**	-.038**
	[-3.83]	[-4.02]	[-3.67]	[3.80]	[2.01]	[2.07]
Mean	.103		.093		.172	
Controls	No	Yes	No	Yes	No	Yes
Obs.	49,396	49,396	43,070	43,070	6,326	6,326

This table contains estimates of the effect of having BAC above the DUI threshold on recidivism for all drivers, those with no prior test, and drivers with at least one prior test. Panel A contains estimates with a bandwidth of .05 while Panel B has a bandwidth of .025, with all regressions utilizing a rectangular kernel for weighting. Controls include indicators for county, year, race, gender, and age of the offender.
*, **, and *** indicate significance at the 10, 5, and 1 % levels, [] contains estimated t-statistics.

Table 5: BAC Over Agg. DUI Threshold and Recidivism

	I	II	III	IV	V	VI
	All Suspected Offenders		No Prior Stops		At Least One Prior Test	
Panel A : *BAC* ∈ [.10, .20]						
Agg DUI	-.011***	-.010***	-.009**	-.009**	-.021**	-0.022**
	[-3.17]	[-3.05]	[-2.19]	[-2.10]	[-2.04]	[-2.15]
Mean	.125		.118		.165	
Controls	No	Yes	No	Yes	No	Yes
Obs.	146,426	146,626	124,192	124,192	22,234	22,234
Panel B : *BAC* ∈ [.125, .175]						
Agg DUI	-.011**	-0.011**	-.010*	-.010*	-.017	-.019
	[-2.29]	[-2.25]	[-1.70]	[-1.65]	[-1.17]	[-1.34]
Mean	.125		.118		.165	
Controls	No	Yes	No	Yes	No	Yes
Obs.	78,622	78,622	66,541	66,541	12,081	12,081

This table contains estimates of the effect of having BAC above the DUI threshold on recidivism for all drivers, those with no prior test, and drivers with at least one prior test. Panel A contains estimates with a bandwidth of .05 while Panel B has a bandwidth of .025, with all regressions utilizing a rectangular kernel for weighting. Controls include indicators for county, year, race, gender, and age of the offender.
*, **, and *** indicate significance at the 10, 5, and 1 % levels, [] contains estimated t-statistics.

Table 6: BAC Over DUI Threshold Recidivism Heterogeneity

	Recidivism Outcomes				
Recidivism BAC Range	[.08,.15]	(.15,.1]	[0,.08)	Refusal	Accident
Panel A : *All Suspected Offenders*					
DUI	-.0153**	-.007**	-.004*	.001	-.003**
	[-4.02]	[-2.37]	[-1.69]	[0.18]	[2.04]
Mean	.0625	.031	.016	.023	.008
Controls	Yes	Yes	Yes	Yes	Yes
Obs.	95,111	95,111	95,111	95,111	95,111
Panel B : *No Prior Stops*					
DUI	-.0148***	-.007**	-.003	.004	-.002
	[-3.90]	[-2.16]	[-1.54]	[1.57]	[-1.15]
Mean	.061	.028	.021	.041	0.00
Controls	Yes	Yes	Yes	Yes	Yes
Obs.	82,626	82,626	82,626	82,626	82,626
Panel C : *At least One Prior Stop*					
DUI	-.021*	-.010	-.009	-0.016	-.0128**
	[-1.92]	[-1.28]	[-1.36]	[-1.63]	[2.51]
Mean	.058	.056	.014	.049	.018
Controls	Yes	Yes	Yes	Yes	Yes
Obs.	12,485	12,485	12,485	12,485	12,485

This table contains estimates of the effect of having BAC above DUI threshold on 5 types of recidivism. Panel A contains estimates for all drivers, Panel B contains estimates for those no prior tests Panel C contains estimates for those with at least one prior test. .
All regressions are estimated with a bandwidth of .05 and use a rectangular kernel for weighting.
Controls include indicators for county, year, race, gender, and age of the offender.
*, **, and *** indicate significance at the 10, 5, and 1 % levels, [] contains estimated t-statistics.

Table 7: BAC Over Agg. DUI Threshold Recidivism Heterogeneity

	Recidivism type				
Recidivism BAC Range	[.08,.15]	(.15,.1]	[0,.08)	Refusal	Accident
Panel A : All Suspected Offenders					
AGG DUI	-.005**	-.004*	-.003***	-.001	-.006
	[-2.35]	[-1.80]	[-3.06]	[-0.75]	[-0.52]
Mean	.053	.056	.014	.049	.019
Controls	Yes	Yes	Yes	Yes	Yes
Obs.	146,626	146,626	146,626	146,626	146,626
Panel B : No Prior Stops					
AGG DUI	-.005**	-.004	-.006	.0005	-.004
	[-2.34]	[-1.63]	[-1.21]	[0.25]	[-0.29]
Mean	.052	.053	.015	.040	.018
Controls	Yes	Yes	Yes	Yes	Yes
Obs.	124,912	124,912	124,912	124,912	124,912
Panel C : At Least One Prior Stop					
AGG DUI	-.004	-.004	-.002	-.014**	-0.002
	[-0.55]	[-0.57]	[-.80]	[-2.06]	[-0.58]
Mean	.071	.071	.001	.076	.023
Controls	Yes	Yes	Yes	Yes	Yes
Obs.	22,234	22,234	22,234	22,234	22,234

This table contains estimates of the effect of having BAC above the aggravated DUI threshold on 5 types of recidivism. Panel A contains estimates for all drivers, Panel B contains estimates for those with no prior tests, and Panel C contains estimates for those with at least one prior test. All regressions are estimated with a bandwidth of .05 and use a rectangular kernel for weighting. Controls include indicators for county, year, race, gender, and age of the offender.
*, **, and *** indicate significance at the 10, 5, and 1 % levels, [] contains estimated t-statistics.

Table 8
Potential First Stages
Panel A: Court-Ordered Punishments and Sanctions

	Fine	Jail	Probation	Prob. Length	Home Mon.	Court Susp.	Susp. Length
			Panel A: Court-Ordered Sanctions and Punishments				
DUI	159.7***	3.84***	.081***	66.67***	.042***	.008***	-28.3
	[6.73]	[6.80]	[8.41]	[4.38]	[9.91]	[4.71]	[-0.69]
Mean (at.079)	523.5	8.61	.25	768.1	.19	.011	241
Median (at .079)	425	0	0	730	0	0	90
Agg. DUI	73.5**	1.40***	.001	25.9*	.005	-.001	78.8***
	[2.52]	[2.46]	[0.39]	[3.53]	[1.87]	[-0.67]	[4.93]
Mean (at .149)	918.8	19.4	.36	1256	.20	.056	246.2
Median (at .149)	662	1	1	1095	0	0	90

	Panel B: Alcohol-Related Court-Ordered Treatments			
	Victims Panel	Alcohol Assess.	Alc. Treatment	AA
DUI	.17***	.14***	.002**	.001
	[10.45]	[10.15]	[6.64]	[2.92]
Mean (at.079)	.58	.43	.12	.01
Median (at .079)	1	0	0	0
Agg. DUI	.001	-.008***	.007**	.002
	[.01]	[2.23]	[1.99]	[.22]
Mean (at .149)	.67	.53	.21	.030
Median (at .149)	1	1	0	0

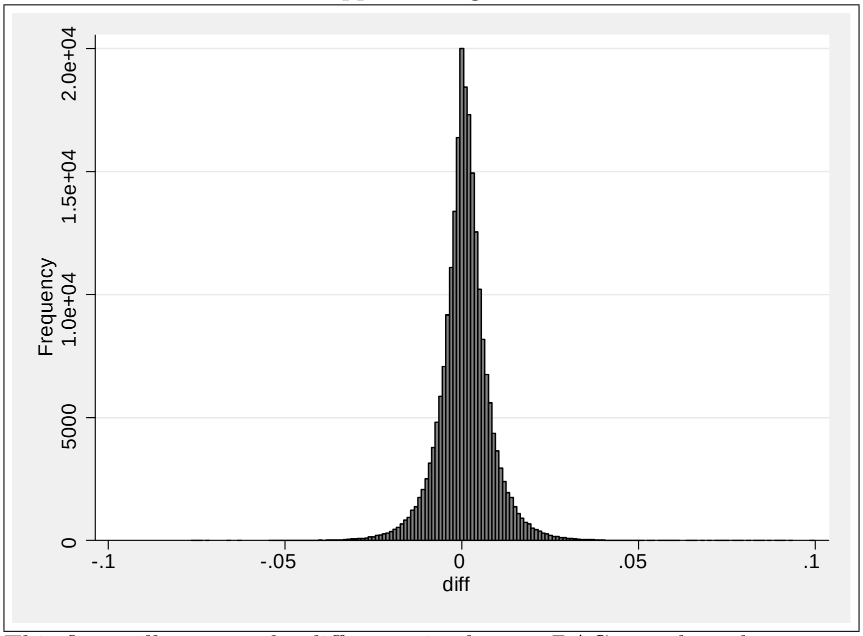
This table contains estimates of the change in court-ordered sanctions at the .08 and .15 thresholds.
Panel A contains court-ordered punishments and sanctions, while Panel B refers to court-ordered alcohol and drug abuse treatments and screening.
All regression models are local linear regressions with a bandwidth of .05 and use a rectangular kernel.
Controls include indicators for county, year, race, gender, and age of the offender.
*, **, and *** indicate significance at the 10, 5, and 1 % levels, [] contains estimated t-statistics.

Table 9
DUI/AGG DUI Thresholds and Other Crimes

Characteristics	Assault	Domestic Violence	Other Crimes	All Other Crimes
Panel A : DUI Threshold				
DUI	.0001	.00001	-.0006	-.0005
	[0.56]	[0.30]	[-1.37]	[0.55]
Mean	.0002	.00005	.001	.002
Controls	Yes	Yes	Yes	Yes
Obs.	95,111	95,111	95,111	95,111
Panel B : Agg DUI Threshold				
AGG DUI	-.0001	-.0001	0.0003	0.0002
	[-0.65]	[-0.11]	[0.75]	[0.54]
Mean	.0002	.0003	.0016	.002
Controls	Yes	Yes	yes	Yes
Obs.	146,626	146,626	146,626	146,626

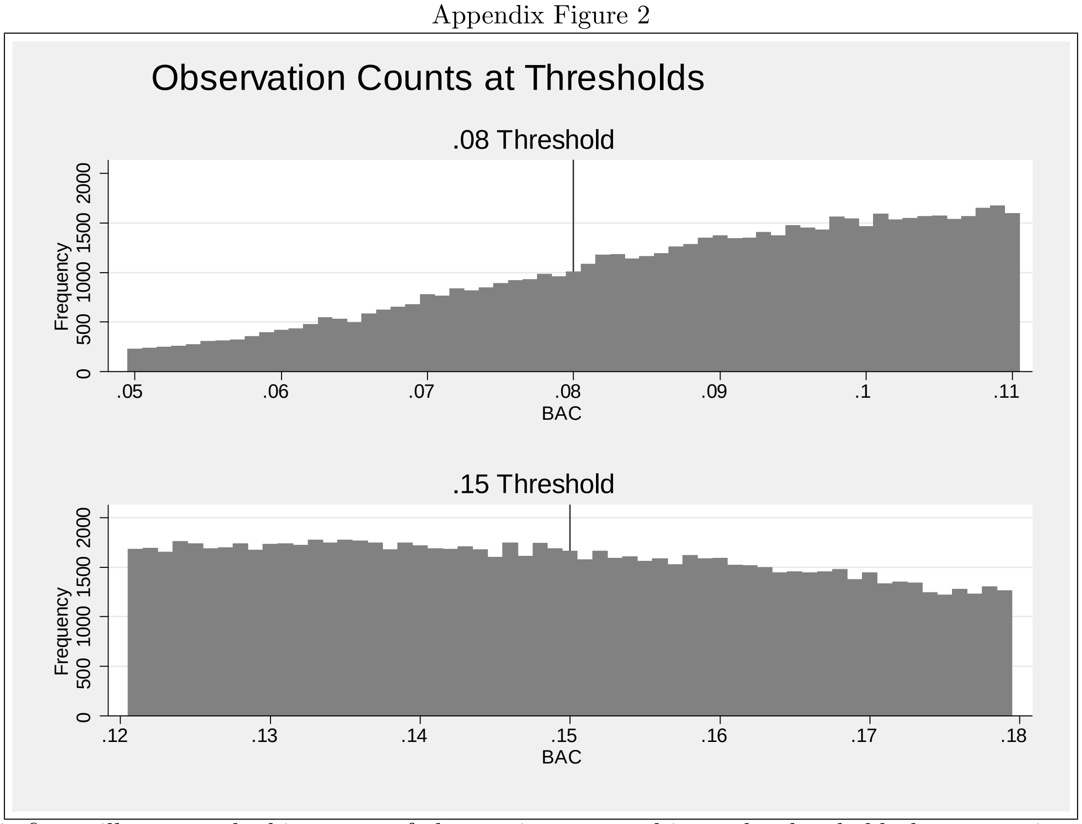
This table contains regression discontinuity based estimates on the effect of having BAC above the DUI threshold on future offending in other crimes involving alcohol tests. Panel A focuses on the effect of BAC above the DUI threshold, while Panel B focuses the Aggravated DUI threshold.
Controls include indicators for county, year, race, gender, and age of the offender.
All regressions have a bandwidth of .05 and use a rectangular kernel for weighting.
*, **, and *** indicate significance at the 10, 5, and 1 % levels, [] contains estimated t-statistics.

Appendix Figure 1



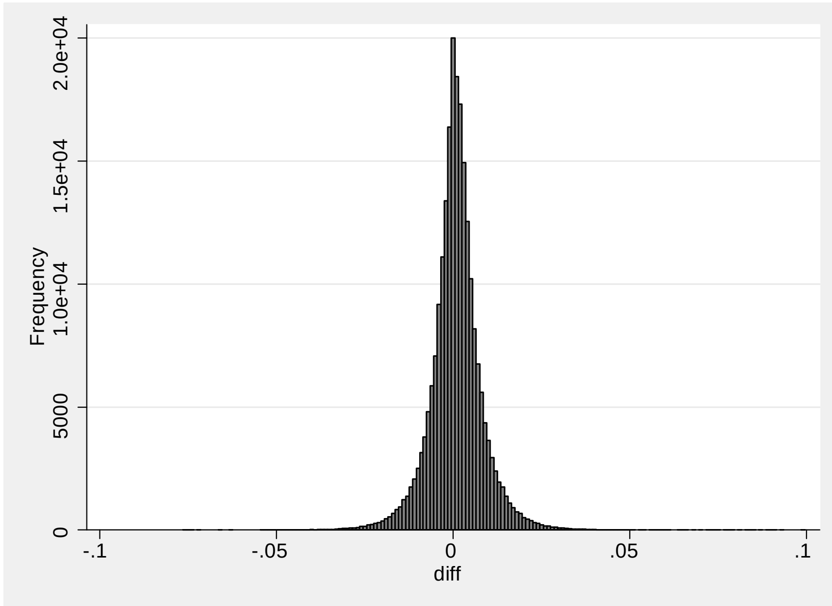
This figure illustrates the difference in the two BAC samples taken.

Appendix Figure 2



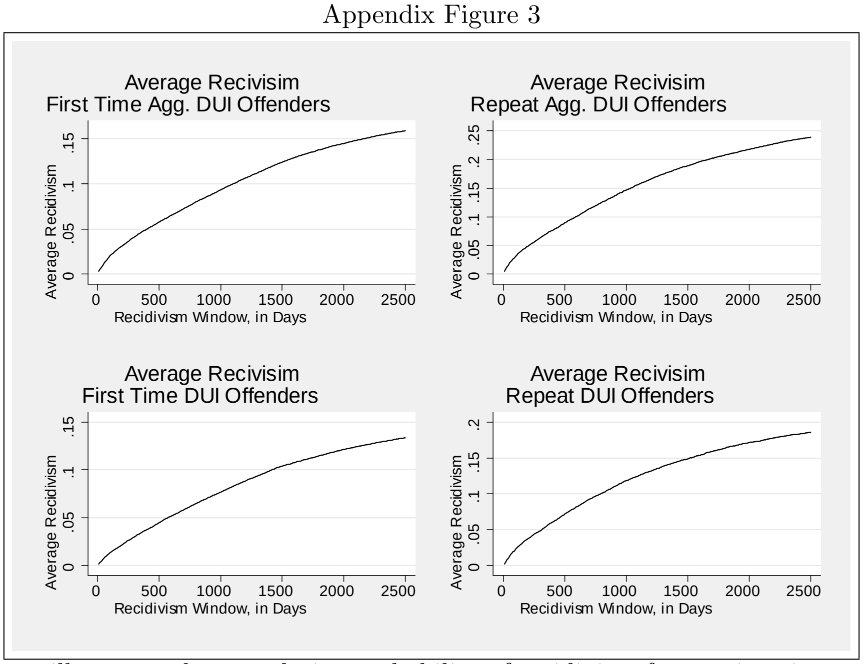
This figure illustrates the histogram of observations zoomed in at the threshold, demonstrating the continuity of the running variable.

Appendix Figure 2



This figure illustrates the difference in the two BAC samples taken.

Appendix Figure 3



This figure illustrates the cumulative probability of recidivism for varying time windows.

Appendix Table 1
DUI/AGG DUI Thresholds and Recidivism Hazards

Characteristics	0-90 Days	90-365 Days	365-730 Days	730-1460 Days
Panel A : DUI Threshold				
DUI	-.003*	-.0074**	-.004*	-.004**
	[-1.93]	[-3.41]	[-1.78]	[-1.97]
Mean	.014	.025	.031	.041
Controls	Yes	Yes	Yes	Yes
Obs.	95,111	95,111	95,111	95,111
Panel B : Agg DUI Threshold				
AGG DUI	-.0002	-.001	-.0007	-.005**
	[-0.24]	[-0.74]	[-.45]	[-2.20]
Mean	.014	.023	.026	.054
Controls	Yes	Yes	No	No
Obs.	146,626	146,626	146,626	146,626

This table contains regression discontinuity based estimates on the effect of having BAC above the DUI threshold on recidivism in time windows to illustrate effects on the hazard function. Panel A focuses on the estimated effect of BAC above the DUI threshold, while Panel B focuses on the estimated effect of BAC above the aggravated DUI threshold.
Controls include indicators for county, year, race, gender, and age of the offender.
All regressions have a bandwidth of .05 and use a rectangular kernel for weighting.
*, **, and *** indicate significance at the 10, 5, and 1 % levels, [] contains estimated t-statistics.

Appendix Table 2: DUI/AGG DUI Receipt

		DUI			AGG DUI	
Characteristics	I	II	III	IV	V	VI
DUI [AGG DUI]	-.021***	-0.013**	-.020***	-0.010***	-0.012**	-0.010*
	[-5.00]	[-2.57]	[3.00]	[3.05]	[-2.45]	[-1.64]
Polynomial Order	1	2	3	1	2	3
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	95,111	95,111	95,111	146,626	146,626	146,626

This table explores the sensitivity of the main estimates to the order of the polynomial
Controls include indicators for county, year, race, gender, and age of the offender.
*, **, and *** indicate significance at the 10, 5, and 1 % levels, [] contains estimated t-statistics.

Appendix Table 3: DUI/AGG DUI Recidivism

		DUI				AGG DUI		
Characteristics	I	II	III	IV	I	II	III	IV
Panel A : Bandwidth = .05								
DUI [AGG DUI]	-.015***	-.016***	-.017***	-.018***	-0.010***	-0.010***	-.010***	-.010***
	[-3.57]	[-3.73]	[-4.03]	[-4.21]	[-2.78]	[-2.73]	[-2.96]	[-2.90]
Kernel	Triangle	Triangle	Gaussian	Gaussian	Triangle	Triangle	Gaussian	Gaussian
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Obs.	95,111	95,111	95,111	95,111	146,626	146,626	146,626	146,626
Panel B : Bandwidth = .025								
DUI [AGG DUI]	-.014***	-.015***	-.016***	-0.17***	-.010**	-.010**	-.010**	-.009**
	[-2.92]	[-3.05]	[-3.15]	[-3.20]	[-2.15]	[-2.15]	[-2.11]	[-2.10]
Kernel	Triangle	Triangle	Gaussian	Gaussian	Triangle	Triangle	Gaussian	Gaussian
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Obs.	49,396	49,396	49,396	49,396	78,622	78,622	78,622	78,622

This table explores the sensitivity of the main estimates to the type of kernel used for weighting. Panel A presents estimates using a bandwidth of .05, while Panel B has estimates with a bandwidth of .025. Controls include indicators for county, year, race, gender, and age of the offender.
*, **, and *** indicate significance at the 10, 5, and 1 % levels, [] contains estimated t-statistics.