American Economic Review 2015, 105(4): 1581–1617
http://dx.doi.org/10.1257/aer.20130189

Punishment and Deterrence: Evidence from Drunk Driving[†]

By Benjamin Hansen*

I test the effect of harsher punishments and sanctions on 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 the additional sanctions experienced by drunk drivers at BAC thresholds are effective in reducing repeat drunk driving. (*JEL* I12, K42, R41)

Since the National Highway Traffic and Safety Administration began recording fatal traffic accident data in 1975, drunk driving was a factor in 585,136 traffic fatalities.[1] To put that magnitude in perspective, 725,347 murders occurred in the United States over a similar window. However, given that drunk driving is a very different crime than murder and other crimes, and it is often closely linked with addiction and substance abuse, what little we do know about preventing other crimes may not apply for drunk drivers. Understanding whether punishments and sanctions are effective in reducing drunk driving is crucial to determine the appropriate combination of enforcement and punishment that can maximize social welfare. To that end this paper offers quasi-experimental evidence on the effectiveness of blood alcohol content (BAC) thresholds, a primary policy tool used in curbing drunk driving.

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,

* University of Oregon, 1285 University of Oregon, Eugene, OR 97403 and NBER (e-mail: bchansen@uoregon.edu). 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.

[†] Go to http://dx.doi.org/10.1257/aer.20130189 to visit the article page for additional materials and author disclosure statement.

[1] Through the end of 2012.

ranging from violent and property crime offenders (Levitt 1997; McCrary 2002; Evans and Owens 2007; and Chalfin and McCrary forthcoming) 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 naïve comparisons of offenders 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 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 the harsher punishments and sanctions offenders experience at the BAC thresholds are effective in reducing drunk driving.

I further investigate several mechanisms including deterrence, incapacitation, and rehabilitation. In order to provide evidence regarding these alternative mechanisms, I examine the degree to which sanctions and punishments change at the thresholds, multiple time windows for recidivism, and alternative alcohol-related crimes. The bulk of the evidence based on the rich administrative data suggests the main channels operate through deterrence, although I cannot wholly rule out some effects operating through incapacitation and rehabilitation.

Broadly, the results suggest that harsher punishments and sanctions associated with BAC limits reduce future drunk driving. Recently the National Traffic Safety Board (NTSB) proposed lowering the BAC limit from 0.08 to 0.05. Central to their argument is the assumption that BAC thresholds are effective in curbing drunk driving. Related to this ongoing public debate, the estimates from this paper provide policy valuation for the effectiveness of current BAC thresholds in reducing drunk driving.

The paper proceeds as follows. Section I provides background on drunk driving and recidivism. Section II reviews the econometric methods and data sources used in the estimation. Section III presents the main estimates while Section IV discusses competing mechanisms which may explain the results. Section V concludes.

I. Background

A. *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).[2] Yet 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 1980s, until 0.08 became the quasi-uniform standard in the late 1990s and early 2000s. Prior research investigating the adoption of lower BAC limits suggests that lowering the BAC limit from 0.10 to 0.08 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.[3] 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 DUIs" 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.[4] In addition, most states maintain "Implied Consent" laws that 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.[5]

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.[6] The average penalties from today based on previous offenses and BAC are laid out in Table 1. Those with BACs over the legal limit face more severe expected punishments if convicted again in the future. However, the punishments for repeat

[2] 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).

[3] See Carpenter (2004) for a thorough review of zero-tolerance laws and their effects on youth risky behavior.

[4] 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 0.15 threshold could be inflated by dividing by 0.944.

[5] 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.

[6] In addition, the presence of a minor in the car increases the offense to aggravated DUI even if the BAC is between 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.

Table 1—Punishments for DUI Conviction Based on BAC and Prior Offenses

	1st offense		2nd offense		>=3rd offense	
	DUI	Agg. DUI	DUI	Agg. DUI	DUI	Agg. DUI
BAC	[0.08, 0.15]	(0.15, 1]	[0.08, 0.15]	(0.15, 1]	[0.08, 0.15]	(0.15, 1]
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

Note: This table outlines the Washington statutes on sanctions and punishments depending on the BAC measured.

** Mandatory

* In lieu of jail time

$^{++}$Revocation

$^{+}$Suspension

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 0.08 or 0.15 increases current punishments. In addition, WA'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.

B. *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. Principally, three main channels serve to determine future criminality of arrested or convicted individuals: incapacitation, rehabilitation, and deterrence.[7] 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 (2012) who finds lower crime rates in states with enhanced punishments for committing crimes with a firearm. Additionally, Drago, Galbiati, and Vertova (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 that 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, Galbiati, and Vertova 2011). Given that the effect of punishments and sanctions has varied in the previous literature across different populations or measures of punishment, previous estimates of the deterability

[7] Later in Section V, I investigate evidence supporting the role of each of these channels.

of offenders may not inform on whether harsher punishments or sanctions would reduce 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 that 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, 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 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 reduce drunk driving.

II. 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, WA applied a 0.08 threshold for determining a DUI, and a 0.15 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 0.08 or 0.15 threshold on recidivism within four years of the original BAC test.[9] For a suspected offender tested on January 1, 1999, the period from January 2, 1999 to January 1, 2003 is used to identify recidivism, while an offender tested on December 31, 2007 could

[8] Even if a study were to randomly 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.

[9] Four years after the original offense is a long enough window to capture behavioral changes outside of license removal, as illustrated in Table 1. Furthermore, it is also long enough to capture average periods before drunk drivers recidivate. Based on the administrative data, the modal drunk driver recidivates within 60 days of his or her first offense, while the median drunk driver recidivates within 1,443 days. The average length to recidivism based on my sample is 1,839, which reflects the skewed nature of the hazard function.

potentially recidivate in the January 1, 2008 to December 31, 2011 window.[10] 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 2001) to test the effect of the punishments imposed at BAC thresholds 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 the drivers would be able to manipulate which side of a threshold their BAC would fall (McCrary 2008).[11] 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 for a driver to have 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 the threshold, while other drunk drivers are randomly unlucky and have a BAC barely above the threshold.[12]

There are a number of reasons why this assumption is likely reasonable. The first is the level of accuracy to which the BAC is recorded in WA: 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, those breathalyzers utilize a portable technology which is far more volatile than the official breathalyzers used to assess guilt.[13] 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 0.99, and on average the difference is 0.0008, with the inter-quartile range of differences ranging from -0.003 to 0.004.[14] 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.

[10] Later on in this paper I also consider 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.

[11] Indeed, websites such as 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.

[12] My usage of "lucky" and "unlucky" in no way condones behaviors which are in essence identically risky both to themselves and others.

[13] 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.

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

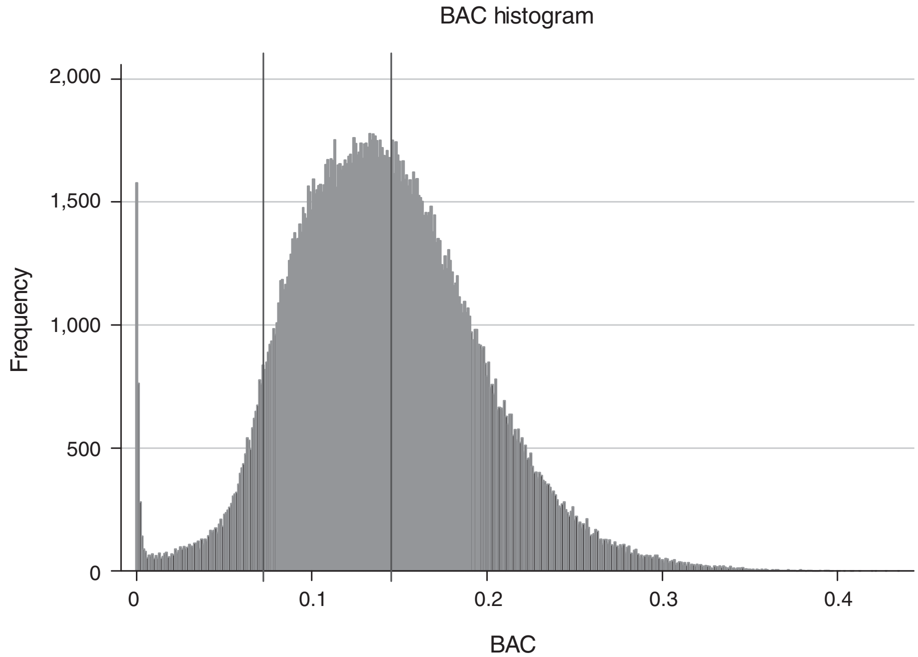


Figure 1. BAC Distribution

Notes: Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. The histogram height on the vertical axis is based on frequency of observations, with BAC on the horizontal axis. The vertical black lines represent the two legal thresholds at 0.08 and 0.15. The bin width is 0.001, the original precision used on the breathalyzers.

Figure 1 contains a histogram displaying the number of observations in each measured BAC level from 1999–2007.[15] 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 0.59 and 0.38 respectively at the 0.08 and 0.15 thresholds. Frandsen (2013) recently offered an alternative density test based on a local approximation to a binomial distribution that may offer improvements both in consistency and finite sample performance when the data are discrete or rounded. That test estimates a p-value of 0.795 at 0.08, and 0.886 at 0.15, 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, Lindo, and Waddell 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

[15] Appendix Figure 2 presents a histogram zoomed at the 0.08 and 0.15 thresholds, also showing little evidence of any sorting at either threshold.

higher order polynomials.[16] An indicator for either a DUI or aggravated DUI indicates, respectively, whether the BAC falls above the 0.08 or 0.15 thresholds. In the regression models the BAC variable is rescaled around the relevant threshold, either 0.08 or 0.15, X_i is a vector of controls, and y_i is a measure of recidivism.

$$(1) \qquad y_i = X_i{}'\gamma + \alpha_1 DUI_i + \alpha_2 BAC_i + \alpha_3 BAC_i \times DUI_i + u_i$$

In the regression discontinuity models, all regression models allow for clustering at the finest bin at which BAC is measured, 0.001.[17] This captures potential autocorrelation between individuals 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.

I offer another test of sorting by examining regression models based on equation (1) that feature predetermined characteristics of the drivers which should remain unchanged at the thresholds. The key driver demographics I examine are age (in years), 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 (PBT) 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.[18]

Table 2 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 0.05 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 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 aggravated DUI. The

[16] 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 0.03 to 0.20, and expanding the bandwidth to include observations from greater BAC ranges does relatively little to increase the sample size.

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

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

Table 2—Regression Discontinuity Estimates for the Effect of Exceeding BAC Thresholds on Predetermined Characteristics

	Driver demographic characteristics				Police ex ante information	
Characteristics	Male (1)	White (2)	Age (3)	Accident (4)	Prior (5)	PBT (6)
Panel A. DUI threshold						
DUI	0.007	0.002	–0.165	–0.004	0.039	–0.0007
	(0.005)	(0.005)	(0.167)	(0.004)	(0.071)	(0.0005)
Mean (at 0.079)	0.792	0.852	34.9	0.089	0.139	0.090
Controls	No	No	No	No	No	No
Observations	95,111	95,111	95,111	95,111	95,111	60,485
Panel B. Agg. DUI threshold						
AGG DUI	–0.001	0.003	0.049	0.003	0.008	0.0002
	(0.001)	(0.003)	(0.123)	(0.004)	(0.006)	0.001)
Mean (at 0.149)	0.785	0.866	35.3	0.145	0.170	0.143
Controls	No	No	No	No	No	No
Observations	146,626	146,626	146,626	146,626	146,626	76,153

Notes: This table contains regression discontinuity based 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 0.05 and use a rectangular kernel for weighting. Based on data from the 1999–2007 Washington State Impaired Driver Program. Standard errors are in parentheses.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

lack of significance in the regression coefficients is also supported graphically in Figure 2.

Figure 2 presents bins of predetermined characteristics and corresponding fitted regression lines based on equation (1) (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 versus 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 design can deliver unbiased estimates in this scenario as it suggests neither the impaired driver nor the police officer is able to manipulate testing on either side of the 0.08 or 0.15 thresholds.

III. Results

I first examine the reduced form effect of having a BAC over the 0.08 and 0.15 thresholds on future drunk driving. As such, this approach answers a fundamental policy question: Do BAC limits as currently administered reduce future drunk driving? In this section, 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,

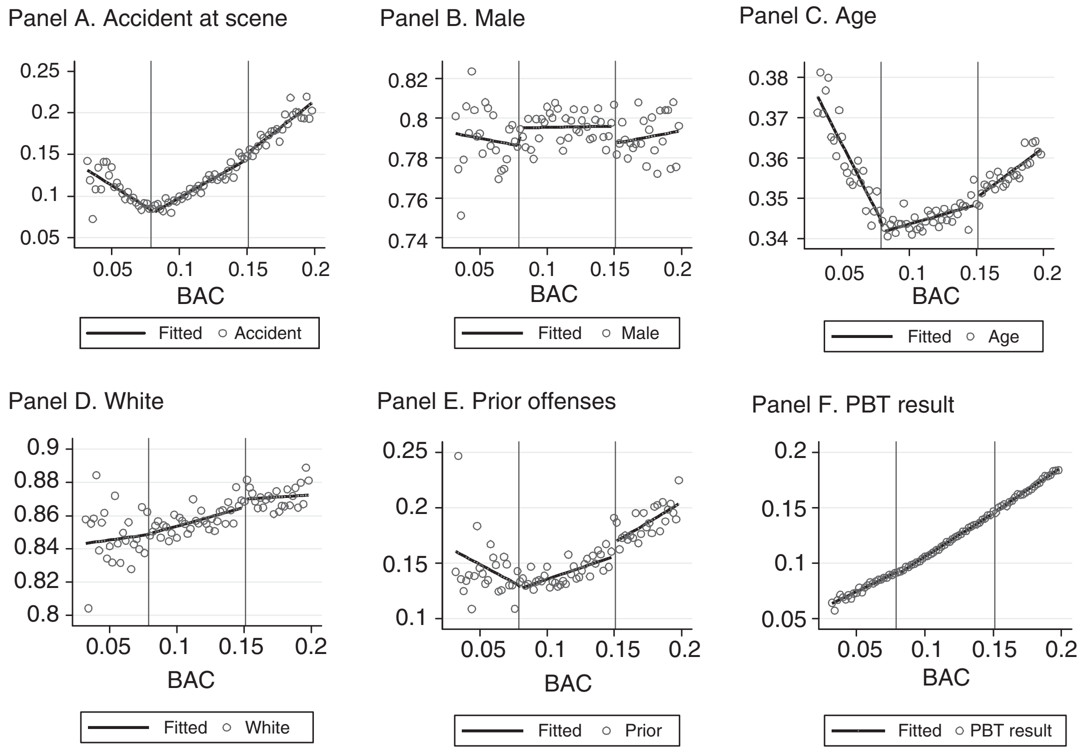


Figure 2. BAC and Characteristics

Notes: Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. Points represent the averages, with fitted values based on local linear models in black lines. The vertical black lines represent the two legal thresholds at 0.08 and 0.15. The bin width is 0.002.

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 2013).[19] Recidivism is an indicator which takes on the value of 0 if the drivers 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 four years of the original offense.

A. *Punishment and Recidivism*

Table 3 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.[20] All of

[19] 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.

[20] 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.

Table 3—Regression Discontinuity Estimates for the Effect of Exceeding the 0.08 BAC Threshold on Recidivism

	All tested drivers (1)	No prior tests (2)	At least one prior test (3)
Panel A. BAC $\in$ [0.03, 0.13]			
DUI	−0.021***	−0.017***	−0.053***
	(0.004)	(0.004)	(0.015)
Mean	0.103	0.093	0.172
Controls	Yes	Yes	Yes
Observations	95,111	82,626	12,485
Panel B. BAC $\in$ [0.055, 0.105]			
DUI	−0.019***	−0.018***	−0.038**
	(0.005)	(0.005)	(0.018)
Mean	0.103	0.093	0.172
Controls	Yes	Yes	Yes
Observations	49,396	43,070	6,326

Notes: This table contains regression discontinuity based 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 0.05 while Panel B has a bandwidth of 0.025, with all regressions utilizing a rectangular kernel for weighting. Controls include indicators for county, year, race, gender, and age of the offender. Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. Standard errors are in parentheses.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

the estimates are from models with controls for gender, race, age fixed effects, prior offenses, county fixed effects, and year fixed effects.[21] Panel A includes estimates with a bandwidth of 0.05, while panel B presents estimates derived with a smaller bandwidth of 0.025, both using a rectangular kernel for weighting.[22] Having a BAC above the 0.08 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 the drivers 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]

Figure 3 plots means of recidivism rates in bins and predicted recidivism rates based on simple regression models for all offenders highlights the stark changes in recidivism which occur at the 0.08 and 0.15 thresholds. The black lines represent

[21] Appendix Table 1 has an identical table without controls. The results are numerically equivalent, with economically small and insignificant differences.

[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.

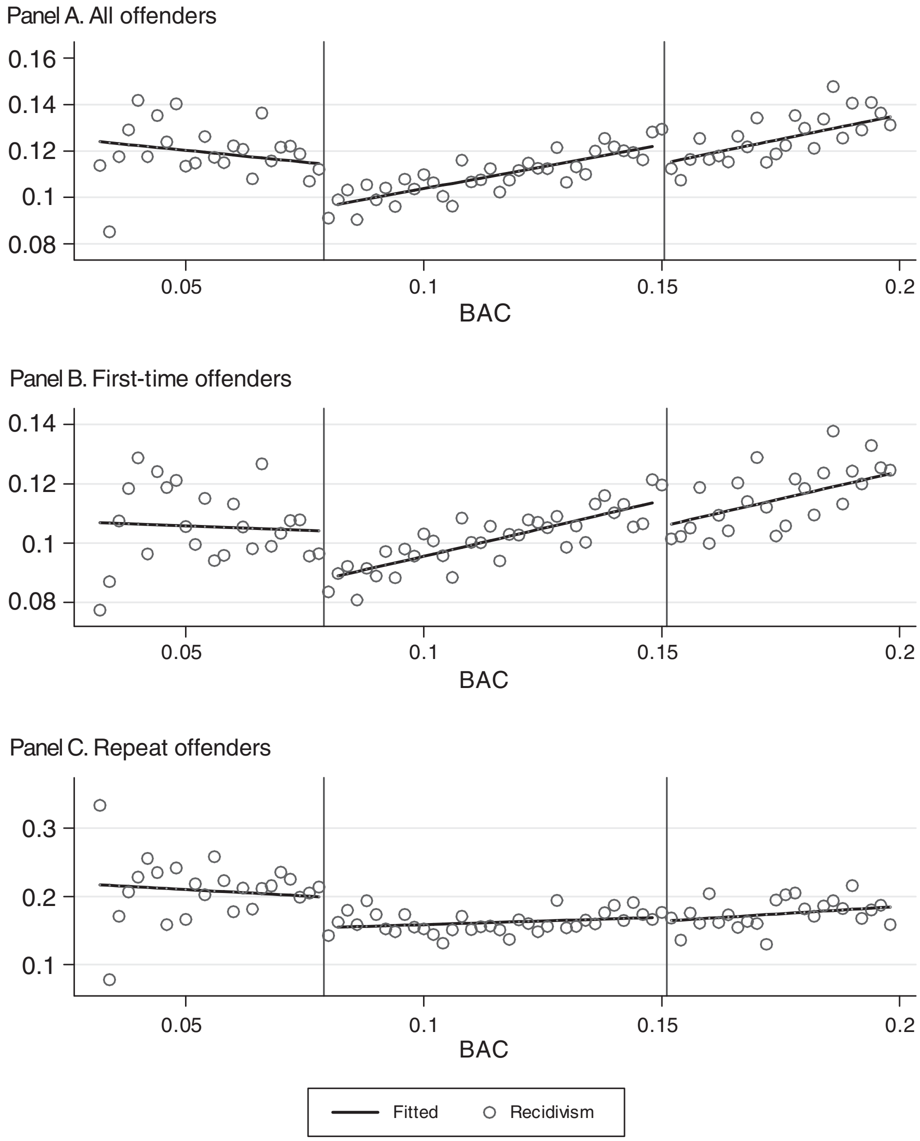


Figure 3. BAC and Recidivism

Notes: Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. Points represent the averages, with fitted values based on local linear models in black lines. The vertical black lines represent the two legal thresholds at 0.08 and 0.15. The bin width is 0.002.

the fitted regressions in the intervals 0.03 to 0.079, 0.08 to 0.15, and 0.15 to 0.20. There is a notable drop in recidivism at both the 0.08 and 0.15 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 tested drivers who have no prior tests. These tested drivers have less experience and face lower expected punishments. The third panel contains recidivism rates for tested drivers 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 0.08 and 0.15 legal limits is associated with lower recidivism rates.

Table 4—Regression Discontinuity Estimates for the Effect of Exceeding the 0.15 BAC Threshold on Recidivism

	All tested drivers (1)	No prior tests (2)	At least one prior test (3)
Panel A. BAC ∈ [0.10, 0.20]			
Agg. DUI	−0.010***	−0.009**	−0.022**
	(0.003)	(0.004)	(0.010)
Mean	0.125	0.118	0.165
Controls	Yes	Yes	Yes
Observations	146,626	124,192	22,234
Panel B. BAC ∈ [0.125, 0.175]			
Agg. DUI	−0.011**	−0.010*	−0.019
	(0.005)	(0.006)	(0.014)
Mean	0.125	0.118	0.165
Controls	Yes	Yes	Yes
Observations	78,622	66,541	12,081

Notes: 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 0.05 while panel B has a bandwidth of 0.025, with all regressions utilizing a rectangular kernel for weighting. Controls include indicators for county, year, race, gender, and age of the offender. Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. Standard errors are in parentheses.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Table 4 presents the estimated effect of having a BAC above the aggravated DUI threshold on recidivism within four years of the initial stop.[24] Likewise, panel A utilizes a bandwidth of 0.05 while panel B uses a bandwidth of 0.025, 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 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 Appendix Figure 3. For every possible bandwidth from 0.005 to 0.068, the estimated effect of having a BAC above the DUI or aggravated DUI threshold is presented along with the 95 percent 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 0.02, the estimates are also statistically significant (at least at the 95 percent 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.

[24] Appendix Table 2 has an identical table without controls. The results are numerically equivalent, with economically small and insignificant differences.

B. *Heterogeneity of Recidivism*

In the previous estimates, recidivism is defined rather simply as whether a driver submits to or refuses a test within four 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 0.08 or 0.15. 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 2008). 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 [0.080, 0.15]; the BAC is [0.151, 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 5 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, for those with no prior tests, and for those with at least 1 prior test. All regressions are weighted using a rectangular kernel and have a bandwidth of 0.05. For the entire population of suspected drunk drivers, having a BAC above the 0.08 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 0.08 to 0.15. 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 the drivers are not getting in accidents or exhibiting the normal signs of impairment.

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 one prior test are less likely to 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 6 presents estimates for the effect of having a BAC above the aggravated DUI thresholds on the probability of specific recidivism outcomes, similar to Table 5. Once again the regressions are weighted using a rectangular kernel and bandwidth of 0.05. 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

Table 5—Regression Discontinuity Estimates for the DUI Threshold-Effect Heterogeneity

	Recidivism outcomes				
Recidivism BAC range	[0.08, 0.15] (1)	(0.15, 0.1] (2)	[0, 0.08) (3)	Refusal (4)	Accident (5)
Panel A. All tested drivers					
DUI	−0.0153***	−0.007**	−0.004*	0.001	−0.003**
	(0.004)	(0.003)	(0.002)	(0.005)	(0.001)
Mean	0.0625	0.031	0.016	0.023	0.008
Controls	Yes	Yes	Yes	Yes	Yes
Observations	95,111	95,111	95,111	95,111	95,111
Panel B. No prior tests					
DUI	−0.0148***	−0.007**	−0.003	0.004	−0.002
	(0.004)	(0.003)	(0.002)	(0.003)	(0.002)
Mean	0.061	0.028	0.021	0.041	0.00
Controls	Yes	Yes	Yes	Yes	Yes
Observations	82,626	82,626	82,626	82,626	82,626
Panel C. At least one prior test					
DUI	−0.021*	−0.010	−0.009	−0.016	−0.0128**
	[0.011]	(0.007)	(0.006)	(0.009)	(0.051)
Mean	0.058	0.056	0.014	0.049	0.018
Controls	Yes	Yes	Yes	Yes	Yes
Observations	12,485	12,485	12,485	12,485	12,485

Notes: This table contains estimates of the effect of having BAC above the 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 0.05 and use a rectangular kernel for weighting. Controls include indicators for county, year, race, gender, and age of the offender. Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. Standard errors are in parentheses.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

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 0.08 recidivate less, as do drivers with BAC over the 0.15 threshold. Having a BAC over either the 0.08 or 0.15 thresholds is associated with a decrease in future accidents particularly among offenders with prior DUI stops. In the subsequent section I discuss potential mechanisms and how they relate to theoretical underpinnings that determine criminality, particularly in the context of drunk driving.

IV. Mechanisms and Connections to Theory of Crime

Having a BAC above the either 0.08 or 0.15 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

Table 6—Regression Discontinuity Estimates for the Agg. DUI Threshold-Effect Heterogeneity

	Recidivism outcomes				
Recidivism BAC range	[0.08, 0.15] (1)	(0.15, 0.1] (2)	[0, 0.08) (3)	Refusal (4)	Accident (5)
Panel A. All suspected offenders					
AGG DUI	−0.005**	−0.004*	−0.003***	−0.001	−0.006
	(0.002)	(0.002)	(0.001)	(0.001)	(0.012)
Mean	0.053	0.056	0.014	0.049	0.019
Controls	Yes	Yes	Yes	Yes	Yes
Observations	146,626	146,626	146,626	146,626	146,626
Panel B. No prior tests					
AGG DUI	−0.005**	−0.004	−0.006	0.0005	−0.004
	(0.002)	(0.003)	(0.005)	(0.002)	(0.014)
Mean	0.052	0.053	0.015	0.040	0.018
Controls	Yes	Yes	Yes	Yes	Yes
Observations	124,912	124,912	124,912	124,912	124,912
Panel C. At least one prior test					
AGG DUI	−0.004	−0.004	−0.002	−0.014**	−0.002
	(0.008)	(0.007)	(0.002)	(0.007)	(0.003)
Mean	0.071	0.071	0.001	0.076	0.023
Controls	Yes	Yes	Yes	Yes	Yes
Observations	22,234	22,234	22,234	22,234	22,234

Notes: 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 0.05 and use a rectangular kernel for weighting. Controls include indicators for county, year, race, gender, and age of the offender. Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. Standard errors are in parentheses.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

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. Some of these sanctions are substitutes (assessments versus treatment), while attending a victims panel is often used complementary to the other sanctions. 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.[25] For an individual to prematurely end a license suspension the driver 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.[26] It would be empirically impossible to separate this combination of treatments all of which potentially shift when a BAC is over either threshold. However, examining the degree to which the

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

[26] It costs roughly $100 to 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 (www.dol.wa.gov/driverslicense/iil.html).

sanctions change at each of the thresholds provides suggestive evidence on likely mechanisms driving the reductions in drunk driving.

Related to theories of criminality, I examine three primary mechanisms: incapacitation, rehabilitation, and deterrence. These mechanisms all could play a role in the effect of BAC thresholds on drunk driving. Related to incapacitation, the increased suspension or revocation of driving privileges at the thresholds could reduce drunk driving. Furthermore, at the thresholds, court-ordered treatments could lead to rehabilitation and reduced alcohol abuse. Finally, with each prior offense expected, repeat sanctions increase. Thus having a BAC over the 0.08 threshold could deter future drunk driving, as Becker's seminal model predicted. Alternatively, individuals could also respond to the past punishment they received, which criminologists have referred to as "specific deterrence." Examples of specific deterrence have been empirically supported in other contexts. In Haselhuhn et al. (2012), they find that individuals at video rental establishments are less likely to return rentals late after paying a fine, despite future fines the individual faced remaining constant.

In order to provide evidence on the role these alternative mechanisms play in the response of drunk drivers to exceeding the BAC thresholds, I examine first the degree to which the sanctions and punishments change at each threshold. I then examine a variety of time-varying windows to discern if the policy effect is driven by the periods of license removal versus the periods with increased punishments. I also examine alternative alcohol related crimes which would be affected by rehabilitation rather than deterrence.

A. *Sanctions and BAC Thresholds*

As discussed earlier, numerous mechanisms 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 7 contains estimates of the effect of having a BAC over the legal limits on court punishments, sanctions, and treatments.[27] All regression models are local linear regressions using a rectangular kernel, include the same previous controls, and use a bandwidth of 0.05. Panel A reports estimates for the 0.08 threshold while panel B reports estimates for the 0.15 threshold. Having a BAC over the 0.08 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 4, as is the estimated percentage change for each sanction at both the 0.08 and 0.15 thresholds. At the 0.08 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 0.15 threshold, jail time increases by 8 percent and

[27] Appendix Tables 3 and 4 contain the results for similar specifications for those with no prior BAC tests and those with at least one prior BAC test, respectively.

Table 7—Regression Discontinuity Estimates of Changes in Judicial Outcomes at the BAC Thresholds

	Fine	Jail	Any fine	Any jail	Home Mon.
Panel A. Fines and incarceration					
DUI	159.7***	3.84***	0.157***	0.112***	0.042***
	(23.72)	(0.564)	(0.014)	(0.013)	(0.004)
Mean (at 0.079)	523.5	8.61	0.69	0.31	0.19
Median (at 0.079)	425	0	1	0	0
Agg. DUI	73.5**	1.40***	−0.001	0.010*	0.005*
	(29.2)	(0.569)	(0.004)	(0.006)	(0.003)
Mean (at 0.149)	918.8	19.4	0.805	0.61	0.20
Median (at 0.149)	662	1	1	1	0

Panel B. Probation and suspensions

	Court suspension	Suspension length	Probation	Probation length
DUI	0.008***	−28.3	0.081***	66.67***
	(0.002)	(41.01)	(0.010)	(15.22)
Mean (at 0.079)	0.011	241	0.25	768.1
Median (at 0.079)	0	90	0	730
Agg. DUI	−0.001	78.8***	0.001	25.9***
Mean (at 0.149)	(0.001)	(15.98)	(0.004)	(7.33)
Median (at 0.149)	0.056	246.2	0.36	1256
	0	90	1	1095

Panel C. Alcohol-related court-ordered treatments

	Victims panel	Alcohol assess	Alcohol treatment	Alcoholics Anonymous	Any alcohol treatment
DUI	0.17***	0.14***	0.028***	0.002***	0.154***
	(0.016)	(0.014)	(0.004)	(0.0003)	(0.014)
Mean (at 0.079)	0.58	0.43	0.43	0.01	0.416
Median (at 0.079)	1	0	0	0	0
Agg. DUI	0.001	−0.008***	0.007**	0.002	−0.004
	(0.01)	(0.003)	(0.003)	(0.009)	(0.004)
Mean (at 0.149)	0.67	0.53	0.53	0.030	0.587
Median (at 0.149)	1	1	1	0	0

Notes: This table contains regression discontinuity estimates of the change in court-ordered sanctions at the 0.08 and 0.15 thresholds. Panel A contains court-ordered fines and incarceration, panel B refers to court-ordered suspensions and probation, while panel C contains alcohol and drug abuse treatments and screening. All regression models are local linear regressions with a bandwidth of 0.05 and use a rectangular kernel. Controls include indicators for county, year, race, gender, and age of the offender. Based on administrative records from the Washington State Impaired Driver Testing Program linked with record from the Washington State Courts. Standard errors are in parentheses.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

fines increase 9 percent, while court ordered license suspension length increase by 35 percent.[28] Interestingly, alcohol assessments decreases by roughly 1 percentage point, while alcohol abuse treatment increases by an essentially offsetting amount.

[28] 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 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.

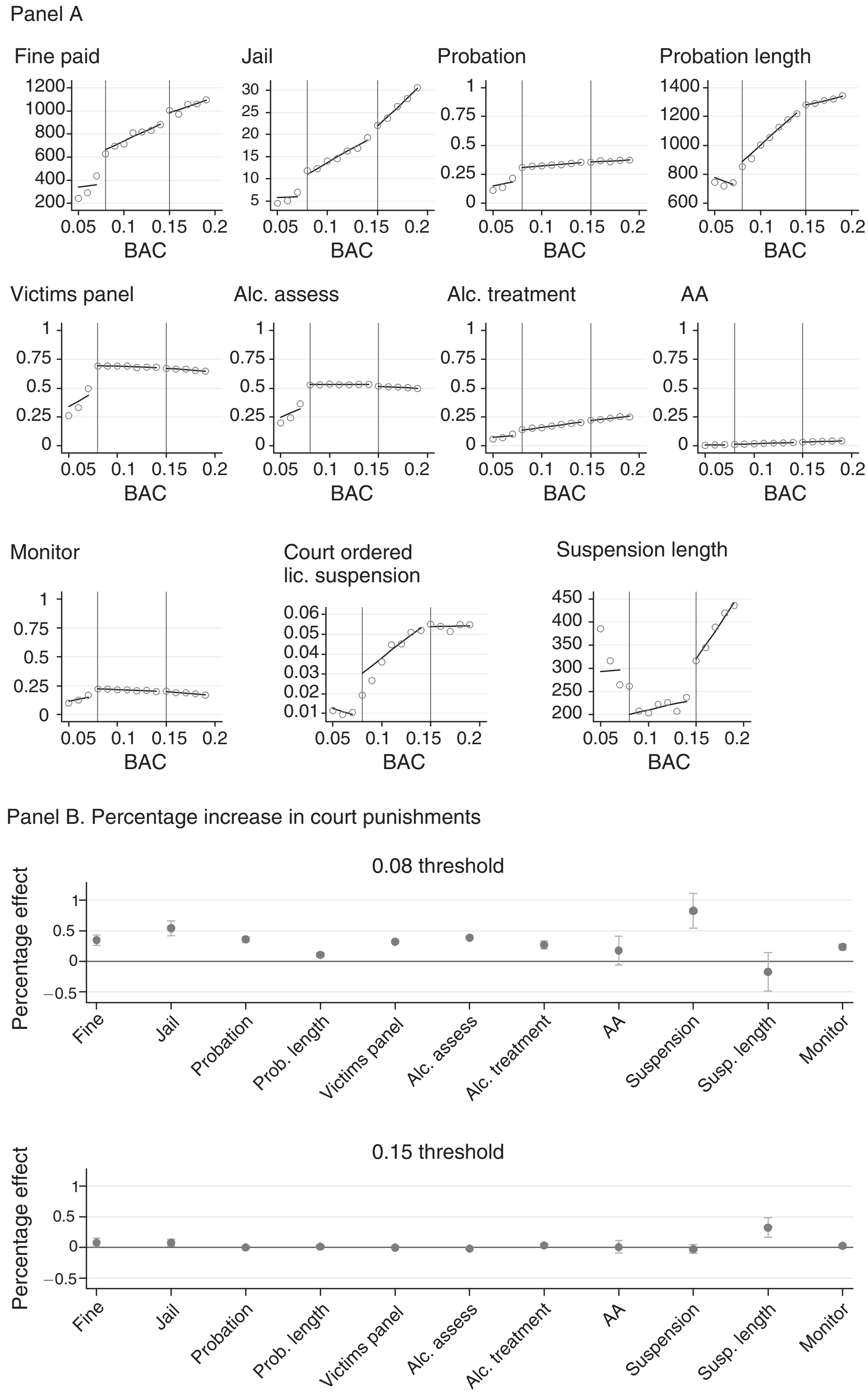


Figure 4. Potential Mechanisms

Notes: Based on administrative records from the Washington State Impaired Driver Testing Program linked with administrative records from the Washington State Courts. In panel A, points represent averages, with fitted values based on local linear models in black lines. The vertical black lines represent the two legal thresholds at 0.08 and 0.15. The bin width is 0.002. Panel B is based on estimates from regression discontinuity models. The points represent estimates while the lines represent the end points of 95 percent confidence interval.

It is worth noting that despite the intricate data maintained by the courts in WA, certain aspects of the sanctions at the 0.08 and 0.15 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 0.08 (for an individual's first offense) and an individual receives a revocation of 365 days with a BAC over 0.15 (resulting in a 400 percent increase in the licensure removal period), as laid out in Table 1.

B. *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 timing of reoffending. Second, it provides evidence on whether the previous estimates concerning the effectiveness of punishment are driven by long-run changes in behavior, or short-run changes due to incapacitation (see Kessler and Levitt 1999; 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 0.05 and rectangular kernel weighting.

Identification of incapacitation effects is 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.[29] 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.[30] Importantly and regardless, this analysis will also allow the detection of any abrupt changes that result because of license suspension or revocation.

The first approach I consider is the effect of exceeding a BAC threshold on adjacent time periods. The periods I analyze are the first 90 days, 91 to 365 days, 366 to

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

[30] In some sense, as driving without a license will bring additional fines, punishments and sanctions, one could consider declines in drunk driving operating through Beckerian deterrence.

730 days, and 731 to 1,460 days. These periods are motivated by the time periods associated with the variety of license suspension periods a driver may face depending on prior offenses and BAC, as laid out in Table 1. If the declines in recidivism are driving by license suspension, then we would expect to see the reduction in recidivism evident at the 0.08 threshold driven largely by a drop in drunk driving in the first 90 days, based on the punishments in Table 1. Likewise, if the earlier results at the 0.15 threshold are driven by declines in drunk driving during the 91 to 365 day period, then the decrease could be largely attributable to the license removal according to the license forfeiture periods in Table 1.

The estimates for the adjacent time windows are presented in Table 8. Having a BAC over the 0.08 threshold is associated with reductions in future drunk driving for each of the four adjacent windows. Notably, the estimated reduction is largest in both absolute magnitude and percentage terms in a 91 to 365 day window, a period after most license suspensions have ended. Likewise, the point estimates would imply having BAC over the 0.15 threshold is also associated with declines in recidivism during each of the adjacent time windows, although the estimates are not always statistically significant. The estimated coefficients suggest the 0.15 threshold effect is largest in the 731 to 1,460 day period, also a period for which the license suspensions have ended for the majority of drivers in the sample. This does not necessarily suggest that license suspension is not effective sanction in curbing driving. Indeed, drivers might be deterred from drunk driving again after they lose their license and experience the inconvenience of that sanction. Nonetheless, the results from the adjacent windows suggest that the declines in drunk driving are not largely driven by the period in which the license is actually suspended or revoked.

Appendix Figures 4 and 5 present additional evidence on the effect of having a BAC over either of the thresholds. Appendix Figure 4 presents the estimated probability effects (with confidence intervals) and semi-elasticities for every potential time window from 10 days to 2,200 days, both for drivers with no prior tests and those with at least one prior test. As might be expected given the point estimates in Table 8, the effect of having a BAC above the DUI threshold grows in absolute magnitude as the window increases in size for both 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.[31] 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 2,200 days (6 years), the long-run effect 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 DUIs leads to both short-term and long-term reductions in recidivism.

The effects of having a BAC above the aggravated DUI threshold in recidivism windows ranging from 10 to 2,200 days are explored in Appendix Figure 5. Similar regressions are employed, once again using rectangular kernels for weighting. For aggravated DUIs, point estimates are initially close to zero before growing

[31] Appendix Figure 6 presents the baseline probability across windows for first-time and repeat offenders.

consistently negative as the recidivism window expands. In the longer windows (those over 1,200 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 toward -0.1. This suggests that enhanced punishments from aggravated DUIs do not appear to be more effective in curbing drunk driving in the short run than an ordinary DUI. However, in the long run, having a BAC above the aggravated DUI threshold decreases recidivism by an additional 10 percent. This is consistent with point estimates in Table 8 and suggests the additional sanctions and punishments at the 0.15 threshold lead drunk drivers to exhibit long-run changes in their behavior, rather than short-run changes related to incapacitation from a suspended license or time in jail.

C. *Rehabilitation*

Another important channel that might reduce future drunk driving is rehabilitation. Indeed many sanctions imposed by the court related to alcohol increase considerably at the 0.08 threshold, including attending a victims panel, taking an alcohol abuse assessment, and receiving alcohol treatment.[32] 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 0.15 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. The evidence from the judicial outcomes suggest that if rehabilitation due to the court-mandated alcohol treatment programs were driving the findings, we would likely only expect a reduction in recidivism at the 0.08 threshold. However the main results show significant reductions at both the 0.08 and 0.15 thresholds, despite the fact that court-mandated alcohol-treatment does not change at the second threshold.

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 0.08 and 0.15 thresholds. While majority of breath tests are conducted for drunk driving, they are also collected at times for other crimes to establish the role of alcohol. Furthermore, Carpenter and Dobkin (2014) and Kilmer et al. (2013) provide evidence that other crimes related to violence increase in response to increased access to alcohol. I utilize econometric models identical to those in the previous sections, with the point estimates reported in Table 9.[33] Overall, the results do not provide strong evidence that these other crimes decrease in response to having a BAC over either the 0.08 or 0.15 thresholds. While this does not completely rule out rehabilitation, it also fails to provide evidence supporting it as a primary mechanism.[34]

[32] In addition, the slope of recidivism kinks at 0.08 which could be due to the change in the slope of the prescription of these court order prescriptions at 0.08. See Card et al. (2012).

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

[34] Future work could improve the power of this analysis by linking to the universe of domestic violence arrests and other assaults, and thereby including the cases which did not involve a breath test.

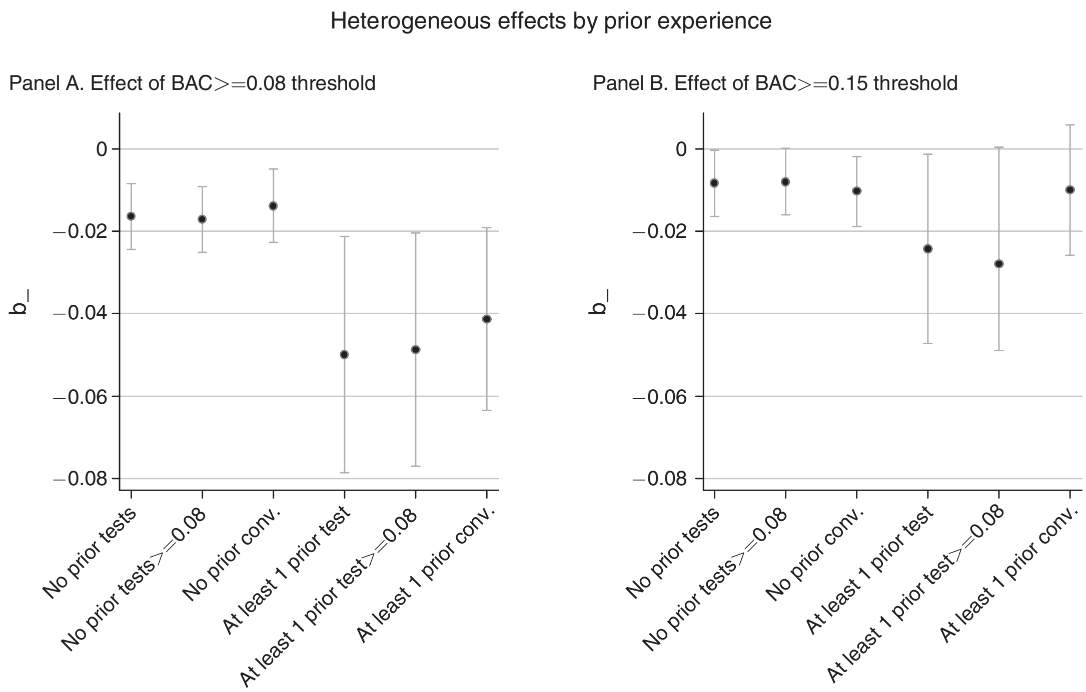


Figure 5. Robustness of Prior Experience Measures

Notes: Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. Based on results from regression discontinuity models estimated with local linear models, a bandwidth of 0.05, and controls for age, gender, race, county fixed effects, and year fixed effects. The points represent point estimates while the lines represent the endpoints of a 95 percent confidence interval.

Table 8—Regression Discontinuity Estimates of the DUI/Agg. DUI Threshold Effects across Recidivism Windows

Characteristics	0–90 Days (1)	90–365 Days (2)	365–730 Days (3)	730–1,460 Days (4)
Panel A. DUI threshold				
DUI	−0.003*	−0.0074**	−0.004*	−0.004**
	(0.002)	(0.003)	(0.002)	(0.002)
Mean	0.014	0.025	0.031	0.041
Controls	Yes	Yes	Yes	Yes
Observations	95,111	95,111	95,111	95,111
Panel B. Agg. DUI threshold				
AGG DUI	−0.0002	−0.001	−0.0007	−0.005**
	(0.001)	(0.001)	(0.002)	(0.002)
Mean	0.0140	0.023	0.026	0.054
Controls	Yes	Yes	No	No
Observations	146,626	146,626	146,626	146,626

Notes: 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 DUI threshold effect, while panel B focuses on the Agg. DUI Threshold effect. Controls include indicators for county, year, race, gender, and age of the offender. Controls include indicators for county, year, race, gender, and age of the offender. Based, on administrative record from the Washington State Impaired Driver Testing Program, 1999–2007. All regressions have a bandwidth of 0.05 and use a rectangular kernel for weighting. Standard errors are in parentheses.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Table 9—Regression Discontinuity Estimates of the DUI/AGG DUI Threshold Effects and Other Crimes

Characteristics	Assault (1)	Domestic violence (2)	Other crimes (3)	All other crimes (4)
Panel A. DUI threshold				
DUI	0.0001	0.00001	−0.0006	−0.0005
	(0.0002)	(0.00003)	(0.0004)	(0.0009)
Mean	0.0002	0.00005	0.001	0.002
Controls	Yes	Yes	Yes	Yes
Observations	95,111	95,111	95,111	95,111
Panel B. Agg. DUI threshold				
AGG DUI	−0.0001	−0.0001	0.0003	0.0002
	(0.0002)	(0.001)	(0.0004)	(0.0004)
Mean	0.0002	0.0003	0.0016	0.002
Controls	Yes	Yes	Yes	Yes
Observations	146,626	146,626	146,626	146,626

Notes: 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 on the Aggravated DUI threshold. Controls include indicators for county, year, race, gender, and age of the offender. Based on administrative record from the Washington State Impaired Driver Testing Program, 1999–2007. All regressions have a bandwidth of 0.05 and use a rectangular kernel for weighting. Standard errors are in parentheses.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

D. *Deterrence and Specific Deterrence*

Given prior channels did not explain the reduction in repeat drunk driving, deterrence remains as an alternative mechanism. As discussed previously regarding Table 1, a deterrent effect of DUI punishments and sanctions existed at the 0.08 threshold, given that statutory punishments increase with each offense. 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 −0.22.[35]

Having a BAC over the 0.15 threshold increases current punishments and sanctions, but does not directly have an effect on statutory sanctions for future offenses. 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 Yellen 1985; Tversky and Kahneman 1986; Sargent 1993; and Chetty, Looney, and Kroft 2009). In short, specific deterrence occurs when a criminal is backward looking and offends less due to a punishment they have already received, rather than because of the threat of future punishments they will receive only if they commit future crimes.

[35] Additionally, the semi elasticites are largest earlier on in the cumulative recidivism windows in Appendix Figure 4. As shown in Table 7, probation is an additional sanction those with a BAC over 0.08 often experience. Recidivism during the probationary period can result in additional punishment and sanctions.

Alternatively, the harsher punishments may have driven the drunk drivers to rehabilitation, with rehabilitation serving as a special case of specific deterrence. Given that fines, jail time, alcohol treatments, and license suspension increase by 74 percent on average at the 0.15 threshold, this would suggest a specific deterrence elasticity of −0.12.[36]

Furthermore, having a BAC over the 0.08 threshold potentially has its own specific deterrent effect in addition to increasing expected future punishments. Average punishments and sanctions increase by 71 percent at 0.08. Due to the combination of treatments received by those with BACs over the 0.08 threshold, we cannot empirically separate if specific deterrence or deterrence is driving the reduction in criminality. If we were to assume drivers at the 0.08 threshold have the same specific deterrence elasticity as those at the 0.15 threshold, then the deterrence elasticity at 0.08 diminishes to −0.11.

E. *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 as a "donut RD"), and testing the stability of conviction probabilities at the 0.15 threshold.

Figure 5 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 0.08 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 0.08 (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 approach 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 be 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.[37]

[36] That said, the reductions in drunk driving at the 0.15 threshold could also in part be driven by deterrence. As shown in Table 7, Appendix Table 3 and Appendix Table 4, court-ordered probation and suspension increase in length at the 0.15 threshold, as does the administrative license suspension and revocation based on Table 1. If an individual reoffends with a suspended license, they face greater fines due to driving without license. Furthermore, reoffending during a probationary period can result in additional jail time and fines which were held during the initial sentencing. Based on Table 8, having a BAC over 0.15 lead to the biggest and most significant reductions in the 730-1460 day period after an initial stop. This is after the end of probation and suspension for most drivers, which suggests these deterrent effects would likely be secondary.

[37] The structure of punishments in Washington also suggest third and fourth time 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 subgroups, the sample sizes are too small to have sufficient power for examining heterogeneous reductions in the hazard functions.

Another concern could be that police or judges treat tested drivers 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 3, excluding observations near the thresholds. To fully investigate the sensitivity of the results, I drop first the observation at the threshold and expand the window dropped by a step of 0.001 BAC in each direction until I drop observations from −0.005 to 0.005 relative to the threshold in question. The estimates and confidence intervals are plotted in Appendix Figure 6.[38] The point estimates and confidence intervals for each of those alternative samples are essentially identical to the main specifications. This gives additional evidence supporting the locally random nature of BAC near the thresholds and of the discrete change in sanctions and punishments that suspected drunk drivers experience at the threshold.[39]

In Figure 6, I investigate the effect of having a BAC above the aggravated DUI threshold 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 6, 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, 0.006 (0.018), −0.014. (0.017), and −0.009 (0.020). This is evidence that changes in conviction probabilities at the 0.15 threshold are not driving the reduction in recidivism.[40]

V. Conclusion

Alcohol abuse continues to be a major public health problem in the United States (Carpenter and Dobkin 2009, 2011). In dollar values, the externality associated with each incident of drunk driving may be as high as $8,000 (Levitt and Porter

[38] Alternative approaches to modeling the polynomial and kernel choice are explored in Appendix Tables 5 and 6. The results show robustness in magnitude and significance across a variety of specifications.

[39] 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 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, −0.024 and−0.014 at the DUI threshold, and −0.0103 and −0.0101 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.

[40] 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.

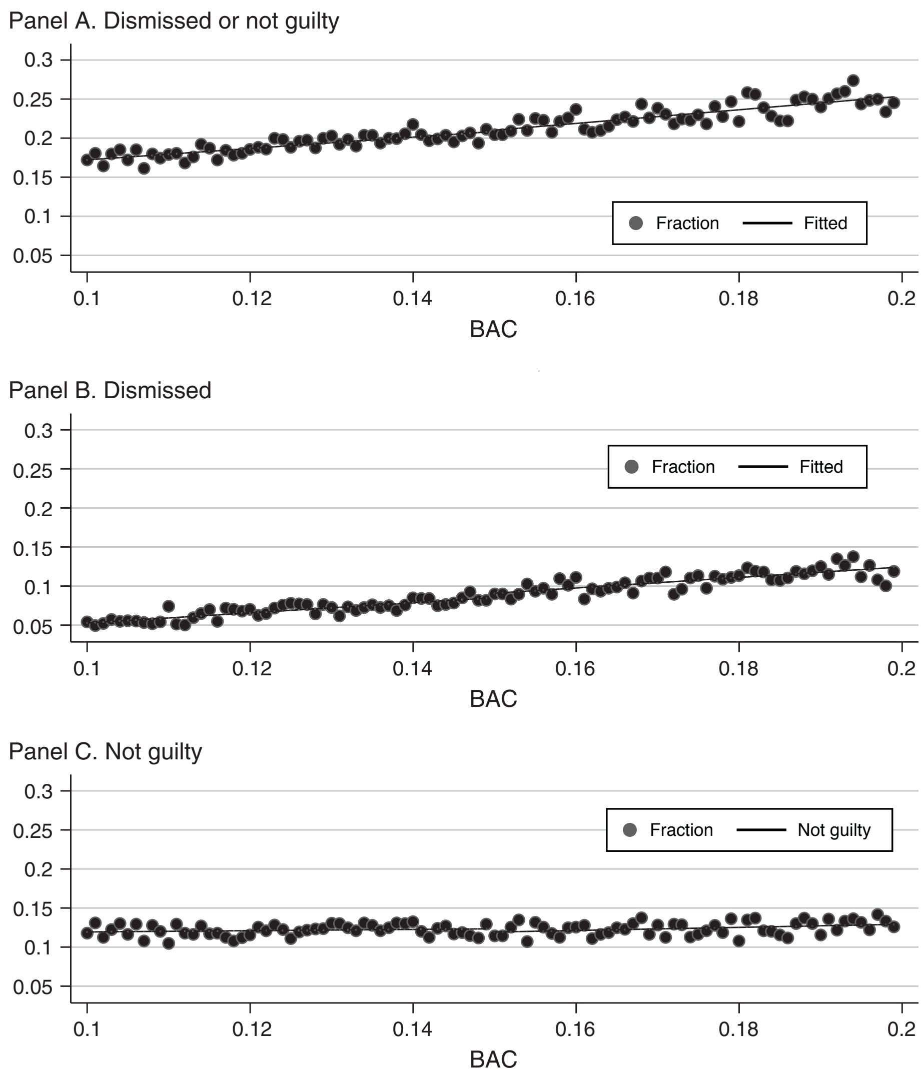


FIGURE 6. JUDICIAL OUTCOMES

Notes: Based on administrative records from the Washington State Impaired Driver Testing Program linked with administrative records from the Washington State Courts. Points represent averages, with fitted values based on local linear models in black lines. The bin width is 0.002.

2001).[41] This paper offers evidence concerning the effectiveness of punishments and sanctions in reducing recidivism among drunk drivers, finding evidence that having a BAC above either the 0.08 DUI threshold or the 0.15 aggravated DUI is associated with reduced repeat drunk driving both in the short and long term. The estimates suggest having a BAC over the 0.08 legal limit corresponds with a 2 percent point decline in repeat drunk driving over the next four years. Likewise, having a BAC over the 0.15 enhanced punishment limit is associated with an additional 1 percentage point decline in repeat drunk driving. Importantly, the identification

[41] Related to the external costs, Yu (2000) and Yu, Evans, and Clark (2006) investigate the patterns of recidivism from a criminal justice perspective.

strategy does not estimate the full benefits of the sanctions and punishments, as the presence of more severe punishments may also prevent those who would have otherwise been first-time drunk drivers from ever being tested.

I investigate several mechanisms which could explain the reductions in repeat driving associated with a BAC over the legal thresholds. Linking the BAC tests with administrative records from Washington Courts I find evidence that a variety of sanctions and punishments increase in severity at each of the BAC legal limits. Translating the percentage increase in sanctions and the decline in drunk driving into an elasticity, I find evidence that 10 percent increase in sanctions and punishments is associated with a 2.3 percent decline in drunk driving. I then investigate 3 primary channels related to criminality that could explain the reductions in recidivism: incapacitation, rehabilitation, and deterrence. While I cannot completely rule out the influence of incapacitation and rehabilitation, the increase in the type of sanction at each threshold and the timing of the reductions of drunk driving are most consistent with deterrence serving as a primary channel. As such, 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.[42] However, the significant decrease in recidivism evident in drunk drivers with BAC over the 0.15 threshold 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).

Lastly, although public debate has often focused on the BAC limit, including recent proposal by the NTSB to lower the BAC limit to 0.05, there are also 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. 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, while substantial resources are spent informing the public of the 0.08 threshold through advertisements and public service announcements, information regarding the higher 0.15 threshold could reduce drunk driving among the drivers with highest BACs who are ultimately responsible for the greatest number of fatalities.

[42] The usage of "bad luck" here in no way condones having a BAC near the aggravated threshold, as that level of intoxication is extremely dangerous both to the driver and other drivers on the road.

Appendix

Appendix Table 1—BAC over DUI Threshold and Recidivism

	All tested drivers (1)	No prior tests (2)	At least one prior test (3)
Panel A. BAC ∈ [0.03, 0.13]			
DUI	−0.020***	−0.016***	−0.053***
	(0.004)	(0.004)	(0.015)
Mean	0.103	0.093	0.172
Controls	No	No	No
Observations	95,111	82,626	12,485
Panel B. BAC ∈ [0.055, 0.105]			
DUI	−0.019***	−0.017***	−0.037**
	(0.005)	(0.005)	(0.018)
Mean	0.103	0.093	0.172
Controls	No	No	No
Observations	49,396	43,070	6,326

Notes: 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 0.05 while panel B has a bandwidth of 0.025, with all regressions utilizing a rectangular kernel for weighting. Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. Standard errors are in parentheses.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Appendix Table 2—BAC over Agg. DUI Threshold and Recidivism

	All tested drivers	No prior tests	At least one prior test
Panel A. BAC ∈ [0.10, 0.20]			
Agg. DUI	−0.011***	−0.009**	−0.021**
	(0.003)	(0.004)	(0.010)
Mean	0.125	0.118	0.165
Controls	No	No	No
Observations	146,426	124,192	22,234
Panel B. BAC ∈ [0.125, 0.175]			
Agg. DUI	−0.011**	−0.010*	−0.017
	(0.005)	(0.006)	(0.015)
Mean	0.125	0.118	0.165
Controls	No	No	No
Observations	78,622	66,541	12,081

Notes: 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 0.05 while panel B has a bandwidth of 0.025, with all regressions utilizing a rectangular kernel for weighting. Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. Standard errors are in parentheses.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Appendix Table 3—Regression Discontinuity Estimates of Changes in Judicial Outcomes at both BAC Thresholds for Drivers with No Prior Tests

	Fine	Jail	Any fine	Any jail	Home Mon.
Panel A. Fines and incarceration					
DUI	110.2***	0.64**	0.079***	0.076***	0.017***
	(24.52)	(0.364)	(0.011)	(0.013)	(0.005)
Mean (at 0.079)	439.7	2.98	0.751	0.274	0.215
Median (at 0.079)	375	0	1	0	0
Agg. DUI	57.6**	0.223	0.005	0.025***	0.005*
	(23.6)	(0.405)	(0.004)	(0.006)	(0.003)
Mean (at 0.149)	918.8	8.55	0.805	0.596	0.225
Median (at 0.149)	662	1	1	1	0

	Court suspension	Suspension length	Probation	Probation length
Panel B. Probation and suspensions				
DUI	0.006***	5.42	0.048***	−0.82
	(0.002)	(20.75)	(0.009)	(10.44)
Mean (at 0.079)	0.009	65.5	0.232	671.5
Median (at 0.079)	0	90	0	720
Agg. DUI	−0.001	65.0***	0.003	30.7***
	(0.001)	(12.6)	(0.004)	(9.2)
Mean (at 0.149)	0.060	107.8	0.329	1153
Median (at 0.149)	0	90	0	730

	Victims panel	Alcohol assess	Alcohol treatment	Alcoholics Anonymous	Any alc. treatment
Panel C. Alcohol-related court-ordered treatments					
DUI	0.089***	0.089***	0.002	−0.0001	0.091***
	(0.012)	(0.011)	(0.004)	(0.001)	(0.011)
Mean (at 0.079)	0.59	0.409	0.083	0.006	0.423
Median (at 0.079)	1	0	0	0	0
Agg. DUI	0.001	−0.008***	0.007**	0.002	−0.004
	(0.01)	(0.003)	(0.003)	(0.009)	(0.004)
Mean (at 0.149)	0.67	0.53	0.53	0.030	0.587
Median (at 0.149)	1	1	1	0	0

Notes: This table contains regression discontinuity estimates of the change in court-ordered sanctions at the 0.08 and 0.15 thresholds. Panel A contains court-ordered fines and incarceration, panel B refers to court-ordered suspensions and probation, while panel C contains alcohol and drug abuse treatments and screening. All regression models are local linear regressions with a bandwidth of 0.05 and use a rectangular kernel. Controls include indicators for county, year, race, gender, and age of the offender. Based on administrative records from the Washington State Impaired Driver Program linked with records from the Washington State Courts. Standard errors are in parentheses.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Appendix Table 4—Regression Discontinuity Estimates of Changes in Judicial Outcomes at Both BAC Thresholds for Drivers with at Least One Prior Test

	Fine	Jail	Any fine	Any jail	Home Mon.
Panel A. Fines and incarceration					
DUI	387.6***	20.10***	0.304***	0.263***	0.098***
	(40.2)	(1.74)	(0.019)	(0.019)	(0.004)
Mean (at 0.079)	442.6	14.22	0.473	0.312	0.091
Median (at 0.079)	0	0	0	0	0
Agg. DUI	105.9	4.19***	-0.012	-0.021**	0.004
	(76.8)	(1.41)	(0.007)	(0.009)	(0.005)
Mean (at 0.149)	918.8	46.8	0.794	0.794	0.156
Median (at 0.149)	662	2	1	1	0

	Court suspension	Suspension length	Probation	Probation length
Panel B. Probation and suspensions				
DUI	0.013***	−34.1	0.180***	257.6***
	(0.003)	(74.7)	(0.015)	(39.8)
Mean (at 0.079)	0.011	445.5	0.19	855.7
Median (at 0.079)	0	450	0	730
Agg. DUI	−0.001	108.4**	−0.003	15.1
	(0.003)	(41,9)	(0.006)	(13.6)
Mean (at 0.149)	0.046	536.9	0.413	1401
Median (at 0.149)	0	730	0	1825

	Victims panel	Alcohol assess	Alcohol treatment	Alcoholics Anonymous	Any alcohol treatment
Panel C. Alcohol-related court-ordered treatments					
DUI	0.310***	0.238***	0.154***	0.022***	0.293***
	(0.021)	(0.019)	(0.011)	(0.003)	(0.019)
Mean (at 0.079)	0.321	0.27	0.123	0.017	0.301
Median (at 0.079)	0	0	0	0	0
Agg. DUI	0.003	−0.013	−0.007	−0.006	−0.010
	(0.006)	(0.008)	(0.006)	(0.004)	(0.007)
Mean (at 0.149)	0.627	0.516	0.311	0.057	0.572
Median (at 0.149)	1	1	0	0	0

Notes: This table contains regression discontinuity estimates of the change in court-ordered sanctions at the 0.08 and 0.15 thresholds. Panel A contains court-ordered fines and incarceration, panel B refers to court-ordered suspensions and probation, while panel C contains alcohol and drug abuse treatments and screening. All regression models are local linear regressions with a bandwidth of 0.05 and use a rectangular kernel. Controls include indicators for county, year, race, gender, and age of the offender. Based on administrative records from the Washington State Impaired Driver Program linked with records from the Washington State Courts. Standard errors are in parentheses.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Appendix Table 5—Polynomial Robustness

	DUI			AGG DUI		
Characteristics	(1)	(2)	(3)	(4)	(5)	(6)
DUI [*AGG DUI*]	−0.021***	−0.013**	−0.020***	−0.010***	−0.012**	−0.010*
	(0.004)	(0.005)	(0.007)	(0.003)	(0.005)	(0.006)
Polynomial order	1	2	3	1	2	3
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	95,111	95,111	95,111	146,626	146,626	146,626

Notes: 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. Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. Standard errors are in parentheses.

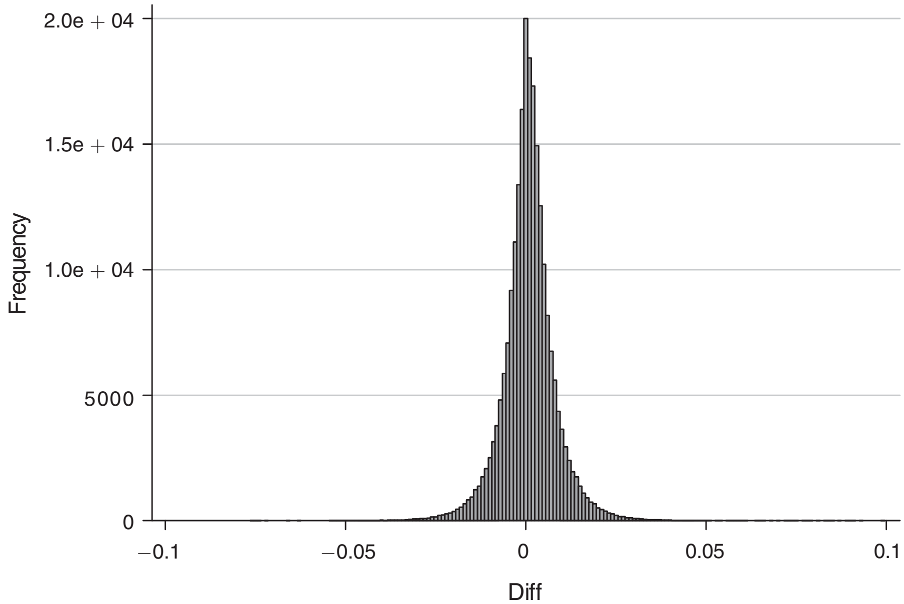
*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Appendix Table 6—Kernel Robustness

	DUI		AGG DUI	
Characteristics	(1)	(2)	(3)	(4)
Panel A. Bandwidth = 0.05				
DUI [AGG DUI]	−0.016***	−0.018***	−0.010***	−0.010***
	(0.004)	(0.004)	(0.003)	(0.003)
Kernel	Triangle	Gaussian	Triangle	Gaussian
Controls	Yes	Yes	Yes	Yes
Observations	95,111	95,111	146,626	146,626
Panel B. Bandwidth = 0.025				
DUI [AGG DUI]	−0.015***	−0.017***	−0.010**	−0.009**
	(0.005)	(0.005)	(0.004)	(0.004)
Kernel	Triangle	Gaussian	Triangle	Gaussian
Controls	Yes	Yes	Yes	Yes
Observations	49,396	49,396	78,622	78,622

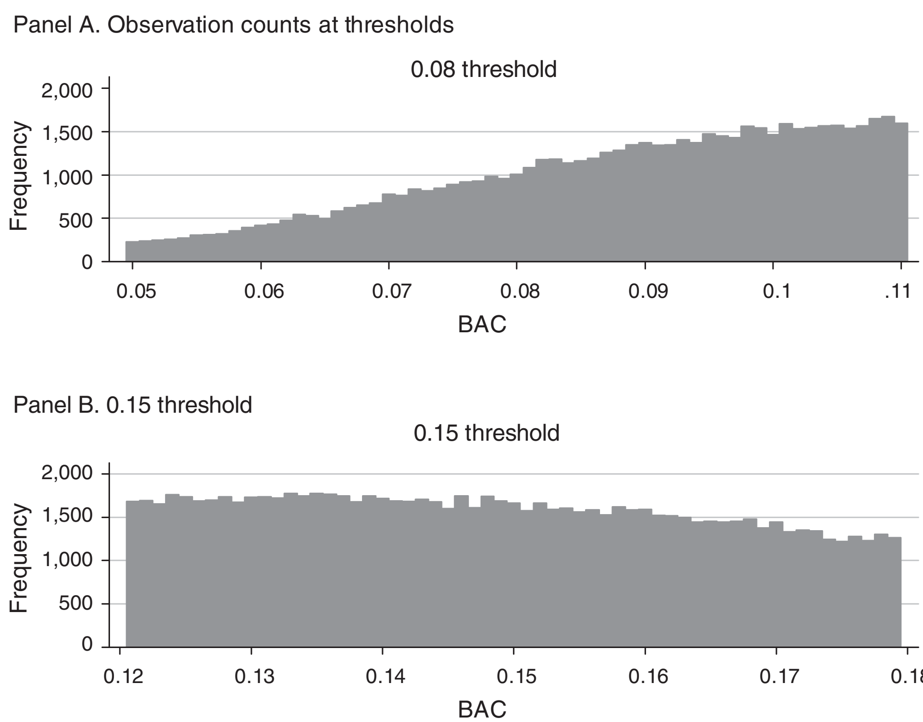
Notes: This table explores the sensitivity of the main estimates to the type of kernel used for weighting. Panel A presents estimates using a bandwidth of 0.05, while panel B has estimates with a bandwidth of 0.025. Controls include indicators for county, year, race, gender, and age of the offender. Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. Standard errors are in parentheses.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.



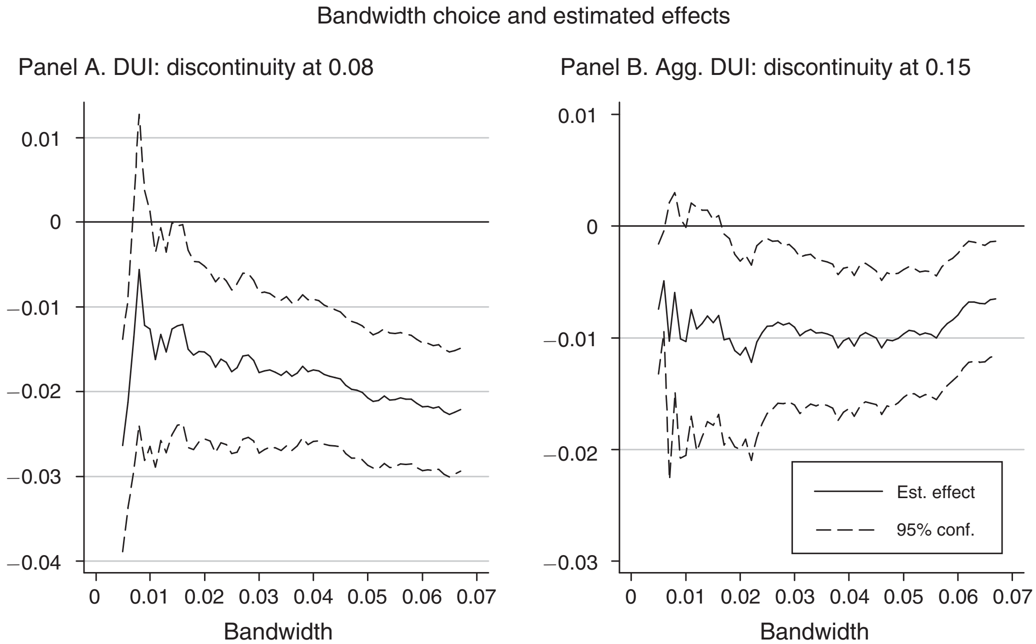
Appendix Figure 1. Difference between Independent BAC Measurements

Notes: Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. The histogram height on the vertical axis is based on frequency of observations, with the difference of the two independent BAC measurements from the breathalyzer on the horizontal axis. The bin width is 0.001, the original precision used on the breathalyzers.



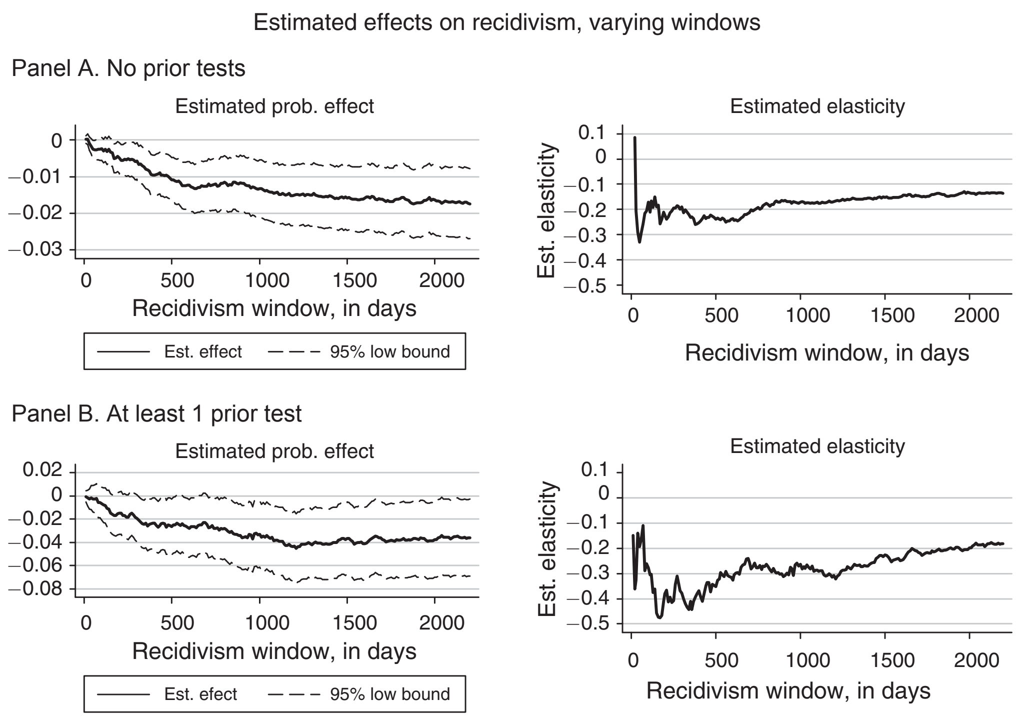
Appendix Figure 2

Notes: Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. The histogram height on the vertical axis is based on the frequency of observations, with the BAC on the horizontal axis. The vertical black lines represent the two legal at 0.08 and 0.15. The bin width is 0.001, the original precision used on the breathalyzers.



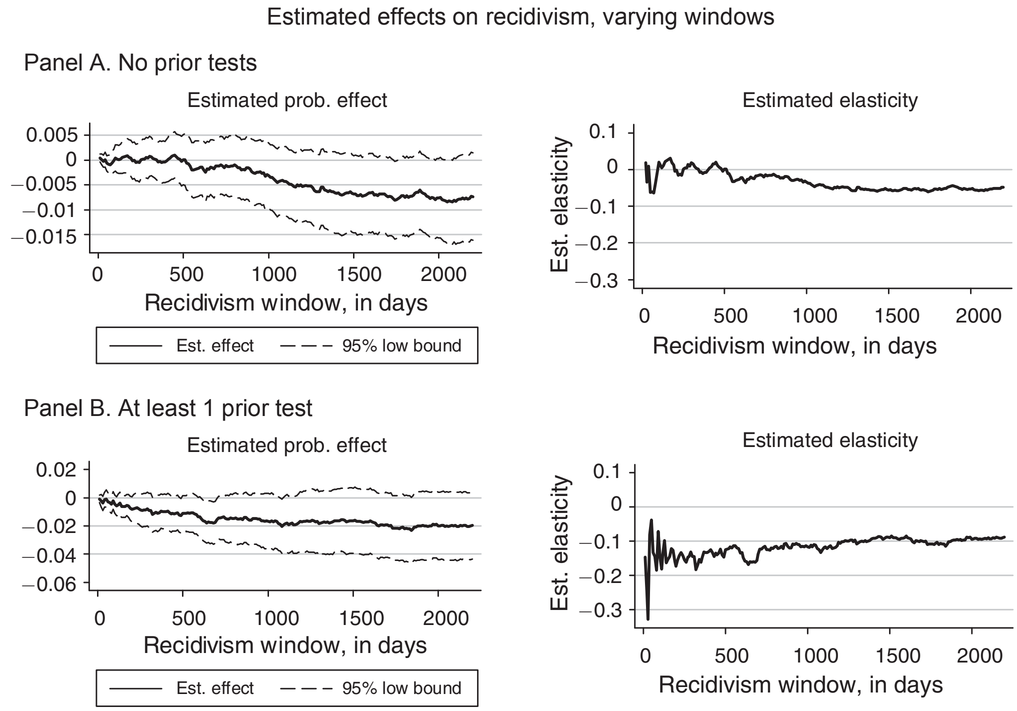
Appendix Figure 3. Bandwidth Choice Sensitivity

Notes: Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. The solid lines represent point estimates from regression discontinuity models estimated with local linear models, a bandwidth of 0.05, and controls for age, gender, race, county fixed effects, and year fixed effects. The dashed lines represent the endpoints of a 95 percent confidence interval.



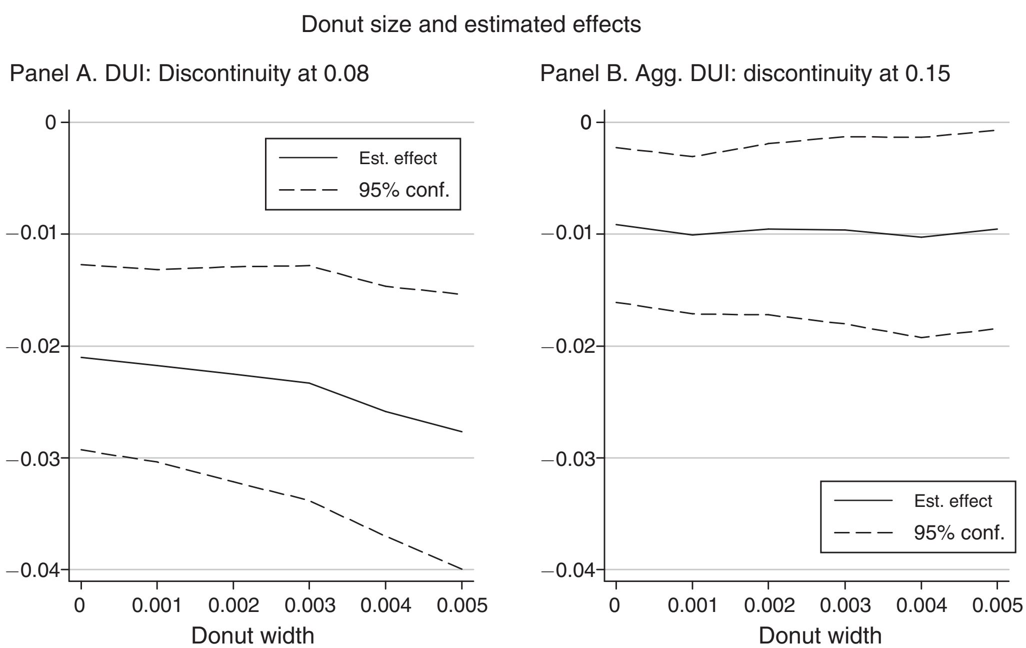
Appendix Figure 4. Recidivism Windows for 0.08 Threshold

Notes: Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. The solid lines represent point estimates from regression discontinuity models estimated with local linear models, a bandwidth of 0.05, and controls for age, gender, race, county fixed effects, and year fixed effects. The dashed lines represent the endpoints of a 95 percent confidence interval.



Appendix Figure 5. Recidivism Windows for the 0.15 Threshold

Notes: Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. The solid lines represent point estimates from regression discontinuity models estimated with local linear models, a bandwidth of 0.05, and controls for age, gender, race, county fixed effects, and year fixed effects. The dashed lines represent the endpoints of a 95 percent confidence interval.



Appendix Figure 6

Notes: Based on administrative records from the Washington State Impaired Driver Testing Program, 1999–2007. The solid lines represent point estimates from "donut" regression discontinuity models estimated with local linear models, a bandwidth of 0.05, and controls for age, gender, race, county fixed effects, and year fixed effects. The dashed lines represent the endpoints of a 95 percent confidence interval.

REFERENCES

Abrams, David S. 2012. "Estimating the Deterrent Effect of Incarceration Using Sentencing Enhancements." *American Economic Journal: Applied Economics* 4 (4): 32–56.

Akerlof, George A., and Janet L. Yellen. 1985. "Can Small Deviations from Rationality Make Significant Differences to Economic Equilibria?" *American Economic Review* 75 (4): 708–20.

Apsler, Robert, A. R. Char, Wayne M. Harding, and Terry M. Klein. 1999. *The Effects of 0.08 BAC Laws*. DOT HS 808 892 Final Report. Washington, DC: National Highway Traffic Safety Administration.

Barreca, Alan I., Jason M. Lindo, and Glen R. Waddell. 2011. "Heaping-Induced Bias in Regression-Discontinuity Designs." National Bureau of Economic Research Working Paper 17408.

Becker, G. S. 1968. "Crime and punishment: an economic approach." *Journal of Political Economy* 76: 169–217.

Buonanno, Paolo, and Steven Raphael. 2013. "Incarceration and Incapacitation: Evidence from the 2006 Italian Collective Pardon." *American Economic Review* 103 (6): 2437–65.

Card, David, David Lee, Zhuan Pei, and Andrea Weber. 2012. "Nonlinear Policy Rules and the Identification and Estimation of Causal Effects in a Generalized Regression Kink Design." National Bureau of Economic Research Working Paper 18564.

Carpenter, Christopher. 2004. "How Do Zero Tolerance Drunk Driving Laws Work?" *Journal of Health Economics* 23 (1): 61–83.

Carpenter, Christopher, and Carlos Dobkin. 2009. "The Effect of Alcohol Consumption on Mortality: Regression Discontinuity Evidence from the Minimum Drinking Age." *American Economic Journal: Applied Economics* 1 (1): 164–82.

Carpenter, Christopher, and Carlos Dobkin. 2011. "The Minimum Legal Drinking Age and Public Health." *Journal of Economic Perspectives* 25 (2): 133–56.

Carpenter, Christopher, and Carlos Dobkin. 2014. "The Minimum Legal Drinking Age and Crime." *Review of Economics and Statistics.* doi: 10.1162/REST_a_00489.

Chalfin, Aaron, and Justin McCrary. Forthcoming. "Are U.S. Cities Underpoliced? Theory and Evidence." *Review of Economics and Statistics*.

Chen, M. Keith, and Jesse M. Shapiro. 2007. "Do Harsher Prison Conditions Reduce Recidivism? A Discontinuity-Based Approach." *American Law and Economics Review* 9 (1): 1–29.

Chetty, Raj, Adam Looney, and Kory Kroft. 2009. "Salience and Taxation: Theory and Evidence." *American Economic Review* 99 (4): 1145–77.

DeAngelo, Gregory, and Benjamin Hansen. 2014. "Life and Death in the Fast Lane: Police Enforcement and Traffic Fatalities." *American Economic Journal: Economic Policy* 6 (2): 231–57.

Dee, Thomas S. 2001. "Does Setting Limits Save Lives? The Case of 0.08 BAC Laws." *Journal of Policy Analysis and Management* 20 (1): 111–28.

Drago, Francesco, Roberto Galbiati, and Pietro Vertova. 2009. "The Deterrent Effects of Prison: Evidence from a Natural Experiment." *Journal of Political Economy* 117 (2): 257–80.

Drago, Francesco, Roberto Galbiati, and Pietro Vertova. 2011. "Prison Conditions and Recidivism." *American Law and Economics Review* 13 (1): 103–30.

Evans, William N., and Emily G. Owens. 2007. "COPS and Crime." *Journal of Public Economics* 91 (1–2): 181–201.

Frandsen, Brigham R. 2013. "Party Bias in Union Representation Elections: Testing for Manipulation in the Regression Discontinuity Design When the Running Variable is Discrete." Unpublished.

Hahn, Jinyong, Petra Todd, and Wilbert Van der Klaauw. 2001. "Identification and Estimation of Treatment Effects with a Regression-Discontinuity Design." *Econometrica* 69 (1): 201–09.

Hansen, Benjamin. 2015. "Punishment and Deterrence: Evidence from Drunk Driving: Dataset." *American Economic Review*. http://dx.doi.org/10.1257/aer.20130189.

Haselhuhn, Michael P., Devin G. Pope, Maurice E. Schweitzer, and Peter Fishman. 2012. "The Impact of Personal Experience on Behavior: Evidence from Video-Rental Fines." *Management Science* 58 (1): 52–61.

Helland, Eric, and Alexander Tabarrok. 2007. "Does Three Strikes Deter? A Nonparametric Estimation." *Journal of Human Resources* 42 (2): 309–30.

Imbens, Guido W., and Thomas Lemieux. 2008. "Regression Discontinuity Designs: A Guide to Practice." *Journal of Econometrics* 142 (2): 615–35.

Iyengar, Radha. 2008. "I'd rather be Hanged for a Sheep than a Lamb: The Unintended Consequences of 'Three-Strikes' Laws." National Bureau of Economic Research Working Paper 13784.

Kessler, Daniel P., and Steven D. Levitt. 1999. "Using Sentence Enhancements to Distinguish between Deterrence and Incapacitation." *Journal of Law and Economics* 42 (1): 343–63.

Kilmer, Beau, Nancy Nicosia, Paul Heaton, and Greg Midgette. 2013. "Efficacy of Frequent Monitoring With Swift, Certain, and Modest Sanctions for Violations: Insights From South Dakota's 24/7 Sobriety Project." *American Journal of Public Health* 103 (1): e37–43.

Lee, David, and Justin McCrary. 2009. "The Deterrence Effect of Prison: Dynamic Theory and Evidence." Princeton University, Department of Economics, Center for Economic Policy Studies Working Paper 1168.

Levitt, Steven D. 1997. "Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime." *American Economic Review* 87 (3): 270–90.

Levitt, Steven D., and Jack Porter. 2001. "How Dangerous Are Drinking Drivers?" *Journal of Political Economy* 109 (6): 1198–1237.

McCrary, Justin. 2002. "Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime: Comment." *American Economic Review* 92 (4): 1236–43.

McCrary, Justin. 2008. "Manipulation of the Running Variable in the Regression Discontinuity Design: A Density Test." *Journal of Econometrics* 142 (2): 698–714.

Owens, Emily G. 2009. "More Time, Less Crime? Estimating the Incapacitative Effect of Sentence Enhancements." *Journal of Law and Economics* 52 (3): 551–79.

Sargent, Thomas J. 1993. *Bounded Rationality in Macroeconomics*. Oxford: Clarendon Press.

Thistlethwaite, Donald L., and Donald T. Campbell. 1960. "Regression-discontinuity analysis: An alternative to the ex post facto experiment." *Journal of Educational Psychology* 51 (6): 309–17.

Tversky, Amos, and Daniel Kahneman. 1986. "Rational Choice and the Framing of Decisions." *Journal of Business* 59 (4): S251–78.

Yu, Jiang. 2000. "Punishment and alcohol problems: Recidivism among drinking-driving offenders." *Journal of Criminal Justice* 28 (4): 261–70.

Yu, Jiang, Peggy Chin Evans, and Lucia Perfetti Clark. 2006. "Alcohol addiction and perceived sanction risks: Deterring drinking drivers." *Journal of Criminal Justice* 34 (2): 165–74.

This article has been cited by:

1. Jennifer L. Doleac. 2017. The Effects of DNA Databases on Crime. *American Economic Journal: Applied Economics* **9**:1, 165-201. [Abstract] [View PDF article] [PDF with links]