Replication1

In the beginning, put a link to my RDD repository: https://github.com/LZHHH4869/RDD.

The second part is to summarize Hansen's paper by several parts. Drunk driving has been a significant factor in hundreds of thousands of traffic deaths since 1975. The punishment was determined by the strict blood alcohol content (BAC) and previous criminal convictions, as the author analyzed. The author used thresholds to determine the severity of penalties and to test whether the more severe penalties and sanctions experienced by offenders under the BAC threshold were effective in reducing the driving under the influence (DUI) by testing the effects of tougher penalties and sanctions on DUI.

The author used administrative records of 512,964 DUI tests in the state of Washington from 1995 to 2011. He used a threshold of 0.08 to determine DUI and a threshold of 0.15 to determine 'aggravated DUI'. In addition, the article limited the attention to people above the legal drinking age.

For the research design, at cutoff points of DUI and aggravated DUI, regression discontinuity design (RDD) was allowed to test the effects of punishment imposed at the BAC threshold on recidivism. For the regression model, the author used the local linear regression discontinuity design to estimate BAC above DUI or aggravated DUI threshold for the recidivism, allowing the slope at the discontinuity to change. The main results based on local linear regression discontinuity of a rectangular nuclear design.

Estimates from RDD showed a significant reduction in recidivism rates due to thresholds of 0.08 (DUI) and 0.15 (aggravated DUI). Also, BAC levels above the legal limit of 0.08 and 0.15 were associated with lower recidivism rates by grouping drivers who had ever taken a breathalyzer test. Then, by the estimated effect of BAC above the aggravated DUI threshold on recidivism, it was found that BAC in that area was associated with varying degrees of reduced recidivism among all potential offenders or among those who have not been tested and those who has been tested. Then, by analyzing the effect of BAC above the DUI threshold on the more detailed definition of recidivism, the results show that BAC above the DUI threshold leads to less or more concentrated drunk driving. Furthermore, the author further studies several mechanisms, including deterrence, incapacitation and rehabilitation. Studies showed that BAC thresholds played a role in the effect of drunk driving primarily through deterrence operations, although some effects through incapacitation and rehabilitation operations cannot be completely excluded. In general, these results showed that harsher penalties and sanctions associated with BAC restrictions would reduce future drunk driving.

In the paper, we know that an officer can arrest a driver if after giving them a blood alcohol content (BAC) test they learn the driver had a BAC of 0.08 or higher, so in question3 we will create a dummy equaling 1 if bac1>= 0.08 and 0 otherwise.

The first thing to do in any RDD is to look at the raw data and see if there's any evidence for manipulation. If people were capable of manipulating their blood alcohol content (bac1), so in question4, we should do a test to check for this.

Figure1. BAC Distribution
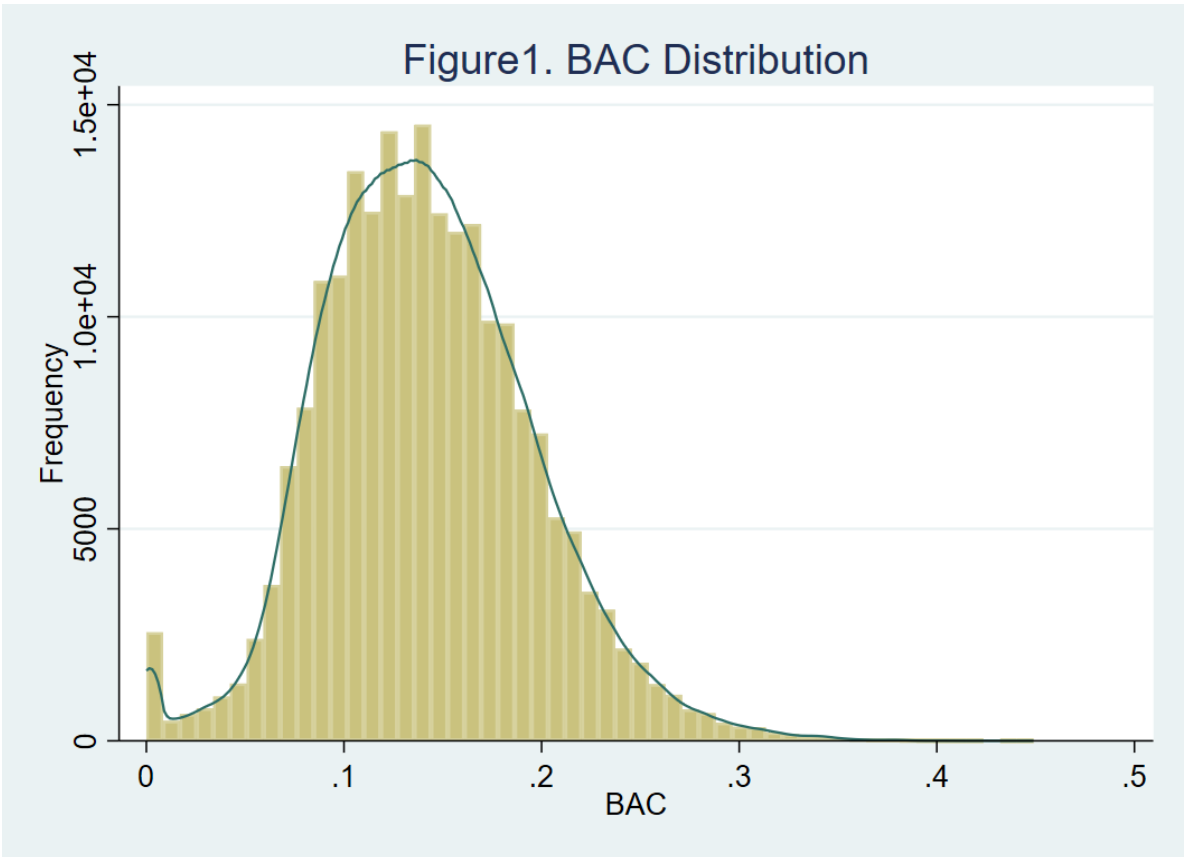
We can also use McCrary density test as shown below.

```
. rddensity bac1, c(0.08)
Computing data-driven bandwidth selectors.

Point estimates and standard errors have been adjusted for repeated observations.
(Use option nomasspoints to suppress this adjustment.)

RD Manipulation test using local polynomial density estimation.
```

c =	0.080	Left of c	Right of c		Number of obs	=	214558
					Model	=	unrestricted
Number of obs		23010	191548		BW method	=	comb

```
Eff. Number of obs │     14727       28946         Kernel      =    triangular
    Order est. (p) │         2           2         VCE method  =     jackknife
    Order bias (q) │         3           3
       BW est. (h) │     0.023       0.023
```

Running **variable**: bac1.

Method	T	P>│T│
Robust	-0.1387	0.8897

Figure 1 is a histogram displaying the number of observations in 0.08 BAC level. This distribution is very similar to Hansen's finding. Similarly, the distribution of BAC shows little evidence of endogenous sorting to one side of the threshold studied. On the other hand, after operating McCrary density test, it shows that the p-value is 0.8897 at the 0.08 threshold, which reveals no evidence of manipulation.

The second thing we need to do is check for covariate balance in question5.

|	(1) male	(2) white	(3) aged	(4) acc
RD_Estimate	0.00618	0.00570	-0.140	-0.00335
	(1.08)	(1.14)	(-0.85)	(-0.82)
N	214558	214558	214558	214558

t **statistics in** parentheses
* **p**<0.05, ** **p**<0.01, *** **p**<0.001

This table contains regression discontinuity based estimates of the effect of having BAC above the 0.08 thresholds on four characteristics: white, male, age, and accident at scene. The results from these regressions show that all of the estimated coefficients are not statistically significant at 5% level, even at 10% level. This is consistent with the result from Hansen's paper. And this indicates that we cannot reject the null that the predetermined characteristics are unrelated to the BAC cutoffs for DUI.

Next, in question6, we will create several graphs to present some predetermined characteristics and corresponding fitted regression lines which should remain unchanged across the punishment thresholds if offenders or police are unable to manipulate the running variable. This time we should fit both linear and quadratic with confidence intervals.
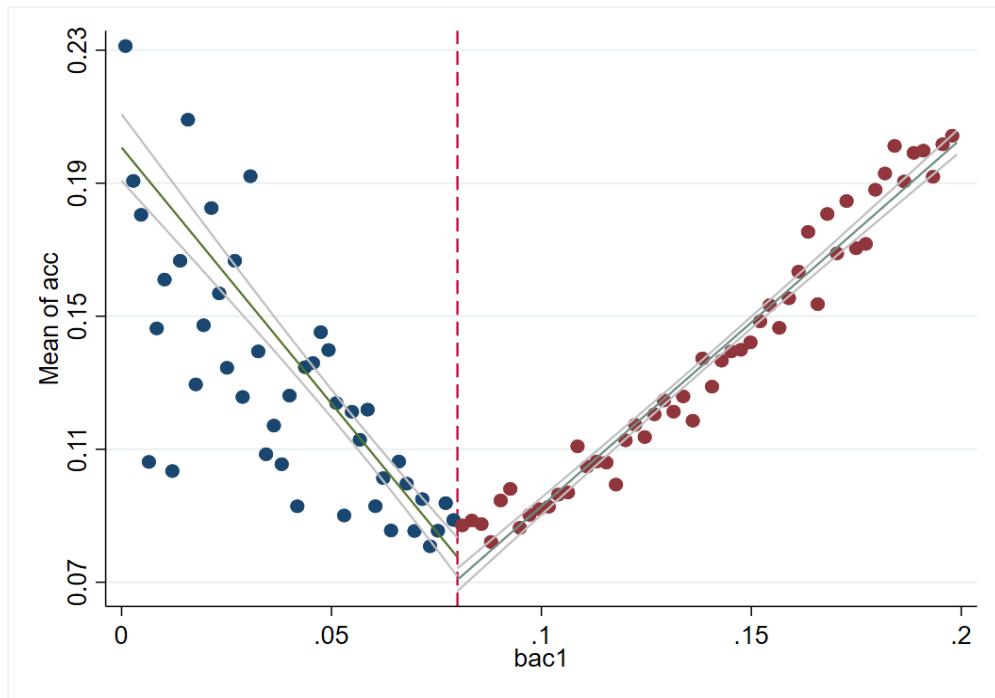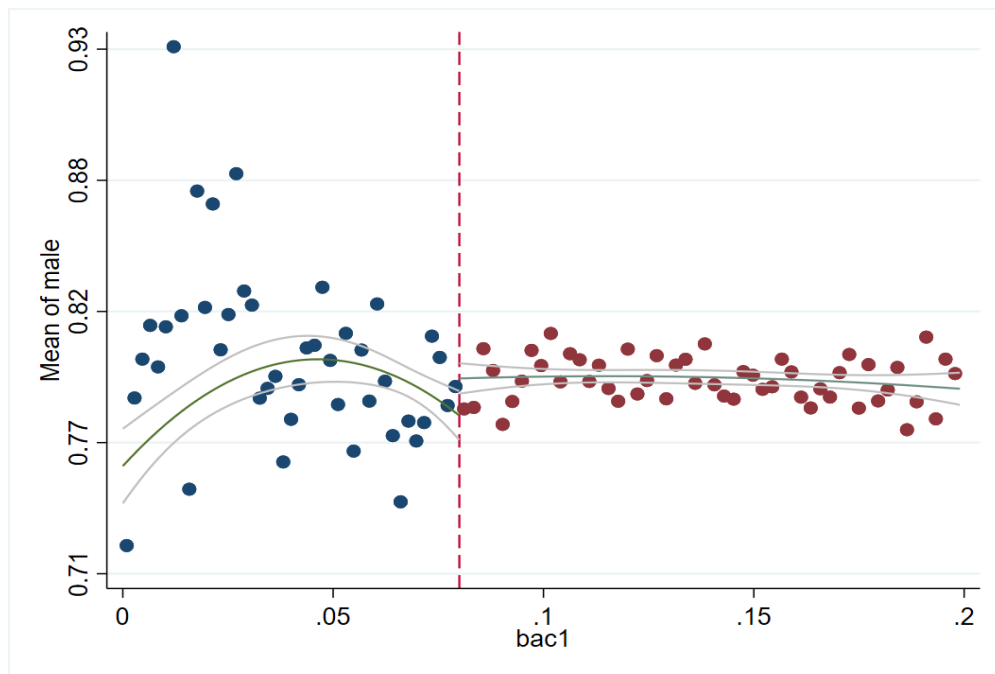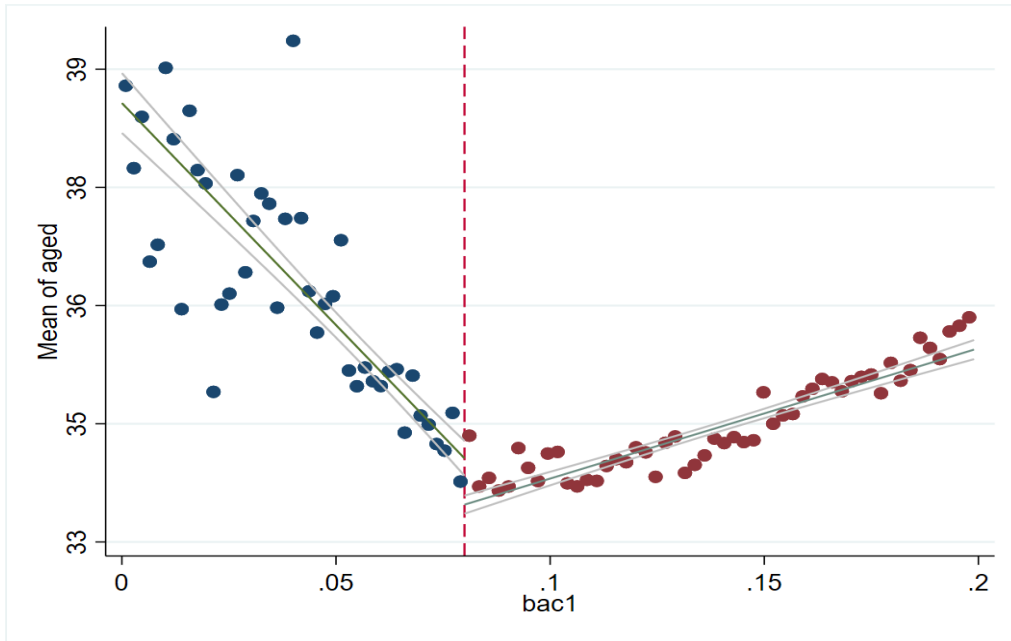
Panel A1. Accident at scene
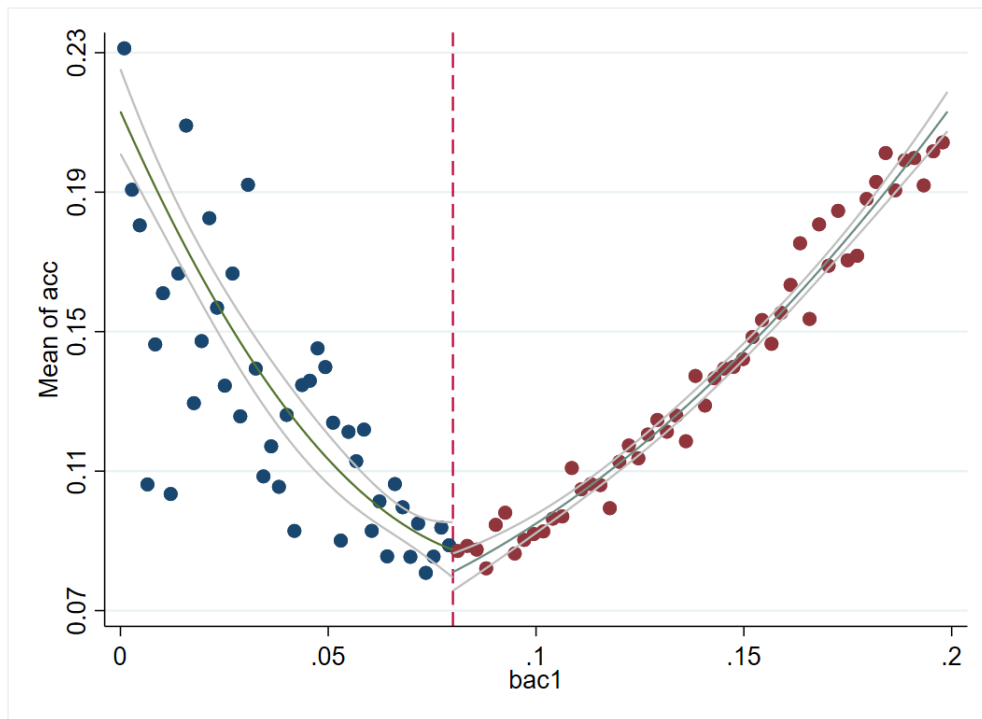
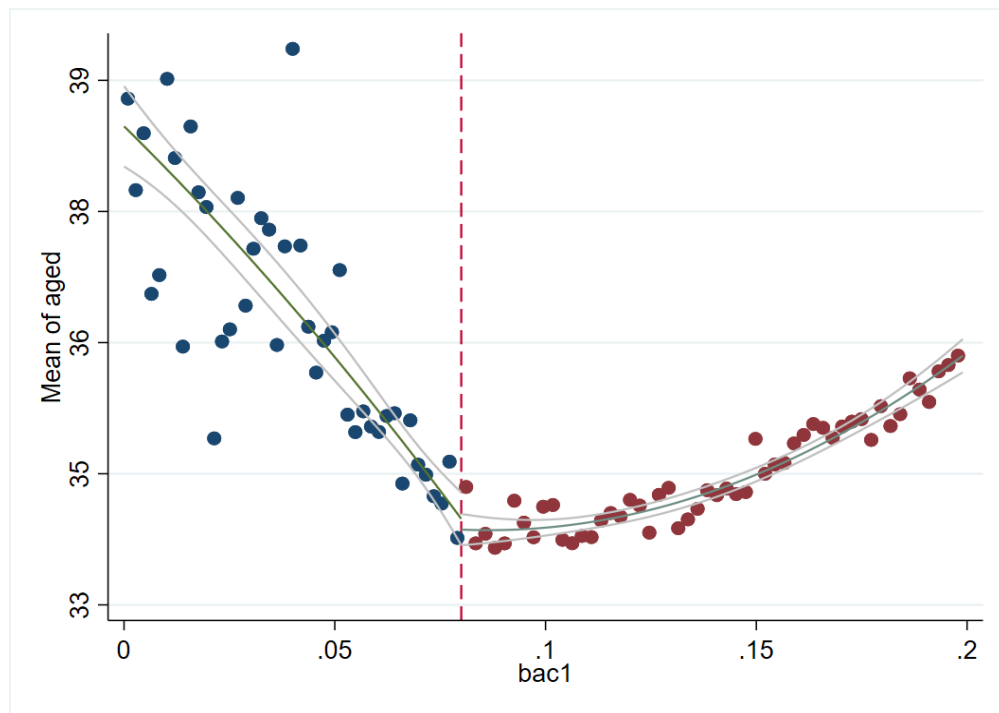*Panel A2. Accident at scene*
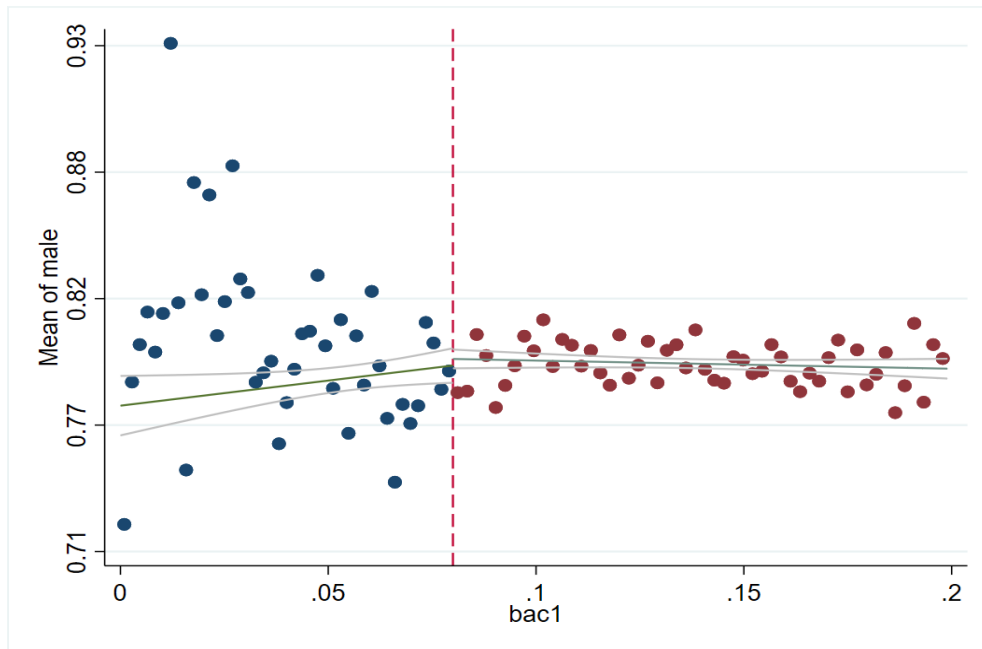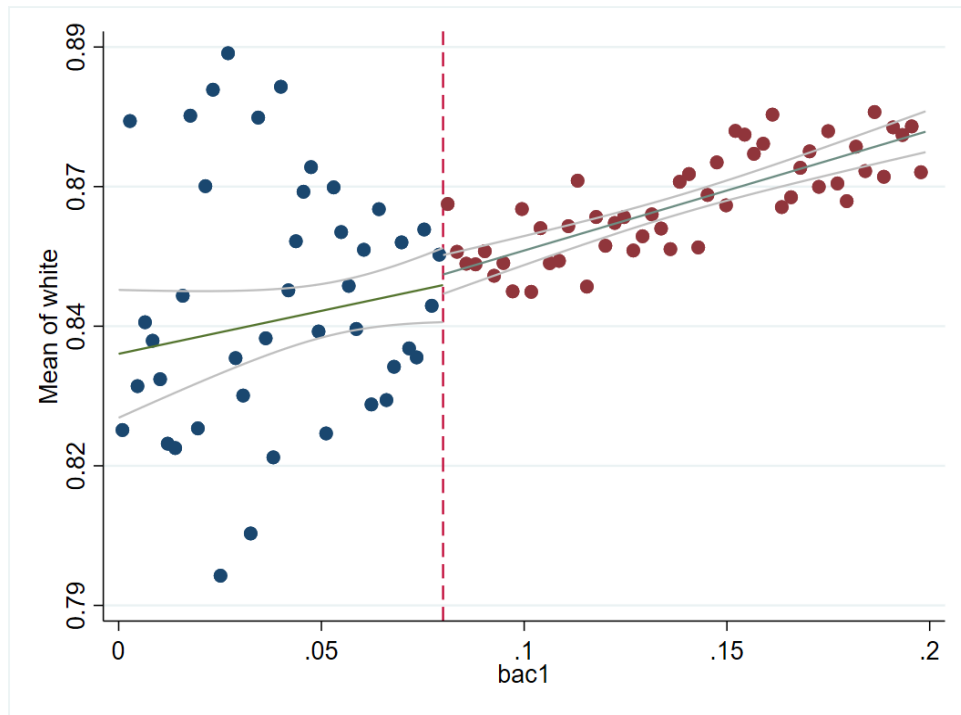
Panel B1. Accident at scene
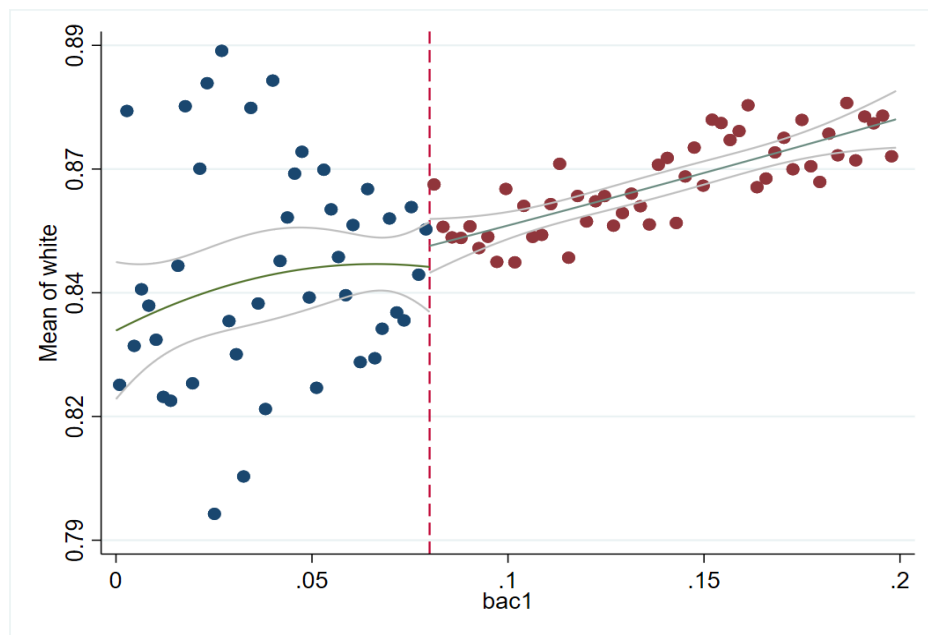

Panel B2. Accident at scene

Panel C1. Accident at scene

Panel C2. Accident at scene

Panel D1. Accident at scene

Panel D2. Accident at scene

In general, the graphs made by myself are similar to those in Hansen's finding. To be specific, in panel A, the beginning of the trend in the BAC<0.08 is higher than that in the article. And in the panel B, when BAC<0.08, the trend tends to be increasing smoothly, which is a bit different from the smoothly decreasing trend in the article's panel B. Furthermore, in the panels fitted quadratic with confidence intervals, before 0.08 threshold

there exists a trend like a quadratic function form (not just increasing), which is a little different from Hansen's finding. The trends in other three panels are similar to those fitted linearly with confidence intervals and those in Hansen's article.

In question7, we will estimate equation (1) from the paper with recidivism (recid) as the outcome. these are local linear regressions and Panel A uses as its bandwidth 0.03 to 0.13, while Panel B has a narrower bandwidth of 0.055 to 0.105. This reports the estimated effect of having BAC over the 0.08 threshold for all drivers.

Panel A:

	(1) recidivism	(2) recidivism	(3) recidivism
bac1	-0.0755 (-1.56)		
RD_Estimate		0.0240 (1.08)	0.0240 (1.08)
N	89967	214558	214558

t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Panel B:

|	(1) recidivism	(2) recidivism	(3) recidivism
bac1	-0.476*** (-4.26)		
RD_Estimate		0.0428 (1.92)	0.0428 (1.92)
N	46957	214558	214558

t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001

In question8, we will recreate the top panel of paper's Figure 3, which plots means of recidivism rates and predicted recidivism rates based on simple regression models for all offenders and highlights the stark changes in recidivism which occur at the 0.08 thresholds.
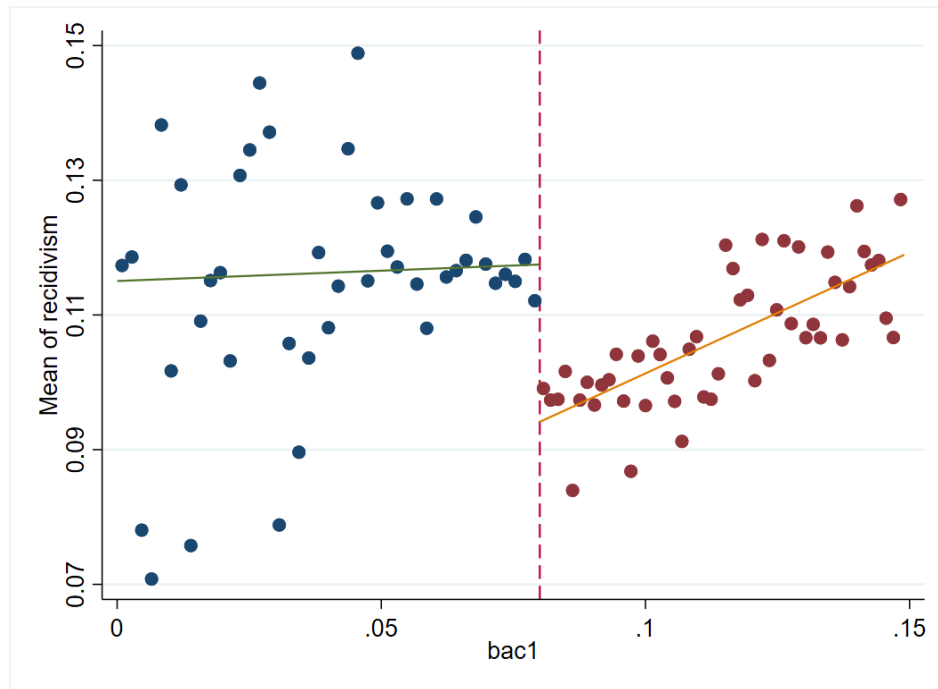
Panel A3. All offenders(linearly)
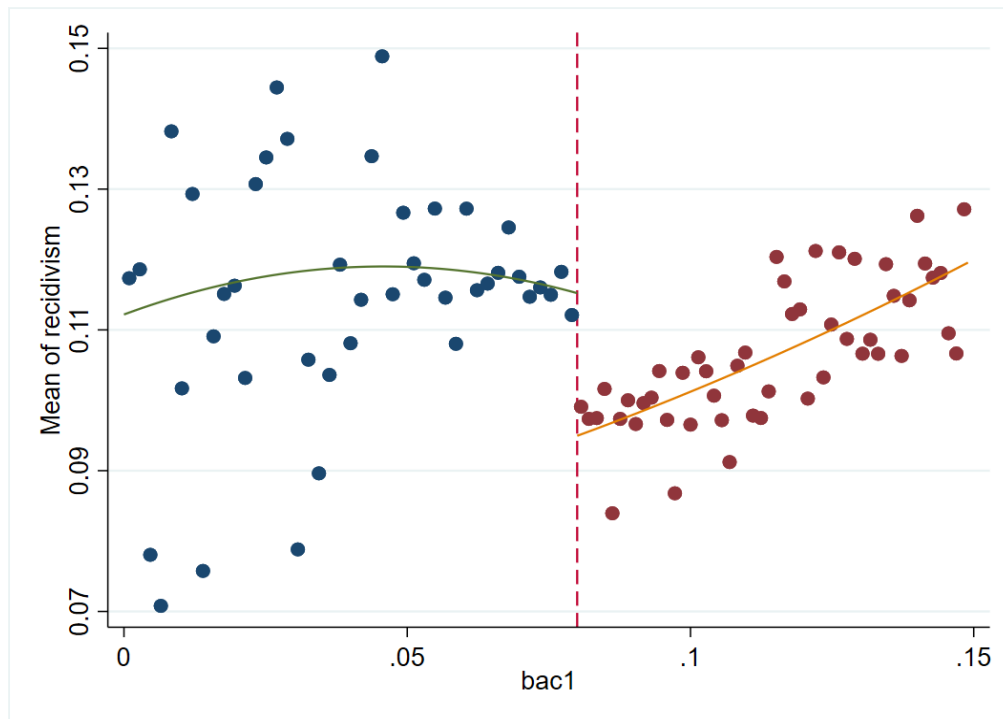
Panel A4. All offenders(quadratic)

The general trend is similar to each other. To be specific, there is a difference before the 0.08 cutoff. The slope of regression line has a smoothly increasing trend (almost parallel to the x-axis) while the slope in the article's graph has a smoothly decreasing trend. When BAC exceeds 0.08, both of the trends are increasing. The most significant similarity

between our regression and author's regression is that there is a notable drop in recidivism at the 0.08 threshold. This indicates that the increase in punishments and sanctions at the threshold is effective in reducing future drunk driving, and having a BAC over the 0.08 legal limit is associated with lower recidivism rates.

In the last section, a conclusion should be needed. In our replication, we just focused on one of the thresholds, 0.08, to analyze problems. Among those, a hypothesis that the original BAC bins determined by the implicit rounding from the breathalyzer has been tested and the BAC distribution showed little evidence of endogenous sorting to one side of either of the thresholds studied. And later the p-values in McCrary test also verified that. From these a series of replications above, most of the results are close to those in Hansen's findings. For example, the fitted regression lines by using regression discontinuity design have very similar trend like the lines in Hansen's paper. And the regression results from regression discontinuity estimates for the effect of exceeding the 0.08 BAC threshold on recidivism are also similar to those in the paper. Thus, I think Hansen's findings are to some extent convincing, since he provided a classic project by using RDD method. There are also several differences from Hansen's results, I think this may be caused by the data which is not perfectly same as Hansen used, and also the operations in Stata by my replication cannot be same as Hansen did.