Env Econ 2 - Homework 6

Min-kyeong (Min) Cha

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1 Python

1.

The regression discontinuity design should be a sharp RD because a strange policy has a sharp discontinuity in the treatment - a length longer than 225 inches.

2.

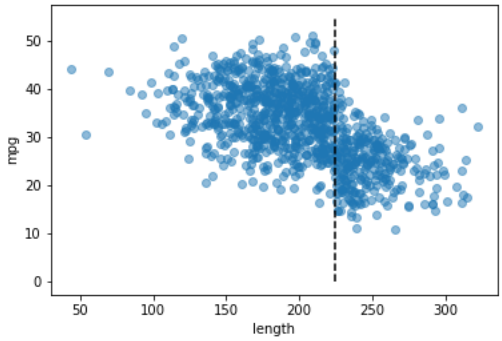

Figure 1: Scatter plot of mpg vs length. Dashed line indicates cutoff (length=225).

In Figure 1, we can visually detect a decrease in mpg at the cutoff. It is hard to see the bunching around the cutoff; the sample seems to spread randomly.

3.

Figure 2 shows first-order polynomials on both sides of cutoffs. The estimated treatment effect (the regression coefficient of the treatment dummy variable) is 8.43. In other words, vehicles longer than 225 inches and therefore belong to the treatment group have, on average, 8.43 lower mpg than shorter vehicles.

4.

Figure 3 shows second-order polynomials on both sides of cutoffs. The estimated treatment effect is 8.05, and the coefficient for $length^2$ is not significant (significance level 0.05). Vehicles longer than 225 inches on average have 8.05 lower mpg than shorter vehicles.

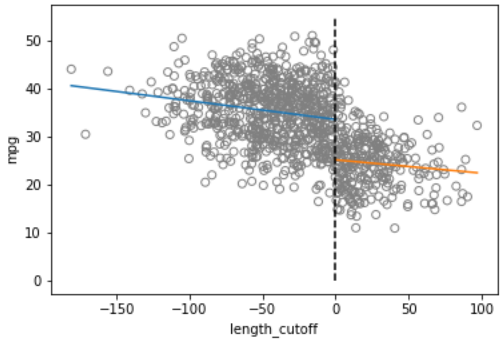

Figure 2: RD estimates of treatment effect, using first-order polynomial.

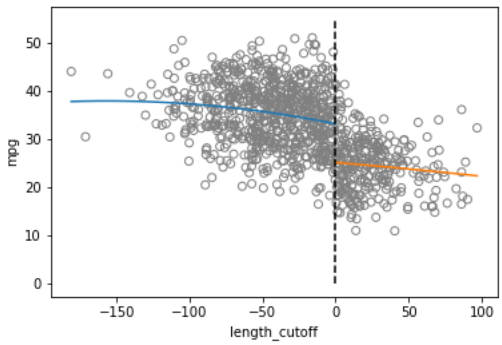

Figure 3: RD estimates of treatment effect, using second-order polynomial.

5.

Figure 4 shows fifth-order polynomials on both sides of cutoffs. The estimated treatment effect is now 7.44, and the coefficient for all polynomials are not significant (significance level 0.05). Vehicles longer than 225 inches on average have 8.05 lower mpg than shorter vehicles. Table 1 shows estimated effect using different order of polynomials. The estimated treatment effect is statistically significant in all cases (α =0.05) and the amount decreases as higher order of polynomial is used.

	(Q3)	(Q4)	(Q5)
treatment effect	-8.43	-8.05	-7.44
	(0.71)	(1.0)	(1.83)
Observations	1000	1000	1000

Table 1: Results of RD estimate with different order of polynomials - first, second, and fifth order. Robust standard error is used.

6.

Since higher-order polynomials are statistically insignificant in the previous questions, I used first-order polynomials in Question 6. In the second stage, the price of vehicles is estimated using the estimated mpg in the first stage and the car indicator variable. The estimated coefficient of mpg in the second stage is 135.92. In other words, around the cutoff, one additional mpg leads to USD 136 higher price. The f-statistic of the

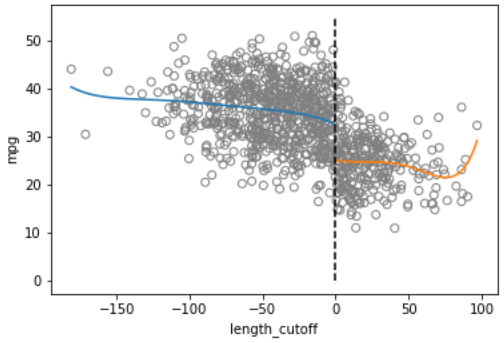

Figure 4: RD estimates of treatment effect, using fifth-order polynomial.

treatment variable (i.e., 1(length >= 225)) is larger than 10 (140.61), though we cannot conclude it is a good instrument.

2 Stata

1.

(a)

As in the previous question, I used first-order polynomial to estimated the treatment effect in the first stage. The estimated coefficient is -7.34, which is different from the effect estimated using Python. Using predicted mpg in the first-stage with the rdplot command, the estimated treatment effect is 135.4, as in Table 2. This is similar to the estimates in the previous question.

VARIABLES	price
mpg(predicted)	135.4***
	(22.21)
car	-3,693***
	(222.4)
Constant	17,623***
	(711.3)
Observations	1,000
R-squared	0.220

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2: Results of RD estimate using first-order polynomial.

(b)

Figure 5 shows RD plots using first-order polynomials. Sample average within a bin, instead of all samples, is presented. It looks similar to Figure 1 except for fewer dots.

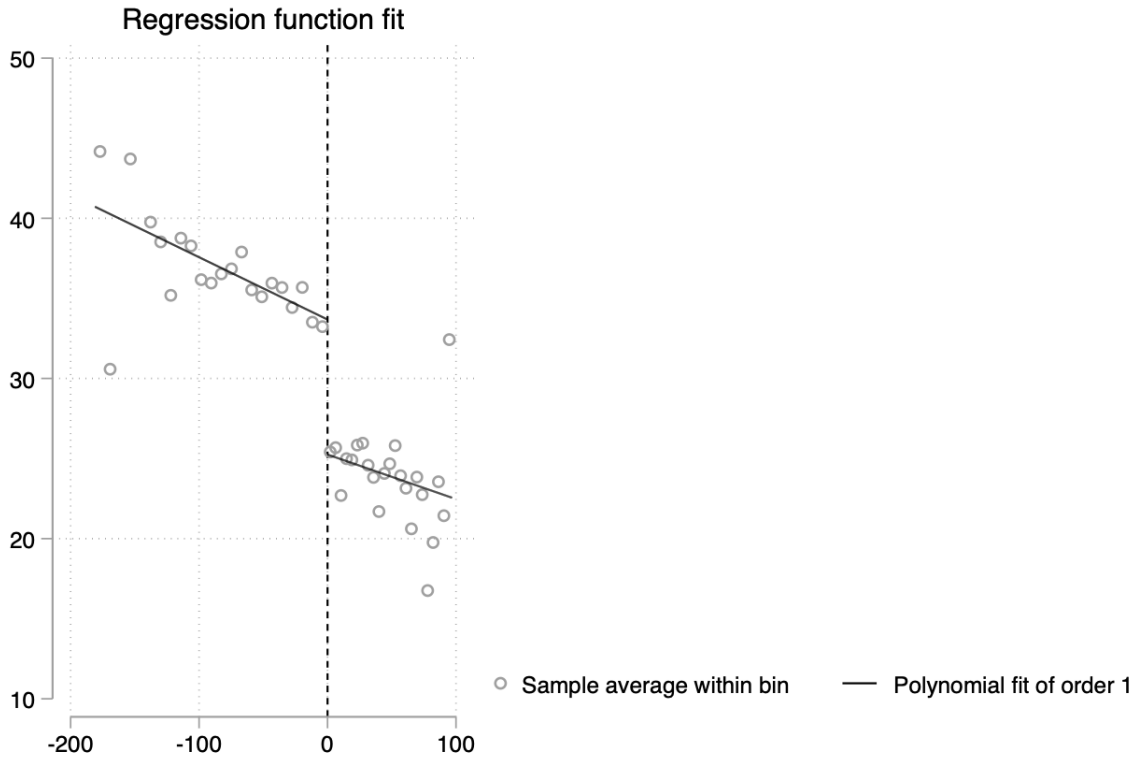

Figure 5: RD estimates of treatment effect, using first-order polynomial.

2.

The instrument used here - discontinuity due to a strange policy - might not be valid because it affects the price not only through fuel efficiency. The policy requires vehicles to adopt a safety technology for the treatment group, which might also affect the price. In general, safety and price have a positive relationship.