Introduction to Causal Inference: Exercise assignment 2: IV methods. Winter, 2018 (By Yamaguchi)

In this assignment you will practice evaluating an instrumental variable. It requires a re-analysis of the Tennessee class size data. Our interest here is in estimating the average effect of class size reduction in first grade (D: D=1 for small-size class and D=0 for regular-size class) on the first-grade reading achievement (Y) of children who had complied with the initial treatment assignment for two consecutive years. Students will be given STATA, SPSS, and EXEL data that include variables Z, D, Y and RD.

I.1 In the Tennessee class size study, students assigned at random to small classes in kindergarten (Z=1) were expected to stay in small classes while those assigned to regular classes in kindergarten (Z=0) were expected to remain in regular classes in the later years. According to the public documentation, there was no evidence of non-compliance during the kindergarten year. Here you are asked to compare the first-grade treatment received (D) with the kindergarten treatment assigned (Z). Do you observe any evidence of non-compliance among first graders? If we assume that the monotonicity condition holds, what proportion of students can be viewed as always takers of small class size in first grade among students initially assigned at random to regular classes? What proportion of students can be viewed as never takers of small class size in first grade among those initially assigned at random to small classes? How did the average first grade reading achievement of the always-takers in first-grade small classes compare with those assigned at random to small classes? How did the average first-grade reading achievement of the never-takers compare with those assigned at random to the regular classes?

I.2 In order to decide whether to use the initial treatment assignment (Z) as an instrumental variable in this case, evaluate this instrumental variable regarding the following three assumptions that is common between the standard IV method and he LATE method, and an additional assumption made in the standard IV method.

(1) The exogeneity of Z, (2) exclusion assumption, and (3) monotonicity assumption, and (4) correlated effects.

How plausible is each of these assumptions in this application?

I.3 Regress Y on D. What is the average mean difference in first-grade reading achievement between those attending small classes (D=1) and those attending regular classes (D=0) in first grade? What is the effect size? This is a PF estimate of the effect of D on Y. Subsequently, estimate the ITT effect of Z on D denoted by α 1. (Although the dependent variable D is binary here, it does not pose a problem for a simple linear regression model in this particular case. This is because when the predictor Z is also binary, α 1 simply represents mean proportion difference.). Then analyze a reduced-form regression model and estimate the ITT effect of Z on Y denoted by γ 1. Compute the ratio of the estimate of γ 1 to the estimate of α 1.

I.4 Run a two-stage least squares analysis with Y as he dependent variable, D as the explanatory variable and Z as the instrumental variable. Write down the regression models first. Specify the assumption about the error. Record the estimated coefficient for D and denote it as an IV estimate of β 1. According to your analytic results, what is the average effect of class size reduction on the reading achievement of students who complied with the random assignment for two consecutive years? Is the effect significant?

I.5. Could you give a reason why the result from I.4 might be different from the PF estimate obtained earlier when you simply regress Y on D? Confirm also that the ratio of the estimate of γ 1 to the estimate of α 1 in 1.3 is the same (except for a very minor difference) as the 2SLS estimate.

1.6 Obtain the 2SLS estimate of the effect of D on Y for African Americans (RD=1) and others (RD=0) separately. Using the 10% significance level, what do you conclude regarding the class-size effect for each racial group?

1.7. Suppose you apply the following linear regression,

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using only the data of D=1. Assuming that Z is completely random and that monotonicity holds, express α and βusing some of the following quantities.



Here, letters *A*, *N*, and C respectively indicate “Always takers”, “Never takers”, and “Compliers”, and *P*(.) indicates the proportion of each latent class.

1.8. (1) Explain why the effect of Z can be significant even if the exclusion assumption holds.

(2). Give the estimate of the effect of Z in the equation of 1.7. What does the result of this analysis inform about the characteristics of selection bias?

Notes on the SPSS syntax for the 2SLS:

TSET NEWVAR=NONE.

2SLS Y WITH D

/INSTRUMENTS Z

/CONSTANT.