Fuzzy RD Design

Exploiting Discontinuities in the *Probability* or *Expected Value* of Treatment Conditional on a Covariate

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Brief Recap from Sharp RD Design

- $f(D_i|x_i)$ is a deterministic function for treatment assignment
- Where $D_i = 1$ if $x_i \geq x_0$ and $D_i = 0$ if $x_i < x_0$
- So we observe only treated units at and above the cut-off point x_0 and only untreated units below the cut-off point x_0

Fuzzy RD

- Now, $f(D_i|x_i)$ is a probabilistic function for treatment assignment
- Hence, the discontinuity in $f(D_i|x_i)$ acts as an instrument
- This means that at an arbitrary cut-off point x_0, the probability of a unit being treated experiences a jump
- So, in expectation, we observe more treated than untreated units at and above the cut-off point x_0
- And only untreated (or more untreated than treated) units below the cut-off x_0

Comparison to Instrumental Variable (IV)

- The cut-off causes *variation* in the treatment across units
- In IV, we relie on three assumptions:
    1. First stage: Hence, at the cut-off, we need to have sufficiently strong variation caused in the treatment assignment
    2. Quasi-random assignment of instrumental value: The idea is that close around the arbitrary cut-off point x_0, the variation in the treatment is quasi-random
    3. Exclusion restriction: At the cutoff, the only channel through which variation in the outcome is caused is the treatment, and not through variation in any other variables

Local Average Treatment Effect (LATE)

- As with Sharp RD and IV, we can only estimate the local average treatment effect (LATE)

Local Average Treatment Effect (LATE)

- Advantage: We do not have to make any assumptions about the functional form of the outcome $Y_i(f(D_i|x_i))$
- Disadvantage: We cannot infer the average treatment effect at other locations (i.e. other values of x_i) than at the cut-off x_0

Angrischt and Lavy (1999), QJE

USING MAIMONIDES' RULE TO ESTIMATE THE EFFECT OF CLASS SIZE ON SCHOLASTIC ACHIEVEMENT*

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The twelfth century rabbinic scholar Maimonides proposed a maximum class size of 40. This same maximum induces a nonlinear and nonmonotonic relationship between grade enrollment and class size in Israeli public schools today. Maimonides' rule of 40 is used here to construct instrumental variables estimates of effects of class size on test scores. The resulting identification strategy can be viewed as an application of Donald Campbell's regression-discontinuity design to the class-size question. The estimates show that reducing class size induces a significant and substantial increase in test scores for fourth and fifth graders, although not for third graders.

Question: Why is this RD Fuzzy and not Sharp?