

Instrumental Variables (IV)

1) The Takeaway

- a. Instrumental variables are a general identification strategy that can be used to deal with selection on unobservable confounders (omitted variable bias), simultaneity and endogeneity, and measurement error
- b. We use two-stages, where the 1st stage estimates the impact of the instrument on treatment assignment, and the second stage estimates the impact of the treatment on the outcome of interest

2) Pros

- a. When you have a good IV, IV is as good as random
- b. Deal with selection on unobservable confounders

3) Cons

- a. There are up to 5 assumptions that need to hold in order for IV to be unbiased and it is very, very hard to find an IV that satisfies all 5 assumptions
- b. We have larger standard errors with IV
- c. We can only identify the local average treatment effects (LATE) for compliers

4) The IV Estimator

- a. With Homogenous Treatment Effects:
- b. With Heterogenous Treatment Effects: is the impact of the treatment for the complier population
- c. Two-Stage Least Squares Estimator:

5) Assumptions and Testable Assumptions

- a. Exclusive Restriction Assumption (Homogenous and Heterogenous Treatment Effects)
 - i. The instrument works only through the treatment on our outcome of interest
 - ii. If the instrument is correlated with an observed or unobserved factor then the estimator will be biased
 - iii.
 - iv. This assumption is only testable on observable covariates and untestable on unobserved covariates
 - v. For heterogenous treatment effects: is a function of only
- b. Non-zero 1st stage assumption (Homogenous and Heterogenous Treatment Effects)
 - i. The instrument must be correlated with the treatment
 - ii. For heterogeneous treatment effect:
 - iii. This assumption is testable
- c. Independence assumption (Heterogenous Treatment Effects)
 - i. This assumption states that potential outcomes AND **potential treatment status** is independent of the instrument
 - ii.
 - iii.

- iv. For example, a draft lottery is independent of potential outcomes and potential treatment status. Is correlated with the actual treatment, but not the potential treatment status?
 - d. Stable Unit Treatment Value Assumption (SUTVA) (Heterogenous Treatment Effects)
 - i. No spillover effects
 - ii. For example, if Child A wins a lottery into a charter school and Child B gets to enroll due to Child A winning, then that is a spillover/externality
 - e. Monotonicity Assumption (Heterogenous Treatment Effects)
 - i. This assumption requires that the instrument to operate in the same direction on all individuals
 - ii. For example, if a judge is not consistent and gives severe and leniency in inconsistent ways, then the monotonicity assumption would be violated
 - iii. From the switching equation, γ is the causal effect of the instrument on the treatment and δ or
- 6) Potential Treatment Status
- a. Compliers are the focus of the LATE:
 - b. See Discussion #5 on ELMS
- 7) Popular Instrumental Variables
- a. Lotteries
 - i. A draft lottery for military service, charter schools, or Medicaid expansion
 - ii. Pro: These are a powerful instrument for treatment assignment
 - iii. Con: They may suffer from nonrandom attrition or noncompliance
 - iv. Intent to Treat (ITT) will be smaller than the LATE, since not everyone who is awarded treatment takes up treatment
 - b. Judge Fixed Effects
 - i. Using a randomized wheel of judges to assign cases to different judges
 - ii. 3 Concepts with Judge Fixed Effects
 - 1. There is a narrow window that all justice-involved individuals must go through
 - 2. Randomized assignment to judges
 - 3. There is discretion among the judges
 - c. Bartik Instruments
 - i. See Discussion #5 on ELMS