Popular IVs

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Popular IVs

- Lotteries
- Natural experiments

Warning: the taxonomy of IVs here is "sloppy" and non-exhaustive.

Lotteries as IV

- (True) Lotteries guarantee that Z_i is as-good-as-randomly assigned.
- Some of the best IVs come from lotteries, either run by the researcher or "natural experiments".
- We only need to worry about the exclusion restriction.

Charter school lotteries

Abdulkadiroglu et al. (2016): whether going to a "charter" school increases students' grades

- Charter students tend to score better, but selection exists.

An **institutional feature** of charters: **admission lotteries**

- When more kids want to enroll than there are seats, admission offers $Z_i \in \{0, 1\}$ are drawn from a hat.
- Offers plausibly only affect later test scores Y_i by changing charter enrollment X_i. (*exclusion*)

"China's College Entrance Exam" Lotteries

- China's College Entrance Exam Score (*Gao Kao*).
  - A fair and controversial heritage of the *Ke Ju* system.
- Whether Albert (a high school student) attends a tier-1 or tier-2 college depends on his grades in *Gao Kao*.
- Suppose the bar for entering a tier-1 college is **600 points**. Then **those scoring 600 and 601** are given admission offers (Z_i) while **those scoring 599 and 598** are not.
  - As-good-as-randomly assigned
  - Exclusion

"China's College Entrance Exam" Lotteries

"The Value of Elite Education in China" Jia and Li (2017)

- The reality is not as ideal as what I just described. Occasionally a student scoring 599 got an offer while another scoring 601 didn't.
- Instead, Jia and Li (2017) use **(fuzzy) Regression Discontinuity Design** (**RDD**), a quasi-experimental evaluation.

Natural experiments

- Natural experiments are not literally random such as lotteries
- However, we may credibly argue Z_i is as-good-as-randomly assigned **conditional on some W_i**.
- Still need to worry about exclusion.

Quarter-of-birth

Angrist and Krueger (1991) estimate labor market returns to schooling with a creative IV: **student quarter-of-birth**

- *Compulsory schooling* requirements prevent students from dropping before *the day they turn 16*
- Fixing school start dates, students who drop out at 16 get **more or less schooling** (X) depending on their **birth date** (Z)

As-good-as-randomly assigned? Exclusion?

Angrist and Krueger (1991)

- Due to compulsory school attendance laws, quarter of birth is related to educational attainment.
- Individuals born in the **beginning of the year** start school at an older age, and can therefore drop out after completing **less schooling** than individuals born near the end of the year.
- Roughly 25 percent of potential dropouts remain in school because of compulsory schooling laws. We estimate the impact of compulsory schooling on earnings by **using quarter of birth as an instrument for education**.
- The result suggests that OVB is not severe in traditional OLS studies.

Why is the exclusion restriction challenging?

- Beware of the exclusion restriction.
- Intuitively, it feels like something (nearly) randomly assigned should satisfy this restriction, so long as it affects X.
- This is not sufficient. One needs to think critically about the IV.
  - Note that it's impossible to empirically test "exclusion".
- I'll give two examples in which the exclusion restriction fails.
  - Vietnam vet
  - Rainfall

Vietnam war lottery numbers

- Using Vietnam war lottery numbers as an IV for military service, studying the impact on mortality.
  - Y is death; X is vietnam vet; Z is lottery number
- Lottery number was randomly assigned as a function of birthdate
  - As-good-as-randomly assigned!
- Does that necessarily satisfy exclusion restriction?

Vietnam war lottery numbers

- Z (lottery number) probably fails the exclusion restriction.
- Consider one simple example: being drafted induces you to change your behavior to avoid the draft
  - Stay in school
  - Flee to Canada
- This would violate the exclusion restriction.

"Identification of causal effects using instrumental variables," Angrist, Imbens and Rubin (1996), *JASA*.

> But a draftee who managed to avoid military service by staying in school or moving abroad could experience an effect of Z on future life outcomes that would violate the *exclusion restriction.* For both these groups of noncompliers, the exclusion restriction requires the researcher to consider a difference in outcomes that were potentially observable, even though after the population was randomly allocated to treatment and control groups, only one of the outcomes was actually observed.

"Identification of causal effects using instrumental variables: Comment," Rosenbaum (1996), *JASA*.

> The fact that economists do not always make a clear distinction between ignorability and exclusion restrictions is evidenced by Moffitt's incorrect comment that randomization makes the draft lottery *by necessity an obvious and convincing instrument* for the effect of the military service. In fact, one contribution of our approach is to provide a framework that clearly separates ignorability and exclusion assumptions. Both statisticians and economists should find this separation useful and clarifying.

Second example: rainfall

- Consider rainfall as an instrument for income in agriculture environments (many crops are heavily dependent on it)
  - This is not uncommon in development papers, as Sarsons (2015) points out
  - Y is conflict; D is income; Z is rainfall.
- Exclusion restriction is that rainfall has no effect on conflict beyond income

Second example: rainfall

- While Exclusion restriction seems reasonable, Sarsons (2015) shows that places with dams (which protect against the income shocks due to rain) have similar conflict to those without dams.
- Plausible that while rain is “random”, it might have many channels besides "rain $\rightarrow$ income $\rightarrow$ conflict".

Rainfall and Conflict: A Cautionary Tale, Sarsons (2015)

> … there could be some unobserved variable X that is correlated with a district being dam-fed and that variable also increases the marginal effect of rainfall on rioting through a non-income channel. For example, dam-fed districts could all have dirt roads and an increase in rainfall destroys these roads, making it more difficult for people to organize and riot. While this is possible, it does not validate the use of rainfall as an instrument for income. **There is now a non-income through which rainfall is affecting rioting in damfed districts.**