



Stockholm
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Methods in Political Science
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Instrumental variables

Introduction

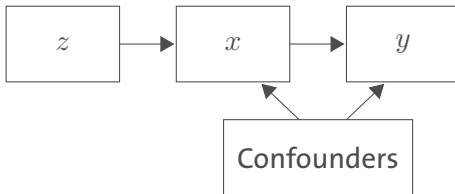
When and why

- We are interested in the effect of x on y but the exogeneity assumption is violated (very common).
- And there is an instrument that meets this assumption and that affects our x (rare).

If true, we have identified some exogenous variation in x .

Introduction

Causal diagram



- z is an instrument.
- x is the endogenous variable. It is instrumented on z .
- y is our outcome or dependent variable.

Introduction

Content

- Instrumental Variables
 - Assumptions
 - Estimation
 - Handling non-compliance
 - Finding instruments
- Three IV papers
- Other techniques
- Words of caution when analyzing experiments

Instrumental variables: Assumptions

Three assumptions for valid instruments

■ Relevance

- z has a causal impact on x .
- Convention: F-statistic above 10 ($p < 0.0016$ for single IV).
- But the stronger the better. And theory matters too.

■ Exogeneity / Independence assumption

- No omitted variables affect both y and z .
- Neither x nor y affects z .
- Cannot be tested

■ Exclusion restriction

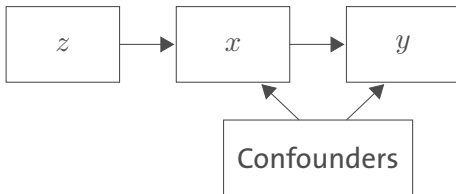
- z only affects y through its impact on x .
- Cannot be tested

Exogeneity and exclusion are sometimes discussed as one.

Instrumental variables: Assumptions

The assumptions can be seen in the causal diagram

- Relevance: z affects x .
- Exogeneity: Nothing (of relevance) affects z .
- Exclusion: z only affects y through its impact on x .



Instrumental variables: Estimation

Two-stage least squares

- First stage: The instrument is used to calculate the expected values of x . That part of the variation in x is only affected by the instrument and will be exogenous if z is.

$$\hat{x} = a_2 + b_2 z$$

- Second stage: These predictions of x are then used instead of the observed values of x to estimate the causal relationship with y .

$$\hat{y} = a_1 + b_1 \hat{x}$$

Stata does it all at once.

Instrumental variables: Estimation

Reduced form

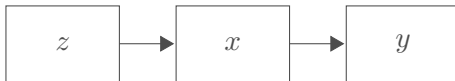
- Sometimes we regress the outcome directly on the instrument. This is called the reduced form.

$$\hat{y} = a_1 + b_1 z$$

- In the canvassing experiment that would give us the intent-to-treat effect.
- Reasons include:
 - Violations of exclusion restriction likely.
 - Endogenous variable difficult to measure.
 - Instrument is interesting on its own.

Instrumental variables: Estimation

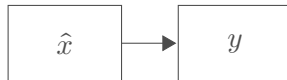
Full chain



First stage



Second stage



Reduced form



Instrumental variables: Handling non-compliance

The technique is often used to analyze experimental designs where something that is randomized or as-if random affects the probability of getting a treatment.

- Experiments with non-compliance.
 - Treatment assignment as instrument.
 - Treatment as endogenous variable.
- Fuzzy RD.
 - Crossing the threshold as instrument.
 - Treatment as endogenous variable.

Instrumental variables: Handling non-compliance

Recall the canvassing experiment

- Whether someone was visited by a canvasser depends both on their treatment assignment and a myriad of other factors (where you live, if you have a job, etc.).
- We only use the variation from treatment assignment, because it was randomized and therefore meets the exogeneity assumption .
- We can think of the treatment assignment as an instrument (z) for getting the treatment (x).

Instrumental variables: Handling non-compliance

- The first-stage regression will give us $\hat{x}$ of 0.6 and 0.
- Whether an individual gets 0.6 or 0 is only affected by the random assignment.

$$\hat{y} = a_1 + b_1 \hat{x}$$

$$\hat{x} = a_2 + b_2 z$$

- The increase from 0 to 0.6 is associated with an increased turnout with 2.3. b_1 is the change in y associated with a *one-unit* increase in x , so b_1 would be about 3.8 (2.3/0.6).

Instrumental variables: Finding instruments

- Assumptions are rarely met in non-experimental studies, but IV can still be a better choice than the alternatives.
- A selection of popular types of instruments:
 - Weather shocks (rain, disasters) on economy (economic growth, oil prices, crop yield).
 - Geography (distance to university, hospital, border, etc.) on (education, heart surgery, refugees, etc.).
 - Historic events (leader deaths, political decisions, etc.).
- Dunning has many more examples!

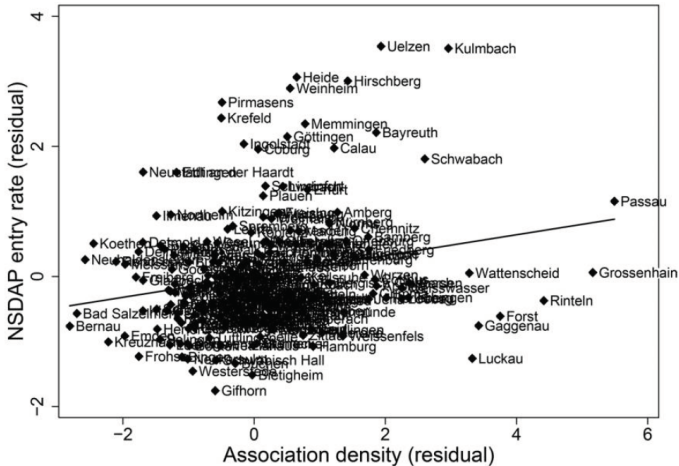
Instrumental variables: Satyanath et al (2017)

Three examples from research on nazism / radical right

- First paper is Satyanath et al (2017) Bowling for Fascism.
- The key argument is borrowed from Sheri Berman (1997): Germany's dense network of social clubs and associations helped spread the party message.
- Indeed there is a correlation between the number of associations and NSDAP members.

Instrumental variables: Satyanath et al (2017)

Association density correlated with density of NSDAP members



Instrumental variables: Satyanath et al (2017)

Correlation does not imply causation

- Industrialization and urbanization as a confounder?
- Aggressive nationalism as a confounder?
- NSDAP created many organisations?
- Solution: instrument 1920s associations on club members in 1860s.

Instrumental variables: Satyanath et al (2017)

Association density 1860 as instrument

- Relevance
 - F-test: 5.7–18.4
- Exogeneity
 - Variation dependent on how and when restrictions on freedom of association were lifted after 1848.
 - 19th century nationalism was liberal. Singer festivals and gymnast associations were therefore not indicative of aggressive nationalist tendencies.
- Exclusion
 - Not correlated with nationalist parties in Imperial Germany (1890–1912).

Little discussion because the IV is only a robustness test.

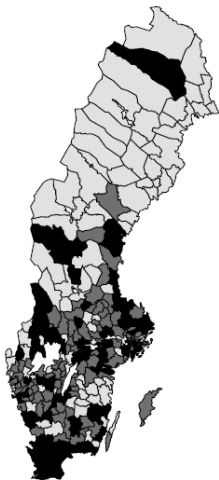
Instrumental variables: Dahlberg et al

- Paper by Dahlberg, Lundqvist and Vernby.
- How important are historical legacies for the current support for SD?
- It appears as if the Sweden Democrats are (somewhat) larger where there was strong support for national socialists.

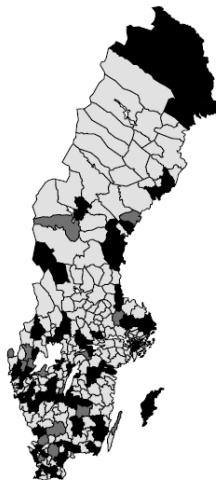
Instrumental variables: Dahlberg et al

Nazi support 1938 associated with SD support today

Radical Right Votes 1998–2006



Fascist Mobilization 1938



Instrumental variables: Dahlberg et al

Correlation does not imply causation

- Political networks persisted and facilitated the reemergence of radical right parties (true state dependence)?
- Or are there some deep-seated local characteristics that give rise to both phenomena (spurious state dependence)?
- Solution: Instrument fascist mobilization on closure of garrisons in 1925 (supposedly not affected by these deep-seated characteristics).

The published paper is only about this 'first stage'.

Instrumental variables: Dahlberg et al

Closure of garrisons as instrument

■ Relevance

- Discontent with disarmament was a driving force behind organisations that preceded the nazi parties.
- $F = 11$

■ Exogeneity

- Imposed by central government. No room for self-selection?
- Control for reasons stated in the bill (military strategic).
- But you can only close a garrison where one exists.

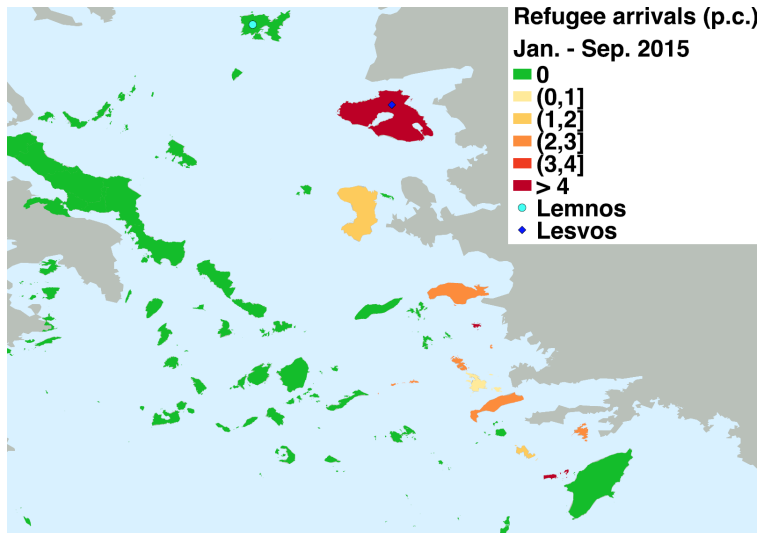
■ Exclusion

- Not discussed in the working paper.
- Maybe these areas still have fewer garrisons which could affect employment and perception of military safety?

Instrumental variables: Dinas et al (2019)

- Dinas et al (2019) Waking Up the Golden Dawn
- How does exposure to the 2015 refugee crisis affect natives' political preferences?
- Correlation between exposure and attitudes do not reflect a causal effect if refugees select host countries dependent on religious or cultural proximity, labor market conditions, and openness toward refugees.
- Solution: Study Greek islands and use distance to Turkey as instrument.

Instrumental variables: Dinas et al (2019)



Instrumental variables: Dinas et al (2019)

Distance to Turkey as instrument

- Relevance
 - Very intuitive and $F > 30$.
- Exogeneity
 - Are there characteristics correlated with living close to Turkey that could also be correlated with a GD upswing?
 - Placebo test finds no effects on voters registered but not currently living on the islands.
- Exclusion
 - No other 2015 events that could have increased the support for GD on islands close to Turkey?
 - GD mobilization? Is that part of the effect?

Other techniques

If only we had more time

- Matching and synthetic controls are two techniques that would be dealt with if we had more time.
- I will cover them briefly.

Other techniques

Matching

- We use randomization or as-if random designs to make the treatment and control group comparable.
- Matching instead relies on combining treated individuals with individuals that are similar on a set of observable characteristics.
- Tools and terminology resemble that of design-based causal inference, but the validity of the exogeneity assumption is closer to the control variable–approach.

Other techniques

Synthetic controls

- For complex aggregates as countries it is difficult to find a comparable unit to use as control.
- Comparisons are often made with the average in EU, OECD or similar, which does not follow the same trajectory.
- A special case of matching suited for case-study work is the synthetic controls method.
- A synthetic control is a weighted average of the potential comparison units.

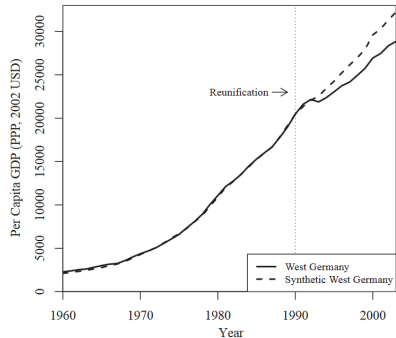
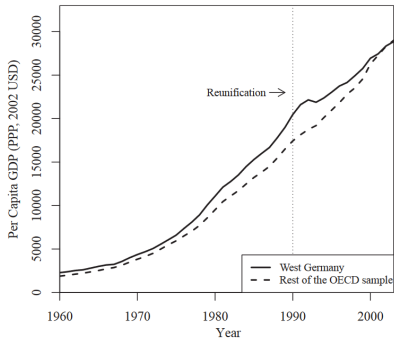
Other techniques

Synthetic controls

- Abadie et al (2014) are interested in how the West German economy was impacted by the reunification.
- But what country would be a suitable counterfactual?
- They take 42% Austria, 22% US, 16% Japan, 11% Switzerland and 9% Netherlands to create a synthetic control that best matches West Germany pre-intervention.
- Countries should be somewhat similar to the treated unit/group and preferably not affected by similar interventions or extra-ordinary events.

Other techniques

How did reunification affect West German GDP?



Words of caution

What is it that is random?

- It is easy to be blinded by a successful randomization or natural experiment.
- Randomization let us meet the exogeneity assumption, but that does not apply to all kinds of analyses and questions.
- Whenever you are analyzing an experiment, always keep in mind what is random and what is not.

Words of caution

Compliers are not random

- We have stressed this a lot, but if you compare compliers to the control group you will violate the exogeneity assumption.

Words of caution

Sometimes there are multiple treatments

- Vocational high school programs (gymnasieprogram) in Sweden went from two to three years in 1991.
- The preceding six-year pilot scheme makes it possible to examine the effects of extending the vocational tracks.
- But we cannot disentangle the effect from the prolongation from that of more academic content, as they come bundled.

Words of caution

Sometimes there are multiple treatments, continued

- Between 1987 and 1991, refugees arriving in Sweden had very little room to choose initial municipality of residence.
- This policy has been used to evaluate how conditions (unemployment, ethnic networks, etc.) affect labour market and educational outcomes.
- Even if placement is exogenous with respect to individual characteristics, the local conditions will be correlated with omitted variables.

Words of caution

Moderators are not randomized

- It is common and interesting to look at how an experimental treatment differs across sub-groups, using split samples or interactions.
- But if the effect appears to be conditioned by some characteristic, it may be because that characteristic is correlated with something else.

Words of caution

Mediators are not randomized

- Sometimes we try to find mediating variables that explain why a treatment had an effect on the outcome.
- It is interesting to use such variables as outcomes, but we cannot do a classic mediation analysis where we include them as additional regressors to see if the treatment effect disappears.

Words of caution

The random variation may not be representative

- The randomish variation is often atypical.
- The affected individuals are often a narrow sub-sample.
- We use force or fortune instead of ability or free choice.
- This is of course just one of many threats to external validity.

Concluding

It does not have to be perfect

- Many of the papers we have discussed have obvious shortcomings.
- If the question is interesting and the field is lacking causal evidence, it can still be a ground-breaking study.

Concluding

- We will replicate IV results of Dinas et al in the workshop.
- It will be related to the seminar assignment.

Concluding

See you on Wednesday!