Discussion of "Negative Control Falsification Tests for Instrumental Variable Designs" by Danieli, Nevo, Walk, Weinstein, and Zeltzer

Mel Stephens

University of Michigan and NBER

November 2025

IV Estimation and Valid Instruments

Many empirical papers hinge on having a valid instrument

Few tests for instrument validity are available
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"Falsification" tests can help fill the void

- E.g., pre-intervention outcomes should not be affected
- However, limited guidance for falsification tests

Falsification Tests in Practice

Survey empirical literature

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- Negative control instrument (NCI)
  - Alternative instrument that should be uncorrelated w/outcome
  - 24% of papers with placebo tests use an NCO
- Often, the NCO or NCI is proxying for an unobservable variable
  - The unobservable may cause the instrument to be invalid.

Outline of Paper/Discussion

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- Illustrating using DAGs (Directed Acyclic Graphs)
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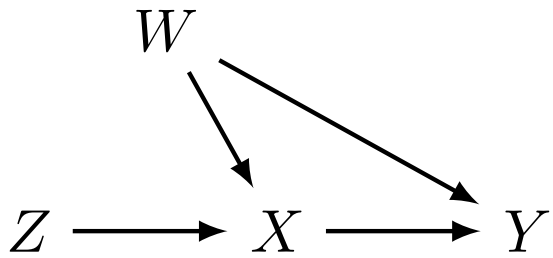
Suggested procedures for researchers

- How can researchers apply this in practice?
- What are the resulting suggested testing procedures?

Illustrating IV Estimation Using a DAG



Y - outcome of interest

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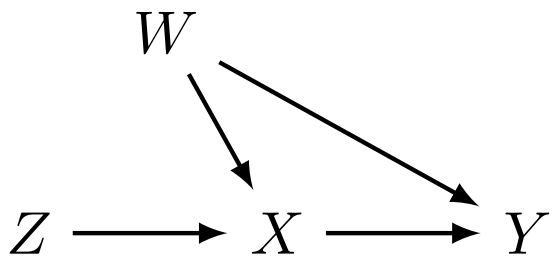

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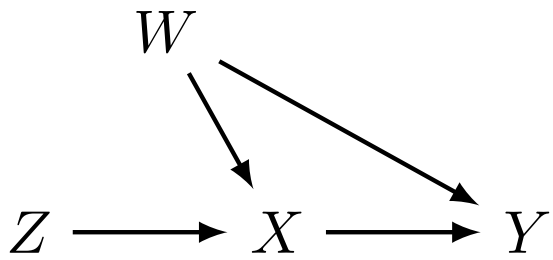
Z - instrumental variable

What Could Go Wrong?



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Instrument not affected by variables also affecting outcome

$\rightarrow$ Ignorability or "as good as randomly assigned"

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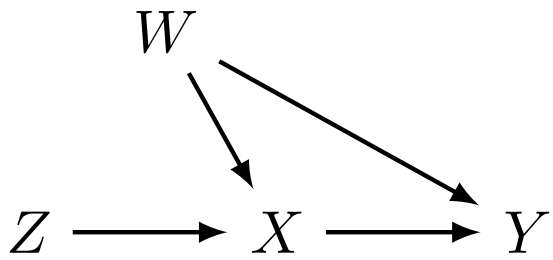

Falsification tests typically address either

i. Outcome Independence

Instrument not affected by variables also affecting outcome

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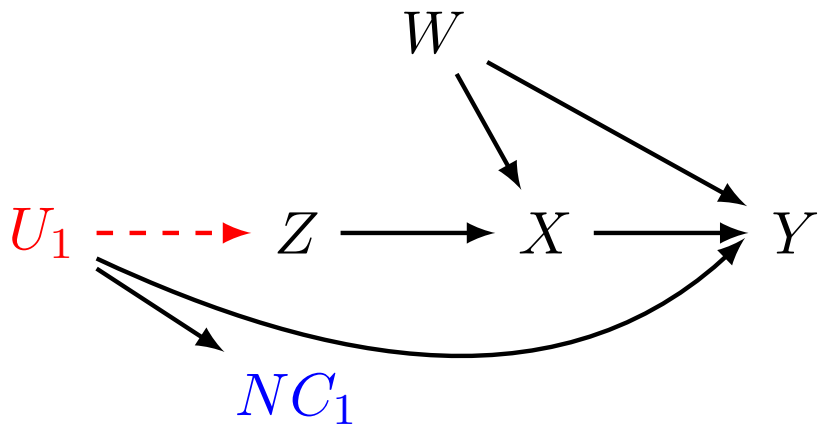
ii. Exclusion Restriction

Instrument only affects outcomes through the treatment

Falsification Example I: NCO + Outcome Independence



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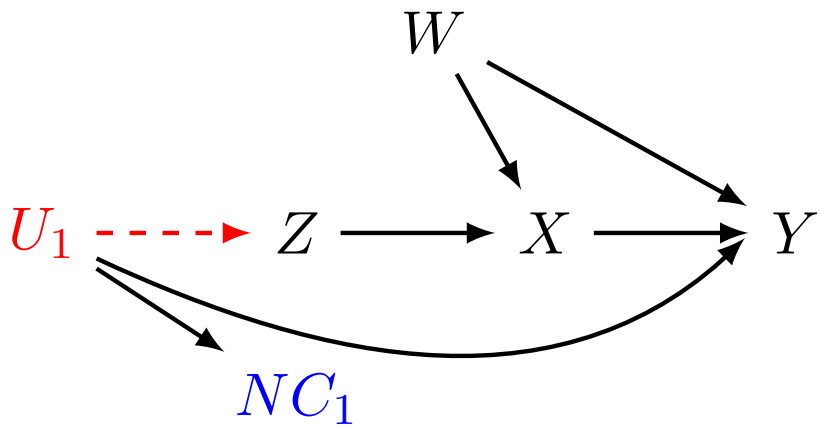

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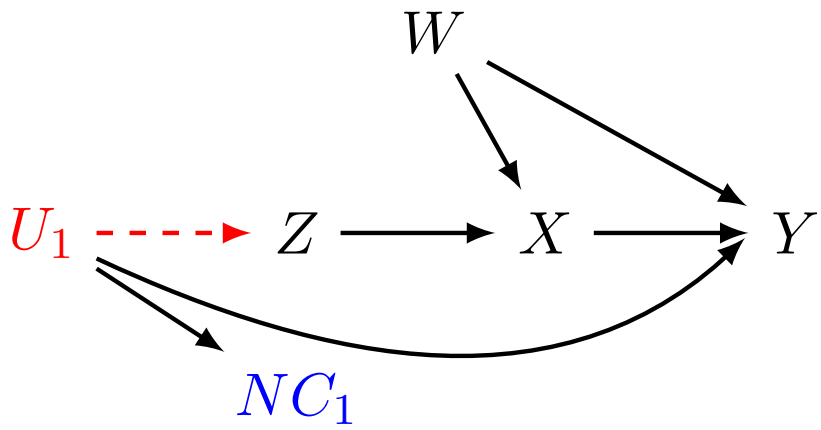

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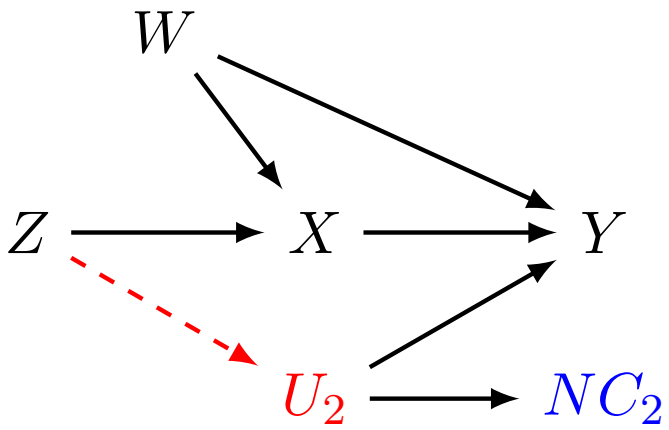
Falsification Example II: NCO + Exclusion Restriction



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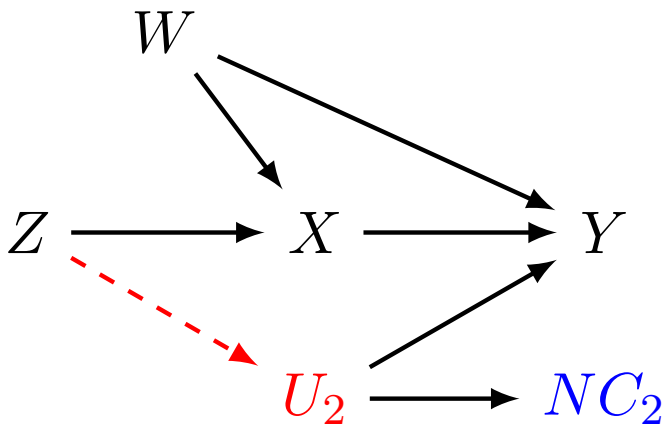

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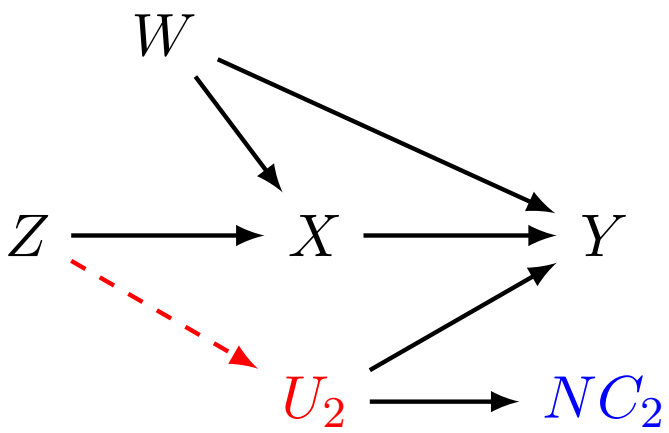

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NC_2 - Clothing expenditures (Rosenzweig and Wolpin 2000)

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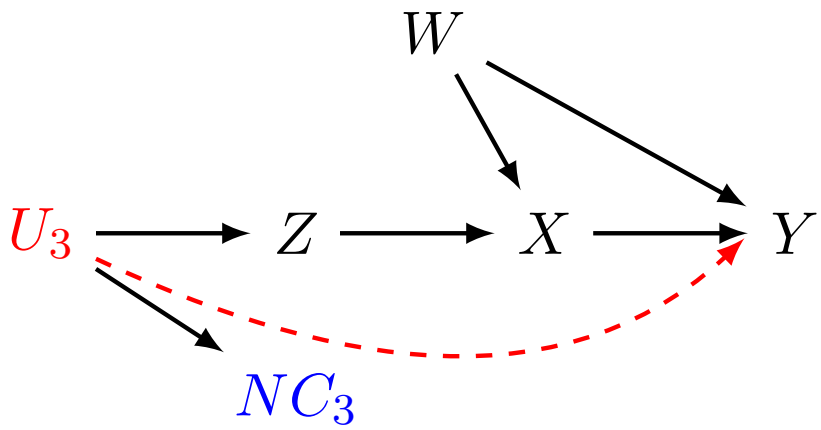

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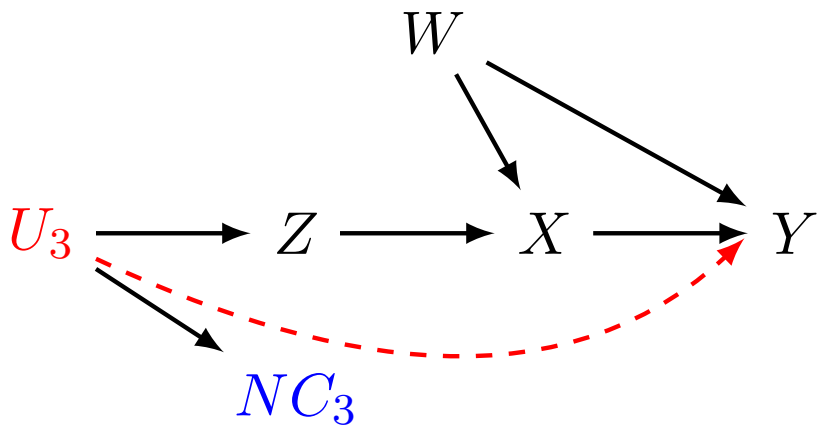

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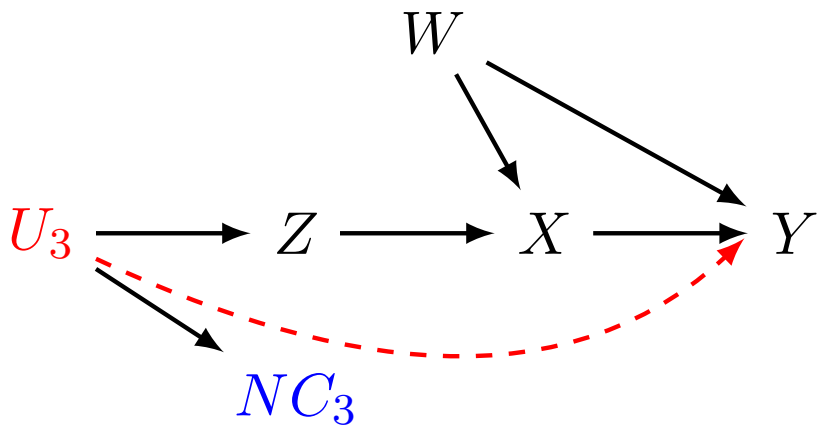

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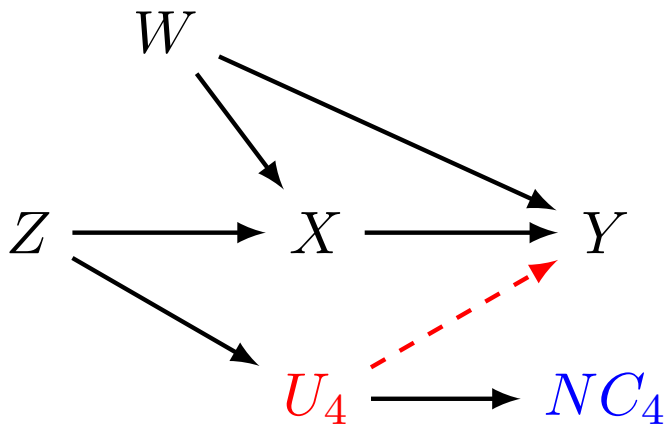

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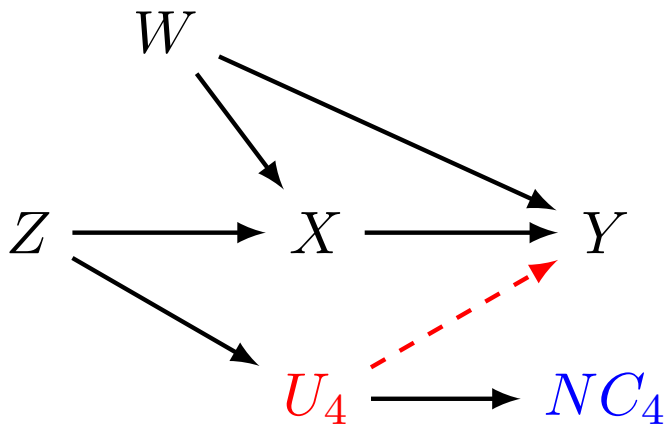

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U_4 - Temporal displacement of economic activity

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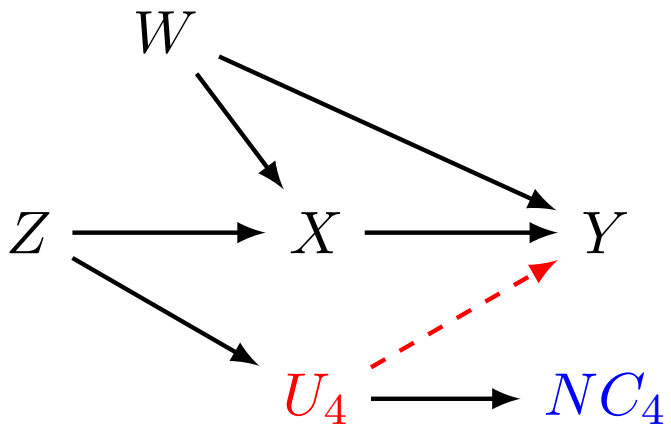

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NC_4 - Traffic patterns (proxy for economic activity)

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Combining these yields $Z \perp\!\!\!\perp Y(x)$ for all x.

Two Broad Falsification Approaches

As noted above, two main types of falsification tests

1. Tests using Negative Outcome Controls (NCOs)
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The discussion will examine each in turn

First NCOs

Then NCIs

Alternative Path Outcomes

Path through which instrument (Z) affects outcome (Y)

But does not (only) go through $X \rightarrow$ alternative path

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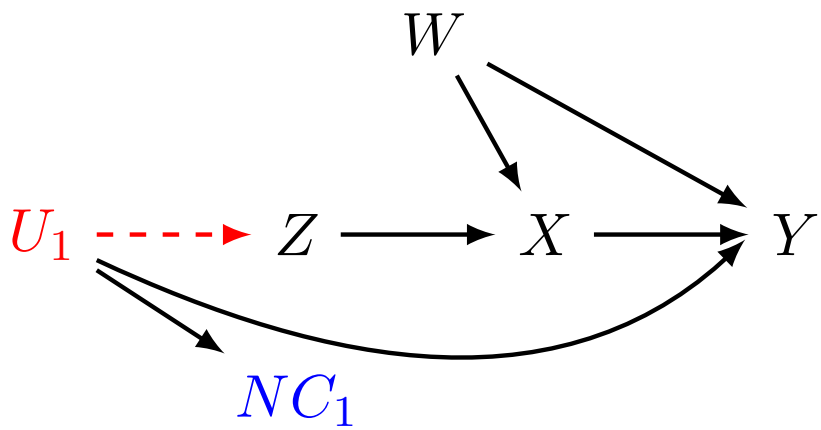
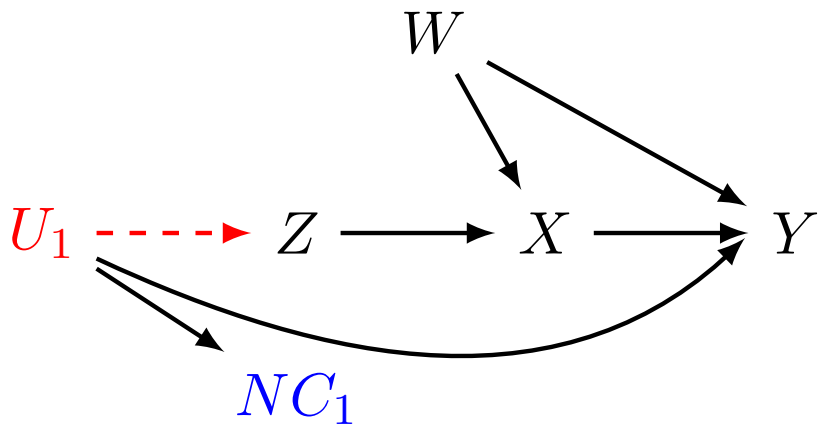


Fox News example

- U_1 (Local conservativeness) is an APO

Alternative Path Outcome Defined



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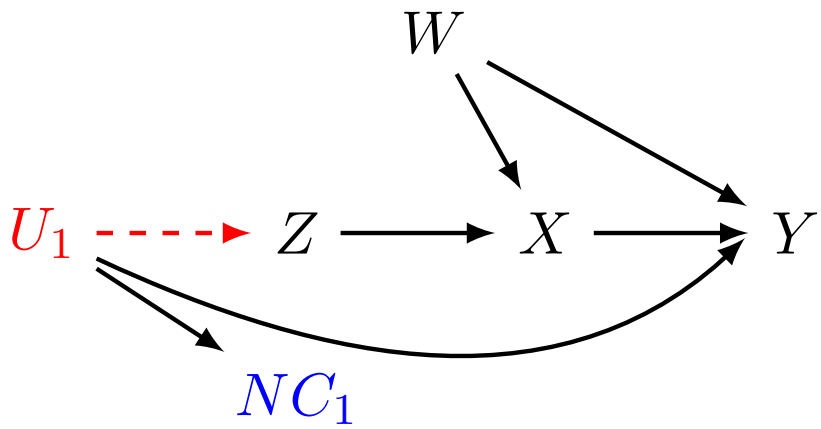

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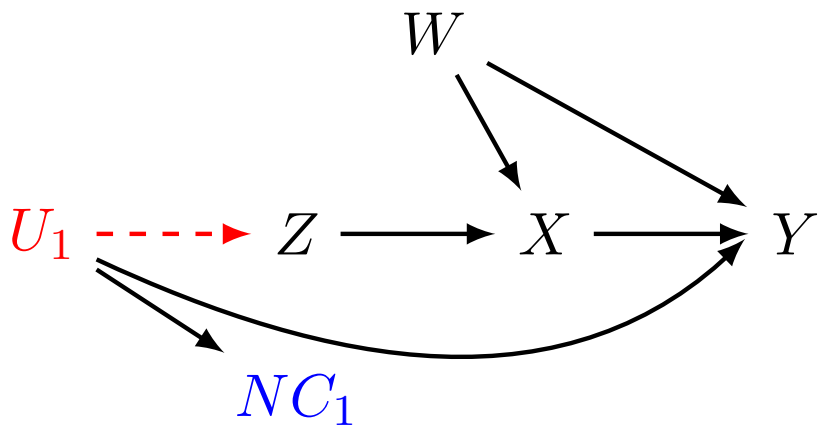
   If an instrument is valid, it is not correlated with an APO.

Negative Control Outcome Defined



Definition 3: A random variable NC is an NCO if there exists an APO variable U such that

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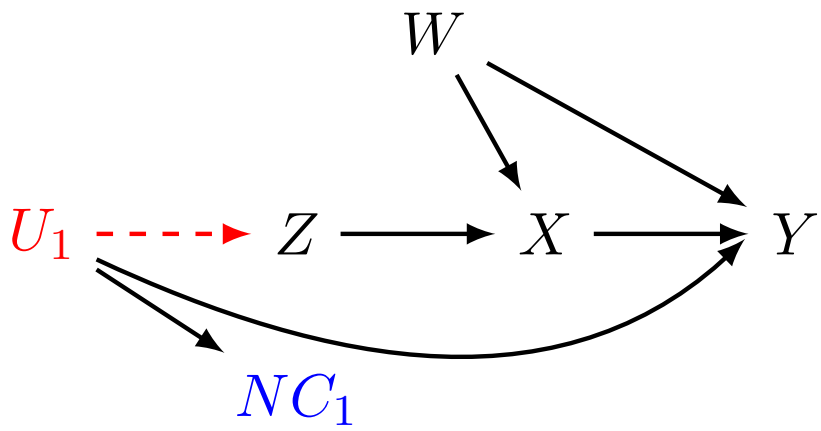

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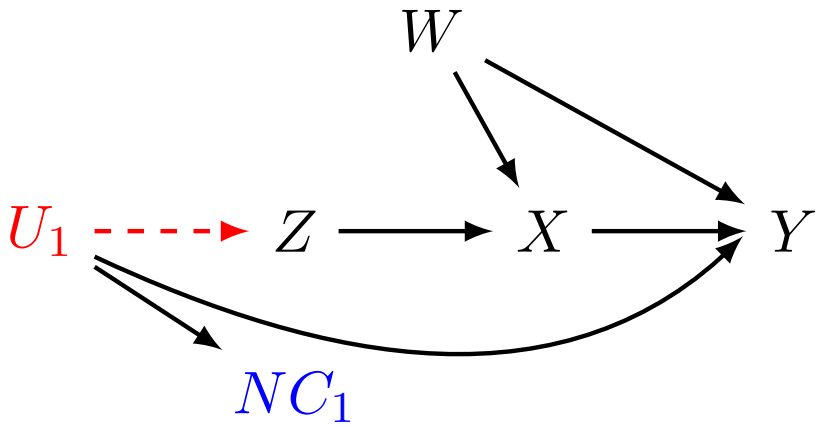
   Negative control is correlated with the APO

Negative Control Outcome Examples



Fox News and Republican Vote Share: NCO that works

Cable channel position of Fox News is Z.

Local conservativeness, U_1, is APO.

Lagged Republican vote share is NC_1.

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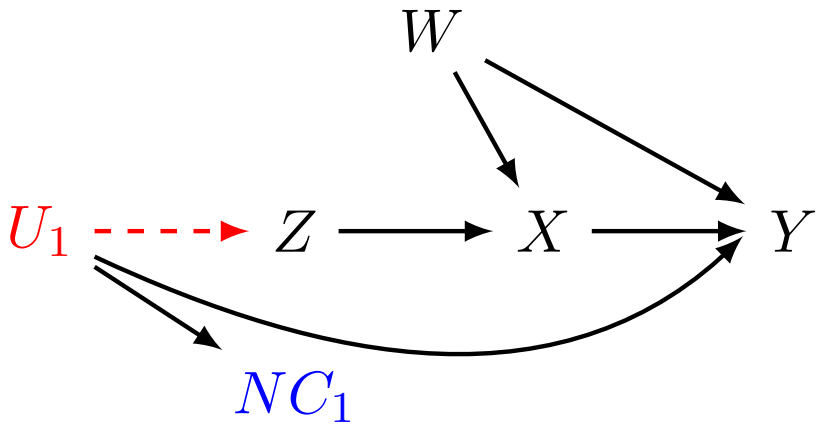

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Any association between Z and NC_1 must be through U_1.

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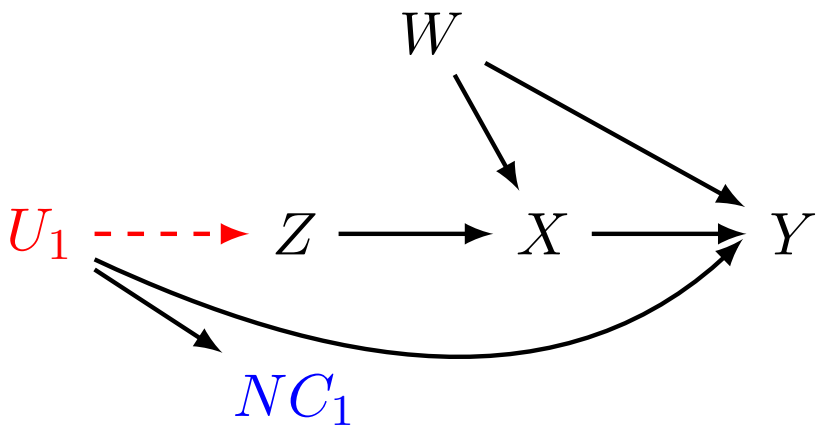

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- Respiratory admissions are Y
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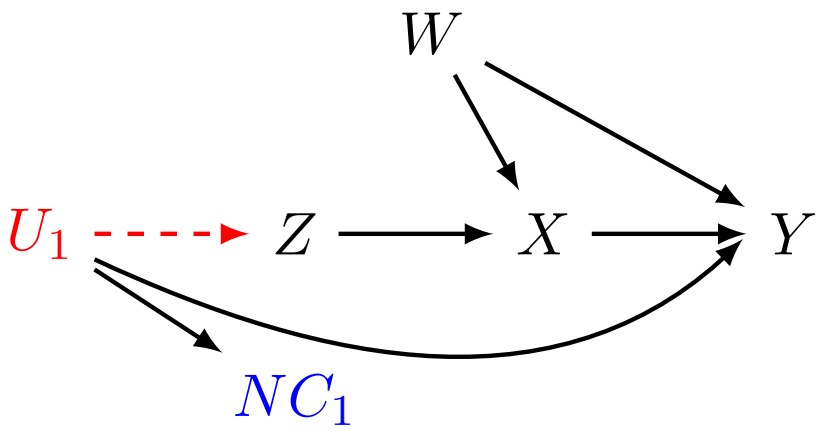

Air pollution and Respiratory Admission: NCO does not work

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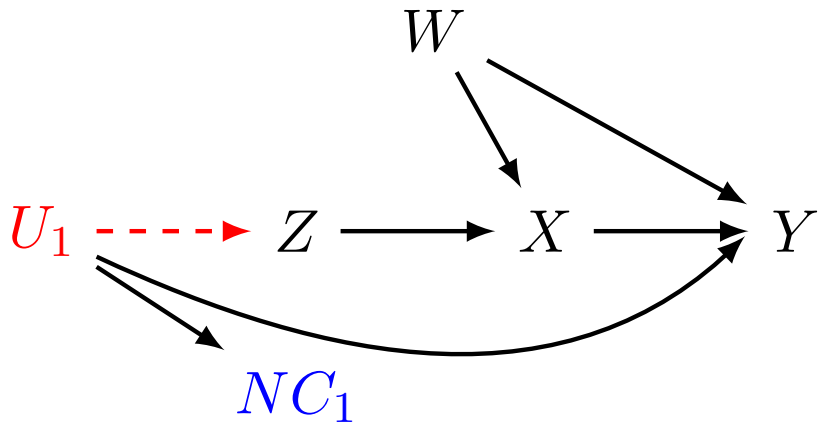
- Congestion from respiratory admissions $\downarrow$ non-resp. admits
- Verdict: non-resp admits not an NCO

Negative Control Outcome Tests



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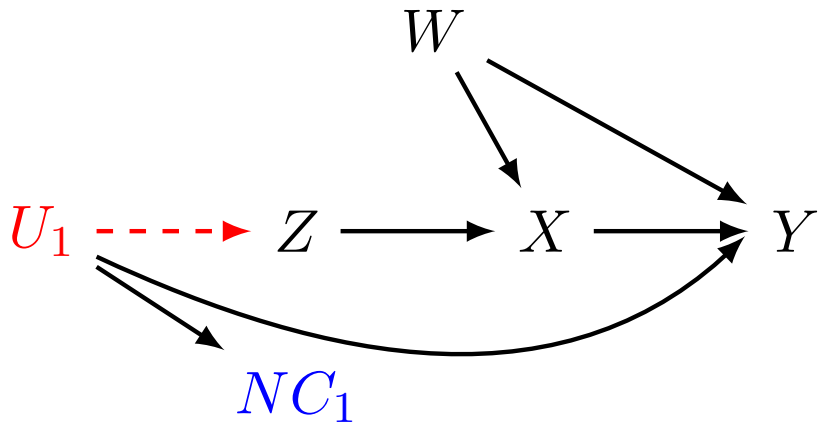
Test: regress Z on NCO or NCO on Z

Should be uncorrelated

Negative Control Outcome Tests



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Straightforward to extend to include covariates in this test

Discuss including "rich covariates" and functional form

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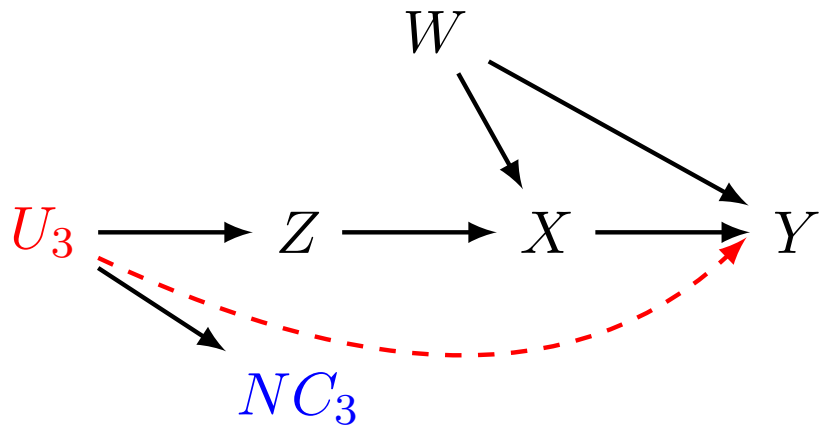
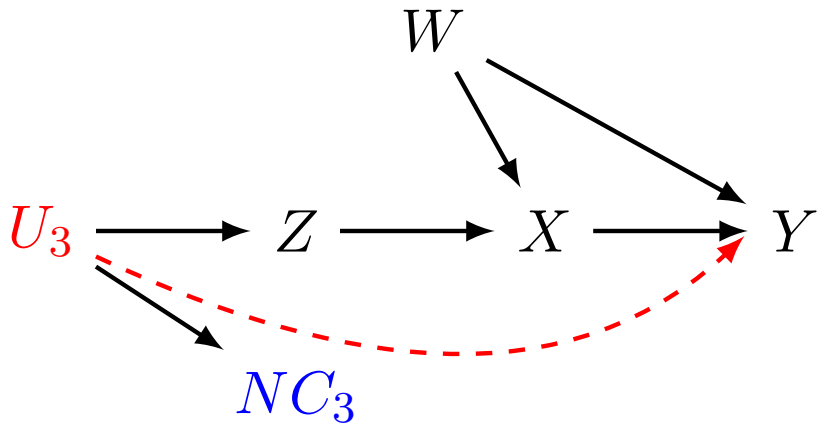


Food Aid example

U_3 (unobserved weather shock) is an API

Alternative Path Instrument Defined



Definition 2: A random variable U is an API if

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   Same condition as for APO.

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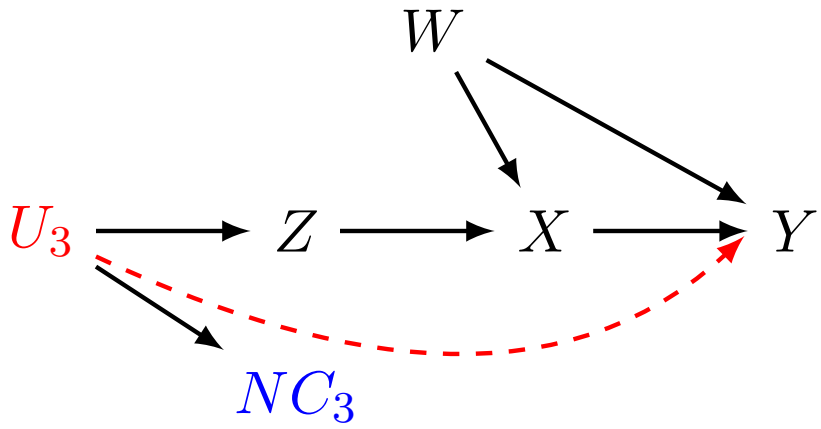

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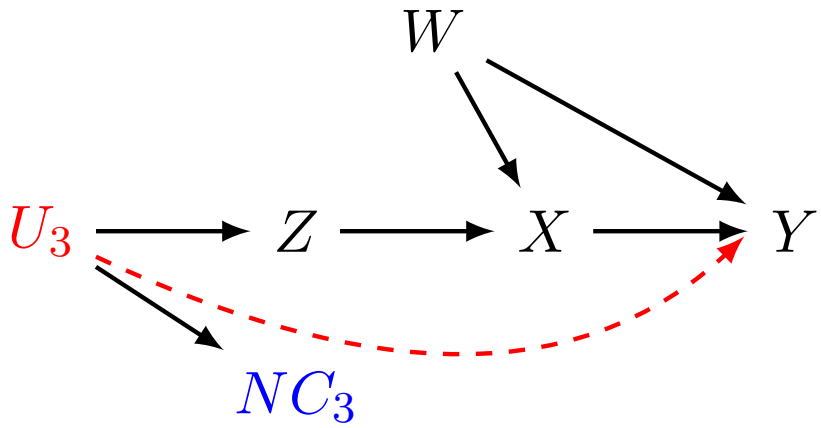
2. *Path indication*. If $Z \perp\!\!\!\perp Y(x)$ then $U \perp\!\!\!\perp Y|Z$.

   Alternative path instrument: U uncorrelated w/ Y, cond. on Z

Negative Control Instrument Defined



Definition 4: A random variable *NC* is an NCI if there exists an API variable *U* such that

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   Unlike NCO case, conditional independence between NC & Y.

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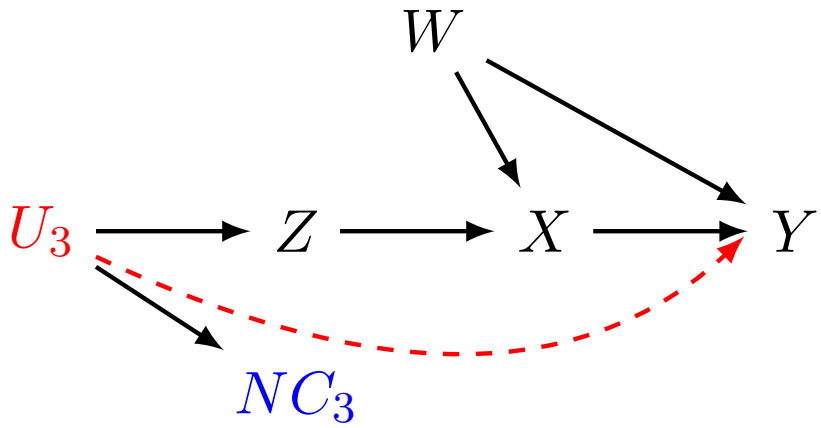

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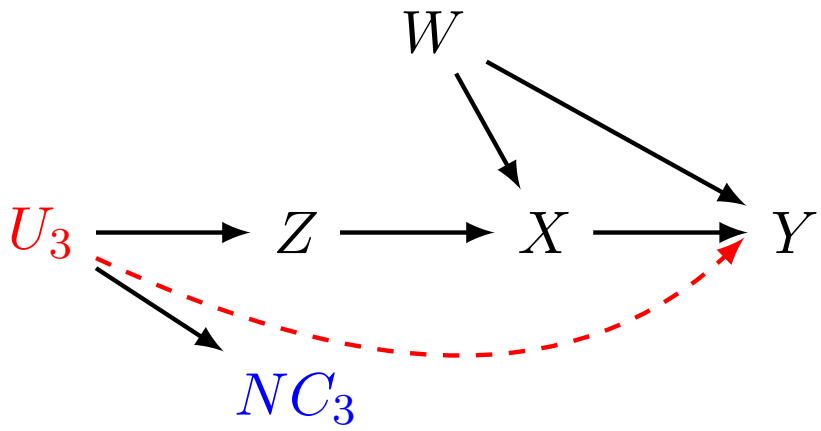
2. *U-comparability*. $NC \not\perp\!\!\!\perp Z$.

   Negative control is correlated with the APO

Negative Control Instrument Example



Food Aid and Conflicts

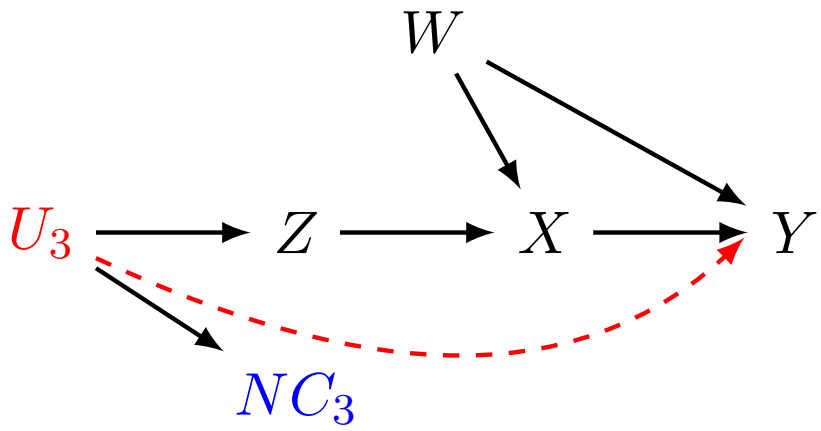
Conflicts in recipient countries is Z.

US Wheat Production is Z.

Unobservable weather conditions, U_3, is API.

US Orange Production is NC_3.

Negative Control Instrument Example



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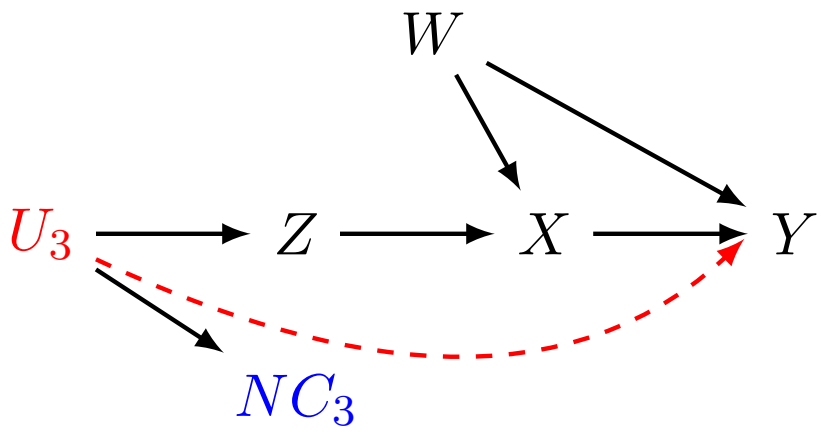
Orange production unrelated to conflicts....

...conditional on weather and wheat production

Negative Control Instrument Tests



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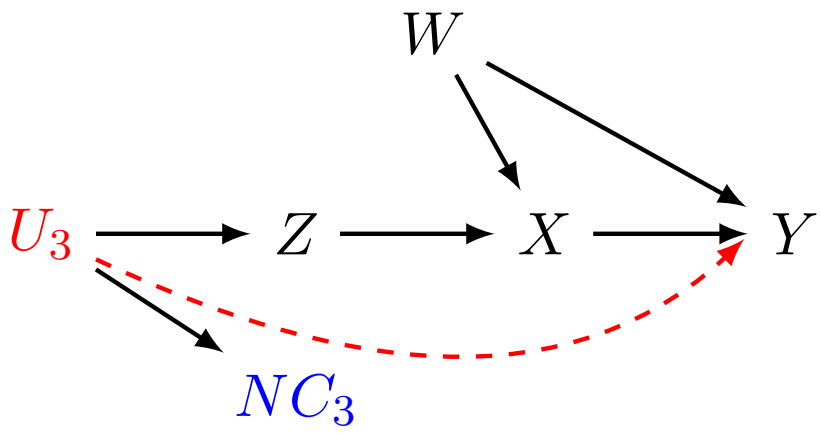
Test: regress Y on NCI controlling for Z

Should be uncorrelated conditional on Z

Negative Control Instrument Tests



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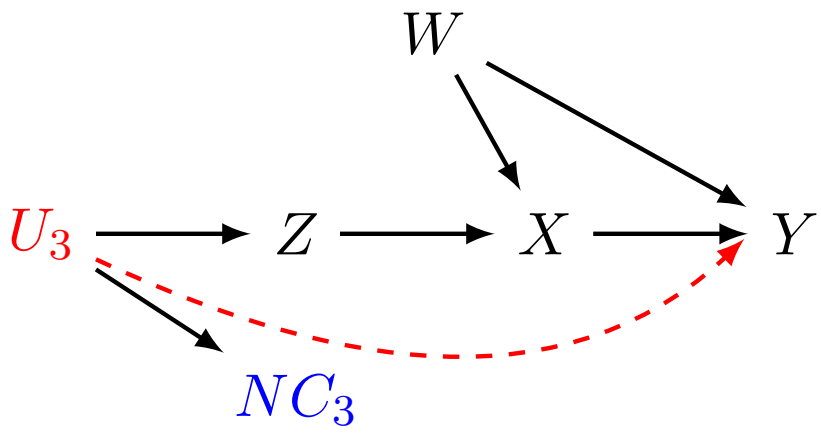

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Also discuss cases $NC \perp\!\!\!\perp Z$ - see Theorem 3

Can test without conditioning on Z

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4. Explore further diagnostics if reject the null

   Caution that may be low powered

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Authors' key highlights

- Most NCI tests fail to condition on the instrument
- Negative control tests jointly test assumptions + model spec.
- Clarify what can be used as negative controls; some overlooked