Epib 605

A few random thoughts

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Week 2

The Era of Progress on Gun Mortality: State Gun Regulations and Gun Deaths from 1991 to 2016

> ** Abstract Conclusion**

“State regulations passed from 1991 to 2016 were associated with substantial reductions in gun mortality. We estimate that restrictive state gun policies passed in 40 states from 1991 to 2016 averted 4297 gun deaths in 2016 alone, or roughly 11% of the total gun deaths that year.”

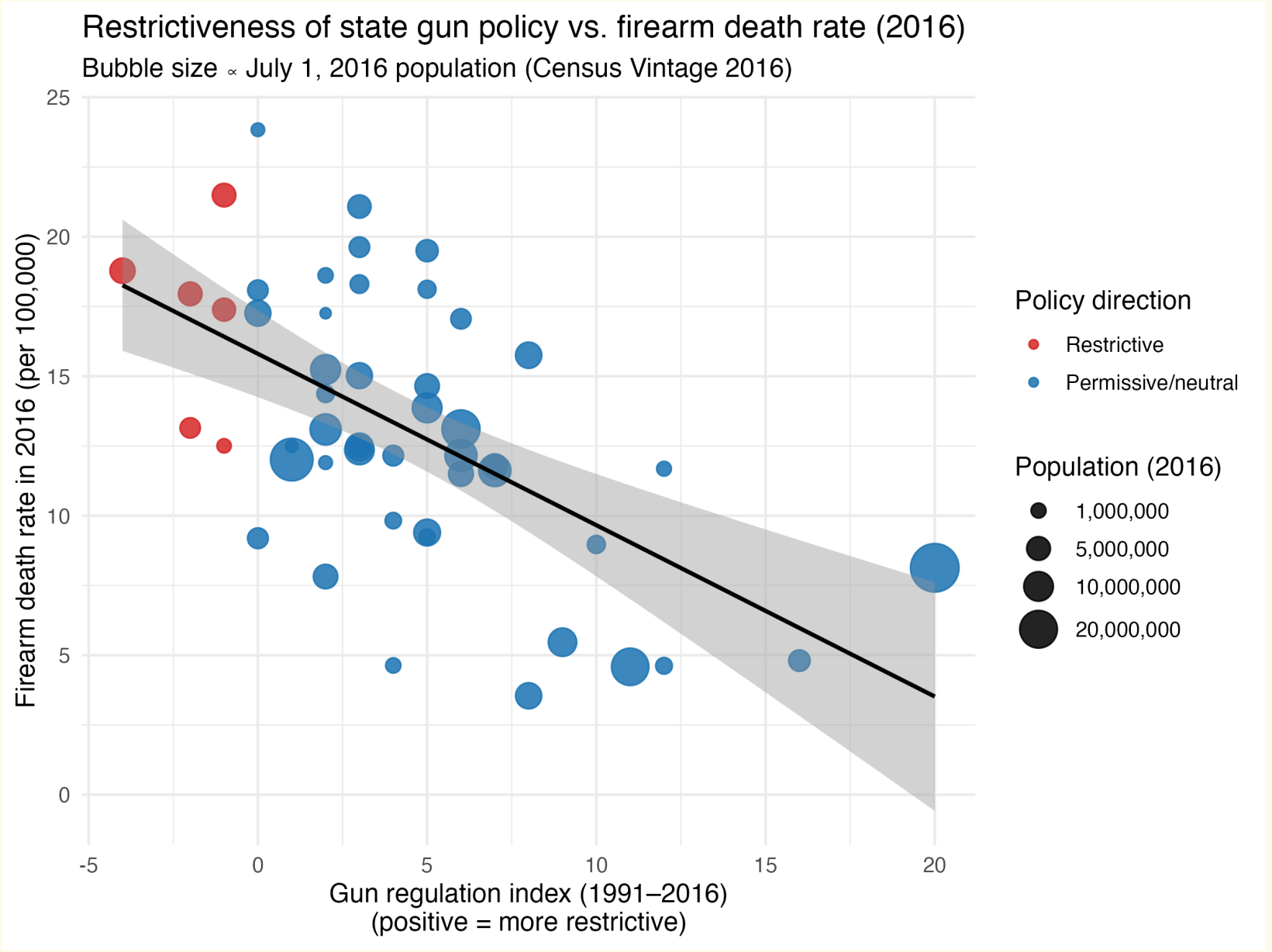
Strengths

- A clear identification strategy
- Multiple robustness checks
- Two instrumental variables (IV) strategies
- Alternative datasets
- Fixed effects sensitivity analyses

Some weaknesses

- Poor visualizations
- Questionable modeling choices
- Conceptualization of “the gun regulation index

Figure 2


Restrictiveness of state gun policy vs. firearm death rate (2016)
Bubble size ∝ July 1, 2016 population (Census Vintage 2016)
Firearm death rate in 2016 (per 100,000)
25
20
15
10
5
0
-5
0
5
10
15
20
Gun regulation index (1991–2016)
(positive = more restrictive)
Policy direction
Restrictive
Permissive/neutral
Population (2016)
1,000,000
5,000,000
10,000,000
20,000,000

Assumptions

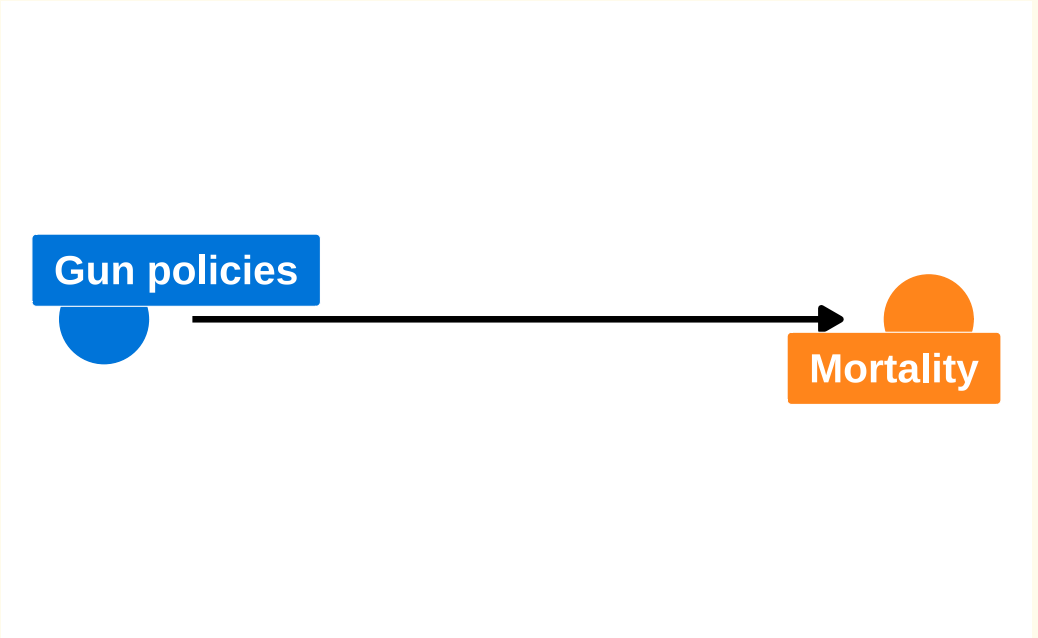
OLS Assumptions in Figure 2

Assumption	Likely Met?	Explanation
Linearity	⚠ Partially	Assumes linear mode. Real relationship may be nonlinear .
Independence of Observations	❌ No	States are spatially clustered Gun markets spill across borders; political and cultural factors cluster Violates independence.
Homoskedasticity	❌ No	Variance in death rates is much higher among permissive states and lower among restrictive states.
Normality of Errors	⚠ Weak	Residuals show heavy tails (AK, WY, WV). Small sample (N=50) makes normality more important. Maybe not well-satisfied.

A few slides

Assumption	Likely Met?	Explanation
No Omitted Variable Bias	❌ No	Socioeconomic conditions, culture, gun ownership prevalence, politics, policing, rurality all correlate with both regulations and death rates. Figure 2 is descriptive but OLS is reported as if causal.
No High-Leverage Points	❌ No	California (very high regulation, low death rate) and AK/WY (high death rates, very low regulation) strongly influence slope.
Measurement Validity	⚠️ Mixed	Firearm death counts are reliable, but the “regulation index” is a crude additive measure treating all laws as equal and linear.

Do guns policies influence gun mortality?



$$\text{Gun policies}_i = \beta_0 + \beta_1 \text{Mortality}_i + \varepsilon_i$$

If we ran this regression, would β_1 give us the causal effect of gun policies?

Probably not! Most likely there is confounding ("unclosed backdoors"), both measured and unmeasured

In econometrics this is often known as **Endogeneity** (especially if the confounder is unmeasured)

Exogenous variables are not determined by anything else in the model, in DAG terms, a node with no arrows going, so in this model gun policies is exogenous

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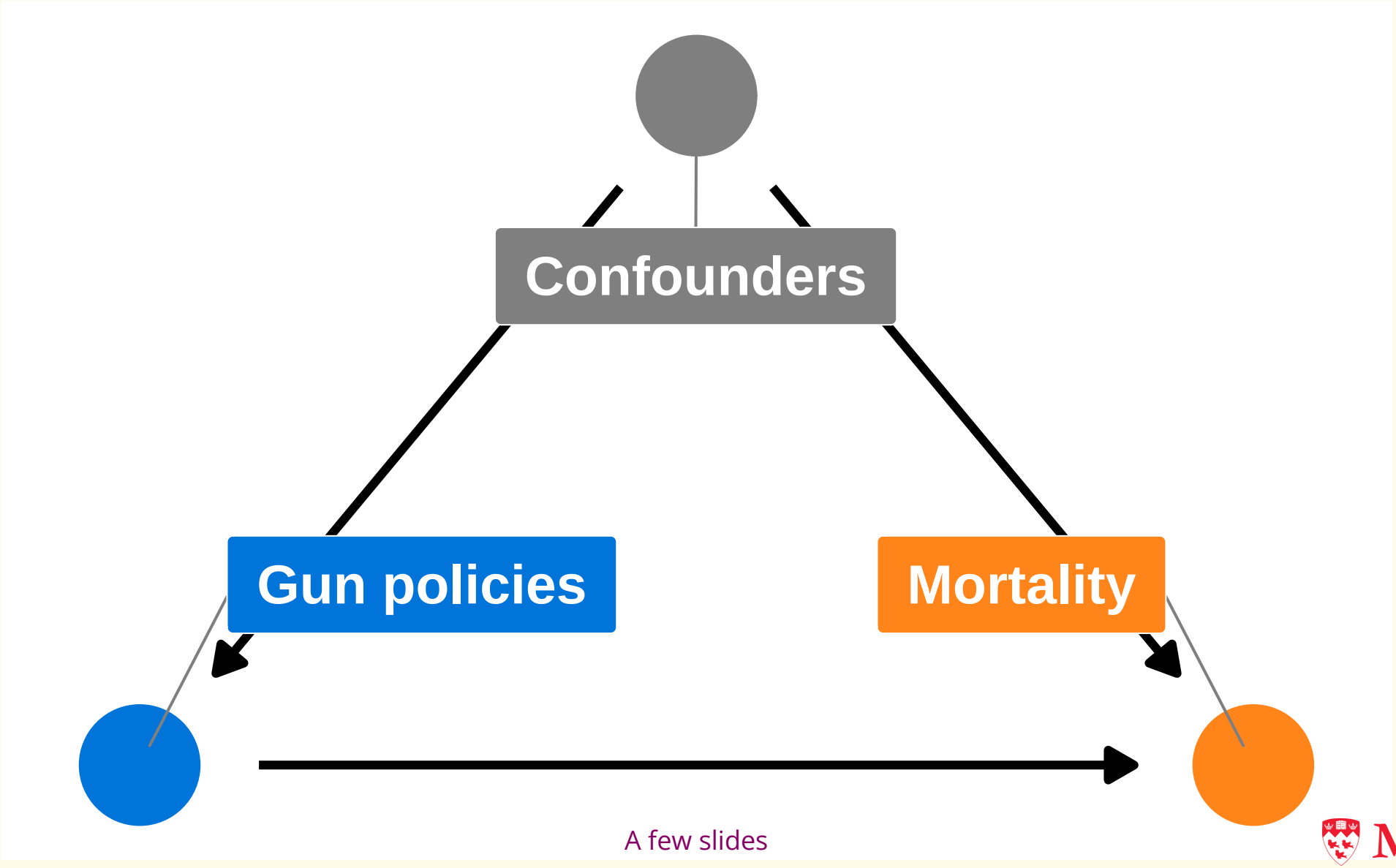
Endogeneity

However, in this model Gun policies is endogenous: e.g. Confounders → Gun policies + Mortality



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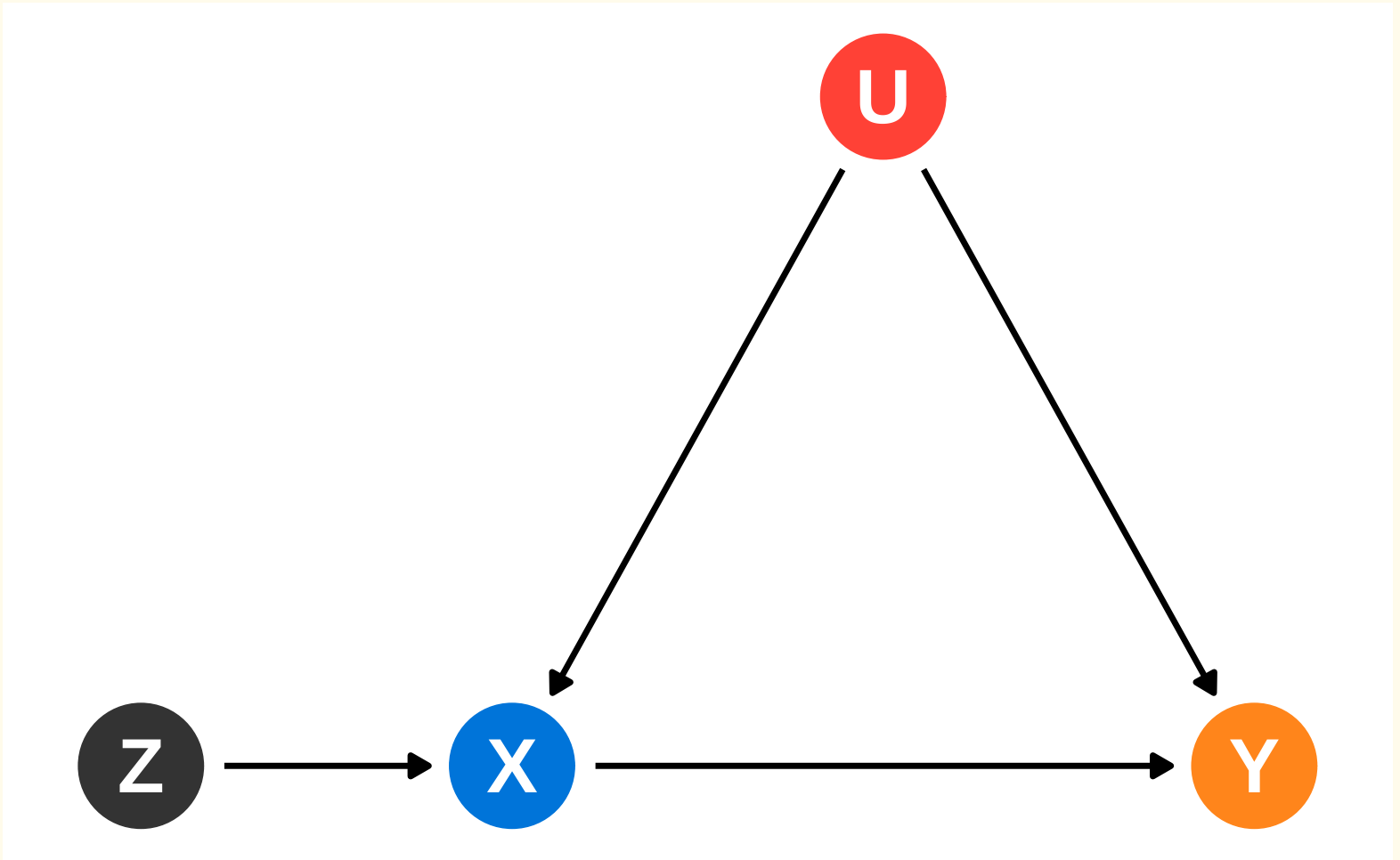
What is an instrumental variable?

- Something that is correlated with the exposure (Relevance)
- Something that does not directly cause the outcome, other than by the treatment (Exclusion, or ignorability)
- Something that is not correlated with the omitted variables (Exogenity)

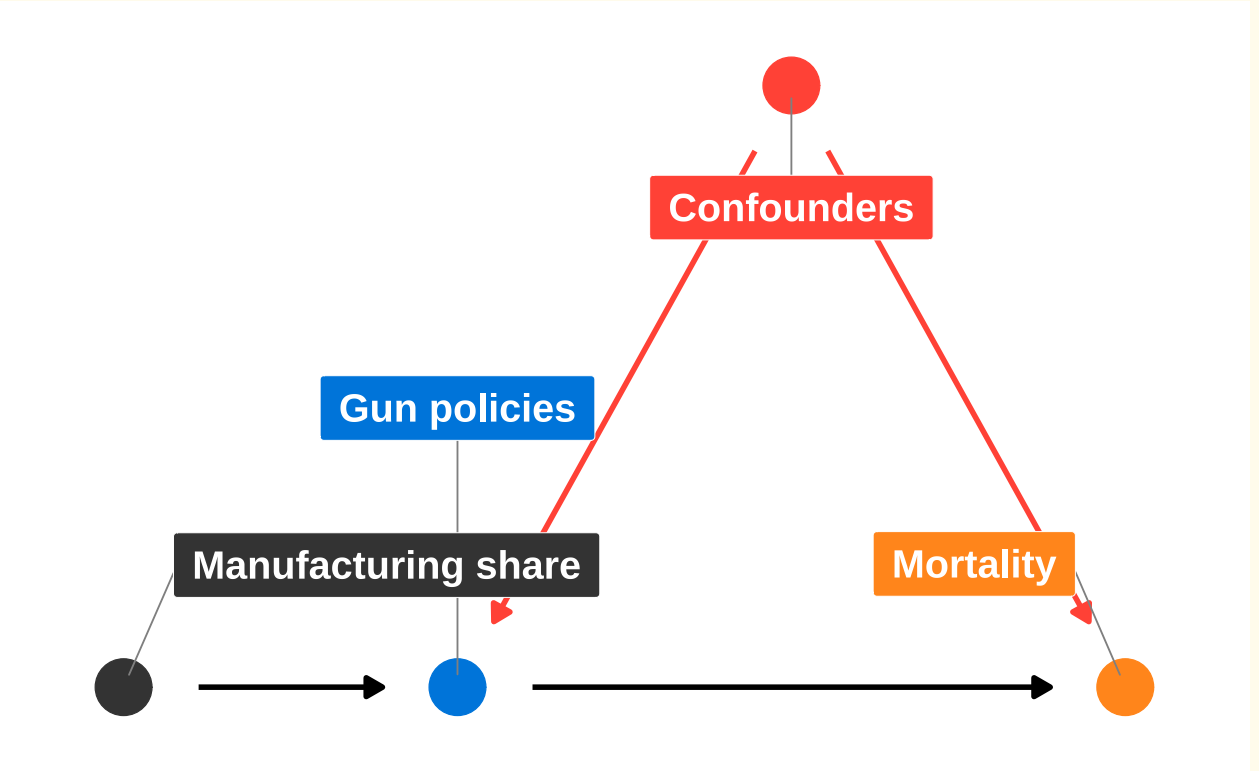
Generic IV DAG



Z = instrument, X = exposure, Y = outcome, U = unmeasured (omitted) variable

Essentially trades one implausible assumption (ignorability of treatment variable) by a more plausible assumption (ignorability of the instrument)

Specific IV DAG example



Remember DAG – arrows and absence of arrows are both assumptions

1. Relevance — correlated with exposure
   $Z \rightarrow X$ $Cor(Z, X) \neq 0$ testable with stats
2. Excludability — affects outcome only through exposure $Z \rightarrow X \rightarrow Y$ $Z \not\rightarrow Y$ $Cor(Z, Y \mid X) = 0$
   stats + story
3. Exogeneity — not correlated with omitted variables $U \nrightarrow Z$ $Cor(Z, U) = 0$ requires story

Other Potential Instruments

Outcome	Exposure	Unobserved stuff	Instrument
Income	Education	Ability	Father's education
Health	Smoking cigarettes	Other negative health behaviors	Tobacco taxes
Health	Cardiac catheterization	Quality of care	Distance to hospital
Health	Drug	Disease severity	Physician prescribing tendancy
Health	Genetic marker (SNP)	Disease severity	Mendelian randomization

Falsifying exclusion assumptions

Can you think of some other way that the instrument can cause the outcome outside of the exposure

If so, the instrument doesn't meet exclusion restriction