

ECON 1123 Section 7

Slides at github.com/cjleggett/1123-section

Outline

- Name Circle
- Midterm Feedback
- Lecture Recap / Questions
- Practice Problems

Name Circle

Name Circle

- Name
- What you did over spring break



Midterm

Midterm

- A bit more difficult than I was expecting
- If you weren't happy with your score, there's still a lot of time!
- Greg said if you do significantly better on the final, he'll give that more weight
- Please meet with me if you have questions/concerns!
 - Slack
 - cjleggett@college.harvard.edu

Lecture Recap

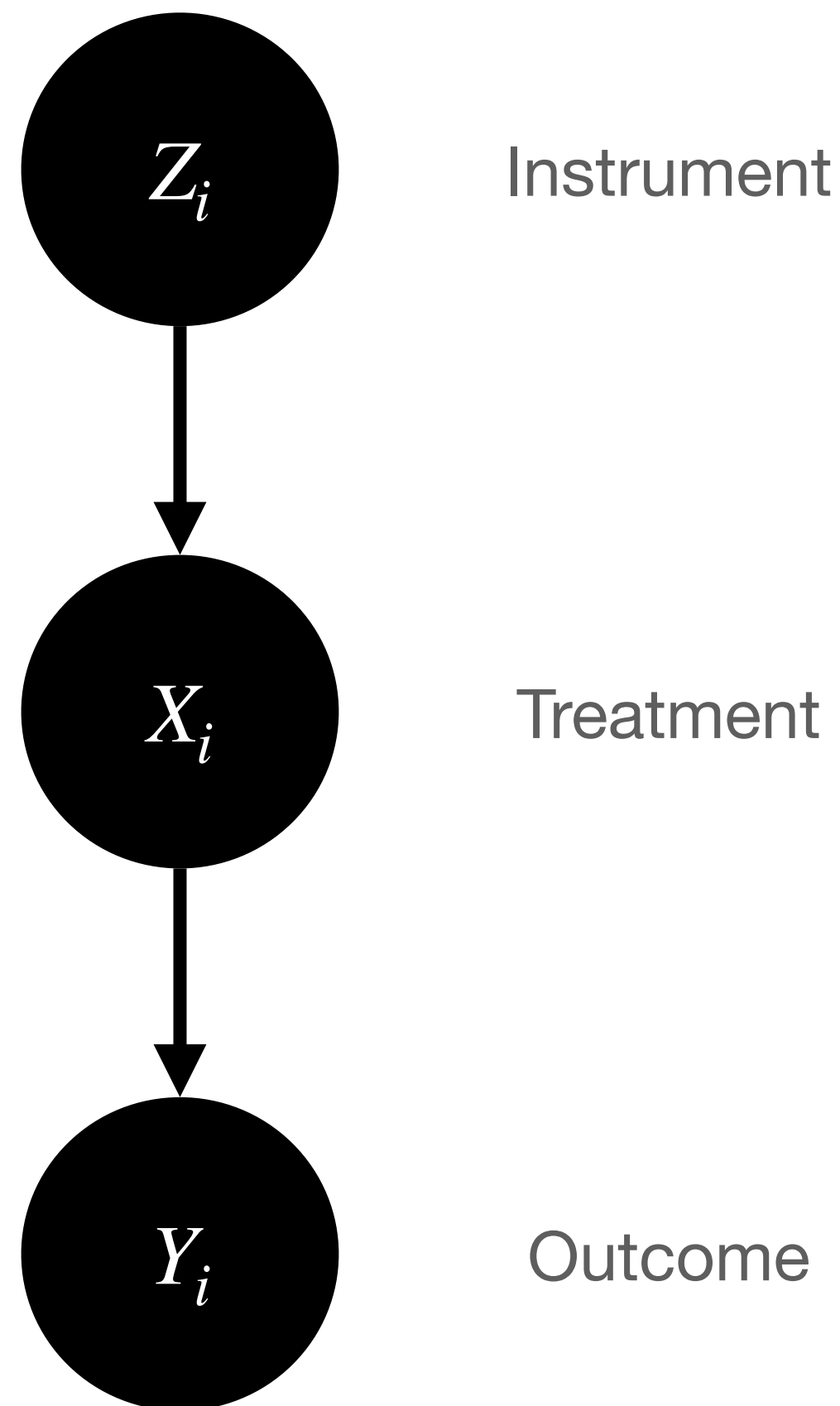
Instrumental Variables

- Really cool way to infer causality!
- Allows us to take advantage of semi-randomness
- Idea is that semi-random instrument (Z) effects treatment (X) which effects outcome (Y)

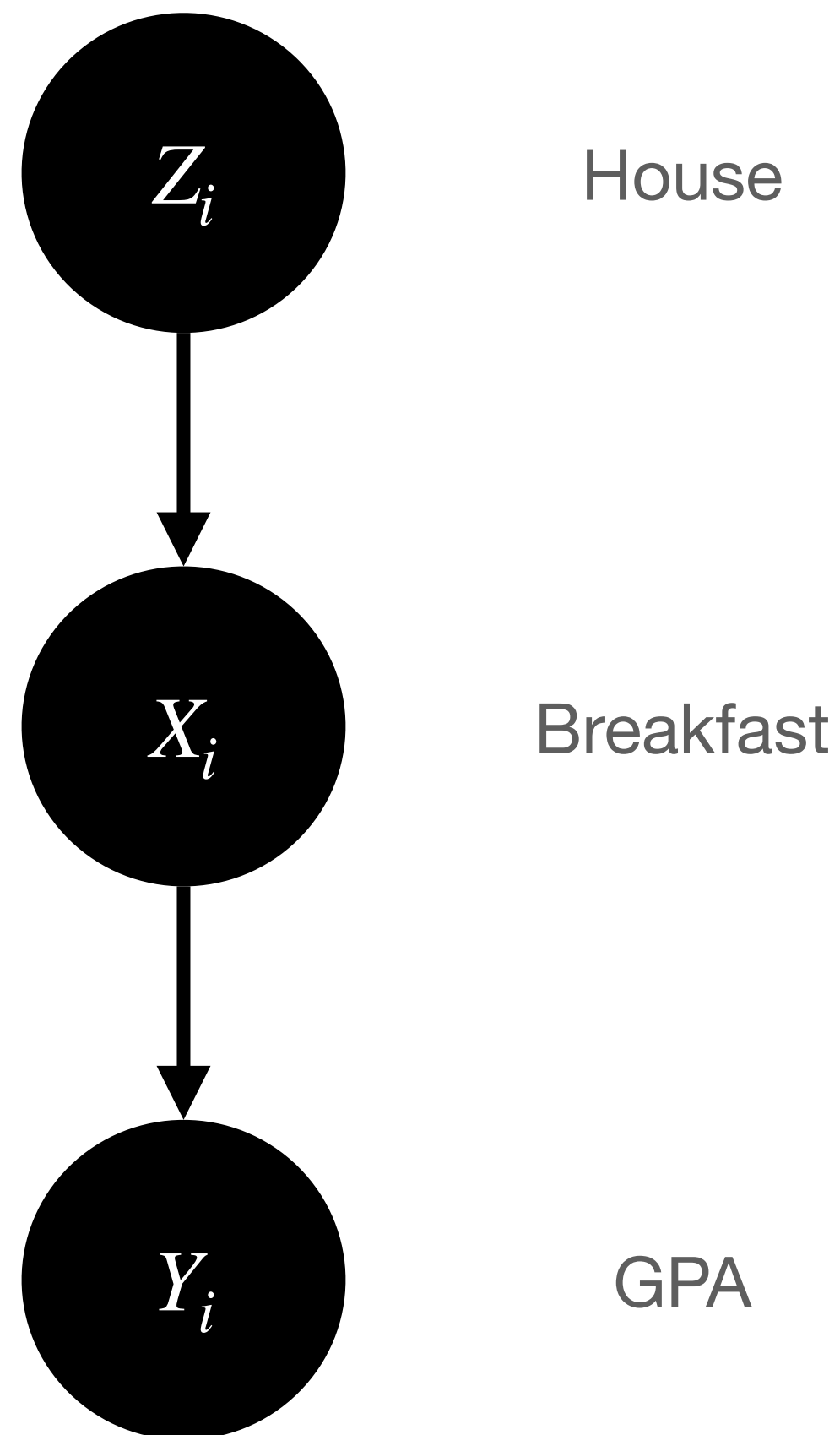
Example: Does eating breakfast boost grades?

- Instrument (Z): Whether your house serves hot breakfast
- Treatment (X): How many times per week does a person eat breakfast
- Outcome (Y): GPA

Instrumental Variables



Instrumental Variables



Two-Stages Least-Squares (2SLS)

- First Stage: regress treatment on the instrument

$$Breakfast = \pi_0 + \pi_1 House$$

- Reduced Form (Intent-to-Treat Effect): Regress outcome on the instrument

$$GPA = \alpha_0 + \alpha_1 House$$

- Second Stage: Divide second coefficient by First

$$\beta_1 = \alpha_1 / \pi_1$$

$$GPA = \beta_0 + \beta_1 \widehat{Breakfast}$$

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Predicted values of Breakfast from 1st regression

Units Interpretation

- $\pi_1 = \frac{\textit{House}}{\textit{Breakfast}}$

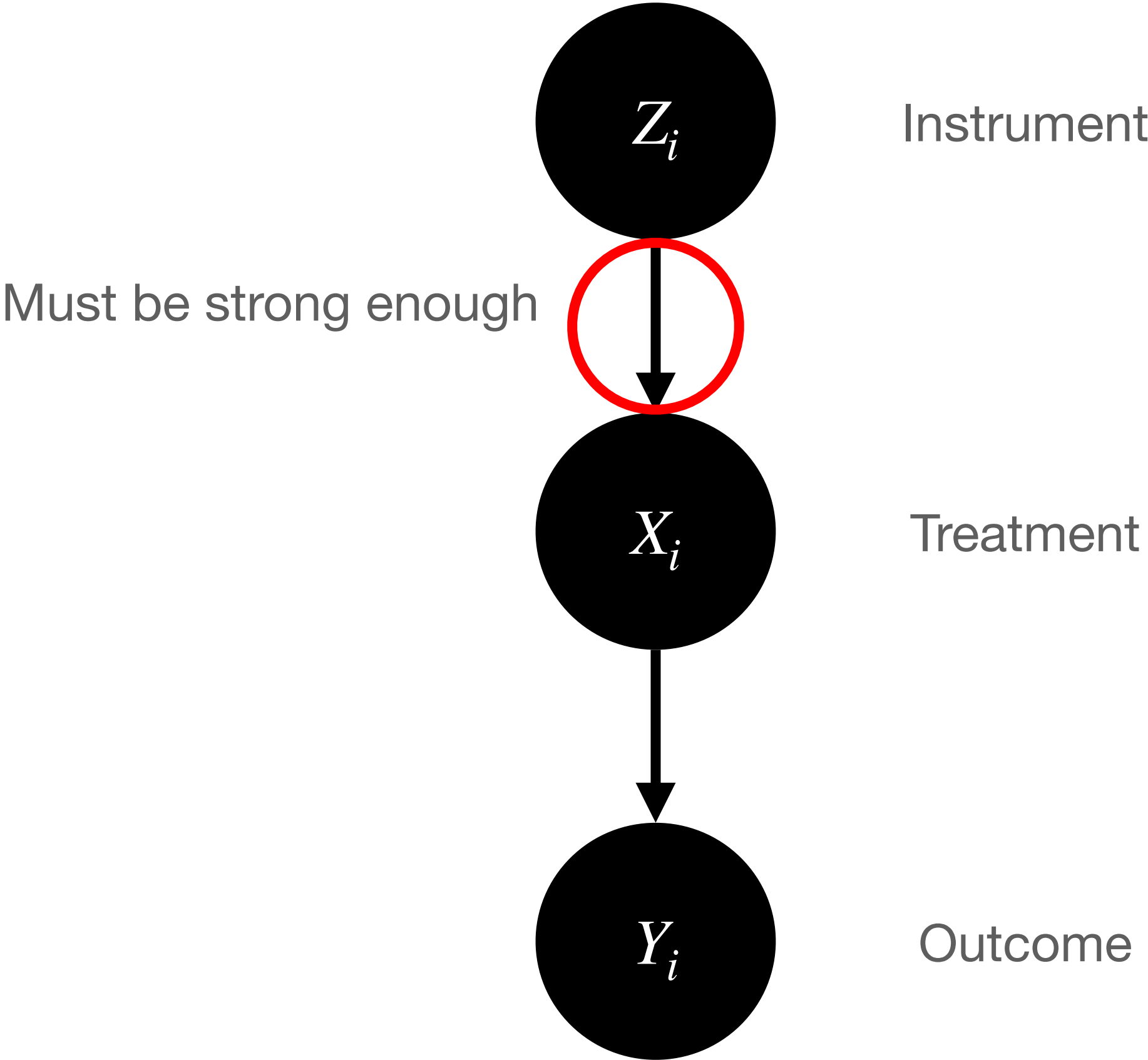
- $\alpha_1 = \frac{\textit{House}}{\textit{GPA}}$

- $\beta_1 = \frac{\alpha_1}{\pi_1} = \frac{\frac{\textit{House}}{\textit{GPA}}}{\frac{\textit{House}}{\textit{Breakfast}}} = \frac{\textit{Breakfast}}{\textit{GPA}}$

Conditions of Valid Instrument

- Relevance: Instrument has to effect treatment variable
- Exogeneity: Instrument can't directly effect outcome variable

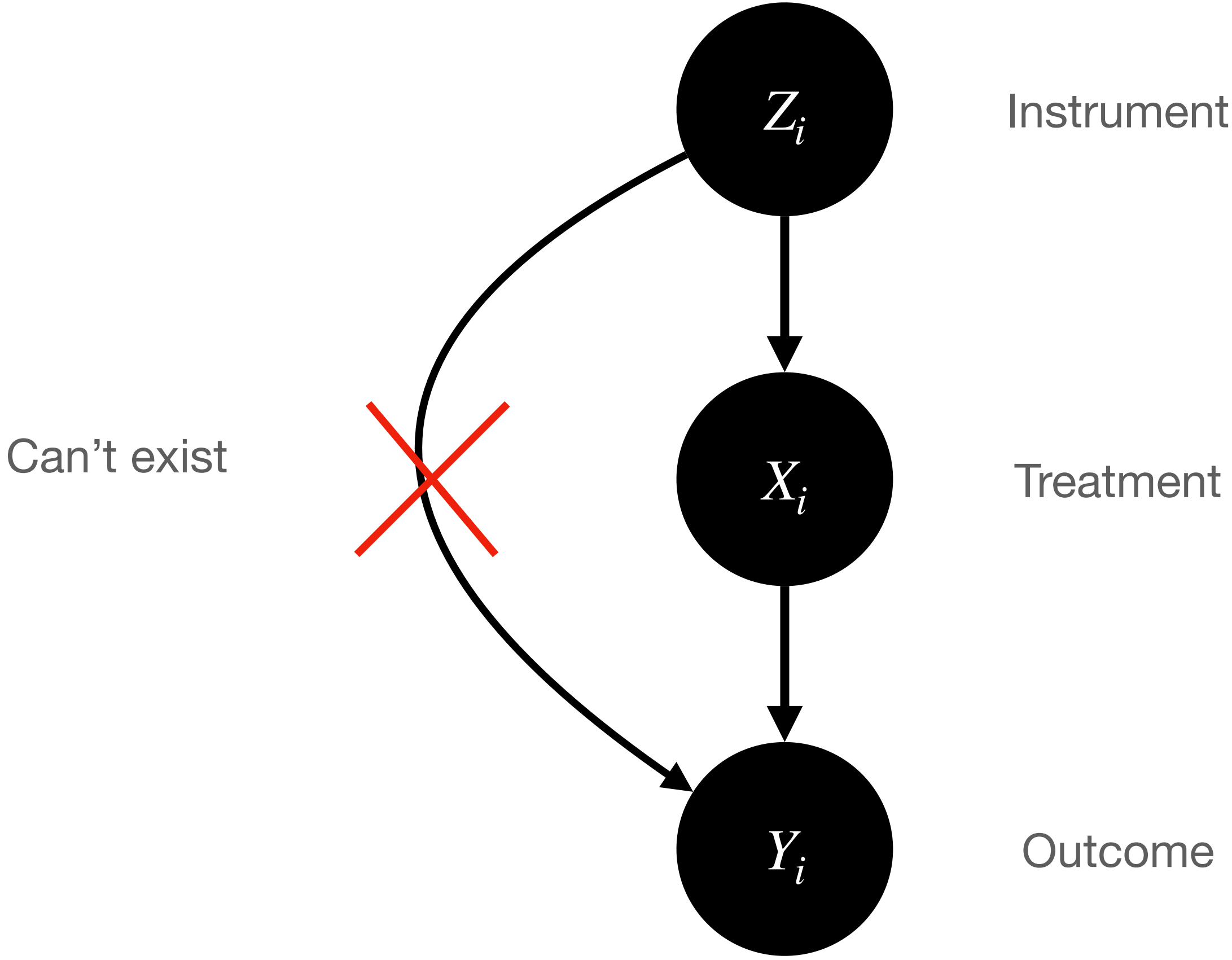
Relevance



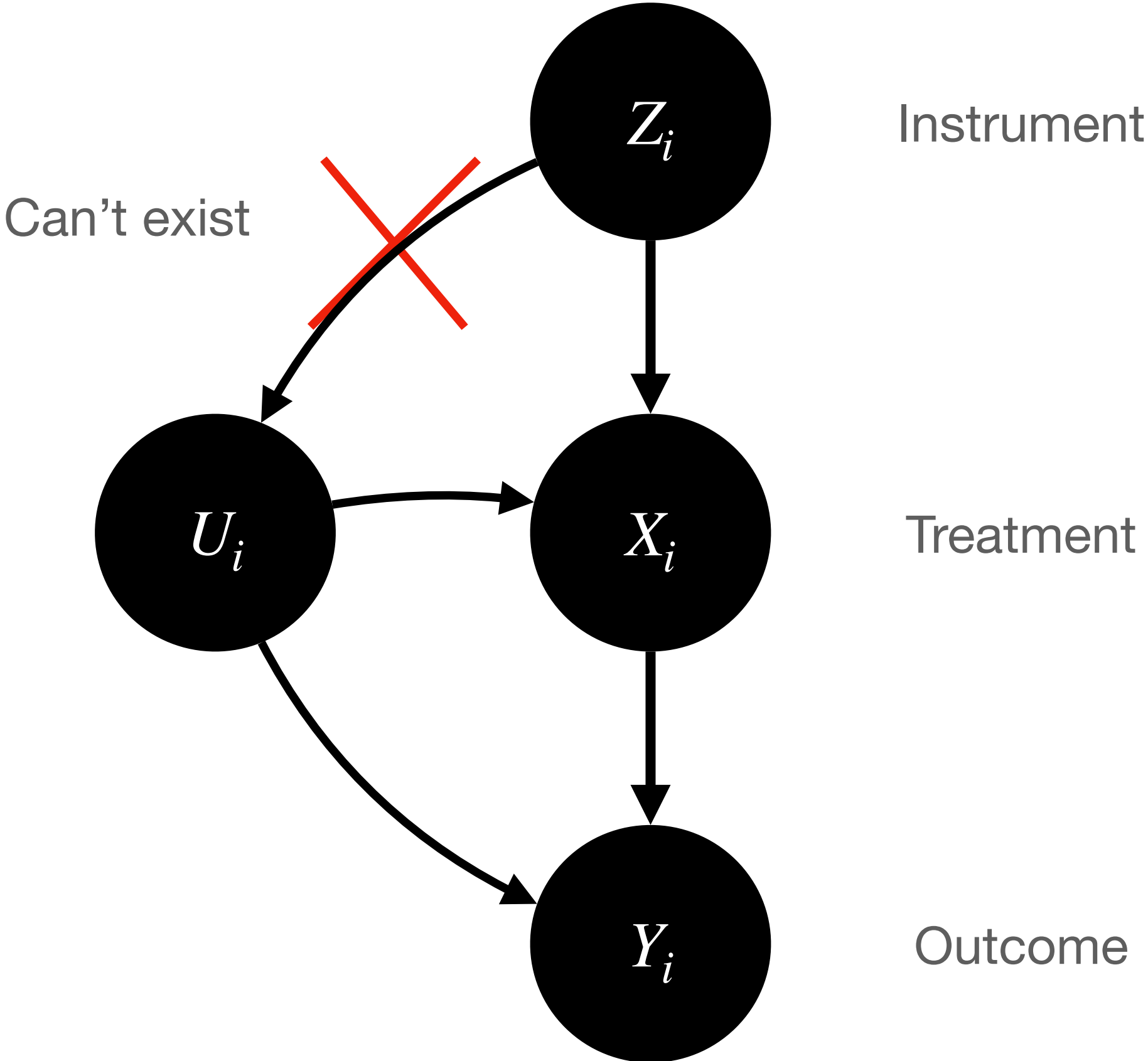
Test for Relevance

- Can't be weak: $\pi_1 \neq 0$
- We use 1st stage F statistic: $F = \left\{ \frac{\hat{\pi}_1}{\hat{SE}(\hat{\pi}_1)} \right\}^2$
- Compare this to Critical value of 23.1
- $F > 23.1$ means bias(2SLS) is at most 10% of bias(OLS)

Exogeneity



Exogeneity

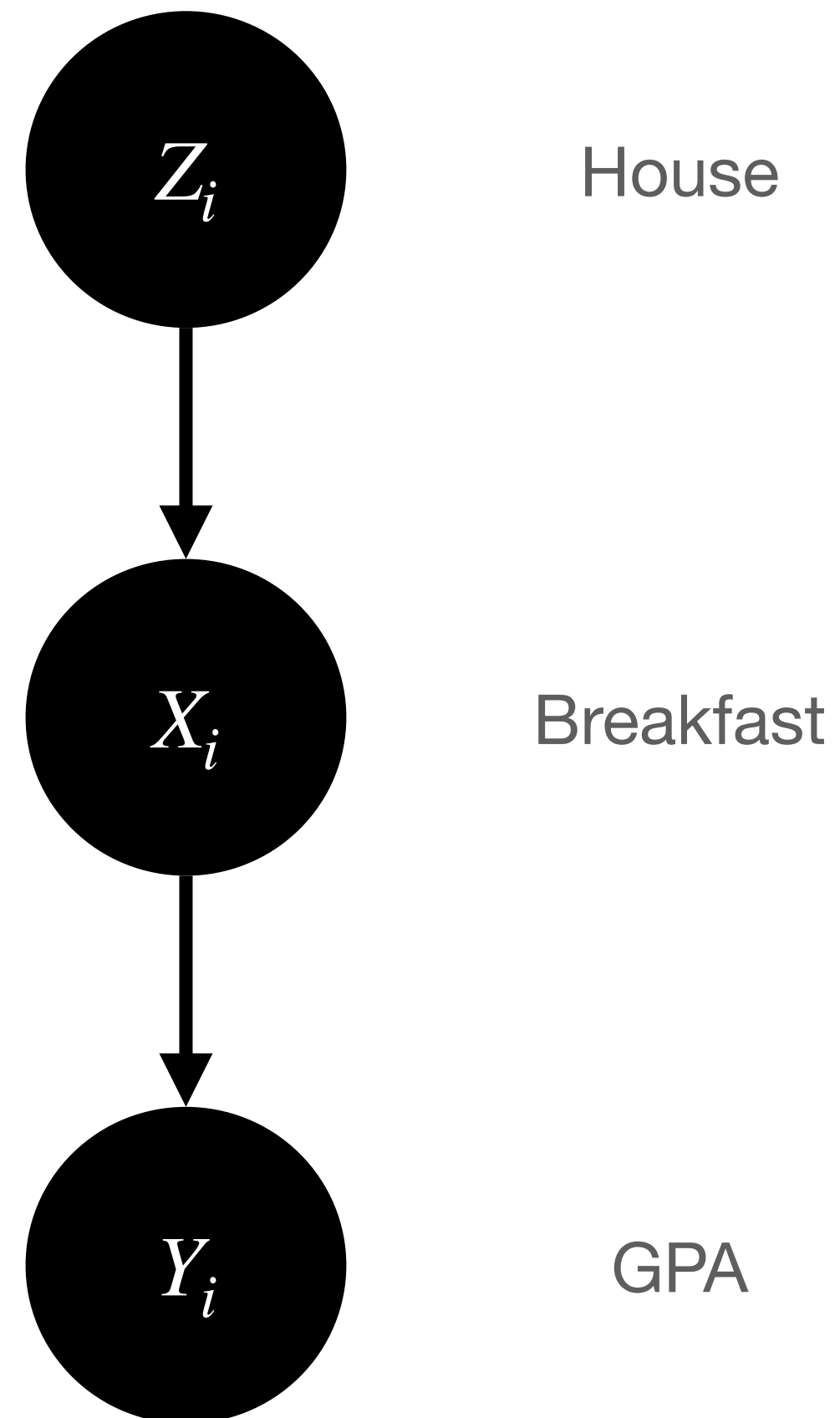


Test for Exogeneity

- Not as straightforward as testing for relevance
- Only affect outcome through the treatment
- As good as randomly assigned
 - We can check for evidence of non-random assignment (Normal F tests)
 - Sometimes we need to add control variables
 - (But only to ensure random assignment!)

Conditions of Valid Instrument (breakfast Example)

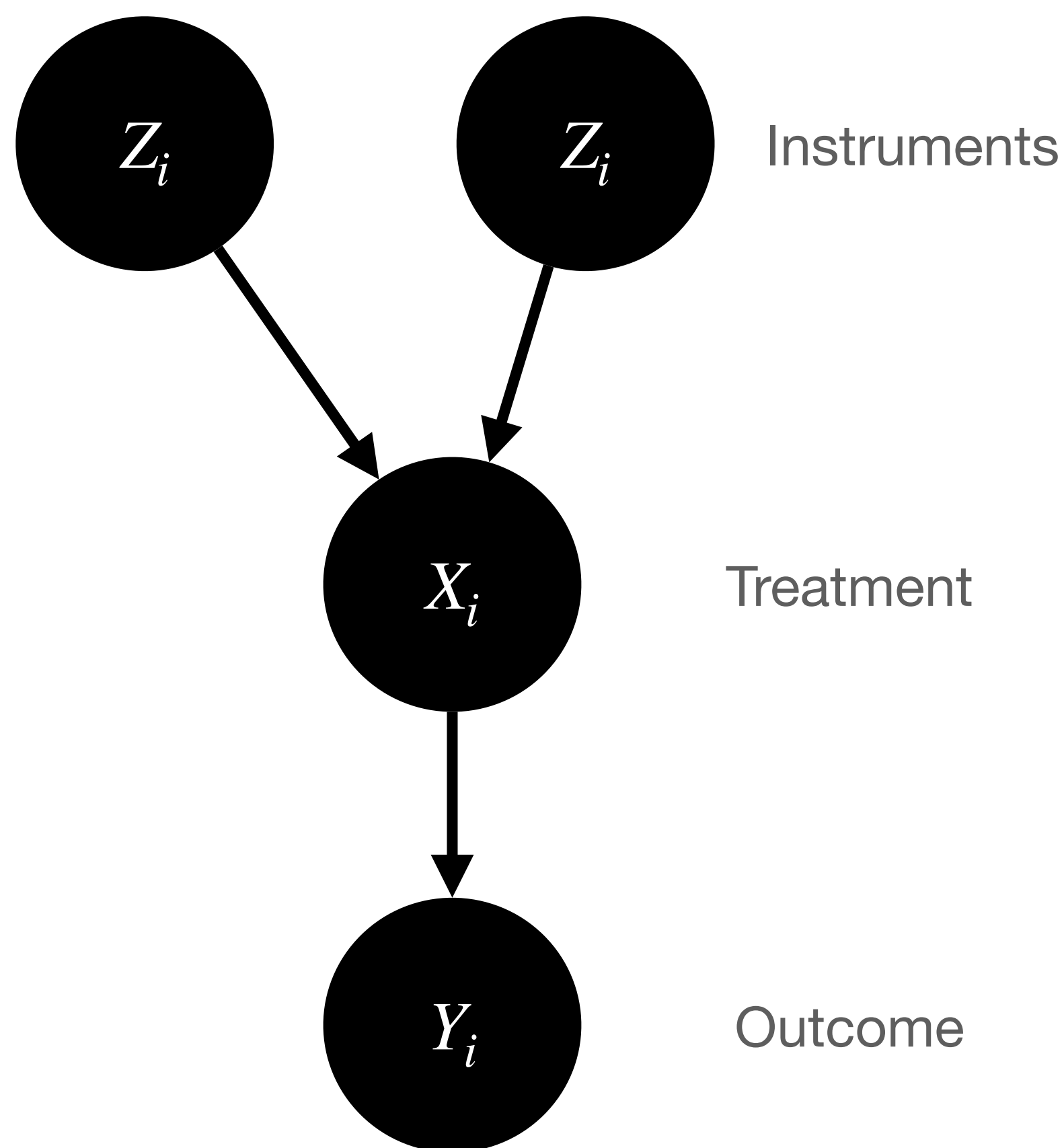
- Relevance?
- Exogeneity?



Multiple Instruments

- We can use 2+ instruments instead of just 1!
- Using 2SLS (not the ratio!), we can estimate an effect using all these instruments
- Relevance condition must be met: use F^{MOP} instead of normal F stat

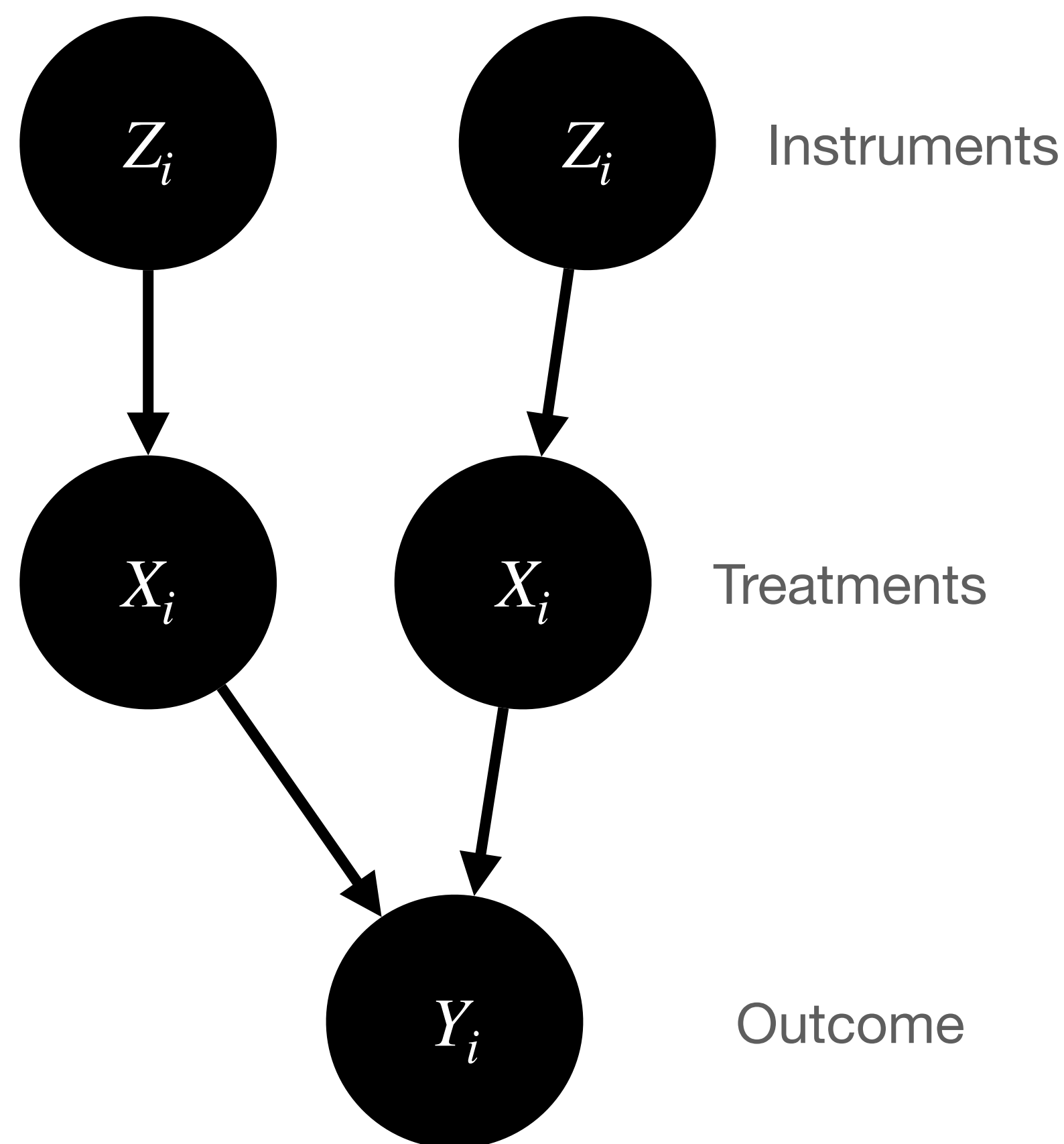
Multiple Instruments



Multiple Endogenous Regressors

- We can use multiple instruments and treatment variables
- Just use separate first-stage regressions for each treatment
- Why? Indicator variables, days/days², etc.

Multiple Instruments



Exercises!

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- First Stage:

$$educ = 13.151 + .255nearc2$$

(.065) (.098)

- Reduced Form:

$$lwage = 6.223 + .088nearc2$$

(.010) (.016)

- 2SLS

$$lwage = 1.709 + .343educ$$

(1.693) (.128)