Problems and Applications

Stock & Watson, Introduction (4th), Chapter 12, Exercise 5.

Consider the IV regression model

$$Y_i = \beta_0 + \beta_1 X_i + \beta_2 W_i + u_i$$

where X_i is correlated with u_i and Z_i is an instrument. Suppose that the first three assumptions are satisfied.

1. $\mathrm{E}[u_i | W_{1i}, \dots, W_{ri}] = 0$;
2. $(X_{1i}, \dots, X_{ki}, W_{1i}, \dots, W_{ri}, Z_{1i}, \dots, Z_{mi}, Y_i)$ are i.i.d. draws from their joint distribution;
3. X, W, Z, and Y have non-zero finite fourth moments (outliers unlikely);

Which IV assumption is not satisfied when:

a. Z_i is independent of (Y_i, X_i, W_i)?

b. $Z_i = W_i$?

c. $W_i = 1$ for all i?

d. $Z_i = X_i$?

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Which IV assumption is not satisfied when:

a. Z_i is independent of (Y_i, X_i, W_i)?

The instrument relevance condition $\mathrm{cov}(Z_i, X_i) \neq 0$ is not satisfied since the independence of (Z_i, X_i) implies $\mathrm{cov}(Z_i, X_i) = 0$.

b. $Z_i = W_i$?

The first-stage regression suffers from perfect multicollinearity since Z cannot be both a regressor and used as an instrument.

c. $W_i = 1$ for all i?

Since W is constant, the regression has no controls. The regression could suffer from an omitted variable bias, but omitting controls does not violate the IV assumptions.

d. $Z_i = X_i$?

The instrument exogeneity condition $\mathrm{cov}(Z_i, u_i) = 0$ is not satisfied since $X_i = Z_i$ is correlated with u_i and therefore $\mathrm{cov}(Z_i, u_i) \neq 0$.