## Advanced Econometrics 1

#### Week 3-4

Instrumental Variables

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# Exogeneity

- Linear regression model starts from assumption E[y|x] = x'β.
- Implies zero mean for u = y − x'B: using

$$E[\phi | \mathbf{x}] = E[\mathbf{y} - \mathbf{x}' \boldsymbol{\beta} | \mathbf{x}] = E[\mathbf{y} | \mathbf{x}] - \mathbf{x}' \boldsymbol{\beta} = 0,$$

law of iterated expectations implies

$$E[\omega] = E[E(\omega|x)] = 0.$$

· Implies also that regressor and error are uncorrelated:

$$Cov[x, u] = E[xu] - E[x]E[u]$$
  
 $= E[E(xu|x)]$   
 $= E[xE(u|x)] = 0.$ 

## Outline:

- · Exogeneity
- · Violation of exogeneity
- Inconsistency of OLS.
- Instrumental variables
- · Two stage least squares
- · Consistency and asymptotic normality
- Other limited information estimators (ILS.LIML.K-Class)
- · Testing instrument validity
- · Testing instrument relevance
- a Inference with weak instruments.
- · Example: returns to education

## Exogeneity

 In case of iid observations {(y<sub>i</sub>, x<sub>i</sub>)}<sup>N</sup><sub>i=1</sub>, condition E[u<sub>i</sub>|x<sub>i</sub>] = 0 implies E[u|X] = 0, because

$$\mathbb{E}[u|\mathbf{x}_i,\mathbf{x}_i,j\neq i] = \mathbb{E}[u|\mathbf{x}_i]$$

In this case regressors are strictly or strongly exogenous (sometimes strengthened to independence between u and X).

 $f(\mathbf{v}, \mathbf{x}; \theta) = f(\mathbf{v}|\mathbf{x}; \theta_1) f(\mathbf{x}; \theta_2)$ 

- O If Pr and Pr are totally unrelated and
- #; contains the parameters of interest (or a function thereof)
- . Then we can do inference using only

$$f(y|\mathbf{x};\theta_0)$$

without losing any information.

- e.g. in CLRM y = x'\(\beta\) + u interest in effect of x on y
- θ<sub>1</sub> = (β', σ<sup>2</sup>)' : β : parameter of interest, σ<sup>2</sup> nuisance parameter
- θ<sub>2</sub> all parameters in the density of x. Irrelevant nuisance parameters

# **Advanced Econometrics**

**Cesar Perez Lopez** 

#### **Advanced Econometrics:**

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