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**Instrumental Variables**

The Problem: Arises when a regressor is correlated with the error term or in other words x is not independent of the error. When this happens, the OLS estimator β will not be consistent.

Main Causes:

1st: When an omitted variable (now in the error term) is correlated with an included variable

2nd: X contains measurement errors

3rd: If X contains endogenous variables jointly determined with y

Underlying considerations in choosing an Instrumental Variable:

1st: Uncorrelated with the error

2nd: Highly correlated with the regressor for which it is to serve as an instrument

3rd: \*No direct effect on the regressand

How to choose an appropriate Instrumental Variable:

1st: Consider context

2nd: Consider theory

3rd: Literature (Kennedy has a list of techniques)

Draw Back:

Variance of the Instrumental Variable estimator is larger than that of the OLS estimator.

Instrumental Variable Estimation:

The variance-covariance matrix of can be estimated using. Actual variance is too difficult to calculate so it is asymptotically estimated.

**Two-Stage Least Squares**

A special case of the IV sometimes called “Best Instrument” because it combines all the exogenous variables to create a combined variable.

Stage 1: Regress each endogenous variable acting as a regressor in the equation being estimated on all the exogenous variables in the system of simultaneous equation, and calculate the estimated values of these endogenous variables.

Stage 2: Use the estimated values as IVs for the endogenous variables or simply use these estimated values and the included exogenous variables as regressors in OLS regression.

2SLS Example

Demand:

Supply:

Where

Price is a function of quantity demanded, price of subsidies, and disposable income; quantity is a function of price and price factor (the cost of producing the good).

For convenience, I have rewritten the equations with y representing the endogenous variables and x representing the exogenous variables.

Let, the set of all exogenous variables which are assumed to be uncorrelated with the error. Then regressing the endogenous variables on the exogenous variables we have

Where is the least squares estimator of and are the least squares residuals. Again substituting we obtain

These equations derive consistent estimators and

Definitions:

Endogenous variable: a variable whose variation an econometric model is designed to explain

Exogenous variable: a variable whose variation is externally determined

Sources:

Kennedy, A Guide to Econometrics 6E

Wooldridge, Introductory Econometrics: A Modern Approach, 4th edition

<http://elsa.berkeley.edu/~mcfadden/e240b_f01/ch4.pdf>