

Lecture 49: The order condition

Econometrics ■ Unit IV: Simultaneous equations models

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Previous lecture

Lecture 48: General form of the system; the problem of identification.

Today

- The order condition (necessary condition)

For equation i , let

- G = number of endogenous variables in the whole system (= number of equations),
- K = number of exogenous (predetermined) variables in the whole system, including the constant,
- g = number of endogenous variables included in equation i (including its left-hand variable),
- k = number of exogenous variables included in equation i (including the constant if present).

Theorem 7.2 (Order condition)

A **necessary** condition for equation i to be identified is

$$K - k \geq g - 1,$$

that is, the number of exogenous variables excluded from the equation must be at least the number of endogenous variables on its right-hand side. Equivalently, the total number of variables excluded from the equation must be at least $G - 1$:

$$(G - g) + (K - k) \geq G - 1.$$

The two forms are the same: subtracting G from both sides of the second form and adding g gives $K - k \geq g - 1$.

Why it is necessary. The rank condition below needs a matrix with $G - 1$ rows to have rank $G - 1$. The columns of that matrix correspond to the variables excluded from equation i , whose number is $(G - g) + (K - k)$. A matrix cannot have rank larger than its number of columns, so we need $(G - g) + (K - k) \geq G - 1$.

Using the order condition.

- If $K - k < g - 1$: the equation is unidentified.
- If $K - k = g - 1$: the equation may be exactly identified.
- If $K - k > g - 1$: the equation may be over-identified.

The order condition is not sufficient

- The word “may” is important: the order condition is *not sufficient*.
- It counts the excluded variables, but does not check whether they bring independent information.
- The rank condition does.

Remember

Order condition: $K - k \geq g - 1$ (excluded exogenous variables $\geq$ included endogenous variables minus one).

Practice

- Exercise 7.4 (Exercises and Solutions booklet).

Next lecture

Lecture 50: The rank condition; working procedure for identification.