[Frequently Asked Questions]

Simultaneous Equations Model

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Unit No. & Title:	Unit – 2 Simultaneous Equation Models
Lecture No. & Title:	Lecture – 1 Simultaneous Equations Model

Frequently Asked Questions

Q1. What is simultaneous equation system model?

A1. In this model there are many equations representing the type of situation and problem. A variable which occurs as endogenous variable in one equation, can occur as exogenous variable in some other equation and vice versa.

e.g. $Y_1=\alpha_1+\alpha_2 I+\alpha_3 C+\alpha_4 Y_2+U_{1t}$

$Y_2=\beta_1+\beta_2 Y_1+\beta_3 I+U_{2t}$

Due to such complexity, such a dependent variable becomes stochastic and it is usually correlated with the disturbance term of the equation in which it is appears as an explanatory variable.

Q2. What is the effect of OLS method estimation in simultaneous system equations model?

A2. If we apply OLS method then the basic assumption of the classical GLM is violated due to explanatory variables correlated with stochastic disturbance term. Thus, OLS estimation gives biased and inconsistent estimators.

Q3. What do you understand by (1) Just identified equation (2) Over identified equation and (3) Unidentified equation

A3. From the given model, we can find reduced from equations. Such equation is one which expresses an endogenous variable completely in terms of the predetermined variables and the stochastic disturbances. Such reduced form equation contains reduced from coefficients which are some functions of structural parameters of the model.

When we solve such coefficient and find that they give unique solutions for the parameters of the model that particular equation is called just (or exact) identified equation.

If we get more than one solution to estimate the parameters, we say that the equation is over identified equation.

If we find that it is not possible to estimate the parameters of the equation in terms reduced from coefficients, the equation is called unidentified equation.

Q4. What is order condition for Identification?

A4. Let G=Number of equation in the given model.

M=Number of variables in the given equation of the model.

K=Number of variables in the model.

As per order conditions,

(1)*If* $K - M > G - 1 \rightarrow$ *The* equation is over identified

(2)If $K - M = G - 1 \rightarrow$ The equation is just identified

Q5. What is rank condition for Identification?

A5. Let G denote the number of equations in the model, then a particular equation can be said to be identified if and only if at least one non-zero determinant minor of order $(G-1) \times (G-1)$ can be constructed from the coefficient of the variables (both endogenous and pre-determined) excluded from that particular equation but included in other equation of the model.

We get such a matrix A pertaining to that equation and decide as under

1) If $\rho(A) = G - 1 \rightarrow$*The* equation is identified.

2) If $\rho(A) < G - 1 \rightarrow$*The* equation is unidentified

Q6. Apply order and rank condition to identified the second equation of the model.

A6. $Y_1=\alpha_1+\alpha_2X_1+\alpha_3X_2+\alpha_4Y_2+U_{1t} \rightarrow (1)$

$Y_2=\beta_1+\beta_2X_1+\beta_3X_3+\beta_4Y_1+U_{2t} \rightarrow (2)$

Order condition

G=number of equation in the model.

M=number of variable in the equation (2).

K= number of variable in the model.

Here, G=2, M=4, K=5

K-M=1, G-1=1, K-M=G-1

Hence, equation (2) is just identified.

Rank condition $Y_1-\alpha_1-\alpha_2X_1-\alpha_3X_2-\alpha_4Y_2-U_{1t}=0$

$Y_2-\beta_1-\beta_2X_1-\beta_3X_3-\beta_4Y_1-U_{2t}=0$

Equation	Y_1	Y_2	X_1	X_2	X_3	U_1	U_1
(1)	1	$-\alpha_4$	$-\alpha_2$	$-\alpha_3$	0	-1	0
√(2)	β_4	1	β_2	0	β_3	0	-1

Resulting matrix A= $(-\alpha_3)$:1 X 1

Assume $\alpha_3 \neq 0$, ρ(A)=1

G=2, $\therefore \rho(A) = G-1 = 1$.

Hence, equation (2) is identified.

Q7. Which method will you apply to estimate exactly Identified equations?

A7. We apply Indirect Least Square (ILS) method to estimate just identified equation. In short, it is pertaining to solving for reduced form coefficients obtained in the reduced form equations. If we get unique solution for structural parameters we can obtain these estimates by applying least squares method indirectly, that is Indirect Least Square Method.

Q8. When can you use 2SLS estimation method?

A8. It is used if a particular equation is over identified. However the method is applicable to estimate just identified equations also.

We do regression exercise in two stages and obtain 2 SLS estimators. If R^2 in stage 1 is very high, OLSE and 2SLSE will be very close. If R^2 in second stage is very low, 2SLSE will be meaningless.

Q9. What are the structural equations and structural parameters?

A9. The equations of the given model are called structural equations. The coefficient attached to the variable of respective equations of the model are called structural parameters of the model.

Q10. What are reduced form equations and reduced form coefficients?

A10. When we attempt to identify a particular equation of the model, we may solve the equations of the model in the terms of endogenous variables. This gives us reduced form equations. The coefficients attached to the variables of the model are called reduced form coefficients. Reduced form coefficients are some functions of the structural parameters.