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Assignment 2
Simultaneous Equation Models

From the data set `assign2.dta`:

Demand and Supply Equations

$$\ln S_t = \beta_{10} + \beta_{11} \ln P_{Dt} + \beta_{12} \ln P_{X2t} + \beta_{13} \ln P_{X3t} + \beta_{14} \ln P_{X4t} + \varepsilon_{1t} \quad (1)$$

$$\ln D_t = \beta_{20} + \beta_{21} \ln P_{Dt} + \beta_{22} \ln GDP_t + \varepsilon_{2t} \quad (2)$$

Equilibrium condition can be achieved by $D_t = S_t$ through the price P_{Dt} mechanism.

where: S_t = Domestic Supply at time t

D_t = Domestic Demand at time t

P_{Dt} = Domestic Price at time t = $P_{Mt} + T_t$

T_t = Tariff at time t

P_{X2t} = Price of Input 2 at time t

P_{X3t} = Price of Input 3 at time t

P_{X4t} = Price of Input 4 at time t

GDP_t = Gross Domestic Product (Representing Income) at time t

Endogenous variables in this system include S_t, D_t, and P_{Dt}
Exogenous variables in this system include P_{X2t}, P_{X3t}, P_{X4t}, and GDP_t

a. State reduce form models of this system. Estimate reduce form models using OLS and prediction of the endogenous variables.

b. Estimate structural form using predicted endogenous variables as independent variables in the structural form models.

c. Estimate this system equations model using OLS, 2SLS, 3SLS, and I3SLS. Determine whether there exists endogeneity bias in the estimated results. Concerning on the asymptotic property, which model is the most appropriated model? Why? What do β_{21} and β_{22} mean?

Additional Issue:

If equilibrium doesn't hold $D_t \neq S_t$, when $D_t > S_t$; then $Q_t = S_t$ but when $D_t < S_t$; then $Q_t = D_t$, where Q_t is transaction quantity at time t.

$$\ln Q_t = \beta_{10} + \beta_{11} \ln P_{Dt} + \beta_{12} \ln P_{X2t} + \beta_{13} \ln P_{X3t} + \beta_{14} \ln P_{X4t} + \varepsilon_{1t} \quad (3)$$

$$\ln Q_t = \beta_{20} + \beta_{21} \ln P_{Dt} + \beta_{22} \ln GDP_t + \varepsilon_{2t} \quad (4)$$

d. Generate lnQ_t and estimate the above system equations (model (3) and model (4)) using OLS, 2SLS, and 3SLS using Q_t, and P_{Dt} as endogenous variables and P_{X2t}, P_{X3t}, P_{X4t}, and GDP_t as exogenous variables.

e. What are the problems, in term of economic concept and econometric technique, of the estimated results in **d**?

a.) $\ln D_t = \ln S_t$

$$\beta_{20} + \beta_{21} \ln P_{Dt} + \beta_{22} \ln GDP_t + \varepsilon_{2t} = \beta_{10} + \beta_{11} \ln P_{Dt} + \beta_{12} \ln P_{X2t} + \beta_{13} \ln P_{X3t} + \beta_{14} \ln P_{X4t} + \varepsilon_{1t}$$

$\rightarrow \ln P_{Dt} = \pi_0 + \pi_1 \ln GDP - \pi_2 \ln P_{x2t} - \pi_3 \ln P_{x3t} - \pi_4 \ln P_{x4t} + W_{1t}$

substitute $\ln P_{dt}$ in $\ln S_t$ and $\ln D_t$ equations

$\rightarrow \ln S_t = \pi_{10} + \pi_{11} \ln GDP_t + \pi_{12} \ln P_{x2t} + \pi_{13} \ln P_{x3t} + \pi_{14} \ln P_{x4t} + W_{1t}$

$\rightarrow \ln D_t = \pi_{20} + \pi_{21} \ln GDP_t + \pi_{22} \ln P_{x2t} + \pi_{23} \ln P_{x3t} + \pi_{24} \ln P_{x4t} + W_{2t}$

Estimation:

$\ln S_t = 24.66 + 0.34 \ln GDP_t - 0.45 \ln P_{x2t} - 0.92 \ln P_{x3t} - 0.39 \ln P_{x4t}$ #

$\ln D_t = 27.19 + 0.13 \ln GDP_t - 0.49 \ln P_{x2t} - 0.72 \ln P_{x3t} - 0.58 \ln P_{x4t}$ #

b.) $\widehat{\ln S_t} = 18.60 + 2.11 \hat{P}_d - 0.73 \ln P_{x2} - 1.12 \ln P_{x3} - 1.43 \ln P_{x4}$ #

$\widehat{\ln D_t} = 35.93 - 2.57 \hat{P}_d + 0.52 \ln GDP$ #

c.) OLS

$$\ln S_t = 41.995 - 1.112 \ln P_{dt} - 0.479 \ln P_{x2t} - 0.942 \ln P_{x3t} - 0.521 \ln P_{x4t}$$

$$\ln P_t = 31.036 - 2.181 \ln P_{dt} + 0.578 \ln dPP_t$$

2SLS

$$\ln S_t = 18.597 + 2.106 \ln P_{dt} - 0.928 \ln P_{x2t} - 1.122 \ln P_{x3t} + 1.429 \ln P_{x4t}$$

$$\ln D_t = 35.935 - 2.594 \ln P_{dt} + 0.521 \ln dPP_t$$

3SLS

$$\ln S_t = 17.849 + 2.172 \ln P_{dt} - 0.797 \ln P_{x2t} - 1.330 \ln P_{x3t} - 1.171 \ln P_{x4}$$

$$\ln D_t = 35.935 - 2.594 \ln P_{dt} + 0.521 \ln dPP_t$$

I3SLS

$$\ln S_t = 17.379 + 2.212 \ln P_{dt} - 0.894 \ln P_{x2t} - 1.46 \ln P_{x3} - 1.010 \ln P_{x4t}$$

$$\ln D_t = 35.935 - 2.594 \ln P_{dt} + 0.521 \ln dPP_t$$

on Asymptotic property 3SLS / I3SLS would be the best one. since, there're correlation between the error term across the equation.

However, if there're specification error it will be worsen off.

β_{21} = Price elasticity of quantity Demand

β_{Z2} = Income elasticity of quantity demand

d.) OLS

$$\ln Q_t = 40.102 - 1.393 \ln p_{dt} - 0.786 \ln p_{x2t} - 0.675 \ln p_{x3t} - 0.360 \ln p_{x4}$$

$$\ln Q_t = 31.036 - 2.181 \ln p_{dt} + 0.578 \ln GDP_t$$

2SLS

$$\ln Q_t = 24.956 + 0.775 \ln p_{dt} - 0.597 \ln p_{x2t} - 0.797 \ln p_{x3t} - 0.961 \ln p_{x4t}$$

$$\ln Q_t = 35.735 - 2.574 \ln p_{dt} + 0.521 \ln GDP_t$$

3SLS

$$\ln Q_t = 24.811 + 0.988 \ln P_{dt} - 0.605 \ln P_{x2t} - 0.837 \ln P_{x3t} - 0.911 \ln P_{x4t}$$

$$\ln Q_t = 35.735 - 2.394 \ln P_{dt} + 0.521 \ln GDP_t$$

e.) the specification error will occur because $\ln P_{dt}$ could not be use as endogenous variable since the equilibrium condition is not exist.