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Assignment 2

a) Reduced Form Model and estimate using OLS

$$\ln S_t = \ln D_t$$

$$\beta_{10} + \beta_{11}\ln P_{Dt} + \beta_{12}\ln P_{x2t} + \beta_{13}\ln P_{x3t} + \beta_{14}\ln P_{x4t} + \varepsilon_{1t} = \beta_{20} + \beta_{21}\ln P_{Dt} + \beta_{22}\ln GDP_t + \varepsilon_{2t}.$$

$$(\beta_{11} - \beta_{21})\ln P_{Dt} = \beta_{20} + \beta_{22}\ln GDP_t + \varepsilon_{2t} - \beta_{10} - \beta_{12}\ln P_{x2t} - \beta_{13}\ln P_{x3t} - \beta_{14}\ln P_{x4t} - \varepsilon_{1t} -$$

$$\ln P_{Dt} = \left(\frac{\beta_{20} - \beta_{10}}{\beta_{11} - \beta_{21}}\right) + \frac{\beta_{22}\ln GDP_t}{(\beta_{11} - \beta_{21})} - \frac{\beta_{12}\ln P_{x2t}}{(\beta_{11} - \beta_{21})} - \frac{\beta_{13}\ln P_{x3t}}{(\beta_{11} - \beta_{21})} - \frac{\beta_{14}(\ln P_{x4t})}{(\beta_{11} - \beta_{21})}$$

$$+ \frac{\varepsilon_{2t} - \varepsilon_{1t}}{\beta_{11} - \beta_{21}}.$$

$$\ln P_{Dt} = \pi_0 + \pi_1 \ln GDP - \pi_2 \ln P_{x2t} - \pi_3 \ln P_{x3t} - \pi_4 \ln P_{x4t} + w_1 t.$$

Substitute $\ln P_{Dt}$ in supply equation, we'll get ;

$$\ln S_t = \pi_{10} + \pi_{11}\ln GDP_t + \pi_{12}\ln P_{x2t} + \pi_{13}\ln P_{x3t} + \pi_{14}\ln P_{x4t} + w_1 t. \# \quad (1)$$

Substitute $\ln P_{Dt}$ in Demand equation, we'll get ;

$$\ln D_t = \pi_{20} + \pi_{21}\ln GDP_t + \pi_{22}\ln P_{x2t} + \pi_{23}\ln P_{x3t} + \pi_{24}\ln P_{x4t} + w_2 t \quad \# \quad (2)$$

Estimation.

$$\underset{(5.310)}{\ln S_t = 24.657} + \underset{(0.191)}{0.344\ln GDP_t} - \underset{(0.152)}{0.450\ln P_{x2t}} - \underset{(0.279)}{0.929\ln P_{x3t}} - \underset{(0.422)}{0.388\ln P_{x4t}}.$$

$$\underset{(5.310)}{\ln D_t = 27.186} + \underset{(0.195)}{0.127\ln GDP_t} - \underset{(0.154)}{0.489\ln P_{x2t}} - \underset{(0.283)}{0.724\ln P_{x3t}} - \underset{(0.429)}{0.578\ln P_{x4t}}.$$

b) $\widehat{\ln S_t} = \beta_{10} + \beta_{11} \ln \widehat{P_{Dt}} + \beta_{12} \ln P_{x_2 t} + \beta_{13} \ln P_{x3t} + \beta_{14} \ln P_{x4t} + \varepsilon_{1t}$.

$$\widehat{\ln S_t} = \underset{(14.051)}{18.599} + \underset{(1.927)}{2.106} \ln P_{Dt} - \underset{(0.303)}{0.728} \ln P_{x2t} - \underset{(0.464)}{1.122} \ln P_{x3t} - \underset{(0.781)}{1.429} \ln P_{x4t}$$

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

$$\widehat{\ln D_t} = \underset{(5.106)}{35.935} - \underset{(0.405)}{2.574} \ln P_{Dt} + \underset{(0.096)}{0.521} \ln GDP$$

c) $\boxed{\text{OLS}}$

$$\ln S_t = \underset{(\cancel{2.957})\ 3.662}{\overset{41.495}{\cancel{40.938}}} \overset{-1.912}{-\cancel{1.232}} \underset{(\cancel{0.410})\ 0.452}{} \ln P_{Dt} \overset{-0.419}{-\cancel{0.379}} \underset{(\cancel{0.137})\ 0.143}{} \ln P_{x2t} \overset{-0.942}{-\cancel{0.947}} \underset{(\cancel{0.243})\ 0.259}{} \ln P_{x3t} \overset{-0.521}{-\cancel{0.359}} \underset{(\cancel{0.340})\ 0.349}{} \ln P_{x4t}$$

$$\ln D_t = \underset{(\cancel{3.653})\ 3.761}{31.036} - \underset{(\cancel{0.275})\ 0.295}{2.181} \ln P_{Dt} + \underset{(\cancel{0.096})\ 0.089}{0.578} \ln GDP_t$$

$\boxed{\text{2SLS}}$

$$\ln S_t = \underset{(14.051)}{18.599} + \underset{(1.927)}{2.106} \ln P_{Dt} - \underset{(0.303)}{0.728} \ln P_{x2t} - \underset{(0.464)}{1.122} \ln P_{x3t} - \underset{(0.781)}{1.429} \ln P_{x4t}$$

$$\ln D_t = \underset{(5.106)}{35.935} - \underset{(0.405)}{2.574} \ln P_{Dt} + \underset{(0.096)}{0.521} \ln GDP$$

$\boxed{\text{3SLS}}$

$$\ln S_t = \underset{(14.041)}{17.849} + \underset{(1.926)}{2.172} \ln P_{Dt} - \underset{(0.299)}{0.799} \ln P_{x2t} - \underset{(0.456)}{1.330} \ln P_{x3t} - \underset{(0.776)}{1.171} \ln P_{x4t}$$

$$\ln D_t = \underset{(5.106)}{35.935} - \underset{(0.405)}{2.574} \ln P_{Dt} + \underset{(0.096)}{0.521} \ln GDP_t$$

$\boxed{\text{I3SLS}}$

$$\ln S_t = \underset{(14.615)}{17.379} + \underset{(2.006)}{2.213} \ln P_{Dt} - \underset{(0.305)}{0.844} \ln P_{x2t} - \underset{(0.464)}{1.460} \ln P_{x3t} - \underset{(0.7998)}{1.010} \ln P_{x4t}$$

$$\ln D_t = \underset{(5.106)}{35.935} - \underset{(0.405)}{2.574} \ln P_{Dt} + \underset{(0.096)}{0.521} \ln GDP_t$$

• Endogeneity bias ? → Hausman Test.

H_0 : No Endogeneity.

H_1 : Endogeneity

Supply Equation

p-value = 0.5659 > 0.05

∴ Not significant (H_0 is not rejected)

Therefore, there is no endogeneity.

Demand Equation

p-value = 0.3667 > 0.05

H_0 is not rejected

Therefore, no endogeneity.

• Concerning on asymptotic property, 3SLS might be the most appropiated. in term of efficiency if there is correlation between error terms across equations. However, here we don't have enough evidence to say that there is endogeneity bias. Therefore, 2SLS might be better, since if there is specification error, 3SLS result would be inconsistent right away. While 2SLS estimators is still consistent and efficient.

• β_{21} is the coefficient of $\ln P_{Dt}$

So, if domestic price increases by 1%, domestic demand is predicted to be decreased by β_{21} %, on average (holding others constant)

β_{22} is the coeficient of lnGDP.

So, If GDP increases by 1%, domestic demand is predicted to be increased by β_{22} %, on average (holding others constant)

d) From the data, $D_t < S_t$ always therefore, $Q_t = D_t$.

So we would have,

$$\ln Q_t = \ln P_t = \beta_{10} + \beta_{11} \ln P_{Dt} + \beta_{12} \ln P_{x2t} + \beta_{13} \ln P_{x3t} + \beta_{14} \ln P_{x4t} + \varepsilon_{1t}.$$

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

$\boxed{\text{OLS}}$

$$\ln Q_t = \overset{40.102}{\cancel{39.076}} - \overset{-1.354}{\cancel{1.1449}} \ln P_{Dt} - \overset{-3.864}{\cancel{0.345}} \ln P_{x2t} - \overset{-0.678}{\cancel{0.687}} \ln P_{x3t} - \overset{-0.3606}{\cancel{0.186}} \ln P_{x4t}.$$
$$(3.019) \quad (0.372) \quad (0.118) \quad (0.2131) \quad (0.283)$$

$$\ln Q_t = 31.0363 - 2.1812 \ln P_{Dt} + 0.578 \ln GDP_t.$$
$$(3.761) \quad (0.295) \quad (0.089)$$

$\boxed{\text{2SLS}}$

$$\ln Q_t = 24.956 + 0.775 \ln P_{Dt} - 0.591 \ln P_{x2t} - 0.797 \ln P_{x3t} - 0.961 \ln P_{x4t}.$$
$$(9.919) \quad (1.360) \quad (0.2145) \quad (0.328) \quad (0.551)$$

$$\ln Q_t = 35.935 - 2.574 \ln P_{Dt} + 0.521 \ln GDP_t.$$
$$(5.106) \quad (0.405) \quad (0.096)$$

$\boxed{\text{3SLS}}$

$$\ln Q_t = 24.811 + 0.788 \ln P_{Dt} - 0.605 \ln P_{x2t} - 0.837 \ln P_{x3t} - 0.911 \ln P_{x4t}.$$
$$(9.919) \quad (1.360) \quad (0.213) \quad (0.327) \quad (0.551)$$

$$\ln Q_t = 35.935 - 2.574 \ln P_{Dt} + 0.521 \ln GDP_t$$
$$(5.106) \quad (0.405) \quad (0.096)$$

e) We use the quantity demanded as transaction quantity since the collected data shows that demand always less than supply. So Q_t is basically quantity demanded. It makes no sense that price of inputs (P_{x2}, P_{x3}, P_{x4}) would affect the quantity demanded by consumers. Also, using demand as supply may cause the specification error (measurement error). Then, estimators would be biased.