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?

<u>Additional Issue</u>:

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

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

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

$$(\beta_{21} - \beta_{11})\ln P_{Dt} = \text{"}\quad\text{"}$$

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

$$\ln P_{Dt} = \Pi_0 + \Pi_1\ln P_{x2t} + \Pi_2\ln P_{x3t} + \Pi_3\ln P_{x4t} - \Pi_4\ln GDP_t + w_{1t}$$

estimation :

$$\ln P_{Dt} = \underset{(2.434717)}{2.87652} + \underset{(.0695123)}{.1316015}\ln P_{x2t} + \underset{(.127627)}{.0939842}\ln P_{x3t} + \underset{(.1936093)}{.4939641}\ln P_{x4t} + \underset{(.0877392)}{.1632779}\ln GDP_t$$

b.) # estimate $\ln D_t$ using lnpathat

$$\ln D_t = \underset{(7.189835)}{35.93494} - \underset{(.5697543)}{2.574157}\,\widehat{\ln P_{Dt}} + \underset{(.1344816)}{.5212927}\ln GDP_t$$

estimate $\ln S_t$ using lnpdthat

$$\ln S_t = \underset{(8.546622)}{18.59912} + \underset{(1.171903)}{2.106112}\,\widehat{\ln P_{Dt}} - \underset{(.1840856)}{.727963}\ln P_{x2t} - \underset{(.2824139)}{1.122146}\ln P_{x3t} - \underset{(.4751381)}{1.428722}\ln P_{x4t}$$

c. OLS & 2SLS

(OLS) $\ln S_t = 41.4946 - 1.111835 \ln P_{Dt} - .4189546 \ln P_{X2t} - .9424196 \ln P_{X3t} - .521346 \ln P_{X4t}$

$\quad\quad (3.661911) \quad (.4515147) \quad (.1431634) \quad (.2585266) \quad (.3441643)$

(2SLS) $\ln S_t = 18.59914 + 2.10611 \ln P_{Dt} - .7279628 \ln P_{X2t} - 1.122146 \ln P_{X3t} - 1.428722 \ln P_{X4t}$

$\quad\quad (14.05113) \quad (1.926677) \quad (.3026471) \quad (.464304) \quad (.7811544)$

From Hausman-Wu test, p-value is 0.5659. H_0 cannot be rejected. ∴ There is no endogenuity bias.

(OLS) $\ln D_t = 31.03578 - 2.181329 \ln P_{Dt} + .5776586 \ln GDP_t$

$\quad\quad (3.761201) \quad (.2946999) \quad (.0887536)$

(2SLS) $\ln D_t = 35.93499 - 2.574157 \ln P_{Dt} + .5212921 \ln GDP_t$

$\quad\quad (5.106302) \quad (.4046743) \quad (.0955104)$

From Hausman test, p-value is 0.3667. H_0 cannot be rejected. ∴ There is no endogeneity bias.

(3SLS) $\ln D_t = 35.93499 - 2.574157 \ln P_{Dt} + .5212921 \ln GDP_t$

$\quad\quad (5.106302) \quad (.4046743) \quad (.0955104)$

$\ln S_t = 17.84948 + 2.171576 \ln P_{Dt} - .7990055 \ln P_{X2t} - 1.329743 \ln P_{X3t} - 1.171403 \ln P_{X4t}$

$\quad\quad (14.04122) \quad (1.926095) \quad (.2985983) \quad (.4560002) \quad (.775654)$

(I3SLS) $\ln D_t = \underset{(5.106302)}{35.93499} - \underset{(.4046743)}{2.574157} \ln P_{Dt} + \underset{(.0955104)}{.5212921} \ln GDP_t$

$\ln S_t = \underset{(14.61488)}{17.37893} + \underset{(2.005956)}{2.212666} \ln P_{Dt} - \underset{(.3049354)}{.8435967} \ln P_{x2t} - \underset{(.4623671)}{1.480044} \ln P_{x3t}$
$- \underset{(.7998393)}{1.009892} \ln P_{x4t}$

Concerning asymptotic property, I3SLS should be the most appropriate method since it is the most asymptotically efficient. However, we need to be careful about misspecification problem since it could make the model inconsistent.

β_{21} is negative. It means that if domestic price and tariff increase. It would negatively affect domestic demand at time t.

β_{22} is positive. It means that, if GDP increase, domestic demand would increase.

d. (OLS) 2 $\ln Q_t = \underset{(3.761201)}{31.03578} - \underset{(.2946999)}{2.181329} \ln P_{Dt} + \underset{(.0887536)}{.5776586} \ln GDP_t$

$\ln Q_t = \underset{(3.019386)}{40.10218} - \underset{(.3722912)}{1.353506} \ln P_{Dt} - \underset{(.1180437)}{.3864994} \ln P_{x2t} - \underset{(.2131651)}{.6782817} \ln P_{x3t}$
$- \underset{(.2837767)}{.360689} \ln P_{x4t}$

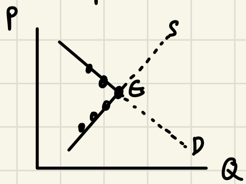
(2SLS) 2 $\ln Q_t = \underset{(5.494633)}{35.93499} - \underset{(.4354519)}{2.574157} \ln P_{Dt} + \underset{(.1027745)}{.5212921} \ln GDP_t$

$\ln Q_t = \underset{(11.2843)}{24.95604} + \underset{(1.547291)}{.7752765} \ln P_{Dt} - \underset{(.2430523)}{.5909191} \ln P_{x2t}$
$- \underset{(.3798771)}{.7971771} \ln P_{x3t} - \underset{(.6273399)}{.9608797} \ln P_{x4t}$

(3SLS) $\ln Q_t = \underset{(5.106302)}{35.93499} - \underset{(.4046743)}{2.574157} \ln P_{Dt} + \underset{(.0955104)}{.5212921} \ln GDP_t$

$\ln Q_t = \underset{(9.918929)}{24.81121} + \underset{(1.360114)}{.7879239} \ln P_{Dt} - \underset{(.2134422)}{.6046439} \ln P_{x2t}$
$- \underset{(.3273419)}{.8372831} \ln P_{x3t} - \underset{(.5511692)}{.9111679} \ln P_{x4t}$

e. From a given condition, we will always obtain the point on the left of the equilibrium. Hence, we will not be able to identify if the point we got is on supply or demand curve.



Furthurmore, there might be identification problem which make the model unsolveable.

```
                                                      ___  ____  ____  ____  ____(R)
                                                     /__    /   ____/   /   ____/
                                                    ___/   /   /___/   /   /___/
                                                      Statistics/Data Analysis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Notes:
      1.  Unicode is supported; see help unicode_advice.
      2.  More than 2 billion observations are allowed; see help obs_advice.
      3.  Maximum number of variables is set to 5000; see help set_maxvar.
      4.  New update available; type -update all-

Checking for updates...
(contacting http://www.stata.com)

Update status
    Last check for updates:  03 Feb 2021
    New update available:    21 Jan 2021  (what's new)
    Current update level:    01 Aug 2019  (what's new)

Possible actions

    Install available updates             (or type -update all-)

Click to edit automatic update checking preferences

1 . reg3 help
variable help not found
r(111);

2 . help reg3

3 . log using "C:\Users\Jilllin\OneDrive\Desktop\Thammasat\EE426\Untitled.smcl"
-----------------------------------------------------------------------------------------------------------------
      name:  <unnamed>
       log:  C:\Users\Jilllin\OneDrive\Desktop\Thammasat\EE426\Untitled.smcl
  log type:  smcl
 opened on:   3 Feb 2021, 15:32:07

4 . use "C:\Users\Jilllin\OneDrive\Desktop\Thammasat\EE426\assign2.dta"
```

```
 5 . tsset obs
        time variable:  obs, 1986 to 2007
                delta:  1 unit

 6 . g pdt = pm + t

 7 . g lnd = log(dt)

 8 . g lns = log(st)

 9 . g lnpdt = log(pdt)

10 . g lnpx2 = log(px2)

11 . g lnpx3 = log(px3)

12 . g lnpx4 = log(px4)

13 . g lngdp = log(gdp)

14 . reg lnpdt lnpx2 lnpx3 lnpx4 lngdp
```

Source	SS	df	MS
Model	.17707359	4	.044268398
Residual	.111247189	17	.006543952
Total	.288320779	21	.013729561

Number of obs	=	22
F(4, 17)	=	6.76
Prob > F	=	0.0019
R-squared	=	0.6142
Adj R-squared	=	0.5234
Root MSE	=	.08089

lnpdt	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnpx2	.1318015	.0695123	1.90	0.075	-.0148567	.2784596
lnpx3	.0939842	.127627	0.74	0.472	-.1752851	.3632535
lnpx4	.4939641	.1936093	2.55	0.021	.0854842	.9024439
lngdp	.1632779	.0877392	1.86	0.080	-.0218357	.3483914
_cons	2.87652	2.434717	1.18	0.254	-2.260283	8.013322

```
15 . predict lnpdthat
   (option xb assumed; fitted values)

16 . tabulate lnpdthat
```

Fitted values	Freq.	Percent	Cum.
10.86244	1	4.55	4.55
10.87219	1	4.55	9.09
10.91296	1	4.55	13.64
10.92396	1	4.55	18.18
10.92918	1	4.55	22.73
10.92925	1	4.55	27.27
10.93898	1	4.55	31.82
10.95263	1	4.55	36.36
10.95362	1	4.55	40.91
10.97325	1	4.55	45.45
10.97517	1	4.55	50.00
10.99762	1	4.55	54.55
11.01884	1	4.55	59.09
11.0242	1	4.55	63.64
11.02422	1	4.55	68.18
11.0481	1	4.55	72.73

	Freq.	Percent	Cum.
11.06404	1	4.55	77.27
11.08475	1	4.55	81.82
11.10226	1	4.55	86.36
11.121	1	4.55	90.91
11.17999	1	4.55	95.45
11.19146	1	4.55	100.00
Total	22	100.00	

17 . reg lnd lnpdthat lngdp

Source	SS	df	MS			
				Number of obs	=	22
				F(2, 19)	=	44.99
Model	3.26129847	2	1.63064924	Prob > F	=	0.0000
Residual	.688574614	19	.036240769	R-squared	=	0.8257
				Adj R-squared	=	0.8073
Total	3.94987309	21	.188089195	Root MSE	=	.19037

lnd	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnpdthat	-2.574157	.5697943	-4.52	0.000	-3.76675	-1.381563
lngdp	.5212927	.1344816	3.88	0.001	.2398194	.802766
_cons	35.93498	7.189835	5.00	0.000	20.88648	50.98347

18 . reg lns lnpdthat lnpx2 lnpx3 lnpx4

Source	SS	df	MS			
				Number of obs	=	22
				F(4, 17)	=	37.32
Model	4.64569773	4	1.16142443	Prob > F	=	0.0000
Residual	.529104183	17	.031123775	R-squared	=	0.8978
				Adj R-squared	=	0.8737
Total	5.17480192	21	.246419139	Root MSE	=	.17642

lns	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnpdthat	2.106112	1.171903	1.80	0.090	-.3663879	4.578612
lnpx2	-.727963	.1840856	-3.95	0.001	-1.11635	-.3395762
lnpx3	-1.122146	.2824139	-3.97	0.001	-1.717988	-.5263052
lnpx4	-1.428722	.4751381	-3.01	0.008	-2.431176	-.4262679
_cons	18.59912	8.546622	2.18	0.044	.5673274	36.63092

19 . reg lns lnpdt lnpx2 lnpx3 lnpx4

Source	SS	df	MS			
				Number of obs	=	22
				F(4, 17)	=	43.14
Model	4.71070935	4	1.17767734	Prob > F	=	0.0000
Residual	.464092568	17	.027299563	R-squared	=	0.9103
				Adj R-squared	=	0.8892
Total	5.17480192	21	.246419139	Root MSE	=	.16523

lns	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnpdt	-1.111835	.4515147	-2.46	0.025	-2.064448	-.1592222
lnpx2	-.4189546	.1431634	-2.93	0.009	-.7210029	-.1169063
lnpx3	-.9424196	.2585266	-3.65	0.002	-1.487863	-.3969762
lnpx4	-.521346	.3441643	-1.51	0.148	-1.247469	.2047773
_cons	41.4946	3.661911	11.33	0.000	33.76865	49.22056

```
20 . estat endogenous
estat endogenous not valid
r(321);

21 . estat endo
estat endo not valid
r(321);

22 . estat endog
estat endog not valid
r(321);

23 . estimate store ols

24 . ivregress 2sls lns lnpx2 lnpx3 lnpx4 (lnpdt = lnpx2 lnpx3 lnpx4 lngdp)

Instrumental variables (2SLS) regression          Number of obs   =         22
                                                  Wald chi2(4)    =      55.22
                                                  Prob > chi2     =     0.0000
                                                  R-squared       =     0.6424
                                                  Root MSE        =     .29004
```

lns	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lnpdt	2.10611	1.926677	1.09	0.274	-1.670107	5.882327
lnpx2	-.7279628	.3026471	-2.41	0.016	-1.32114	-.1347853
lnpx3	-1.122146	.464304	-2.42	0.016	-2.032165	-.212127
lnpx4	-1.428722	.7811544	-1.83	0.067	-2.959757	.1023125
_cons	18.59914	14.05113	1.32	0.186	-8.940569	46.13886

```
Instrumented:  lnpdt
Instruments:   lnpx2 lnpx3 lnpx4 lngdp

25 . estimate store twostage

26 . hausman twostage ols
```

	Coefficients (b) twostage	(B) ols	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lnpdt	2.10611	-1.111835	3.217945	1.873023
lnpx2	-.7279628	-.4189546	-.3090082	.266645
lnpx3	-1.122146	-.9424196	-.1797266	.3856712
lnpx4	-1.428722	-.521346	-.907376	.7012511

```
                  b = consistent under Ho and Ha; obtained from ivregress
   B = inconsistent under Ha, efficient under Ho; obtained from regress

    Test:  Ho:  difference in coefficients not systematic
```

```
                chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                        =        2.95
              Prob>chi2 =      0.5659

27 . reg lnd lnpdt lngdp

      Source |       SS           df       MS      Number of obs   =        22
-------------+----------------------------------   F(2, 19)        =     92.53
       Model |  3.58210899         2  1.79105449   Prob > F        =    0.0000
    Residual |  .367764099        19  .019356005   R-squared       =    0.9069
-------------+----------------------------------   Adj R-squared   =    0.8971
       Total |  3.94987309        21  .188089195   Root MSE        =    .13913

------------------------------------------------------------------------------
         lnd |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lnpdt |  -2.181329   .2946999    -7.40   0.000    -2.798143   -1.564515
       lngdp |   .5776586   .0887536     6.51   0.000     .3918952    .7634221
       _cons |   31.03578   3.761201     8.25   0.000      23.1635    38.90807
------------------------------------------------------------------------------

28 . estimate store olsd

29 . ivregress 2sls lnd lngdp (lnpdt = lnpx2 lnpx3 lnpx4 lngdp)

Instrumental variables (2SLS) regression          Number of obs   =         22
                                                  Wald chi2(2)    =     178.41
                                                  Prob > chi2     =     0.0000
                                                  R-squared       =     0.8982
                                                  Root MSE        =      .1352

------------------------------------------------------------------------------
         lnd |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lnpdt |  -2.574157   .4046743    -6.36   0.000    -3.367304    -1.78101
       lngdp |   .5212921   .0955104     5.46   0.000     .3340951     .708489
       _cons |   35.93499   5.106302     7.04   0.000     25.92682    45.94316
------------------------------------------------------------------------------
Instrumented:  lnpdt
Instruments:   lngdp lnpx2 lnpx3 lnpx4

30 . estimate store twostaged

31 . hausman twostaged olsd

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |   twostaged       olsd        Difference          S.E.
-------------+----------------------------------------------------------------
       lnpdt |   -2.574157    -2.181329       -.3928286        .2773324
       lngdp |    .5212921     .5776586       -.0563666         .035285
------------------------------------------------------------------------------
                          b = consistent under Ho and Ha; obtained from ivregress
           B = inconsistent under Ha, efficient under Ho; obtained from regress

    Test:  Ho:  difference in coefficients not systematic

                chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                        =        2.01
              Prob>chi2 =      0.3667
              (V_b-V_B is not positive definite)
```

```
32 . reg3 (lnd lnpdt lngdp) (lns lnpdt lnpx2 lnpx3 lnpx4), 3sls inst(lnpx2 lnpx3 lnpx4 lngdp)
```

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
lnd	22	2	.135203	0.8982	178.41	0.0000
lns	22	4	.2963642	0.6266	57.47	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lnd						
lnpdt	-2.574157	.4046743	-6.36	0.000	-3.367304	-1.78101
lngdp	.5212921	.0955104	5.46	0.000	.3340951	.708489
_cons	35.93499	5.106302	7.04	0.000	25.92682	45.94316
lns						
lnpdt	2.171576	1.926095	1.13	0.260	-1.603501	5.946652
lnpx2	-.7990055	.2985983	-2.68	0.007	-1.384247	-.2137635
lnpx3	-1.329743	.4560002	-2.92	0.004	-2.223487	-.4359989
lnpx4	-1.171403	.775654	-1.51	0.131	-2.691657	.348851
_cons	17.84948	14.04122	1.27	0.204	-9.670808	45.36976

Endogenous variables: lnd lnpdt lns
Exogenous variables: lnpx2 lnpx3 lnpx4 lngdp

```
33 . reg3 (lnd lnpdt lngdp) (lns lnpdt lnpx2 lnpx3 lnpx4), 3sls ireg3 inst(lnpx2 lnpx3 lnpx4 lngdp)

Iteration 1:   tolerance =   .1059484
Iteration 2:   tolerance =  .04569793
Iteration 3:   tolerance =  .01846611
Iteration 4:   tolerance =  .00725496
Iteration 5:   tolerance =  .00281814
Iteration 6:   tolerance =  .00108981
Iteration 7:   tolerance =  .00042072
Iteration 8:   tolerance =  .00016231
Iteration 9:   tolerance =   .0000626
Iteration 10:   tolerance =  .00002414
Iteration 11:   tolerance =  9.310e-06
Iteration 12:   tolerance =  3.590e-06
Iteration 13:   tolerance =  1.384e-06
Iteration 14:   tolerance =  5.339e-07
```

Three-stage least-squares regression, iterated

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
lnd	22	2	.135203	0.8982	178.41	0.0000
lns	22	4	.3022006	0.6117	54.83	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lnd						
lnpdt	**-2.574157**	**.4046743**	**-6.36**	**0.000**	**-3.367304**	**-1.78101**
lngdp	**.5212921**	**.0955104**	**5.46**	**0.000**	**.3340951**	**.708489**
_cons	**35.93499**	**5.106302**	**7.04**	**0.000**	**25.92682**	**45.94316**
lns						
lnpdt	**2.212666**	**2.005956**	**1.10**	**0.270**	**-1.718936**	**6.144268**
lnpx2	**-.8435967**	**.3049354**	**-2.77**	**0.006**	**-1.441259**	**-.2459342**
lnpx3	**-1.460044**	**.4623671**	**-3.16**	**0.002**	**-2.366267**	**-.5538216**
lnpx4	**-1.009892**	**.7998393**	**-1.26**	**0.207**	**-2.577548**	**.557764**
_cons	**17.37893**	**14.61488**	**1.19**	**0.234**	**-11.26571**	**46.02357**

```
Endogenous variables:  lnd lnpdt lns
Exogenous variables:   lnpx2 lnpx3 lnpx4 lngdp
```

```
34 . estimate store i3sls

35 . hausman i3sls ols olsd
too many names specified
r(198);

36 . hausman i3sls ols
no coefficients in common; specify equations(matchlist)
for problems with different equation names.
r(498);

37 . g qt = dt if st>dt

38 . g lnqt = log(qt)

39 . reg3 (lnqt lnpd lnpx2 lnpx3 lnpx4) (lnqt lnpd lngdp), ols
lnpd ambiguous abbreviation
r(111);

40 . reg3 (lnqt lnpdt lnpx2 lnpx3 lnpx4) (lnqt lnpdt lngdp), ols
```

Multivariate regression

Equation	Obs	Parms	RMSE	"R-sq"	F-Stat	P
lnqt	**22**	**4**	**.136235**	**0.9201**	**48.95**	**0.0000**
2lnqt	**22**	**2**	**.1391259**	**0.9069**	**92.53**	**0.0000**

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnqt						
lnpdt	**-1.353506**	**.3722912**	**-3.64**	**0.001**	**-2.108548**	**-.5984645**
lnpx2	**-.3864994**	**.1180437**	**-3.27**	**0.002**	**-.6259031**	**-.1470957**
lnpx3	**-.6782817**	**.2131651**	**-3.18**	**0.003**	**-1.110601**	**-.2459629**
lnpx4	**-.3606189**	**.2837767**	**-1.27**	**0.212**	**-.9361448**	**.2149069**
_cons	**40.10218**	**3.019386**	**13.28**	**0.000**	**33.97858**	**46.22578**
2lnqt						
lnpdt	**-2.181329**	**.2946999**	**-7.40**	**0.000**	**-2.779008**	**-1.58365**
lngdp	**.5776586**	**.0887536**	**6.51**	**0.000**	**.397658**	**.7576593**
_cons	**31.03578**	**3.761201**	**8.25**	**0.000**	**23.40771**	**38.66385**

```
41 . reg3 (lnqt lnpdt lnpx2 lnpx3 lnpx4) (lnqt lnpdt lngdp), 2sls inst(lnpx2 lnpx3 lnpx4 lngdp)
```

Two-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	F-Stat	P
lnqt	**22**	**4**	**.2329302**	**0.7665**	**15.68**	**0.0000**
2lnqt	**22**	**2**	**.1454858**	**0.8982**	**77.04**	**0.0000**

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnqt						
lnpdt	**.7752765**	**1.547291**	**0.50**	**0.619**	**-2.362776**	**3.913329**
lnpx2	**-.5909191**	**.2430523**	**-2.43**	**0.020**	**-1.083852**	**-.0979861**
lnpx3	**-.7971771**	**.3728771**	**-2.14**	**0.039**	**-1.553407**	**-.0409473**
lnpx4	**-.9608797**	**.6273359**	**-1.53**	**0.134**	**-2.233176**	**.3114165**
_cons	**24.95604**	**11.2843**	**2.21**	**0.033**	**2.07042**	**47.84166**
2lnqt						
lnpdt	**-2.574157**	**.4354519**	**-5.91**	**0.000**	**-3.457295**	**-1.69102**
lngdp	**.5212921**	**.1027745**	**5.07**	**0.000**	**.3128558**	**.7297283**
_cons	**35.93499**	**5.494663**	**6.54**	**0.000**	**24.7913**	**47.07868**

Endogenous variables: lnqt lnpdt
Exogenous variables: lnpx2 lnpx3 lnpx4 lngdp

```
42 . reg3 (lnqt lnpdt lnpx2 lnpx3 lnpx4) (lnqt lnpdt lngdp), 3sls inst(lnpx2 lnpx3 lnpx4 lngdp)
```

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
lnqt	**22**	**4**	**.2056595**	**0.7644**	**81.74**	**0.0000**
2lnqt	**22**	**2**	**.135203**	**0.8982**	**178.41**	**0.0000**

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lnqt						
lnpdt	**.7879239**	**1.360114**	**0.58**	**0.562**	**-1.877851**	**3.453699**
lnpx2	**-.6046439**	**.2134422**	**-2.83**	**0.005**	**-1.022983**	**-.1863049**
lnpx3	**-.8372831**	**.3273419**	**-2.56**	**0.011**	**-1.478861**	**-.1957047**
lnpx4	**-.9111679**	**.5511692**	**-1.65**	**0.098**	**-1.99144**	**.1691039**
_cons	**24.81121**	**9.918929**	**2.50**	**0.012**	**5.370467**	**44.25195**
2lnqt						
lnpdt	**-2.574157**	**.4046743**	**-6.36**	**0.000**	**-3.367304**	**-1.78101**
lngdp	**.5212921**	**.0955104**	**5.46**	**0.000**	**.3340951**	**.708489**
_cons	**35.93499**	**5.106302**	**7.04**	**0.000**	**25.92682**	**45.94316**

Endogenous variables: lnqt lnpdt
Exogenous variables: lnpx2 lnpx3 lnpx4 lngdp

```
43 . log close
      name:  <unnamed>
       log:  C:\Users\Jilllin\OneDrive\Desktop\Thammasat\EE426\Untitled.smcl
  log type:  smcl
 closed on:   3 Feb 2021, 20:28:04
-------------------------------------------------------------------------------------------------------

44 .
```