

Assignment - Solution Simultaneous Equations Model

Export-Import Equations System

$$\ln Ex_t = \beta_{10} + \beta_{11} \ln Im_t + \beta_{12} \ln P_{Ext} + \beta_{13} \ln Fx_t + \beta_{14} \ln GDP_{wt} + \varepsilon_{1t} \quad (1)$$

$$\ln Im_t = \beta_{20} + \beta_{21} \ln Ex_t + \beta_{22} \ln Fx_t + \beta_{23} \ln Inf_t + \varepsilon_{2t} \quad (2)$$

where: $\ln Ex_t$ = Natural log of export at time t
 $\ln Im_t$ = Natural log of Import at time t
 $\ln P_{Ext}$ = Natural log of Export price at time t
 $\ln Fx_t$ = Natural log of Exchange rate at time t
 $\ln GDP_{wt}$ = Natural log of World GDP at time t
 $\ln Inf_t$ = Natural log of Inflation at time t

Endogenous variables in this system include $\ln Ex_t$ and $\ln Im_t$

Exogenous variables in this system include $\ln P_{Ext}$, $\ln Fx_t$, $\ln GDP_{wt}$, and $\ln Inf_t$

1. State reduce form model of these system models.
2. Estimate reduce form model using OLS and prediction of the endogenous variables.
3. Estimate structural form using predicted endogenous variables as independent variables in the structural form model.
4. Estimate the structural models of these system equations using OLS, 2SLS, 3SLS, and I3SLS. Concerning on the asymptotic property, which model is the most appropriated model? Why?

1. State reduce form model of these system models.

$$\ln Ex_t = \pi_{10} + \pi_{11} \ln P_{Ext} + \pi_{12} \ln Fx_t + \pi_{13} \ln GDP_{wt} + \pi_{14} \ln Inf_t + w_{1t}$$

$$\ln Im_t = \pi_{20} + \pi_{21} \ln P_{Ext} + \pi_{22} \ln Fx_t + \pi_{23} \ln GDP_{wt} + \pi_{24} \ln Inf_t + w_{2t}$$

2. Estimate reduce form model using OLS and prediction of the endogenous variables.

```
. reg lnEx lnPx lnFx lnGDP lnInf
```

Source	SS	df	MS			
Model	4.36664537	4	1.09166134	Number of obs =	21	
Residual	.526002198	16	.032875137	F(4, 16) =	33.21	
Total	4.89264757	20	.244632378	Prob > F =	0.0000	
				R-squared =	0.8925	
				Adj R-squared =	0.8656	
				Root MSE =	.18132	

lnEx	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
lnPx	-.1110137	.1571182	-0.71	0.490	-.4440893	.222062
lnFx	-1.007752	.2705841	-3.72	0.002	-1.581365	-.4341397
lnGDP	.3261323	.2855086	1.14	0.270	-.2791189	.9313836
lnInf	-.4805428	.1543648	-3.11	0.007	-.8077815	-.1533041
_cons	17.19214	4.426529	3.88	0.001	7.808317	26.57596

```
. predict lnExhat, xb
```

```
. reg lnIm lnPx lnFx lnGDP lnInf
```

Source	SS	df	MS			
Model	3.17268356	4	.793170891	Number of obs =	21	
Residual	.528186051	16	.033011628	F(4, 16) =	24.03	
Total	3.70086961	20	.185043481	Prob > F =	0.0000	
				R-squared =	0.8573	
				Adj R-squared =	0.8216	
				Root MSE =	.18169	

lnIm	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
lnPx	-.2393878	.157444	-1.52	0.148	-.5731542	.0943785
lnFx	-.9198543	.2711453	-3.39	0.004	-1.494657	-.3450521
lnGDP	-.0561052	.2861007	-0.20	0.847	-.6626115	.5504012
lnInf	-.5148627	.1546849	-3.33	0.004	-.84278	-.1869453
_cons	21.67905	4.435708	4.89	0.000	12.27577	31.08233

```
. predict lnImhat, xb
```

3. Estimate structural form using predicted endogenous variables as independent variables in the structural form model.

```
. reg lnEx lnImhat lnPx lnFx lnGDP
```

Source	SS	df	MS			
Model	4.36664607	4	1.09166152	Number of obs =	21	
Residual	.526001498	16	.032875094	F(4, 16) =	33.21	
Total	4.89264757	20	.244632378	Prob > F =	0.0000	
				R-squared =	0.8925	
				Adj R-squared =	0.8656	
				Root MSE =	.18131	

lnEx	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
lnImhat	.9333426	.2998171	3.11	0.007	.2977587	1.568927
lnPx	.1124171	.1773003	0.63	0.535	-.2634427	.4882769
lnFx	-.1492134	.4028666	-0.37	0.716	-1.003252	.7048255
lnGDP	.3784973	.2828313	1.34	0.200	-.2210783	.978073
_cons	-3.041833	6.591676	-0.46	0.651	-17.01556	10.9319

```
. reg lnIm lnEx lnFx lnInf
```

Source	SS	df	MS	Number of obs =	21
Model	3.63756346	3	1.21252115	F(3, 17) =	325.61
Residual	.063306149	17	.003723891	Prob > F =	0.0000
Total	3.70086961	20	.185043481	R-squared =	0.9829
				Adj R-squared =	0.9799
				Root MSE =	.06102

lnlm	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
lnEx	.8872779	.0678579	13.08	0.000	.7441103 1.030445
lnFx	.1353143	.1219833	1.11	0.283	-.1220478 .3926765
lnlnf	-.0466293	.0654818	-0.71	0.486	-.1847839 .0915253
_cons	1.161823	1.565075	0.74	0.468	-2.140197 4.463842

4. Estimate the structural models of these system equations using OLS, 2SLS, 3SLS, and I3SLS. Concerning on the asymptotic property, which model is the most appropriated model? Why?

```
. reg3 (lnEx lnlnm lnPx lnFx lngdp) (lnlnm lnEx lnFx lnlnf), ols inst(lnPx lnFx lngdp lnlnf)
```

Multi variate regression

Equation	Obs	Parms	RMSE	"R-sq"	F-Stat	P
lnEx	21	4	.0242282	0.9981	2079.73	0.0000
lnlnm	21	3	.0610237	0.9829	325.61	0.0000

	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
lnEx					
lnlnm	.9666047	.0256256	37.72	0.000	.914469 1.01874
lnPx	.1216148	.0221084	5.50	0.000	.0766348 .1665948
lnFx	-.1159967	.044184	-2.63	0.013	-.2058896 -.0261038
lngdp	.3744132	.0376037	9.96	0.000	.297908 .4509185
_cons	-3.605975	.709242	-5.08	0.000	-5.048938 -2.163011
lnlnm					
lnEx	.8872779	.0678579	13.08	0.000	.74922 1.025336
lnFx	.1353143	.1219833	1.11	0.275	-.1128625 .3834911
lnlnf	-.0466293	.0654818	-0.71	0.481	-.1798531 .0865945
_cons	1.161823	1.565075	0.74	0.463	-2.022346 4.345991

```
. reg3 (lnEx lnlnm lnPx lnFx lngdp) (lnlnm lnEx lnFx lnlnf), 2sls inst(lnPx lnFx lngdp lnlnf)
```

Two-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	F-Stat	P
lnEx	21	4	.0254719	0.9979	1682.53	0.0000
lnlnm	21	3	.0747698	0.9743	186.93	0.0000

	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
lnEx					
lnlnm	.9333418	.0421197	22.16	0.000	.8476486 1.019035
lnPx	.112417	.024908	4.51	0.000	.0617414 .1630926
lnFx	-.1492139	.0565966	-2.64	0.013	-.2643605 -.0340673
lngdp	.3784976	.0397334	9.53	0.000	.2976593 .4593359
_cons	-3.041822	.9260292	-3.28	0.002	-4.925843 -1.157802
lnlnm					
lnEx	.6891913	.1406215	4.90	0.000	.4030948 .9752879
lnFx	-.152624	.2225184	-0.69	0.498	-.6053411 .3000931
lnlnf	-.1788222	.1102958	-1.62	0.114	-.4032207 .0455763
_cons	5.645315	3.204096	1.76	0.087	-.8734677 12.1641

Endogenous variables: lnEx lnlnm
 Exogenous variables: lnPx lnFx lngdp lnlnf

```
. reg3 (lnEx lnIm lnPx lnFx lnGDP) (lnIm lnEx lnFx lnInf), 3sls inst(lnPx lnFx lnGDP lnInf)
```

Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi 2	P
lnEx	21	4	.0223085	0.9979	8833.40	0.0000
lnIm	21	3	.067273	0.9743	692.76	0.0000

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
lnEx					
lnIm	.9329992	.0367649	25.38	0.000	.8609414 1.005057
lnPx	.1182527	.0216467	5.46	0.000	.0758259 .1606796
lnFx	-.1468878	.0493949	-2.97	0.003	-.2437 -.0500755
lnGDP	.3886832	.0345013	11.27	0.000	.321062 .4563044
_cons	-3.186449	.8067418	-3.95	0.000	-4.767634 -1.605265
lnIm					
lnEx	.6891913	.1265221	5.45	0.000	.4412126 .9371701
lnFx	-.152624	.2002077	-0.76	0.446	-.5450239 .2397758
lnInf	-.1788222	.099237	-1.80	0.072	-.3733232 .0156788
_cons	5.645315	2.882839	1.96	0.050	-.0049452 11.29557

Endogenous variables: lnEx lnIm
 Exogenous variables: lnPx lnFx lnGDP lnInf

```
. reg3 (lnEx lnIm lnPx lnFx lnGDP) (lnIm lnEx lnFx lnInf), 3sls ireg3 inst(lnPx lnFx lnGDP lnInf)
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```
Iteration 1: tolerance = .03578262
Iteration 2: tolerance = .01420935
Iteration 3: tolerance = .00576258
Iteration 4: tolerance = .00235664
Iteration 5: tolerance = .00096703
Iteration 6: tolerance = .00039737
Iteration 7: tolerance = .00016338
Iteration 8: tolerance = .00006719
Iteration 9: tolerance = .00002763
Iteration 10: tolerance = .00001137
Iteration 11: tolerance = 4.675e-06
Iteration 12: tolerance = 1.923e-06
Iteration 13: tolerance = 7.909e-07
```

Three-stage least-squares regression, iterated

Equation	Obs	Parms	RMSE	"R-sq"	chi 2	P
lnEx	21	4	.0224232	0.9978	8684.98	0.0000
lnIm	21	3	.067273	0.9743	692.76	0.0000

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
lnEx					
lnIm	.9327599	.0370778	25.16	0.000	.8600888 1.005431
lnPx	.12233	.0216546	5.65	0.000	.0798878 .1647723
lnFx	-.1452626	.0498035	-2.92	0.004	-.2428757 -.0476495
lnGDP	.3957996	.0344575	11.49	0.000	.3282642 .463335
_cons	-3.287497	.810712	-4.06	0.000	-4.876463 -1.69853
lnIm					
lnEx	.6891913	.1265221	5.45	0.000	.4412126 .9371701
lnFx	-.152624	.2002077	-0.76	0.446	-.5450239 .2397758
lnInf	-.1788222	.099237	-1.80	0.072	-.3733232 .0156788
_cons	5.645315	2.882839	1.96	0.050	-.0049452 11.29557

Endogenous variables: lnEx lnIm
 Exogenous variables: lnPx lnFx lnGDP lnInf