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EE435: Assignment 8

1. Estimate VARs models using spot return (rspot) and future return (rfuture) as endogenous variables and determine the most appropriate lags models using SBIC.

```
. varsoc rspot rfuture, maxlag(10)

Selection-order criteria
Sample:  12 - 7684                        Number of obs      =      7673
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	76671.7				7.2e-12	-19.9843	-19.9837	-19.9825
1	76840.9	338.5	4	0.000	6.9e-12	-20.0274	-20.0255	-20.0219
2	76931.4	180.85	4	0.000	6.7e-12	-20.0499	-20.0468	-20.0408
3	76963.2	63.709	4	0.000	6.7e-12	-20.0571	-20.0528	-20.0445
4	76979.4	32.291	4	0.000	6.7e-12	-20.0603	-20.0547	-20.044
5	77017.6	76.544	4	0.000	6.6e-12	-20.0692	-20.0624	-20.0493
6	77049.6	63.872	4	0.000	6.5e-12	-20.0765	-20.0684	-20.053*
7	77059.6	20.054	4	0.000	6.5e-12	-20.0781	-20.0688	-20.0509
8	77070.3	21.332	4	0.000	6.5e-12	-20.0798	-20.0693*	-20.0491
9	77076.4	12.37*	4	0.015	6.5e-12*	-20.0804*	-20.0686	-20.046
10	77080.2	7.4487	4	0.114	6.5e-12	-20.0803	-20.0673	-20.0423

```
Endogenous:  rspot rfuture
 Exogenous:  _cons
```

From the table above, the most appropriate lag model using SBIC is lag (1/6) with the lowest value of SBIC (-20.053).

```
. var rspot rfuture, lag (1/6)

Vector autoregression

Sample:  8 - 7684                               Number of obs     =      7,677
Log likelihood =    77062.5                     AIC               =  -20.06943
FPE            =   6.59e-12                     HQIC              =  -20.06136
Det(Sigma_ml)  =   6.55e-12                     SBIC              =   -20.0459

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
rspot                 13     .001777   0.0159   124.0308   0.0000
rfuture               13     .002042   0.0211   165.0864   0.0000
------------------------------------------------------------------
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
rspot						
rspot						
L1.	-.0429887	.0160995	-2.67	0.008	-.0745432	-.0114342
L2.	-.1255145	.0163803	-7.66	0.000	-.1576194	-.0934097
L3.	-.0654555	.0165559	-3.95	0.000	-.0979044	-.0330066
L4.	-.0555308	.0165648	-3.35	0.001	-.0879973	-.0230644
L5.	-.0646528	.0163598	-3.95	0.000	-.0967173	-.0325882
L6.	-.0420281	.0160563	-2.62	0.009	-.0734979	-.0105584
rfuture						
L1.	.1025108	.0140081	7.32	0.000	.0750554	.1299661
L2.	.0827253	.0143869	5.75	0.000	.0545274	.1109231
L3.	.0530446	.0145602	3.64	0.000	.0245072	.081582
L4.	.057478	.0145501	3.95	0.000	.0289603	.0859958
L5.	.0435619	.0143967	3.03	0.002	.0153449	.0717788
L6.	.0372007	.0140183	2.65	0.008	.0097254	.064676
_cons	.0000232	.0000203	1.14	0.252	-.0000165	.0000629
rfuture						
rspot						
L1.	.2117743	.0185008	11.45	0.000	.1755133	.2480352
L2.	.0743206	.0188235	3.95	0.000	.0374272	.1112139
L3.	.0828566	.0190252	4.36	0.000	.0455679	.1201454
L4.	.0448446	.0190355	2.36	0.018	.0075357	.0821535
L5.	.0674903	.0187999	3.59	0.000	.0306433	.1043374
L6.	.0590473	.0184511	3.20	0.001	.0228838	.0952109
rfuture						
L1.	-.1623592	.0160974	-10.09	0.000	-.1939096	-.1308088
L2.	-.1054217	.0165328	-6.38	0.000	-.1378253	-.073018
L3.	-.0724314	.0167319	-4.33	0.000	-.1052253	-.0396376
L4.	-.042915	.0167203	-2.57	0.010	-.0756863	-.0101437
L5.	-.0604119	.016544	-3.65	0.000	-.0928375	-.0279863
L6.	-.0392965	.0161092	-2.44	0.015	-.0708699	-.0077232
_cons	.0000259	.0000233	1.11	0.266	-.0000198	.0000715

2. Perform stability test and Granger exogeneity test.

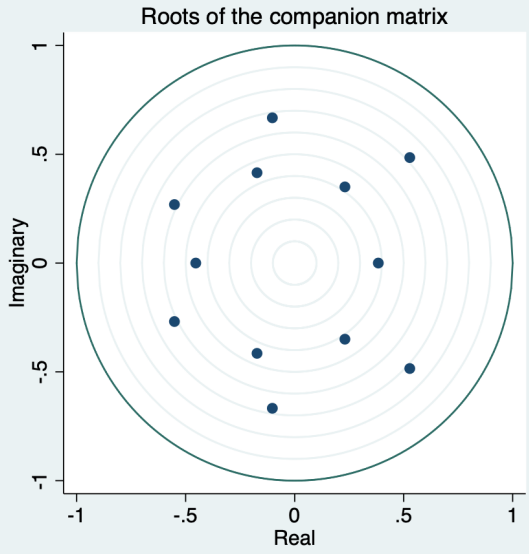
Stability Test

```
. varstable, graph
```

Eigenvalue stability condition

Eigenvalue	Modulus
.5279554 + .4847924*i*	.716771
.5279554 - .4847924*i*	.716771
-.1022778 + .6675194*i*	.67531
-.1022778 - .6675194*i*	.67531
-.5513603 + .2689237*i*	.613448
-.5513603 - .2689237*i*	.613448
-.4536067	.453607
-.1726167 + .4151256*i*	.449584
-.1726167 - .4151256*i*	.449584
.2305361 + .3500458*i*	.419141
.2305361 - .3500458*i*	.419141
.3837855	.383786

All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.



we see that all eigenvalues lie inside the unit circle. Therefore, the VAR satisfies the stability condition and the model has stability property.

Granger Test

we use the Granger test to prove for the independent system or whether x_t is exogeneous variables. we see that the prob > chi2 for all variables are 0 ($0 < 0.05$), indicating that the null hypothesis is rejected at 95% confidence level. Therefore, both variables have endogeneity and interdependent relationship.

```
. vargranger
```

$H_0: \Delta_{21}(L) = 0$ $H_a: \Delta_{22}(L) \neq 0$

```
Granger causality Wald tests
```

Equation	Excluded	chi2	df	Prob > chi2
rspot	rfuture	82.299	6	0.000
rspot	ALL	82.299	6	0.000
rfuture	rspot	148.42	6	0.000
rfuture	ALL	148.42	6	0.000

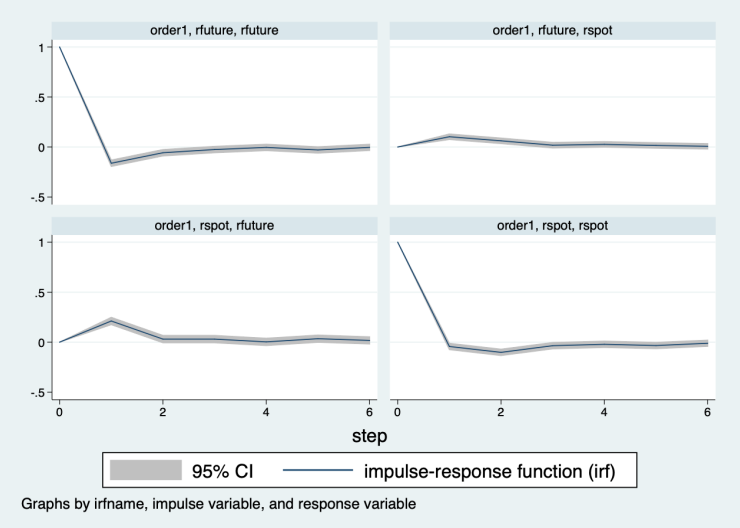
3. Perform Impulse response analysis and determine which variable has more impact.

```
. irf create order1, order(rspot rfuture) step(6) set(irf01)
(file irf01.irf created)
(file irf01.irf now active)
(file irf01.irf updated)

. irf table irf, impulse(rspot rfuture) response(rspot rfuture)
```

Results from order1

step	(1) irf	(1) Lower	(1) Upper	(2) irf	(2) Lower	(2) Upper	(3) irf	(3) Lower	(3) Upper	(4) irf	(4) Lower	(4) Upper
0	1	1	1	0	0	0	0	0	0	1	1	1
1	-.042989	-.074543	-.011434	.211774	.175513	.248035	.102511	.075055	.129966	-.162359	-.19391	-.130809
2	-.101957	-.133505	-.070409	.030833	-.00561	.067276	.061675	.034224	.089126	-.057352	-.089063	-.025641
3	-.034997	-.066566	-.003428	.030738	-.005677	.067153	.018216	-.009265	.045697	-.025324	-.057023	.006376
4	-.02148	-.052956	.009995	.002714	-.033596	.039023	.026291	-.001106	.053688	-.004062	-.035665	.027541
5	-.033647	-.06485	-.002443	.034962	-.001046	.070971	.01553	-.011653	.042713	-.029332	-.060699	.002035
6	-.010717	-.041519	.020085	.017646	-.017933	.053226	.006933	-.01982	.033686	-.003566	-.034475	.027344

```
95% lower and upper bounds reported
(1) irfname = order1, impulse = rspot, and response = rspot
(2) irfname = order1, impulse = rspot, and response = rfuture
(3) irfname = order1, impulse = rfuture, and response = rspot
(4) irfname = order1, impulse = rfuture, and response = rfuture

. irf graph irf, impulse(rspot rfuture) response(rspot rfuture)
```



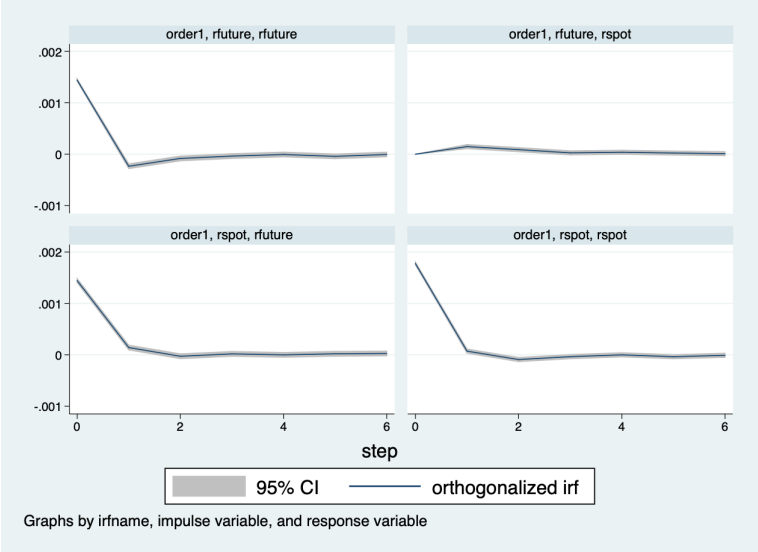
To see whether which variable has more impact, we need to consider the magnitude of the impulse response function (irf).

```
. irf table oirf, impulse(rspot rfuture) response(rspot rfuture)
```

Results from order1

step	(1) oirf	(1) Lower	(1) Upper	(2) oirf	(2) Lower	(2) Upper	(3) oirf	(3) Lower	(3) Upper	(4) oirf	(4) Lower	(4) Upper
0	.001775	.001747	.001803	.001444	.001404	.001483	0	0	0	.001441	.001419	.001464
1	.000072	.000032	.000112	.000142	.000096	.000188	.000148	.000108	.000187	-.000234	-.00028	-.000188
2	-.000092	-.000132	-.000052	-.000028	-.000074	.000018	.000089	.000049	.000128	-.000083	-.000128	-.000037
3	-.000036	-.000076	4.1e-06	.000018	-.000028	.000064	.000026	-.000013	.000066	-.000037	-.000082	9.2e-06
4	-1.8e-07	-.00004	.00004	-1.0e-06	-.000047	.000045	.000038	-1.6e-06	.000077	-5.9e-06	-.000051	.00004
5	-.000037	-.000077	2.5e-06	.00002	-.000026	.000066	.000022	-.000017	.000062	-.000042	-.000087	2.9e-06
6	-9.0e-06	-.000049	.000031	.000026	-.00002	.000072	1.0e-05	-.000029	.000049	-5.1e-06	-.00005	.000039

95% lower and upper bounds reported
(1) irfname = order1, impulse = rspot, and response = rspot
(2) irfname = order1, impulse = rspot, and response = rfuture
(3) irfname = order1, impulse = rfuture, and response = rspot
(4) irfname = order1, impulse = rfuture, and response = rfuture



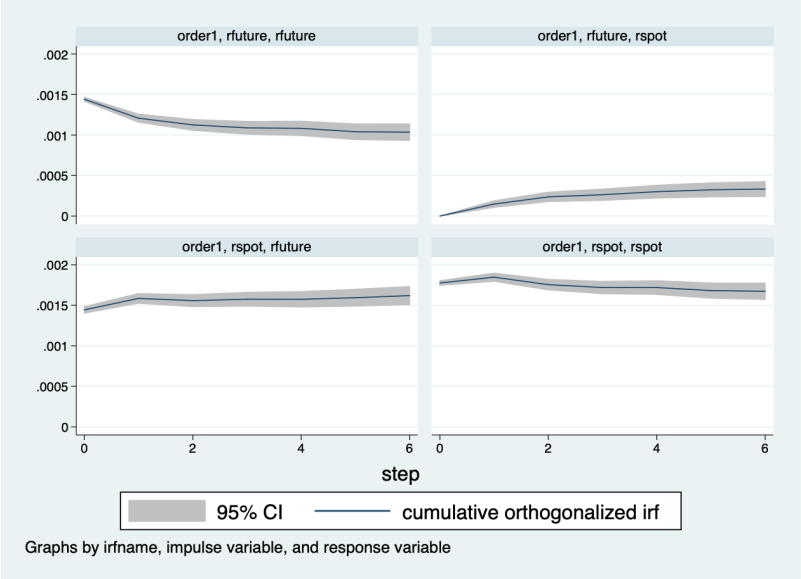

```
. irf table coirf, impulse(rspot rfuture) response(rspot rfuture)
```

Results from order1

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper	(3) coirf	(3) Lower	(3) Upper	(4) coirf	(4) Lower	(4) Upper
0	.001775	.001747	.001803	.001444	.001404	.001483	0	0	0	.001441	.001419	.001464
1	.001847	.001798	.001896	.001585	.001527	.001644	.000148	.000108	.000187	.001207	.001158	.001257
2	.001755	.001691	.001819	.001557	.001484	.00163	.000237	.00018	.000294	.001125	.001059	.00119
3	.001719	.001644	.001794	.001575	.001491	.001659	.000263	.000194	.000332	.001088	.00101	.001166
4	.001719	.001635	.001803	.001574	.00148	.001668	.000301	.000223	.000379	.001082	.000995	.00117
5	.001682	.001589	.001774	.001594	.001491	.001697	.000323	.000238	.000409	.00104	.000945	.001136
6	.001673	.001573	.001772	.00162	.001509	.001731	.000333	.000242	.000424	.001035	.000934	.001136

95% lower and upper bounds reported
(1) irfname = order1, impulse = rspot, and response = rspot
(2) irfname = order1, impulse = rspot, and response = rfuture
(3) irfname = order1, impulse = rfuture, and response = rspot
(4) irfname = order1, impulse = rfuture, and response = rfuture

From the table of cirf, we see that all lower and upper don't cover zero, so the test is significant at 95% confidence level.
The impulse response of rspot has more impact on rspot while the impulse response of rspot has more impact on rfuture.



4. Perform Forecast error variance decomposition and determine variable that has more impact on each endogenous variable.

```
. irf table fevd, impulse(rspot rfuture) response(rspot)
```

Results from order1

step	(1) fevd	(1) Lower	(1) Upper	(2) fevd	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	1	1	1	0	0	0
2	.993131	.989465	.996798	.006869	.003202	.010535
3	.990693	.98638	.995006	.009307	.004994	.01362
4	.990483	.986145	.994821	.009517	.005179	.013855
5	.990038	.98565	.994426	.009962	.005574	.01435
6	.989888	.985487	.994289	.010112	.005711	.014513

95% lower and upper bounds reported
(1) irfname = order1, impulse = rspot, and response = rspot
(2) irfname = order1, impulse = rfuture, and response = rspot

From the table, about 98-99% of variation of rspot caused by rspot and less than 1% caused by rfuture. We see that the lower and upper don't cover 0, so the test is significant. Thus, rspot has more impact on rspot because of a higher decomposition percentage.

```
. irf table fevd, impulse(rspot rfuture) response(rfuture)
```

Results from order1

step	(1) fevd	(1) Lower	(1) Upper	(2) fevd	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	.500791	.484986	.516596	.499209	.483404	.515014
2	.496679	.480799	.512558	.503321	.487442	.519201
3	.495972	.480066	.511879	.504028	.488121	.519934
4	.495855	.479951	.51176	.504145	.48824	.520049
5	.495851	.479947	.511756	.504149	.488244	.520053
6	.495689	.479783	.511594	.504311	.488406	.520217

95% lower and upper bounds reported
(1) irfname = order1, impulse = rspot, and response = rfuture
(2) irfname = order1, impulse = rfuture, and response = rfuture

The variance of rfuture that caused by rspot and rfuture is approximately 49-50%. The lower and upper bounds of the test don't cover zero, so the test is significant. Thus, the impact of rspot and rfuture are almost the same on rfuture.