1.

```
. 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

According to SBIC, lag term 6 = -20.053 is the most appropriate model since it has the lowest value (lower error term), such that it has the best fit data.

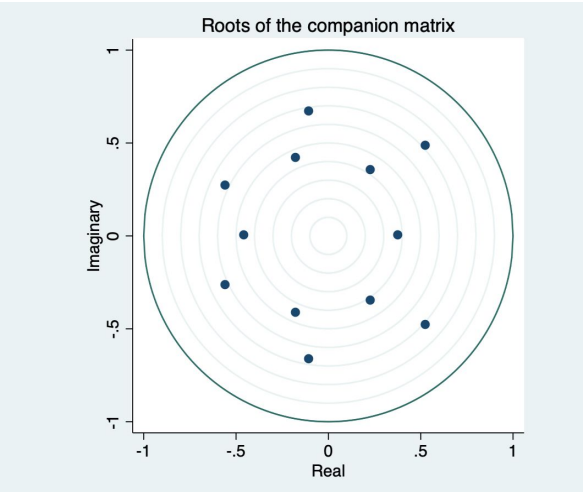
2.

```
. 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.




```
. vargranger
```

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

From the stability test, all eigenvalues are less than 1 or less than unit root, and lie in unit circle, therefore, VARs meet the stability condition and are stationary.

From Granger test, we test whether rspot cross rfuture and rfuture cross rspot or not (whether it's independent or not). We set hypothesis of H_0 : $\Delta_{21}(L) = 0$ and $\Delta_{12}(L)=0$, from the test Prob of Chi2 are all 0.000 (p-value < 0.05), thus, H0 is rejected and rspot and rfuture are endogeneity.

3.

```
. irf create order1, order(rspot rfuture) step(10) set(irf01)
(file irf01.irf now active)
(file irf01.irf updated)

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

Results from order1

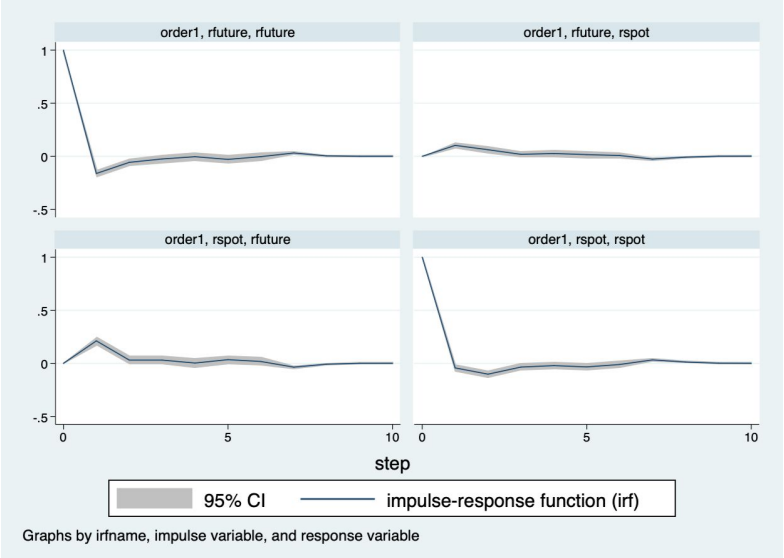
step	(1) irf	(1) Lower	(1) Upper	(2) irf	(2) Lower	(2) Upper
0	1	1	1	0	0	0
1	-.042989	-.074543	-.011434	.211774	.175513	.248035
2	-.101957	-.133505	-.070409	.030833	-.00561	.067276
3	-.034997	-.066566	-.003428	.030738	-.005677	.067153
4	-.02148	-.052956	.009995	.002714	-.033596	.039023
5	-.033647	-.06485	-.002443	.034962	-.001046	.070971
6	-.010717	-.041519	.020085	.017646	-.017933	.053226
7	.032265	.020916	.043615	-.03579	-.049542	-.022038
8	.012189	.004402	.019975	-.007864	-.015341	-.000387
9	.001296	-.00312	.005713	-.000034	-.004255	.004186
10	.000061	-.003519	.003642	.000285	-.003305	.003874

step	(3) irf	(3) Lower	(3) Upper	(4) irf	(4) Lower	(4) Upper
0	0	0	0	1	1	1
1	.102511	.075055	.129966	-.162359	-.19391	-.130809
2	.061675	.034224	.089126	-.057352	-.089063	-.025641
3	.018216	-.009265	.045697	-.025324	-.057023	.006376
4	.026291	-.001106	.053688	-.004062	-.035665	.027541
5	.01553	-.011653	.042713	-.029332	-.060699	.002035
6	.006933	-.01982	.033686	-.003566	-.034475	.027344
7	-.026277	-.036538	-.016016	.03073	.017939	.043521
8	-.008158	-.014491	-.001824	.003756	-.002191	.009704
9	-.0002	-.003504	.003105	-.000652	-.003805	.002502
10	.000499	-.00231	.003308	-.000346	-.003173	.002482

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 estimated result,

1. Direction : From IRF graph, all variables have positive impact.
2. Magnitude : The impact of rspot on rfuture is larger than rfuture on rspot.
3. Duration : It takes 6 periods until the impact goes to zero.




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

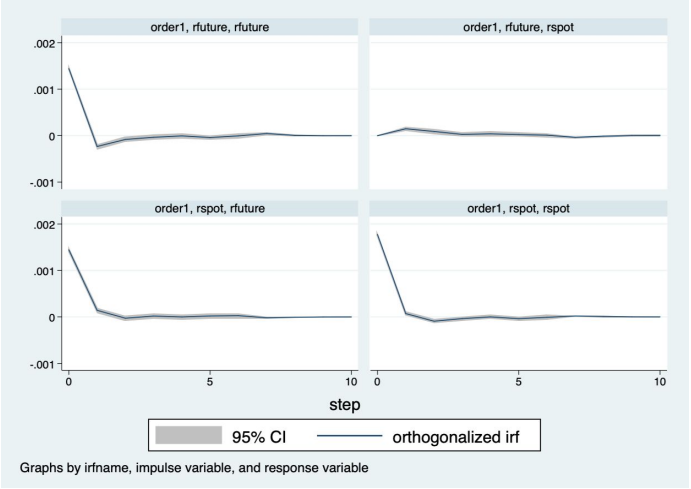
Results from order1

step	(1) oirf	(1) Lower	(1) Upper	(2) oirf	(2) Lower	(2) Upper
0	.001775	.001747	.001803	.001444	.001404	.001483
1	.000072	.000032	.000112	.000142	.000096	.000188
2	-.000092	-.000132	-.000052	-.000028	-.000074	.000018
3	-.000036	-.000076	4.1e-06	.000018	-.000028	.000064
4	-1.8e-07	-.00004	.00004	-1.0e-06	-.000047	.000045
5	-.000037	-.000077	2.5e-06	.00002	-.000026	.000066
6	-9.0e-06	-.000049	.000031	.000026	-.00002	.000072
7	.000019	.000011	.000028	-.000019	-.000028	-1.0e-05
8	9.9e-06	3.6e-06	.000016	-8.5e-06	-.000015	-2.5e-06
9	2.0e-06	-1.8e-06	5.8e-06	-1.0e-06	-4.7e-06	2.7e-06
10	8.3e-07	-2.1e-06	3.8e-06	6.5e-09	-3.0e-06	3.0e-06

step	(3) oirf	(3) Lower	(3) Upper	(4) oirf	(4) Lower	(4) Upper
0	0	0	0	.001441	.001419	.001464
1	.000148	.000108	.000187	-.000234	-.00028	-.000188
2	.000089	.000049	.000128	-.000083	-.000128	-.000037
3	.000026	-.000013	.000066	-.000037	-.000082	9.2e-06
4	.000038	-1.6e-06	.000077	-5.9e-06	-.000051	.00004
5	.000022	-.000017	.000062	-.000042	-.000087	2.9e-06
6	1.0e-05	-.000029	.000049	-5.1e-06	-.00005	.000039
7	-.000038	-.000053	-.000023	.000044	.000026	.000063
8	-.000012	-.000021	-2.6e-06	5.4e-06	-3.2e-06	.000014
9	-2.9e-07	-5.1e-06	4.5e-06	-9.4e-07	-5.5e-06	3.6e-06
10	7.2e-07	-3.3e-06	4.8e-06	-5.0e-07	-4.6e-06	3.6e-06

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 oirf, impulse (rspot rfuture) response(rspot rfuture)
```




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

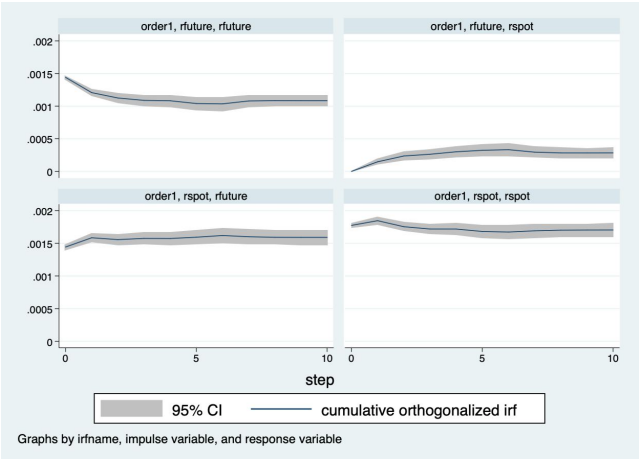
Results from order1

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	.001775	.001747	.001803	.001444	.001404	.001483
1	.001847	.001798	.001896	.001585	.001527	.001644
2	.001755	.001691	.001819	.001557	.001484	.00163
3	.001719	.001644	.001794	.001575	.001491	.001659
4	.001719	.001635	.001803	.001574	.00148	.001668
5	.001682	.001589	.001774	.001594	.001491	.001697
6	.001673	.001573	.001772	.00162	.001509	.001731
7	.001692	.001594	.00179	.001601	.001492	.00171
8	.001702	.001606	.001797	.001592	.001485	.001699
9	.001704	.001609	.001798	.001591	.001485	.001698
10	.001705	.00161	.001799	.001591	.001485	.001698

step	(3) coirf	(3) Lower	(3) Upper	(4) coirf	(4) Lower	(4) Upper
0	0	0	0	.001441	.001419	.001464
1	.000148	.000108	.000187	.001207	.001158	.001257
2	.000237	.00018	.000294	.001125	.001059	.00119
3	.000263	.000194	.000332	.001088	.00101	.001166
4	.000301	.000223	.000379	.001082	.000995	.00117
5	.000323	.000238	.000409	.00104	.000945	.001136
6	.000333	.000242	.000424	.001035	.000934	.001136
7	.000295	.000216	.000374	.001079	.000991	.001167
8	.000284	.00021	.000357	.001085	.001001	.001168
9	.000283	.000211	.000355	.001084	.001001	.001166
10	.000284	.000212	.000356	.001083	.001001	.001166

```
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 coirf, impulse (rspot rfuture) response(rspot rfuture)
```



According to COIRF, 95% lower and upper bound does not cover zero, therefore, all values are significant for impulse response function.

4.

```
. 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
7	.989857	.985466	.994248	.010143	.005752	.014534
8	.989415	.984856	.993973	.010585	.006027	.015144
9	.989372	.9848	.993944	.010628	.006056	.0152
10	.989372	.9848	.993944	.010628	.006056	.0152

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

```
. 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
7	.495767	.479862	.511672	.504233	.488328	.520138
8	.495582	.479675	.511488	.504418	.488512	.520325
9	.495587	.479681	.511493	.504413	.488507	.520319
10	.495587	.479681	.511493	.504413	.488507	.520319

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

From FEVD test, about 99% of impact caused by rspot itself (rspot on rspot), and less than 1% caused by rfuture (rfuture on rspot). And from the impact on rfuture, rfuture caused by rspot about half and rfuture impact on rfuture also about half.