Assignment 15

VARs Models

From the data set `assign_timeseries.dta`:

The following VARs models:

$$Y_t = A_0 + A_1 Y_{t-1} + \in_t \tag{3}$$

where: $Y_t = \begin{pmatrix} rspot_t \\ rfuture_t \end{pmatrix}$, $A_0 = \begin{pmatrix} a_{10} \\ a_{20} \end{pmatrix}$, $A_1 = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}$, $\in_t = \begin{pmatrix} e_{1t} \\ e_{2t} \end{pmatrix}$

1. Estimate VARs models using spot return (rspot) and future return (rfuture) as endogenous variables and determine the most appropriated lags models using SBIC.
2. Perform stability test and Granger exogeneity test.
3. Perform Impulse response function analysis (irf), Orthogonal impulse response function analysis (oirf), Cumulative impulse response function analysis (coirf), make interpretation of the analysis, and determine which variable has more impact (using Cholesky order – rspot rfuture).
4. Perform Forecast error variance decomposition (fevd) and determine variable that has more impact on each endogenous variable.
5. Determine whether changing Cholesky order from – "rspot rfuture" to "rfuture rspot" will change the results of irf, oirf, coirf, and fevd. Why? or why not?

2 Var & lag(3) $= 2 \times 3 + 2 \times 2 \times 2 = 6 + 8$
$= 14$ //

```
      name:  <unnamed>
       log:  C:\Users\Kang\Downloads\15.smcl
  log type:  smcl
 opened on:  12 May 2021, 16:29:23

1 . use "C:\Users\Kang\Downloads\assign_timeseries.dta", clear

2 . tsset t
        time variable:  time, 1 to 795
                delta:  1 unit

3 . g rspot=(spot/l.spot)-1
(1 missing value generated)

4 . g  rfuture=(future/l.future)-1
(1 missing value generated)

5 . varsoc rspot rfuture, maxlag(5)

   Selection-order criteria
   Sample:  7 - 795                        Number of obs      =       789
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	4774.48				1.9e-08	-12.0975	-12.093	-12.0857
1	4837.65	126.33	4	0.000	1.6e-08	-12.2475	-12.2339	-12.212
2	4857.92	40.555	4	0.000	1.6e-08	-12.2888	-12.266	-12.2296
3	4882.17	48.486*	4	0.000	1.5e-08*	-12.3401*	-12.3082*	-12.2572*
4	4884.45	4.5566	4	0.336	1.5e-08	-12.3357	-12.2948	-12.2292
5	4886.05	3.2155	4	0.522	1.5e-08	-12.3297	-12.2796	-12.1994

```
   Endogenous:  rspot rfuture
    Exogenous:  _cons

6 . var rspot rfuture, lag(1/3)

Vector autoregression

Sample:  5 - 795                        Number of obs      =       791
Log likelihood =    4893.31             AIC                =  -12.33707
FPE            =   1.50e-08             HQIC               =  -12.30527
Det(Sigma_ml)  =   1.45e-08             SBIC               =  -12.25435
```

2 Var & lag(3) = 2x3 + 2x2x2 = 6+8 = 14

Equation	Parms	RMSE	R-sq	chi2	P>chi2
rspot	7	.018581	0.0169	13.624	0.0341
rfuture	7	.0217	0.0338	27.62952	0.0001

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
rspot						
rspot						
L1.	.1282088	.1145511	1.12	0.263	-.0963071	.3527248
L2.	.2334538	.118681	1.97	0.049	.0008434	.4660643
L3.	-.1169759	.1100791	-1.06	0.288	-.332727	.0987753
rfuture						
L1.	-.0590319	.0980706	-0.60	0.547	-.2512466	.1331829
L2.	-.1415632	.1041653	-1.36	0.174	-.3457234	.062597
L3.	.1057702	.096238	1.10	0.272	-.0828529	.2943933
_cons	-.000025	.0006579	-0.04	0.970	-.0013144	.0012644

1

rfuture						
rspot						
L1.	.5741704	.1337768	4.29	0.000	.3119727	.8363682
L2.	.5086657	.1385999	3.67	0.000	.237015	.7803165
L3.	.0617779	.1285544	0.48	0.631	-.190184	.3137398
rfuture						
L1.	-.520118	.1145303	-4.54	0.000	-.7445933	-.2956428
L2.	-.4253538	.1216479	-3.50	0.000	-.6637794	-.1869283
L3.	-.0947954	.1123902	-0.84	0.399	-.3150762	.1254854
_cons	.0000732	.0007683	0.10	0.924	-.0014326	.001579

2 Stability

```
7 . varstable, graph
```

Eigenvalue stability condition

Eigenvalue	Modulus
.05126276 + .5960908*i*	.598291
.05126276 - .5960908*i*	.598291
-.5255917	.525592
-.4199276	.419928
.2255423 + .0823411*i*	.240103
.2255423 - .0823411*i*	.240103

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

```
8 . vargranger
```

Granger exogenity test

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
rspot	rfuture	4.8624	3	0.182
rspot	ALL	4.8624	3	0.182
rfuture	rspot	25.19	3	0.000
rfuture	ALL	25.19	3	0.000

> 0.05

It fails to reject H_0, they are not interdependent.

3

```
9 . irf create order1, order(rspot rfuture) step(5) set( rspot rfuture)
(file rspot rfuture.irf created)
(file rspot rfuture.irf now active)
(file rspot rfuture.irf updated)

10 . 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	.128209	-.096307	.352725	.57417	.311973	.836368
2	.215997	-.004582	.436576	.283643	.022104	.545182
3	-.157378	-.363594	.048839	-.140741	-.388189	.106707
4	.044136	-.033389	.12166	-.074446	-.192648	.043755
5	-.002029	-.037484	.033426	.03033	-.017472	.078132

↳ insignificant

↳ insignificant

3

step	(3) irf	(3) Lower	(3) Upper	(4) irf	(4) Lower	(4) Upper
0	0	0	0	1	1	1
1	-.059032	-.251247	.133183	-.520118	-.744593	-.295643
2	-.118428	-.30696	.070103	-.188725	-.412415	.034964
3	.161576	-.013545	.336696	.126573	-.084013	.337158
4	-.035795	-.116425	.044835	.092632	-.027457	.212721
5	.003637	-.027138	.034412	-.029808	-.073835	.014219

↳ insignificant ↳ insignificant

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

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

12 . 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	.018499	.017587	.019411	.020599	.019487	.021711
1	.001156	-.000134	.002445	-.000092	-.001615	.00143
2	.001556	.000268	.002844	.00136	-.000159	.002878
3	.000417	-.000872	.001706	3.7e-06	-.001515	.001522
4	.000079	-.000334	.000492	.000531	.000055	.001007
5	.000037	-.000242	.000317	-.000053	-.000327	.000222

↳ insignificant ↳ insignificant

step	(3) oirf	(3) Lower	(3) Upper	(4) oirf	(4) Lower	(4) Upper
0	0	0	0	.006512	.006191	.006833
1	-.000384	-.001636	.000867	-.003387	-.004858	-.001916
2	-.000771	-.002	.000457	-.001229	-.002687	.000229
3	.001052	-.000089	.002194	.000824	-.000548	.002196
4	-.000233	-.000758	.000292	.000603	-.000179	.001386
5	.000024	-.000177	.000224	-.000194	-.000481	.000093

↳ insignificant ↳ insignificant

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

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

3

```
14 . 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	.018499	.017587	.019411	.020599	.019487	.021711
1	.019655	.018043	.021266	.020507	.018681	.022332
2	.021211	.01906	.023362	.021866	.019517	.024215
3	.021628	.019017	.024239	.02187	.019072	.024668
4	.021707	.018875	.024539	.022401	.019447	.025355
5	.021744	.018756	.024733	.022348	.019246	.025449

↳ significant ↳ significant

step	(3) coirf	(3) Lower	(3) Upper	(4) coirf	(4) Lower	(4) Upper
0	0	0	0	.006512	.006191	.006833
1	-.000384	-.001636	.000867	.003125	.001655	.004595
2	-.001156	-.002924	.000612	.001896	-.000065	.003858
3	-.000103	-.002162	.001955	.00272	.000502	.004939
4	-.000337	-.001961	.001288	.003324	.001697	.004951
5	-.000313	-.00196	.001334	.003129	.001427	.004832

↳ insignificant ↳ significant

```
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
```

4

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

16 . 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	.99957	.99677	1.00237	.00043	-.00237	.00323
3	.997858	.991698	1.00402	.002142	-.004018	.008302
4	.994684	.985216	1.00415	.005316	-.004153	.014784
5	.994529	.984823	1.00424	.005471	-.004235	.015177

↳ significant ↳ insignificant

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

4

```
17 . 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	.909133	.897058	.921209	.090867	.078791	.102942
2	.887324	.863844	.910804	.112676	.089196	.136156
3	.884973	.861047	.908899	.115027	.091101	.138953
4	.883726	.859086	.908366	.116274	.091634	.140914
5	.883128	.858185	.908071	.116872	.091929	.141815

significant

significant

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

5

rsport has more impact than rfuture response to rfuture

```
18 . irf create order1, order(rfuture rspot ) step(5) set( rfuture rspot)
(file rfuture rspot.irf created)
(file rfuture rspot.irf now active)
(file rfuture rspot.irf updated)

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

Results from order1

step	(1) irf	(1) Lower	(1) Upper	(2) irf	(2) Lower	(2) Upper
0	1	1	1	0	0	0
1	-.520118	-.744593	-.295643	-.059032	-.251247	.133183
2	-.188725	-.412415	.034964	-.118428	-.30696	.070103
3	.126573	-.084013	.337158	.161576	-.013545	.336696
4	.092632	-.027457	.212721	-.035795	-.116425	.044835
5	-.029808	-.073835	.014219	.003637	-.027138	.034412

insignificant

insignificant

step	(3) irf	(3) Lower	(3) Upper	(4) irf	(4) Lower	(4) Upper
0	0	0	0	1	1	1
1	.57417	.311973	.836368	.128209	-.096307	.352725
2	.283643	.022104	.545182	.215997	-.004582	.436576
3	-.140741	-.388189	.106707	-.157378	-.363594	.048839
4	-.074446	-.192648	.043755	.044136	-.033389	.12166
5	.03033	-.017472	.078132	-.002029	-.037484	.033426

insignificant

insignificant

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

5

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

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

Results from order1

step	(1) oirf	(1) Lower	(1) Upper	(2) oirf	(2) Lower	(2) Upper
0	.021604	.020539	.022668	.017638	.016686	.018591
1	-.001109	-.00263	.000412	.000986	-.000304	.002276
2	.000926	-.000592	.002444	.001251	-.000035	.002538
3	.000252	-.001259	.001763	.000715	-.000566	.001995
4	.000688	.000053	.001323	5.2e-06	-.000504	.000515
5	-.000109	-.000403	.000185	.000043	-.000238	.000324

↳ insignificant ↳ insignificant

step	(3) oirf	(3) Lower	(3) Upper	(4) oirf	(4) Lower	(4) Upper
0	0	0	0	.005576	.005302	.005851
1	.003202	.001731	.004672	.000715	-.000538	.001967
2	.001582	.000121	.003042	.001204	-.000027	.002436
3	-.000785	-.002165	.000596	-.000878	-.002028	.000273
4	-.000415	-.001075	.000244	.000246	-.000186	.000679
5	.000169	-.000098	.000436	-.000011	-.000209	.000186

↳ insignificant ↳ insignificant

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

22 . irf graph oirf,impulse( rfuture rspot) response( rfuture rspot)

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

Results from order1

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	.021604	.020539	.022668	.017638	.016686	.018591
1	.020495	.01867	.02232	.018625	.016984	.020266
2	.021421	.019067	.023774	.019876	.017699	.022052
3	.021673	.018892	.024453	.020591	.017978	.023203
4	.022361	.019535	.025186	.020596	.017861	.023331
5	.022252	.019288	.025215	.020639	.017765	.023513

↳ significant ↳ significant

step	(3) coirf	(3) Lower	(3) Upper	(4) coirf	(4) Lower	(4) Upper
0	0	0	0	.005576	.005302	.005851
1	.003202	.001731	.004672	.006291	.005001	.007581
2	.004783	.002803	.006764	.007496	.005684	.009307
3	.003999	.001749	.006248	.006618	.00451	.008726
4	.003584	.00174	.005427	.006864	.005018	.00871
5	.003753	.001814	.005691	.006853	.004952	.008754

95% lower and upper bounds reported ↳ significant ↳ significant

(1) irfname = order1, impulse = rfuture, and response = rfuture
(2) irfname = order1, impulse = rfuture, and response = rspot
(3) irfname = order1, impulse = rspot, and response = rfuture
(4) irfname = order1, impulse = rspot, and response = rspot

5

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

25 . irf table fevd,impulse( rfuture rspot) 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	1	1	1	0	0	0
2	.978563	.95918	.997946	.021437	.002054	.04082
3	.973517	.952896	.994138	.026483	.005862	.047104
4	.972277	.95079	.993765	.027723	.006235	.04921
5	.971958	.950314	.993602	.028042	.006398	.049686

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

significant

significant

```
26 . irf table fevd,impulse( rfuture rspot) 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	.909133	.897058	.921209	.090867	.078791	.102942
2	.908039	.894928	.921149	.091961	.078851	.105072
3	.904654	.889058	.92025	.095346	.07975	.110942
4	.902792	.886072	.919512	.097208	.080488	.113928
5	.902635	.885887	.919383	.097365	.080617	.114113

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

significant

significant

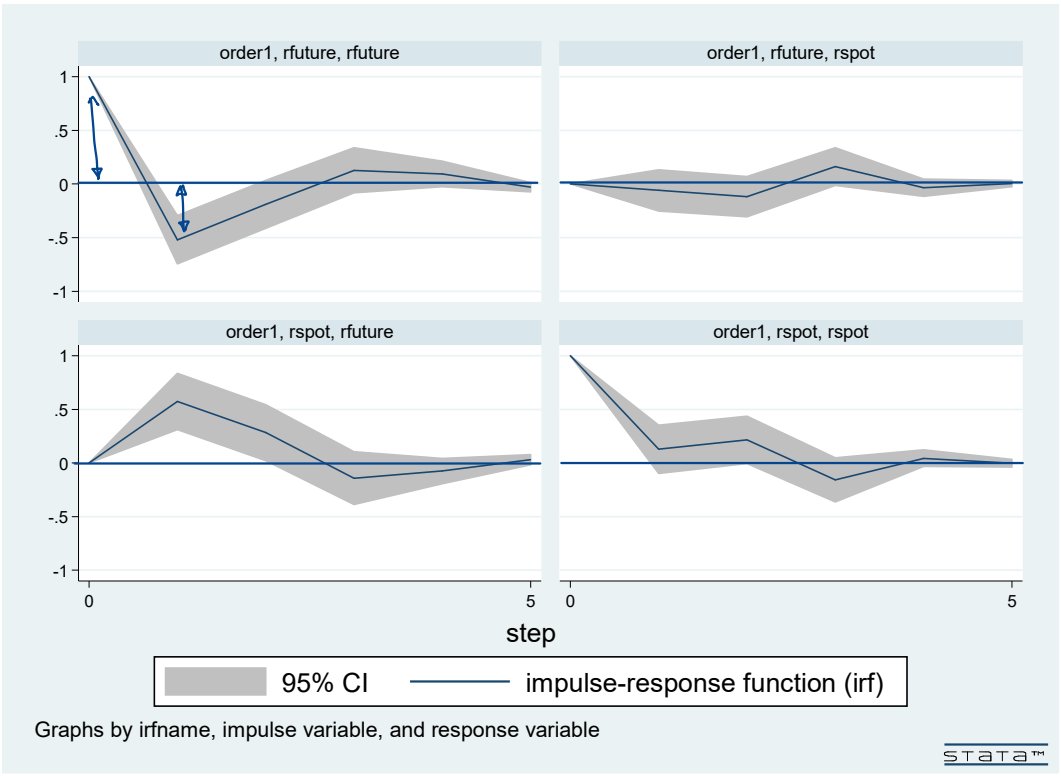
rfuture has more impact than rfuture response to each endogenous variable (rfuture & rspot) by 90%

```
27 . log close
      name:  <unnamed>
       log:  C:\Users\Kang\Downloads\15.smcl
  log type:  smcl
 closed on:  12 May 2021, 16:40:52
```

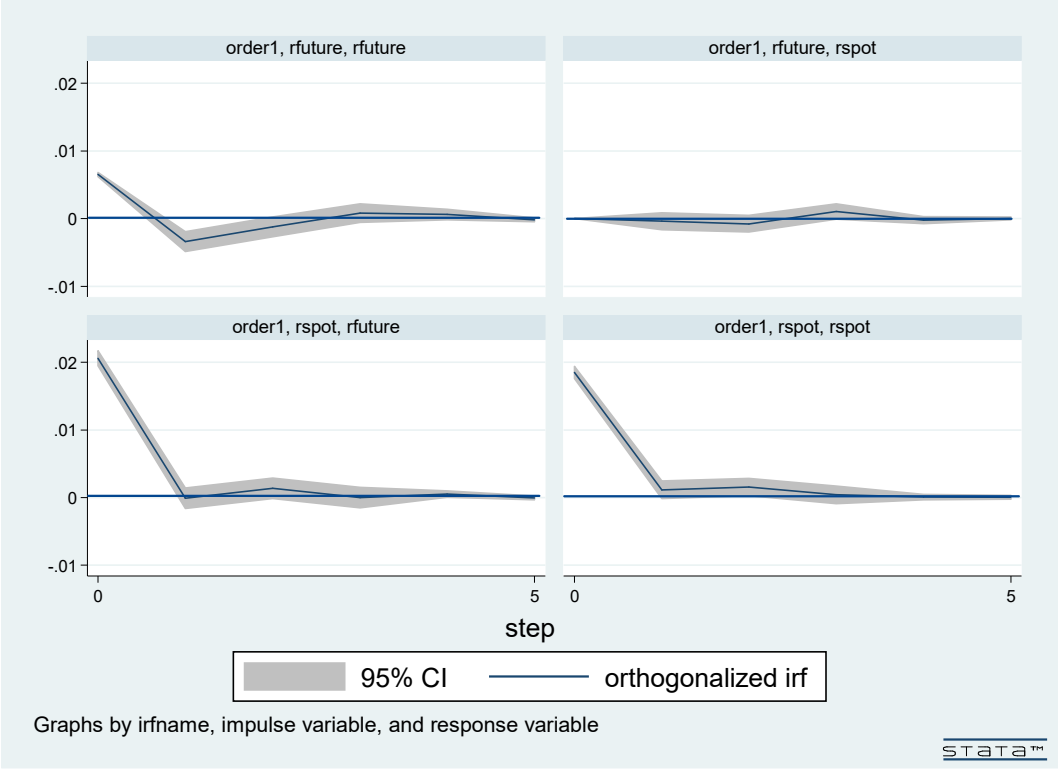
It charges as

(2)

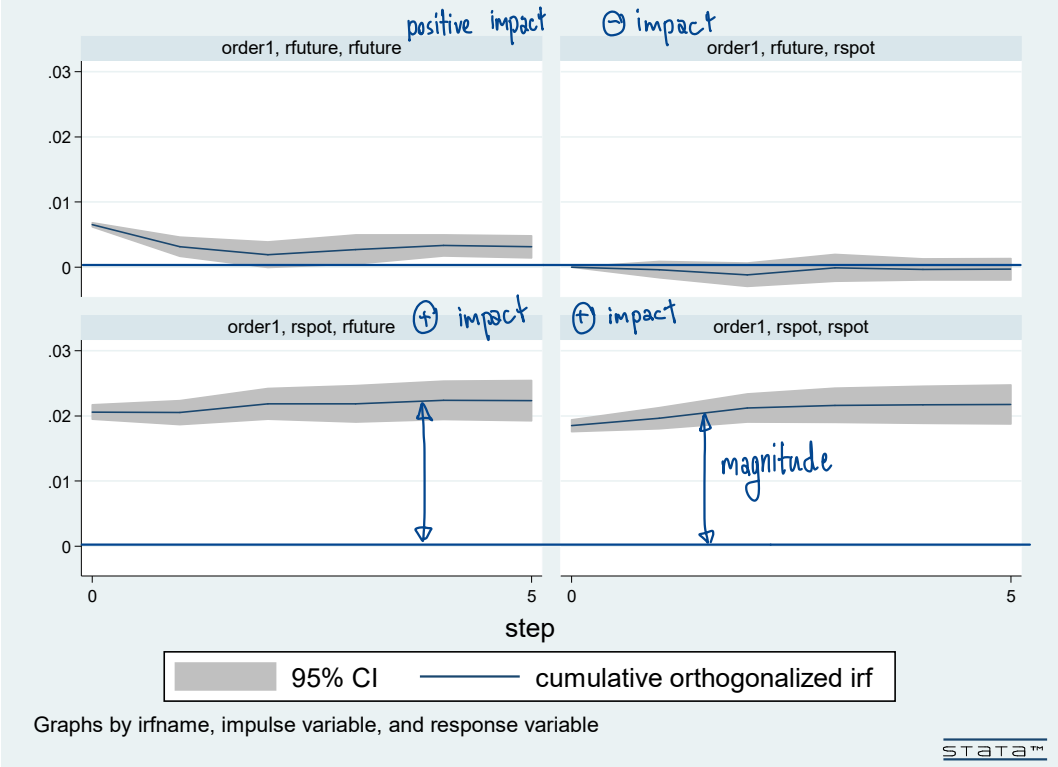
```
11 . irf graph irf,impulse( rspot rfuture) response( rspot rfuture)
```



13 . irf graph oirf,impulse(rspot rfuture) response(rspot rfuture)

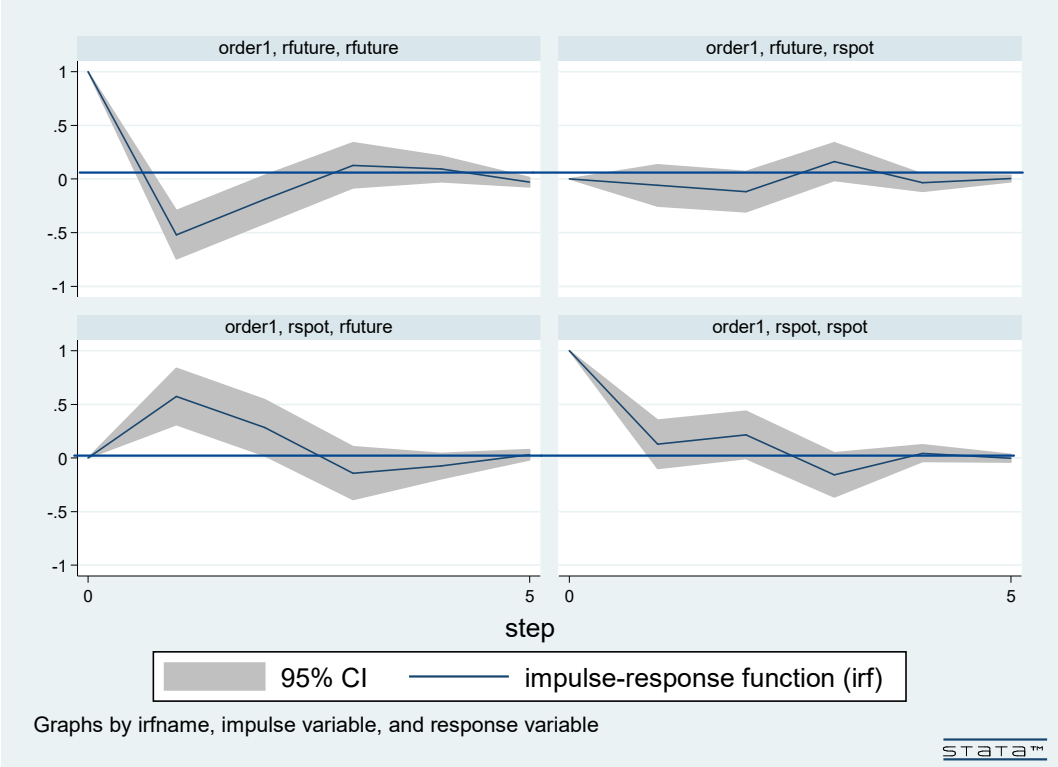


```
15 . irf graph coirf,impulse( rspot rfuture) response( rspot rfuture)
```

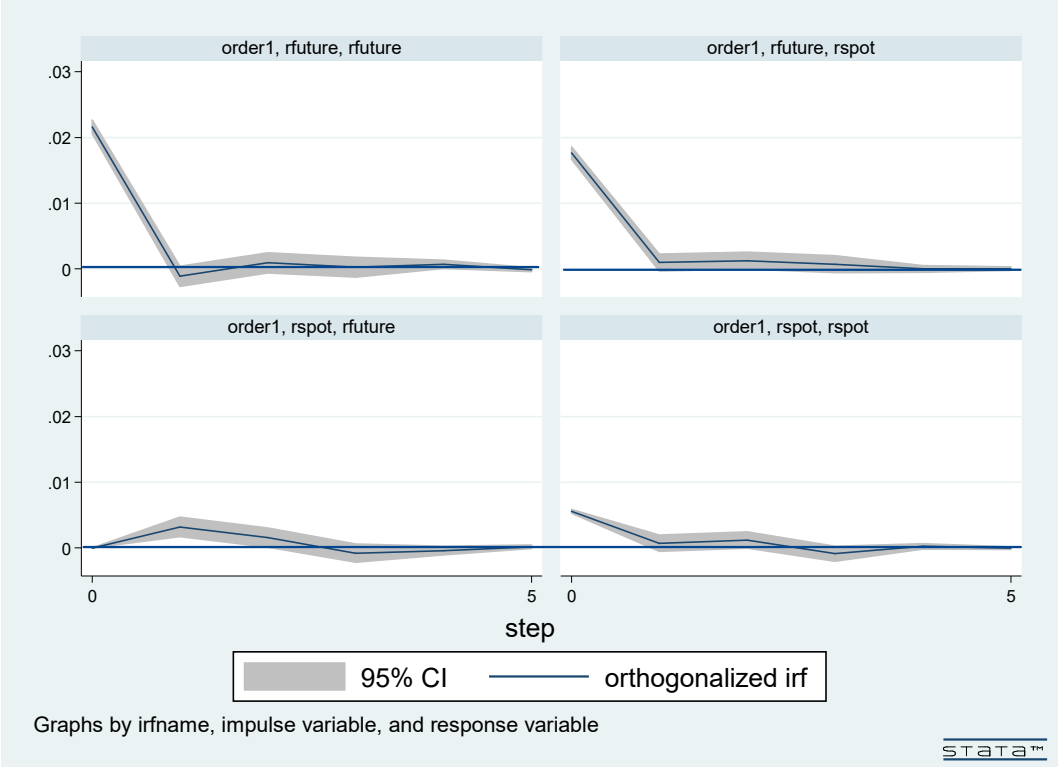


5

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



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



5

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