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Assignment 15

VARs Models

From the data set `assign_timeseries.dta`:

The following VARs models:

$$Y_t = A_0 + A_1 Y_{t-1} + \epsilon_t \qquad (3)$$

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

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

```
. tsset time

        time variable:  time, 1 to 795

                delta:  1 unit

. gen rspot = (spot-l.spot)/l.spot

(1 missing value generated)

. gen rfuture = (future-l.future)/l.future

(1 missing value generated)

. 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
```

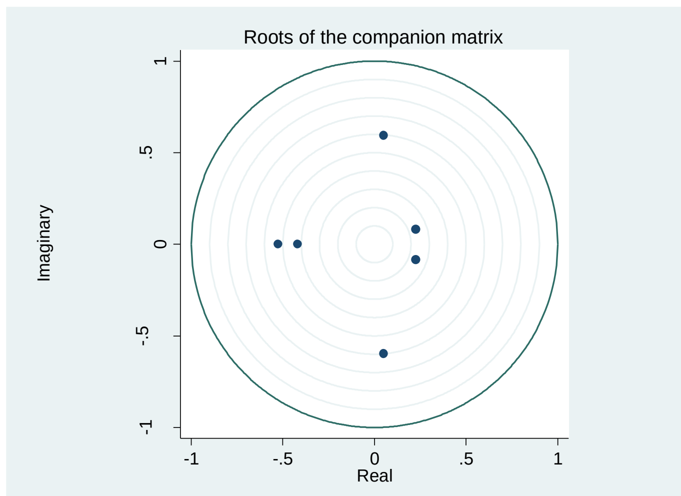
From SBIC, 3 lags models are the most appropriated lags model since it gives the lowest value of SBIC.

2. Perform stability test and Granger exogeneity test.

```
. 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

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
-------------+----------------------------------------------------------------
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
------------------------------------------------------------------------------
```

```
. varstable, graph

   Eigenvalue stability condition
  +----------------------------------------+
  |        Eigenvalue        |    Modulus   |
  |--------------------------+-------------|
  |  .05126276 +  .5960908i  |   .598291   |
  |  .05126276 -  .5960908i  |   .598291   |
  |  -.5255917               |   .525592   |
  |  -.4199276               |   .419928   |
  |   .2255423 +  .0823411i  |   .240103   |
  |   .2255423 -  .0823411i  |   .240103   |
  +----------------------------------------+
   All the eigenvalues lie inside the unit circle.
   VAR satisfies stability condition.
```



VAR satisfies the stability condition since all Eigenvalue lie in a unit circle.

. vargranger

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**

From the exogeneity test, it shows that rfuture does not cause rspot since the null hypothesis cannot be rejected. While, rspot causes rfuture because the null hypothesis is rejected.

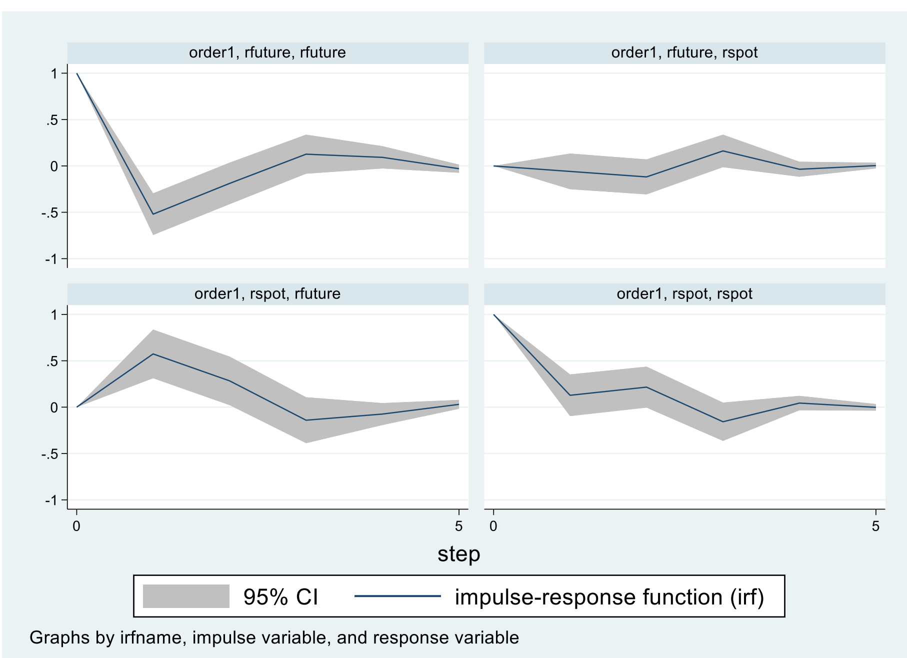
3. Perform Impulse response function analysis (irf), Orthogonal impulse response function analysis (oirf), Cumulative impulse response function analysis (coirf), make interpretation of the analysis, and determine which variable has more impact (using Cholesky order – rspot rfuture).

```
. irf create order1, order(rspot rfuture) step(5) 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

	(1)	(1)	(1)	(2)	(2)	(2)	(3)	(3)	(3)	(4)	(4)	(4)
step	irf	Lower	Upper	irf	Lower	Upper	irf	Lower	Upper	irf	Lower	Upper
0	1	1	1	0	0	0	0	0	0	1	1	1
1	.128209	-.096307	.352725	.57417	.311973	.836368	-.059032	-.251247	.133183	-.520118	-.744593	-.295643
2	.215997	-.004582	.436576	.283643	.022104	.545182	-.118428	-.30696	.070103	-.188725	-.412415	.034964
3	-.157378	-.363594	.048839	-.140741	-.388189	.106707	.161576	-.013545	.336696	.126573	-.084013	.337158
4	.044136	-.033389	.12166	-.074446	-.192648	.043755	-.035795	-.116425	.044835	.092632	-.027457	.212721
5	-.002029	-.037484	.033426	.03033	-.017472	.078132	.003637	-.027138	.034412	-.029808	-.073835	.014219

```
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)
```



```
. 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	.018499	.017587	.019411	.020599	.019487	.021711	0	0	0	.006512	.006191	.006833
1	.001156	-.000134	.002445	-.000092	-.001615	.00143	-.000384	-.001636	.000867	-.003387	-.004858	-.001916
2	.001556	.000268	.002844	.00136	-.000159	.002878	-.000771	-.002	.000457	-.001229	-.002687	.000229
3	.000417	-.000872	.001706	3.7e-06	-.001515	.001522	.001052	-.000089	.002194	.000824	-.000548	.002196
4	.000079	-.000334	.000492	.000531	.000055	.001007	-.000233	-.000758	.000292	.000603	-.000179	.001386
5	.000037	-.000242	.000317	-.000053	-.000327	.000222	.000024	-.000177	.000224	-.000194	-.000481	.000093

95% lower and upper bounds reported

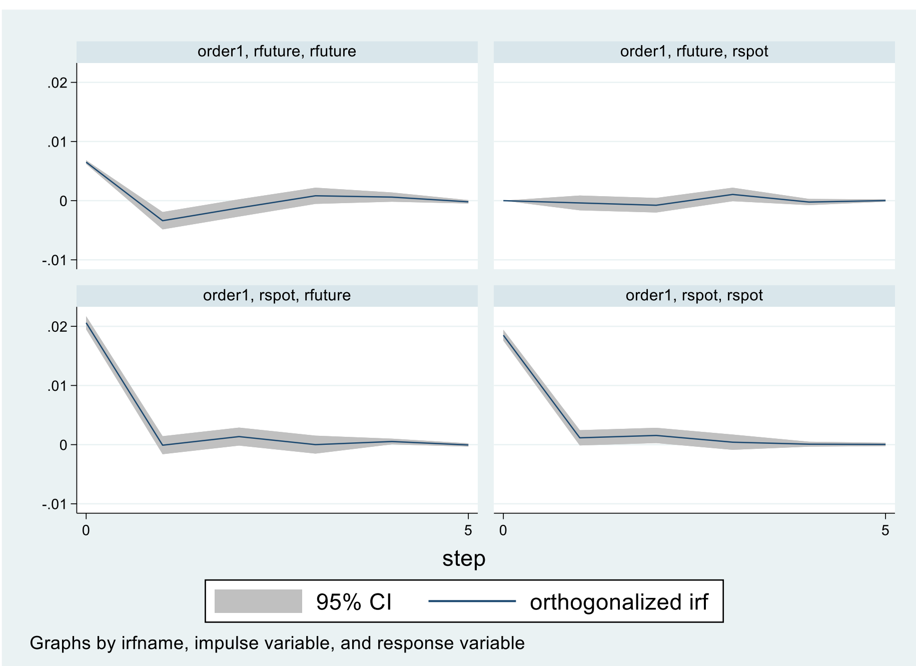
(1) irfname = order1, impulse = rspot, and response = rspot

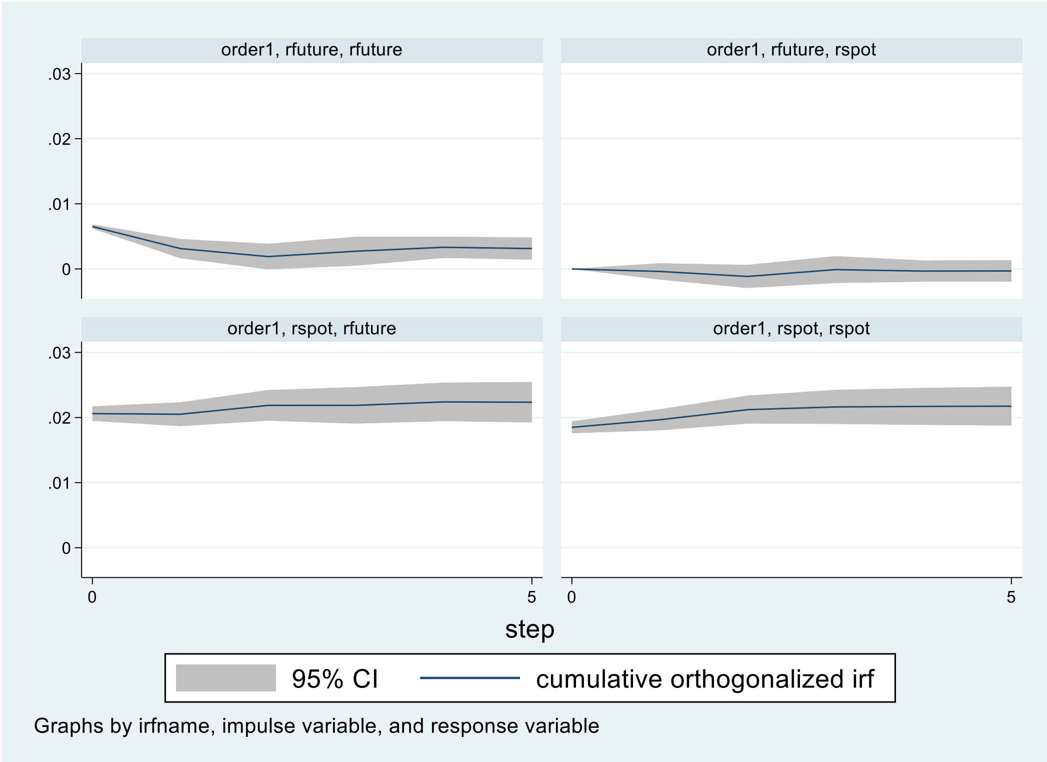
(2) irfname = order1, impulse = rspot, and response = rfuture

(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)
```





From the result, rspot has more impact than rfuture

4. Perform Forecast error variance decomposition (fevd) 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	.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

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	.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

95% lower and upper bounds reported

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

(2) irfname = order1, impulse = rfuture, and response = rfuture

From the result, rspot has more impact on the endogenous variables.

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?

```
. irf create order1, order(rfuture rspot) step(5) set(irf02)
(file irf02.irf created)
(file irf02.irf now active)
(file irf02.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	.128209	-.096307	.352725	.57417	.311973	.836368	-.059032	-.251247	.133183	-.520118	-.744593	-.295643
2	.215997	-.004582	.436576	.283643	.022104	.545182	-.118428	-.30696	.070103	-.188725	-.412415	.034964
3	-.157378	-.363594	.048839	-.140741	-.388189	.106707	.161576	-.013545	.336696	.126573	-.084013	.337158
4	.044136	-.033389	.12166	-.074446	-.192648	.043755	-.035795	-.116425	.044835	.092632	-.027457	.212721
5	-.002029	-.037484	.033426	.03033	-.017472	.078132	.003637	-.027138	.034412	-.029808	-.073835	.014219

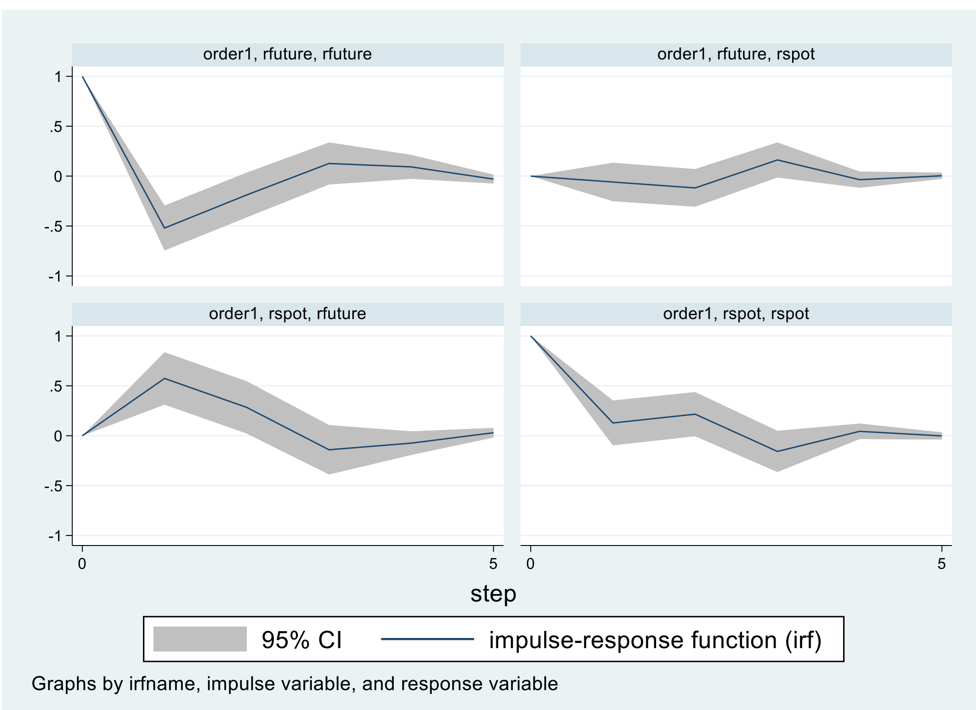
95% lower and upper bounds reported

(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 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	.005576	.005302	.005851	0	0	0	.017638	.016686	.018591	.021604	.020539	.022668
1	.000715	-.000538	.001967	.003202	.001731	.004672	.000986	-.000304	.002276	-.001109	-.00263	.000412
2	.001204	-.000027	.002436	.001582	.000121	.003042	.001251	-.000035	.002538	.000926	-.000592	.002444
3	-.000878	-.002028	.000273	-.000785	-.002165	.000596	.000715	-.000566	.001995	.000252	-.001259	.001763
4	.000246	-.000186	.000679	-.000415	-.001075	.000244	5.2e-06	-.000504	.000515	.000688	.000053	.001323
5	-.000011	-.000209	.000186	.000169	-.000098	.000436	.000043	-.000238	.000324	-.000109	-.000403	.000185

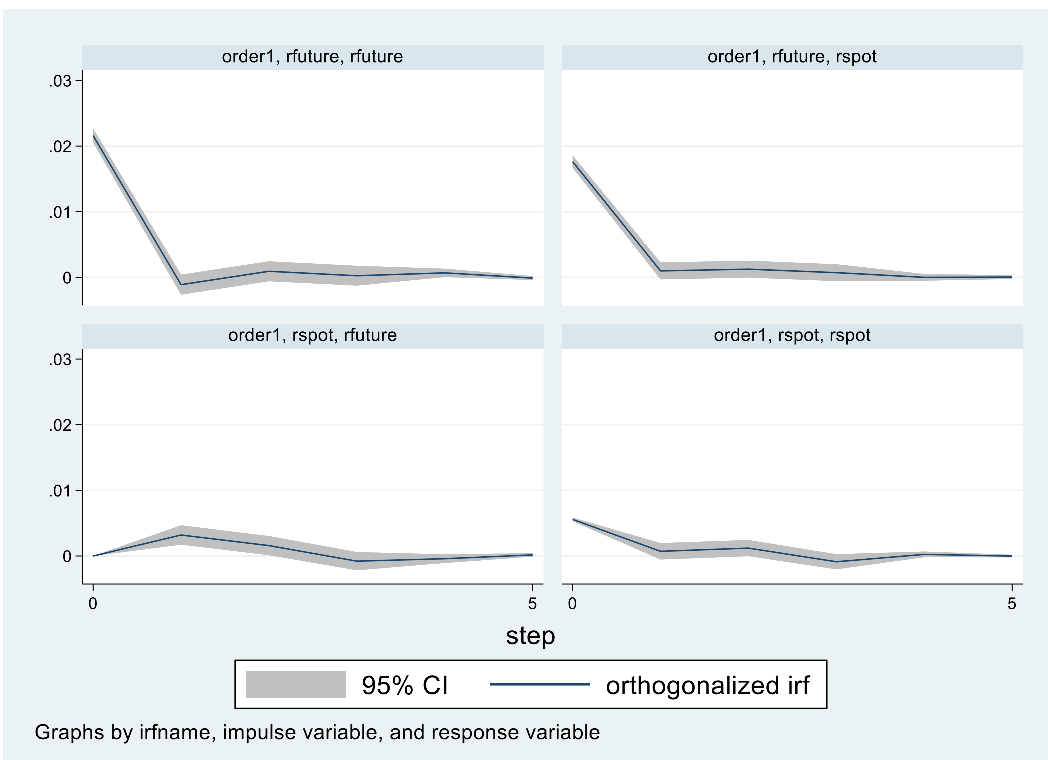
95% lower and upper bounds reported

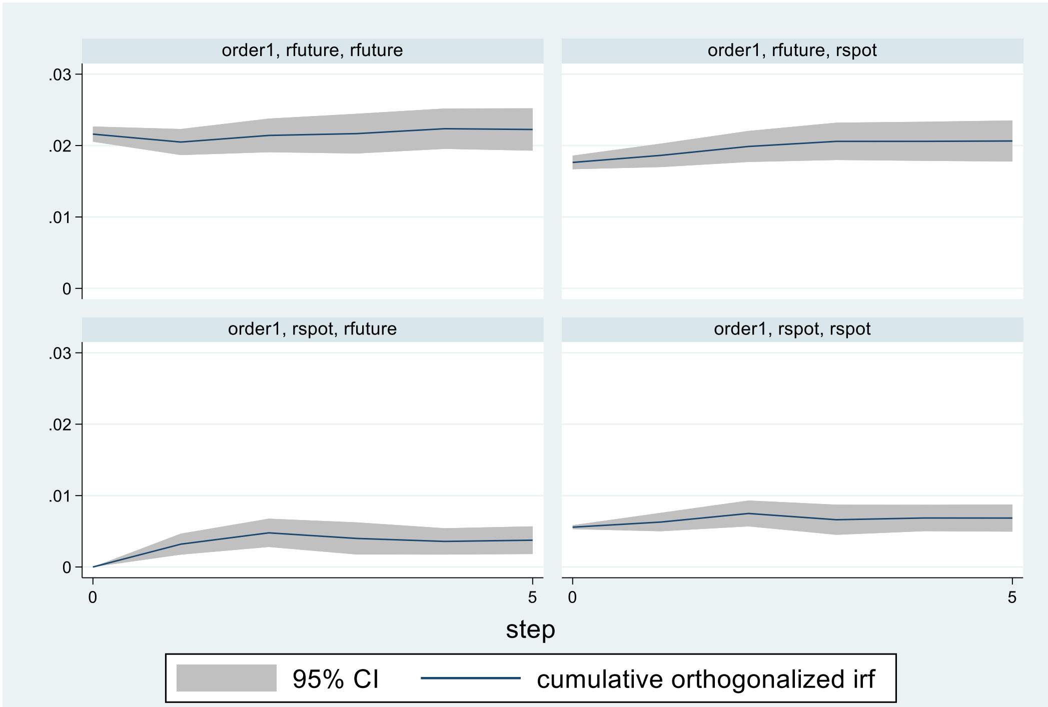
(1) irfname = order1, impulse = rspot, and response = rspot

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

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

(4) irfname = order1, impulse = rfuture, and response = rfuture





Graphs by irfname, impulse variable, and response 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	.090867	.078791	.102942	.909133	.897058	.921209
2	.091961	.078851	.105072	.908039	.894928	.921149
3	.095346	.07975	.110942	.904654	.889058	.92025
4	.097208	.080488	.113928	.902792	.886072	.919512
5	.097365	.080617	.114113	.902635	.885887	.919383

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	0	0	0	1	1	1
2	.021437	.002054	.04082	.978563	.95918	.997946
3	.026483	.005862	.047104	.973517	.952896	.994138
4	.027723	.006235	.04921	.972277	.95079	.993765
5	.028042	.006398	.049686	.971958	.950314	.993602

95% lower and upper bounds reported

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

(2) irfname = order1, impulse = rfuture, and response = rfuture

The result are different since we use different order at the first place. Order matters.