Assignment 5 -- Solution

From the data set Assign_TimeSeries:

1. Estimate Autoregressive Integrated Moving Average (ARIMA(p,d,q))model for spot return (spot) and future return (future) – determine the most appropriated order for p, d, and q using BIC given the maximum lag equals 3.

```
. do "J:\TU\ECON\EE435\Assignments\Assign05.do"

. *Define Variable y
.         g y = spot
(4 missing values generated)

. *Specify order p d q
. forvalue d = 0(1)0 {
  2.  forvalue p = 1(1)3 {
  3.  forvalue q = 1(1)3 {
  4.          display "estimate arima`p'`d'`q'"
  5.          capture: quietly arch y, arima(`p',`d',`q') nolog
  6.          if _rc~=0 {
  7.          display "flatlog when pdq =" `p'`d'`q'
  8.          continue
  9.          }
 10.          estimates store arima`p'`d'`q'
 11.          display "arima`p'`d'`q' already estimated"
 12.  }
 13.  }
 14.  estimates table arima1`d'1 arima1`d'2 arima1`d'3, star(0.1 0.05 0.01) stat(aic bic ll)
 15.  estimates table arima2`d'1 arima2`d'2 arima2`d'3, star(0.1 0.05 0.01) stat(aic bic ll)
 16.  estimates table arima3`d'1 arima3`d'2 arima3`d'3, star(0.1 0.05 0.01) stat(aic bic ll)
 17.  }
estimate arima101
arima101 already estimated
estimate arima102
arima102 already estimated
estimate arima103
arima103 already estimated
estimate arima201
arima201 already estimated
estimate arima202
arima202 already estimated
estimate arima203
arima203 already estimated
estimate arima301
arima301 already estimated
estimate arima302
arima302 already estimated
estimate arima303
arima303 already estimated

-------------------------------------------------------------
    Variable |   arima101        arima102        arima103
-------------+-----------------------------------------------
y            |
       _cons |  .00235741       .00235788       .00235884
-------------+-----------------------------------------------
ARMA         |
          ar |
         L1. | -.39230156***    .42864188***    .65151421**
             |
          ma |
         L1. |  .44524247***   -.38281716***   -.60599959**
         L2. |                 -.06805846***   -.07856536***
         L3. |                                  .01544447
-------------+-----------------------------------------------
SIGMA2       |
       _cons |  .03191009***     .0318591***     .0318577***
-------------+-----------------------------------------------
Statistics   |
         aic | -4655.2422      -4665.5424      -4663.9162
         bic | -4627.4551      -4630.8085      -4622.2356
          ll |  2331.6211       2337.7712       2337.9581
-------------------------------------------------------------
                          legend: * p<.1; ** p<.05; *** p<.01

-------------------------------------------------------------
    Variable |   arima201        arima202        arima203
-------------+-----------------------------------------------
y            |
       _cons |  .00235716       .00235872       .00235613
-------------+-----------------------------------------------
```


By Tatre Jantarakolica

```
ARMA            |
         ar     |
         L1.    |  .38030326***    .44305108***   -.29690212
         L2.    | -.06527105***    .06478823       .18533487
                |
         ma     |
         L1.    | -.33479683**    -.39733898***    .34286602
         L2.    |                 -.13333505      -.22071408
         L3.    |                                 -.04555167
-------------+----------------------------------------------
SIGMA2          |
       _cons    |   .0318617***    .03185804***    .03185812***
-------------+----------------------------------------------
Statistics      |
         aic    | -4664.9752      -4663.7362      -4661.7463
         bic    | -4630.2413      -4622.0556      -4613.1189
          ll    |  2337.4876       2337.8681       2337.8731
------------------------------------------------------------
                           legend: * p<.1; ** p<.05; *** p<.01

------------------------------------------------------------
    Variable    |   arima301        arima302        arima303
-------------+----------------------------------------------
y               |
       _cons    |  .00235766       .00235746       .00235826
-------------+----------------------------------------------
ARMA            |
         ar     |
         L1.    |  .77459277***    .75374093      -.00990197
         L2.    | -.08502045***   -.07129309       .14114161
         L3.    |  .02488932       .02349443       .27351658*
                |
         ma     |
         L1.    | -.72897906***   -.70811284       .05503806
         L2.    |                 -.01280924      -.19123469
         L3.    |                                 -.29976449**
-------------+----------------------------------------------
SIGMA2          |
       _cons    |  .03185649***     .0318562***    .03184624***
-------------+----------------------------------------------
Statistics      |
         aic    | -4664.1345       -4662.137      -4662.6339
         bic    | -4622.4539      -4613.5097      -4607.0598
          ll    |  2338.0672       2338.0685        2339.317
------------------------------------------------------------
                           legend: * p<.1; ** p<.05; *** p<.01

. drop y

. *Define Variable y
.    g y = future
(4 missing values generated)

. *Specify order p d q
. forvalue d = 0(1)0 {
  2.  forvalue p = 1(1)3 {
  3.  forvalue q = 1(1)3 {
  4.          display "estimate arima`p'`d'`q'"
  5.          capture: quietly arima y, arima(`p',`d',`q') nolog
  6.          if _rc~=0 {
  7.          display "flatlog when pdq =" `p'`d'`q'
  8.          continue
  9.          }
 10.          estimates store arima`p'`d'`q'
 11.          display "arima`p'`d'`q' already estimated"
 12.  }
 13.  }
 14.  estimates table arima1`d'1 arima1`d'2 arima1`d'3, star(0.1 0.05 0.01) stat(aic bic ll)
 15.  estimates table arima2`d'1 arima2`d'2 arima2`d'3, star(0.1 0.05 0.01) stat(aic bic ll)
 16.  estimates table arima3`d'1 arima3`d'2 arima3`d'3, star(0.1 0.05 0.01) stat(aic bic ll)
 17.  }
estimate arima101
arima101 already estimated
estimate arima102
arima102 already estimated
estimate arima103
arima103 already estimated
estimate arima201
arima201 already estimated
estimate arima202
arima202 already estimated
estimate arima203
arima203 already estimated
estimate arima301
arima301 already estimated
estimate arima302
arima302 already estimated
```

```
estimate arima303
arima303 already estimated

------------------------------------------------------------
    Variable |   arima101        arima102        arima103
-------------+----------------------------------------------
y            |
       _cons |  .00261517       .00261579       .00261577
-------------+----------------------------------------------
ARMA         |
          ar |
         L1. |  .57881552***    .16418729      -.99197565***
             |
          ma |
         L1. | -.61268782***    -.1922571       .96411185***
         L2. |                 -.03062454**    -.06339421***
         L3. |                                 -.03780679***
-------------+----------------------------------------------
sigma        |
       _cons |  .20593659***    .20590197***    .20586946***
-------------+----------------------------------------------
Statistics   |
         aic | -2469.7286      -2470.3208      -2470.7314
         bic | -2441.9415       -2435.587      -2429.0509
          ll |  1238.8643       1240.1604       1241.3657
------------------------------------------------------------
                           legend: * p<.1; ** p<.05; *** p<.01

------------------------------------------------------------
    Variable |   arima201        arima202        arima203
-------------+----------------------------------------------
y            |
       _cons |  .00261336       .00261592       .00261574
-------------+----------------------------------------------
ARMA         |
          ar |
         L1. |  .19702513       .15238162      -.89451145***
         L2. | -.02960415**     .01290458       .09684725
             |
          ma |
         L1. | -.22511772      -.18046541        .8667681***
         L2. |                  -.0438418      -.15730465
         L3. |                                 -.03516023***
-------------+----------------------------------------------
sigma        |
       _cons |   .2059025***    .20590188***    .20586829***
-------------+----------------------------------------------
Statistics   |
         aic | -2470.3006      -2468.3228       -2468.821
         bic | -2435.5668      -2426.6422      -2420.1936
          ll |  1240.1503       1240.1614       1241.4105
------------------------------------------------------------
                           legend: * p<.1; ** p<.05; *** p<.01

------------------------------------------------------------
    Variable |   arima301        arima302        arima303
-------------+----------------------------------------------
y            |
       _cons |   .0026159        .0026158       .00261599
-------------+----------------------------------------------
ARMA         |
          ar |
         L1. |  .43865033      -.86030504***   -.52633415***
         L2. |  -.0229658       .09653429      -.40298947**
         L3. |  .00955072      -.03405749***    .51822432***
             |
          ma |
         L1. | -.46673101       .83253098***      .495946***
         L2. |                 -.15579179       .35985892**
         L3. |                                 -.55439735***
-------------+----------------------------------------------
sigma        |
       _cons |  .20590156***    .20586899***    .20582887***
-------------+----------------------------------------------
Statistics   |
         aic | -2468.3416      -2468.7519      -2469.7457
         bic |  -2426.661      -2420.1245      -2414.1716
          ll |  1240.1708       1241.3759       1242.8729
------------------------------------------------------------
                           legend: * p<.1; ** p<.05; *** p<.01

.
end of do-file

.
```

According to BIC, the optimal lag for spot is ARIMA(1,0,2) or ARMA(1,2) and for future is ARIMA(1,0,1) or ARMA(1,1).

2. Estimate GARCH(p,q) for spot return (spot) using future return (future) as explanatory variable for mean equation – Test whether there exists significant GARCH effect and determine the most appropriated order p and q for variance equation using SBIC given the maximum lag equals to 2.

```
. reg spot future

      Source |       SS       df       MS              Number of obs =    7683
-------------+------------------------------           F(  1,  7681) = 6787.71
       Model |  115.395382     1  115.395382           Prob > F      =  0.0000
    Residual |  130.581975  7681  .017000648           R-squared     =  0.4691
-------------+------------------------------           Adj R-squared =  0.4691
       Total |  245.977357  7682  .032019963           Root MSE      =  .13039

------------------------------------------------------------------------------
        spot |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      future |    .594594    .007217    82.39   0.000     .5804466    .6087413
       _cons |   .0008007   .0014877     0.54   0.590    -.0021155    .0037169
------------------------------------------------------------------------------

. estat archlm
LM test for autoregressive conditional heteroskedasticity (ARCH)
-----------------------------------------------------------------------------
    lags(p)  |          chi2               df                 Prob > chi2
-------------+---------------------------------------------------------------
       1     |          4.919               1                   0.0266
-----------------------------------------------------------------------------
         H0: no ARCH effects      vs.  H1: ARCH(p) disturbance

. arch spot future, arch(1/1) nolog

ARCH family regression

Sample: 2 - 7684                                  Number of obs   =      7683
Distribution: Gaussian                            Wald chi2(1)    = 199295.46
Log likelihood =  4828.862                        Prob > chi2     =    0.0000

------------------------------------------------------------------------------
             |                 OPG
        spot |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
spot         |
      future |   .6210706   .0013912   446.43   0.000     .6183439    .6237973
       _cons |   .0009981   .0014105     0.71   0.479    -.0017665    .0037626
-------------+----------------------------------------------------------------
ARCH         |
        arch |
         L1. |   .1165968   .0073186    15.93   0.000     .1022526     .130941
             |
       _cons |   .0152236   .0000738   206.28   0.000      .015079    .0153683
------------------------------------------------------------------------------

. estat ic

-----------------------------------------------------------------------------
       Model |    Obs    ll(null)   ll(model)     df          AIC         BIC
-------------+---------------------------------------------------------------
           . |   7683           .    4828.862      4    -9649.723   -9621.936
-----------------------------------------------------------------------------
               Note:  N=Obs used in calculating BIC; see [R] BIC note

. arch spot future, arch(1/2) nolog

ARCH family regression

Sample: 2 - 7684                                  Number of obs   =      7683
Distribution: Gaussian                            Wald chi2(1)    = 129655.42
Log likelihood =  5115.985                        Prob > chi2     =    0.0000

------------------------------------------------------------------------------
             |                 OPG
        spot |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
spot         |
      future |   .6005641   .0016679   360.08   0.000     .5972952    .6038331
       _cons |  -.0000788   .0009416    -0.08   0.933    -.0019243    .0017668
-------------+----------------------------------------------------------------
```

```
ARCH         |
        arch |
         L1. |   .1095337   .0080471    13.61   0.000     .0937617    .1253057
         L2. |   .3383839   .0067081    50.44   0.000     .3252362    .3515316
             |
       _cons |   .0108903   .0001084   100.43   0.000     .0106777    .0111028
------------------------------------------------------------------------------

. estat ic

-----------------------------------------------------------------------------
       Model |    Obs    ll(null)   ll(model)     df          AIC         BIC
-------------+---------------------------------------------------------------
           . |   7683           .    5115.985      5    -10221.97   -10187.24
-----------------------------------------------------------------------------
               Note:  N=Obs used in calculating BIC; see [R] BIC note

. arch spot future, arch(1/1) garch(1/1) nolog

ARCH family regression

Sample: 2 - 7684                                    Number of obs   =      7683
Distribution: Gaussian                              Wald chi2(1)    = 126855.94
Log likelihood =  5137.242                          Prob > chi2     =    0.0000

------------------------------------------------------------------------------
             |                 OPG
        spot |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
spot         |
      future |   .6471733    .001817   356.17   0.000      .643612    .6507347
       _cons |   .0000654    .001113     0.06   0.953     -.002116    .0022468
-------------+----------------------------------------------------------------
ARCH         |
        arch |
         L1. |   .1833993   .0074921    24.48   0.000     .1687151    .1980835
             |
       garch |
         L1. |   .6065925   .0136351    44.49   0.000     .5798682    .6333168
             |
       _cons |   .0038578   .0001449    26.62   0.000     .0035738    .0041418
------------------------------------------------------------------------------

. estat ic

-----------------------------------------------------------------------------
       Model |    Obs    ll(null)   ll(model)     df          AIC         BIC
-------------+---------------------------------------------------------------
           . |   7683           .    5137.242      5    -10264.48   -10229.75
-----------------------------------------------------------------------------
               Note:  N=Obs used in calculating BIC; see [R] BIC note

. arch spot future, arch(1/1) garch(1/2) nolog

ARCH family regression

Sample: 2 - 7684                                    Number of obs   =      7683
Distribution: Gaussian                              Wald chi2(1)    = 131273.02
Log likelihood =  5155.231                          Prob > chi2     =    0.0000

------------------------------------------------------------------------------
             |                 OPG
        spot |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
spot         |
      future |   .6400245   .0017665   362.32   0.000     .6365623    .6434868
       _cons |  -.0002536   .0010592    -0.24   0.811    -.0023297    .0018225
-------------+----------------------------------------------------------------
ARCH         |
        arch |
         L1. |   .1704474   .0078817    21.63   0.000     .1549996    .1858951
             |
       garch |
         L1. |   .8489987   .0319169    26.60   0.000     .7864427    .9115547
         L2. |   -.206975   .0208913    -9.91   0.000    -.2479213   -.1660288
             |
       _cons |   .0035026   .0001258    27.84   0.000      .003256    .0037492
------------------------------------------------------------------------------

. estat ic

-----------------------------------------------------------------------------
       Model |    Obs    ll(null)   ll(model)     df          AIC         BIC
-------------+---------------------------------------------------------------
           . |   7683           .    5155.231      6    -10298.46   -10256.78
-----------------------------------------------------------------------------
               Note:  N=Obs used in calculating BIC; see [R] BIC note
```

```
. arch spot future, arch(1/2) garch(1/1) nolog

ARCH family regression

Sample: 2 - 7684                                    Number of obs   =      7683
Distribution: Gaussian                              Wald chi2(1)    = 127298.70
Log likelihood =  5199.879                          Prob > chi2     =    0.0000

------------------------------------------------------------------------------
             |                 OPG
        spot |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
spot         |
      future |   .6259136   .0017543   356.79   0.000     .6224753     .629352
       _cons |  -.0008745   .0009739    -0.90   0.369    -.0027832    .0010343
-------------+----------------------------------------------------------------
ARCH         |
        arch |
         L1. |    .103905   .0084471    12.30   0.000      .087349    .1204609
         L2. |    .237832    .006037    39.40   0.000     .2259997    .2496642
             |
       garch |
         L1. |   .3403756   .0079198    42.98   0.000     .3248531    .3558981
             |
       _cons |    .006225   .0001099    56.63   0.000     .0060095    .0064404
------------------------------------------------------------------------------

. estat ic

-----------------------------------------------------------------------------
       Model |    Obs    ll(null)   ll(model)     df          AIC         BIC
-------------+---------------------------------------------------------------
           . |   7683           .    5199.879      6    -10387.76   -10346.08
-----------------------------------------------------------------------------
               Note:  N=Obs used in calculating BIC; see [R] BIC note

. arch spot future, arch(1/2) garch(1/2) nolog

ARCH family regression

Sample: 2 - 7684                                    Number of obs   =      7683
Distribution: Gaussian                              Wald chi2(1)    = 120955.67
Log likelihood =  5221.741                          Prob > chi2     =    0.0000

------------------------------------------------------------------------------
             |                 OPG
        spot |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
spot         |
      future |   .6237113   .0017934   347.79   0.000     .6201963    .6272262
       _cons |  -.0010619   .0009468    -1.12   0.262    -.0029175    .0007937
-------------+----------------------------------------------------------------
ARCH         |
        arch |
         L1. |    .101415   .0082531    12.29   0.000     .0852392    .1175908
         L2. |   .2988581   .0063882    46.78   0.000     .2863375    .3113788
             |
       garch |
         L1. |   .0765849   .0154151     4.97   0.000     .0463719    .1067979
         L2. |   .1771549   .0174297    10.16   0.000     .1429932    .2113165
             |
       _cons |    .006862   .0001357    50.58   0.000     .0065961    .0071278
------------------------------------------------------------------------------

. estat ic

-----------------------------------------------------------------------------
       Model |    Obs    ll(null)   ll(model)     df          AIC         BIC
-------------+---------------------------------------------------------------
           . |   7683           .    5221.741      7    -10429.48   -10380.85
-----------------------------------------------------------------------------
               Note:  N=Obs used in calculating BIC; see [R] BIC note
```

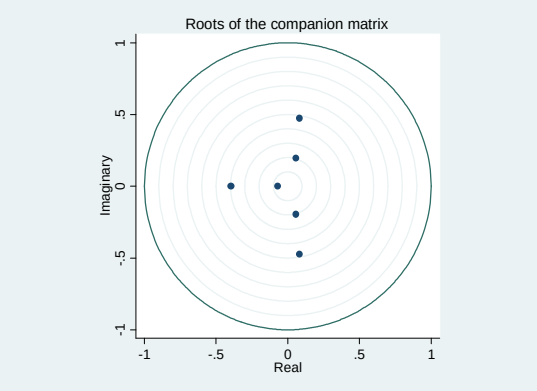
According to ARCH-LM test, there exists significant ARCH effect. The most appropriated order p and q for variance equation using SBIC given the maximum lag equals to 2 is GARCH(2, 2)

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

```
. varsoc spot future

   Selection-order criteria
   Sample:  6 - 7684                         Number of obs      =      7679
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 |  5979.48                      .000723  -1.55684  -1.55622  -1.55503  |
  |  1 |  6150.21  341.45    4  0.000  .000692  -1.60026   -1.5984  -1.59483  |
  |  2 |  6239.97  179.52    4  0.000  .000677   -1.6226   -1.6195  -1.61355  |
  |  3 |     6273   66.06    4  0.000  .000672  -1.63016  -1.62582   -1.6175* |
  |  4 |  6289.45  32.907*   4  0.000  .000669*  -1.6334* -1.62782* -1.61712  |
  +---------------------------------------------------------------------------+
   Endogenous:  spot future
    Exogenous:  _cons

. var spot future, lag(1/3)

Vector autoregression

Sample:  5 - 7684                                 No. of obs      =      7680
Log likelihood =  6274.733                        AIC             = -1.630399
FPE            =  .0006714                        HQIC            = -1.626056
Det(Sigma_ml)  =   .000669                        SBIC            = -1.617737

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
spot                   7      .17791   0.0122   95.07421   0.0000
future                 7     .204367   0.0181   141.3296   0.0000
------------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
spot         |
        spot |
         L1. |  -.0323987   .0159661    -2.03   0.042    -.0636918   -.0011057
         L2. |  -.1099664   .0160841    -6.84   0.000    -.1414905   -.0784422
         L3. |  -.0418984   .0159205    -2.63   0.008    -.0731019   -.0106949
             |
      future |
         L1. |   .0933035   .0138966     6.71   0.000     .0660668    .1205403
         L2. |   .0688434   .0141336     4.87   0.000     .0411421    .0965447
         L3. |   .0317131   .0139194     2.28   0.023     .0044315    .0589946
             |
       _cons |   .0023077   .0020298     1.14   0.256    -.0016705     .006286
-------------+----------------------------------------------------------------
future       |
        spot |
         L1. |   .2004382   .0183405    10.93   0.000     .1644915    .2363849
         L2. |   .0600679    .018476     3.25   0.001     .0238557    .0962801
         L3. |   .0609707    .018288     3.33   0.001     .0251268    .0968146
             |
      future |
         L1. |  -.1528221   .0159632    -9.57   0.000    -.1841093   -.1215349
         L2. |  -.0926647   .0162354    -5.71   0.000    -.1244855   -.0608439
         L3. |  -.0524571   .0159894    -3.28   0.001    -.0837958   -.0211184
             |
       _cons |   .0026168   .0023316     1.12   0.262    -.0019531    .0071866
------------------------------------------------------------------------------
```

4. Perform stability test and Granger exogeneity test.

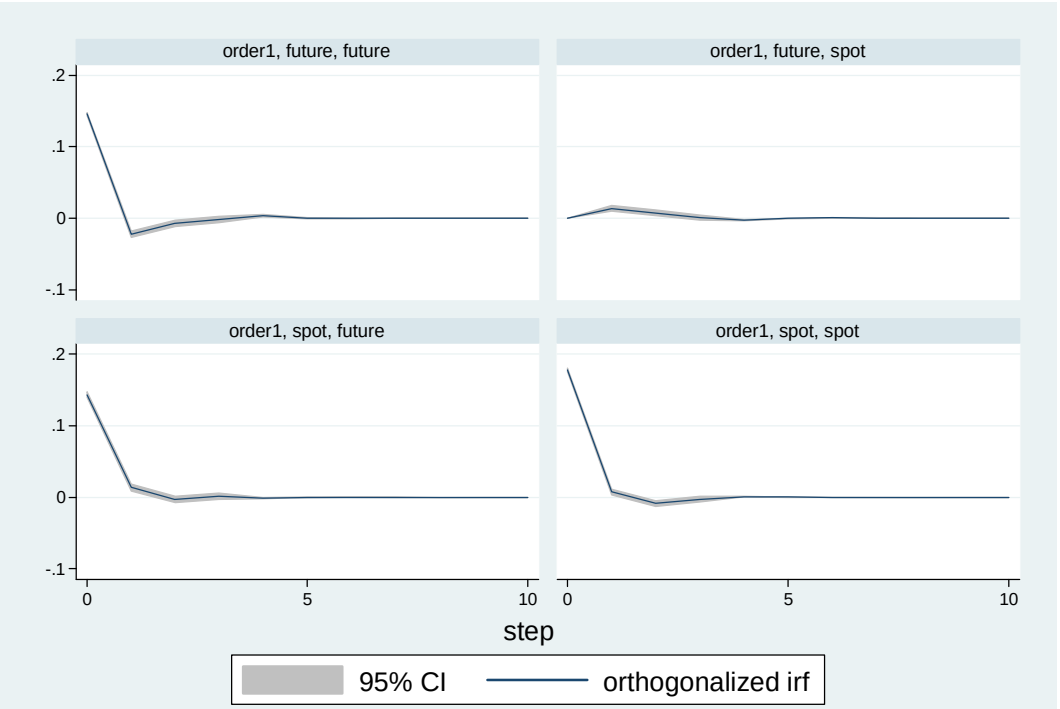
```
. varstable, graph

   Eigenvalue stability condition
  +--------------------------------------+
  |        Eigenvalue        |   Modulus   |
  |--------------------------+-------------|
  |   .0829301 +  .4737693i  |   .480973   |
  |   .0829301 -  .4737693i  |   .480973   |
  |  -.3959128               |   .395913   |
  |  .05719759 +  .1954789i  |   .203675   |
  |  .05719759 -  .1954789i  |   .203675   |
  | -.06956341               |   .069563   |
  +--------------------------------------+
   All the eigenvalues lie inside the unit circle.
   VAR satisfies stability condition.
```




```
. vargranger

   Granger causality Wald tests
  +-------------------------------------------------------------------------+
  |          Equation           Excluded |   chi2     df Prob > chi2 |
  |-------------------------------------+-----------------------------|
  |              spot             future |  58.069     3    0.000     |
  |              spot                ALL |  58.069     3    0.000     |
  |-------------------------------------+-----------------------------|
  |            future               spot |   125.3     3    0.000     |
  |            future                ALL |   125.3     3    0.000     |
  +-------------------------------------------------------------------------+
```

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

```
. irf create order1, o(spot future) step(10) set(irf01)
(file irf01.irf created)
(file irf01.irf now active)
(file irf01.irf updated)

. irf table oirf, impulse(spot future) response(spot future)

                              Results from order1

+-------------------------------------------------------------------------------------+
|        |    (1)         (1)         (1)     |    (2)         (2)         (2)     |
|  step  |   oirf       Lower       Upper     |   oirf       Lower       Upper     |
|--------+-----------------------------------+-----------------------------------|
|0       | .177829     .175017     .180641    | .143437     .139471     .147402    |
|1       | .007622     .003634     .01161     | .013723     .009126     .018321    |
|2       | -.008647    -.012632    -.004662   | -.003179    -.007773    .001415    |
|3       | -.002812    -.006788    .001165    | .001257     -.003325    .005839    |
|4       | .001056     .000349     .001764    | -.001236    -.00202     -.000451   |
|5       | .000508     .000035     .00098     | -.000245    -.000701    .00021     |
|6       | -.000083    -.00028     .000115    | .00008      -.000104    .000264    |
|7       | -.000146    -.000267    -.000025   | .000154     .000013     .000294    |
|8       | 4.6e-06     -.000041    .00005     | -.000021    -.000056    .000013    |
|9       | .000031     6.8e-06     .000054    | -.000028    -.000052    -3.8e-06   |
|10      | 5.4e-06     -1.0e-05    .000021    | -4.3e-06    -.000019    .00001     |
+-------------------------------------------------------------------------------------+

+-------------------------------------------------------------------------------------+
|        |    (3)         (3)         (3)     |    (4)         (4)         (4)     |
|  step  |   oirf       Lower       Upper     |   oirf       Lower       Upper     |
|--------+-----------------------------------+-----------------------------------|
|0       | 0           0           0          | .145444     .143144     .147744    |
|1       | .01357      .009603     .017538    | -.022227    -.026791    -.017663   |
|2       | .007499     .003558     .011441    | -.007361    -.011912    -.00281    |
|3       | .00066      -.003215    .004536    | -.002127    -.006604    .00235     |
|4       | -.002825    -.004018    -.001631   | .003583     .001998     .005169    |
|5       | -.000341    -.001009    .000328    | -.000034    -.00066     .000592    |
|6       | .00047      .000208     .000732    | -.000413    -.000688    -.000138   |
|7       | .000213     -.000033    .00046     | -.00022     -.000492    .000051    |
|8       | -.000094    -.000155    -.000034   | .000124     .000058     .00019     |
|9       | -.000057    -.000109    -4.2e-06   | .000046     -5.3e-06    .000097    |
|10      | 9.1e-06     -.000013    .000031    | -.000011    -.000031    8.6e-06    |
+-------------------------------------------------------------------------------------+
95% lower and upper bounds reported
(1) irfname = order1, impulse = spot, and response = spot
(2) irfname = order1, impulse = spot, and response = future
(3) irfname = order1, impulse = future, and response = spot
(4) irfname = order1, impulse = future, and response = future

. irf graph oirf, impulse(spot future) response(spot future)
```



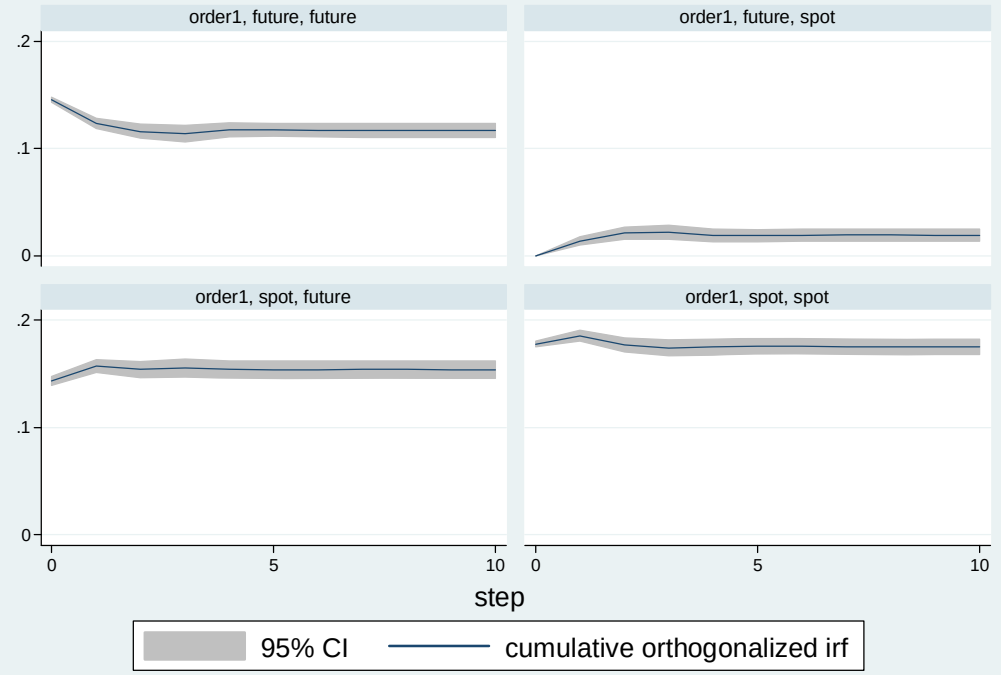
Graphs by irfname, impulse variable, and response variable

```
. irf table coirf, impulse(spot future) response(spot future)

                                Results from order1
```

step	(1) coirf	(1) Lower	(1) Upper	(2) coirf	(2) Lower	(2) Upper
0	.177829	.175017	.180641	.143437	.139471	.147402
1	.185451	.180502	.190399	.15716	.151277	.163044
2	.176804	.170404	.183203	.153981	.146686	.161275
3	.173992	.16649	.181494	.155238	.146795	.16368
4	.175048	.167609	.182487	.154002	.145719	.162285
5	.175556	.168363	.182748	.153757	.145689	.161824
6	.175473	.16832	.182625	.153837	.14578	.161893
7	.175327	.16814	.182513	.15399	.145903	.162078
8	.175331	.168135	.182528	.153969	.145881	.162057
9	.175362	.16817	.182554	.153941	.145858	.162023
10	.175367	.168179	.182556	.153937	.145855	.162018

step	(3) coirf	(3) Lower	(3) Upper	(4) coirf	(4) Lower	(4) Upper
0	0	0	0	.145444	.143144	.147744
1	.01357	.009603	.017538	.123217	.118267	.128167
2	.02107	.015385	.026754	.115856	.109296	.122416
3	.02173	.014984	.028476	.113729	.106101	.121358
4	.018905	.013154	.024656	.117313	.11086	.123766
5	.018564	.013156	.023973	.117279	.111077	.123481
6	.019035	.013538	.024531	.116866	.110547	.123185
7	.019248	.013625	.024871	.116646	.110216	.123075
8	.019154	.013546	.024761	.11677	.110373	.123166
9	.019097	.013518	.024676	.116815	.110443	.123188
10	.019106	.013531	.024681	.116804	.11043	.123178

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

. irf graph coirf, impulse(spot future) response(spot future)
```



Graphs by irfname, impulse variable, and response variable