

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)-1
(1 missing value generated)

. gen rfuture=(future/l.future)-1
(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
```

The most appropriate lag is lag3.

2. Perform stability test and Granger exogeneity test

```
. var rspot rfuture, lag(3/3)

Vector autoregression

Sample: 5 - 795                Number of obs   =       791
Log likelihood = 4792.689      AIC             = -12.10288
FPE            = 1.90e-08      HQIC           = -12.08925
Det(Sigma_ml) = 1.87e-08      SBIC          = -12.06743
```

Equation	Parms	RMSE	R-sq	chi2	P>chi2
rspot	3	.01866	0.0036	2.8357	0.2422
rfuture	3	.022016	0.0004	.2922264	0.8641

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
rspot						
rspot						
L3.	-.1337006	.1055832	-1.27	0.205	-.3406399	.0732388
rfuture						
L3.	.1403907	.089659	1.57	0.117	-.0353377	.3161192
_cons	-.0000461	.0006622	-0.07	0.944	-.001344	.0012518
rfuture						
rspot						
L3.	-.0630787	.1245721	-0.51	0.613	-.3072355	.1810782
rfuture						
L3.	.0571784	.105784	0.54	0.589	-.1501543	.2645112
_cons	5.44e-06	.0007813	0.01	0.994	-.0015259	.0015368

. varstable, graph

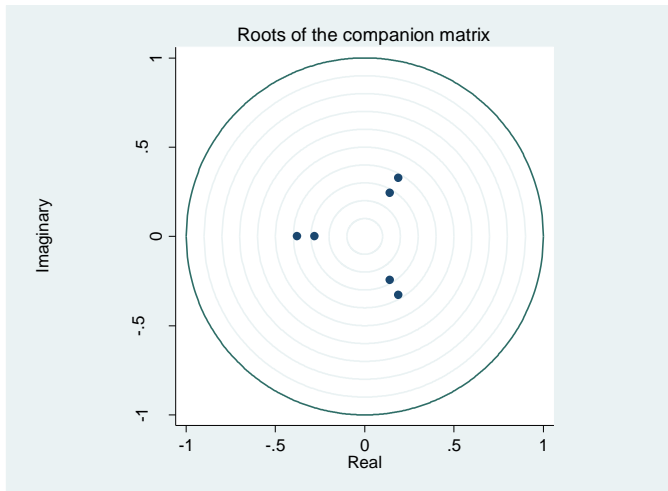
Eigenvalue stability condition

Eigenvalue	Modulus
.1891842 + .3276766i	.378368
.1891842 - .3276766i	.378368
-.3783683	.378368
.1408493 + .2439581i	.281699

```

| .1408493 - .2439581i | .281699 |
| -.2816986           | .281699 |
+-----+

```



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

```
. vargranger
```

```

Granger causality Wald tests
+-----+
|      Equation      | Excluded | chi2   | df | Prob > chi2 |
+-----+-----+
|      rspot         | rfuture  | 2.4518 | 1  | 0.117       |
|      rspot         | ALL      | 2.4518 | 1  | 0.117       |
+-----+-----+
|      rfuture       | rspot    | .2564  | 1  | 0.613       |
|      rfuture       | ALL      | .2564  | 1  | 0.613       |
+-----+-----+

```

we cannot reject the null hypothesis. The test does not guarantee endogeneity. Therefore, rspot and rfuture do not have interdependent relationship.

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 order3, order ( rspot rfuture ) step(5) set(irf03)
(file irf03.irf now active)
(file irf03.irf updated)
. irf table irf, impulse(rspot rfuture) response(rspot rfuture)

```

Results from order3

```

+-----+
|      | (1)      (1)      (1)  | (2)      (2)      (2)  |
| step | irf      Lower    Upper  | irf      Lower    Upper  |
+-----+-----+-----+-----+
| 0    | 1        1        1      | 0        0        0      |
| 1    | 0        0        0      | 0        0        0      |
| 2    | 0        0        0      | 0        0        0      |
| 3    | -.133701 -.34064   .073239 | -.063079 -.307236   .181078 |
| 4    | 0        0        0      | 0        0        0      |
| 5    | 0        0        0      | 0        0        0      |
+-----+

```

```

+-----+
|      | (3)      (3)      (3)  | (4)      (4)      (4)  |
| step | irf      Lower    Upper  | irf      Lower    Upper  |
+-----+-----+-----+-----+
| 0    | 0        0        0      | 1        1        1      |
| 1    | 0        0        0      | 0        0        0      |
| 2    | 0        0        0      | 0        0        0      |
| 3    | .140391  -.035338   .316119 | .057178  -.150154   .264511 |
| 4    | 0        0        0      | 0        0        0      |
| 5    | 0        0        0      | 0        0        0      |
+-----+

```

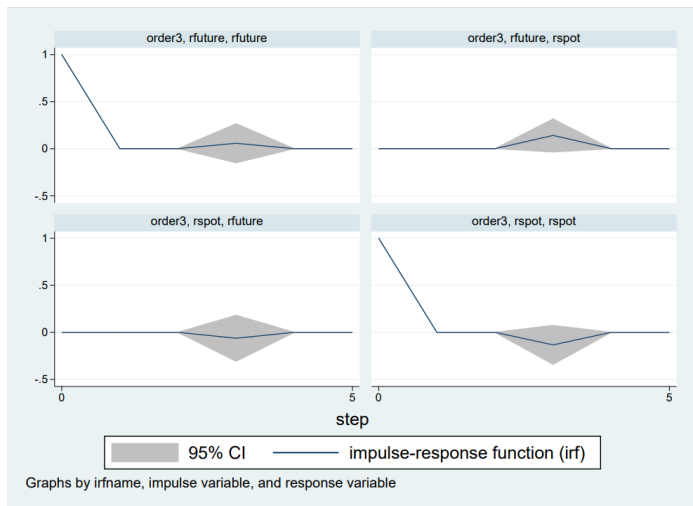
95% lower and upper bounds reported

- (1) irfname = order3, impulse = rspot, and response = rspot
- (2) irfname = order3, impulse = rspot, and response = rfuture
- (3) irfname = order3, impulse = rfuture, and response = rspot
- (4) irfname = order3, 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 order3

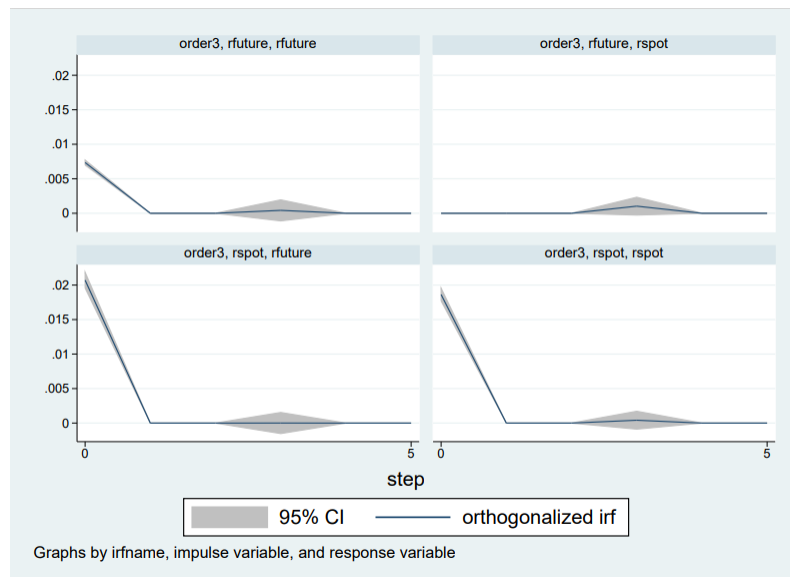
-----+-----						
	(1)	(1)	(1)	(2)	(2)	(2)
step	oirf	Lower	Upper	oirf	Lower	Upper
-----+-----						
0	.018624	.017707	.019542	.02071	.019568	.021851
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	.000417	-.000881	.001716	9.3e-06	-.00152	.001539
4	0	0	0	0	0	0
5	0	0	0	0	0	0
-----+-----						

-----+-----						
	(3)	(3)	(3)	(4)	(4)	(4)
step	oirf	Lower	Upper	oirf	Lower	Upper
-----+-----						
0	0	0	0	.007346	.006984	.007708
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	.001031	-.000261	.002323	.00042	-.001103	.001943
4	0	0	0	0	0	0
5	0	0	0	0	0	0
-----+-----						

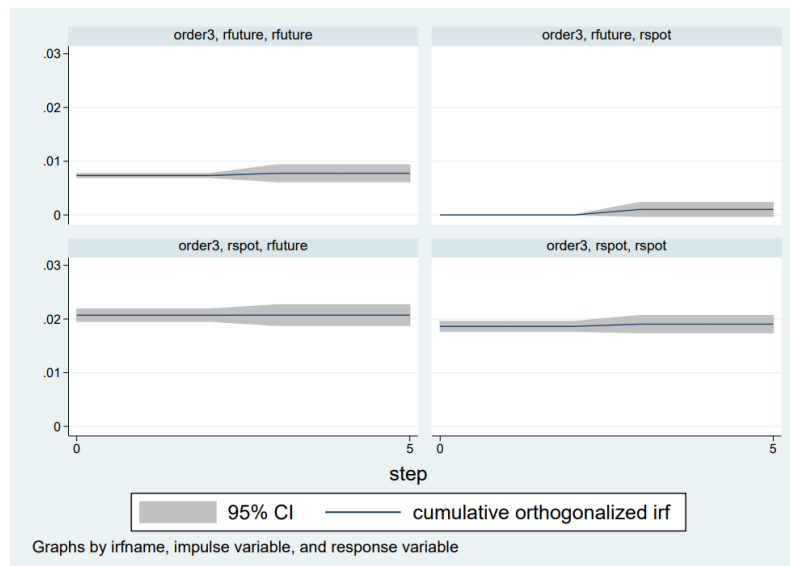
95% lower and upper bounds reported

- (1) irfname = order3, impulse = rspot, and response = rspot
- (2) irfname = order3, impulse = rspot, and response = rfuture
- (3) irfname = order3, impulse = rfuture, and response = rspot
- (4) irfname = order3, impulse = rfuture, and response = rfuture

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



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



From COIRF, the impact of rspot on rfuture is the highest in a positive manner (the graph marks around 0.2).

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 order3

	(1)	(1)	(1)	(2)	(2)	(2)
step	fevd	Lower	Upper	fevd	Lower	Upper
0	0	0	0	0	0	0
1	1	1	1	0	0	0
2	1	1	1	0	0	0
3	1	1	1	0	0	0
4	.996945	.989307	1.00458	.003055	-.004582	.010693
5	.996945	.989307	1.00458	.003055	-.004582	.010693

95% lower and upper bounds reported

- (1) irfname = order3, impulse = rspot, and response = rspot
- (2) irfname = order3, impulse = rfuture, and response = rspot

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

Results from order3

	(1)	(1)	(1)	(2)	(2)	(2)
step	fevd	Lower	Upper	fevd	Lower	Upper
0	0	0	0	0	0	0
1	.888241	.873561	.902921	.111759	.097079	.126439
2	.888241	.873561	.902921	.111759	.097079	.126439
3	.888241	.873561	.902921	.111759	.097079	.126439
4	.887917	.873012	.902821	.112083	.097179	.126988
5	.887917	.873012	.902821	.112083	.097179	.126988

95% lower and upper bounds reported

- (1) irfname = order3, impulse = rspot, and response = rfuture
- (2) irfname = order3, impulse = rfuture, and response = rfuture

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?

Yes, it can change the result since Different order sets up different var-cov matrix.