Wannakit Bira
6001040852.

1.

```
. tsset t
        time variable:  t, 1 to 7684
                delta:  1 unit

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

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

.
end of do-file

. reg rfuture rspot
```

Source	SS	df	MS	Number of obs	=	7,683
				F(1, 7681)	=	6787.70
Model	.01531231	1	.01531231	Prob > F	=	0.0000
Residual	.017327485	7,681	2.2559e-06	R-squared	=	0.4691
				Adj R-squared	=	0.4691
Total	.032639795	7,682	4.2489e-06	Root MSE	=	.0015

rfuture	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rspot	.7889924	.0095766	82.39	0.000	.7702196	.8077651
_cons	7.58e-06	.0000171	0.44	0.658	-.000026	.0000412

```
. estat archlm
LM test for autoregressive conditional heteroskedasticity (ARCH)
```

lags(p)	chi2	df	Prob > chi2
1	6.951	1	0.0084

H0: no ARCH effects vs. H1: ARCH(p) disturbance

```
.
```

2) From the ARCH-effect test $H_0 : \alpha_1 = 0$. The P-value is $0.0084 < 0.05$, Thus H_0 is rejected. There exist significant ARCH effect.

2.

```
. arch rfuture rspot, arch(1/1) nolog

ARCH family regression

Sample: 2 - 7684                                    Number of obs   =      7,683
Distribution: Gaussian                              Wald chi2(1)    =  110869.23
Log likelihood =  39218.14                          Prob > chi2     =     0.0000
```

rfuture	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
rfuture						
rspot	.8122744	.0024395	332.97	0.000	.8074931	.8170557
_cons	-1.78e-06	.0000129	-0.14	0.890	-.000027	.0000234
ARCH						
arch						
L1.	.2336897	.0081368	28.72	0.000	.2177418	.2496375
_cons	1.84e-06	8.36e-09	219.94	0.000	1.82e-06	1.86e-06

```
. estat ic

Akaike's information criterion and Bayesian information criterion
```

Model	N	ll(null)	ll(model)	df	AIC	BIC
.	7,683	.	39218.14	4	-78428.29	-78400.5

Note: BIC uses N = number of observations. See [R] BIC note.

```
. arch rfuture rspot, arch(1/2) nolog

ARCH family regression

Sample: 2 - 7684                                    Number of obs   =      7,683
Distribution: Gaussian                              Wald chi2(1)    =  108336.81
Log likelihood =  39351.85                          Prob > chi2     =     0.0000
```

rfuture	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
rfuture						
rspot	.8356598	.0025389	329.15	0.000	.8306837	.8406359
_cons	-.0000147	9.46e-06	-1.55	0.121	-.0000332	3.89e-06
ARCH						
arch						
L1.	.2467996	.0079396	31.08	0.000	.2312382	.262361
L2.	.1915004	.0060913	31.44	0.000	.1795618	.2034391
_cons	1.50e-06	1.03e-08	145.53	0.000	1.48e-06	1.52e-06

```
. estat ic

Akaike's information criterion and Bayesian information criterion
```

Model	N	ll(null)	ll(model)	df	AIC	BIC
.	7,683	.	39351.85	5	-78693.69	-78658.96

```
Note: BIC uses N = number of observations. See [R] BIC note.
```

```
. arch rfuture rspot, arch(1/1) garch(1/1) nolog

ARCH family regression

Sample: 2 - 7684                                    Number of obs   =      7,683
Distribution: Gaussian                              Wald chi2(1)    =  144306.26
Log likelihood =  39695.02                          Prob > chi2     =     0.0000
```

rfuture	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
rfuture						
rspot	.8163572	.002149	379.88	0.000	.8121452	.8205692
_cons	9.03e-06	.0000117	0.77	0.442	-.000014	.000032
ARCH						
arch						
L1.	.1583904	.0035413	44.73	0.000	.1514496	.1653312
garch						
L1.	.7734061	.0038485	200.96	0.000	.7658632	.7809491
_cons	1.95e-07	5.80e-09	33.59	0.000	1.84e-07	2.06e-07

```
. estat ic

Akaike's information criterion and Bayesian information criterion
```

Model	N	ll(null)	ll(model)	df	AIC	BIC
.	7,683	.	39695.02	5	-79380.04	-79345.3

Note: BIC uses N = number of observations. See [R] BIC note.

```
. arch rfuture rspot, arch(1/1) garch(1/2) nolog

ARCH family regression

Sample: 2 - 7684                                    Number of obs   =      7,683
Distribution: Gaussian                              Wald chi2(1)    =  118876.48
Log likelihood =  39697.75                          Prob > chi2     =     0.0000
```

rfuture	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
rfuture						
rspot	.8153011	.0023647	344.78	0.000	.8106665	.8199358
_cons	8.43e-06	.0000118	0.71	0.476	-.0000148	.0000316
ARCH						
arch						
L1.	.1729248	.0061172	28.27	0.000	.1609353	.1849144
garch						
L1.	.6136021	.0310713	19.75	0.000	.5527034	.6745007
L2.	.1402062	.0250337	5.60	0.000	.091141	.1892714
_cons	2.09e-07	8.64e-09	24.17	0.000	1.92e-07	2.26e-07

```
. estat ic

Akaike's information criterion and Bayesian information criterion
```

Model	N	ll(null)	ll(model)	df	AIC	BIC
.	7,683	.	39697.75	6	-79383.5	-79341.82

Note: BIC uses N = number of observations. See [R] BIC note.

```
. arch rfuture rspot, arch(1/2) garch(1/1) nolog
flat log likelihood encountered, cannot find uphill direction
r(430);

. arch rfuture rspot, arch(1/2) garch(1/2) nolog

ARCH family regression

Sample: 2 - 7684                                Number of obs   =      7,683
Distribution: Gaussian                          Wald chi2(1)    =  110218.44
Log likelihood =  39717.26                      Prob > chi2     =     0.0000
```

rfuture	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
rfuture						
rspot	.8240952	.0024823	331.99	0.000	.81923	.8289603
_cons	9.85e-06	.0000119	0.83	0.409	-.0000135	.0000332
ARCH						
arch						
L1.	.13296	.0033007	40.28	0.000	.1264908	.1394292
L2.	.1345722	.0032469	41.45	0.000	.1282084	.140936
garch						
L1.	-.1805799	.0040099	-45.03	0.000	-.1884392	-.1727207
L2.	.8100838	.0034601	234.12	0.000	.8033022	.8168653
_cons	2.94e-07	1.07e-08	27.39	0.000	2.73e-07	3.15e-07

```
. estat ic

Akaike's information criterion and Bayesian information criterion
```

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
.	7,683	.	39717.26	7	-79420.51	-79371.89

Note: N=Obs used in calculating BIC; see [R] BIC note.

From SBIC or BIC, GARCH(2,2) gives lowest BIC score. Thus, the most appropriate is GARCH(2,1).

3.

```
. predict sigmahat, v

. line sigmahat t
```