1.)

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

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

. 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
```

Since the p-value (0.0084) is less than 0.05, the null hypothesis is rejected so there exist a significance ARCH effect in this model.

2.)

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

. est store garch11

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

. est store garch21

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

. est store garch12

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

. est store garch22
```

```
. est table garch*, star(0.1 0.05 0.01) stat(N ll chi2 aic bic)
```

Variable	garch11	garch21	garch12	garch22
rfuture				
rspot	.81635662***	.81530526***		
_cons	9.030e-06	8.434e-06		
ARCH				
arch				
L1.	.158392***	.1729232***		
garch				
L1.	.77340359***	.61359169***		
L2.		.14021906***		
_cons	1.949e-07***	2.088e-07***		
_				
__000003				
L1.			.62083787***	.68844496***
L2.			.01945821*	-.08678925
__000004				
L1.			-.61385787***	-.68147208***
L2.				.10808718
_cons			8.055e-07***	8.922e-07***
Statistics				
N	7683	7683	7651	7650
ll	39695.018	39697.749	75820.156	75810.682
chi2	144307.39	118874.79		
aic	-79380.035	-79383.498	-151632.31	~~-151611.36~~
bic	-79345.302	-79341.818	~~-151604.54~~	~~-151576.65~~

legend: * p<.1; ** p<.05; *** p<.01

I use STATA 14 and could not run garch (1,2) and garch (2,2) normally. So, from this results, the most appropriate model is garch (1,1)

3.

```
. predict sigma2, variance

. line sigma2 t
```