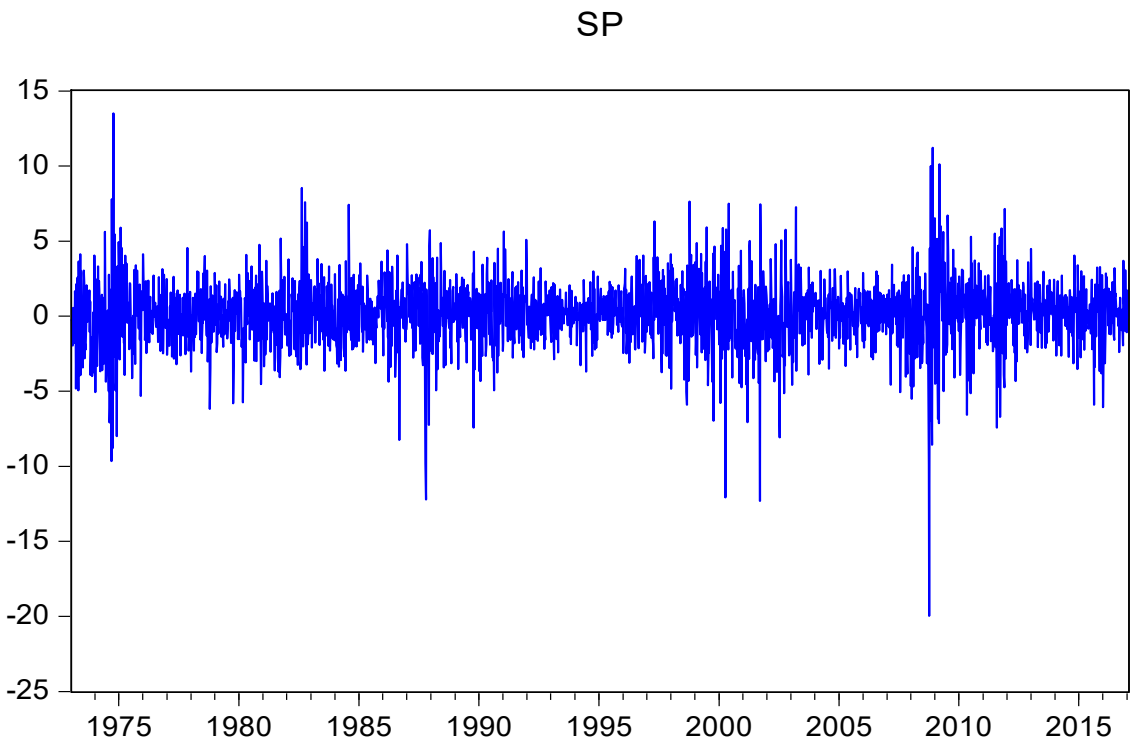
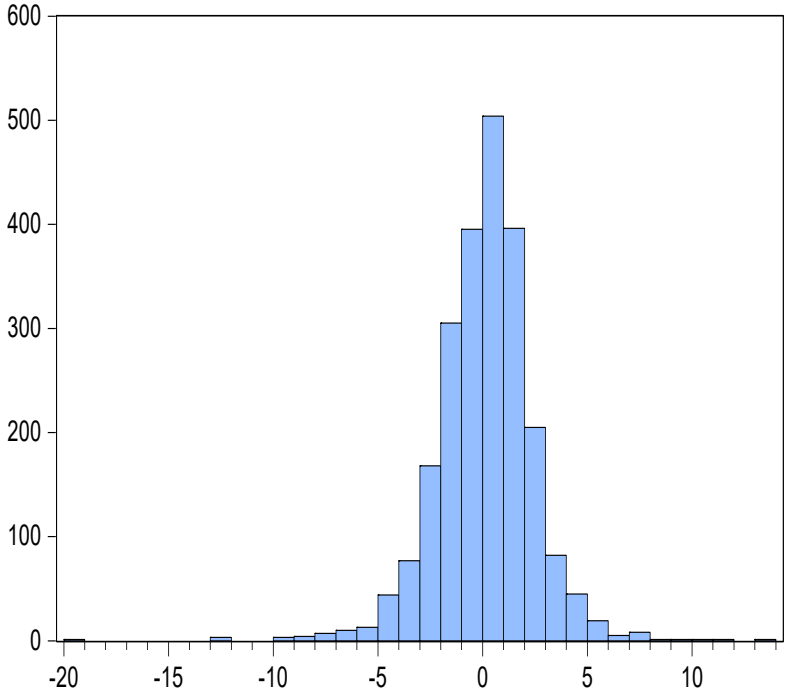
Consider the S&P500 weekly excess returns, from 1/12/1973 1/27/2017 a sample size of 2300 observations.



Histogram of SP



Series: SP	
Sample 1/12/1973 1/27/2017	
Observations 2299	
Mean	0.103597
Median	0.237349
Maximum	13.51952
Minimum	-19.96490
Std. Dev.	2.298991
Skewness	-0.541119
Kurtosis	8.304513
Jarque-Bera	2807.567
Probability	0.000000

Table 1 (Excess Returns - Correlogram)

Sample: 1/05/1973 1/27/2017
Included observations: 2299

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
| |	| |	1	-0.064	-0.064	9.3091	0.002
| |	| |	2	0.037	0.034	12.547	0.002
| |	| |	3	0.011	0.015	12.819	0.005
| |	| |	4	-0.034	-0.033	15.408	0.004
| |	| |	5	-0.004	-0.010	15.454	0.009
| |	| |	6	0.070	0.072	26.627	0.000
| |	| |	7	-0.046	-0.036	31.457	0.000
| |	| |	8	-0.003	-0.014	31.477	0.000
| |	| |	9	-0.008	-0.008	31.618	0.000
| |	| |	10	-0.013	-0.007	31.982	0.000
| |	| |	11	0.002	-0.000	31.996	0.001
| |	| |	12	-0.001	-0.006	32.000	0.001
| |	| |	13	0.002	0.007	32.012	0.002
| |	| |	14	-0.017	-0.018	32.707	0.003
| |	| |	15	0.069	0.068	43.657	0.000

Table 2 (Squared Excess Returns - Correlogram)

Sample: 1/05/1973 1/27/2017
Included observations: 2299

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
|** |	|** |	1	0.267	0.267	164.62	0.000
|* |	|* |	2	0.168	0.104	229.80	0.000
|* |	|* |	3	0.197	0.141	319.46	0.000
|* |	| |	4	0.139	0.050	363.78	0.000
|* |	| |	5	0.111	0.036	392.29	0.000
|* |	|* |	6	0.143	0.077	439.68	0.000
|* |	|* |	7	0.212	0.143	543.45	0.000
|* |	| |	8	0.115	0.000	573.93	0.000
| |	| |	9	0.057	-0.036	581.50	0.000
| |	| |	10	0.066	-0.010	591.47	0.000
| |	| |	11	0.045	-0.011	596.25	0.000
|* |	| |	12	0.089	0.058	614.69	0.000
| |	| |	13	0.050	-0.019	620.42	0.000
| |	| |	14	0.060	0.004	628.65	0.000
|* |	| |	15	0.079	0.035	642.96	0.000

AR(1) Estimation

Dependent Variable: SPRET
Method: ARMA Maximum Likelihood (OPG - BHHH)
Sample: 1/12/1973 1/27/2017
Included observations: 2299
Convergence achieved after 16 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.103582	0.047877	2.163517	0.0306
AR(1)	-0.063569	0.013158	-4.831373	0.0000
SIGMASQ	5.261695	0.083881	62.72798	0.0000

R-squared	0.004044	Mean dependent var	0.103597
Adjusted R-squared	0.003177	S.D. dependent var	2.298991
S.E. of regression	2.295337	Akaike info criterion	4.500942
Sum squared resid	12096.64	Schwarz criterion	4.508432
Log likelihood	-5170.833	Hannan-Quinn criter.	4.503673
F-statistic	4.661644	Durbin-Watson stat	1.995701
Prob(F-statistic)	0.009541		

Inverted AR Roots	-.06

AR(1) Estimation White-Heteroskedasticity Robusts s.e.

Dependent Variable: SPRET
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Sample (adjusted): 1/19/1973 1/27/2017
Included observations: 2298 after adjustments
Convergence achieved after 4 iterations
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.103723	0.045013	2.304292	0.0213
AR(1)	-0.063596	0.035555	-1.788665	0.0738

R-squared	0.004044	Mean dependent var	0.103757
Adjusted R-squared	0.003610	S.D. dependent var	2.299479
S.E. of regression	2.295324	Akaike info criterion	4.500495
Sum squared resid	12096.50	Schwarz criterion	4.505490
Log likelihood	-5169.068	Hannan-Quinn criter.	4.502316
F-statistic	9.323287	Durbin-Watson stat	1.995668
Prob(F-statistic)	0.002289		

Inverted AR Roots	-.06

AR(1)-GARCH (1,1) Model

Dependent Variable: SPRET
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Sample (adjusted): 1/12/1973 1/27/2017
Included observations: 2299 after adjustments
Convergence achieved after 25 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.174594	0.035635	4.899474	0.0000
AR(1)	-0.084650	0.022404	-3.778322	0.0002
Variance Equation				
C	0.245971	0.043567	5.645751	0.0000
RESID(-1)^2	0.143606	0.011452	12.53993	0.0000
GARCH(-1)	0.811664	0.016457	49.32169	0.0000

R-squared	0.002478	Mean dependent var	0.103597
Adjusted R-squared	0.002044	S.D. dependent var	2.298991
S.E. of regression	2.296641	Akaike info criterion	4.294512
Sum squared resid	12115.66	Schwarz criterion	4.306996
Log likelihood	-4931.542	Hannan-Quinn criter.	4.299064
Durbin-Watson stat	1.950007		

Inverted AR Roots	-.08

Table 4: Variance-Covariance Matrix of the AR(1)-GARCH(1,1) estimation

	C	AR(1)	C	resid(-1)^2	garch(-1)
C	0.001270	6.94E-05	0.000214	-3.13E-05	-1.02E-05
AR(1)	6.94E-05	0.000502	-4.99E-05	-3.22E-05	3.67E-05
C	0.000214	-4.99E-05	0.001898	0.000148	-0.000581
resid(-1)^2	-3.13E-05	-3.22E-05	0.000148	0.000131	-0.000140
garch(-1)	-1.02E-05	3.67E-05	-0.000581	-0.000140	0.000271

Wald Test:

Test Statistic	Value	df	Probability
t-statistic	-4.053975	2294	0.0001
F-statistic	16.43472	(1, 2294)	0.0001
Chi-square	16.43472	1	0.0001

Null Hypothesis: C(5)+C(4)=1
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
-1 + C(4) + C(5)	-0.044730	0.011034

Restrictions are linear in coefficients.

Standardised Residuals from AR(1)-GARCG(1,1) estimation

Sample: 1/12/1973 1/27/2017
Included observations: 2299
Q-statistic probabilities adjusted for 1 ARMA term

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
| |	| |	1	0.025	0.025	1.4758	
| |	| |	2	0.033	0.033	4.0310	0.045
| |	| |	3	0.004	0.003	4.0755	0.130
| |	| |	4	-0.031	-0.032	6.2243	0.101
| |	| |	5	-0.021	-0.019	7.2085	0.125
| |	| |	6	0.028	0.031	9.0521	0.107
| |	| |	7	-0.031	-0.031	11.338	0.078
| |	| |	8	0.014	0.013	11.810	0.107
| |	| |	9	-0.008	-0.008	11.948	0.154
| |	| |	10	-0.016	-0.015	12.525	0.185
| |	| |	11	0.011	0.012	12.821	0.234
| |	| |	12	-0.004	-0.005	12.862	0.302
| |	| |	13	0.004	0.005	12.895	0.377
| |	| |	14	-0.005	-0.008	12.945	0.452
| |	| |	15	0.048	0.050	18.345	0.192

*Probabilities may not be valid for this equation specification.

Squared Standardised Residuals from AR(1)-GARCG(1,1) estimation

Sample: 1/12/1973 1/27/2017
Included observations: 2299

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
| |	| |	1	0.060	0.060	8.4248	0.004
| |	| |	2	-0.016	-0.020	9.0471	0.011
| |	| |	3	0.001	0.004	9.0507	0.029
| |	| |	4	-0.005	-0.005	9.1029	0.059
| |	| |	5	-0.010	-0.009	9.3203	0.097
| |	| |	6	-0.023	-0.022	10.496	0.105
| |	| |	7	0.004	0.006	10.530	0.160
| |	| |	8	-0.000	-0.002	10.530	0.230
| |	| |	9	-0.013	-0.012	10.892	0.283
| |	| |	10	-0.023	-0.022	12.098	0.279
| |	| |	11	-0.000	0.002	12.098	0.356
| |	| |	12	-0.012	-0.013	12.413	0.413
| |	| |	13	-0.010	-0.009	12.662	0.474
| |	| |	14	-0.008	-0.008	12.828	0.540
| |	| |	15	0.030	0.030	14.966	0.454

*Probabilities may not be valid for this equation specification.

AR(1)-EGARCH (1,1) Model

Dependent Variable: SPRET
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Sample (adjusted): 1/12/1973 1/27/2017
Included observations: 2299 after adjustments
Convergence achieved after 29 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(3) + C(4)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(5)
*RESID(-1)/@SQRT(GARCH(-1)) + C(6)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.100366	0.037505	2.676087	0.0074
AR(1)	-0.065303	0.021492	-3.038462	0.0024
Variance Equation				
C(3)	-0.077964	0.016624	-4.689823	0.0000
C(4)	0.206031	0.019842	10.38368	0.0000
C(5)	-0.130993	0.011485	-11.40598	0.0000
C(6)	0.941698	0.008095	116.3362	0.0000

R-squared	0.004039	Mean dependent var	0.103597
Adjusted R-squared	0.003606	S.D. dependent var	2.298991
S.E. of regression	2.294843	Akaike info criterion	4.265712
Sum squared resid	12096.70	Schwarz criterion	4.280693
Log likelihood	-4897.436	Hannan-Quinn criter.	4.271174
Durbin-Watson stat	1.992113		

Inverted AR Roots	-.07