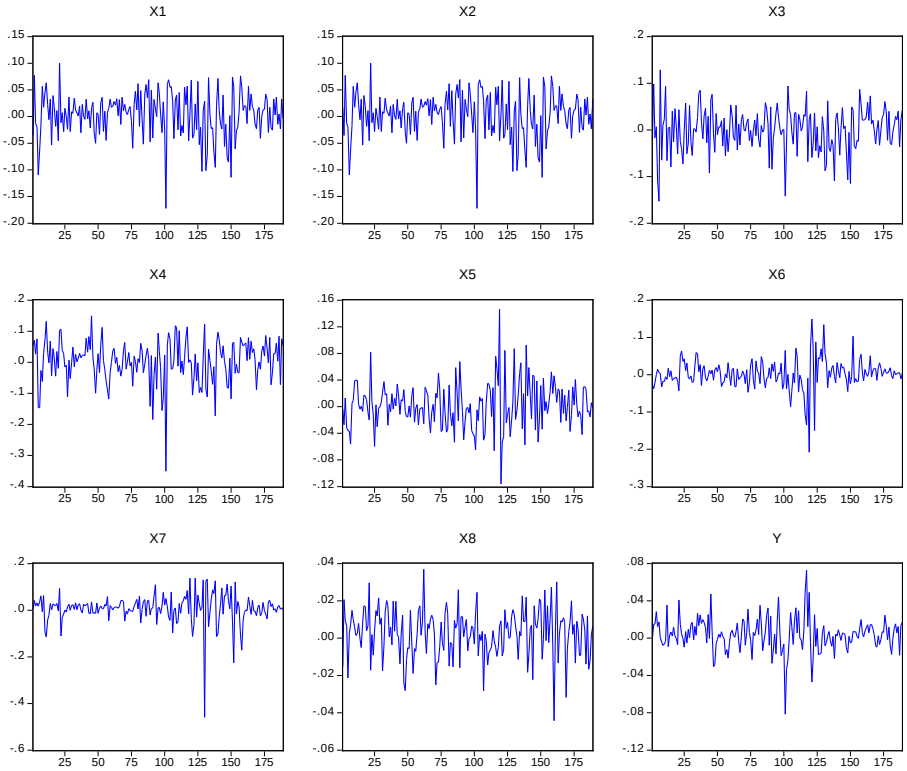
Αυτοσυσχετιση (Απαντησεις- Ασκηση 2)

Αναλυση δεδομενων: autocorr_2.wf1

Διαγραμματα των μεταβλητων

Μαρκαρουμε τα x1, ….x8, y και παταμε enter→View→ Graph→ multiple series=multiple graphs.



Εκτιμηση του πολλαπλου γραμμικου μοντελου

ls y c x1 x2 x3 x4 x5 x6 x7 x8

Dependent Variable: Y
Method: Least Squares
Date: 10/24/22 Time: 00:41
Sample: 1 189
Included observations: 189

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002493	0.000940	2.651147	0.0087
X1	0.024972	0.035613	0.701220	0.4841
X2	0.048539	0.022840	2.125147	0.0349
X3	-0.007074	0.028050	-0.252189	0.8012

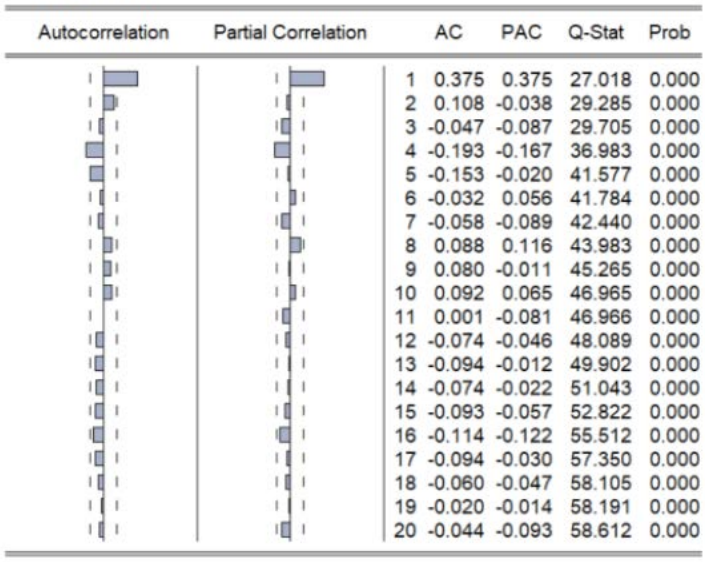
X4	0.146959	0.020512	7.164705	0.0000
X5	0.080942	0.033106	2.444915	0.0155
X6	-0.061501	0.031955	-1.924604	0.0559
X7	0.054356	0.019696	2.759765	0.0064
X8	0.131851	0.072305	1.823528	0.0699

R-squared	0.534904	Mean dependent var	0.004097
Adjusted R-squared	0.514233	S.D. dependent var	0.017224
S.E. of regression	0.012004	Akaike info criterion	-5.960642
Sum squared resid	0.025939	Schwarz criterion	-5.806273
Log likelihood	572.2807	Hannan-Quinn criter.	-5.898103
F-statistic	25.87707	Durbin-Watson stat	1.244903
Prob(F-statistic)	0.000000		

Ελεγχος αυτοσυσχετισης των καταλοιπων

1) Correlogram των καταλοιπων

Sample: 1 189
Included observations: 189



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.375	0.375	27.018	0.000
		2	0.108	-0.038	29.285	0.000
		3	-0.047	-0.087	29.705	0.000
		4	-0.193	-0.167	36.983	0.000
		5	-0.153	-0.020	41.577	0.000
		6	-0.032	0.056	41.784	0.000
		7	-0.058	-0.089	42.440	0.000
		8	0.088	0.116	43.983	0.000
		9	0.080	-0.011	45.265	0.000
		10	0.092	0.065	46.965	0.000
		11	0.001	-0.081	46.966	0.000
		12	-0.074	-0.046	48.089	0.000
		13	-0.094	-0.012	49.902	0.000
		14	-0.074	-0.022	51.043	0.000
		15	-0.093	-0.057	52.822	0.000
		16	-0.114	-0.122	55.512	0.000
		17	-0.094	-0.030	57.350	0.000
		18	-0.060	-0.047	58.105	0.000
		19	-0.020	-0.014	58.191	0.000
		20	-0.044	-0.093	58.612	0.000

2) Breusch-Godfrey Serial Correlation LM Test με 1χρονικη υστερηση των καταλοιπων

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	30.70113	Prob. F(1,179)	0.0000
Obs*R-squared	27.67040	Prob. Chi-Square(1)	0.0000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 11/07/22 Time: 13:47
Sample: 1 189
Included observations: 189
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.15E-05	0.000871	-0.070569	0.9438
X1	0.014025	0.033091	0.423820	0.6722
X2	0.000609	0.021162	0.028762	0.9771
X3	-0.006927	0.026018	-0.266249	0.7904
X4	0.008061	0.019059	0.422933	0.6729
X5	-0.006710	0.030696	-0.218594	0.8272
X6	-0.004876	0.029619	-0.164637	0.8694
X7	-0.002269	0.018253	-0.124295	0.9012
X8	0.014030	0.067037	0.209282	0.8345
RESID(-1)	0.390300	0.070440	5.540860	0.0000

R-squared	0.146404	Mean dependent var	-6.33E-19
Adjusted R-squared	0.103486	S.D. dependent var	0.011746
S.E. of regression	0.011122	Akaike info criterion	-6.108357
Sum squared resid	0.022141	Schwarz criterion	-5.936836
Log likelihood	587.2398	Hannan-Quinn criter.	-6.038870
F-statistic	3.411237	Durbin-Watson stat	1.975179
Prob(F-statistic)	0.000679		

Αρα το μοντελο μας πασχει απο αυτοσυσχετιση (πρωτης ταξης)

Αντιμετωπιση αυτοσυσχετισης

Προσθετουμε στο αρχικο μοντελο την πρωτη χρονικη υστερηση της εξαρτημενης μεταβλητης και ελεγχουμε για αυτοσυσχετιση

ls y c x1 x2 x3 x4 x5 x6 x7 x8 y(-1)

Dependent Variable: Y
Method: Least Squares
Date: 10/24/22 Time: 00:58
Sample (adjusted): 2 189
Included observations: 188 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001162	0.000872	1.332146	0.1845
X1	0.052938	0.032533	1.627198	0.1055
X2	-0.019108	0.022750	-0.839907	0.4021
X3	-0.011956	0.025087	-0.476567	0.6343
X4	0.141610	0.018590	7.617535	0.0000
X5	0.082547	0.029802	2.769865	0.0062

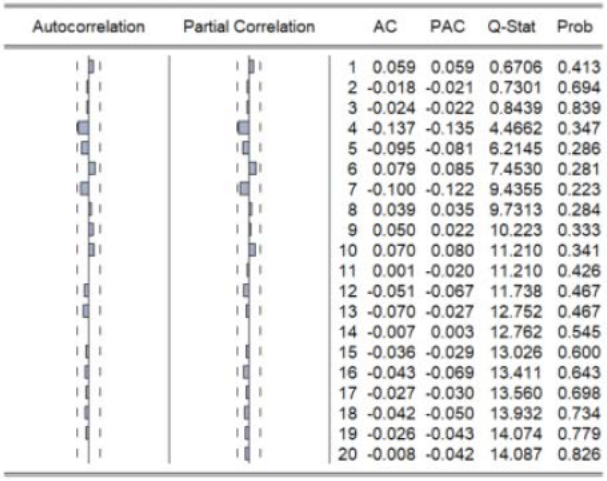
X6	-0.055617	0.028813	-1.930275	0.0552
X7	0.054952	0.017648	3.113831	0.0022
X8	0.161557	0.064972	2.486555	0.0138
Y(-1)	0.357378	0.052492	6.808263	0.0000

R-squared	0.632452	Mean dependent var	0.004118
Adjusted R-squared	0.613868	S.D. dependent var	0.017267
S.E. of regression	0.010730	Akaike info criterion	-6.179873
Sum squared resid	0.020493	Schwarz criterion	-6.007721
Log likelihood	590.9080	Hannan-Quinn criter.	-6.110123
F-statistic	34.03232	Durbin-Watson stat	1.879393
Prob(F-statistic)	0.000000		

Ελεγχος αυτοσυσχετισης

1) Correlogram των καταλοιπων

Sample: 2 189
Included observations: 188



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.059	0.059	0.6706	0.413
		2	-0.018	-0.021	0.7301	0.694
		3	-0.024	-0.022	0.8439	0.839
		4	-0.137	-0.135	4.4662	0.347
		5	-0.095	-0.081	6.2145	0.286
		6	0.079	0.085	7.4530	0.281
		7	-0.100	-0.122	9.4355	0.223
		8	0.039	0.035	9.7313	0.284
		9	0.050	0.022	10.223	0.333
		10	0.070	0.080	11.210	0.341
		11	0.001	-0.020	11.210	0.426
		12	-0.051	-0.067	11.738	0.467
		13	-0.070	-0.027	12.752	0.467
		14	-0.007	0.003	12.762	0.545
		15	-0.036	-0.029	13.026	0.600
		16	-0.043	-0.069	13.411	0.643
		17	-0.027	-0.030	13.560	0.698
		18	-0.042	-0.050	13.932	0.734
		19	-0.026	-0.043	14.074	0.779
		20	-0.008	-0.042	14.087	0.826

Breusch-Godfrey Serial Correlation LM Test με 2 χρονικες υστερησεις των καταλοιπων

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.628505	Prob. F(2,176)	0.5346
Obs*R-squared	1.333193	Prob. Chi-Square(2)	0.5135

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 10/28/22 Time: 00:40
Sample: 2 189
Included observations: 188
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000217	0.000899	0.241927	0.8091
X1	-0.002177	0.032660	-0.066657	0.9469
X2	0.009919	0.025541	0.388352	0.6982
X3	-0.002793	0.025264	-0.110552	0.9121
X4	0.004145	0.019064	0.217411	0.8281
X5	-0.000517	0.029894	-0.017282	0.9862
X6	-0.000956	0.028896	-0.033070	0.9737
X7	-0.000748	0.017699	-0.042265	0.9663
X8	-0.006724	0.065396	-0.102823	0.9182
Y(-1)	-0.056212	0.076782	-0.732104	0.4651
RESID(-1)	0.118456	0.108290	1.093877	0.2755
RESID(-2)	-0.004141	0.079994	-0.051762	0.9588

R-squared	0.007091	Mean dependent var	-1.38E-19
Adjusted R-squared	-0.054965	S.D. dependent var	0.010468
S.E. of regression	0.010752	Akaike info criterion	-6.165713
Sum squared resid	0.020347	Schwarz criterion	-5.959131
Log likelihood	591.5770	Hannan-Quinn criter.	-6.082014
F-statistic	0.114274	Durbin-Watson stat	2.001472
Prob(F-statistic)	0.999823		

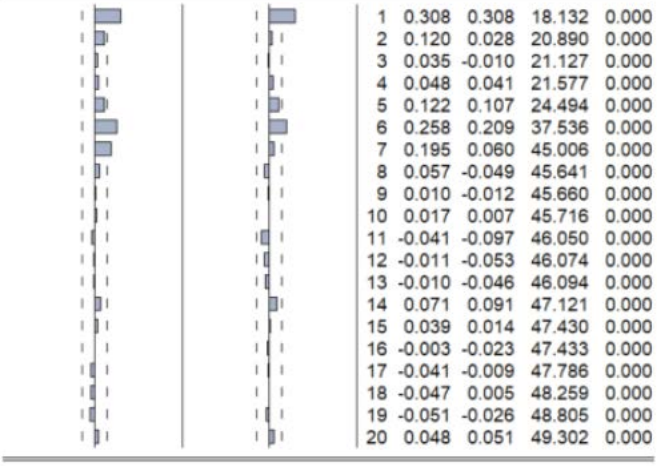
Οσες υστερησεις και να προσθεσουμε στην βοηθητικη παλινδρομηση δεν αλλαζει το συμπερασμα του LM test.

Αρα το μοντελο μας που περιεχει την υστερηση της εξαρτημενης μεταβλητης δεν πασχει απο αυτοσυσχετιση

Ελεγχος για υπαρξη δευσμευμενης ετεροσκεδαστικοτητας του μοντελου μας που περιεχει την υστερηση της εξαρτημενης μεταβλητης

1) Correlogram των τετραγωνων των καταλοιπων

Sample: 2 189
Included observations: 188



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.308	0.308	18.132	0.000
		2	0.120	0.028	20.890	0.000
		3	0.035	-0.010	21.127	0.000
		4	0.048	0.041	21.577	0.000
		5	0.122	0.107	24.494	0.000
		6	0.258	0.209	37.536	0.000
		7	0.195	0.060	45.006	0.000
		8	0.057	-0.049	45.641	0.000
		9	0.010	-0.012	45.660	0.000
		10	0.017	0.007	45.716	0.000
		11	-0.041	-0.097	46.050	0.000
		12	-0.011	-0.053	46.074	0.000
		13	-0.010	-0.046	46.094	0.000
		14	0.071	0.091	47.121	0.000
		15	0.039	0.014	47.430	0.000
		16	-0.003	-0.023	47.433	0.000
		17	-0.041	-0.009	47.786	0.000
		18	-0.047	0.005	48.259	0.000
		19	-0.051	-0.026	48.805	0.000
		20	0.048	0.051	49.302	0.000

2) ARCH τεστ με μια χρονικη υστερηση των τετραγωνων των καταλοιπων

Heteroskedasticity Test: ARCH

F-statistic	19.45296	Prob. F(1,185)	0.0000
Obs*R-squared	17.79237	Prob. Chi-Square(1)	0.0000

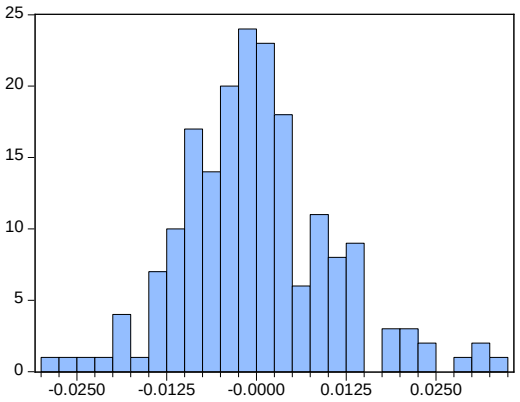
Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/28/22 Time: 00:46
Sample (adjusted): 3 189
Included observations: 187 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.56E-05	1.51E-05	5.005939	0.0000
RESID^2(-1)	0.308519	0.069950	4.410551	0.0000

R-squared	0.095146	Mean dependent var	0.000109
Adjusted R-squared	0.090255	S.D. dependent var	0.000187
S.E. of regression	0.000178	Akaike info criterion	-14.41754
Sum squared resid	5.87E-06	Schwarz criterion	-14.38298
Log likelihood	1350.040	Hannan-Quinn criter.	-14.40354
F-statistic	19.45296	Durbin-Watson stat	2.017504
Prob(F-statistic)	0.000017		

Αρα υπαρχει μεταβαλλομενη διακυμανση και επομενως τα καταλοιπα δεν ειναι κανονικα.

Ελεγχος κανονικοτητας



Series: Residuals
Sample 2 189
Observations 188

Mean	-1.38e-19
Median	-0.000701
Maximum	0.032764
Minimum	-0.028068
Std. Dev.	0.010468
Skewness	0.452079
Kurtosis	3.906934
Jarque-Bera	12.84690
Probability	0.001623

Για να μοντελοποιησουμε επαρκως την δεσμευμενη ετεροσκεδαστικοτητα μπορουμε να χρησιμοποιησουμε το υποδειγμα y c x1 x2 x3 x4 x5 x6 x7 x8 y(-1) μαζι με ενα GARCH(2,2) για τη διακυμανση των τυχαιων σφαλματων.

Αποτελεσματα εκτιμησης

Dependent Variable: Y
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 11/03/22 Time: 21:43
Sample (adjusted): 2 189
Included observations: 188 after adjustments
Convergence achieved after 42 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(11) + C(12)*RESID(-1)^2 + C(13)*RESID(-2)^2 + C(14)
*GARCH(-1) + C(15)*GARCH(-2)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000993	0.000521	1.906766	0.0566
X1	0.045014	0.027576	1.632344	0.1026
X2	-0.013034	0.013303	-0.979816	0.3272
X3	0.012415	0.019767	0.628049	0.5300
X4	0.131564	0.016501	7.973071	0.0000
X5	0.080061	0.020124	3.978396	0.0001
X6	-0.041892	0.023787	-1.761091	0.0782
X7	0.034416	0.011129	3.092489	0.0020
X8	0.182016	0.046031	3.954169	0.0001
Y(-1)	0.299263	0.052528	5.697178	0.0000

Variance Equation

C	1.51E-07	4.24E-07	0.356387	0.7216
RESID(-1)^2	0.258299	0.145324	1.777399	0.0755
RESID(-2)^2	-0.293251	0.148375	-1.976417	0.0481
GARCH(-1)	1.145848	0.270728	4.232471	0.0000
GARCH(-2)	-0.119681	0.275717	-0.434071	0.6642

R-squared	0.619334	Mean dependent var	0.004118
Adjusted R-squared	0.588529	S.D. dependent var	0.017267
S.E. of regression	0.011076	Akaike info criterion	-6.425421
Sum squared resid	0.021224	Schwarz criterion	-6.167194
Log likelihood	618.9896	Hannan-Quinn criter.	-6.320797
F-statistic	20.10477	Durbin-Watson stat	1.767163
Prob(F-statistic)	0.000000		

Τα τετραγωνα των καταλοιπων αυτου του μοντελου δεν αυτοσυσχετιζονται.

Date: 11/03/22 Time: 21:45
Sample: 2 189
Included observations: 188

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|. |	.|. |	1	-0.048	-0.048	0.4473	0.504
.|. |	.|. |	2	-0.024	-0.026	0.5580	0.757
.|. |	.|. |	3	-0.063	-0.065	1.3142	0.726
.|. |	.|. |	4	-0.008	-0.015	1.3261	0.857
.|. |	.|. |	5	0.039	0.035	1.6276	0.898
.|. |	.|. |	6	0.034	0.033	1.8530	0.933
.|. |	.|. |	7	0.046	0.050	2.2634	0.944
.|. |	.|. |	8	0.006	0.018	2.2706	0.972
.|. |	.|. |	9	-0.022	-0.013	2.3685	0.984
.|. |	.|. |	10	-0.060	-0.057	3.0804	0.979
.|. |	.|. |	11	-0.014	-0.023	3.1220	0.989
.|. |	.|. |	12	0.043	0.032	3.5023	0.991
.|. |	*|. |	13	-0.058	-0.067	4.1868	0.989
.|. |	.|. |	14	0.062	0.054	4.9730	0.986
.|. |	.|. |	15	0.023	0.036	5.0788	0.991
.|. |	.|. |	16	0.022	0.029	5.1785	0.995
*|. |	*|. |	17	-0.107	-0.095	7.5642	0.975
.|* |	.|* |	18	0.078	0.080	8.8267	0.964
.|. |	.|. |	19	0.000	-0.000	8.8267	0.976
.|. |	.|. |	20	0.040	0.028	9.1690	0.981
.|. |	.|. |	21	-0.018	-0.017	9.2364	0.987
.|. |	.|. |	22	-0.054	-0.049	9.8751	0.987
.|* |	.|* |	23	0.108	0.104	12.412	0.964
*|. |	*|. |	24	-0.085	-0.078	13.998	0.947
.|. |	*|. |	25	-0.065	-0.073	14.936	0.943
.|. |	.|. |	26	0.035	0.028	15.210	0.953
.|. |	.|. |	27	-0.017	-0.027	15.277	0.965
*|. |	*|. |	28	-0.112	-0.131	18.094	0.924
.|. |	.|. |	29	-0.028	-0.023	18.273	0.939
.|* |	.|* |	30	0.140	0.129	22.718	0.827
.|. |	.|. |	31	0.039	0.061	23.060	0.847
.|. |	.|. |	32	-0.023	-0.027	23.185	0.872
*|. |	*|. |	33	-0.129	-0.101	26.996	0.760
.|* |	.|* |	34	0.115	0.123	30.055	0.661

.|. |	.|. |	35	0.024	0.024	30.190	0.699
.|* |	.|. |	36	0.079	0.073	31.638	0.676

ARCH τεστ με τρεις χρονικες υστερησεις (οσες και να βαλουμε τα συμπερασματα δεν αλλαζουν)

Heteroskedasticity Test: ARCH

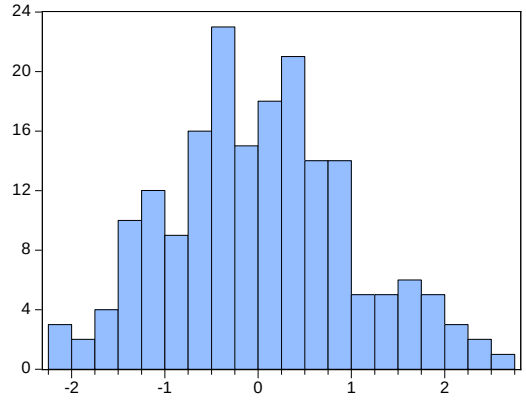
F-statistic	0.467573	Prob. F(3,181)	0.7053
Obs*R-squared	1.422692	Prob. Chi-Square(3)	0.7002

Test Equation:
Dependent Variable: WGT_RESID^2
Method: Least Squares
Date: 11/03/22 Time: 21:45
Sample (adjusted): 5 189
Included observations: 185 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.118906	0.160639	6.965340	0.0000
WGT_RESID^2(-1)	-0.054437	0.074193	-0.733730	0.4641
WGT_RESID^2(-2)	-0.030179	0.074181	-0.406832	0.6846
WGT_RESID^2(-3)	-0.066086	0.074528	-0.886728	0.3764

R-squared	0.007690	Mean dependent var	0.973179
Adjusted R-squared	-0.008757	S.D. dependent var	1.283375
S.E. of regression	1.288982	Akaike info criterion	3.366966
Sum squared resid	300.7267	Schwarz criterion	3.436596
Log likelihood	-307.4444	Hannan-Quinn criter.	3.395185
F-statistic	0.467573	Durbin-Watson stat	1.955900
Prob(F-statistic)	0.705263		

Τα καταλοιπα εχουν κανονικη κατανομη



Series: Standardized Residuals	
Sample 2 189	
Observations 188	
Mean	0.026726
Median	0.000177
Maximum	2.543455
Minimum	-2.123244
Std. Dev.	0.983756
Skewness	0.222794
Kurtosis	2.721486
Jarque-Bera	2.162923
Probability	0.339100

Και οι εκτιμηθεισες δεσμευμενες διακυμανσεις