FINANCIAL ECONOMETRICS AND EMPIRICAL FINANCE (20192) – HOMEWORK 2

GROUP 9

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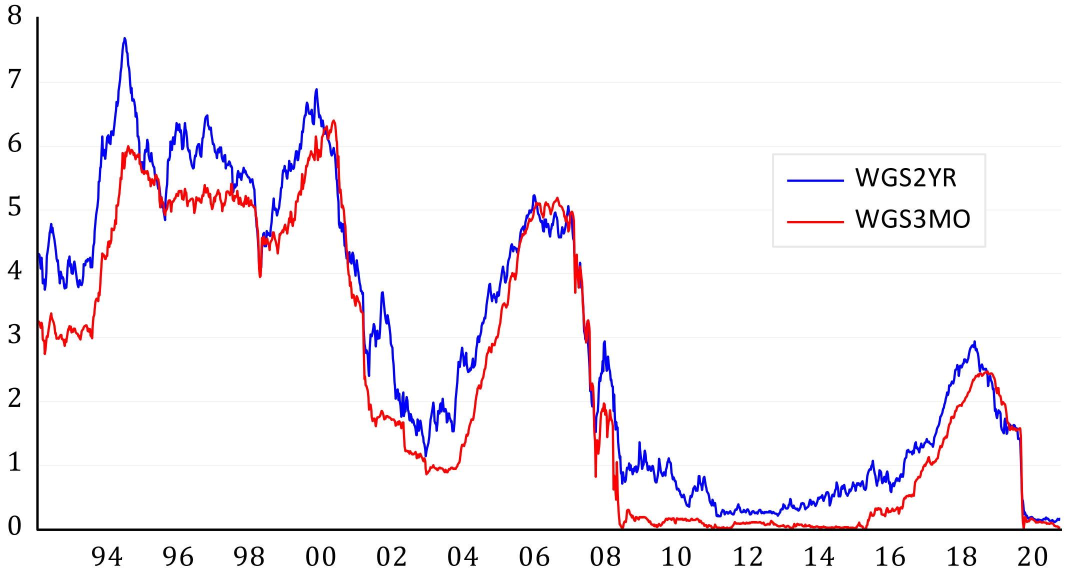
GENERAL INDEX

Task 1

Graph of WGS2YR and WGS3MO:



Summary statistics of WGS2YR and WGS3MO:

Date: 04/21/21 Time: 18:54 Sample: 7/24/1992 4/09/2021		
	WGS3MO	***WGS2YR***
Mean	2.377612	2.898499
Median	1.820000	2.520000
Maximum	6.400000	7.690000
Minimum	0.000000	0.110000
Std. Dev.	2.099627	2.152588
Skewness	0.332412	0.296417
Kurtosis	1.574632	1.674789
Jarque-Bera	154.5010	131.6394
Probability	0.000000	0.000000
Sum	3564.040	4344.850
Sum Sq. Dev.	6603.831	6941.183
Observations	1499	1499
Correlation		
	WGS3MO	**WGS2YR**
WGS3MO	1.000000	0.976613
WGS2YR	0.976613	1.000000

As can be observed from the summary statistics table, both series show absence of normality. This derives from the fact that both series present a slightly positive skewness (longer tails to the right) and a kurtosis different from three (platykurtic) and therefore their tails are thicker than a normal distribution. This is confirmed by the p-value of virtually 0 for the Jarque-Bera test, allowing us to reject the null hypothesis of normality.

From both the graph and the table, it can be alleged that the series are not stationary. Moreover, it can be seen from the correlation matrix, that the series have an almost perfect positive correlation. This two information could lead to the conclusion that both series contain a similar trend, thing that in case of regressing one variable over the other could lead to invalid inference (spurious regression). In this case of non-stationarity of the series, the first moment will lose its importance.

Finally, both series have an extremely high standard deviation, and this could partially explain their significant constant fluctuation.

Task 2

ADF unit roots test:

Null Hypothesis: Unit root (individual unit root process)
Series: WGS3MO, WGS2YR
Date: 04/21/21 Time: 20:09
Sample: 7/24/1992 4/09/2021
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 1 to 8
Total number of observations: 2987
Cross-sections included: 2

Method	Statistic	Prob.**
ADF - Fisher Chi-square	2.23394	***0.6928***
ADF - Choi Z-stat	0.27051	0.6066

** Probabilities for Fisher tests are computed using an asymptotic Chi
-square distribution. All other tests assume asymptotic normality.

Intermediate ADF test results.

Series	Prob.	Lag	Max Lag	Obs
WGS3MO	0.5169	*8*	23	1490
WGS2YR	0.6331	*1*	23	1497

The ADF unit roots test has been performed using the SBIC as it is suitable for large samples and does not impose a too large penalization for added lags. From the p-value of the ADF test, the null hypothesis cannot be rejected at any conventionally adopted confidence level. This result was backtested using all other information criteria: the only difference lies in the number of lags selected by different ICs. Based on these results, at the 95% confidence level, the two series are I(1) processes and show one unit root. Also, the KPSS test confirms the non-stationarity of the series.

Task 3

Engle and Granger's univariate regression test:

Date: 04/22/21 Time: 20:58
Series: WGS3MO WGS2YR
Sample: 7/24/1992 4/09/2021
Included observations: 1499
Null hypothesis: Series are not cointegrated
Cointegrating equation deterministics: C @TREND @TREND^2
Automatic lags specification based on Schwarz criterion (maxlag=23)

Dependent	tau-stati...	Prob.*	z-statistic	Prob.*
WGS3MO	-4.948981	0.0043	-51.61782	***0.0017***
WGS2YR	-5.235426	0.0015	-54.76786	***0.0009***

*MacKinnon (1996) p-values.

Intermediate Results:

	WGS3MO	WGS2YR
Rho - 1	-0.030716	-0.032385
Rho S.E.	0.006206	0.006186
Residual variance	0.008758	0.007136
Long-run residual variance	0.011080	0.009108
Number of lags	***4***	***1***
Number of observations	1494	1497
*Number of stochastic trends***	2	2

**Number of stochastic trends in asymptotic distribution

Engle-and Granger's test, which is an ADF test applied on the residuals to assess whether they are stationary, is based on a univariate regression test and a null hypothesis of no cointegration between the two series. From the p-values of the test (extremely close to 0) the null hypothesis can be rejected at any conventional confidence level, concluding that the variables are cointegrated. The number of lags selected by the Schwarz criterion suggests that WGS3MO is a VAR(4) while WGS2YR is a VAR(1).

Johansen multivariate VECM based test:

Date: 04/22/21 Time: 21:08
Sample: 7/24/1992 4/09/2021
Included observations: 1494
Series: WGS3MO WGS2YR
Lags interval: 1 to 4

Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	**None**	**None**	**Linear**	**Linear**	**Quadratic**
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	*1*	*1*	*1*	*1*	*2*
Max-Eig	*1*	*1*	*1*	*1*	*2*

*Critical values based on MacKinnon-Haug-Michelis (1999)

Information Criteria by Rank and Model

Data Trend:	**None**	**None**	**Linear**	**Linear**	**Quadratic**
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
	Log Likelihood by Rank (rows) and Model (columns)				
0	3305.471	3305.471	3305.753	3305.753	3305.958
1	3316.263	3323.986	3324.197	3333.620	3333.755
2	3317.133	3325.051	3325.051	3336.716	3336.716
	Akaike Information Criteria by Rank (rows) and Model (columns)				
0	-4.403576	-4.403576	-4.401275	-4.401275	-4.398873
1	-4.412668	-4.421668	-4.420612	**-4.431887***	-4.430729
2	-4.408478	-4.416401	-4.416401	-4.429338	-4.429338
	Schwarz Criteria by Rank (rows) and Model (columns)				
0	-4.346717	-4.346717	-4.337309	-4.337309	-4.327800
1	-4.341594	-4.347040	-4.342431	**-4.350153***	-4.345441
2	-4.323189	-4.324005	-4.324005	-4.329835	-4.329835

The Johansen test is instead a multivariate regression VECM test. Its objective is to test the number of cointegrating relations between the series, which coincides with the number of eigenvalues different from zero in the long run coefficient matrix (its rank). In this test the variables are not assumed to have a specific distribution, therefore its critical values are estimated from reiterated simulations. The data suggest that the model best explaining the variables' correlation is a linear one with an intercept and a trend.

The selection of the best model is confirmed both from the ICs and the first part of the table, which agree on the presence of one cointegrating relation, therefore presenting only one eigenvalue.

From ***both tests' conclusions*** it can be inferred that the two series are cointegrated. While from the Engle and Granger's test the only conclusion is the existence of cointegration between the two-time series, the Johansen test reveals the order of cointegration of the two variables. In this case, therefore, the two series of data are cointegrated of order 1.

Task 4

a) Since in the model there is evidence of a cointegration relation, the next step is the estimation of a VEC model. From task 3, it can be assumed that the cointegration equation should include an intercept plus a linear trend. Accordingly, the cointegration equation is estimated several times using different lag specification (*see below*) in order to understand which is the model that delivers the lowest Schwarz criterion. Since the Schwarz IC is known as the most parsimonious among the different ICs, it can be expected it to select a model with a limited number of lags. Indeed, the model with lag specification (1,2) shows the lowest value for this criterion and, hence, it is the best one among all VEC models. This is consistent both analyzing equation-by-equation and for the whole model. Interestingly, the Akaike IC suggest the use of a model with more lags, since it decreases as we increase the lags. This is consistent with what is theoretically expected, as this criterion has the lowest penalty factor for added lags.

VECM for lag specification (1,2):

R-squared	0.111157	0.064085
Adj. R-squared	0.108175	0.060945
Sum sq. resids	9.621201	11.66945
S.E. equation	0.080357	0.088498
F-statistic	37.26739	20.40504
Log likelihood	1652.111	1507.743
Akaike AIC	-2.200683	-2.007677
Schwarz SC	-2.179384	-1.986378
Mean dependent	-0.002146	-0.002761
S.D. dependent	0.085091	0.091324

Determinant resid covariance (dof adj.)	4.05E-05
Determinant resid covariance	4.01E-05
Log likelihood	3326.617
Akaike information criterion	-4.427295
Schwarz criterion	-4.374047
Number of coefficients	15

VECM for lag specification (1,3):

R-squared	0.115888	0.067169
Adj. R-squared	0.111726	0.062777
Sum sq. resids	9.567963	11.61589
S.E. equation	0.080215	0.088383
F-statistic	27.84490	15.29595
Log likelihood	1654.654	1509.674
Akaike AIC	-2.202882	-2.008928
Schwarz SC	-2.174468	-1.980514
Mean dependent	-0.002114	-0.002676
S.D. dependent	0.085110	0.091296

Determinant resid covariance (dof adj.)	4.03E-05
Determinant resid covariance	3.98E-05
Log likelihood	3330.219
Akaike information criterion	-4.429724
Schwarz criterion	-4.362241
Number of coefficients	19

VECM for lag specification (1,4):

R-squared	0.116302	0.071651
Adj. R-squared	0.110943	0.066021
Sum sq. resids	9.562797	11.55453
S.E. equation	0.080274	0.088239
F-statistic	21.70079	12.72627
Log likelihood	1653.451	1512.121
Akaike AIC	-2.200068	-2.010871
Schwarz SC	-2.164531	-1.975334
Mean dependent	-0.002095	-0.002624
S.D. dependent	0.085135	0.091304

Determinant resid covariance (dof adj.)	4.01E-05
Determinant resid covariance	3.95E-05
Log likelihood	3333.620
Akaike information criterion	-4.431887
Schwarz criterion	-4.350153
Number of coefficients	23

In the cointegration graph below, we can see the amount of deviation from the long run cointegrating relationship based on the estimates.

Cointegrating relation between WGS2YR and WGS3MO:

b) The output of the full model is presented in the table below. The cointegration vector extracted from the cointegrating equation is (1; -0.872668)' with an intercept equal to -1.451149 and a statistically significant linear trend coefficient of 0.000850. The speed of adjustment coefficients estimated on this data are respectively 0.006876 for WGS2YR and 0.045878 for WGS3MO. Both are statistically significant. When there are deviations from the long-term equilibrium, in order to return to an equilibrium situation, most of the adjustments will occur in the WGS3MO series, since its coefficient is higher in absolute value (as visible in the cointegration vector). This happens even though the two series are cointegrated. A trader could use this information to find latent arbitrage opportunities and a policy maker would be able to state which series is more reactive to shocks and adjust market policies accordingly.

VECM specification for WGS2YR and WGS3MO with 2 lags:

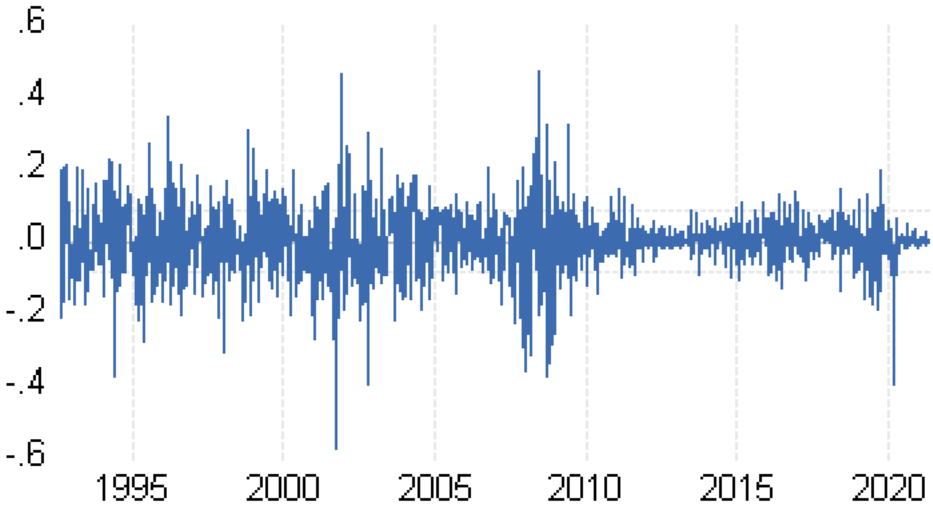
Vector Error Correction Estimates
Date: 04/25/21 Time: 22:43
Sample (adjusted): 8/14/1992 4/09/2021
Included observations: 1496 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
WGS2YR(-1)	1.000000
WGS3MO(-1)	-0.872668
	(0.02965)
	[-29.4319]
@TREND(7/24/92)	0.000850
	(0.00014)
	[5.90485]
C	-1.461149

Error Correction:	D(WGS2YR)	D(WGS3MO)
CointEq1	0.006876	0.045878
	(0.00661)	(0.00600)
	[1.04038]	[7.64513]
D(WGS2YR(-1))	0.233229	0.134078
	(0.02920)	(0.02651)
	[7.98783]	[5.05724]
D(WGS2YR(-2))	0.019425	0.049819
	(0.02964)	(0.02692)
	[0.65531]	[1.85094]
D(WGS3MO(-1))	-0.030839	0.097775
	(0.03111)	(0.02824)
	[-0.99142]	[3.46174]
D(WGS3MO(-2))	0.072731	-0.053639
	(0.03074)	(0.02791)
	[2.36626]	[-1.92192]
C	-0.001970	-0.001540
	(0.00229)	(0.00208)
	[-0.86017]	[-0.74067]

Task 5

WGS2YR Residuals:



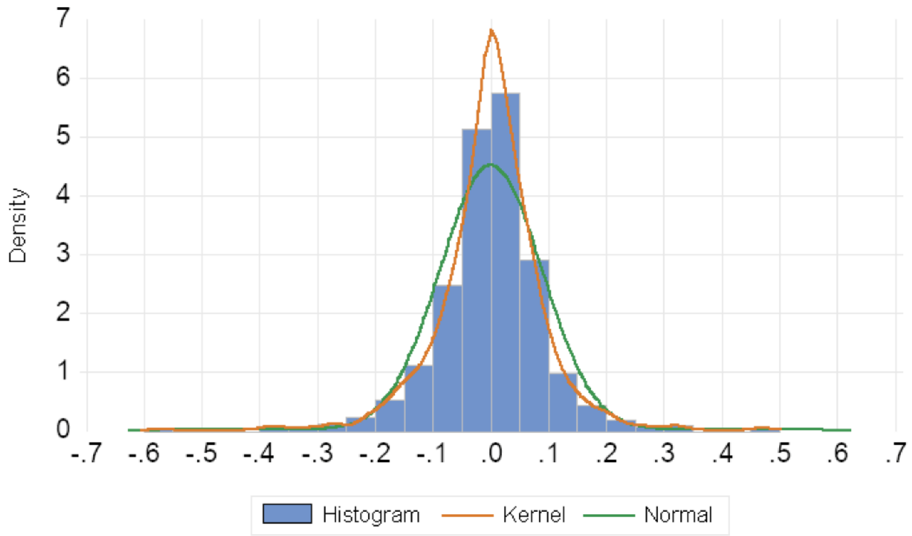
Instances of volatility clustering can be observed whenever large changes tend to trigger subsequent periods of high volatility (of either sign), and small changes tend to be followed by periods of low volatility. We can see that starting in the global financial crisis, when volatility was exceptionally pronounced, such patterns became evident. Thereafter, starting in about 2010, volatility remained remarkably low and even and only recently started to pick up again in the context of the COVID-19 shock.

The kernel density represents a local smoother of the histogram. As can be seen by comparing the kernel regression line to the normal distribution line, the residuals are indeed leptokurtic (the image must be magnified to actually appreciate that the kernel regression lies above the normal distribution in both tails). The same conclusion can be drawn by observing the kurtosis value of 7.0673, which is far over 3, thus confirming the previous observation of the presence of volatility clustering.

Summary statistics for the WGS2YR residuals:

Mean	2.61E-18
Median	0.002621
Maximum	0.470772
Minimum	-0.570609
Std. Dev.	0.088350
Skewness	-0.245186
Kurtosis	7.067298
Jarque-Bera	1046.164
Probability	0.000000
Sum	2.21E-15
Sum Sq. Dev.	11.66945
Observations	1496

Distribution of the WGS2YR residuals:



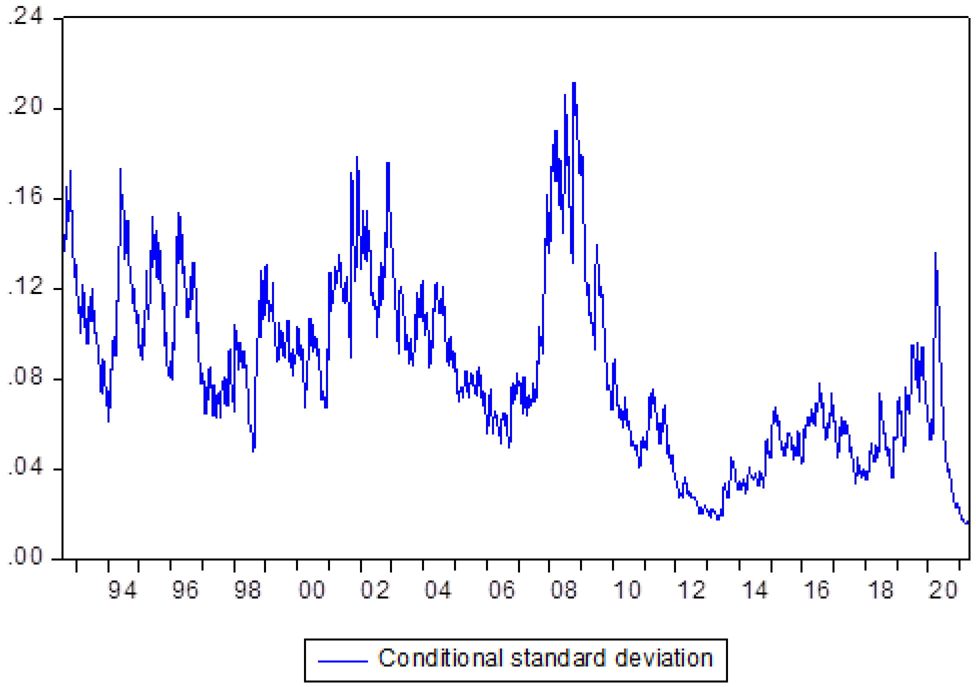
TASK 6

T-Student EGARCH (1,1):

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.003691	0.001282	2.878206	0.0040
Variance Equation				
C(2)	-0.217488	0.036553	-5.949920	0.0000
C(3)	0.231794	0.031200	7.429164	0.0000
C(4)	0.001934	0.017761	0.108880	0.9133
C(5)	0.991880	0.004775	207.7206	0.0000
T-DIST. DOF	5.467678	0.787346	6.944440	0.0000

R-squared	-0.001747	Mean dependent var	2.61E-18
Adjusted R-squared	-0.001747	S.D. dependent var	0.088350
S.E. of regression	0.088427	Akaike info criterion	-2.430633
Sum squared resid	11.68983	Schwarz criterion	-2.409334
Log likelihood	1824.113	Hannan-Quinn criter.	-2.422697
Durbin-Watson stat	2.004070		

Conditional standard deviation of T-Student EGARCH (1,1):



TASK 7

LM test for heteroskedasticity:

Heteroskedasticity Test: ARCH			
F-statistic	1.455984	Prob. F(10,1475)	0.1503
Obs*R-squared	14.52504	Prob. Chi-Square(10)	0.1504

Test Equation:
Dependent Variable: WGT_RESID^2
Method: Least Squares
Date: 04/26/21 Time: 16:39
Sample (adjusted): 10/23/1992 4/09/2021
Included observations: 1486 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.931992	0.099184	9.396575	0.0000
WGT_RESID^2(-1)	0.040235	0.026010	1.546885	0.1221
WGT_RESID^2(-2)	-0.014874	0.025982	-0.572480	0.5671
WGT_RESID^2(-3)	0.004072	0.025978	0.156756	0.8755
WGT_RESID^2(-4)	-0.004307	0.025977	-0.165804	0.8683
WGT_RESID^2(-5)	-0.021374	0.025971	-0.823011	0.4106
WGT_RESID^2(-6)	-0.018845	0.025972	-0.725603	0.4682
WGT_RESID^2(-7)	-0.004013	0.025975	-0.154506	0.8772
WGT_RESID^2(-8)	-0.024432	0.025974	-0.940644	0.3470
WGT_RESID^2(-9)	0.062125	0.025979	2.391362	0.0169
WGT_RESID^2(-10)	0.046701	0.026009	1.795582	0.0728

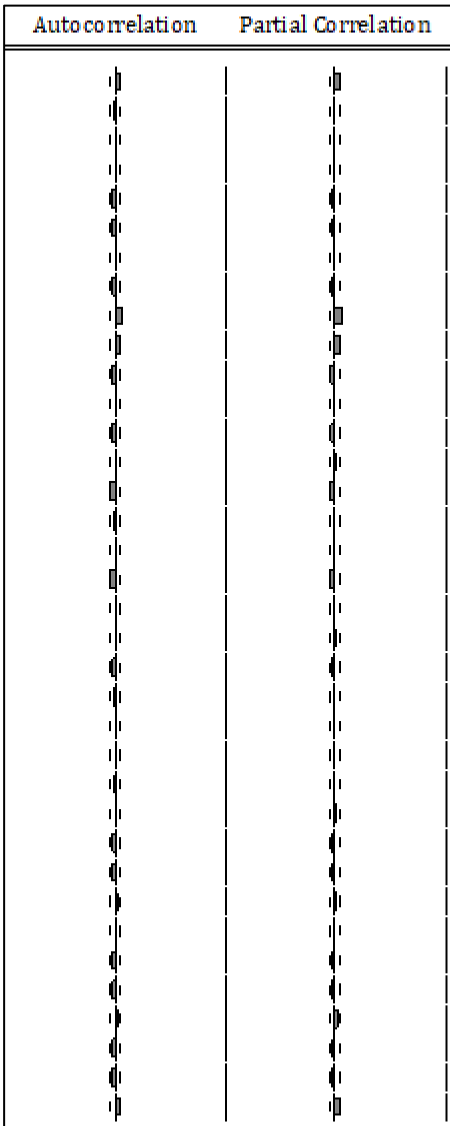
R-squared	0.009775	Mean dependent var	0.997400
Adjusted R-squared	0.003061	S.D. dependent var	2.178102
S.E. of regression	2.174766	Akaike info criterion	4.399094
Sum squared resid	6976.168	Schwarz criterion	4.438355
Log likelihood	-3257.527	Hannan-Quinn criter.	4.413727
F-statistic	1.455984	Durbin-Watson stat	1.996476
Prob(F-statistic)	0.150254		

EGARCH(1;1) residuals correlogram:

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.033	0.033	1.6244	0.202
		2	-0.015	-0.016	1.9442	0.378
		3	0.020	0.021	2.5167	0.472
		4	0.047	0.045	5.8328	0.212
		5	-0.009	-0.012	5.9630	0.310
		6	0.015	0.017	6.3030	0.390
		7	0.030	0.027	7.6678	0.363
		8	0.024	0.020	8.5022	0.386
		9	0.009	0.009	8.6379	0.471
		10	0.028	0.026	9.8430	0.454
		11	-0.027	-0.032	10.960	0.447
		12	-0.013	-0.012	11.205	0.511
		13	0.100	0.098	26.324	0.015
		14	-0.012	-0.022	26.550	0.022
		15	0.017	0.023	26.969	0.029
		16	0.033	0.027	28.596	0.027
		17	0.021	0.010	29.268	0.032
		18	-0.041	-0.038	31.876	0.023
		19	-0.033	-0.034	33.479	0.021
		20	0.001	-0.005	33.482	0.030
		21	0.003	0.001	33.500	0.041
		22	0.027	0.030	34.570	0.043
		23	-0.014	-0.023	34.888	0.053
		24	-0.020	-0.014	35.504	0.061
		25	-0.021	-0.019	36.179	0.069
		26	0.029	0.021	37.487	0.068
		27	0.004	0.011	37.508	0.086
		28	0.002	0.003	37.514	0.108
		29	0.020	0.014	38.096	0.120
		30	0.052	0.043	42.163	0.069
		31	0.007	0.012	42.231	0.086
		32	-0.033	-0.030	43.851	0.079
		33	0.058	0.061	49.037	0.036
		34	-0.019	-0.026	49.562	0.041
		35	-0.028	-0.029	50.803	0.041
		36	0.014	0.016	51.111	0.049

*Probabilities may not be valid for this equation specification.

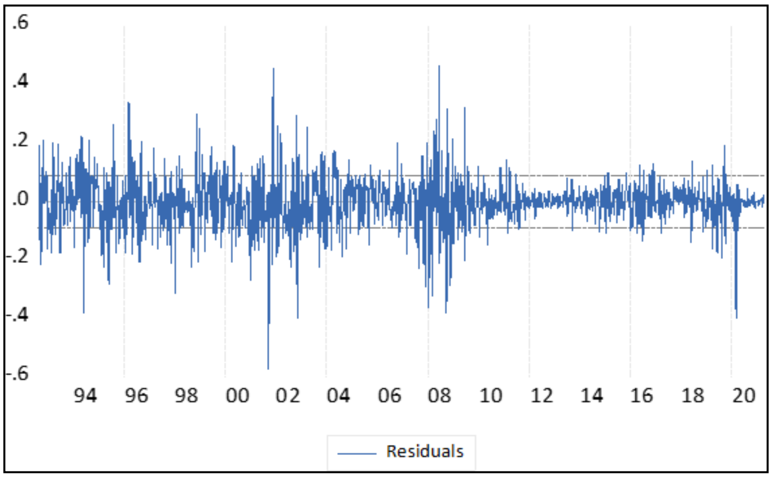
EGARCH(1;1) squared residuals correlogram:



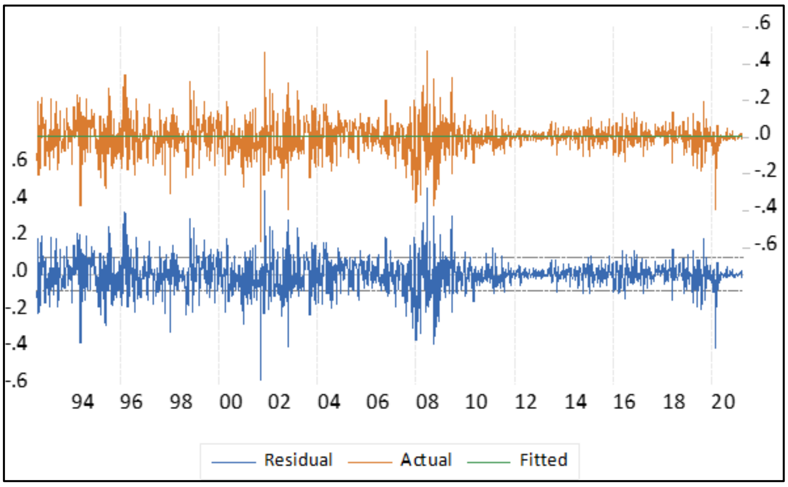
	AC	PAC	Q-Stat	Prob*
1	0.042	0.042	2.6381	0.104
2	-0.014	-0.016	2.9309	0.231
3	0.002	0.003	2.9351	0.402
4	-0.007	-0.007	3.0060	0.557
5	-0.024	-0.023	3.8797	0.567
6	-0.021	-0.019	4.5177	0.607
7	-0.007	-0.006	4.5857	0.710
8	-0.023	-0.023	5.3492	0.720
9	0.062	0.064	11.214	0.261
10	0.053	0.047	15.475	0.116
11	-0.033	-0.037	17.166	0.103
12	-0.002	0.001	17.171	0.143
13	-0.031	-0.033	18.623	0.135
14	0.010	0.015	18.766	0.174
15	-0.047	-0.045	22.135	0.104
16	-0.016	-0.011	22.514	0.127
17	0.004	0.005	22.535	0.165
18	-0.042	-0.047	25.245	0.118
19	0.000	-0.005	25.245	0.153
20	0.015	0.014	25.609	0.179
21	-0.027	-0.028	26.692	0.181
22	-0.009	-0.005	26.829	0.218
23	-0.006	-0.009	26.893	0.261
24	-0.000	0.000	26.893	0.309
25	-0.013	-0.006	27.133	0.349
26	0.016	0.010	27.525	0.382
27	-0.032	-0.031	29.117	0.355
28	-0.023	-0.018	29.891	0.368
29	0.020	0.015	30.489	0.390
30	0.002	0.000	30.498	0.440
31	-0.021	-0.021	31.175	0.457
32	-0.028	-0.027	32.407	0.447
33	0.023	0.021	33.234	0.456
34	-0.021	-0.027	33.923	0.471
35	-0.023	-0.021	34.769	0.479
36	0.051	0.049	38.828	0.343

*Probabilities may not be valid for this equation specification.

EGARCH(1;1) residuals graph:



EGARCH(1;1) residual, Actual, Fitted graph:



From the high F statistic (of 15.03%) of the Lagrange Multiplier test, it can be concluded that there is no structure left in the residuals (in particular, the null hypothesis of homoskedasticity is not rejected at a 10% confidence level). The same conclusion can be drawn by observing the both the simple and squared standardized residuals correlogram since the p-value of the Ljung-Box test does not allow us to reject the null hypothesis (no autocorrelation) at any confidence level, thus concluding that both residuals and squared residuals behave like a white noise. It is worth mentioning the fact that in the latest part of the series some lags appear to be statistically significant but this fact it is not relevant for the scope of the analysis. This result shows the absence of a structure (existence of autocorrelation), and therefore the model seems to be well specified. Moreover, looking at the Residuals graph it can be noticed that there is evidence of volatility clustering, in particular, during crisis periods such as the dotcom in 2001, the Lehman crash of 2008, and the COVID-19 pandemic. During these periods frequent spikes can be observed. Finally, from the *Actual,Fitted,Residual graph it* can be observed that the series is not capturing that much in terms of forecast of the mean since, especially during crises, the residuals present big spikes, therefore they are not a White Noise Process. From the AFR graph the actual expected values are completely explained by the residuals, while fitted values seems to be not relevant, thus reinforcing the hypothesis that the model does not capture mean forecast.

TASK 8

GARCH(2;2) model estimation:

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.004206	0.001369	3.071873	0.0021
Variance Equation				
C	1.63E-05	3.68E-05	0.443429	0.6575
RESID(-1)^2	0.110300	0.018227	6.051318	0.0000
RESID(-2)^2	0.041361	0.330656	0.125087	0.9005
GARCH(-1)	0.452397	3.071600	0.147284	0.8829
GARCH(-2)	0.407753	2.772450	0.147073	0.8831

R-squared	-0.002267	Mean dependent var	2.61E-18
Adjusted R-squared	-0.002267	S.D. dependent var	0.088350
S.E. of regression	0.088450	Akaike info criterion	-2.352127
Sum squared resid	11.69591	Schwarz criterion	-2.330828
Log likelihood	1765.391	Hannan-Quinn criter.	-2.344191
Durbin-Watson stat	2.003029		

EGARCH(1;1) variance forecast regression:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001860	0.000724	2.570088	0.0103
FORECAST_EGARCH11	0.699927	0.063977	10.94024	0.0000

R-squared	0.074171	Mean dependent var	0.007800
Adjusted R-squared	0.073551	S.D. dependent var	0.019220
S.E. of regression	0.018500	Akaike info criterion	-5.140753
Sum squared resid	0.511323	Schwarz criterion	-5.133653
Log likelihood	3847.283	Hannan-Quinn criter.	-5.138108
F-statistic	119.6889	Durbin-Watson stat	2.039471
Prob(F-statistic)	0.000000		

GARCH(2;2) variance forecast regression:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002211	0.000700	3.159855	0.0016
FORECAST_GARCH22	0.639853	0.058438	10.94927	0.0000

R-squared	0.074284	Mean dependent var	0.007800
Adjusted R-squared	0.073665	S.D. dependent var	0.019220
S.E. of regression	0.018499	Akaike info criterion	-5.140875
Sum squared resid	0.511261	Schwarz criterion	-5.133776
Log likelihood	3847.375	Hannan-Quinn criter.	-5.138230
F-statistic	119.8865	Durbin-Watson stat	2.051882
Prob(F-statistic)	0.000000		

Wald's Test for EGARCH (1;1):

Wald Test:
Equation: REGRESSION_EGARCH11_

Test Statistic	Value	df	Probability
F-statistic	12.03123	(2, 1494)	0.0000
Chi-square	24.06247	2	0.0000

Null Hypothesis: C(1)=0, C(2)=1
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(1)	0.001860	0.000724
-1 + C(2)	-0.300073	0.063977

Wald's Test GARCH (2;2):

Wald Test:
Equation: REGRESSION_GARCH22_

Test Statistic	Value	df	Probability
F-statistic	20.90479	(2, 1494)	0.0000
Chi-square	41.80958	2	0.0000

Null Hypothesis: C(1)=0, C(2)=1
Null Hypothesis Summary:

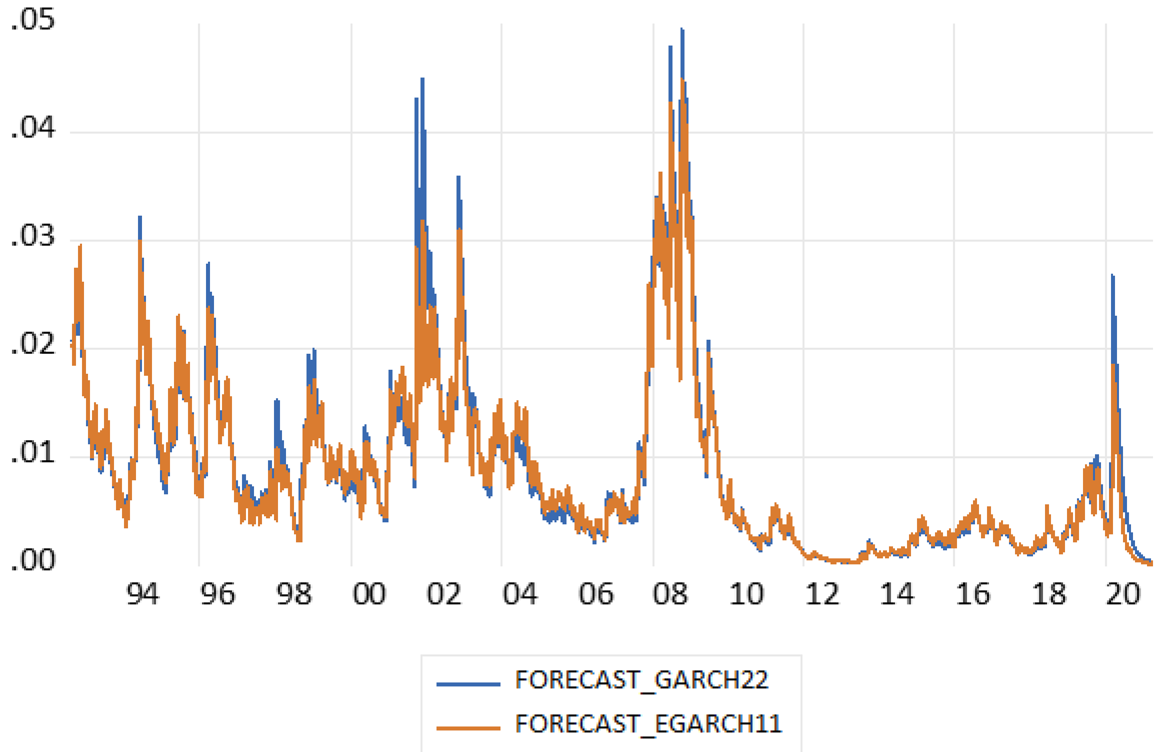
Normalized Restriction (= 0)	Value	Std. Err.
C(1)	0.002211	0.000700
-1 + C(2)	-0.360147	0.058438

In order to check whether the two estimated models (EGARCH (1;1) and GARCH (2;2)) accurately predict future variance, the requirement is that on average the realized squared residuals should be as close as possible to the variance forecast that the model offers. It implies that in the regression:

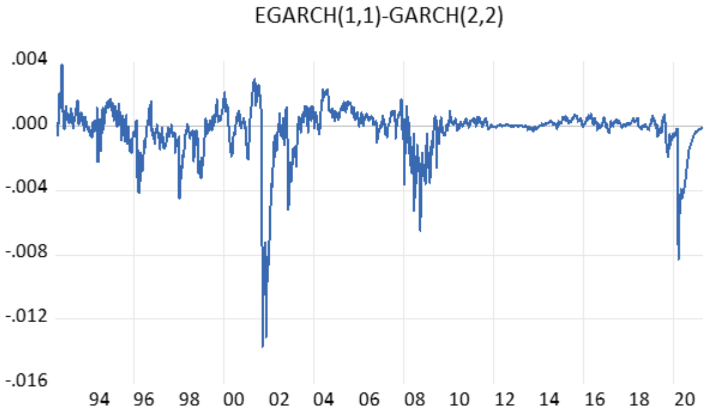
$$\varepsilon_{t+1}^{2} = a + b\sigma_{t+1|t}^{2} + e_{t+1|t}$$

a=0 and b=1 jointly. This is true whenever the variance from the model offers an unbiased predictor of squared residuals used as a proxy for the realized variance.
In the tables of both EGARCH (1;1) and GARCH(2;2) regressions it can be seen that the constant is practically zero but the p-value tells us that the coefficient is statistically different from zero. Instead, the other test performed is aimed at assessing whether the slope of the regression is equal to or different from 1. In this, limiting the analysis only to the p-value would not be correct since the aim is not testing the null hypothesis of absence of a slope, but rather perform a test to assess whether it is equal to one. For this reason, a Wald test must be performed. The result is unsatisfactory, however, since observing the very low p-value of the F-statistic shows that the two coefficients are not respectively equal to 0 and 1 simultaneously for both the models. The R-squared values of the models are quite low (7.4171% for EGARCH(1;1) and 7.4284% for GARCH(1,1)), as well. However, this test of predictive performance may be fallacious because the process of the squared residuals provides a pure proxy for the process of the true time-varying variance. When standardized residuals show a large kurtosis, the variance of the squared residuals will be large, therefore creating a lot of noise and a low R-squared value in case their squared residuals are used as a proxy for instantaneous variance.

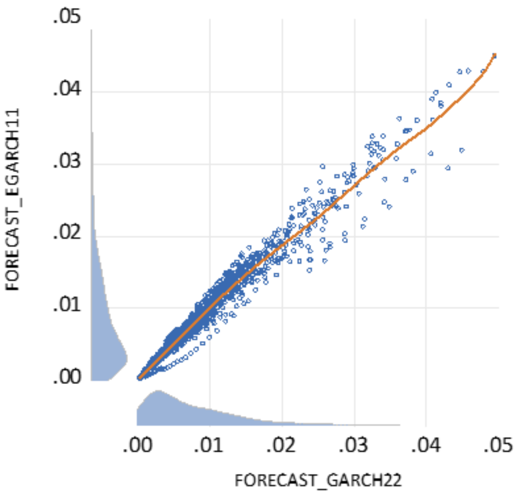
Variance forecast from EGARCH(1;1) and GARCH(2;2):



EGARCH(1,1) and GARCH(2,2) forecast difference:



EGARCH(1,1) and GARCH(2,2) forecast scatter plot:



Looking at the scatterplot it can be noticed that the slope of the regression line between the two forecasts is different from 45°. This is quite evident especially in the upper-right corner, meaning that the difference between the two forecasts appears mainly in the correspondence of big spikes of volatility. Observing the graph of variance forecasts from the two models, it is possible to distinguish the two of them, meaning that the two forecasts are quite different (even if not in a striking way). Another remarkable fact is that, while there seems to be on average a slight prevalence of the forecast values of EGARCH(1;1), in correspondence of high volatility periods GARCH(2;2) values are actually overshooting on top of the EGARCH's spikes. Since EGARCH models take into account the leverage effect, bigger spikes of variances during periods of crisis are expected more in this kind of model, rather than in a GARCH one. In fact, in the EGARCH(2;2) model, negative returns generate a larger variance than positive ones. The graph shows that the GARCH(2;2) model always forecasts elevated variance during negative periods. A possible explanation for this could be the fact that in the GARCH(2;2) model the past variance forecasts have large but not significant coefficients and, therefore, they cause higher variance forecasts whilst not being statistically different from zero.