FINANCIAL ECONOMETRICS AND EMPIRICAL FINANCE (20192) – HOMEWORK 2

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***Task 1***

***Graph of WGS2YR and WGS3MO:***



***Summary statistics of WGS2YR and WGS3MO:***

As can be seen from the summary statistics table, both the 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 flatter than a normal distribution. This is also confirmed by the p-value of 0 of the Jarque-Bera test that allows the null hypothesis of normality, to be refused.

From both the graph and the table, it can be suspected that the series are not stationary. Moreover, it can be seen from the correlation matrix, that the series have a very strong positive correlation. This two information could lead to the assumption 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.

Also, the series have both an extremely high standard deviation, and this could partially explain their important constant fluctuation.

***Task 2***

***ADF unit roots test:***



The test has been performed using the Schwartz Information Criteria as it is best suited for large samples, and it does not impose too big penalizations 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 back-tested using all other information criteria: the only difference lies in the number of lags selected by them. Based on all 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:***



***Engle-and Granger’s*** test, which is an ADF test applied on the residual’s stationarity, 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) null hypothesis can be rejected at any conventional confidence level, thus concluding that the variables are cointegrated. The number of lags selected by the Schwarz criterion suggest that WGS3MO is a VAR(4) while WGS2YR is a VAR(1).

***Johansen multivariate VECM based test:***



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

The selected model shows one cointegrated relation both from the ICs and first part of the table with the rank of the matrix of the best performing model equals to 1, therefore presenting only one eigenvalue.

From ***both the test*** it can be inferred that the two series are cointegrated. While from the Engle and Granger’s test it can be just observed the existence of cointegration between the two-time series, following the Johansen test can be assessed the order of cointegration of the two variables and in this case they are cointegrated of order 1.

***Task 4***

1. Now that we know that a cointegration relation exists, we want to estimate a VEC model. From the task before, we know that the cointegration equation should include an intercept plus a linear trend. Accordingly, we estimate the cointegration equation several times using different lag specification (see below) and then decide on the model that delivers the lowest Schwarz criterion. Since the Schwarz IC is known as the most parsimonious among the different ICs, we would naturally expect it to point toward a model with few lags. Indeed, the model with lag specification (1,2) has the lowest value for this criterion and, hence, we choose it. This is consistent both on equation-by-equation basis and for the joint model. Interestingly, on the contrary, the Akaike IC suggest the use of a model with more lags, as it keeps getting smaller.

Lag specification (1,2) Lag specification (1,3) Lag specification (1,4)

Table

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

Chart

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1. We report the output of the full mode below. The cointegration vector (cointegrating equation) is (1, -0.872668) with an intercept of -1.451149 and a statistically significant linear trend coefficient of 0.000850. The speed of adjustment coefficients estimated on this data are 0.006876 for WGS2YR and 0.045878 for WGS3MO. Both are statistically significant. Even though the two series are cointegrated, when there are deviations from the long-term equilibrium, as described by the cointegration vector, to reach equilibrium again, most of the adjustments occur in the WGS3MO series, since the coefficient is higher in absolute value. A trader could use this information to find apparent arbitrage opportunities and a policy maker would be able to see, which series is more reactive and adjust market policies accordingly.

Table

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***Table

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***Task 5***

In the graph below, we observe instances of volatility clustering whenever large changes tend to be followed by large changes, of either sign, and small changes tend to be followed by small changes. Particularly, we can see such patterns mainly starting during the financial crisis, when volatility was particularly pronounced. 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 (one has to magnify the image to actually see that the kernel regression lies above the normal distribution at the far tails). Of course, the same conclusion can be drawn by considering the kurtosis value of 7.0673, which is far above 3. This confirms the previous observation of volatility clustering.

***Chart

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***Table

Description automatically generated*** Chart, histogram

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