If integration order of is . solving the

If someone wants to run a regression he has to checkif the auxiliary variables of the regression are not stationary 1, if not he has to use the first differences of those variables.

It is of grateimportance for the auxiliary variables to be stationary. In case of non-stationarity, any deviation from equilibrium willnot be temporary. This of course is the safe way which has been used in manyregressions of time series ever since Granger &Newbold published theirpaper about the problem of spurious regression. Apparently, that technic cannotbe considered flowless. The need of using the levels and not the firstdifferences of the variables “ created” the meaning of cointegration.

CointegrationIn most of cases, the linear combination of two variables which are I(1)is also I(1). In general, variables with different orders of integration are combined, their combination order of integration equals the largest. So, if for , we have variables each integrated of order , so that The integrationorder of is . Solving theabove requisition with respect to , we have: Where The equation can be considered as a newregression where is a disturbance term.

This disturbance termhas two unwanted properties: first it is not stationary in most of the casesand secondly is autocorrelated since all the are Let’s consideran example: The sampleregression function of the above equation will be written as follows: If we solvethe above requisition with respect to we have: We haveexpressed the residuals like a linear combination of our auxiliary variables. In most of the regressions the combination of non stationary variables willitself be non stationary but this is not very convenient. The perfect case wouldbe the residuals to be This is the case when the variables are cointegrated. Back in 1987, Engle and Granger proposed the following definition about cointegration. Let be a vector ofvariables integrated of order : Ø All are Ø Thereis at least one vector of coefficients such that In reality mostof the financial variables have one unit root so they are . Having this in mind, a set of variables is consideredcointegrated if their linear combination is stationary.

It has been observed that many time series may not be stationary, butthey may be related in the long run. A cointegration relationship is also a longterm or else equilibrium phenomenon because it is possible that cointegratedvariables may seem unrelated in the short run but this is not be true for the longrun. In this point it is important to distinct the meaning of spurious relationswith cointegrated ones. The spuriousregression problem is appeared when totally unrelated time seriesmay appear to be related using traditional testing procedures. And fromthe other hand, we face genuine relationships which arise when the time seriesare cointegrated. Engleand Granger test Engle and Granger in 1987, recommended that « If a set of variables are cointegrated, then there exists a valid error correction representation of the data, andviceversa».

To put it different, if two variables are cointegrated there mustbe some force that will make the equilibrium error to go back to zero. Engle and Granger in 1987, also suggested a two-step model for cointegrationanalysis. For example, let’s say that we have an independent variable and a dependent one .

First of all, it should be estimated the long-run equilibrium equation: We run a OLSregression and we have: We solve theabove equation with respect to and we have: In practice acointegration test is a test which examines if the residuals have not got unit root. To examine this, we run a ADF test on the residuals, but we use the MacKinnon(1991) critical values. If the hypothesis of the existence of cointegration cannotbe rejected, the OLS estimator, is said to be super-consistent. This means thatfor a very big sample it is not necessary to include variables in our model. The only important thing from the above test is the stationarity of theresiduals, if they are stationary (no unit root) we can move to the secondstep. So, we save the residuals from the OLS and we prosed to the second step.

The secondstep we use the unit root process for the stationarity of the residuals to thenext equation: The aboveequation does not have constant term because of the fact that, the residualshave been calculated with the method of ordinary lest squares, so they have zeromean. The test suggested from the Engle Granger is a little bit different fromthose of the one of Dickey-Fuller. The hypothesis of this test is: Ø   : (no cointegration)Ø (cointegration)The null hypothesiscan be rejected only when (? is the critical value of Engle-Granger table). The Engle-Granger Test can be also used for more than two variables.

The process is alike the one we have described. In conclusion the cointegration process is a way to estimate the longrun relation between two or even more variables. Engle and Granger in 1987 provedthat if two variables are cointegrated, then they have a long run relationequilibrium, while in short run this may not be true. To check if their is a shortrun disequilibrium we can use an Error Correction Mechanism (ECM). Theequilibrium error can be used to combine the long run with the short run withthe help of ECM.

The equation of this model is: Where: Ø : is theequilibrium errorØ : is the shortrun coefficient which has to be between 0 and -1. Ø and : are thefirst differences of and which are not stationary We now can nowuse ordinary least squares since all the variables are . It is importantto point out that long run equilibrium is tested trough the p-value of coincidence . If is significant then causes in the long run. Furthermore, the coefficient measures the speed of adjustment to the longrun equilibrium.

The higher this coefficient the faster the return to the equilibrium. 1 Integration is when in a one variablecontext, is if its (d-1)th difference is That is isstationary? is if is .