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Cointegration of Interest Rate- The Case of Albania

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Abstract: In economic theories, the study of non-stationary time series, takes a special place. These series may have causal links between them in the short and medium term. In this paper, attention focuses on discovering links in the long term. If there are long-term bonds between the series then the series are said that cointegrate. Various tests, such as Engel-Granger's two-steps procedure, three steps Engle-Yoo method, Saikkonen method and Johansen method, will be analyzed. For each of these methods, advantages and disadvantages are given. In the last part of the paper, these methods are applied for real series such as the interest rate on credit and deposit interest ratesfor Albania.

***Keywords**:Cointegration, interest rates on credit, Long-term, Medium Term, interest rates on deposit.*

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I. INTRODUCTION

Non-stationary time series are considered as a potentially large problem for empirical econometrics. In such situations, the estimated models may not be "correct" so we can get unbelievable values for the student test, while model selection criteria can get great value and consequently evaluation of the appropriate model falls into a difficult situation. In the analysis of most of the macroeconomic time series it is noticed that they have as their components the trend component as well. So, it is thought that cleaningthe series from trend can turn this time series into stationary series, or else we can call them stationary series according to the trend. On the other hand, the series and why they may have a trend, do not return to the stationary with his help, therefore the use of the difference rule is needed until the series returns to the stationary. The number of differences needed to return to the stationary series is also called the order of differentiation, which is usually d-denoted and the series is called integral of the order d, I (d). This rule, in addition to benefiting from the return of the series to stationary series, may result in the loss of some valuable data information in the long term periods.

The concept of 'cointegration' is a real breakthrough in econometrics. This concept has its beginnings in the 1980s. The concept was introduced for the first time by Granger (1981). Subsequently, Engle and Granger (1987), in their work, provided a strong theoretical basis for representing, testing, evaluating and modeling cointegrated time series. Since then, there has been a blast of research on cointegration and related fields (Utkulu (1994)).Cointegration analysis allows non stationary data to be used so that "incorrect" results are avoided. It also provides researchers with a formal effective framework for testing and evaluating long-term time series models.

The existence of cointegration between two macroeconomic variables means "a long-term sustainable economic relationship", which prevents residuals of the regression equation between the variables from becoming larger in the long run. The literature suggests different methods for evaluating the long-term and short-termequation, we can distinguish the error correction model (ECM). Such models represent both long-term theoretical behavior between variables and their short-term regulation. Between these two different treatments Engle and Granger have used a regression to discover the long term bond and that was introduced by Engle and Granger (1987). Some researchersconsider this method as a good method where models rated with LSMare stable and efficient (see ex. Stock (1987)) but of course there are otherresearchers who do not support it (Banerjee 1986).In attempts to evaluate alternative cointegrating regimes, many researchers have been thinking about adding to dynamic component models (or, say, inclusion in modeling time lags) (see Charemza and Deadman (1992), Cuthbertson et al. (1992), Inder (1993), Phillips and Loretan). While some other scholars have been thinking of realizing the changes and corrections needed in the estimates made with current models (see eg Engle and Yoo (1991), Park and Phillips (1988), Phillips and Hansen (1990), West (1988) . Both suggested alternatives lead to different solutions.

II. SOME ALTERNATIVE WAYS OF ASSESSING LONG-TERM RELATIONSHIPS

2.1. Two- step Engel-Granger procedure.

This method is suggested by Engle and Granger (1987) and has been further improved. In the first step it should be shown that the series taken in the study are not stationary butintegrated offirst order. Then it is built using LSM regression model that has economic significance and has statistical support. Thinking that the variables taken in consideration are X_t and Y_t, we may think that the long-term model (cointegrating equation) is:

$Y_t = \beta X_t + u_t$ (1)

If the series are cointegrated then the regression residues are stationary so I (0). Corrections of various types are suggested by Engle and Yoo (1991), Park of Phillips (1988), Phillips of Hansen (1990) and West (1988). The second step continues with the model's evaluation in the short term with an error correction mechanism (ECM). Relying on the Granger theorem if a number of variables, such as Y_t and X_t are cointegrated then there is an ECM between these variables and vice versa. Since the aim is to discover the cointegration between the Y and X variables, we can use the β from the long-term regression (1) of the first step in the error correction term (Y_t-βX_t) in the short-term equation as follows:

$\Delta Y_t = \alpha_1 \Delta X_t + \alpha_2 (Y-\beta X)_{t-1} + \varepsilon_t$ (2)

Where Δ denotes the first difference of the respective variable and ε_t the residue of the model. On the other hand, in practice, we have $Y_t - \alpha X_t = u_t$, can substitute regression residues (1), since both are identical. We point out that the coefficient α_2 in the short-term equation (2) should be negative and should be statistically significant. We underline that in order to avoid the explosive processes we say that the coefficient should be between -1 and 0. The negative value and the statistical significance of the coefficient $\alpha_2$is a necessary condition for the variables taken in the study to be cointegrated.

In practice, this is considered as a compelling evidence and confirms the existence of the cointegration found in the first step. It is also important to note that, in the second step of the two-pronged Engel-Granger procedure, there is no risk of assessing an incorrect regression due to the insured variability of the variables. The two-step combinations then provide a model incorporating both with short and long-term components.

2.2. Engle-Yoo Space Method (M3EY)

Engle and Yoo (1991) proposed a three-step technique to avoid two disadvantages of the Engel-Granger Two-step method (M2EG). The two disadvantages of M2EG are: 1) although long-term regression provides steady estimates, they can not be fully effective; 2) If the residues does not have normal distribution we can estimate the ineffective parameters. The third step corrects parameter estimates of the first step so that test standards, such as t-test, can be applied (for further details see Engle and Yoo (1991), Cuthbertson et al. (1992)). . The three steps of M3EY are: First, evaluate a cointegrative standard regression such as the equation (1) estimated by the MZKV, where are the residuals earned from the equation estimate and which will give us the first step estimation for β which is β *. Then, we evaluate in the second step a dynamic model like the equation (2) using residuals evaluated by the cointegrating regression as a term of error correction. The third step is based on the following regression:

$\varepsilon_t = \eta(-\alpha_2 X_t) + v_t$ (3)

Suitable correction for first step estimates is:

$\beta_{cor} = \beta^* + \eta$ (4)

And the standard error errors for βcor are given by the standard error η in the third step regression

2.3Saikkonen Method(MS)

Banerjee (1986) states that if the volume of choice is small then the long-term component should be avoided. Above we have noted that most scholars attempting to evaluate alternative cointegrating regression have added dynamic components to avoid problems that may arise (for details, see Inder (1993), Phillips and Loretan (1991), Saikkonen (1991) , also for the use of autoregressive delay distribution (ADL), see Charemza and Deadman (1992, 157-8)). Saikkonen (1991) suggests a new asymptotic effective evaluator which is quite simple to calculate using LSM without any initial assessment. In practice, the proposed long-term evaluator will take the following structure (note that this model is a simplified version of the Saikkonen method):

$Y_t = \beta_0 + \beta_1 X_t + \beta_2 \Delta X_{t-1} + \beta_3 \Delta X_{t+1} + e_t$ (5)

In this case correction is achieved by adding the differences ΔY_{t-1} and ΔY_{t+1} to the classical equation Engle-Granger, so the equation (1). The idea is to remove the asymptotic inefficiency of the estimates obtained by the MZKV using all the stationary data system information to explain the short-term dynamics in the cointegration regression. Increasing the amount of stationary information can reduce the matrix responsible for variance-covariances of cointegration regression and thus improve asymptotic efficiency ... ".

2.4. Johansen maximum longitude method.

The maximum longitude method Johansen (1988) is probably the best method for estimating long-term variables and economic relationships.

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The Johansen methodology begins with the estimation of the VAR (p) k dimensional model in the general form, which includes the trend and the intercept:

$$X_t = \phi_1 X_{t-1} + \phi_2 X_{t-2} + \ldots + \phi_p X_{t-p} + \mu + \delta t + u_t \qquad (6)$$

which turns into the following form:

$$\Delta X_t = \Gamma_1 X_{t-1} + \Gamma_2 X_{t-2} + \ldots + \Gamma_p X_{t-p} + \mu + \delta t + u_t$$

Ku $\Gamma_i = \phi_i + \phi_{i-1} + \ldots + \phi_1 - I$

We can write the last equation in a known form:

$$\Delta X_t = \Pi X_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \mu + \delta t + u_t$$

In these equation the notes are:

$$\Pi = \sum_{i=1}^{p} \phi_i - I, \quad \Gamma_i = -\sum_{j=i+1}^{p} \phi_j$$

We can write the matrix Π = αβ 'where α is the matrix of the coefficients arranged while the β' matrix of the cointegrating vectors. The test has its own values λ 1≥ λ 2≥ ... ≥ λ k and the matrix path by the following tests:

Trace statistics $\lambda_{trace} = -n \sum_{i=r+1}^{k} \log(1 - \hat{\lambda} i)$

Statistics of its maximal value $\lambda_{max} = -n \log (1- \hat{\lambda}_{r+1})$

III. EMPIRICAL ANALYSIS

Two very important economic variables such as the interest rate on loans (NK) and the deposit interest rate (NI) in the case of Albania will be taken into consideration. The banking system interest rate performance is a very important indicator for the economy of each country. Their performance and timely fluctuations can be an indicator of the current state of the economy, but also a reference base for their level forecasts in future periods. But what do the credit and deposit rates represent? The deposit rate (12 months) up to 1995 showed the floor level set by the Bank of Albania for the 12-month deposit interest rate in Albanian Leke. After that time shows the weighted average percentage of new deposits with twelve-month maturity. Thus, the deposit rate is an indicator of the average deposit rate placed on second level banks for different periods.

The credit rate (12 months) before 1995 was orientated by the Bank of Albania. After that time shows the weighted average for new twelve-month maturity loans. By analogy, the credit rate is an indicator of the average rate of credit given by second-level banks for different periods. Suffice it to say that the difference between these two rates is the gross profit of second level banks to understand their significance.

Sinaj.V (2015) has shown that these two variables are non-stationary and furthermore areI (1). Based on the Granger test of causation, it has been shown that between the interest rate and the credit in Albania there are two-way causality (for more see 2). Since the series taken in the study are integral first-rate and there is a causal connection between them, the need for testing is established if this relationship is sustainable in the long run. Let's use some of the tests cited in the previous paragraphs.

3.1 Two-steps Engel-Granger procedure

The model estimated in the first step is presented in the following table:

Dependent Variable: NK Method: Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.959921	0.363671	21.88772	0.0000
NI	1.019344	0.033575	30.36027	0.0000
R-squared	0.800999	Mean dependent var		16.77879
Adjusted R-squared	0.800130	S.D.dependentvar		7.438994
S.E. of regression	3.325741	Akaikeinfo criterion		5.249882
Sum sq. resid	2532.867	Schwarz criterion		5.279687
LikehoodLog	-604.3614	Hannan-Quinn criterion		5.261904
F-Statistic	921.7458	Stat Durbin-Watson		0.693177
Prob(F-statistic)	0.000000			

Table 1.The model of rate. Authors calculation

The model is statistically significant and with an explanation at the 80% level. After generating the residues of the estimated first step model, we appreciate the second step pattern that is presented in the following table:

Dependent Variable D(NK)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(NI)	-0.115382	0.288261	-0.400271	0.7056
UT(-1)	-0.388988	0.049711	-7.824929	NA
S.E. of regression	2.441631	Akaike info criterion		4.631867
Sum squared resid	1359.236	Schwarz criterion		4.661763
Log likelihood	-530.6647	Hannan-Quinn criter.		4.643927
Durbin-Watson stat	2.363642			

Table 2. The Engel-Granger model Authors calculation

As is seen coefficients α_2 = -0.388. So its value is as expected between -1 and 0, and moreover it is statistically significant that shows that among our variables there is a stable connection in the long term periods.

3.2 Method Saikkonen (MS)

The model evaluated according to MS is given in the table below.

Dependent Variable: NK				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.790973	0.349477	22.29321	0.0000
NI	1.027895	0.032183	31.93912	0.0000
D(NI)	-1.753681	0.436575	-4.016905	0.0001
DNI(t+1)	0.314090	0.043579	7.207251	0.0000
R-squared	0.821986	Mean dependent var		16.80218
Adjusted R-squared	0.819613	S.D. dependent var		7.444688
S.E. of regression	3.161908	Akaike info criterion		5.157541
Sum squared resid	2249.474	Schwarz criterion		5.217519
Log likelihood	-586.5385	Hannan-Quinn criter.		5.181738
F-statistic	346.3161	Durbin-Watson stat		0.821818
Prob(F-statistic)	0.000000			

Table 3.ModelSaikkonen Authors calculation

Referring to the model we estimate that the variables cointegrate among them because the components of the MS model are statistically significant.

3.3 Method Johansen

We use the Johansen test to find out whether the series of studies studied between them. The test results are presented in the following table:

Trend assumption: Linear deterministic trend
Series: NI NK
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.067196	17.19553	15.49471	0.0275

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At most 1	0.006505	1.474941	3.841466	0.2246

Trace test indicates 1 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.067196	15.72059	14.26460	0.0292
At most 1	0.006505	1.474941	3.841466	0.2246

Max-eigenvalue test indicates 1 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 4.The results of Johansen test Authors calculation

Referring to the test of its maximum value as well as the Tracking Statements, it is concluded that the series of interest rates on credit deposits have a stable connection in the long term in the case of Albania.

IV. CONCLUSIONS

The cointegration of the series is a generalization of the unitary root test in the vector systems. If two series are non-stationary and their linear combination is stationary then it is said that the series are cointegrated. The cointegration of the series means that the variables have a connection between them in the long term, so they have long-term causal relationships. To test the cointegration of the series are listed a set of tests as the two-steps Engel-Granger procedure, the three Engle-Yoo method , the Saikkonen method and the Johansen method, and then these tests were used for a real series such as credit interest rate deposits for Albania. From the use of some of the tests it resulted that between the loan and the deposit interest there is a stable bond in the long term periods.

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