An Econometrics Analysis of the Relationship between Interest rate and Loan rate. Albanian case.

Prof.As.Phd. Valentina Sinaj[1]
[1]Economics Faculty,Tirana University. Albania.
sinajv@yahoo.com

Abstract. On economic analysis, must often be detected if the loan rate responds to changes in interest rates. This problem is the object of study of this paper, regarding to Albanian case, for a period from August 1995 to October 2014. In this study conducted an empirical and econometric analysis to detect the connection that exists between the two variables rate loan and deposit interest rate. The construction of a VAR model is the focus of the second part of the paper. ADF and Granger test are used to study the stationarity and discover the relationship between the variables. ADF and the Engle- Granger two-step procedure are used to discover if the relation is also in long term periods.

Keywords: interest rate, credits rate, causality, Johnasen.

1. INTRODUCTION

An interest rate (the loan rate) is the price that one pays for the use of money borrowed from a bank or the payment that one gets for lending his money to the others. The deposit rate is the compensation that takes the depositor since he relinquished temporarily from the ability to spend his money. The loan rate is an indication of the average rate of loans granted by commercial banks to 1-year term. The deposit rate is an indicator of the average rate of deposits placed in commercial banks for the same period.
The difference between the average interest rate on loans and deposits represents "the spread" of interest rates. "The Spread" credit-deposit (which is the main factor of gross profit of banks) has increased over the period 2009-2014, from 8.96% at 10.47% in ALL (according to OpenData).
When interest rates are low, then it is easier for people to borrow money, the activity for the company increase, also the investments and manufacturing capacity, new jobs are opened and additional investments that are fund by taking loans from banks. In this way, the economy develops. These benefits lost when the interest rate is high. A higher interest rate does not affect much the level of deposits. On the one hand, the depositors increase their savings to benefit from high rates of interest and on the other hand, the income growth from deposits makes them feel wealthier, consequently spend more.
The interest is determined by the rate of inflation. In fact, one reason why the interest is paid, is inflation. Anyone who deposits money or lends them for some time, wants to be ensured that when he withdraws from the bank or when the loan is returned, it would have the same value. Since prices rise, to maintain the value of savings helps interest. The level of interest must compensate the decline of the value or purchasing power of money because of rising prices.
There are two most common types of deposits:
1. Demand deposit- this is a kind of deposit where you can keep your money and you have the opportunity to withdraw them at any time. The longer you keep your money the higher the interest rate will be.

2. Time deposit- it is a kind of deposit where you can keep your money for a limited period of maturity (1, 3, 6, 12 months; also 2 to 5 years). Interest offered depends on the amount and maturity.

Some types of loans are:

1. Consumer loan- is a financing tool, fast and flexible to cover your needs for: purchases of electronic equipment, furniture, personal vehicles.
2. Home loan- is an option that allows you to purchase a desired apartment. Banks offer many possibilities with different conditions.
3. Personal loan- is a tool that can be used to complete the most pressing needs like education, tourist trip, the best medication, computer purchase, etc. This is a very quick type of loan that you can easily get.
4. Floating capital loan- is a type of loan that is offered in the form of a bank advance payment or overdraft, for all those who have a bank account. Usually it is suitable for companies or persons who have continued demand for circulating money.
5. Investment loan- is the type of loan that helps to finance purchases of furniture and office equipment, construction machinery, renovation and expansion of business environments.
6. Business loan- is a tool that provides financing for medium to long term investments. This loan gives opportunities for business expansion. You can use this loan to buy machinery or equipment, to update the technology or for any other investment and refinancing of existing loans.
7. Flexi loan from the current account is a bank advance, which helps you complete your short-term financial needs. This opportunity is offered to all persons who have a bank account on the banks that give this type of loan.

2. LITERATURE REVIEW

According to a study conducted by OpenData about Albania from 2009 to 2014 is noted that the increase in deposit interest rates has led to an increase of the rate of the loan, a positive correlation, this until 2012. After this year interest rate is reduced further by going up 2.4% while the loan rate has remained almost constant.

According to a study made on China's Commercial Banks [1] about the fluctuations of interest rates, has been proven that the model EGARCH (2,1) could describe better the characteristics of the distribution of interest rates in the interbank commercial loan market of China through theoretical and empirical research. Therefore, this model can be useful for commercial banks risk management, using VAR estimation.

According to another study in China [2] by Si.W., (2014), has shown that there is a positive effect of the interest rate on the total volume of credit rates. It is used the Vector Autoregression model (VAR) with monthly data from January 2007 to June 2014. Granger causality test showed that interest rates have reciprocal causal connection with loan rates based on a 5% confidence level. The response impulse function shows that the interest rate has a significantly positive effect on the growth of bank loan.

Another study conducted at the University of Lagos in Nigeria by Ajibola [3], Arewa, (2013), has developed VAR-GARCH models in the context of the review of direction of causality and the transmission of information between loan rates and volatility rates interest using time series data collected from CBN statistical bulletins and annual accounting reports of banks for a period of 1981 to 2011. The results showed that there was no causal connection between the loan rate and interest rate volatility.

3.METHODOLOGY

This paper uses monthly data for the deposit interest rate and loan rate for the period August 1995 to October 2014 for Albania. The data for the study were collected by the Bank of Albania. On these variables are used econometric methods to study stationarity through Dickey-Fuller test, then the Granger test is used to detect the Granger causality connection between variables and further it is tested whether the series are cointegrated in the long term period.

3.1Stationarity

Stationarity shows how the values of a time series stand around an average value. The series of interest rate and loan rate will be called stationary if the mathematical expectation, variance and covariance tend to be constant (not depended on time), and therefore to fulfill the following conditions:

E $NI(t)= \mu$

Var $(NI_t)= \sigma^2$

Cov $(NI_{t+k}, NI)= \gamma_k$

We do the same for the other variable.

Will see and verify the nature of time series of interest rate and loan rate in Albania. Testing will be done through the unitary root test.

We use the generalized Dickey-Fuller test ADF (p), which is an asymptotic test to show the existence of unitary roots. Referring to the data we have for two series, and by wanting to test their stationarity, we present below the Dickey-Fuller equation form for the series:

$$\Delta NI = \beta_1+\beta_2 t + \delta NI_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta NI_{t-i} + u_t$$

$$\Delta NK = \beta_1+\beta_2 t + \delta NK_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta NK_{t-i} + u_t$$

where the expression that represents the trend is taken into consideration only in one case. If we were in the case that $\delta = 0$ then the series has one unitary root, so the time series is not stationary.

Below are the test results of the Unit Root Test for the series of interest rates with monthly data from August 1995 to October 2014.

		Level		1st difference	
		t-Statistic	Prob.*	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.039584	0.7392	-8.233745	0
Test critical values	1% level	-3.458845		-3.458845	
	5% level	-2.873974		-2.873974	
	10% level	-2.573472		-2.573472	

Table 1: Result of Unit root test for Interest Rates Author's calculations

The series of interest rate has one unitary which means it is not stationary (tv = -1.039584> tk) for any level of importance. If we do the Unit Root test again for the first difference we note that statistics (tv = -8.233745 <TK) for each level of importance. This means that H0 goes down and the series is now a first order stationary I (1).

We follow the same procedure for the series of rate loan. Test results are presented below:

Augmented Dickey-Fuller test statistic	Level		1st difference	
	t-Statistic	Prob.*	t-Statistic	Prob.*

		-1.74266	0.4084	-22.75558	0
Test critical values	1% level	-3.45885		-3.458845	
	5% level	-2.87397		-2.873974	
	10% level	-2.57347		-2.573472	

Table 2 Result of Unit root test for Loan Rates Author's calculations

Arguing in the same way we can say that the series of rate loan is a first order stationary I (1).

3.2Test of Granger causality

To identify which variable affects another, we use the Granger causality test which assesses which is the dependent variable and which can be used independently. To study the causal connection between the interest rate (IR) and loan rate (LR) variables, we rely on the analysis VAR (p) two dimensional, where values of lag moved from two to four.

Granger test results shown in the table below:

Lag	2		3		4	
Null Hypothesis	F-Statistic	Prob.	F-Statistic	Prob.	F-Statistic	Prob.
IR does not Granger Cause LR	17.6916	7.00E-08	12.1017	2.00E-07	10.3068	1.00E-07
LR does not Granger Cause IR	1.31464	0.2706	1.03644	0.3773	1.8388	0.1224

Table 3 Result of Granger causality test Author's calculations

From the execution of the causality test to verify the connection that exists between the variable interest rate and loan rate, were obtained the data presented in the table above. The test is done for different values of lag. From the results we see that there is an unilateral causality connection, on the direction that the interest rate causes the loan rate. So interest rate changes are reflected by changes in the loan rate.

3.3Cointegration

Since the series of interest rate and loan rate are first order stationary they have a connection in the short term, it is necessary to study whether this relationship exists in the long term.
To see if the series are cointegrated there are some conditions that must be completed: the series to be I (1) and their remains to be I (0).
The series of interest rate and loan rate are I (1), as we saw above.
According to Engel-Granger two step method, we build the model Nk = C1 + C2 * Ni (which appears in the Table 1.1 in the appendix). The model built is statistically significant and satisfies the conditions of Goodness of Fit.
According to Engel Granger method is sufficient to show that the remains of this model are stationary and therefore the series are cointegrated between them.
We check whether residues are I (0) by the root unitary test. Test results are presented in the following table

Augmented Dickey-Fuller test	t-Statistic	Prob.*

statistic		-4.726619	0.0001
Test critical values	1% level	-3.458845	
	5% level	-2.873974	
	10% level	-2.573472	

Table 4 Result of Unit root test for residual. Author's calculations

From the table we see that the value of the observed statistics for any level of importance is less than the critical value. From here we can say that the hypothesis H0, that the remains are not stationary series, goes down. So residues are stationary and exactly I (0).

So the series of interest rate and loan rate are cointegrated between them and we can say that the connection between them is stable even in the long term.

Same results are achieved through Johansen test. According to this test, we test step by step by testing the hypothesis:

• H0: r = 0 (series are not cointegrated)

H1: r> 0

The results of the trace and max eigen statistics exceed the critical values by 5%, therefore the hypothesis falls.

• H0: r = 1

H1: r> 1

The results of the trace and max eigen statistics do not exceed the critical values by 5%, consequently hypothesis stands. (Results are shown in Table 1.2 in the appendix). You can say that the relationship between interest rates and loan rates is stable even in long term.

3.4 The time series model

From the analysis above, it is necessary the construction of a model to predict the loan rate depending on the interest rate. The general form of VAR (p) two dimensional model will be:

$$\begin{cases} NI_t = \sum_{i=1}^{p} \alpha_{1i} NI_{t-i} + \sum_{i=1}^{p} \alpha_{2i} NK_{t-i} + \varepsilon_{1,t} \\ NK_t = \sum_{i=1}^{p} \beta_{1i} NI_{t-i} + \sum_{i=1}^{p} \beta_{2i} NK_{t-i} + \varepsilon_{2,t} \end{cases}$$

Where, the remains of the model must have two-dimensional normal distribution.

For the determination of the lag in the VAR model will use the model selection criteria AIC, GCS, HQ etc.

The results obtained about the values of the criteria, with different lags from 1 to 8 are presented on the table below:

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1323.318	NA	497.9511	11.88626	11.91681	11.89859
1	-705.1508	1219.701	2.018356	6.378034	6.469707	6.415042
2	-636.5337	11.60425*	1.348110*	5.974051*	6.166543*	6.075435*
3	-658.2725	4.380466	1.424238	6.029350	6.243253	6.115701
4	-652.6139	10.86048	1.403274	6.014474	6.289493	6.125498

5	-648.0399	8.696772	1.396170	6.009326	6.345460	6.145021
6	-642.3272	10.75935	1.375031	5.993966	6.391215	6.154332
7	-660.1066	11.80425	1.448110	5.974051*	6.432415	6.159089
8	-633.3607	5.073168	1.363611	5.985298	6.504777	6.195008

Table 5 Result of selection criteria VAR Author's calculations

By watching the criteria AIC, SC and HQ we note that the most appropriate lag is 2. So our model is VAR (2) 2 dimensional.

Since we have shown in the first part of this paper that the series are I (1) we can build the VEC model:

$D(NI)_{(t)} = 0.264 + 0.036 * NI_{(t-1)} - 0.037 * NK_{(t-1)} + u_i$ $R^2 = 0.992738$
[81.7843] [-3.35297]

$D(NK)_{(t)} = 2.891 + 0.405 * NI_{(t-1)} + 0.615 * NK_{(t-1)} + u_i$ $R^2 = 0.893220$
[7.32975] [12.6590]

From the analysis is clear that the interest rate increase causes an increase on the loan rate in the short term and long term periods.

Normality of residuals:

In the Graphic 1.1 on the appendix, are presented the residuals of the model, which clearly reflect years 1996-1999, where the Albanian economy had big changes and also had a very high informality.

To use the constructed model for predictions let's see if the residuals have normal distribution, by using the Jarque-Bera test. The test is given as below:

$$JB = \frac{n}{6}\left[S - \frac{(K-3)^2}{4}\right] \sim \chi_2^2$$

We build the hypothesis: $H_0 : u_i \sim N(\mu = 0, \sigma^2)$

The test results are presented on the table below:

Component	Jarque-Bera	df	Prob.
1	4.8101	2	0.2432
2	2.1750	2	0.1230

Since the values of JB are lower than the critical value, it means that the H_0 stands. So, the residuals of the model have normal distribution.

4.CONCLUSIONS

The level of interest rates has a significant impact on the economy. The interest rate is the price of money landed or borrowed. Therefore, its level is determined primarily by the demand and supply for loans of deposits. For example, if increases the demand for loans, then the price of the loan which is the interest rate increases, and the reverse is also true. The

demand and the supply for loans and deposits is affected by the complex of all the decisions that take businesses and people regarding to deposits and loans.

In this analysis we made different tests to point out how is this related to the case of Albania. Initially with the help of unitary root test was shown that the series of interest rate and loan rate were first order stationary. According to Granger test results, was found a unilateral causal link between the series for the case of Albania, on the direction that the interest rate causes the loan rate. So interest rate changes are reflected by changes in the loan rate.

The unitary root test series showed that the residual series is stationary I (0), so the variables are cointegrated even in the long term. The most appropriate is the VAR (2) 2-dimensional and residues have a normal distribution.

Literature

Wang, B., Wang, C., Zhang, X., (2012), "A Research on Interbank Loan Interest Rate Fluctuation Characteristics and the VaR Risk of China's Commercial Banks", *Business School, Hohai University, Nanjing, China*

Si,W., (2014), "Interest-Rate Derivatives and Bank Lending in China", I*nstitute of World Economy, Shanghai Academy of Social Science.*

Ajibola , Arewa, (2013), "Bank credit risk and interest rate volatility- granger causality vs. var-garch approach", *Lagos State University, Lagos, Nigeria, Faculty of Management Sciences, Accounting and Finance Department.*

Weth, M. A. (2002) "The Pass-Through from Market Interest rates to Bank Lending Rates in Germany", *Discussion Paper*, 11/02, Economic Research Centre of the Deutsche Bundesbank, Germany.

Winker, P. (1999) "Sluggish adjustment of interest rates and credit rationing: an application of unit root testing and error correction modelling", *Applied Economics*, 31: 267-277.

Woodford, M., (2003) *Interest and Prices: Foundations of a Theory of Monetary Policy,* Princeton: Princeton University Press

www.open.data.al/sq/lajme/lajm/id/1073/Normat-e-Interesit-ne-Ekonomine-Shqiptare -2009-2014

www.bankofalbania.org/web/Statistika

Apendix

Table 1.1 Estimated Model of loan rate

Dependent Variable: NK
Method: Least Squares

Sample: 1995M08 2014M10
Included observations: 231

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. dependent var	7.438994
S.E. of regression	3.325741	Akaike info criterion	5.249882
Sum squared resid	2532.867	Schwarz criterion	5.279687
Log likelihood	-604.3614	Hannan-Quinn criter.	5.261904
F-statistic	921.7458	Durbin-Watson stat	1.893177
Prob(F-statistic)	0.000000		

Table 1.2 Result of Johansen Test

Sample (adjusted): 1996M01 2014M10
Included observations: 226 after adjustments
Trend assumption: Linear deterministic trend
Series: NK NI
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

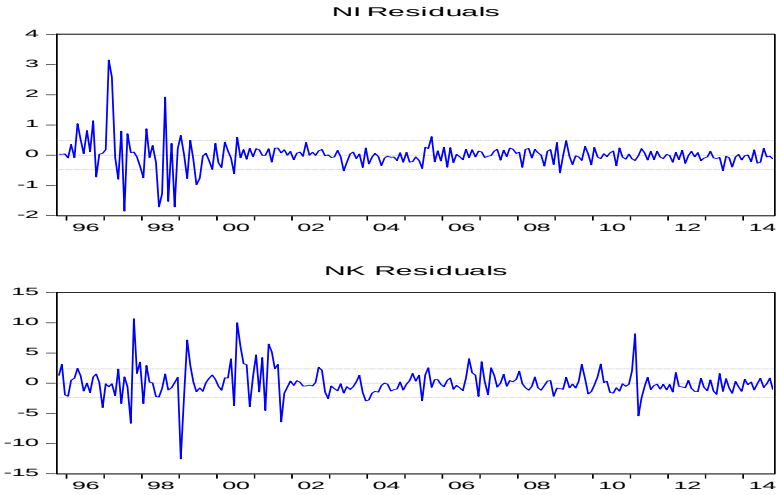
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.067196	17.19553	15.49471	0.0275
At most 1	0.006505	1.474941	3.841466	0.2246

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

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

Graph 1.1. The Graph of VAR residuals



Graf 1. 2 Impulse response