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Measuring Interest Rate Risk through Value at Risk Models (VaR) in Albanian Banking System

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Abstract:

The main methodology adopted by financial institutions to calculate the risk associated with a financial asset is those of Value at Risk. Correct application of this methodology allows these institutions to understand financial risk attached to contracts that they sign.

The main methodology adopted by financial institutions to calculate the risk associated with a financial asset is those of Value at Risk. Correct application of this methodology allows these institutions to understand the risk-bearing financial contracts that they sign.

In the analysis of this paper will apply the theory of Cox-Ingersoll-Ross on the fluctuation of interest rates when the objective is to achieve the forecast performance of the interest rate of a bond in order to benefit fabric-term interest rates to assess a particular bond.

The objective of this study is assessment of the interest rate risk of a bank being set in this way the amount that should be set aside to deal with the risk. By combining these two functions can estimate the probability distribution function of accumulated losses and calculate Value at Risk (VaR) with a confidence level of 95%.

Key words: Value at Risk. Interest rate Risk

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The purpose of this paper is the benefit of a quantitative instrument that reaches valuation of a bank's interes rate risk in order to predict correctly that it should be the amount that must keep aside to meet potential risks. The practical application of this model will be taking a 10-year bond that pays a coupon of 1 year. The market data will serve for determination of the term structure of interest rates. Once the benefit structure can define the term of the bond price by CIR model and can we see his performance. Analysis of the last to make is about the quality of the model and the application of a 1 factorial model. The objective of this paper is to assess the interes rate risk of a bank being defined in this way the amount that should be set aside to deal with the risk.

(Gallati, 2003) Value at risk is a necessary component for risk calculation because it is a quantitative instrument where his objective is proper risk forecast with a reasonable cost. This reasoning implies a selection between different methods that better suit that has an individual portfolio or financial institution. Value at risk is an instrument which, assuming a portfolio of given financial assets accounts maximum loss in which can incur portfolio, which may be caused by the evolution of market prices, in a bow-limit, under a level certain confidence.

Historical Simulation Method

The methods used to calculate the VaR in this paper is *Historical simulation*. This method is placed in an intermediate stage cases that we considered above. Historical simulation is a so-called non-parametric method (Pichler S., Selitsch, 1999).
Unlike other models of historical simulation requires no assumption about the probability distribution of returns. Inside the historic simulation methods exist 2 different VaR, VaR parametric and non-parametric. Historical simulation uses the historical distribution of the assets of portfolio returns to simulate the VaR of the portfolio, based on the assumption that

the portfolio will be maintained beyond the period covered by historical data available.

To apply this model before take as identify different instruments to portfolio and historical data are taken from the returns on a given observation period. Also it assumed as historical distribution of returns is a good predictor of the distribution of returns during the next period of retention.

Each observation t gives us a unique portfolio yield R_t^p and each of them will be produced corresponding gain or loss. The latter will be organized in order of ascending and desired percentile is considered to calculate VaR.

The advantages are many historical simulations. The main one is the simplicity of this model, since the data can be found in a simple and does not depend on assumptions about the distribution of returns.

In fact it should not be assumed that the distribution of returns is normal, *t-student* or any other distribution. It should not be assumed as the yields are independent in time. This allows us to overcome the problem of modeling leptokurtosis which is one of the main problems of the normal approaches to calculating VaR (Dowd, 1999).

Nature non parametric historical simulation allows us to overcome the problem of evaluating the variance, correlation and covariance or calculating the variance-covariance matrix.

In historical simulation correlation it is reflected in the historical record and the only thing we have calculated are current yields. Evaluation of VaR that will benefit will be independent of the risk model is a problem that normal approaches.

Basel 2 Regulatory

Market risk is further defined as the current or prospective risk to earnings and capital arising from adverse movements in bond prices, security and commodity prices and foreign exchange rates in the trading book. This risk arises from

market making, dealing, and position taking in bonds, securities, currencies, commodities, and derivatives (bonds, securities, currencies, and commodities) (CEBS, 2006).

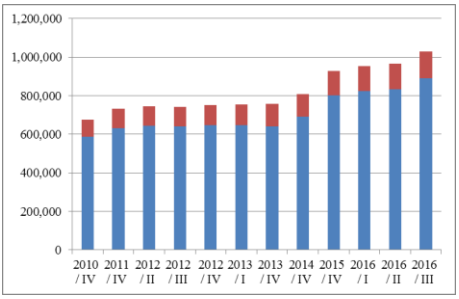
Market risk is categorized into:

- General market risk
- Specific market risk

Performance of regulatory capital to risk-weighted assets (in%)

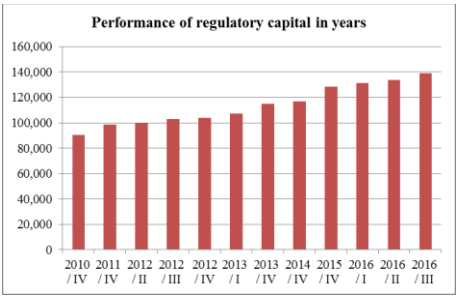
Author Elaboration

The regulatory capital against risk-weighted assets



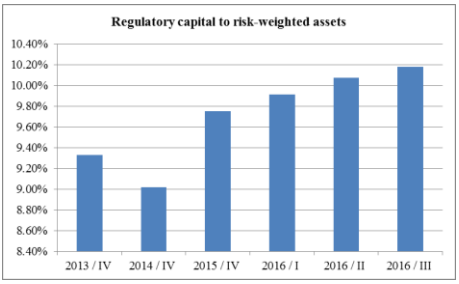
Author Elaboration

Performance of regulatory capital in years



Author Elaboration

Regulatory capital to risk-weighted assets



Author Elaboration

TERM STRUCTURE EVALUATION UNDER CIR MODEL

Cox, Ingersoll and Ross (1985) falls under the category of models of economic balance in overall prices, because it allows us to benefit price of a bond to compare it with the market price, allowing us in this way to understand all those times when the price of the title is not the right value. The main feature of this model is that economic theory does not fit the model based on models which use assumptions of not arbitration.

One factorial CIR model assumes that dynamics of the immediate process of return r follows a process that is described by the following stochastic differential equation:

$$\mathrm{d}r = \alpha(\gamma - r)dt + \sigma\sqrt{r}dW$$

In this case we are dealing with this model where the term is explained by a single variable represented by lower short-term r, which is heteroscedasticity because volatility "r" changes by varying the level of immediate return r. The advantage of this model can be explained by the limited number of parameters to be estimated, and the fact that interest rates in this model are never negativity. Disadvantages of the model can be summarized based on the limitations of assumptions, and in perfect correlation between interest rates.

Operating under the assumption of perfect market, the model CIR bond price is equal to that of model Vašíček,

showing that the term structure of interest rates is given by the following function:

$$P(t,T) = A(t,T)e^{-B(t,T)r}$$

Must consider whether we get a period s, where (s> t), then the distribution of returns of r (s) is a distribution chi-square which is not focused on the expected value and variance given by the following expressions

$$E_t\left[r(s)\right] = \theta + (r-\theta)e^{-k(s-t)}$$

$$Var_t\left[r(s)\right] = \frac{\rho^2 r(t)}{k}\left[e^{k(s-t)} - e^{2k(s-t)}\right] + \frac{\rho^2\theta}{2k}\left[1-e^{k(s-t)}\right]^2$$

The expected value of r (s) is equivalent to what we have in the model variance Vašíček while the expression is more complex. The risk of a headline basis which provides for the payment of a coupon, can be expressed as the weighted average of the risk-based bonds with maturities discounted at different dates, taking as weight, current values of payment:

$$\frac{-B_r}{B} = \frac{\sum cP_r}{cP} = \frac{\sum cPG(\tau)}{\sum cP}$$

This measure of risk to pay coupon bonds that can be expressed in units of time, and in this case is called "stochastic Duration" (Stochastic Duration) and is equal to the maturity of the bond discounted at the same rate risk:

$$\tau = \frac{1}{\sqrt{[\alpha +}} \ln\left[1 - \frac{B_r / B\phi_1}{1 + B_r / B\phi_2}\right]$$

In this case the results of the application are:

MATURITY	T	COUPON	Market price of obligation	Interes Rate	Price of Obligation
01-ago-11	4.35	5.25	104.86	0.827	105.687
01-feb-12	4.85	5	104.21	0.787	104.997
01-feb-13	5.86	4.75	103.63	0.748	104.378
01-ago-13	6.35	4.25	101.11	0.669	101.779
01-ago-14	7.35	4.25	101.08	0.669	101.749
01-feb-15	7.86	4.25	100.96	0.669	101.629
01-ago-15	8.35	3.75	97.35	0.59	97.94
01-ago-16	9.36	3.75	96.71	0.59	97.3
01-ago-17	10.36	5.25	108.55	0.827	109.377
01-feb-19	11.86	4.25	99.75	0.669	100.419
01-feb-20	12.86	4.5	101.76	0.708	102.468
01-ago-21	14.36	3.75	93.48	0.59	94.07

The price of the bond by CIR model:

Maturity	Price of Obligation	Price %	basis point	in %	Price of Obligation under CIR
01-ago-11	105.69	-0.23	-22.11	-0.22%	105.921
01-feb-12	105.00	-0.19	-18.23	-0.18%	105.188
01-feb-13	104.38	-0.02	-1.45	-0.01%	104.393
01-ago-13	101.78	0.09	8.61	0.09%	101.691
01-ago-14	101.75	0.20	19.93	0.20%	101.546
01-feb-15	101.63	0.19	18.41	0.18%	101.442
01-ago-15	97.94	0.18	18.02	0.18%	97.764
01-ago-16	97.30	0.12	12.03	0.12%	97.183
01-ago-17	109.38	0.00	0.08	0.00%	109.376
01-feb-19	100.42	0.00	0.30	0.00%	100.416
01-feb-20	102.47	-0.15	-14.70	-0.15%	102.619
01-ago-21	94.07	-0.15	-15.67	-0.16%	94.217

Value at Risk	
VaR	
Int.confidence.(α)	**Historical Approach**
95%	***1559.678***

Conclusion

Analysis of the dynamics of interest rates is done by reference to specific economic theories that explain the configuration of the stars of the maturity structure of interest rates, allowing us to provide information about the expectations regarding the performance of the market.

Analysis of different models used to calculate the value at risk, understood as the loss of value in a portfolio of fixed instrument, they can occur as a result of changes unfavorable to one or more interest rate risk, in a given horizon of holding period.

For banks considered that the application of historical simulation is not an appropriate tool to measure value at risk because systematically underestimates the risk of portfolio, especially when there are optional products.

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