The historical VaR (Value at Risk) in a low-rate context

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1. Introduction

The VaR is defined as the maximum loss on the value of an asset or portfolio that will be incurred with a given (low) probability over a given time period. In other words, it is the worst expected loss for a given time period and a given confidence level. The historical method for computing the VaR consists of two steps : the computation of the VaR for a period of one day or a few days and the annualization of the resulting value by the square-root-of-time rule. The VaR depends upon three parameters :

(a) the distribution of the portfolio gains and losses,

(b) the confidence level that enables one to compute the probability of achieving a return greater than or equal to the VaR, and

(c) the time horizon during which the asset is held.

The most widespread method for computing the VaR is the historical method, which uses scenarios of risk factors in order to obtain the distribution of the portfolio gains and losses. Often these scenarios are daily or weekly scenarios. To compute the yearly VaR, one usually multiply a VaR for N days by the square root of N, under the following (implicit) assumptions :

(a) the distributions are normal (one assumes that the price of a financial instrument follows a log-normal distribution), and

(b) the portfolio gains and losses over time are independent from one another.

2. Research question

How does one compute the historical VaR when the standard hypotheses do not hold?

3. Issues with the current method : unrealistic risk measures

For a long-term investor, the method for computing the yearly VaR presented above may generate risk levels that are not realistic, i.e., overestimated or underestimated. For instance consider a Canadian investing in fixed-income instruments. If we use weekly scenarios with long-term rates for the last ten years, the yearly VaR of interest rates roughly equals 3%. Since the current interest rate equals 1,3%, this estimation of the VaR implies that long-term interest rates of -2% are possible in Canada. This implication follows

(a) because one used, to simulate the portfolio gains and losses, scenarios that took place in economic and financial circumstances different from the current ones, and

(b) because the annualization of the VaR was obtained by assuming that the portfolio gains and losses were independent and followed a normal law.

4. The difficulties encountered

The historical method for computing the VaR (which consists of two steps) exhibits two difficulties that must be solved. First one must simulate risk factors scenarios by taking the current circumstances into account. For instance, given that low interest rates are observed for the first time in Canada, how should one simulate Canadian interest rate scenarios? The second challenge is to improve the annualization method, or more generally, the method for computing the VaR over a period longer than one year. The square-root-of-time rule is a standard one, even if the necessary assumptions do not hold. How can one annualize the VaR without overestimating or underestimating the risk?

No global and robust solution has been proposed to remove these two difficulties, although some partial solutions have been proposed in recent research work. A solution is deemed global and robust if it takes into account diverse economic and financial circumstances (observed in the past or likely to occur in the future), as well as the consistency of VaR estimates for a portfolio including several types of financial assets : bonds, shares, currency, etc.