

# Some Aspects of the Practical Problems Arising upon the Application of Value-at-Risk

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**Summary:** Bulgaria soon will become member of united Europe. This historical fact will no doubt cause changes in the economic practice and theory, particularly in the field of identifying and measuring risk exposures. The modern concepts in the field suggest that a relatively new method of risk assessment – Value-at-Risk – is to be applied. Despite the method's wide popularity, it is important to be aware of its potential weaknesses and problems during its application.

The main criticism, to which VaR is subject, is based on the assumption that the portfolio return will follow the normal distribution curve.

The author of the article presents an alternative, based on two tests, which could give an idea how accurate VaR is, calculated according to the premises regarding time horizon and the level of probability.

The sphere of implementation of the two methods for predicting the values of the conditional normal distribution, recommended by RiskMetrics, are analyzed.

At the end the author suggests a few alternatives for modifications and application of the main principles of VaR in the area of corporate business.

**Key words:** Risk; Value-at-Risk; Disadvantages of VaR; Standard distribution; Portfolio Risk; EWMA; GARCH;

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Bulgaria is about to become a full-fledged member of united Europe! This historical step will open a brand new page of local business. It is without any doubt that the Bulgarian economy will sooner or later become integrated within the European and world markets; however, the question that still remains open is what new forms of risk might appear and what consequences they might give rise to.

The effects of the lack of adequate risk estimation are clear. The most significant of them has been known as the bankruptcy of the 20<sup>th</sup> century. Among the biggest financial failures are the names of Barings Bank – losses over 1 billion USD; Orange County – losses over 2 billion USD; Procter & Gamble – losses over 200 million USD; Daiwa Bank – losses over 2 billion USD; Metallgesellschaft – losses over 1.5 billion USD. These imposing figures have already been subject to much research and investigation. As a result we could summarize that there are two features to all of them, i.e. the losses are caused by two factors – the trade in derivatives and innovative financial in-

struments, on the one hand, and the lack of adequate risk-control system, on the other.

In Bulgaria there are numerous private companies, commercial banks and investment brokers, who trade actively on the world biggest bourse floors. Among the main aims of the local dealers in Bulgaria is the establishment of a paper cover for the physical shipment of goods, creating some form of mutual funds or securing their customers' interest. The use of innovative and derivative instruments, typical of the modern financial engineering, is expected to grow rapidly soon after the economic integration of the country. All this attaches significance to the causes that determined the biggest financial failures.

As far as derivatives are concerned, they are no threat to anybody. The problem stems from their incorrect and hazardous practical usage. Typical examples are the collapses of Barings Bank and Orange County, which were caused by the misinterpretation of market trends and power abuse. These two factors determined catastrophic risk levels. Taking into account the fact that in the modern highly dynamic corporate environment there can hardly exist unsolved problems for a long time, risk control has been recently effected via the relatively new system of Value-at-Risk. Developed by JP Morgan in the mid 80<sup>ties</sup>, this system was originally designed to provide an overall assessment of the risk, related to all instruments held in a portfolio within 24 hours. Nowadays on a global scale VaR by far exceeds its original design as a short-term estimator of financial risk. There are lots of corporate risk management strategies based on VaR. The method has been successfully applied in the banking sector- the new Basel regulations for the determination of the capital adequacy are the best evidence in this respect.

The advantages of VaR are beyond any doubt. Among its key advantages is its easy application. Even for non-professionals the risk measured in monetary terms, which indicates the maximum possible loss, sounds reasonable. Secondly, VaR encompasses the risk connected with all financial instruments, which are part of the portfolio in their interrelatedness. That is VaR takes into consideration the fact that a specific change in the market environment could bring about loss or profit of different instruments.

Despite its mass-scale application, VaR should not be considered a universal panacea. This method, as all other well-known in the scientific sphere in Bulgaria methods, has its disadvantages and drawbacks. Knowing the weaknesses of the method is significant for its application. This could help many researchers and experts in their VaR- based studies.

The most popular method of computing VaR is variation-covariation. It is based on the assumption that the portfolio return will follow the normal distribution curve. And indeed – in a long-term perspective this assumption looks logical, since the quotations of certain indices are equally likely either to rise or fall. And yet, what could be expected with regard to the quotations of crude oil? At present the chances that its price will rise exceed those of a dramatic drop. In such an environment it is highly likely that the so called "fat tail" should take place. If the properties of the normal distribution curve are used, a much lower than the real value of expected loss will be predicted. These circumstances necessitate that a special test to verify the normal distribution of the returns in the analyzed portfolio be included. There is a wide range of alternatives. An easily interpretable test is Kolmogorov- Smirnov, which is an integral part of SPSS (SPSS is a special statistical toolpack). The test allows creating charts to show the difference

between theoretical normal distribution and the real distribution curve. With the help of SPSS, the specialist could compute coefficients of relevance, which provide a straightforward answer to the question of whether the analyzed time series could be regarded as a normally distributed one. Given a positive answer, based on specific measurements, the expert may use the properties of the area below the normal distribution curve.

Another problem during the practical calculation of VaR is the correct setting of the confidential level. In practical terms there has been a mismatch between the instructions issued by different institutions. In risk metrics technical documents, it is suggested to assume 95% for confidential level. This measure has been practically applied by numerous world companies. On the other hand, Basel fixed the confidential level at 99%. If we are sure about the future risk forecast, we needn't worry about future trend – it might support the higher values of the confidential level. The high confidential levels result in significantly higher VaR-based risk values. Having in mind that risk estimation is not an end in itself, risk managers should set aside resources for hedging risk. The bigger the risk, the greater the amount of resources put aside. This presupposes that the company should give up investing resources set aside in more lucrative enterprises, but should rather plough them in a special hedge position. Practically creating greater hedge positions means lower profitability, which makes the company unattractive to potential investors. This problem could be solved with stress testing and/or back testing. Both these tests present a supplement to VaR; their purpose is to measure the precision of VaR. In its nature, the first method is essentially akin to the scenario analysis – a hypothetical alternative is arrived at, based on the assumption that the key risk market factors related to the analyzed port-

folio will change simultaneously following the worst possible alternative. Based on this hypothesis the value of the portfolio is recalculated and the loss is compared with the maximum potential figure, predicted by VaR.

Back testing is recommended as an obligatory part of the risk analysis via VaR in the bank sector. Basel regulations are liberal regarding the choice of VaR calculation methodology, but there is a rule that in the last 250 observations there should be less than 5 that exceed the value of the loss, predicted by VaR. If there are more than 5 exceptions, the methodology should be changed, or there is second possibility to correct the calculations by changing the value of several special multipliers.

The same test should be applied regarding the reliability of the measure, calculated on the basis of different amounts of real past data relating to the key market risk factors in the model. The appropriate amounts of information has always been a controversial issue. An analysis based on relatively recent data would not be reasonable, since the center of the distribution will hardly be described precisely enough and the sample is unlikely to be representational. On the other hand, a wealth of historical data will cause distortions, since certain events are unlikely to reoccur in the future.

The proponents of the VaR often claim that its main advantage is the aggregated estimation of all types of risk, arrived at by a revaluation of the portfolio. Despite this commonly held view, should we assume that VaR gives an adequate estimation of the liquidity risk? VaR is based on the revaluation of the portfolio or its sensitivity to the change in a certain market risk factor. The alternative – i.e. to close a position should it be causing losses – is not taken into account. The assumption that there will be no structural changes in

the portfolio is reliable in the short run; however this assumption is highly unlikely from the perspective of a one-month period. The problem with liquidity and the lack of secondary market becomes obvious if an optional instrument is included in the portfolio. Such specific financial instruments usually are developed by banks and brokers for the special and individual purposes of their customers and in this sense are unique. In such cases VaR could not be used as a means for risk assessment because it is useless to reevaluate a position to the market in case it could not be really sold. This special case should be considered with great caution, because there are many special instruments that incorporate the specific characteristics of few derivatives simultaneously.

It has been proven a long time ago that assessments based only on historical data could not accurately predict the future bourse trends. The JP Morgan system- RiskMetrics- recommends two statistical methods for calculating forecast of the future conditional standard deviation- EWMA and GARCH. These two methods are mainly used in variation-covariation method for VaR calculation. The problem is that these two methods predict different values for the same parameter.

Empirically it has been found that lengthening the time horizon and raising the confidential level affects the deviation between the forecasts. Therefore the inappropriate selection of a forecasting model could result in unpredicted losses, especially when the risk assessment model has long horizon. Usually when the markets are stable, without any fluctuations, there is no significant difference between the standard deviation suggested by both models. On the contrary – the forecasts will differ significantly on markets of high fluctuations. Thus the importance of forecasting technique selected for the reli-

ability of the risk analysis. The RiskMetrics-developed systems heavily rely on EWMA. Having in mind that EWMA usually comes up with lower forecasts than those of GARCH, it may be assumed that EWMA better describes when the time series is close to the normal distribution, whereas GARCH better describes distributions with fat tails; thus it should be used when the distribution is abnormal. It has been proved that GARCH comes up with much more reliable results when it comes to forecasting standard deviation on currency markets or stock markets. And yet GARCH's has a major disadvantage: the forecast does not account for the asset's ROI brought forward positive or negative value.

Originally VaR was meant to be a short-term financial risk measure. Today this method has been increasingly applied by the corporate sector, which imposes some modifications to the original. It should be specifically noted that risk management from the perspective of all possible effects likely to occur with certain financial key figures, encompass a broader range of factors, which are not limited to financial risks. Form a methodological point of view, VaR is focused on the changes in the portfolio value, consisting of securities of a maturity of one day to a month. On the contrary, the corporate risk measure should evaluate the impact of different market risk factors on the company performance for a period ranging from two months to two years. To this effect, based on the VaR rationale, Earnings-at-Risk; Earnings per Share-at-Risk and Cash flow-at-Risk are applied in the field of corporate risk management. The first method aims at specifying the risk connected with company earnings; the second method shows the maximum decline in earnings-per-share at a given probability level; the third illustrates the worst possible future structure of the cash-flow statement within a given time limit. The rationale underlying the analysis logic is the same as the original VaR's;

therefore the same disadvantages and difficulties might occur in the described cases.

Despite all criticisms, in global aspect VaR enjoys wide popularity at the moment. This is due to the fact that currently there is no adequate alternative as a comprehensive, comparable and a relatively easily applicable measure of risk, derived from several different types of financial assets combined in a single

portfolio. The weaknesses of the method do not suffice to have its application denounced. Being aware of the deficiencies of VaR would contribute to the greater precision of the risk assessment and evaluation and prevent some of the described dangers. Having in mind that the new types of danger presuppose the application of improved and state-of-the-art evaluation methods, VaR will certainly find its place in risk management in Bulgaria. ~~VIA~~