

APPLICATION OF THE VALUE-AT-RISK METHODOLOGY ON THE CAPITAL MARKET

VĂDUVA MARIA

UNIV. ASSOC. PHD AT CONSTANTIN BRANCUSI UNIVERSITY IN TÂRGU-JIU

e-mail: vaduvamaria09@yahoo.com

Abstract

The analysis of the VaR framework methodology will begin by defining the concept and highlighting its advantages and disadvantages, followed by an examination of different VaR calculation methods for portfolios exposed to market risk. VaR serves to evaluate the total risk of a portfolio of financial assets, expressed by a single value. Its use has grown significantly among corporate treasurers, investment fund managers and generally all financial institutions. The VaR methodology is a way of assessing risk. This concept is not recent. In reality, many financial institutions around the world were already applying procedures similar to value at risk (previously known as money at risk or dollars at risk). Risk is an inevitable aspect of investment and finance that must be properly assessed and managed. A commonly used method to quantify the risk of loss associated with a portfolio or investment is known as Value at Risk (VaR). You can think of it as a personal dollar risk calculator that evaluates all the pros and cons of an investment, helping you determine whether you're in a favorable or unfavorable situation. The purpose of this article is to introduce you to this risk model and show you how you can apply it more effectively in your company.

Keywords: capital, metode, model, risc,

1. Introduction

The Value at Risk (VaR) method has become one of the most frequently used tools in bank management to assess potential losses in a foreign exchange portfolio. This research aims to determine the maximum loss associated with the euro caused by exchange rate volatilities by applying the VaR method using historical simulations as a basis.

VaR is an estimate of the maximum loss in value of a portfolio, with a certain probability, over a specified time period[1].

The benefits of value-at-risk estimation derive from its ability to quantify, in numerical terms, the level of risk associated with a portfolio at a given moment, as well as the risk of a specific open position (in capital market financial instruments, in foreign , goods or credits granted) by an economic agent, especially a financial-banking institution.

Thus, its role consists in facilitating a more efficient allocation of capital by banks, in defining the minimum risk they are willing to assume, acting as a useful tool for central banks, but also as a performance evaluation method. In the recent history of the financial sector, there have been times when applying a VaR methodology could have prevented significant losses and even bankruptcies.

The VaR methodology has not proven to be a universal solution for financial risk management, however, it has a number of limitations.

A first critical observation is that, although VaR models manage to estimate the level of market and credit risks with relatively high accuracy (this statement should not be considered absolute), they are not able to provide solutions for other types of risks. Another limitation of the methodology is related to its reliance on correlations and covariances between assets. Some views argue that VaR should not take this data into account to highlight losses in extreme conditions such as a stock market crash, while others argue otherwise.

Neglecting correlations can lead to extreme VaR estimates, resulting in excessive losses that do not reflect reality – crises appear as isolated events caused by chronic market dysfunctions. The integration of correlations and covariances, given their volatility, may lead to an underestimation of the capital needed to cover losses and, by implication, the effective risk in the context of VaR.

Third, from an accounting perspective, it is essential to promote a VaR calculation model that prevents banks from being tempted to use models designed specifically to obtain lower than actual values in order to avoid capital adequacy requirements of central banks.

The existence of a single model would limit the flexibility needed to adapt to the unique specificities of each bank's portfolio. A potential problem could arise in the event of a stock market crash, where all banks, using the same market risk assessment model, would react in very similar ways, which would intensify market volatility.

A limitation of using VaR is the assumption that asset returns follow a lognormal distribution, which does not reflect reality because price fluctuations are larger than the normal distribution suggests. This can lead to underestimating extreme risks, including price crashes[1].

Value at Risk (VaR) is a statistical method used to assess the maximum possible loss that a portfolio or individual financial instrument could experience in a specific period, given a certain level of certainty. In short, VaR answers the question: What is the maximum amount I could lose after X days, with a probability of X%? Let's take as an example a portfolio with a VaR of 10% for an amount of USD 1 million over a one-day period. This indicates that, based on the assumptions and data used in the VaR model, there is a 10% probability that the portfolio will experience a loss greater than \$1 million on that trading day.

2. The advantages of value at risk

VaR has several key advantages that make it a measure of risk widely used by banks, hedge funds, asset managers and other financial institutions. This is a tool capable of analyzing a variety of economic positions and comes with a number of benefits, including[2]:

- Evaluates the total risk of the portfolio through a single value.

VaR calculates total portfolio risk by aggregating risks across all asset classes and sources. This provides a simple method to compare various offices, investments or companies using a single risk metric.

- Enables risk-adjusted performance assessment

By estimating possible losses, Value at Risk contributes to more relevant indicators of risk-adjusted return and performance compensation. Thus, an investment that offers returns of 15% but has a risk VaR of 20% is considered less safe than one with returns of 12% and a VaR of 10%.

- Assess risk and set limits

Similarly, organizations can set VaR caps at the portfolio, department or trader level to control risk exposure across the firm. Traders have the responsibility to keep the VaR limit constant.

- It allows the distribution of capital according to the level of risk.

Financial regulators offer institutions the opportunity to set regulatory capital requirements by using internal risk assessment models instead of conventional portfolio calculation methods.

- Ensures uniform risk communication.

By measuring the percentage of risk in a clear and standardized way, regulators, senior management, traders and investors can quantify, discuss and evaluate market risks. VaR provides a common statistical language, frequently used for various tasks, in a unified way across all markets.

3. Methods of determining Value at Risk

Before starting the actual calculation of VaR, any bank or securities firm must establish two essential aspects: the time horizon for estimating risk and the level of risk tolerance[2].

After the risk horizon and risk tolerance percentage have been determined, VaR is determined as the difference between the expected value of the portfolio at the selected risk horizon and the lowest value of the portfolio (also known as the quantile) at the same horizon, estimated with a probability of 95%. Regardless of the type of distribution that portfolio asset returns follow, the methods used to calculate VaR remain constant.

Next, we will refer to a type of risk, named after a Greek word, from the three essential in hedging operations (delta, gamma and vega). For example, the vega risk increases as the value of the vega indicator becomes higher. An instrument has no vega risk if the value of this indicator is zero, which means that the price of the instrument is not affected by fluctuations in volatility.

In the specialized literature, certain methods for calculating VaR are identified, such as[3]:

a. the delta-normal method (also called the parametric method, due to the assumption of the use of the normal distribution, or the variance-covariance method). The basic assumption of this method is that the returns on assets in a portfolio obey a normal distribution. The total portfolio return is calculated as a weighted average of asset returns, given their initial value. The variance-covariance method, which uses the variance-covariance matrix, allows the estimation of market risk for an extended portfolio of zero range securities. This implies a linear payoff function, where the delta is constant and the range is zero. To calculate the variance-covariance matrix, there are two distinct methods, as well as a third that is a combination of the two. One approach would be to use historical data to calculate the covariances between assets, based on the assumption of heteroscedasticity of the variance (which implies a dependence on the time variable). A second approach is based on option premiums and the premise that the market provides the most relevant information about its own working mechanism. Thus, the risk measures (covariances) obtained in this way most faithfully reflect the current reality. Criticisms of the delta-normal method emphasize the presence of "fat tails" in the real distributions of gamma-zero asset returns, suggesting that prices are more prone to extreme values than the normal distribution implies. This leads to an underestimation of the maximum estimated loss for a given risk horizon. It does not consider extreme situations that could occur during the analysis period and that cannot be anticipated at present. This is a common limitation of all VaR calculation methods based on historical data. The method focuses only on delta risk, which restricts the assessment of VaR to portfolios with non-linear instruments, such as options and mortgages, where the range is not constant. This limitation is due to the fact that delta can vary rapidly in wide range conditions, and significant losses can also occur at intermediate values of the rates, not just at the extremes.

b. the delta-gamma method (or the Greeks' method) - To counter the disadvantage of the previous method, one can resort to the delta-gamma method, so named because it also takes gamma and vega risks into account. However, the method has a major drawback: the excessive complexity of the calculations. As more types of risk (delta, gamma and vega) are added and the instruments in the portfolio are diversified, the complexity of the analysis increases significantly (geometrically). An efficient alternative to this approach is Monte Carlo simulation. For this reason, the delta-gamma method has a rather limited applicability.

This is the most robust and efficient approach to VaR estimation. The process involves two stages. First, the risk manager defines a stochastic process for the financial variables as well as its associated covariances. Dummy prices are then generated for all variables included in the model, resulting in the simulated value of the portfolio for the selected risk horizon (one day, one month or more). All these simulated values are then used to create a distribution of returns, from which the VaR is calculated. The efficiency of the method is based on its ability to assess delta, vega and gamma risks, as well as the ability to include extreme values and any type of distribution associated

with asset returns. Its main disadvantage lies in the complexity of the calculations, which are even more numerous than in the case of the delta-gamma method. The latter, however, lacks the assumption of the normality of the distribution of dS . Therefore, the significant cost of implementing this method makes it less affordable, and some banks opt for one of the other four alternatives. There is also the risk associated with possible errors in the model used from the start. Thus, adopting such a method can amplify operational risk.

c. method of historical simulations - This method is very similar to stochastic simulation, but instead of using fictitious returns, it is based on returns calculated based on historical rates. A risk horizon is established for estimating the maximum loss of a portfolio, using historical rates with time intervals equal to the risk horizon. The first course used is the last official course, and the total number of courses can vary between 40 and 60.

The benefits of this method include: it covers all types of risk (delta, gamma and vega); it is not based on specific valuation models or a specific stochastic market structure; it is not limited to a certain type of distribution.

On the other hand, this method has two disadvantages: in practice, asset returns are not identically and independently distributed, there are periods when clusters of high volatility and others of lower volatility are formed. Thus, the method fails to predict whether or not a first-type cluster will appear at the risk horizon, leading to lower than actual VaR estimates; the method treats all historical data with the same relevance, without assigning a greater weight to recent returns, which could contain significant information about the evolution of short-term returns; the implementation of the method becomes difficult in the case of very complex portfolios[3].

d. RiskMetrics methodology for market risk assessment used in the Romanian capital market - RiskMetrics represents a high-quality tool for risk managers, but does not guarantee specific results. By "specific results", the authors of the document refer to the clear provision of the real risk dimension and hedging solutions. They emphasize that no analysis, no matter how sophisticated, can replace the experience and judgment of a competent risk management professional.

This methodology provides a set of tools that allow capital market participants to assess exposure to market risk related to portfolios composed of currencies, equities, fixed income securities, commodity products (such as oil, gold and other commodities) and their associated derivatives. The key word in the definition, which highlights the relevance of the methodology in risk management, is "estimate". It indicates that the methodology provides support, not a one-size-fits-all solution to the complexity of market risk management.

RiskMetrics uses a portfolio's or asset's return expressed in continuous time, meaning it is based on logarithmic price changes, not relative (percentage) changes. The main assumptions and features of the RiskMetrics methodology: [4]

- The asset price evolves according to a stochastic Ito-type process;
- Relative price changes are not identically and independently distributed;
- The variance of returns shows heteroscedasticity, which means that it is influenced by the passage of time.
- RiskMetrics mainly focuses on making forecasts over a period of one day. It also provides useful information for developing forecasts with a risk horizon of one month.
- Considering that the risk horizon is very short (one day), the expected value of the return in this interval is considered to be zero, i.e., from a mathematical point of view, $E(r) = 0$. This assumption influences all calculations, including estimation of covariances.
- The basic model used to estimate volatility and correlations between time series is the EWMA.
- J.P. Morgan analysts have determined, through calculations based on empirical data, that the lambda value (degradation factor) is 0.94 for a one-day horizon and 0.97 for a month.
- Uses three of the five previously mentioned VaR estimation techniques: the delta-normal method, the delta-gamma method, and Monte Carlo simulation.

Considering the specificities of the capital market in Romania, the methodology can be used for portfolios made up of shares (I consider that options do not fit for the reasons mentioned at the beginning of this subsection) [5].

As mentioned before, to calculate the VaR of a stock portfolio, the delta-normal method is applied. The RiskMetrics methodology presents some differences from the previously mentioned parametric method. The text describes a method for analyzing the correlations between stock prices in a portfolio, which is based on the market portfolio instead of correlation coefficients between time series. This involves using a model that establishes the relationship between the return of a stock in the portfolio and the return of the stock market index.

The management process is cyclical and includes a set of specific activities carried out by managers. The transition from the theoretical to the practical part requires an ordering of them in management positions. [7]

5. Conclusions

VaR is a fundamental methodology used to estimate the potential loss of financial institutions and other economic agents on the capital market, integrating advanced techniques and models, such as RiskMetrics, GARCH or stochastic volatility, depending on the chosen risk horizon.

The development of VaR has been so significant that it now covers a wider range than the traditional approach to market risk. Of the two directions that make up the general approach to VaR, I have focused exclusively on one: market risk. Another severe criticism of the model is its inflexibility with respect to the risk horizon. A financial analyst in the capital market can only make short-term forecasts, of a day or a month, without being able to transform the obtained VaRs into estimates of market risk for other time horizons.

VaR is currently used to assess market risk, although there have been suggestions to apply the same concept to measure credit risk and operational risk.

VaR has gained significant importance because it represents the first joint attempt by market participants to develop a standardized method for assessing the risks associated with assets, whether it is a specific asset, a portfolio or the entire balance sheet of an organization. However, it is important to emphasize that VaR is only a statistical estimate, based on the analysis of the distribution of historical data.

Value at Risk (VaR) is a statistical tool that estimates the probability of potential losses. Value at Risk (VaR) is one of the most popular and widely used methods for assessing and managing market risks, including currency, interest rate and stock market risk. VaR (Value at Risk) is a tool that helps risk managers assess market activity and allocate resources efficiently, preventing overexposure to risk. It also supports regulatory authorities in establishing the capital required to cover the market risks of financial institutions.

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