

ECONOMICS

PROBLEMS ASSOCIATED WITH THE DETERMINATION OF RISKS IN THE FINANCIAL MARKETS

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ABSTRACT

The article is devoted to the problem of measuring risks in financial markets. From various complex scientific definitions, it synthesizes an intelligent definition of entropy. Furthermore, risk is considered a probabilistic criterion, described in connection with the normal probability distribution. The next step suggests a method for calculating the risk index for practitioners not burdened with deep mathematical knowledge, using the covariance index and the determination of the Sharpe ratio. Recommendations are provided at the end of the article.

Keywords: risks, covariance, correlation coefficient, probability distribution

Introduction

Globalization associated with the complication of economic relations leads to higher ambiguity in the analysis of the financial activity of economic entities.

The concepts of volatility, entropy, and instability have become inseparable in meaning and methodological content. The volatility as a measure of temporal series characterizes the instability of the financial market behavior. Entropy is treated as a measure of the stability of the financial market. Entropy characterizes the amount of the system order. At the same time, entropy can show the amount of the system disorder. Thus, chaos and order are not antipodes.

In modern scientific literature, authors compete in complex definitions of entropy. According to the author of this paper, the most comprehensible definition of entropy is the logarithm of the number of states. If we remove the mathematical formulas, it becomes clear that the greater the number of states, the greater the possible outcomes. If the two states are heads or tails, then the degree of certainty is maximum, and the degree of uncertainty is minimal, respectively. As the number of states increases, the system shifts from order to chaos. Order and chaos represent risk categories in financial markets. As a result, issues related to determining risk indicators of the financial markets become a top priority.

Risks associated with financial markets

Hypothetically accepting that the change in risk indicators obeys the normal probability distribution, then the total risk of the portfolio depends on the number of shares according to the law of opposites. Moreover, the less dependent the fluctuations in the prices of portfolio shares on one another, the lower the risk of the portfolio is. Similar thought in econometric terms means that the lower the correlation coefficient between the individual stocks, the lower the risk of the portfolio. In other words, the problem pops up when determining a measure for the joint variability of prices of several assets, which is an indicator of their covariance. Therefore, if we have, for ease of calculating, two shares (A and B), then the measure of their joint variability will be the following:

$$cov(A, B) = \sum_{i=1}^n (X_A - \overline{x_A})(X_B - \overline{x_B}) \cdot p_i$$

The research carried out within the framework of this paper has confirmed that the covariance indicator, as opposite to the average values (mathematical expectations), is an informative indicator for the study of the financial markets. If the

value of the modular covariance is large, then depending on the sign, the asset's profitability indices change according to the direct or inverse law. If this indicator changes around zero, then this marks a random nature of profitability fluctuations.

This paper is replete with statistical terminology, so we will focus on some classic concepts that have transferred from mathematical statistics to economics.

A probability distribution is the set of different possible outcomes with the probability of their occurrence. We are interested in discrete probability distributions since, in our problems, the number of outcomes is finite, and each outcome has its probability of occurrence. Therefore, by multiplying each outcome by the probability of its occurrence and then adding them up, we get a weighted average of outcomes.

The quantitative risk analysis is carried out in two stages. In the first place, it is necessary to determine the expected return:

$$\bar{x} = \sum_{i=1}^n x_i \cdot P_i$$

where x_i - i - stands for the possible outcome, and P_i - represents the probability of i - an outcome with n - possible outcomes.

The measure of the distribution from the expected average return is the variance indicator:

$$\sigma^2 = \sum_{i=1}^n (x_i - \bar{x})^2 p_i$$

Thus, the dispersion is the mean square of the deviations. To begin with, the average value is taken. The difference between the initial indicators of the profitability of a particular asset and their average values are also taken, and all these values are squared. The resulting values for each security are added and divided by the number of values. The dispersion indicator is rarely used in the behavior analysis of financial instruments due to the inconvenience of the calculated units of measure. They are obtained as second-degree equations. For this reason, the square root of the variance is to be extracted to get a very convenient indicator of the standard deviation. For example, the mean-square deviation, or as it is also called, standard deviation, is used to create an indifference curves graph of the dependence of risk indicators and expected profitability.

The aim of all investors is the same – to maximize profit with minimal expenditure. At the same time, strategies applied to solve this problem may be different. Differences can be of both objective and subjective nature. The differences can be eva-

luated based on the individual approach of the particular investor. So, investment preferences are formed depending on the investor's approach. Hence, investment preferences are a set of characteristics a particular investor employs to choose a financial instrument and the platform where this instrument is traded. The author regards these preferences as the handwriting of the investor.

The level of an investor's income is an important characteristic that forms an investment preference. The income level determines the upper threshold of risks an investor can take for high profits. According to the author of this paper, the following characteristic forming investment preferences is the level of investor awareness. Furthermore, the initial awareness should be about the issuing company's financial condition. The next level of awareness includes information about a particular financial market and the macroeconomic situation. Awareness in this respect refers to the volume of and quick access to the information. The author of this paper identifies six criteria for establishing investment preferences. The three include direct criteria, and the other three are derivatives. The author refers to the level of return on assets (excess of income over expenditure), risk level, and financial instrument liquidity as direct criteria. Derivative criteria include the frequency of transactions in a particular financial market, the ratio of profitable transactions to total transactions, and the number of market participants. Derived criteria can be indirectly defined through the indicators of direct criteria.

If it is possible to determine the level of risk, the investor attempts to maximize the expected profit within a predetermined risk range. Otherwise, the investor must diversify investments within an expected rate of return, thereby reducing risk indicators. For clarity, this can be shown on a graph of indifference curves. Suppose we postpone the risk indicators in the form of standard deviations of the σ along the abscissa axis and the indicators of profitability (expected) γ along the ordinate axis. We can get many graphs on the same coordinate plane in that case. The investor will choose from the maximum return at maximum risk to the minimum return and minimum risk. The investor will be able to choose an alternative depending on the situation. This problem can be solved analytically by minimizing the continuous function with undetermined Lagrange multipliers.

If the financial market can be described within the hypothesis of the efficient market, where the price of each financial instrument is close to its investment value, and the market is anti-persistent where today's trading does not mirror or reflect yesterday's trading (3) volatility in such markets can be analyzed using such parameters as the opening price of the research period, the price at the close of the

research period, the maximum price for the research period and the minimum price for the research period and statistical methods.

Hedging as a method of reducing risks

Contract hedging is considered one of the most common and effective strategies for managing market risks. Hedging can insure the hedger against losses, but unlike contract insurance, it also deprives the insured of the opportunity to take advantage of favorable market conditions. Insurance by hedging a contract implies the opening of an opposite position in the financial market (1). The hedging mechanism implies a decrease in the variance of the profit of a financial market participant, and, as a result, the total cash flow becomes more predictable. Hedging can be complete or incomplete. Under full hedging, the required number of futures from contracts is defined as the ratio of the number of futures from contracts to the number of units of an asset in one future contract.

$$N_F = \frac{N_h}{N_{h/F}} \text{ where } N_f - \text{required number of future contracts.}$$

In real life, it is hardly possible to hedge all contracts in an investment portfolio. For the assessment of the total risks, it is necessary to define a ratio between the hedged assets and the futures contracts. This ratio is determined by a dimensionless variable, which is called the hedging ratio. Considering this, the assets' portfolio is defined as

$$V_p = V_s - h \times V_f$$

where V_p – represents the value of the portfolio

V_s – represents the value of the hedged asset

V_f – represents the value of the future contract

h – represents the hedging ratio

To eliminate the risk of losses with a small price change, the following equation must be satisfied:

$$\Delta V_p = \Delta V_s - h \times \Delta V_f = 0$$

From this formula, the hedging ratio is derived as:

$$h = \frac{\Delta V_S}{\Delta v_F}$$

The hedging ratio represents the strength of the statistical relationship between the standard deviation of the price of the hedged asset and the futures price:

$$N_F = \frac{N_h}{N_{h/F}} h$$

ρ – stands for the correlation coefficient between the price of the hedged asset and the futures price.

Considering the hedging ratio, the formula for determining the required number of futures contracts can take the following form:

$$N_F = \frac{N_h}{N_{h/F}} h$$

At the same time, it is necessary to consider the high correlation both between the price of a financial instrument and its underlying asset, and between the market price of a financial asset and the interest rate. In this case, the risk analysis of a financial instrument needs to include such indicators as the delta indicator, which is equal to the ratio of the value of the financial instrument to the change in the value of the underlying asset; $D = \Delta V / \Delta S$ and the elasticity index between the price of a financial asset and the interest rate.

$$D = \frac{\Delta V}{\Delta I} \cdot \frac{I}{V} \quad \text{WHERE } V \text{ represents the market value of the financial asset, } I \text{ is the rate of return of the security.}$$

(Thus, the hedging ratio is determined by econometric modeling. The first step is to determine the regression coefficient between spot yield and futures yield.)

Sharpe ratio as an indicator of profitability per unit of risk

According to the author, one of the most important and convenient indicators in the theory of risk of financial portfolios is the Sharpe ratio. It is calculated as the ratio of the difference between the return on the portfolio and the risk-free benchmark to the volatility of the portfolio. The standard (or, as it is also called, linear) deviation of profitability is taken to measure the portfolio volatility.

$Sh = \frac{P_p - P_b}{\sigma_p}$, where P_p is the return of portfolio, P_b is the return of risk-free standard, σ_p is the standard deviation of the portfolio's excess return.

The bank's deposit rate is usually taken as a risk-free standard.

It can be seen from the formula that the higher the Sharpe ratio, the greater the income the investor will receive per unit of risk, and the higher the volatility of the portfolio, the lower the expected return of the investor. Furthermore, the dynamics of the Sharpe ratio allow us to conclude whether the increased return on investment is an outcome of "luck" or a well-developed investment project. According to the author, one of the main disadvantages of the Sharpe ratio is a constraint imposed by the linear laws of the relationship between income and volatility. In addition, the indicators of asymmetry and excess are also to be considered.

They may not be equal either to each other or in relation to the mathematical expectation. In other words, the graph of the normal (Gaussian) distribution may not be symmetrical. We can talk about the normal distribution law of a random variable if there are many independent random variables, each having a minor effect on the indicator of the effective parameter. If there is a small number of random variables, and they have a major total effect on the effective parameter, then we must be careful by accepting the unsubstantiated normality of the distribution. Otherwise, we may encounter an infinite variance, which in turn means that there is no optimal point between risk and return. The risks can be endless, and the correlation score may not be adequate.

Conclusions and recommendations

Even without conducting a computer study (a computer study has not been carried out due to the lack of statistical data), the pure analysis of the formulas leads to the conclusion that the instruments of the financial market should not be used without considering the macroeconomic situation in the country. Given the close correlation between the money supply, interest rates, and the activity of financial markets, it can be concluded that if there is a frequent change in the exchange rate of the national currency in the country's economy, there is a need for complete hedging of the currency risk. Also, the presence of a high correlation between the market price of a financial instrument and the interest rate should be considered in the analysis at any level. High interest rates inherent mainly in developing economies are attractive for foreign investors and speculators. This factor should be accounted for by regulators. Another point to consider is that in developing countries, the number of traded financial instruments, both in terms of nomenclature and quantity,

is usually less than in the well-known world markets. The smaller is the number of instruments sold, the greater is the correlation coefficient and, as a result, the higher are the risk indicators of the portfolio.

As a recommendation, I would like to draw attention to the need for further involvement of the general population in the activities of the financial markets. It is necessary to improve the availability of financial instruments to the population. The experience of large foreign companies, especially whose income and well-being directly depend on the experience of its employees, where the leakage of personnel brings direct damage to production, employees are encouraged by shares and options to buy them. In this case, each employee is interested in the high financial performance of the organization and also tied to the place of occupation on a long-term basis.

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