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MODELING INVESTMENT PORTFOLIOS TAKING INTO ACCOUNT THE SPECIFICS OF THE ENERGY SECTOR

The energy sector plays a key role in the modern global financial system, and its influence is evident in the composition of major commodity and stock indices. For instance, energy assets constitute around 28% of the Bloomberg Commodity Index, highlighting the sector's significant impact on this indicator's dynamics. At the same time, energy companies also hold significant weight in leading stock indices, particularly the S&P 500. However, depending on the stage of the economic cycle, this can fluctuate significantly (between 1992 and 2025, for example, it ranged from 2% to 15%). This highlights the strategic importance of energy as a key driver of global financial markets. The energy companies included in the S&P 500 are involved in extracting, processing, transporting and selling energy resources, as well as supplying related equipment and services [1; 2].

This is a brief algorithm for analysing the opportunities and prospects of investing in the shares of companies in the energy sector [3; 4].

Stage 1. Formation of the initial dataset and preliminary statistical processing.

The output system of indicators should be presented in the following basic form:

$$P = \{\mathrm{p}_{it}\}_{n \times T},$$

p_{it} – quotation of the i-th indicator (sectoral index) in time period t, i = [1, n], t = [1, T],

n - total number of indices,

T- total number of analysis periods.

Once the initial dataset has been received, the main statistical characteristics of the distribution of the indices under study must be analysed, anomalous values and outliers must be processed, and normalization must be performed. Normalisation is achieved using chain logarithms of price ratios (logarithmic returns). This data transformation preserves as much of the initial information as possible, taking into account proportional changes in prices while reducing the impact of large absolute fluctuations:

$$R_{it} = ln\frac{p_{it}}{p_{i,t-1}}. \quad (1)$$

Stage 2. Building investment portfolios.

This stage involves creating a Markowitz model to generate an optimal investment portfolio. Rather than evaluating individual assets, the model considers the entire portfolio, as the combination of different instruments enables risk to be reduced through diversification.

The model involves a preliminary calculation of the expected returns and risks of all the components of the portfolio. This calculation can be performed in several ways. If we only have information about asset price dynamics ($p_{i1}, \dots, p_{iT}$), formulas (1)–(3) are used. If the list of possible company states $S_{i1}, \dots, S_{im}$ is known, as are the corresponding probabilities of occurrence $q_{i1}, \dots, q_{im}$ and returns $R_{i1}, \dots, R_{im}$, then the expected return is calculated using the weighted average formula:

$$R_i = \sum_{j=1}^{m} q_{ij} R_{ij}. \quad (2)$$

Stage 3. Comparative assessment of portfolios and determination of the role of energy sector assets.

The previous stage results in a set of portfolios providing the best risk-return ratio, i.e. minimum risk for a given level of return or maximum return for a given risk. Based on graphical interpretation, this set of portfolios is known as the 'efficient frontier' (if there are no additional restrictions, a rational investor will only choose portfolios from the efficient frontier).

These portfolios differ in structure, i.e. they have different asset ratios. Therefore, the share of the energy sector must first be assessed, along with changes in aggregate risk and return.

Additional quantitative efficiency criteria should be used to compare portfolios, such as the Sharpe ratio, Sortino ratio and Treynor ratio. In this study, we use the widely adopted Sharpe ratio, which illustrates the excess return per unit of total risk. It is calculated as follows:

$$S = \frac{R_p - R_f}{\sigma_p}, \quad (3)$$

R_f – risk-free rate.

A higher Sharpe ratio indicates a more efficient portfolio. A negative value indicates that the portfolio performs worse than a risk-free investment.

The energy sector plays a key role in shaping the dynamics of global financial markets. This makes an in-depth analysis of its assets essential when making investment decisions. This study shows that stock market sectors vary significantly in terms of the amplitude and nature of their fluctuations. This should be taken into account when building a diversified portfolio. The Markowitz model enables us to determine optimal investment combinations and evaluate the effect of energy sector assets on risk and return. Applying additional performance criteria, such as the Sharpe, Sortino and Treynor ratios, provides a more accurate assessment of the attractiveness of investing in energy companies.

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