Vol 3 No 1 Juny (2026), Pages 1-11
Mortalita: Journal of Mathematics and Its Applications
e-ISSN 3088-9812
DOI 10.61159/mortalita.v2i2.768

MORTALITA

Expected Shortfall Analysis on Optimal Portfolios Using the Downside Deviation Method (Case Study: Jakarta Islamic Index (JII) Sharia Stocks for the 2020–2024 Period)

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ABSTRACT

Portfolio optimization is crucial in financial management to maximize expected returns while minimizing downside risks. Traditional portfolio models often assume that asset returns are normally distributed, which fails to capture extreme market risks (*tail risk*) in empirical stock data. This study aims to construct an optimal portfolio of Jakarta Islamic Index (JII) stocks using the Downside Deviation method and evaluate its extreme loss potential using Expected Shortfall (ES). The dataset consists of daily stock returns from 17 sharia-compliant companies consistently listed in JII during the 2020–2024 period. The empirical results show that the stock returns are non-normally distributed, justifying the use of downside risk measures. Out of 17 stocks, 8 exhibited positive expected returns and were selected for optimization. The optimal portfolio formed by the Downside Deviation method yields a daily expected return of 0.0196% with a portfolio standard deviation of 0.8185%, with the largest asset allocations assigned to ICBP (45.828%), UNTR (16.451%), and TPIA (12.676%). Furthermore, risk estimation using Expected Shortfall with an initial capital of IDR 100,000,000 for a 1-day holding period reveals maximum average losses of IDR 2,206,782 (2.21%) at the 99% confidence level, IDR 1,712,351 (1.71%) at the 95% confidence level, and IDR 1,459,819 (1.46%) at the 90% confidence level. These findings suggest that combining Downside Deviation with Expected Shortfall provides a more realistic and comprehensive risk assessment framework for sharia stock investors under non-normal market conditions.

Keywords: *Downside Deviation, Expected Shortfall, Jakarta Islamic Index, Optimal Portfolio.*

1. INTRODUCTION

The Islamic capital market in Indonesia has experienced significant growth in recent years. One of the main sharia stock indices serving as a primary benchmark for investors is the Jakarta Islamic Index (JII). According to data from the Indonesia Stock Exchange, JII consists of the 30 most liquid sharia-compliant stocks that have passed a rigorous screening process based on Islamic principles [3]. Investing in sharia stocks not only offers potential returns but also ensures that financial activities remain free from riba (interest), gharar (uncertainty), and maysir (gambling).

However, the period from 2020 to 2024 presented severe challenges for stock price movements. Setiawan [7] noted that domestic capital market volatility rose sharply due to the impacts of global economic uncertainty and the post-pandemic recovery. This 1volatile market environment underscores that investors cannot rely solely on high returns; rather, they must implement measurable risk management through optimal portfolio construction.

In classical portfolio theory introduced by Markowitz [1], variance or standard deviation is employed as the primary risk measure. However, standard deviation has a fundamental limitation because it treats positive and negative deviations equally. As explained by Rahmawati [6], investors in reality perceive only downward deviations (downside risk) as actual loss risks, whereas upward deviations (upside risk) are desirable. Consequently, the Downside Deviation approach offers a more accurate measure of loss risk by processing only those returns that fall below a specified threshold return.

Optimal portfolio construction using the Downside Deviation method has been proven to perform more adaptively under non-normally distributed market conditions. According to Pratama [5], portfolios constructed using downside risk-based ratios provide superior protection against severe stock price drops. Nevertheless, once an optimal portfolio is formed, investors still require an extreme risk metric to evaluate the worst-case loss potential that could occur.

The most widely used risk measure is Value at Risk (VaR). However, Rockafellar and Uryasev [2] demonstrated that VaR possesses a fundamental weakness: it fails to satisfy the sub-additivity property, meaning VaR cannot measure tail losses beyond the specified confidence level. To overcome this limitation, the Expected Shortfall (ES) method also known as Conditional Value at Risk (CVaR) was developed.

As highlighted by Hidayat [4], Expected Shortfall estimates the average size of losses that exceed the VaR threshold, thereby providing a far more comprehensive picture of tail risk. Combining Downside Deviation portfolio optimization with Expected Shortfall risk evaluation is particularly relevant for JII constituent stocks during the 2020–2024 period, which was characterized by sudden economic trend shifts.

Based on the background above, this study aims to construct an optimal stock portfolio from the Jakarta Islamic Index (JII) during the 2020–2024 period using the Downside Deviation method, and to analyze extreme risk exposure represented by Expected Shortfall. The findings of this study are expected to make a theoretical contribution to the Islamic portfolio management literature while serving as a practical reference for investors in making well-calculated investment decisions.

2. METHODS

The dataset employed in this study consists of quantitative secondary data sourced from historical records of the Indonesia Stock Exchange (IDX) and Yahoo Finance. The data encompasses daily closing prices of stocks listed on the Jakarta Islamic Index (JII) over a 5-year period, spanning from January 1, 2020, to December 31, 2024.

As explained by Arifin [8], selecting the 2020–2024 timeframe is crucial as it encompasses three significant market dynamic phases: the pandemic crisis phase, the recovery phase, and the new stability phase. The sampling process was conducted using a purposive sampling technique, where the selected stocks are issuers that were consistently included as JII constituents throughout the observation period to maintain data continuity.

Based on research data and official publications from IDX Islamic, 17 sharia-compliant stocks consistently remained on the JII constituent list throughout the 2020 to 2024 period:

Table 1. Dataset.

No.	Stock Code	Company / Issuer Name
1	ADRO	PT Adaro Energy Indonesia Tbk.
2	ANTM	PT Aneka Tambang Tbk.
3	BRPT	PT Barito Pacific Tbk.
4	CPIN	PT Charoen Pokphand Indonesia Tbk.
5	EXCL	PT XL Axiata Tbk.
6	ICBP	PT Indofood CBP Sukses Makmur Tbk.

7	INCO	PT Vale Indonesia Tbk.
8	INDF	PT Indofood Sukses Makmur Tbk.
9	KLBF	PT Kalbe Farma Tbk.
10	MDKA	PT Merdeka Copper Gold Tbk.
11	PGAS	PT Perusahaan Gas Negara Tbk.
12	PTBA	PT Bukit Asam Tbk.
13	SMGR	PT Semen Indonesia (Persero) Tbk.
14	TLKM	PT Telkom Indonesia (Persero) Tbk.
15	TPIA	PT Chandra Asri Petrochemical Tbk.
16	UNTR	PT United Tractors Tbk.
17	UNVR	PT Unilever Indonesia Tbk.

The steps involved in constructing the optimal portfolio using the Downside Deviation method are as follows:

1. Stock Return
   The stock rate of return measures the change in an asset's price from one period to the next [9]. Daily return values are calculated using the logarithmic approach according to Equation (1):
   $$R_{i,t} = \ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right) \tag{1}$$
   Where:
   $R_{i,t}$ = Return of stock i in period t
   $P_{i,t}$ = Closing price of stock i in period t
   $P_{i,t-1}$ = Closing price of stock i in period $t-1$

2. Expected Return
   The expected return is an estimate of the rate of return anticipated by an investor in the future for a given amount of invested capital [10]. The expected return for each asset is calculated using the historical average return according to Equation (2):
   $$E(R_i) = \frac{1}{T}\sum_{t=1}^{T} R_{i,t} \tag{2}$$
   Where:
   $E(R_i)$ = Expected return of stock i
   $R_{i,t}$ = Return of stock i in period t
   T = Total number of observation periods

3. Downside Deviation
   Measuring downside loss risk below a specified threshold using the Downside Deviation method [9] is calculated according to Equation (3):
   $$\delta_i = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}\left(\min\left(R_{i,t} - b, 0\right)\right)^2} \tag{3}$$
   Where:
   δ_i = Downside Deviation value for the i-th stock
   i = Index representing the stock ticker under study
   b = Benchmark target return set by the investor
   The benchmark value (b) can be adjusted according to specific market indicators, such as the inflation rate or the daily risk-free reference rate. If the investor defines risk specifically as the potential loss of initial capital (*capital loss*), the benchmark value (b) can be assumed to be 0.

4. Downside Covariance

To measure the co-movement of downside risk between two assets, the covariance calculation in the Downside Deviation method [9] is formulated in Equation (4):

$$\delta_{i,j} = \frac{1}{T-1}\sum_{t=1}^{T} \min(R_{i,t} - b, 0) \cdot \min(R_{j,t} - b, 0) \tag{4}$$

All estimated individual downside variances (Equation 3) together with the downside covariances between pairs of assets (Equation 4) are then arranged into an $N \times N$ Covariance Matrix X in Equation (5):

$$X = \begin{bmatrix} \delta_1^2 & \delta_{1,2} & \cdots & \delta_{1,N} \\ \delta_{2,1} & \delta_2^2 & \cdots & \delta_{2,N} \\ \vdots & \vdots & \ddots & \vdots \\ \delta_{N,1} & \delta_{N,2} & \cdots & \delta_N^2 \end{bmatrix} \tag{5}$$

Where:
$\delta_{i,j}$ = Downside covariance between stock i and stock j
δ_i^2 = Downside variance of stock i (where $\delta_i^2 = \delta_{i,i}$)
N = Total number of selected stocks included in the portfolio
X = Downside Variance-Covariance Matrix of size $N \times N$

5. Optimal Asset Allocation Weights

The determination of capital allocation proportions or stock weights (W) in the portfolio using a heuristic approach [9] is formulated in Equation (6):

$$W = \frac{X^{-1}e}{e^T X^{-1} e} \tag{6}$$

Where:
W = Weight matrix representing the allocation proportion of each stock in the portfolio
X^{-1} = Inverse of the downside variance-covariance matrix
e = Column vector of size $N \times 1$ in which all elements are equal to 1
e^T = Transpose of the column vector e

6. Portfolio Expected Return

The expected rate of return for the entire portfolio ($E(R_P)$) is the weighted average of the expected returns of its constituent individual stocks [9]. The calculation is expressed in Equation (7):

$$E(R_P) = \sum_{i=1}^{N} w_i \cdot E(R_i) \tag{7}$$

Where:
$E(R_P)$ = Expected return of the portfolio
w_i = Investment weight proportion assigned to stock i
$E(R_i)$ = Expected return of stock i

7. Portfolio Risk

Portfolio risk is computed using the portfolio variance (σ_P^2), which accounts for asset allocation weights and pairwise downside covariances [9]. The portfolio variance formula is expressed in Equation (8):

$$\sigma_P^2 = W^T X W \tag{8}$$

Where:
σ_P^2 = Portfolio risk variance
W = Matrix of investment allocation weights from stock 1 to N
W^T = Transpose of the weight matrix W
X = Downside variance-covariance matrix of size $N \times N$

The portfolio standard deviation (σ_P), representing total downside risk, is obtained by taking the square root of the portfolio variance:

$$\sigma_P = \sqrt{\sigma_P^2}$$

8. Expected Shortfall (ES)
   Once the optimal portfolio is constructed, the analysis continues by estimating potential extreme loss risk using the Expected Shortfall (ES) method. This measurement provides investors with a more detailed projection of maximum potential losses that could occur over a specific time horizon and confidence level.

   Unlike conventional risk metrics, Expected Shortfall is categorized as a coherent risk measure, is convex, and satisfies the sub-additivity property [11]. A risk measure is defined as coherent if it satisfies four primary axioms [12]:
   a. Translation Invariance: Adding or subtracting a loss of a deterministic constant c alters the measured risk linearly by the exact same amount c. For any random loss variable X and real number c, it holds that:
   $$\rho(X+c)=\rho(X)+c$$
   b. Sub-additivity: Combining two portfolio risks will never result in a total risk greater than the sum of the individual risks measured separately. This property mathematically proves that investment diversification reduces risk. For any random risk variables X and Y, it holds that:
   $$\rho(X+Y)\leq\rho(X)+\rho(Y)$$
   c. Positive Homogeneity: Scaling a portfolio loss by a non-negative constant factor λ increases the risk measure by the same factor λ. For any random variable X and constant $\lambda\geq 0$, it holds that:
   $$\rho(\lambda X)=\lambda\rho(X)$$
   d. Monotonicity: If one investment portfolio consistently yields a lower risk than another across all potential market scenarios, its computed risk value will always be smaller. For any random risk variables X and Y, if $X\leq Y$, then:
   $$\rho(X)\leq\rho(Y)$$

   The primary advantage of the Expected Shortfall method lies in its flexibility to be applied to both normally and non-normally distributed return data [15]. The Expected Shortfall value at a confidence level of $(1-\alpha)$, given a holding period of T and an initial investment value of V_0, is calculated using Equation (9):
   $$\mathrm{ES}_{1-\alpha}=V_0\cdot\left(-E(R_P)\cdot T+\sigma_P\cdot\sqrt{T}\cdot\frac{\phi(z_{1-\alpha})}{\alpha}\right) \quad (9)$$
   Where:
   $\mathrm{ES}_{1-\alpha}$ = Expected Shortfall value at the $(1-\alpha)$ confidence level
   V_0 = Initial investment capital
   $E(R_P)$ = Mean return of the optimal portfolio
   σ_P = Standard deviation of the optimal portfolio return
   $\phi(\cdot)$ = Probability Density Function (PDF) of the standard normal distribution
   $z_{1-\alpha}$ = Critical quantile value of the standard normal distribution at the significance level α
   T = Investment holding period

3. RESULTS AND DISCUSSION

This section presents the empirical analysis results of constructing an optimal portfolio using the Downside Deviation method on sharia-compliant stocks listed on the Jakarta Islamic Index (JII) during the 2020–2024 period. The analytical process begins with calculating daily returns, expected returns, and the downside variance-covariance matrix to determine the optimal capital allocation weights for each constituent asset in the portfolio. Furthermore, once the optimal portfolio structure is established, the analysis proceeds to evaluate the extreme risk exposure faced by investors through Expected Shortfall (ES) testing across various confidence levels. This evaluation aims to provide a more comprehensive estimation of maximum potential losses (*tail risk*), thereby serving as a strategic reference for investors to manage sharia stock investment risks in a measurable manner.

1. Optimal Portfolio Construction using the Downside Deviation Method
   Prosedur The analytical procedure begins by evaluating the individual rates of return for the 17 sharia-compliant stocks consistently listed on the Jakarta Islamic Index (JII) during the 2020–

2024 period, yielding a total of 1,211 daily price observations per issuer. From this historical time series, the daily return of each individual stock was calculated using Equation (1). Subsequently, the expected return for each asset was synthesized using Equation (2).

The expected return reflects the average projected return anticipated by investors for a selected equity instrument, which can be positive or negative depending on historical price performance during the observation period. The daily expected return estimation results for all sampled JII stocks are detailed in Table 2.

Table 2. Daily Expected Return Calculation Results for JII Sharia Stocks (2020–2024).

No.	Stock Code	$E(R_i)$
1	ADRO	0.000401
2	ANTM	0.000493
3	BRPT	-0.000380
4	CPIN	-0.000267
5	EXCL	-0.000294
6	ICBP	0.000017
7	INCO	0.000000
8	INDF	-0.000029
9	KLBF	-0.000142
10	MDKA	0.000345
11	PGAS	-0.000246
12	PTBA	0.000037
13	SMGR	-0.001081
14	TLKM	-0.000303
15	TPIA	0.000886
16	UNTR	0.000181
17	UNVR	-0.001250

Berdasarkan Based on Table 1, the daily expected return values of the 17 JII sharia-compliant stocks vary between positive and negative values. Stocks with positive expected returns indicate that historically their prices tended to experience daily return gains, with the highest daily expected returns achieved by TPIA (0.000886 per day) and ANTM (0.000493 per day). Conversely, several stocks such as UNVR (-0.001250 per day) and SMGR (-0.001081 per day) exhibited negative expected returns, reflecting a downward return trend over the 2020–2024 observation period. Meanwhile, INCO recorded a daily expected return close to zero (0.000000), reflecting relatively stable or constant return dynamics.

Subsequently, in this portfolio construction stage, only stocks with non-negative (positive or zero) expected returns are processed further for optimization. Stocks with positive expected returns were selected because they offer positive anticipated future earnings, resulting in 8 stocks meeting the selection criteria: ADRO, ANTM, ICBP, INCO, MDKA, PTBA, TPIA, and UNTR. The dynamics of the daily return movements for these eight selected stocks are visualized in Figure 1.

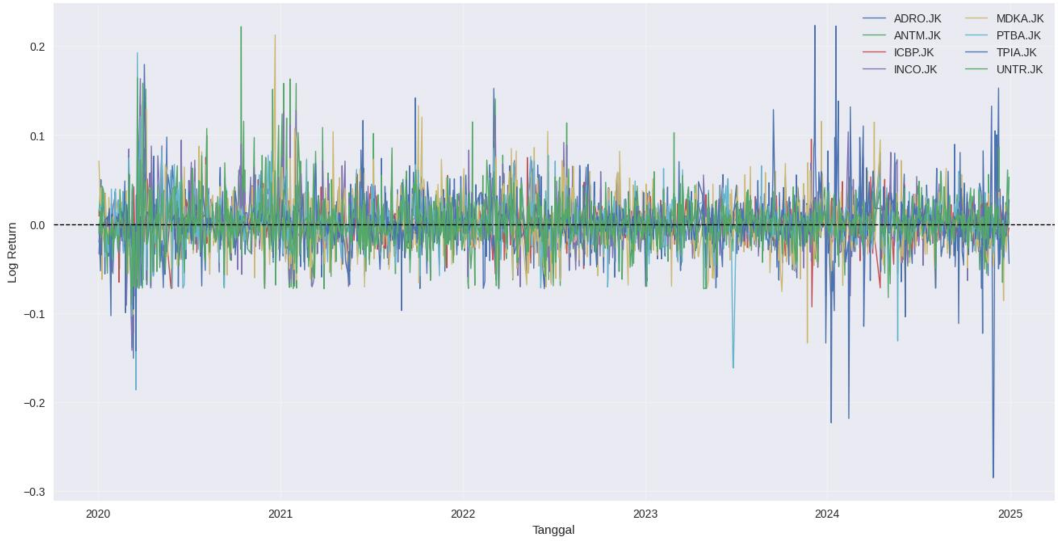

Figure 1. Daily Return Movements of JII Sharia Stocks with Positive Expected Returns.

Figure 1 displays the daily return movement charts for ADRO, ANTM, ICBP, INCO, MDKA, PTBA, TPIA, and UNTR over the observation period from 2020 to 2024. Based on the plotted charts, the return data for all stocks fluctuate around the horizontal zero line (indicated by the red dashed line). These fluctuations occur as a result of dynamic daily stock price movements in the capital market.

Furthermore, the charts in Figure 1 reveal several extreme spikes and drops during specific periods such as in early 2020 and throughout the 2021–2024 range. This data distribution pattern, characterized by extreme upward and downward spikes, indicates the presence of volatility clustering and heavy tails (*fat-tailed distribution*), reinforcing that daily stock return data are non-normally distributed and possess varying levels of downside risk across assets.

The next step is to calculate the Downside Deviation value for each stock to quantify downside loss risk based on return movements below a specified threshold (*benchmark*). The benchmark value (b) used in this study is set to zero ($b = 0$). The choice of a zero benchmark is grounded in the consideration that the analysis focuses on protecting investor capital against maximum potential losses (*capital loss*).

Table 3. Nilai *Downside Deviation* Saham Syariah JII Terpilih.

No.	Stock Code	Downside Deviation (δ_i)
1	ICBP	0.012231
2	UNTR	0.016213
3	PTBA	0.018316
4	INCO	0.018738
5	ANTM	0.018974
6	MDKA	0.019712
7	TPIA	0.020225
8	ADRO	0.022456

Based on Table 3, ICBP exhibits the lowest Downside Deviation value at 0.012231 (1.22%), followed by UNTR at 0.016213 (1.62%). These relatively low Downside Deviation values indicate that both stocks possess the lowest downside price risk compared to the other assets. Conversely, ADRO recorded the highest Downside Deviation value at 0.022456 (2.25%), implying that ADRO experienced the most volatile negative deviations below the zero target during the 2020–2024 period.

After obtaining the individual risk values, the downside covariances between stock pairs were calculated using Equation (4). The combined downside variance and covariance estimation results were then arranged into an 8×8 Variance-Covariance Matrix X according to Equation (5) as follows:

$$X = \begin{bmatrix} 0.000402 & 0.000106 & 0.000031 & 0.000099 & 0.000084 & 0.000157 & 0.000057 & 0.000126 \\ 0.000106 & 0.000255 & 0.000040 & 0.000156 & 0.000108 & 0.000104 & 0.000032 & 0.000080 \\ 0.000031 & 0.000040 & 0.000114 & 0.000035 & 0.000020 & 0.000035 & 0.000025 & 0.000032 \\ 0.000099 & 0.000156 & 0.000035 & 0.000251 & 0.000101 & 0.000083 & 0.000031 & 0.000072 \\ 0.000084 & 0.000108 & 0.000020 & 0.000101 & 0.000276 & 0.000063 & 0.000043 & 0.000053 \\ 0.000157 & 0.000104 & 0.000035 & 0.000083 & 0.000063 & 0.000262 & 0.000040 & 0.000113 \\ 0.000057 & 0.000032 & 0.000025 & 0.000031 & 0.000043 & 0.000040 & 0.000335 & 0.000025 \\ 0.000126 & 0.000080 & 0.000032 & 0.000072 & 0.000053 & 0.000113 & 0.000025 & 0.000193 \end{bmatrix}$$

The order of stocks corresponding to the matrix rows and columns is: [1] ADRO, [2] ANTM, [3] ICBP, [4] INCO, [5] MDKA, [6] PTBA, [7] TPIA, and [8] UNTR..

The main diagonal elements of Matrix X represent the individual downside variance values for each stock, while the off-diagonal elements indicate the downside covariance values between pairs of stocks. All computed variance values are relatively small (ranging from 10^{-4} to 10^{-3}), reflecting that downside risk deviations are relatively controlled. Meanwhile, all covariance values are positive, indicating that downside price risk movements across all eight sharia stocks tend to move co-directionally. This downside variance-covariance matrix information is subsequently used as the input basis for optimizing portfolio weights.

Based on the obtained downside variance-covariance matrix, the optimal portfolio capital allocation weights were calculated using Equation (6). The estimated weight allocation results for each stock are presented in Table 4.

Table 4. Optimal Weight Allocation Proportions for JII Sharia Stocks.

No.	Stock Code	Weight (W_i)
1	ICBP	45.828%
2	UNTR	16.451%
3	PTBA	12.676%
4	INCO	11.868%
5	ANTM	7.163%
6	MDKA	5.329%
7	TPIA	1.007%
8	ADRO	-0.320%

Based on Table 4, the largest investment allocation proportion is assigned to ICBP at 45.828% (0.458276), followed by UNTR at 16.451% (0.164505) and TPIA at 12.676% (0.126757). The predominant weight allocation to ICBP aligns with the previous analytical findings, where ICBP exhibited the lowest Downside Deviation.

Conversely, ADRO received a negative weight allocation proportion of -0.320% (-0.003204). Mathematically, this negative weight signifies a short-selling position resulting from ADRO's relatively higher downside risk compared to other constituent assets in the portfolio. However, in practical applications within Islamic capital markets which strictly prohibit short-selling practices this weight value, being extraordinarily close to zero, implies that ADRO makes a negligible contribution and is effectively allocated a 0% weight in a short-selling-constrained optimal sharia portfolio.

Based on the optimal stock allocation weights presented in Table 4, the subsequent stage estimates the overall portfolio expected return and risk profile. The expected return of the portfolio was calculated using Equation (7), while portfolio risk (variance and standard deviation) was computed using Equation (8). The summary of these two key parameter calculations is presented in Table 5.

Table 5. Expected Return and Risk Parameters of the Optimal Portfolio.

Portofolio Parameter	Value
Portofolio Expected Return	0.000196
Portfolio Risk (Variance)	0.000067

From the optimal portfolio constructed, the portfolio expected return $E(R_P)$ is obtained at 0.000196 (or 0.0196% per day). This value indicates that if an investor allocates capital according to this JII sharia stock portfolio composition, the projected average daily return potential is 0.0196% of the total initial capital.

Furthermore, the portfolio risk measured based on the downside variance value σ_P^2 yields a value of 0.000067 (6.7×10^{-5}). By taking the square root of this variance value ($\sqrt{\sigma_P^2}$), the portfolio standard deviation (σ_P) is determined to be 0.008185 or 0.8185% per day. This standard deviation value reflects the magnitude of risk or average downside fluctuation that an investor might experience, which is approximately 0.8185% of the initial investment value.

2. Extreme Loss Risk Estimation Using Expected Shortfall (ES)
   Based on the constructed optimal portfolio, the subsequent stage involves conducting an in-depth analysis of the potential extreme loss risk (*tail risk*) that an investor might face. This risk evaluation is calculated using the Expected Shortfall (ES) method based on Equation (9), assuming an initial investment capital (V_0) of IDR 100,000,000 and an investment holding period (T) of 1 day ($T = 1$). The analysis was carried out across three distinct significance levels (α), namely 1%, 5%, and 10% (which correspond to confidence levels of 99%, 95%, and 90%, respectively). The estimated Expected Shortfall values are summarized in Table 6.

Table 6. Expected Shortfall (ES) Estimation and Maximum Potential Loss.

Significance Level (α)	Expected Shortfall (ES)	Maximum Potential Loss (IDR)
1%	0,022068	IDR 2,206,782
5%	0,017124	IDR 1,712,351
10%	0,014598	IDR 1,459,819

Based on Table 6, it can be observed that the Expected Shortfall value is inversely proportional to the significance level (α) used, or directly proportional to the confidence level ($1 - \alpha$). A smaller α value (or a higher confidence level) yields a larger estimated potential loss.

At the 99% confidence level ($\alpha = 1\%$), the Expected Shortfall value is IDR 2,206,782 (or 2.21% of the total capital). This indicates that under extreme worst-case market conditions (the 1% most extreme scenarios), the projected average maximum loss an investor could potentially suffer over a one-trading-day holding period is IDR 2,206,782. Meanwhile, at the 95% ($\alpha = 5\%$) and 90% ($\alpha = 10\%$) confidence levels, the Expected Shortfall values are IDR 1,712,351 (1.71% of capital) and IDR 1,459,819 (1.46% of capital), respectively.

Utilizing a smaller α value (such as 1%) yields a more conservative loss estimation and a more comprehensive coverage of tail risk, thereby minimizing the risk of underestimating unexpected losses. This Expected Shortfall information provides sharia stock investors with a clear picture of the worst-case risk thresholds, enabling them to formulate risk management strategies and establish measurable risk tolerance limits prior to making investment decisions.

CONCLUSION

Based on the empirical results and discussion, constructing an optimal portfolio using the Downside Deviation method on JII sharia stocks for the 2020–2024 period yields an optimal investment weight allocation heavily dominated by three primary stocks: ICBP at 45.828%, UNTR at 16.451%, and TPIA at 12.676%, followed by MDKA (11.868%), INCO (7.163%), PTBA (5.329%), ANTM (1.007%), and ADRO (-0.320%). This optimal portfolio combination generates a daily expected return of 0.000196 (0.0196%) with a portfolio standard deviation risk of 0.008185 (0.8185%).

Furthermore, the risk analysis demonstrates that the Expected Shortfall (ES) measurement effectively provides a precise quantification of potential extreme loss risk (*tail risk*), aligning with the non-normally distributed nature of stock returns. At a 99% confidence level ($\alpha = 1\%$), assuming an initial investment capital of IDR 100,000,000 and a one-trading-day holding period, the estimated Expected Shortfall is IDR 2,206,782 (2.21% of total capital). Meanwhile, at the 95% and 90% confidence levels, the projected maximum potential losses are IDR 1,712,351 and IDR 1,459,819, respectively. Therefore, integrating the Downside Deviation framework with Expected Shortfall proves to be an effective and comprehensive reference for investors to optimize return potential while mitigating tail risk in sharia stock investments.

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