INTISARI

STUDI PERBANDINGAN EFEKTIVITAS METODE *HIERARCHICAL RISK PARITY*, *MINIMUM VARIANCE*, *RISK PARITY PORTFOLIO*, DAN *UNIFORM ALLOCATION* DALAM OPTIMALISASI PORTOFOLIO *CRYPTOCURRENCY*

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Pandemi COVID-19 telah memengaruhi berbagai sektor ekonomi, termasuk pasar keuangan, sekaligus mendorong pertumbuhan aset *cryptocurrency* sebagai alternatif investasi berbasis teknologi. Penelitian ini bertujuan untuk membandingkan efektivitas empat metode optimisasi portofolio—*Hierarchical Risk Parity* (HRP), *Minimum Variance* (MV), *Risk Parity Portfolio* (RPP), dan *Uniform Allocation* (UA) dalam mengelola risiko dan memaksimalkan *return* pada pasar *cryptocurrency* di berbagai fase pasar, yaitu *Bearish* (9 November 2021–18 Juni 2022), *Sideways* (19 Juni 2022–12 Oktober 2023), dan *Bullish* (13 Oktober 2023–13 Maret 2024). Data yang digunakan adalah *log return* harian dari 10 koin *cryptocurrency* yakni BTC, ETH, TRX, MATIC, NEAR, DOGE, INJ LINK, AR, dan BNB, yang diolah menggunakan *Python* pada *Google Colab*. Analisis meliputi *tree clustering*, *quasi-diagonalization*, dan *recursive bisection* untuk HRP, serta perhitungan matriks kovarians untuk MV dan RPP, dengan UA sebagai *baseline*. Evaluasi kinerja portofolio dilakukan menggunakan tujuh metrik statistik: *Cumulative Return*, *Phase Volatility*, *Sharpe Ratio*, *Max Drawdown*, *Sortino Ratio*, *Skewness*, dan *Kurtosis*. Hasil menunjukkan bahwa MV unggul dalam mengurangi risiko dengan volatilitas dan *max drawdown* terendah pada ketiga fase pasar (misalnya, volatilitas 1,76% pada *Bullish*), sementara UA mencatat *cumulative return* tertinggi pada fase *Bullish* (253,62%) namun dengan volatilitas tinggi (2,79%). HRP dan RPP memberikan keseimbangan antara risiko dan pengembalian, dengan HRP menonjol pada stabilitas distribusi (*kurtosis* rendah) dan RPP pada paritas risiko. Pengujian tambahan pada periode *Bullish* baru (2 September 2024–2 Desember 2024) mengkonfirmasi konsistensi performa, dengan HRP menawarkan *Sharpe Ratio* terbaik (0,2085).

ABSTRACT

A Comparative Study on the Effectiveness of Hierarchical Risk Parity, Minimum Variance, Risk Parity Portfolio, and Uniform Allocation Methods in Cryptocurrency Portfolio Optimization

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The COVID-19 pandemic has impacted various economic sectors, including financial markets, while also accelerating the growth of cryptocurrency as a technology-based investment alternative. This study compares the effectiveness of four portfolio optimization methods—Hierarchical Risk Parity (HRP), Minimum Variance (MV), Risk Parity Portfolio (RPP), and Uniform Allocation (UA)—in managing risk and maximizing returns in the cryptocurrency market across three market phases: Bearish (November 9, 2021–June 18, 2022), Sideways (June 19, 2022–October 12, 2023), and Bullish (October 13, 2023–March 13, 2024). The data comprise daily log returns of 10 cryptocurrencies: BTC, ETH, TRX, MATIC, NEAR, DOGE, INJ, LINK, AR, and BNB, processed using Python in Google Colab. The HRP method utilizes tree clustering, quasi-diagonalization, and recursive bisection; MV and RPP rely on covariance matrices, while UA serves as the baseline. Portfolio performance is evaluated using Cumulative Return, Volatility, Sharpe Ratio, Max Drawdown, Sortino Ratio, Skewness, and Kurtosis. Results show that MV consistently minimizes risk, producing the lowest volatility and drawdown across all phases (e.g., 1,76% volatility in the Bullish phase). UA delivers the highest cumulative return during the Bullish phase (253,62%) but with high volatility (2,79%). HRP and RPP offer balanced performance, with HRP showing better stability (lower kurtosis) and RPP aligning with risk parity principles. Additional testing in a new Bullish phase (September 2, 2024–December 2, 2024) confirms consistent performance, with HRP achieving the highest Sharpe Ratio (0.2085). This study contributes to the literature on financial statistics by providing empirical insights into the effectiveness of data-driven portfolio optimization methods in cryptocurrency markets under different conditions.