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CREATION AND APPLICATION OF AN AI-POWERED CRYPTO INDEX FOR OPTIMAL CRYPTOCURRENCY PORTFOLIO FORMATION

The rapid growth of the cryptocurrency market, high asset volatility, and fragmented regulatory frameworks create a need for reliable tools that can measure the overall condition of the “digital” market and provide balanced investment decisions [1]. Traditional capitalization-weighted indices (CMC 200, Bitwise 10) tend to be dominated by a few top coins and do not account for the dynamic correlation structure, which significantly reduces their stability during market shocks [3].

The use of artificial intelligence methods (clustering, recurrent neural networks, risk parity optimization) opens the door to creating flexible indices that can adapt asset weights to current market regimes and limit portfolio risk without relying on subjective assumptions about returns [2, 4].

This study presents a comprehensive approach to modeling the AI-Powered Crypto Index (AICI), which combines: clustering-based asset selection using log returns [5], volatility forecasting for each coin via LSTM networks, and balancing of risk

contributions through the Risk Parity method. The algorithm updates the composition and weights of the index monthly, based on a 180-day historical data window.

Markowitz's classical portfolio theory scales poorly to cryptocurrencies due to an unstable covariance matrix and "fat tails" in return distributions. To minimize dependence on forecast accuracy, we propose combining the principle of Risk Parity (ensuring equal contribution of assets to overall dispersion) with dynamic refinement of forecast volatility using univariate LSTM networks [2, 4]. Empirical results demonstrate that, for a sample of log returns of the top 100 coins, the Gini coefficient of the classical cap-weighted index is 0.71, whereas AICI achieves 0.28, indicating superior diversification.

The AI-Powered Crypto Index integrates several key development stages. Beginning with data collection and cleansing, it involves downloading daily OHLCV candles for the top 100 coins from the Binance API, followed by filtering of assets with $\geq 90\%$ trading days per year and sufficient liquidity. The composition of the asset pool is determined using listings from the CoinMarketCap API, with stablecoins excluded.

The next stage is asset clustering, based on a hierarchical algorithm using the correlation distance $d = (1 - \rho)/2$, where the optimal number of clusters ($k \in [3;5]$) is determined through silhouette analysis. From each cluster, assets with the highest modified Sharpe ratio are selected, provided their pairwise correlation does not exceed 0.9.

This is followed by risk forecasting and portfolio weight optimization. For each asset, a two-layer LSTM model (32+16 neurons, Dropout 0.2) is trained on a 30-day rolling window of absolute log returns. Based on the forecasted covariance matrix, weights are optimized using the Risk Parity method (SLSQP, $w \in [3\%; 25\%]$). Monthly rebalancing ensures weight adaptation to new data while maintaining a balance between performance and transaction costs.

Data and methodology. Backtest from June 2021 to May 2025: 48 monthly rebalances, out-of-sample simulation without look-ahead bias. For each month, a portfolio is constructed based on data from the preceding 180 days and applied to the subsequent calendar month.

Table 1 – Comparative Characteristics of AI-Powered Crypto Index and Benchmarks

<i>Index</i>	<i>CAGR (%)</i>	<i>Volatility (%)</i>	<i>Sharpe Ratio</i>	<i>Max Drawdown (%)</i>
<i>AI-Powered Crypto Index</i>	31.04	69.33	0.45	-79.45
Bitwise 10 (estimate)	29,0	85,0	0,35	–85,0
CMC 200 (estimate)	23,0	82,0	0,30	–90,0
BCGI (Bloomberg Galaxy)	24,0	75,0	0,34	–83,0

Key results. AICI achieves a CAGR of 31.0%, annualized volatility of 69.3%, a Sharpe ratio of 0.45, and a maximum drawdown of –79.5%. A comparison with benchmarks is provided in Table 1. Through risk parity, the index reduces volatility by approximately 10 percentage points compared to Bitwise 10 while maintaining higher returns.

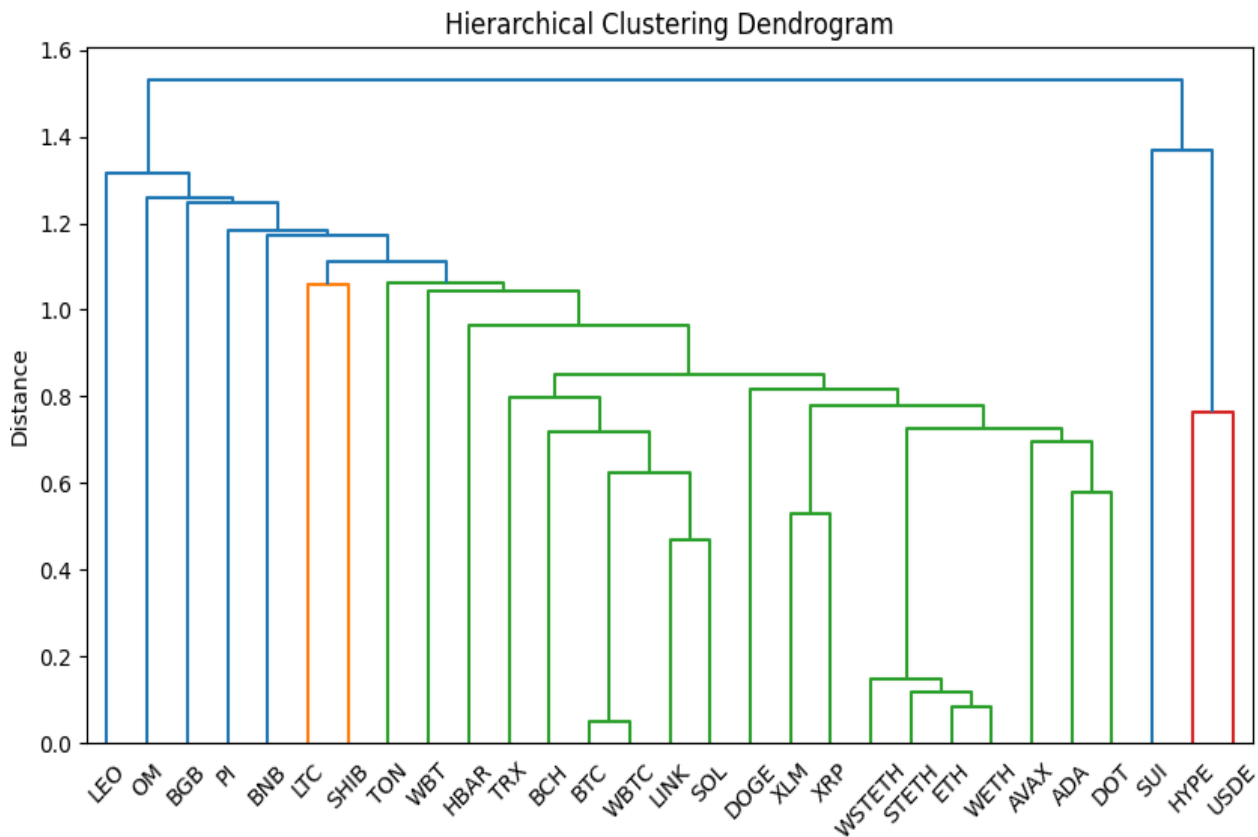


Figure 1 – Clustering of Cryptocurrencies Using the K-Means Method



Figure 2 – Capital Curve of AI-Powered Crypto Index for 2021–2025

Graphical interpretation. Figure 1 presents the dendrogram of clusters illustrating correlation-based stratification, while Figure 2 shows the capital curve of AICI, which recovers historical peaks faster than CMC 200 due to the automatic exclusion of “dead” coins.

The analysis demonstrated that including the AI-Powered Crypto Index in a portfolio significantly expands diversification opportunities. Compared to classic cryptocurrency pairs such as Bitcoin–Ethereum, the index provides a notable risk reduction effect due to internal diversification and independence from highly correlated coins. Empirical results show that the index has nearly zero correlation with major market coins, reducing the impact of macro market movements on the portfolio. This ensures more stable returns and mitigates drawdowns even during market shocks, as illustrated in Figure 3:

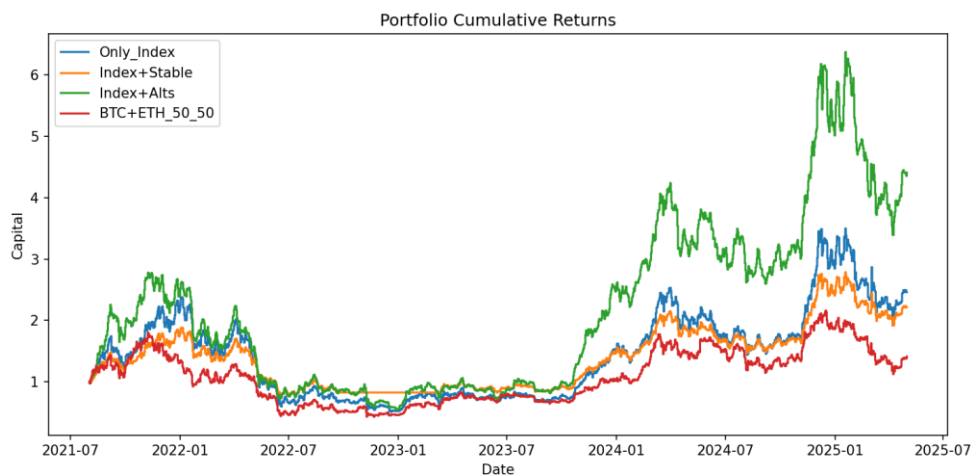


Figure 3 – Cumulative Returns of Portfolios Based on AI-Powered Crypto Index and Benchmark BTC+ETH for 2021–2025

The obtained research results demonstrate the significant potential of the AI-Powered Crypto Index in forming optimal cryptocurrency portfolios. The integration of asset clustering, volatility forecasting with LSTM networks, and weight optimization using the Risk Parity method has enabled the creation of an index characterized by high resilience and adaptability to changing market regimes. Empirical results indicate that the AI-Powered Crypto Index delivers higher annualized returns at reduced volatility compared to traditional capitalization-weighted indices. For example, the index exhibits a CAGR of 31.04% with volatility of 69.3%, whereas benchmarks such as Bitwise 10 or CMC 200 show lower returns and higher volatility.

An important advantage of the index is its low correlation with major market assets such as Bitcoin and Ethereum, creating opportunities for true diversification and portfolio risk reduction. The AI-Powered Crypto Index not only reflects the current market situation but also has the ability to automatically exclude excessively correlated or weakly liquid assets, ensuring more stable returns even during market shocks. This approach enables the construction of balanced portfolios with a predictable risk profile and provides potential for further integration into multi-factor and decentralized financial strategies.

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