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IV. FINANCE AND INVESTMENT: NEW CHALLENGES AND OPPORTUNITIES *https://vilniustech.lt/bm*

ANALYSIS OF INVESTMENT STRATEGIES IN CRYPTOCURRENCIES

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Abstract. Cryptocurrency investment is a rapidly growing financial sector, marked by high volatility, decentralized technologies, and significant profit potential. Investors use strategies like long-term holding ("HODLing"), portfolio diversification, and short-term trading. "HODLing" relies on long-term value appreciation but requires resilience to price fluctuations. Diversifying with assets like Bitcoin and Ethereum reduces risk due to their low correlation with traditional investments. The crypto market is highly sensitive to geopolitical, economic, and technological factors, attracting investors during economic instability. Advanced models like LASSO and AutoEncoder aid in price prediction and strategy optimization. Despite high return potential, careful risk management is essential due to volatility and regulatory uncertainty. This study experimentally applies identical cryptocurrency portfolios to different investment strategies, identifying the most profitable approach.

Keywords: cryptocurrencies, investment, portfolio, investment strategies.

JEL Classification: G10, O30.

1. Introduction

Cryptocurrency investment has emerged as one of the most dynamic and disruptive sectors in modern finance, reflecting the broader transformation brought about by digital innovation in the financial industry. Unlike traditional markets, the cryptocurrency market is defined by extreme volatility, decentralized infrastructure, rapid technological advancement, and evolving regulatory landscapes (Yermack, 2017). These characteristics create both unique investment opportunities and complex risks, challenging conventional financial theories and investment models (Jiang et al., 2018). The relevance of this topic has grown significantly as cryptocurrencies transition from niche assets to mainstream investment instruments. Institutional investors, hedge funds, and retail traders are increasingly allocating capital to crypto assets, attracted by their high return potential and diversification benefits (Cheng et al., 2020). Yet, this market remains highly speculative, with sharp price swings, limited liquidity, and frequent market manipulation, necessitating more sophisticated investment approaches. While traditional strategies such as buy-and-hold ("HODL"), swing trading, and day trading are widely used, their effectiveness in the crypto environment remains underexplored. Moreover, recent developments in artificial intelligence, blockchain analytics, and algorithmic trading open new frontiers for managing crypto portfolios with enhanced precision and risk control (Ghabri et al., 2021). These technologies enable more accurate forecasting of market trends and adaptive responses to volatile conditions. The novelty of this research lies in its comparative analysis of various investment strategies–both conventional and technology-driven–within the cryptocurrency market context (Liu & Tsyvinski, 2021). It aims to evaluate how these strategies perform under different market conditions, and how investors can balance risk and return in an increasingly complex digital asset landscape (Katsiampa et al., 2019). The urgency of this research is underscored by recent market developments: after a historic high of $3 trillion in 2021, total crypto market capitalization plunged by over 50% in 2022, only to rebound to $1.7 trillion in 2023 amid renewed optimism around Bitcoin ETFs and the expansion of decentralized finance (DeFi). With trading volumes reaching $36.6 trillion in 2023, understanding effective investment strategies is more crucial than ever. Ultimately, this study seeks to provide investors – both individual and institutional – with practical insights into navigating the volatile and

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rapidly evolving world of cryptocurrency, contributing to more informed decision-making and robust portfolio management.

2. Investments to cryptocurrencies theoretical aspects

Cryptocurrency investment is becoming increasingly important for both individual investors and financial institutions (Al Mamun et al., 2020). One of the main reasons for its growing appeal is the potential for high returns. Despite market volatility, research suggests that long-term investments in cryptocurrencies like Bitcoin often yield significant profits compared to traditional assets (Katsiampa et al., 2019).

Bitcoin is increasingly viewed as "digital gold" due to its limited supply of 21 million coins, making it a potential hedge against inflation. Unlike fiat currencies, its value is not directly influenced by central banks or governments, making it an attractive alternative asset in times of economic uncertainty. Beyond financial gains, cryptocurrencies also provide opportunities to participate in a rapidly evolving technological ecosystem (Urom et al., 2020).

To develop effective investment strategies, it is essential to understand the nature of cryptocurrencies and the motivations behind investing in this high-risk market. This study will explore different investment approaches and identify the most profitable cryptocurrency investment strategy.

2.1. Understanding cryptocurrencies

Bitcoin, introduced in 2008 by the anonymous Satoshi Nakamoto, was the first successful cryptocurrency (Nakamoto, 2008). It aimed to create a decentralized digital currency independent of financial institutions. Based on blockchain technology, Bitcoin revolutionized digital finance and inspired numerous other cryptocurrencies (Panda et al., 2021).

Blockchain is a decentralized and immutable digital ledger that ensures data security through cryptography. Originally designed for Bitcoin, it has since expanded into various industries, including finance, logistics, and healthcare. The technology operates without a central authority, relying on a network of nodes that validate transactions through consensus mechanisms like Proof-of-Work (Panda et al., 2021).

Cryptocurrencies offer several advantages, such as decentralization, security, and global accessibility (Pernice & Scott, 2021). However, they also present challenges, including regulatory uncertainty, volatility and potential misuse for illegal activities (Caro, 2017). A significant concern is the environmental impact of crypto mining, which consumes vast amounts of electricity. Green cryptocurrencies, like Algorand and BitGreen, aim to address this issue by utilizing renewable energy sources (Dung et al., 2024).

While cryptocurrencies reshape financial systems, they also create new power structures (Giudici et al., 2020). Despite being designed for decentralization, economic and technological disparities can lead to centralization within blockchain networks (Bousfield, 2019). Balancing innovation with sustainability and regulation will be crucial for the future of cryptocurrencies.

2.2. Investment into cryptocurrencies strategies

Cryptocurrencies have become one of the fastest-growing financial assets of the 21st century, attracting attention from both private investors and major institutions (Liu & Yang, 2024). While the cryptocurrency market is known for its volatility and risk, it also offers opportunities not only to rapidly increase capital but also to diversify investment portfolios with a new class of assets that expand the boundaries of traditional investing (Rosenbach, 2021). Due to their decentralized nature, security technologies, and unique financial mechanisms, cryptocurrencies are increasingly appealing to those seeking alternatives to conventional investment options (Ye et al., 2023). However, successful investing in cryptocurrencies requires a clear understanding of both the market's operating principles and various investment strategies that can help mitigate risks and maximize potential profit margins.

2.2.1. Profit generating strategies

Investing in cryptocurrencies involves several key strategies aimed at managing the high volatility and risks associated with this unique asset class (Petukhina & Sprünken, 2021). Long-Term Holding (HODLing)The HODLing strategy is based on the belief that despite frequent price fluctuations, the value of major cryptocurrencies like Bitcoin will increase over time (Müser et al., 2024). This approach is favored by investors who believe in the long-term growth of the crypto market and want to avoid the risks of short-term speculation. Studies suggest that HODLing has been historically profitable, with Bitcoin's value rising from mere cents to tens of thousands of dollars over a decade (Sahu et al., 2024). However, it requires psychological resilience, as investors must endure significant price swings without panic-selling. The main drawback is low liquidity, as investors hold onto their assets even during market downturns (Liu & Tsyvinski, 2018).

2.2.2. Portfolio diversification using cryptocurrencies

Cryptocurrencies, particularly Bitcoin and Ethereum, tend to have low or negative correlation with traditional assets like stocks, bonds, and real estate (Mattke et al., 2021). This characteristic makes them an effective diversification tool, helping to reduce overall portfolio risk and improve the risk-return ratio. Research shows that adding crypto to an investment portfolio can increase long-term returns, especially during market upswings. However, due to their high volatility, experts recommend

limiting crypto allocation to a small but strategic portion of the portfolio. Additionally, regulatory uncertainties must be considered, as legal frameworks for cryptocurrencies are still evolving globally.

Short-term trading

Some investors prefer short-term trading to capitalize on frequent price fluctuations. Strategies like day trading and arbitrage (profiting from price differences across exchanges) can be lucrative. Studies suggest that active trading can yield profits when market trends are effectively analysed and risk management techniques, such as stop-loss orders, are applied.

Risk management techniques

Given the extreme volatility of cryptocurrencies, investors often use risk management methods such as options trading, stop-loss orders, and periodic portfolio rebalancing. These techniques help minimize losses while maintaining the opportunity for gains.

Staking and yield farming

With the rise of decentralized finance (DeFi), strategies like staking and yield farming have gained popularity. These allow investors to earn passive income by locking up their crypto assets in blockchain networks (Hwang & Zhang, 2025). While these methods can be profitable, they come with risks, including liquidity issues and potential losses if asset values decline significantly during the holding period.

In summary, while cryptocurrencies offer high return potential, they require careful strategy selection, risk assessment, and long-term vision to maximize gains while mitigating risks.

2.2.3. Algorithmic trading

As technology advances, new models are being applied to the crypto space. One such approach is the use of AutoEncoder, a deep learning technique, for optimizing cryptocurrency portfolios. AutoEncoder models reduce data dimensionality and uncover hidden relationships between cryptocurrencies that traditional methods might overlook (Bouri et al., 2018). This technique helps detect price patterns that improve portfolio diversification and returns beyond simple price monitoring. By leveraging AutoEncoder, investors can filter out short-term volatility and market noise, focusing on essential data features for long-term investment strategies such as HODLing or diversification (Almeida & Gonçalves, 2023). Research indicates that combining AutoEncoder with other deep learning methods, such as clustering and principal component analysis (PCA), leads to more balanced portfolios that withstand market fluctuations while enhancing the risk-return ratio. These models also create alternative diversification strategies without requiring prior knowledge of asset correlations, making them especially useful in highly volatile crypto markets (Urom et al., 2020).

Bitcoin's role in portfolio optimization Bitcoin, as the dominant cryptocurrency, provides liquidity and relative stability compared to other crypto assets. However, relying solely on Bitcoin for portfolio optimization is insufficient due to its sensitivity to market shifts. Studies suggest that including assets like Ethereum, Ripple, and Litecoin enhances diversification, as many altcoins follow unique market dynamics. For instance, Ethereum, with its decentralized applications ecosystem, exhibits price movements less correlated with Bitcoin, improving the overall risk-return balance.

LASSO and LASSO-BMA for market prediction

The LASSO (Least Absolute Shrinkage and Selection Operator) method is widely used in finance for efficient forecasting using large datasets. It is particularly useful in addressing multicollinearity, where high correlations among independent variables can reduce predictive accuracy. LASSO applies regularization, eliminating irrelevant factors and improving model stability.

An advanced variation, LASSO-BMA (Bayesian Model Averaging), combines LASSO with Bayesian inference to enhance accuracy in predicting Bitcoin futures. Given the extreme volatility of crypto derivatives, this model helps investors manage risks while maintaining profitability. Bitcoin futures allow traders to hedge against unexpected price fluctuations, but their effectiveness depends on reliable forecasts. LASSO-BMA improves risk assessment by identifying significant market factors, providing a flexible approach to volatility management. Furthermore, LASSO-based models adapt to changing social and economic indicators, making them highly relevant for crypto markets, where investor sentiment plays a crucial role in price movements (Urom et al., 2020).

By continuously updating risk assessments, these models offer a dynamic solution for navigating cryptocurrency volatility.

2.2.4. Risk management using cryptocurrencies

Research on Bitcoin's interactions with other asset classes suggests that Bitcoin is not entirely isolated and is sensitive to shifts in other markets, especially during bull and bear market conditions (Kim et al., 2021). Using a return and volatility spillover model, Bouri et al. (2018) found that Bitcoin exhibits strong return linkages with other assets, particularly commodities, and experiences significant volatility spillovers (Mironeanu et al., 2021). Their findings indicate that Bitcoin absorbs more volatility from other markets than it transmits, making it more susceptible to external market changes than traditional assets such as stocks or currencies (Gómez Martínez et al., 2024; Huang & Gao, 2023).

This spillover effect between Bitcoin and other assets during different market cycles presents new risk management opportunities for investors. It enables more effective portfolio diversification by considering Bitcoin's unique responses to bull and bear phases. Moreover, these asset relationships are relevant not only for investors but

also for regulators, as Bitcoin's volatile market can have broader financial system implications beyond its own market fluctuations (Chuen, 2015). The results confirm that cryptocurrencies are becoming integrated into traditional finance, serving as potential portfolio additions while requiring stricter risk management controls.

Portfolio allocation and risk management

A passive investment strategy in cryptocurrencies requires not only asset selection but also regular portfolio rebalancing due to market volatility. A strict asset allocation model that balances cryptocurrencies based on different risk levels and market capitalizations is recommended. This approach helps manage investment risks while maximizing returns and avoiding overreliance on a single asset.

Quantitative analysis shows that Bitcoin, due to its high volatility, can transmit shocks to other asset classes during market crises or extreme instability (Nakano & Takahashi, 2020). This means that Bitcoin's price fluctuations can act as a source of risk, affecting stock and commodity markets. For example, a sharp decline in Bitcoin's value may lead to increased volatility in other financial sectors due to the psychological effect of investors withdrawing from riskier assets.

Furthermore, some strategic commodities, such as gold, exhibit a negative correlation with Bitcoin, making them a potential hedge against Bitcoin's price swings (Wirth et al., 2024). This is particularly important for portfolio diversification, as gold, traditionally considered a "safe haven", can help protect the overall portfolio from value depreciation. This trend is especially evident during periods of high Bitcoin volatility when investors shift toward safer assets like gold.

2.2.5. Investment strategies and market cycles

Investing in cryptocurrencies is a multi-layered and high-risk process influenced by various factors, including market cycles, volatility spillovers, and technological models. While the HODL strategy, which involves holding long-term positions, has often been effective for Bitcoin, it may not always be suitable for other cryptocurrencies or risk-averse investors (Wirth et al., 2024). Diversification becomes crucial, particularly given Bitcoin's heightened volatility spillover effects on other asset classes, such as stocks, commodities, and currencies.

Market cycles indicate that Bitcoin, like other crypto assets, is sensitive to external changes. Integrating it into a diversified portfolio can help stabilize returns by offsetting its volatility with traditional assets. Advanced analytical methods such as LASSO and AutoEncoder make it easier to predict returns and risk factors, helping manage cryptocurrency market instability while capturing profitable opportunities (García-Corral et al., 2022).

Successful cryptocurrency investment strategies rely on well-structured portfolio compositions, combining both crypto assets and traditional financial instruments to reduce excessive risk while maximizing long-term profits. Investing in cryptocurrencies requires a comprehensive approach, considering technological, economic, social, and psychological factors (Shahzad et al., 2024). While Bitcoin and other digital assets offer decentralized financial systems and high return potential, they also demand responsible risk management due to their extreme volatility and market cycle sensitivity.

Analytical models like LASSO and AutoEncoder enhance market prediction accuracy, but in the long run, diversification remains the most reliable strategy. By combining cryptocurrencies with traditional assets such as stocks and commodities, investors can reduce risk exposure and stabilize returns, ensuring a balanced and resilient investment approach.

3. Methods for constructing and comparing the efficiency of investment portfolios

In the theoretical part, three investment portfolio construction strategies were selected:

- Profit Generation Strategy;
- Algorithmic Trading Strategy;
- Risk Management Strategy.

These strategies represent different approaches to portfolio construction, focusing on return optimization, risk management, and advanced technological methods.

To implement these strategies, specific methods are required to determine asset weights in the portfolio. Each asset (e.g., cryptocurrencies, stocks, bonds) is assigned optimal weights based on the chosen strategy.

Equal Weight Strategy (Profit Generation & Long-Term Investing)

The Equal Weight Strategy assigns equal weights to all portfolio components, regardless of market capitalization or other factors. This method reduces dependence on a single asset, lowering overall portfolio risk. It is simple to implement, minimizes transaction costs, and benefits from compound interest over time. Additionally, it remains effective in different market conditions as it does not rely on any single asset class dominance (Iqbal et al., 2024).

Maximum Sharpe Ratio Strategy (Algorithmic Trading)

The Maximum Sharpe Ratio Strategy aims to optimize the portfolio for the highest possible return-to-risk ratio. It is based on the Sharpe Ratio, which measures excess return per unit of risk). In algorithmic trading, this strategy helps determine optimal asset weights to maximize returns while managing risk. By integrating deep learning methods, investors can uncover complex relationships between assets and improve portfolio allocation efficiency (Jasmine, 2014).

Minimum Risk Portfolio Strategy (Risk Management)

The Minimum Risk Portfolio Strategy seeks to create a portfolio with the lowest possible volatility, regardless of expected returns (Bauder et al., 2021). It optimizes asset weights to minimize variance, making it particularly relevant in volatile markets like cryptocurrencies. Modern Portfolio Theory suggests that diversification reduces overall portfolio risk (Urom et al., 2020). This strategy prioritizes stability over return maximization, helping investors manage risk effectively. However, while it reduces volatility, it does not guarantee higher returns–investors seeking higher profits must accept greater risk.

3.1. The creation of investment portfolios

The investment portfolio under analysis includes three stock components and two cryptocurrency components, selected from the most popular stocks and cryptocurrencies. The choice of these assets was made to represent a diversified portfolio, incorporating both traditional and digital asset classes.

Since this study focuses on portfolio construction strategies, the selected components are not fixed and could be replaced with other assets, depending on specific investment goals and market conditions. The primary objective is to analyse how different strategies perform rather than evaluating the individual assets themselves.

To begin the analysis, we first assess the risk, return, and Sharpe ratios of each selected component. This evaluation provides insights into the performance and volatility of individual assets, which is crucial for optimizing portfolio allocation and balancing risk and reward effectively.

Next it will be provided return, risk and Sharp ratio calculation equations:

$$\ln\left(\frac{P_1}{P_0}\right) = \ln(P_1) - \ln(P_0).$$

This is the logarithmic returns equation. Following with the risk equation:

$$s^2 = \frac{\sum(x-\overline{x})^2}{n-1}, \quad s = \sqrt{s^2}.$$

And finally, to end with the Sharp ratio equation:

$$Sharp = \frac{\overline{r} - r_f}{\sigma}.$$

After calculating these key financial metrics–return, risk, and Sharpe ratio–we can proceed with constructing investment portfolios using the Python programming language. This approach allows for a data-driven and systematic portfolio optimization process.

Each investment portfolio will consist of the same asset components; however, the weight allocation of each component will vary depending on the chosen investment strategy. By applying different portfolio construction methodologies, we can analyse how various strategies impact overall portfolio performance in terms of risk-adjusted returns.

Using Python, we will implement different allocation techniques, adjusting the weights of each asset according to the specific strategy–whether it prioritizes return maximization, risk minimization, or an optimal balance between the two. This computational approach ensures a more precise and efficient portfolio construction process, allowing for back testing and performance evaluation under different market conditions.

3.2 Efficiency comparison of investment portfolios

We conducted the comparison of investment portfolios using two approaches.

First, after constructing the investment portfolios, we compared their returns, risks, and Sharpe ratios. This allowed us to determine which portfolio construction strategy yielded the highest profit, which one was the riskiest, and which had the best risk-adjusted performance based on the Sharpe ratio.

The second stage of strategy comparison involved forecasting portfolio performance using the ARIMA model and comparing the predictions with actual data.

The forecasts were made for the year 2024 and then compared with real market data. This approach enabled us to assess which portfolio construction strategy provided the most accurate predictions, thereby evaluating its overall effectiveness and reliability.

4. Empirical illustration

4.1. Data analysis

For the empirical research, three stocks and two cryptocurrencies were selected: Nvidia, Tesla, Intel, Bitcoin, and Ethereum. The analysis covers the adjusted period from November 9, 2017, to January 31, 2025. Following the data normalization process (see Figure 1), a graphical

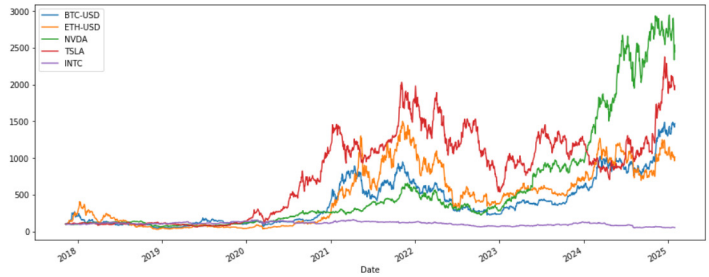

Figure 1. Normalized data (source: created by authors)

representation was generated to provide a clearer visualization of the trends.

Following to that, return, risk and Sharp ratio was calculated for each component and accordingly three portfolios were created with different weight ratio of each component based on each strategy (see Tables 1, 2 and 3).

Table 1. Equal wights (source: created by authors)

BTC-USD	20.0%
ETH-USD	20.0%
NVDA	20.0%
TSLA	20.0%
INTC	20.0%

Table 2. Minimum risk (source: created by authors)

BTC-USD	15.63%
ETH-USD	0.0%
NVDA	14.76%
TSLA	11.23%
INTC	58.37%

Table 3. Maximum Sharp (source: created by authors)

BTC-USD	20.7%
ETH-USD	0.0%
NVDA	56.58%
TSLA	22.72%
INTC	0.0%

Every portfolios risk, return and Sharp ratio was calculated (see Figure 2) and compared their efficiency to determinate which strategy is the most efficient.

Portfolio	Yearly return	Yearly risk	Sharpe ratio
Equal wights	0.290072	0.436332	0.664797
min_rizikos_s	0.115791	0.357661	0.323746
max_sharpe_s	0.419752	0.436054	0.962614

Figure 2. Portfolio comparison (source: created by authors)

From the table we can tell that the most efficient is the maximum Sharp ratio strategy, as the strategy name says, sharp ratio is the biggest, which means the investor that chooses this strategy gets the most return from the risk he is willing to take it.

4.2. Forecasting

Forecasting covers data from November 9, 2017, to December 31, 2023 with a forecast for year 2024.

We used ARIMA forecast model (5, 1, 0) without seasonal adjustment. As the following year has ended, we can compare ARIMA model forecast with results (see Figure 3).

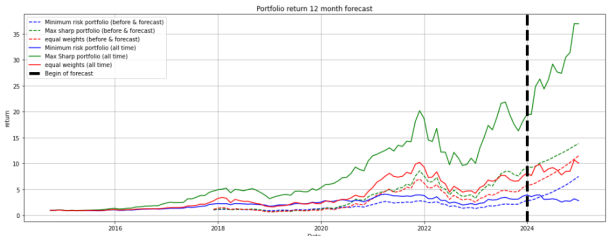

Figure 3. 12-month forecast (source: created by authors)

Black dashed vertical line marks forecast beginning, green line from forecast beginning (dashed- forecast, solid- real data) marks max sharp portfolio, red line (dashed- forecast, solid- real data) marks equal wights, blue line (dashed- forecast, solid- real data) marks minimum risk portfolio.

From graphical image we can see that the most accurate forecast was for equal wights portfolio, in which we can interpretate, that this strategy portfolio is the most effective forecasting wise.

5. Conclusions

In conclusion, this study investigated the effectiveness of three cryptocurrency-inclusive portfolio strategies–Equal Weight (profit-generation), Minimum Risk (risk management), and Maximum Sharpe Ratio (algorithmic trading)–through empirical analysis and predictive modelling. Key findings include Maximum Sharpe Ratio Strategy yielded the highest risk-adjusted returns, with Nvidia and Tesla dominating the asset weightings, and no allocation to Ethereum or Intel. This confirms that machine-learning-driven optimization can significantly enhance portfolio efficiency in volatile markets. Minimum Risk Strategy provided the lowest portfolio volatility, heavily favouring.

Intel while excluding Ethereum entirely. Although this strategy sacrifices return potential, it caters to risk-averse investors prioritizing capital preservation over profit maximization. Equal Weight Strategy, while not the top performer in terms of returns or risk, produced the most accurate performance forecast under the ARIMA model. This consistency suggests that equally weighted portfolios may offer greater predictability in uncertain markets, which is particularly valuable for long-term planning and conservative investment profiles. The dual-layered approach–backward-looking performance evaluation combined with forward-looking forecasting–highlights that no single strategy is universally superior. Instead, the optimal strategy depends on investor priorities: return maximization, risk minimization, or forecast reliability.

However, this research is not without limitations. The scope of assets analysed was relatively narrow, including only a small selection of equities and cryptocurrencies, which may restrict the generalizability of the findings. Additionally, the models applied were based on static allocation and did not incorporate

real-time rebalancing, limiting their responsiveness to sudden market shifts. The use of the ARIMA model, while effective for linear trend forecasting, may not fully capture the complex, nonlinear behaviour of crypto assets. Furthermore, the analysis was conducted over a limited time frame, which might not reflect longer-term market cycles or account for major regulatory and macroeconomic events.

Future research could address these constraints by expanding the asset pool to include a wider range of digital and traditional assets, and by employing adaptive, AI-driven portfolio strategies capable of responding to real-time market data. Incorporating alternative forecasting models, such as deep learning architectures like LSTM or Transformer networks, could enhance predictive accuracy in the presence of nonlinear trends. Moreover, applying scenario-based stress testing and integrating behavioural or sentiment-based indicators could further refine the understanding of portfolio performance under varied market conditions. By building on these directions, future studies can deepen insights into the construction of resilient and efficient portfolios in the evolving landscape of crypto-inclusive investing.

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