

-RESEARCH ARTICLE-

PORTFOLIO OPTIMIZATION AND HEDGING EFFECTIVENESS OF TRADITIONAL AND ALTERNATIVE ASSETS: EVIDENCE FROM THE IRAQI FINANCIAL MARKET

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—Abstract—

In this study, we will analyze portfolio optimization and hedging effectiveness of the financial assets for the Iraqi market, such as private bank stocks, gold and cryptocurrencies. Research will test to see if the introduction of alternative assets increases the efficiencies of the portfolio and if such assets can offer some degree of protection against exchange rate fluctuations. The contribution of this study lies in the empirical aspect of the study and the clarification of the different roles of traditional and alternative assets in portfolio management in a developing market. This finding is relevant in the context of investors who want to improve their portfolio performance by using quantitative optimization methods. The monthly data from period (2022-2024) were studied through descriptive statistics, correlation analysis and regression approach for hedging properties. The portfolio construction was carried out in the following two methods: a traditional portfolio with equal weights and a modern portfolio based on the Markowitz mean-variance optimization model. Three measures, namely return, risk (standard deviation), and Sharpe ratio were introduced to assess the performance of the portfolio. The empirical results show that there is no significant hedging relationship for most assets with the price of the Iraqi dinar, as this is due to the relative stability of

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the Iraqi dinar. In addition, gold exhibited weak hedging properties, whereas cryptocurrencies failed to provide strong hedging properties in the presence of their high volatility. With respect to portfolio performance, the results show the inefficiency that occurs when there is an incorrect allocation. The results indicate that portfolio efficiency is not only achieved through diversification but also through optimal asset allocation.

Keywords: Portfolio Optimization; Markowitz Model; Cryptocurrencies; Hedging; Sharpe Ratio; Emerging Markets.

INTRODUCTION

Over the past few decades, there is a tremendous amount of development in the field of portfolio management, because of the changes that have come in the financial markets and the need to have an efficient portfolio management in terms of return and risk. Generally, modern financial literature is based on the Modern Portfolio Theory of Harry Markowitz, which focuses on the fact that efficient asset diversification is the cornerstone of enhancing the performance of an investment portfolio by minimizing unsystematic risk without compromising the expected return ([Markowitz, 1952](#)). This framework has been the basis for quantitative optimization models for portfolio management in contexts with high levels of uncertainty. As the financial markets have evolved around the world, diversification has come to mean not just diversifying among financial assets but also diversifying into alternative assets like gold or cryptocurrencies. The expansion has been stimulated by investors' quest for new products that can improve the efficiency of the investment portfolio in some capacity; either by boosting performance or by offering market and money risk mitigation characteristics.

Cryptocurrencies, especially Bitcoin and Ethereum, have become a new asset class that has garnered significant interest from the financial world, beyond their potential for high returns, because they offer unique features such as volatility, independence from traditional assets, and investment diversification ([Jeleskovic et al., 2023](#)). However, there is debate about whether such assets could be used effectively as hedging assets or as merely highly speculative and risky assets. On the other hand, gold remains a safe-haven asset and often is seen as a hedge against inflation and currency volatility, and it is an essential asset in multi-asset investment portfolios ([Baur & McDermott, 2010](#)).

This debate is even more prominent in emerging markets, which have distinct characteristics in terms of market depth, pricing efficiency, and the kinds of risks. The importance of diversification and hedging tools can vary from the evidence available in the advanced economies, which may necessitate empirical studies in emerging markets, like the Iraqi market. The case of the Iraqi financial market is particularly interesting in this respect because it is an emerging market that is subject to unique institutional and

monetary conditions and has a relatively stable exchange rate and limited structure of investments in terms of diversification. The above features suggest a number of issues concerning the role of traditional and alternative assets in improving the efficiency of the portfolios in the Iraqi context.

Therefore, the objective of the current study is to investigate the possibility of enhancing portfolio performance and hedging properties in the Iraqi stock market by using traditional and alternative assets in order to explore this possibility, quantitative optimization models and risk return analysis will be used.

Research Problem

Although there is an expanding literature on cryptocurrencies in developed markets, empirical studies on cryptocurrencies and their use in emerging markets, in particular in Iraq are scarce. This is the reason for this lack in literature that is the prime incentive to undertake the present study. The research problem is essentially that there is insufficient empirical evidence that can be found to support the use of alternative assets such as cryptocurrencies, which may help to improve the efficiency of a portfolio and offer hedging properties in the emerging markets, particularly in the Iraqi financial market. While the number of studies in this field has increased significantly, earlier research has not been conclusive as to whether cryptocurrencies are good hedging instruments or they only serve to enhance the efficiency of the portfolios.

Based on this, the following primary research question is put forward:

What is the extent of enhancing the efficiency of the portfolios and adding hedging properties for alternative assets, especially cryptocurrencies and traditional assets in the Iraqi market?

The following sub-questions arise with this major question:

1. How well do cryptocurrencies prove to be hedge instruments in the context of exchange rate changes?
2. Is there evidence that cryptocurrencies provide value to investors' portfolios in terms of risk adjusted performance?
3. Are there investment efficient portfolios that are superior to those of the equally weighted portfolios when optimal asset allocation is used?

Research Objectives

This study seeks to examine the role of traditional and alternative assets in enhancing the efficiency of portfolios and hedging properties in the Iraqi market using a quantitative approach, which integrated risk–return analysis and portfolio optimization models. The goals of the research can be summarized as follows:

1. To study the hedging ability of the assets selected with the focus on cryptocurrencies, using the relationship between the return of the assets and the fluctuations of the exchange rate (USD/IQD).
2. To measure the effect of introducing cryptocurrencies in investment portfolios on the improvement of risk-adjusted performance (efficiency indicators: William F. Sharpe Ratio).
3. To compare the efficiency of equally weighted portfolio and optimally weighted portfolio to find the influence of optimal asset allocation on portfolio efficiency.
4. To discuss the relative importance of alternative assets in investment portfolios and how they perform relative to the hedging and diversification effects.
5. To offer an applied model that increases the efficiency of the portfolio through quantitative analysis models, especially for emerging market like the Iraqi market.

Significance of the Study

The significance of the study is that it contributes to solving the one of the current issues in financial literature, which is the role of alternative assets in their efficiency and hedging properties, especially in emerging markets, in the presence of cryptocurrencies. The study findings are of academic and practical importance as below:

Academic Significance

The academic value of this study is on the use of integrating hedging properties with the study of portfolio efficiency in a single framework to enrich the financial literature. Another advantage of the study is that it introduces empirical evidence from an emerging market which has little coverage in the previous studies, the Iraqi market. This helps to develop an understanding of the role of cryptocurrencies in different economic environments compared to those of developed markets. Moreover, the study helps contribute to the ongoing debate in literature whether cryptocurrencies are good hedging tools or only diversification tools in investment portfolios.

Practical Significance

From the practical point of view, the study offers some implications for investors and portfolio managers who need to include alternative assets in their investment portfolio, especially to consider the value of optimal asset allocation, instead of equally weighted. Further, the study results can aid in investment decision making in emerging markets by shedding light on the positive or negative relationship between risk and cryptocurrencies. The study also provides an applied model that could be used in the development of more effective investment portfolios in an economic environment with different exchange rate structures and market development.

Contribution of the Study

This study adds to the financial literature in both theory and practice by adding to the field of portfolio management. The study makes the following contributions:

Theoretical Contribution

To understand the various functions of alternative assets, especially cryptocurrencies in investment portfolios, the study develops an integrated framework, which includes the theories of Modern Portfolio Theory, safe-haven theory and behavioral portfolio theory. Furthermore, the study helps to fill the gap in the existing literature regarding the different functions of assets as a hedge and diversification assets, the distinction of which has not yet been enough explored.

Methodological Contribution

The study has an integrated methodological approach as it includes several analytical approaches in one model. In particular, regression analysis is used to investigate the hedging properties, the Harry Markowitz model is used to calculate optimum portfolio weights and the William F. Sharpe ratio is used to analyse risk adjusted performance. This methodological integration allows carrying out a more complete evaluation of portfolios efficiency than the one that is based on a single analytical method.

Empirical Contribution

The study contributes to filling a gap in the literature on the role of cryptocurrencies in portfolio efficiency in the context of emerging markets, especially the Iraqi market, since there are few studies that have investigated this issue in this market. Moreover, the results can differentiate between the hedging role of cryptocurrencies in exchange rate fluctuations and its role in portfolio diversification.

Practical Contribution

The study provides practical implications for investors and portfolio managers on how to include alternative assets in investment portfolios. It particularly highlights that the performance of the portfolios will not be improved simply by adding these items to the portfolios, but rather depends upon the optimal asset allocation that, in the final analysis, will improve the efficiency of investment decisions

Research Hypotheses

The study assumes that adding alternative assets, especially cryptocurrencies, can help improve portfolio efficiency, but this depends on the hedging properties and optimally allocating assets.

Sub-Hypothesis One (H1)

Cryptocurrencies do not represent effective hedging instruments against the depreciation of the Iraqi dinar.

Sub-Hypothesis Two (H2)

The inclusion of cryptocurrencies in investment portfolios contributes to improving risk-adjusted performance through diversification benefits.

Sub-Hypothesis Three (H3)

Optimal asset allocation leads to a significant improvement in portfolio efficiency compared with equally weighted portfolios.

Sub-Hypothesis Four (H4)

The contribution of alternative assets to portfolio efficiency differs between their role as hedging instruments and their role as diversification assets.

Hypothesis	Description	Result	Decision
H1	Digital currencies are not effective hedging instruments against the depreciation of the Iraqi dinar	Regression analysis will be used to test hedging effectiveness	Accepted / Rejected
H2	Cryptocurrencies improve risk-adjusted performance through diversification benefits.	William F. Sharpe Ratio will be used to evaluate portfolio performance	Accepted / Rejected
H3	Optimal portfolio weights outperform equally weighted portfolios in terms of efficiency	Harry Markowitz Model will be used to test optimal allocation efficiency	Accepted / Rejected
H4	The contribution of digital assets to portfolio efficiency is more diversification-oriented than hedging-oriented	Comparative portfolio analysis will be applied to evaluate diversification and hedging roles.	Accepted / Rejected

Source: Developed by the researcher based on the study hypotheses

The above hypotheses will be tested using regression analysis to examine hedging properties, the William F. Sharpe Ratio to evaluate risk-adjusted performance, and the Harry Markowitz model to assess the impact of optimal asset allocation on portfolio efficiency.

Conceptual Framework

Figure (1) illustrates the conceptual framework of the study, which links alternative assets, particularly cryptocurrencies, to portfolio efficiency through four main relationships representing the research hypotheses. The framework examines the role of cryptocurrencies as hedging instruments as well as their contribution to portfolio

diversification. In addition, the study analyzes the impact of optimal asset allocation on improving portfolio efficiency. The framework also illustrates the connection between hedging assets and diversification assets, and their impact on investment portfolio performance.

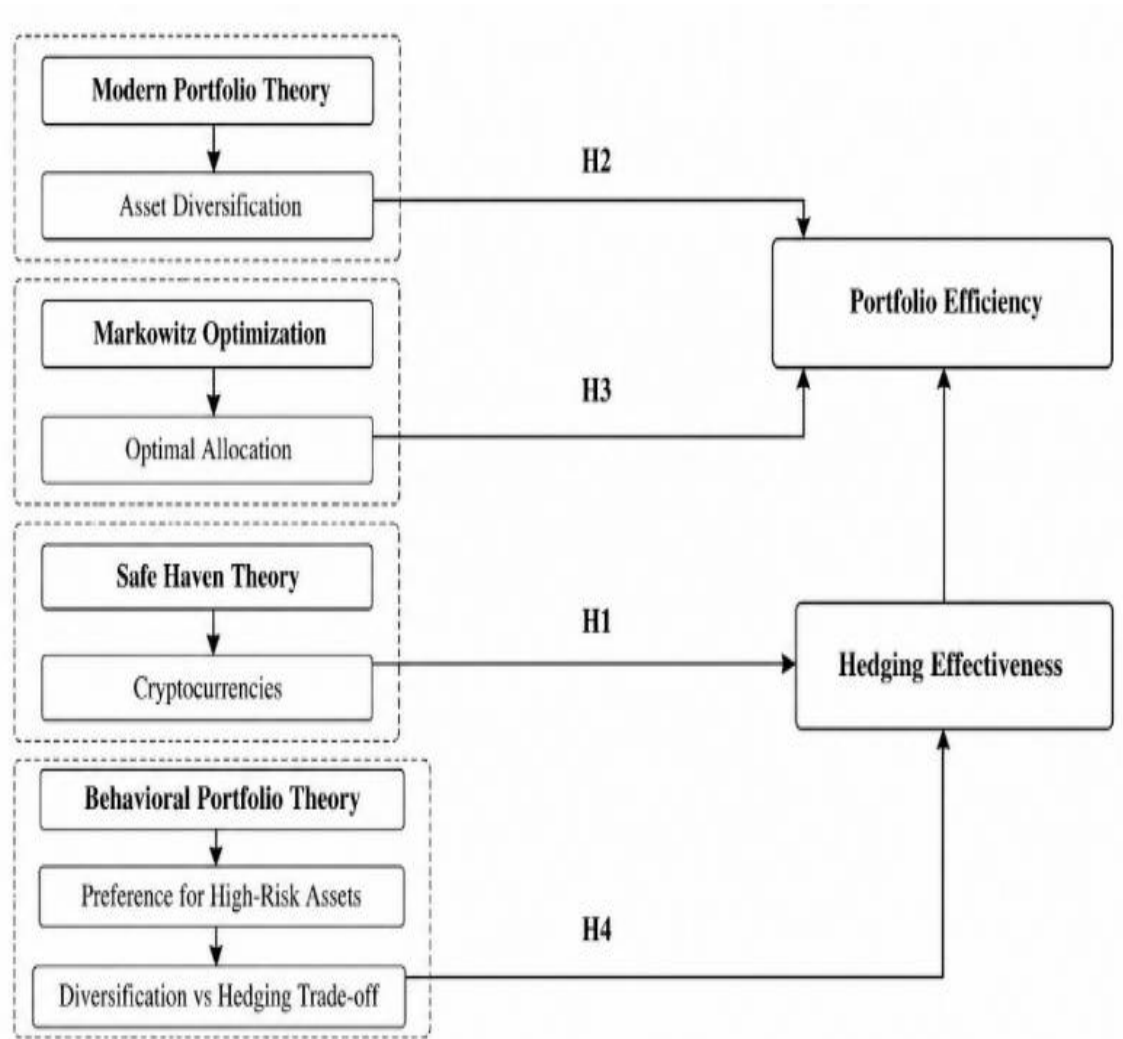


Figure 1: Conceptual Framework of Portfolio Efficiency and Hedging Analysis

Previous Studies

Researcher & Year	Study Title	Field of Study	Objective of the Study	Main Findings
Markowitz (1952)	Portfolio Selection	Modern Portfolio Theory and Portfolio Management	To develop a mathematical model for portfolio selection based on	The study emphasized the importance of diversification in reducing risk and introduced the concept of the Efficient

			the relationship between return and risk	Frontier, which became the theoretical foundation of Modern Portfolio Theory.
Sharpe (1994)	The Sharpe Ratio	Risk-adjusted Performance Evaluation	To develop a measure for evaluating portfolio efficiency by comparing return to risk	The study concluded that a higher Sharpe Ratio reflects superior portfolio performance relative to the level of risk undertaken, making it one of the most important investment performance indicators.
Baur and McDermott (2010)	Is Gold a Safe Haven? International Evidence	Gold as a Safe Haven and Risk Management	To test the ability of gold to function as a safe haven during financial crises	The results showed that gold acts as a safe haven in some markets during periods of crisis and contributes to reducing portfolio risk.
Jeleskovic et al. (2023)	Optimization of Portfolios with Cryptocurrencies: Markowitz and GARCH-Copula Approach	Portfolio Optimization Using Cryptocurrencies	To examine the impact of cryptocurrencies on improving portfolio efficiency using advanced models	The study found that incorporating cryptocurrencies may improve portfolio efficiency, especially when using GARCH-Copula models for risk estimation.
Just and Echaust (2024)	Cryptocurrencies Against Stock Market Risk: New Insights into Hedging Effectiveness	Hedging Using Cryptocurrencies	To measure the effectiveness of cryptocurrencies in hedging against stock market risks	The study showed that cryptocurrencies provide partial hedging against stock market risks, although their effectiveness varies according to market conditions.
Sahu et al. (2024)	Analyzing Portfolio Optimization in Cryptocurrency Markets: A Comparative Study of Short-Term Investment Strategies	Portfolio Optimization in Cryptocurrency Markets	To compare short-term investment strategies in cryptocurrency markets	The study concluded that dynamic portfolio rebalancing improves risk-adjusted performance despite high volatility.
Boyd (2024)	Markowitz Portfolio Construction at Seventy: Recent Developments and Future Directions	Recent Developments in Portfolio Theory	To review recent developments in the Markowitz model and its future directions	The study confirmed the continuing importance of the Markowitz model, especially when integrated with modern techniques such as artificial intelligence and alternative assets.
Grujić and Šoja (2022)	Portfolio Diversification with Bitcoin: Evidence from Institutional Investors Perspective	Portfolio Diversification Using Bitcoin	To examine the effect of including Bitcoin in investment portfolios	The study found that adding Bitcoin may increase the Sharpe Ratio and improve diversification when optimal weights are used instead of equal weights.

Nurhakim et al. (2024)	Constructing Optimal Portfolios Using the Single Index Model and Markowitz Model: A Study on Cryptocurrencies	Optimal Portfolio Construction for Cryptocurrencies	To compare the Single Index Model and the Markowitz Model in cryptocurrency portfolio management	The results showed the superiority of the Markowitz Model in achieving higher returns, lower risk, and better diversification efficiency.
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Source: The researcher's work, which was done based on literature and previous studies mentioned in the references.

Research Gap

Although many financial studies have been conducted over the years on the role and impact of alternative assets on portfolio efficiency, the available literature still offers inconsistent and conflicting findings, particularly on the hedging properties of alternative assets versus diversification. Some studies indicate that cryptocurrencies can be used as effective hedges, while others say that they can only be used to improve diversification, and not to offer any financial risk protection. Furthermore, most empirical studies have been conducted on developed market economies, while empirical evidence from emerging markets is quite scarce, especially when markets are heavily beset by different monetary and institutional structures like the Iraqi market, where the exchange rate regime is relatively stable and there is not much diversification in the investment structure. Moreover, most of the earlier research has been conducted separately regarding hedging and portfolio efficiency, lacking a comprehensive analytical model which jointly considers the effectiveness of hedging, efficiency of the portfolio and optimal asset allocation. Thus, this study fills the gap of the study by exploring the integrated effect between traditional versus alternative assets on boosting portfolio efficiency and hedging properties in an emerging market environment. The study aims to achieve this through hedging analysis and portfolio optimisation models and by assessing whether the effect of cryptocurrencies is mostly as a hedging tool or a diversification tool in an optimal asset allocation framework.

THEORETICAL FRAMEWORK

Modern Portfolio Theory

One of the most important and pioneering theories in modern financial literature is the Modern Portfolio Theory developed by Harry Markowitz in 1952 which provided a scientific approach to the decision of investing in a financial portfolio based on the relationship between the portfolio returns and its risk.

The theory assumes that one rational investor does not consider an asset on their own, but rather its contribution to the portfolio, which incorporates the impact of the asset on the overall risk of the portfolio due to the correlation between the asset and other assets

in the portfolio. The theory avers that unsystematic risk can be efficiently diversified away without necessarily compromising on expected returns.

The theory also implies that investors are aiming to build a best portfolio to get the maximum return for a given amount of risk or the minimum risk for a given amount of expected return. In the context of the modern portfolio theory, diversification is considered the main principle of the portfolio construction procedure.

Expected Return of the portfolio

$$E(R_p) = \sum_{i=1}^n w_i E(R_i) \dots \dots \dots (1)$$

Portfolio variance (Risk)

$$\sigma^2_p = \sum \sum W_i W_j \sigma_{ij} \dots \dots \dots (2)$$

Two – Asset portfolio case

$$\sigma^2_p = w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1 w_2 \sigma_{12} \dots \dots \dots (3)$$

$E(R_p)$: Expected return of the portfolio

w_i : Weight of asset i in the portfolio

$E(R_i)$: Expected return of asset i

σ^2_p : Variance of the portfolio

σ_i^2 : Variance of asset i

σ_{ij} : Covariance between asset i and j

These relationships give rise to the notion of the “efficient frontier” – the collection of portfolios that provide the maximum return for a given level of risk, or the minimum risk for a given level of return. The present study is based on this theory to assess the effect of conventional and alternative assets on improving the efficiency of the portfolio (Markowitz, 1952).

Although Modern Portfolio Theory (MPT) is still present in financial literature, recent research has expanded the use of MPT to more intricate scenarios that incorporate alternative assets and cryptocurrencies. Current articles validate that the Markowitz approach is the most important theory used to examine the efficiency of portfolios, with extensions in risk management which include the Sharpe Ratio developed by William F. Sharpe. This measure compares excess returns over the risk-free return to total risk (standard deviation), for a risk-adjusted measure of performance. In the world of investments, the Sharpe Ratio is a well-known metric used for assessing the efficiency of an investment portfolio. In the investment world, the Sharpe Ratio is a widely

recognized measure used to evaluate a portfolio's performance in relation to its level of risk(Sharpe, 1994).

$$S = (R_p - R_f) / \sigma_p \dots\dots\dots (4)$$

The Markowitz optimization model is an applied version of Modern Portfolio Theory which is designed to find the weights for a portfolio of assets that are optimal with respect to the risk versus return relationship.

The model can be solved by solving an optimization problem either:

Minimizing portfolio risk at a target level of return.

Maximizing risk-adjusted return, as reflected in maximizing the Sharpe Ratio.

The quantitative optimization tools used in this research, including Solver, are applied to the practical application to calculate the optimal weights of the portfolio that provide higher efficiency in investing than the traditional methods. The reason for the significance of this model within the present study is because it is the major instrument used to evaluate if the usage of an optimum allocation of traditional and alternative assets would increase the efficiency of the portfolio. The present study is therefore based on the integration of these theoretical frameworks: The diversification analysis is based on Modern Portfolio theory, the hedging properties can be understood as per Safe Haven Theory and the applied diversification model is Markowitz model. (Sharpe, 1994).

Safe Haven and Hedging Theory

The Safe Haven Theory proposes that some assets offer a way to protect from risk by maintaining or expanding their worth when financial markets are trading in turmoil. Financial literature distinguishes between the concepts of a hedge and a safe haven. A hedge is an asset with a negative or weak correlation on average to a source of risk, while a safe haven is an asset that has this property during a crisis (Baur & McDermott, 2010). Gold is said to be the classic proof of this theory, and cryptocurrencies, especially Bitcoin, have sparked a great deal of discussion about whether they can be deemed to be safe-haven or hedging assets.

The present study is directly related to this theory as it discusses the capacity of assets to insure exchange rate risk. Recent literature indicates that the safe-haven and hedging properties of assets, especially cryptocurrencies, are dynamic and vary according to market conditions. Some cryptocurrencies may have different diversification properties rather than stable properties as safe-haven assets, while gold is a consistent safe-haven asset. In financial literature, the issue of hedging financial risks and market fluctuations has gained significant attention in recent years, especially in relation to traditional and

alternative assets as instruments to hedge market shocks and currency risks. In this sense, the literature states that the effectiveness of the hedge depends on the characteristics of the investment asset's relationship to the risk factor: An asset is said to be a hedge if it has a negative or weak correlation to the risk being examined. The study by [Baur and McDermott \(2010\)](#) is It was one of the first studies of this type to validate the hedging effects of gold as a safe haven when there is uncertainty in the financial markets. The study showed that gold still retains the power to hedge risk during market turmoil, continuing its status as a traditional hedge asset. ([Baur & McDermott, 2010](#)).

In contrast, recent literature has expanded the discussion of hedging to include cryptocurrencies. demonstrated that the hedging and safe-haven characteristics of assets, including cryptocurrencies, are not constant but rather vary according to market conditions, volatility levels, and the nature of economic shocks. Consequently, the effectiveness of these assets as hedging tools is more contextual than permanent. Similarly, [Just and Echaust \(2024\)](#). Recently, crypto-assets have shown significant evidence that their hedging properties may be limited or volatile relative to those of traditional assets, and are more akin to diversification than to hedging. This view is consistent with the view taken by most modern literature which separates the use of an asset as a hedger from the use of it as part of the portfolio enhancement. ([Just & Echaust, 2024](#)).

Therefore, the present study takes this theoretical approach into consideration to investigate whether other assets such as digital currencies (cryptocurrencies) can do the job of hedging against exchange rate fluctuations in the Iraqi market, or whether they are just for diversification and enhancing portfolio efficiency. Recent research has also found that the Markowitz model remains valid in portfolios that include cryptocurrencies, pointing out that the value of their inclusion is largely determined by the cryptocurrencies' weights in the portfolio rather than just their presence. Efficiency in the portfolio is looked upon as one of the main concepts in modern financial literature and is theoretically grounded on the work of Harry Markowitz, who developed the scientific approach of optimizing the allocation of money among various investments by balancing return and risk. Markowitz theory states that asset selection should be done based on contribution to the overall risk of the portfolio and not independently, thus the concept of the Efficient Frontier was developed as the theoretical basis of optimal asset selection ([Nurhakim et al., 2024](#)).

Recent literature has extended the application of this framework to include alternative assets, particularly cryptocurrencies. In this context, [Jeleskovic et al. \(2023\)](#) found that If optimal asset allocation is used, cryptocurrencies can enhance the risk return performance of an investment portfolio. Therefore, the diversification benefits of achieving are more closely related to the allocation of weights rather than the fact of cryptocurrencies being in the portfolio. Likewise, [Sahu et al. \(2024\)](#) Backed this

argument by showing that the Markowitz-processed optimization models are still adequate in portfolios with cryptocurrencies, and that when quantitative methods are used to allocate portfolios the performance of investment is better than the usual allocation methods. Furthermore, [Boyd \(2024\)](#), Even though new asset classes have emerged, in their 70-year re-evaluation of the Markowitz model they found that it remains a “fundamental” reference model in portfolio management. The study stated that the model has not been superseded by the developments in recent times, but the applications of the model have been extrapolated to more complex environments. Based on this theoretical extension, the present study seeks to examine whether optimal weight allocation helps to enhance the efficiency of the portfolio, as it involves the classical modern portfolio theory (MPT) concepts and practical application of alternative assets concepts.

Behavioral Portfolio Theory

In addition to the Modern Portfolio Theory, Behavioral Portfolio Theory was developed by Hersh Shefrin and Meir Statman, a behavioral variant of the traditional investment theories. This theory is based on the premise that the investor does not always make investments decisions rationally as stated by Markowitz theory but are also influenced by psychological and behavioral factors like loss aversion, speculation and cognitive bias. The theory also postulates that investors do not view the portfolio as an entire entity but rather build up their portfolios in layers, with a portion of assets allocated to safety and other assets allocated to higher-risk stocks that may have higher returns. In addition to this, this theory is important in explaining the incorporation of alternative assets, particularly cryptocurrencies, in investment portfolios, where there is no direct hedging function but the asset is still held by investors as a speculative, high-risk investment that is acceptable to them within the “growth layer”. In this context, Behavioral Portfolio Theory provides a complementary explanation for the findings of the present study, particularly regarding the role of cryptocurrencies as diversification assets rather than traditional hedging instruments ([Shefrin & Statman, 2000](#)). Thus, the present study is based on several theories: Modern Portfolio Theory constitutes an underpinning theory for diversification analysis, the Safe Haven Theory provides a basis for hedging characteristics, and the Markowitz model is the applied theory for asset allocation optimization; and Behavioral Portfolio Theory gives the interpretive dimension on investor's behavior towards high-risk assets.

Cryptocurrencies

In more recent literature on finance cryptocurrencies have become the subject of considerable interest as an asset class alternative to traditional assets that can be used to enhance the efficiency of financial portfolios, not just because they can offer potentially high returns but also due to their diversification properties which can be distinct from those of traditional assets. In this context, it is suggested that assessing the

function of cryptocurrencies should not only provide an analysis of their hedging properties but should also consider the function of cryptocurrencies in enhancing the risk-adjusted performance of a portfolio. Almeida and Gonçalves (2023) Performed a wide and systematic review and identified that cryptocurrencies are not typically used as a stable hedging instrument, but rather primarily for improving diversification. Their role in portfolio enhancement is heavily dependent on the correlation of cryptocurrencies with other investments, as well as the weight allocation strategy in the portfolio. Similarly, Platanakis and Urquhart (2020) Including Bitcoin in investment portfolios has been shown to enhance the Sharpe Ratio and the risk-adjusted return efficiency, but this effect is greater if optimal asset allocation is used instead of equal-weight allocation. Kumar et al. (2025) This view was echoed by further research which suggested that cryptocurrencies could help enhance emerging markets portfolio efficiency, depending on portfolio construction techniques. This can result in increased risk rather than improved performance without quantitative optimization of weights in the cryptocurrencies. These studies all conclude that the investment merits of cryptocurrencies are not necessarily understood and related to their use as hedging assets, but rather to their possibility of offering potential diversification benefits in an optimal asset allocation structure. This is the theoretical framework that will be used in the current study to investigate the use of cryptocurrencies in investment portfolios in the Iraqi market. The present study is applied quantitative analytical study to assess the efficiency of the portfolios and the hedging properties of a financial portfolio for the financial assets in the Iraqi market using statistical tools and modern financial models, in addition to the above.

MATERIALS AND METHODS

The first and most basic task in drawing conclusions from financial information being analyzed is descriptive analysis. Its goal is to give a general idea about the nature of the financial assets using statistical data, such as their mean, standard deviation, maximum values, and minimum values. Using descriptive analysis, it is possible to assess the return and risk of each financial asset on an individual basis and the level of volatility and stability of returns over the period under analysis. This in turn can then be used for the transition to more sophisticated analysis like variance–covariance analysis, portfolio construction and hypothesis testing of a hedging strategy.

Therefore, descriptive analysis can be used to compare the performance of the various assets under study such as bank stocks, gold and cryptocurrencies and determine which of the assets has the best performance and the highest volatility. Stock Prices of Banks, Cryptocurrency Prices, Gold Prices, and the Dollar Exchange Rate in the Study Sample The prices of assets which are priced in Iraqi dinars are given in Table (1).

Table 1: Asset Prices (Stocks, U.S. Dollar, Gold, and Cryptocurrencies) in Iraqi Dinars.

Date	Baghdad Bank Stock	Mansour Bank Stock	Commercial Bank Stock	Gold Prices	Dollar Exchange Rate	BTC-ID Prices	ETH-ID Prices
1-1-2022	1.060	0.510	0.610	2603112.500	1450.000	55800538.500	3898006.000
1-2-2022	1.110	0.520	0.600	2769282.500	1450.000	62630183.500	4232840.000
1-3-2022	1.330	0.510	0.580	2816117.500	1450.000	66031086.000	4758378.000
1-4-2022	1.240	0.510	0.560	2738325.000	1450.000	54686576.000	3958775.500
1-5-2022	1.240	0.500	0.550	2666115.000	1450.000	46098849.500	2816378.500
1-6-2022	1.300	0.490	0.540	2634650.000	1450.000	28687858.500	1547585.000
1-7-2022	1.240	0.480	0.530	2542575.000	1450.000	33838505.000	2438204.000
1-8-2022	1.380	0.470	0.500	2488055.000	1450.000	29072152.000	2252836.000
1-9-2022	1.490	0.510	0.510	2399460.000	1450.000	28176095.500	1925571.000
1-10-2022	1.390	0.560	0.500	2376550.000	1450.000	29718866.500	2280429.500
1-11-2022	1.380	0.570	0.500	2542575.000	1450.000	24894426.500	1878750.500
1-12-2022	1.370	0.620	0.500	2629937.500	1450.000	23993875.000	1735316.500
1-1-2023	1.440	0.670	0.520	2789655.000	1450.000	33551956.000	2300483.000
1-2-2023	1.470	0.660	0.510	2375464.000	1339.000	30994301.650	2150300.100
1-3-2023	1.770	0.610	0.490	2575195.610	1300.000	37022024.000	2368626.000
1-4-2023	2.500	0.630	0.500	2587534.950	1300.000	38049453.000	2439996.000
1-5-2023	2.100	0.640	0.520	2551957.070	1300.000	35385558.000	2436369.000
1-6-2023	2.170	0.650	0.530	2488339.750	1300.000	39620425.000	2513147.000
1-7-2023	2.360	0.880	0.570	2555741.240	1300.000	37999143.000	2413008.000
1-8-2023	3.150	0.960	0.750	2522625.040	1300.000	33710911.000	2139332.000
1-9-2023	3.320	0.970	0.650	2424845.670	1300.000	35058296.000	2172508.000
1-10-2023	3.260	0.990	0.640	2578296.630	1300.000	45068114.000	2361398.000
1-11-2023	3.550	1.270	0.690	2646480.850	1300.000	49026575.000	2668328.000
1-12-2023	3.560	1.280	0.710	2681367.000	1300.000	54944747.000	2965911.000
1-1-2024	3.470	1.270	0.880	2648347.000	1300.000	55357393.000	2967302.000
1-2-2024	3.610	1.270	0.980	2656217.330	1300.000	79557894.000	4344496.000
1-3-2024	3.200	1.310	0.790	2902088.410	1300.000	92733745.000	4742218.000
1-4-2024	4.200	1.340	0.810	2971245.160	1300.000	78827918.000	3915977.000
1-5-2024	3.080	1.320	0.880	3045897.790	1300.000	87738833.000	4888039.000
1-6-2024	3.070	1.310	0.850	3023416.630	1300.000	81481777.000	4462757.000
1-7-2024	2.930	1.380	0.820	3182528.570	1300.000	84005025.000	4200690.000
1-8-2024	2.890	1.340	0.840	3277530.360	1300.000	76660870.000	3267407.000
1-9-2024	3.080	1.720	0.850	3424842.070	1300.000	82328350.000	3383978.000
1-10-2024	4.050	1.900	0.900	3566946.110	1300.000	91279747.000	3270540.000
1-11-2024	4.110	1.950	0.900	3433248.000	1300.000	125383765.000	4817423.000
1-12-2024	4.240	1.980	0.900	3410955.600	1300.000	121457960.000	4332289.000

Prepared by the researcher based on:

<https://www.isc.gov.iq/reports/yearly>

<https://cbi.iq>

<https://finance.yahoo.com>

Calculation of Returns for Bank Stocks, Cryptocurrencies, Gold, and the U.S. Dollar in the Study Sample

One of the most significant indicators available for measuring the performance of investment assets is their returns, which represent how much the value of an investment asset increased or decreased over a given time period. Thus, they are the most important indicator from which investors make their investment decisions and the benchmark used to analyse and compare investments objectively. Under this study, the monthly returns of the financial assets studied (bank stocks, gold and cryptocurrencies) were determined according to their relative price changes, as shown in [Table \(1\)](#). The logarithmic returns of gold, stock indices, and cryptocurrencies were calculated using the following equation:

$$r_t = 100 \times \ln \left(\frac{P_t}{P_{t-1}} \right) \dots \dots \dots (5)$$

Where:

r_t denotes the logarithmic return of the asset at time (t).

P_t refers to the asset price at time (t).

P_{t-1} refers to the asset price at time (t-1).

$\ln$ denotes the natural logarithmic operator ([Brooks, 2019](#)).

Accordingly, these returns are used in risk analysis and in calculating portfolio returns, as illustrated in [Table \(2\)](#).

Table 2: Returns of Stocks, U.S. Dollar, Gold, and Cryptocurrencies in Iraqi Dinars.

Date	Return of Baghdad Bank Stock	Return of Mansour Bank Stock	Return of Commercial Bank Stock	Return of Gold Prices	Return of Dollar Exchange Rate	Return of BTC-ID Prices	Return of ETH-ID Prices
1-1-2022	-0.001	-0.002	-0.002	-0.038	0.000	-0.115	-0.082
1-2-2022	0.046	0.019	-0.017	0.062	0.000	0.115	0.082
1-3-2022	0.181	-0.019	-0.034	0.017	0.000	0.053	0.117
1-4-2022	-0.070	0.000	-0.035	-0.028	0.000	-0.189	-0.184
1-5-2022	0.000	-0.020	-0.018	-0.027	0.000	-0.171	-0.340
1-6-2022	0.047	-0.020	-0.018	-0.012	0.000	-0.474	-0.599
1-7-2022	-0.047	-0.021	-0.019	-0.036	0.000	0.165	0.455
1-8-2022	0.107	-0.021	-0.058	-0.022	0.000	-0.152	-0.079
1-9-2022	0.077	0.082	0.020	-0.036	0.000	-0.031	-0.157
1-10-2022	-0.069	0.094	-0.020	-0.010	0.000	0.053	0.169
1-11-2022	-0.007	0.018	0.000	0.068	0.000	-0.177	-0.194
1-12-2022	-0.007	0.084	0.000	0.034	0.000	-0.037	-0.079
1-1-2023	0.050	0.078	0.039	0.059	0.000	0.335	0.282

1-2-2023	0.021	-0.015	-0.019	-0.161	-0.080	-0.079	-0.068
1-3-2023	0.186	-0.079	-0.040	0.081	-0.030	0.178	0.097
1-4-2023	0.345	0.032	0.020	0.005	0.000	0.027	0.030
1-5-2023	-0.174	0.016	0.039	-0.014	0.000	-0.073	-0.001
1-6-2023	0.033	0.016	0.019	-0.025	0.000	0.113	0.031
1-7-2023	0.084	0.303	0.073	0.027	0.000	-0.042	-0.041
1-8-2023	0.289	0.087	0.274	-0.013	0.000	-0.120	-0.120
1-9-2023	0.053	0.010	-0.143	-0.040	0.000	0.039	0.015
1-10-2023	-0.018	0.020	-0.016	0.061	0.000	0.251	0.083
1-11-2023	0.085	0.249	0.075	0.026	0.000	0.084	0.122
1-12-2023	0.003	0.008	0.029	0.013	0.000	0.114	0.106
1-1-2024	-0.026	-0.008	0.215	-0.012	0.000	0.007	0.000
1-2-2024	0.040	0.000	0.108	0.003	0.000	0.363	0.381
1-3-2024	-0.121	0.031	-0.216	0.089	0.000	0.153	0.088
1-4-2024	0.272	0.023	0.025	0.024	0.000	-0.162	-0.191
1-5-2024	-0.310	-0.015	0.083	0.025	0.000	0.107	0.222
1-6-2024	-0.003	-0.008	-0.035	-0.007	0.000	-0.074	-0.091
1-7-2024	-0.047	0.052	-0.036	0.051	0.000	0.030	-0.061
1-8-2024	-0.014	-0.029	0.024	0.029	0.000	-0.091	-0.251
1-9-2024	0.064	0.250	0.012	0.044	0.000	0.071	0.035
1-10-2024	0.274	0.100	0.057	0.041	0.000	0.103	-0.034
1-11-2024	0.015	0.026	0.000	-0.038	0.000	0.317	0.387
1-12-2024	0.031	0.015	0.000	-0.007	0.000	-0.032	-0.106

Source: The researcher prepared the data in MS Excel on the basis of historical data.

As seen in the Monthly return analysis, there is a clear difference in performance and risk between assets. The returns of bank stocks were moderately volatile; values were both positive and negative during some periods, especially for Baghdad Bank and the Commercial Bank. This is indicative of the economic conditions and the economic activity in the local area. However, bank equity shares were relatively steady in comparison with crypto stocks even as they dipped a few times.

Gold, meanwhile, looked like it was relatively more stable with the returns being consistent, which further highlighted its traditional use as a portfolio diversifier and protector against investment risk. Cryptocurrencies, on the other hand, were heavily volatile with some periods showing high positive returns and others having large negative returns. This is because they are much risky. While cryptocurrencies offer high returns, they also serve to raise the degree of uncertainty in a portfolio.

It was also noticed that exchange rate returns (U.S. dollar) has been almost steady during the study period, which indicates stability in the Iraqi market exchange rate, as a result of monetary policy interventions. This has less immediate impact as a risk factor than the other assets.

From the above it can be concluded that there is a clear gradient in respect of the return structure of the assets in terms of risk and return. Bank stocks are the next riskiest and

most volatile asset category after cryptocurrencies and gold is the relatively most stable asset. These results are useful foundation for portfolio construction and show the importance of balancing this asset class portfolio to obtain a balance between return and risk.

RESULTS

Analysis of Returns of the Study Sample Assets

One of the most basic tools employed to give a complete and simplified picture of the nature of investment asset returns being examined is descriptive statistical measures. These measures are the mean, maximum, minimum and standard deviation, each of which is a measure of a particular aspect of the behavior in the data. The arithmetic mean is a measure of expected return, as it is the average value of returns over a given time period and can help to assess overall performance. By contrast, the range of fluctuation (max and min) gives an indication of the range of return fluctuations.

The standard deviation is regarded as one of the most significant measures of risk because it quantifies the amount of variation or dispersion around the average return, and thus, the risk or volatility. The larger the standard deviation, the more risk there will be in the asset.

In this study, these measures will be used to examine the properties of monthly returns for the assets being examined (the stock, the gold, and the cryptocurrencies) to assess the level of returns and the level of risk. The study sample returns results are analyzed in [table \(3\)](#).

Table 3: Analysis of Returns of Stocks, U.S. Dollar, Gold, and Cryptocurrencies in Iraqi Dinars.

Asset	Mean	Minimum	Maximum	Standard Deviation
Baghdad Bank	0.038	-0.310	0.345	0.128
Mansour Bank	0.038	-0.079	0.303	0.081
Commercial Bank	0.011	-0.216	0.274	0.082
Gold	0.006	-0.161	0.089	0.047
U.S. Dollar	-0.003	-0.080	0.000	0.014
BTC-ID	0.018	-0.474	0.363	0.168
ETH-ID	0.001	-0.599	0.455	0.205

Source: Author's calculations using Microsoft Excel.

The results of the analysis show that there is a significant difference in the returns of the assets studied, in terms of the level of risk and average return. As far as average return is concerned, the average return of bank stocks (Baghdad Bank and Mansour Bank) was the highest at (0.038) as these stocks can yield relatively stable returns compared to other stocks. On the other hand, gold and the U.S. dollar posted the

smallest average returns of (-0.006) and (-0.003), respectively, which suggests that they are low return assets and are commonly purchased to hedge against other assets.

However, the performance of cryptocurrencies was mixed. Bitcoin had an average return of (0.018) while Ethereum had an average return of (0.001) and was more unstable than Bitcoin, with the dollar and gold showing negative average returns. Cryptocurrencies emerged as the most volatile assets, in terms of risk, as measured by the standard deviation. Ethereum had the highest risk level (0.205), followed by Bitcoin (0.168), indicating that these assets are highly speculative with a strong response to market fluctuations. The U.S. dollar, on the other hand, showed the least risk (0.014), adding to its stability in the Iraqi market. The high values also indicate that cryptocurrencies tend to have greater volatility, with the maximum and minimum values showing significant fluctuation, which contrasts with the relative stability seen in gold and the U.S. dollar. The large positive and negative values also highlight the volatility of cryptocurrencies, with significant fluctuations in values, compared to gold and the U.S. dollar which have more limited value ranges. From the above, it can be concluded that assets with high return are generally high-risk assets like cryptocurrencies, and traditional assets like gold and the U.S. dollar are relatively low-risk assets with relatively low returns. On the other hand, bank stocks showed a relative balance of return and risk which makes them appropriate tools to play a significant role in building the optimum investment portfolio in the Iraqi financial environment.

Hedging Analysis of the Study Sample Assets

A linear regression model was used to examine the extent to which financial assets can offset exchange rate movements by examining the relationship between asset returns and movements in the US dollar exchange rate. The results showed that some assets were not statistically significant, which means the role of hedging power in the study period was limited. Such a trend can be attributed to the relatively stable rate of the Iraqi exchange rate. The goal of this analysis is to find out if the change in exchange rate (USD/IQD) has a statistically significant influence on the returns of financial assets, such as stocks in banks, gold, and cryptocurrencies. A popular measure of the effectiveness of hedging is the correlation between the returns of the assets and exchange rate changes. The result is that the statistically significant negative relationship means that the hedging ability is strong, while the statistically insignificant relationship means the hedging properties are weak or absent. This method is common in financial books to assess the power of assets to hedge the investors against currency depreciation risk. [Table \(4\)](#) shows the results of the hedging analysis. The findings of the regression analysis show that most of the assets selected do not have statistically significant hedging properties against exchange rate fluctuations as indicated by the high P-values that are greater than the accepted level of significance at (0.05), especially in the case of bank stocks and cryptocurrencies. This suggests that the impacts of the change in exchange rate between the U.S. dollar and the Iraqi dinar on the returns of

these assets are relatively insignificant and thus they do not seem to have a strong hedging ability.

Table 4: Analysis of Returns of Stocks, U.S. Dollar, Gold, and Cryptocurrencies in Iraqi Dinars.

Asset	Beta (USD)	t-Statistic	P-value	R ²
Baghdad Bank	-0.425	-0.273	0.786	0.002
Mansour Bank	1.108	1.143	0.260	0.037
Commercial Bank	0.566	0.568	0.573	0.009
Gold	1.615	3.241	0.002	0.236
Bitcoin (BTC)	0.446	0.217	0.829	0.001
Ethereum (ETH)	0.376	0.150	0.881	0.000

Source: Prepared by the researcher using EViews and Excel based on monthly data.

Gold, however, showed a significant relationship statistically with the exchange rate at significance level less than 0.05, which means that gold has some hedging properties. The positive coefficient also shows that gold and the exchange rate are directly related, as financial literature considers gold as a safe-haven asset from currency fluctuations. The weak hedging characteristics of most assets can be attributed to the fact that the Central Bank intervenes in the market to keep the Iraqi dinar relatively stable against the U.S. dollar within Iraq's managed exchange rate system. This structural stability lowers the volatility of exchange rates and hence may result in low demand for hedging instruments, as shown in the absence of the statistically significant relationship between the return of assets and exchange rate changes.

However, volatile cryptocurrencies like Bitcoin and Ethereum were not able to effectively hedge. This can be explained by the relative importance of global conditions such as investor sentiment and technological change over local exchange rates, which affect the behaviour of these assets. This discovery aligns with the notion that cryptocurrencies are not conventional hedging tools but are rather extremely speculative and risky investments. The findings indicate, therefore, that the major value of allocating these assets to investment portfolios has little to do with the currency risk-hedging properties of these assets, but more to do with the portfolio performance enhancement property of diversifying sources of return and the reduction of unsystematic risk. Therefore, investment diversification could be a better choice for hedging strategies in the Iraqi economy, which is a relatively stable exchange rate economy. So, in the Iraqi economy, which is a relatively stable exchange rate economy, investment diversification may be more appropriate alternative to hedging strategies.

Construction of the Traditional Portfolio of the Study Sample Assets Using Equal Weights

To build investment portfolios based on Markowitz model, the equal-weighting principle was used, which involves allocating the same amount of investment across all the assets studied as shown in [Table \(5\)](#).

Table 5: Equal Portfolio Weights.

Asset	Baghdad Bank	Mansour Bank	Commercial Bank	Gold
Weight	0.25	0.25	0.25	0.25

Source: Prepared by the researcher.

The variance–covariance matrix for the returns of the assets under study was calculated, reflecting the degree of risk for each asset and the interrelationships among them. This matrix represents the quantitative basis used to estimate portfolio risk, as shown in [Table \(6\)](#).

Table 6: Variance–Covariance Matrix of the Traditional Portfolio.

Asset	Baghdad Bank	Mansour Bank	Commercial Bank	Gold
Baghdad Bank	0.016328928	0.001746924	0.002300691	0.000261238
Mansour Bank	0.001746924	0.006535690	0.001608191	0.000791759
Commercial Bank	0.002300691	0.001608191	0.006725604	-0.000316340
Gold	0.000261238	0.000791759	-0.000316340	0.002173235

Source: Author's calculations using Microsoft Excel.

The matrix demonstrates variation in risk levels among the assets, in addition to differences in the nature of the covariance relationships between them. Some positive covariance values indicate that certain assets move in the same direction, whereas negative values indicate opportunities for diversification and risk reduction. At this stage, the traditional portfolio was constructed based on the equal-weighting principle, whereby investment was distributed equally among the assets under study without considering differences in their risk and return characteristics. This type of portfolio is commonly used as a benchmark for evaluating the efficiency of other portfolios. In addition to basing a risk-free rate on the interest rate data, portfolio return and risk were computed using the variance–covariance matrix of asset returns. The results indicated that return of portfolio was (0.023331), risk level of portfolio was (0.052766) and Sharpe Ratio was (0.396366). This means that the portfolio returned a fair excess return to the level of risk, but not an optimum allocation strategy. as shown in [Table \(7\)](#).

Table 7: Performance of the Equal-Weight Portfolio.

Portfolio Type	Return (Rp)	Risk (σ)	Risk-Free Rate (Rf)	Sharpe Ratio
Equal-Weight Portfolio	0.023331391	0.052766219	0.002417	0.396366

Source: Author's calculations using Microsoft Excel.

Construction of the Traditional Portfolio of the Sample Assets Using Optimal Weights. The second stage was the development of the optimal portfolio using the Markowitz Model (Mean-Variance Optimization) using the Solver tool in Excel to determine the optimal distribution of weights to maximize risk-adjusted return or minimize risk at a given return level. This method utilizes the variance-covariance matrix to consider the interdependence of the assets to allocate weights based on the contribution to the risk of that asset to the portfolio. The findings were that the optimal portfolio reweighed the assets unequally, giving greater weight to the more efficient assets and less or no weight to the less efficient assets, indicating a more efficient risk management process than the equal-weighted portfolio. as shown in [Table \(8\)](#).

Table 8: Optimal Weights of the Traditional Portfolio.

Asset	Baghdad Bank	Mansour Bank	Commercial Bank	Gold
Weight	0.253904585	0.746095415	0	0

Source: Author's calculations using Microsoft Excel Solver.

The outcome of the Markowitz model suggested that the proportions of the various assets to be included in the portfolio were not equal and that different proportions needed to be assigned to each asset based on its contribution to minimizing risk and balancing risk and return. There were also high weights assigned to some assets and low or even zero weights to others. Some assets were assigned to zero weight, which does not mean that they were weak, but rather that they were relatively ineffectual in the portfolio context because they did not achieve positive results in the risk-adjusted return. This could be attributed to some of the following reasons: high risk levels, low expected returns, or a strong correlation with other assets, making them less diversifying. The exclusion of some assets also suggests that the optimization model is trying to reduce the overall risk of the portfolio, which it does by excluding assets that would introduce more variability into the portfolio than they would offset with the returns they offer. This aligns with the tenets of Modern Portfolio Theory, which focus on the asset's impact on overall portfolio efficiency, not just its performance. Therefore, optimal weights exhibit a better risk-return relationship for the assets invested than equal weights, because investments are focused on assets that have a better risk-return relationship and assets that don't add real value are excluded. as shown in [Table \(9\)](#).

Table 9: Performance of the Optimal Portfolio

Portfolio Type	Return (Rp)	Risk (σ)	Risk-Free Rate (Rf)	Sharpe Ratio
Optimal Portfolio	0.03784223	0.073162125	0.002416667	0.484206

Source: Author's calculations using Microsoft Excel Solver.

When we compare the equal weight portfolio with the optimal portfolio, the obvious advantage of the optimal portfolio in terms of investment efficiency can be observed. Under the Equal weighting approach, the allocation of investments is suboptimal due to the lack of consideration for the difference in risk and return characteristics of various assets and covariance relationships of assets. The best portfolio, however, is a quantitative approach that considers the interdependencies of assets, allowing for a more balanced risk-return tradeoff. Hence, weight redistribution using the Markowitz model helps to minimize the unsystematic risk and maximize the risk-adjusted return, usually indicated by an increase in Sharpe ratio from the traditional portfolio. The results show that the portfolio efficiency is not only determined by the diversification but also by the distribution of the weights in the portfolio. While asset allocation may not be the most effective way to allocate assets to maximize performance, it is the key to investment efficiency. Thus, quantitative models are indispensable in portfolio management, particularly for emerging markets, to have the best use of resources.

The inference drawn from analysing the traditional equal weight portfolio can be seen that the portfolio had performed moderately in order to obtain an acceptable level of diversification as seen from the satisfactory portfolio returns with moderate level of risk. But this performance was not the best allocation efficiency as the weights were distributed equally and the distinctions between the assets about their returns, volatility and interrelation were ignored. The realized Sharpe ratio also suggests that the efficiency of risk utilization was not as high as it could be with a quantitative optimization model, as the value of risk per unit of return was not high. Furthermore, this type of portfolio lacks the advantages of diversification since the same weight is given to assets that can be very volatile or not doing well and that therefore diminish the overall effectiveness of the portfolio. These results, from an economic point of view, indicate that although diversification is important, it has to be planned to reach investment efficiency, particularly in markets where the assets have significant differences in their characteristics, as in the Iraqi market. As such, this approach of equal weights is a simple way to go and should only be used as a standard, and is not an optimal behaviour of a rational investor who wants to maximise risk-adjusted return.

Accordingly, there is a need to shift toward investment portfolios based on quantitative optimization techniques, such as the Markowitz model, in order to achieve more efficient asset allocation. In this context, the following section analyzes the modern portfolio based on optimal weights and compares its performance with the traditional portfolio to assess its ability to improve efficiency.

Construction of the Modern Portfolio for the Sample Assets

As part of improving portfolio efficiency, a modern portfolio was constructed including diversified assets such as bank stocks, gold, and cryptocurrencies, with the objective of enhancing diversification and improving risk-adjusted returns. This approach is based

on modern financial literature, which confirms that including alternative assets such as cryptocurrencies may improve portfolio efficiency due to their behavioral characteristics differing from traditional assets. The modern portfolio was constructed using two approaches: the first based on equal weights, and the second based on optimal weights using the Markowitz model, in order to measure the impact of including cryptocurrencies on portfolio performance in terms of returns and risk, as shown in [Table \(10\)](#).

Table 10: Equal Weights of the Modern Portfolio

Asset	Baghdad Bank	Mansour Bank	Commercial Bank	Gold	BTC-ID	ETH-ID
Weight	0.167	0.167	0.167	0.167	0.167	0.167

Source: Prepared by the researcher.

The variance-covariance matrix of asset returns (stocks, gold, and cryptocurrencies) was calculated, as shown in [Table \(11\)](#).

Table 11: Variance-Covariance Matrix of the Modern Portfolio

Asset	Baghdad Bank	Mansour Bank	Commercial Bank	Gold	BTC-ID	ETH-ID
Baghdad Bank	0.016328928	0.001746924	0.002300691	0.000261238	-0.001505181	-0.004099885
Mansour Bank	0.001746924	0.00653569	0.001608191	0.000791759	0.001273337	0.001240624
Commercial Bank	0.002300691	0.001608191	0.006725604	-0.00031634	5.44742E-05	0.000678098
Gold	0.000261238	0.000791759	-0.00031634	0.002173235	0.002279127	0.001015826
BTC-ID	-0.001505181	0.001273337	5.44742E-05	0.002279127	0.028255528	0.030888342
ETH-ID	-0.004099885	0.001240624	0.000678098	0.001015826	0.030888342	0.041936397
Baghdad Bank	0.016328928	0.001746924	0.002300691	0.000261238	-0.001505181	-0.004099885

Source: Author's calculations using Microsoft Excel..

Based on the above matrix, the performance of the modern portfolio with equal weights was calculated as shown in [Table \(12\)](#).

Table 12: Performance of the Modern Portfolio with Equal Weights

Portfolio Type	Return (Rp)	Risk (σ_p)	Risk-Free Rate (Rf)	Sharpe Ratio
Equal-Weight Portfolio	0.018728075	0.0703937	0.002417	0.231716868

Source: Author's calculations using Microsoft Excel.

The results of the equal-weight modern portfolio indicate a return of (0.0187) against a relatively highrisk level of (0.0703), reflecting a clear increase in portfolio volatility compared to the traditional portfolio. The Sharpe ratio reached (0.2317), which is lower than that of the traditional portfolio, indicating a decline in risk-adjusted return efficiency.

It is this slump in performance that is blamed on the presence of cryptocurrencies in the portfolio, which are volatile and unstable, resulting in a greater amount of risk in the portfolio, but not proportionately offset by the returns generated, when using equal weighting.

It has been found that diversification by “high-risk” assets does not always enhance the efficiency of the portfolio, especially if the attributes of the assets are not taken into account in giving them weights.

In the second stage, the optimal portfolio was constructed using the Markowitz Model (Mean-Variance Optimization) by employing the Solver tool in Excel to determine the optimal distribution of weights. as shown in [Table \(13\)](#).

Table 13: Optimal Weights of the Modern Portfolio

Asset	Baghdad Bank	Mansour Bank	Commercial Bank	Gold	BTC-ID	ETH-ID
Weight	0.24702	0.690242	0	0	0.062738	0

Source: Author’s calculations using Microsoft Excel Solver.

The modern portfolio with optimal weights, on the contrary, showed significant improvement in the performance, with the return being (0.0366) and the relative decrease in risk compared to the equal-weight portfolio. The Sharpe ratio also rose to (0.4897), indicating an improvement in the efficiency of returns earned versus taking risks. as shown in [Table \(14\)](#).

Table 14: Performance of the Modern Portfolio with Optimal Weights

Portfolio Type	Return (Rp)	Risk (σ_p)	Risk-Free Rate (Rf)	Sharpe Ratio
Optimal Portfolio	0.036630074	0.069862392	0.002416667	0.489725682

Source: Author’s calculations using Microsoft Excel Solver.

This is an improvement because the Markowitz model was able to rearrange the weights in a way that maximizes the utilization of the high-performing assets while minimizing the amount of exposure to the high-risk assets or highly correlated assets. Notably, it is noted that some assets, especially cryptocurrencies, were assigned low or no weights, meaning the assets added little or nothing to the portfolio's efficiency during the study period even though they delivered high individual returns. This is to indicate that adding alternative assets does not necessarily mean that performance is better unless they are added to an optimum asset allocation program. This is in line with the results obtained

in the hedging analysis as cryptocurrencies failed to exhibit any adequate hedging properties, leading to the poor performance of cryptocurrencies in the portfolio under an equal-weight approach. The characteristics of these instruments could be used in part however, not as a hedge, but as a diversification component of an optimal allocation framework, when they were included in the optimal portfolio. Hence, the findings endorse that portfolio efficiency is not just related to diversified asset inclusion, but too allocation of weights among the assets included, since the same assets can generate completely different outcomes in terms of portfolio efficiency based on different weights allocation.

The study is based on the basic principle of weight allocation among assets, instead of just diversification. The traditional equal-weight portfolio did not perform optimally about return and risk, since it did not account for differences in asset characteristics. The modern portfolio with optimal weights, however, gained a significant improvement in overall performance with higher returns, comparatively low risk and higher Sharpe ratio which is a better measure of efficiency in utilizing the return/risk relationship between the two. This further demonstrates the significance of the application of quantitative optimization models in portfolio management, especially the Markowitz model.

The findings also showed that cryptocurrencies, although they offer a high return potential, are not useful for hedging. But when added to an optimal asset allocation framework, they added a minimal amount to improving portfolio efficiency. This suggests that these assets are not intended to be used for hedging but rather to be used as means of diversifying within strict boundaries. Hence, investment efficiency in emerging markets, including the Iraqi market, needs to be achieved by applying modern quantitative methods instead of conventional methods that are based on traditional models that ignore the interrelationships between various assets and the relationship between assets and risk, which ultimately leads to poor investment decisions and increased risk.

DISCUSSION

Authors should discuss the results and how they can be interpreted from the perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

CONCLUSIONS

The study contributed to presenting an applied framework for integrating traditional assets with alternative assets, such as cryptocurrencies, within the Modern Portfolio Theory framework in an emerging market environment. The study also clarified the

distinction between the role of assets as hedging instruments and their role as diversification components, representing a valuable contribution to financial literature, particularly in markets characterized by relative exchange rate stability. Furthermore, the study provides practical evidence of the importance of using quantitative optimization tools in determining optimal weights instead of relying on random or equal allocations, thereby enhancing the efficiency of portfolio management. Considering the results obtained, the study recommends the adoption of quantitative optimization models in portfolio construction rather than relying solely on traditional allocation methods. It also recommends dealing cautiously with cryptocurrencies and avoiding dependence on them as hedging tools; instead, they should be considered high-risk assets that may be utilized within carefully controlled limits. The study further advises investors in emerging markets to focus on optimal asset allocation and benefit from interrelationships among assets in order to achieve the best possible balance between return and risk. In addition, the study recommends conducting further research integrating traditional financial models with artificial intelligence techniques to improve portfolio efficiency.

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