Cryptocurrency Digital Assets: Evidence of the Emergence of Cryptocurrency Securities Markets as an Investment Asset Class, 2018-2023

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This study seeks to understand the value of digital assets as investments. The study compared the returns of the FAANG stocks and the S&P 500 TR Index to Bitcoin and the CRIX index. The results found no significant difference between the returns of the FANG stocks and Bitcoin on a risk-adjusted basis. However, the study found a significant difference between the S&P 500 TR Index as compared to Bitcoin and the CRIX index on a risk-adjusted basis. The period of the study, 2018-2023, reflects the relevant time band measured by the number of published studies and academic articles. The authors conclude that while Bitcoin may be an investment of choice for a risk-seeking investment style, better assets of choice exist for a risk-averse investor building a diversified portfolio.

Keywords: cryptocurrency, Bitcoin, digital currency, FAANG [Facebook, Apple, Amazon, Netflix, Google] stocks

INTRODUCTION

Cryptocurrency is a digital currency created with algorithms and used as an alternative secure form of payment. Cryptography is the artful process of writing or solving codes. Cryptography involves the study of secure communication techniques between a sender and a recipient (Kaspersky, 2022). Bitcoin is the original iteration and manifestation of a cryptocurrency, a currency whose existence is digital and located on the internet. As a digital currency, Bitcoin was created in 2009 by a group of programmers known by the pseudonym Satoshi Nakamoto (Bitcoin.org, n.d.). Bitcoins are created through a process referred to as *mining*. As a digital form of currency/payment, Bitcoin appeals to people suspicious of the government and banks. The encryption aspects of a digital currency like Bitcoin offer the perception of protection against Black Swan events such as pandemics, war, or similar exogenous shocks (Serwer & Liebelson, 2013).

LITERATURE REVIEW

Cryptocurrencies as a Digital Asset Class and Diversification Benefit?

Ankenbrand and Bieri's (2018) research examined and assessed the asset class attributes of cryptocurrency using the Markowitz model. Their research suggests that cryptocurrency's risk and return distinguish it from other asset classes, such as stocks and bonds. The researchers further observed a low-

performance correlation between cryptocurrency markets and other established asset classes, a potential diversification benefit. The potential diversification benefit would be expected to produce an enhanced risk-return profile. Based on the researchers' limited study, cryptocurrencies meet most requirements as a unique asset class (Ankenbrand & Bieri, 2018).

Researchers Kuo Chuen et al. (2018) considered investing in cryptocurrencies as an alternative asset class. Their article, *Cryptocurrency: A New Investment Opportunity*, compared the characteristics of cryptocurrencies and traditional asset classes, examining their correlation. Their findings show that CRIX, the cryptocurrency index, and cryptocurrencies are suitable for diversifying portfolio risks due to the low return correlations between traditional assets and cryptocurrencies. The authors acknowledged the experimental, exciting nature of their result findings. They documented that many issues remain to be addressed before cryptocurrencies and crypto tokens become an asset class of interest (Kuo Chuen et al., 2018).

Corbet et al. (2018) analyzed the behavioral characteristics of three popular cryptocurrencies and other financial assets. The authors used the term *relative isolation* to describe results supporting the premise that cryptocurrencies offer diversification benefits for short-term investors. The researchers found that an investment portfolio's allocation to cryptocurrencies can enhance the portfolio's s *relative isolation*. These researchers sustained the notion that cryptocurrency is an asset class and acknowledged the need to observe the performance of cryptocurrencies over more extended periods (Corbet et al., 2018).

Ram (2019) posited that Bitcoin is a new asset class and explored the asset class concept, including risks, returns, and group similarities (i.e., stocks and bonds). The author accepted the definition of diversification as investing in multiple asset classes to manage portfolio investment risk and wealth preservation. The author reviewed the asset class literature, affirming asset allocation choices/decisions, including Bitcoin, as a significant factor in successful long-term investing (Ram, 2019).

Ehlers and Gauer (2019) offered a cryptocurrency currency versus fiat currency quantitative analysis to assess each currency's influence on portfolio diversification. Their primary research question asked if cryptocurrencies can potentially improve portfolios composed of cryptocurrencies and fiat currencies. The authors solved numerous optimization problems to assess the portfolio impact of blending cryptocurrencies with fiat currencies as a diversified portfolio. Their research analysis revealed near-zero currency correlations between cryptocurrencies and fiat currencies, suggesting that adding cryptocurrencies to a portfolio can lower the return volatility and potentially improve diversification (Ehlers & Gauer, 2019).

Liu (2019) studied the alternative asset class attributes/characteristics and the role of risk-return considerations in the cryptocurrency market. Liu's study used classical portfolio selection models to show that cryptocurrency portfolio diversification measurably improves portfolio performance, measured by an enhanced Sharpe ratio, the metric of investment return to investment risk. Liu concluded his research by opining that the complexities of the cryptocurrency market require further exploration, leaving a more detailed analysis for future research (Liu, 2019).

Glas (2019), in his article, *Investments in Cryptocurrencies: Handle with Care!* discussed the evolution of cryptocurrency investments as a new asset class. The author studied a data set of more than 1,500 cryptocurrencies; based on his research, the author reported and concluded that cryptocurrency markets are less mature than other asset classes and show minimal-to-no connections to traditional markets such as stocks or foreign exchange. The author believed cryptocurrencies should be approached carefully (Glas, 2019).

Pavković et al. (2019) examined the feasibility of using cryptocurrencies as a diversification tool/vehicle. To appraise the diversification attributes of cryptocurrencies, the researchers utilized econometric analysis, summarizing that the strength of the relationship between the value of cryptocurrencies and selected indices was anemic and mildly unfavorable, suggesting that cryptocurrencies may facilitate portfolio diversification. Their study sample was small, and further research and analysis between cryptocurrencies and capital market indicators are required (Pavković et al., 2019).

Kajtazi and Moro's (2019) academic study examined the effects of adding Bitcoin to an optimized portfolio. Their results indicated that adding Bitcoin to a portfolio improved performance more than reducing volatility. Given Bitcoin's speculative attributes, the researchers opined that Bitcoin might have a

role in portfolio diversification. Their results suggest that portfolios' improved return performance compensates for the elevated risk because of Bitcoin's inclusion. The researchers' study illustrates that Bitcoin is a relevant, emerging alternative asset class that may impact portfolio diversification strategies (Kajtazi & Moro, 2019).

Guesmi et al. (2019) investigated what they refer to as the conditional cross effects, and volatility spillover (hedging and diversification) attributes between Bitcoin and financial indicators. The authors' posture was that cryptocurrencies are understood as a disruptive technology raising angst and fear in the minds of market stakeholders. Investment-wise, cryptocurrencies are potentially harmful to investors and other individual and business market participants. The authors concluded that investors see alternative investments like cryptocurrencies to diversify their portfolios. They found that cryptocurrencies' overperformance and low correlation with financial assets represent an alternative investment that may increase portfolio diversification, reduce investment risk, and enhance portfolio optimality (Guesmi et al., 2019).

Corbet et al. (2019) researched investor impressions of cryptocurrencies as a credible investment asset class and the related diversification benefit. The authors reported diversification benefits from the improved risk-return trade-off of adding a small amount of Bitcoin to a well-diversified portfolio. They acknowledged the immaturity of the cryptocurrency research field and explained its main limitations and concerns. Summarizing their research study of the cryptocurrency market, the authors moderated their expectations of cryptocurrencies' potential value and societal benefits as a rational asset class offering diversification benefits (Corbet et al., 2019).

Kurka (2019) studied the nexus between typical examples of traditional asset classes and cryptocurrencies represented by Bitcoin. The author's findings support negligible relatedness between cryptocurrencies and traditional assets. The author acknowledged the relatedness of financial markets; little is known about the relatedness between traditional assets and cryptocurrencies. The implications of the relatedness between cryptocurrencies and traditional assets support the hedging potential of Bitcoin as a portfolio diversifier (Kurka, 2019).

Charfeddine et al. (2020) studied the relationship between cryptocurrencies and conventional assets, focusing on their implications for potential diversification. The researchers' study compared the properties of digital currencies and examined their relationship with conventional financial asset securities, focusing on digital currency diversification implications. The researchers' conclusions suggest that Bitcoin and other digital currency investments can optimize portfolio risk-return profiles using a relatively small amount of digital currency (Charfeddine et al., 2020).

Bianchi's (2020) article, *Cryptocurrencies as an Asset Class, An Empirical Assessment*, investigated cryptocurrency returns and volatilities with traditional asset classes. Volatility spillover refers to the process and magnitude by which instability in one market affects other markets; empirical results are measured by the degree of correlation, positive or negative. The author's perspective was that cryptocurrencies represent a global investment vehicle; therefore, an accurate analysis comparing cryptocurrencies and traditional asset classes should be based on global benchmarks such as inflation, uncertainty, and economic growth. Bianchi's primary empirical results infer no significant relationship between cryptocurrency returns and more traditional asset classes; macroeconomic factors do not significantly drive trading activity in cryptocurrency markets (Bianchi, 2020).

Akhtaruzzaman et al. (2020) researched the influence of Bitcoin on portfolio diversification and construction. Related studies have scrutinized how Bitcoin can be diversified with traditional financial assets and alternative investments; Their research demonstrated how Bitcoin is diversified with industry portfolios and the bond markets. Research results demonstrated lower correlation and substantial variation in relationships across industries and the bond index, providing an efficient hedging mechanism for many industrial sectors and bonds. The researchers' findings advise investor decision-making when adding cryptocurrencies to the portfolio risk-return analysis process. Summarizing their findings indicated that future research is required to determine if Bitcoin can support global diversification practices (Akhtaruzzaman et al., 2020).

Ma et al. (2020) studied the impact on portfolio diversification by adding various cryptocurrencies. The writers contend that adding numerous cryptocurrencies to different asset portfolios yields a diversification benefit, increasing returns, reducing portfolio volatility, and providing higher returns vis-a-vis traditional portfolios with the same risk level. The study's findings presented evidence that cryptocurrencies possess a better-than-average potential of helping to diversify existing portfolios of stocks, commodities, and currencies. Based on their research findings, the authors posited that investors should explore cryptocurrency investment opportunities as a feasible asset diversification technique (Ma et al., 2020).

Sudacevschi's (2021) study defined a well-diversified portfolio as a portfolio that includes investments in stocks, bonds, cash, or alternative assets such as cryptocurrencies and real estate. The author introduced the capital market as the market where traditional financial instruments, such as stocks, bonds, and government securities, are traded. The research argued that investors could also choose efficient alternative asset classes, such as cryptocurrencies, whose advantages are enhanced diversification created by cryptocurrencies' low correlation with traditional assets. The author concluded that investments in alternative assets like cryptocurrencies enhance diversification, a fundamental law for efficient portfolio management (Sudacevschi, 2021).

Pele et al. (2021) sought to answer the research question, can *cryptocurrency-type investments be classified as alternative assets?* The authors researched cryptocurrencies' quantitative and statistical properties compared to classical assets like bonds, stocks, real estate, and commodities. The authors' primary research finding was the total separation of cryptocurrencies from classical asset types. A subordinate research finding was the authors' detection of cryptocurrencies' characteristic similarities compared with classical asset types. Synchronicity refers to the notion that individual cryptocurrencies regularly develop similar characteristics over time, making them entirely distinguishable from classical assets. Cryptocurrencies' characteristic similarities with classical asset types support the perspective that cryptocurrencies can be viewed as an alternative asset class for portfolio diversification (Pele et al., 2021).

Anyfantaki et al. (2021) investigated if cryptocurrencies provide diversification benefits to risk-averse investors. The researchers' question was if cryptocurrency investments offer diversification benefits for risk-averse investors. The authors constructed optimized portfolios with and without cryptocurrencies to test their research question. The authors observed the outperformance of the optimal portfolios with cryptocurrency investments. Balancing their findings, the authors observe cryptocurrency's short investment history and note that issues must be considered before cryptocurrencies form an established asset class with the potential to enhance portfolio diversification and optimality (Anyfantaki et al., 2021).

Banerji (2022) reported that investors face a market dilemma as stocks and bonds fall in tandem as the market and the economy head toward bear market-recession territory. The concurrent drop in stocks and bonds was the largest in Dow Jones Market Data dating to 1976. With inflation at a 40-year high, investors have liquidated their stock and bond positions as the Federal Reserve has shifted to aggressively raising interest rates to combat inflation. Locating *diversifying* assets has been difficult; it is thought that cryptocurrencies, as an alternative asset class, could offer an asset allocation alternative to traditional stock and bond portfolios (Banerji, 2022).

Telesca (2022) wrote that the cryptocurrency market fell in sync with the overall market. Bitcoin, the world's largest cryptocurrency, and Ethereum, the second largest cryptocurrency, fell with the broader market; both cryptocurrencies are known for their volatility. Heretofore, individual investors initially controlled the cryptocurrency market; institutional investors such as hedge funds are now dominating the market, causing the market to move in sync with traditional markets, potentially mitigating the diversification benefit of cryptocurrency-type investments (Telesca, 2022).

Coinbase Global is the largest publicly owned cryptocurrency exchange in the United States. Driebusch and Singh (2022) reported that Coinbase Global lost hundreds of millions of dollars in the first quarter of 2022, reflecting investors' sentiment about risky assets. Thus far, cryptocurrencies have moved relative to the overall market's volatility, disguising the currencies' diversification value as an asset class. Coinbase Global's chief financial officer believes that the cryptocurrency exchange is in a strong position and continues diversifying into other digital-type assets (Driebusch & Singh, 2022).

Recently, cryptocurrency prices have been moving in sync with the stock and bond markets, penalizing investors who purchased bitcoin and other digital assets to diversify their investment portfolios. Zuckerman (2022) reported that according to Dow Jones Market Data, the performance correlation between bitcoin and the major U.S. stock indices hit its highest level on record, more than tripling the average correlation between crypto and the S&P 500 from 2019 to 2021.

Zuckerman (2022) suggests that digital assets, including bitcoin, are considered among the riskiest market investments; analysts say the depth of the 2022 crypto declines and their tendency to move in tandem with stocks and bonds could serve to limit crypto currency's adoption by the mainstream investment community. Moreover, crypto's assimilation into the financial system limits its utility as an alternative asset class (Zuckerman, 2022).

CRIX, the Cryptocurrency Market Index

Trimborn and Hardle (2018) reported that the growth of the cryptocurrency market had necessitated the development of an index, the CRIX, to track cryptocurrency market movements and to compare the cryptocurrency market against other indices. Comparing a cryptocurrency market index like CRIX against a market index can answer economic, investment, and financial questions. CRIX rules require routine quarterly checks of the 'model-selected' constituents of CRIX to ensure that the index fairly represents its universe population (Trimborn & Hardle, 2018).

Are Cryptocurrencies a Good Investment?

Cunha and Murphy (2019), both affiliated with the Federal Reserve Bank of Boston, reported on the risks related to cryptocurrency investments. The authors' key objective was to understand the investment environment investors will face when deciding to buy cryptocurrency. The authors found that many investors favor cryptocurrency investments based on current returns, although potential abnormal returns do not justify a good investment. Investment risks and volatility must also be considered. Ongoing, consistent investor considerations should include evaluating the risk-reward trade-off of cryptocurrencies (Cunha & Murphy, 2019).

Fama et al. (2019), writing in the *International Journal of Political Economy*, sought to answer how Bitcoin should be classified: as a current asset, investment vehicle, or speculative asset. The initial issue the researchers cited was whether Bitcoin should be classified as a currency or an asset. The researchers' results proposed that Bitcoin value has become part of the value embedded in the traditional financial system. The researchers reviewed the work of Baek and Elbeck (2015), who examined Bitcoin's variability by comparing the cryptocurrency market with the American stock market to ascertain if fundamental economic variables affect Bitcoin's market return. Baek and Elbeck (2015) found that Bitcoin is 26 times more volatile than the S&P 500 index. Fama et al. (2019) surmised that Bitcoin is a highly speculative financial asset providing investors new, potentially attractive opportunities to realize capital gains.

Sheets and Wang (2019) offered a comprehensive, operational synopsis of cryptocurrencies and a comparative performance analysis of key cryptocurrency stock market indices. The authors found significant divergence in the performance of cryptocurrencies, reasoning that cryptocurrencies are unsuitable investments for risk-averse investors. Alternatively, cryptocurrency investments may be better suited to a risk-seeking investment style (Sheets & Wang, 2019).

Noda's (2021) research examined whether cryptocurrency markets evolve efficiently over time. The author sought to measure the degree of Bitcoin's market efficiency, basing his research on the adaptive market hypothesis, which seeks to reconcile market efficiency with behavioral alternatives. Noda's research supported the alternative markets' hypothesis for the established cryptocurrency market. Noda's research further explored cryptocurrency market efficiency in the context of economist Fama's 1970 research; however, the market efficiency of cryptocurrency has been controversial between proponents and opponents of efficient markets. Finally, the author concluded that his empirical results support the notion of efficiency for a more established cryptocurrency market (Noda, 2021).

Conlon et al. (2021) investigated the linkage between cryptocurrency prices and future inflation expectations, pinpointing a positive connection between cryptocurrency prices and future inflation

expectations. The researchers' observational summaries support that Bitcoin should not be considered a future inflation indicator and add to the developing questions of cryptocurrencies as a financial asset. The researchers found that the absence of consistent cryptocurrency hedging properties may alarm investors as they fail to find a storage of value outside of traditional mechanisms. Thus, the research data suggest that cryptocurrencies are not an effective hedge against future inflation expectations (Conlon et al., 2021).

Bianchi et al. (2022) selected a predictive approach to compare the information content of various market risk factors, including cryptocurrency-specific predictors and cryptocurrency sentiment return variables versus traditional asset classes. The researchers explored if including cryptocurrency assets in a diversified portfolio could lead to incremental gains. The researchers found documentation that digital currencies represent a new asset class, substantially delinked from traditional asset classes. The researchers concluded that less predictable returns characterize cryptocurrency investments compared to other asset classes. They recognized that future research is essential to understand better return segmentation drivers (Bianchi et al., 2022).

Fidelity is the first significant retirement plan provider that will permit investors to add bitcoin to their retirement plans. Under the proposed plan, workers at companies signing up for the plan may defer up to 20% of their payroll to digital assets. Beginning in 2022, Fidelity's 23,000 retirement client companies can add bitcoin to their investment offerings. Fidelity's endorsement of bitcoin suggests the emergence of crypto investing in mainstream investing; however, it remains to be seen how employers embrace crypto investing (Tergesen, 2022a).

Fidelity's affirmation of bitcoin is expected to spark wider employer acceptance. Fidelity claims growing client interest, especially from employers with younger employees. Fidelity suspects that younger employees are evaluating investments, including alternative investments like bitcoin (Tergesen, 2022a). With the stock market down more than 20% in 2022, and the Labor Department expressing regulatory concerns, the environment suggests that the timing of Fidelity's move may be less than fortuitous. Fidelity's head of workplace retirement solutions and platforms believes that bitcoin increases the diversity of its products and investment solutions. Fidelity intends to initially offer bitcoin, with plans to add additional digital assets (Tergesen, 2022a).

Tergesen, 2022b identified Liu and Tsyvinski's examination of the emergence of investing in a digital currency such as bitcoin; investing bitcoin in a 401(k) is currently being debated. Bitcoin is one of the thousands of new digital assets known as cryptocurrencies. The Employee Benefits Security Administration has voiced concern about cryptocurrency as speculative; Fidelity has countered that it believes that blockchain technology and cryptocurrency digital assets represent a growing portion of the financial industry's future (Tergesen, 2022b).

Whether one should invest in crypto depends on their risk tolerance, ability to absorb losses, and knowledge of the digital assets industry. Presently, crypto needs more academically substantiated valuation models investors rely on. Many crypto proponents argue that digital currencies can help serve as an inflation hedge and enhance a portfolio's long-term returns by rising when other asset classes are falling. Such claims, however, are hard to evaluate given the short duration of cryptocurrency as an asset class (Tergesen, 2022b).

Regulatory uncertainty may ultimately give way to regulation, but it is not the only reason mainstream financial firms cautiously approach crypto. Crypto skeptics inside these mainstream financial firms still outnumber the crypto-curious. For example, JPMorgan Chase's CEO, Jamie Dimon, derided bitcoin as worthless in recent years. Firms have different philosophies and strategies, even as they observe that something revolutionary is taking place that will impact their business models (Baer, 2022).

Bianchi and Babiak (2022) researched the performance of mutual funds specializing in the cryptocurrency market, seeking to learn the value of digital assets as investments. Referencing Jensen (1968), the authors' research sought to study the capacity of fund managers to create *outperformance* for investors. This measure of outperformance, termed alpha, suggests that a search for securities that could outperform the market could be worth the additional expense. Their observational findings support the notion that cryptocurrency funds spawn significantly positive alphas compared to passive benchmarks. The researchers explain that the outperformance represented by the positive alphas is unlikely to be explained

by fund manager luck. This study contributes to the active fund management/manager debate (Bianchi & Babiak, 2022).

DATA AND METHODOLOGY

The following research process tested the hypotheses derived from the research question.

Research Question

The study's primary research question was: During the period from January 2018 to December 2022 did the market outperform cryptocurrency on a risk-adjusted basis?

Research Model and Variables

The study used Bitcoin as the individual proxy for cryptocurrency to compare to the growth stocks Meta, Amazon, Apple, Netflix, and Alphabet while using the Royalton Crix Crypto Index as the proxy for multiple cryptocurrencies to compare to the S&P 500 index. The study is limited in scope as the data encompasses a portion of the pre-pandemic bull market, the subsequent pandemic market downturn and recovery, and the market period affected by the interest hikes by the Federal Reserve to combat inflation.

Bitcoin was selected as the proxy for cryptocurrency as the coin holds the largest market cap in the cryptocurrency space. The FAANG stocks were selected due to their market dominance, momentum, and high market multiples. The CRIX index was selected as it closely tracks at least five liquid cryptocurrencies in the cryptocurrency universe.

Hypotheses

Seven hypotheses derived from the above research question were tested.

$H1_0$: *For the period January 2018 to December 2022, the Meta (FB) Sharpe ratio is not significantly different from the Bitcoin (BTC) Sharpe ratio.*

$H1_a$: *For the period January 2018 to December 2022, the Meta (FB) Sharpe ratio is significantly different from the Bitcoin (BTC) Sharpe ratio.*

$H2_0$: *For the period January 2018 to December 2022, the Amazon (AMZN) Sharpe ratio is not significantly different from the Bitcoin (BTC) Sharpe ratio.*

$H2_a$: *For the period January 2018 to December 2022, the Amazon (AMZN) Sharpe ratio is significantly different from the Bitcoin (BTC) Sharpe ratio.*

$H3_0$: *For the period January 2018 to December 2022, the Apple (AAPL) Sharpe ratio is not significantly different from the Bitcoin (BTC) Sharpe ratio.*

$H3_a$: *For the period January 2018 to December 2022, the Apple (AAPL) Sharpe ratio is significantly different from the Bitcoin (BTC) Sharpe ratio.*

$H4_0$: *For the period January 2018 to December 2022, the Netflix (NFLX) Sharpe ratio is not significantly different from the Bitcoin (BTC) Sharpe ratio.*

$H4_a$: *For the period January 2018 to December 2022, the Netflix (NFLX) Sharpe ratio is significantly different from the Bitcoin (BTC) Sharpe ratio.*

$H5_0$: *For the period January 2018 to December 2022, the Alphabet (GOOG) Sharpe ratio is not significantly different from the Bitcoin (BTC) Sharpe ratio.*

$H5_a$: *For the period January 2018 to December 2022, the Alphabet (GOOG) Sharpe ratio is significantly different from the Bitcoin (BTC) Sharpe ratio.*

$H6_0$: *For the period January 2018 to December 2022, the S&P 500 Index Sharpe ratio is not significantly different from the Bitcoin (BTC) Sharpe ratio.*

$H6_a$: *For the period January 2018 to December 2022, the S&P 500 Index Sharpe ratio is significantly different from the Bitcoin (BTC) Sharpe ratio.*

$H7_0$: *For the period January 2018 to December 2022, the S&P 500 Index Sharpe ratio is not significantly different from the Royalton CRIX Index Sharpe ratio.*

$H7_a$: *For the period January 2018 to December 2022, the S&P 500 Index Sharpe ratio is significantly different from the Royalton CRIX Index Sharpe ratio.*

Data Collection Methods

Secondary data were collected and analyzed from the Morningstar Direct database for Meta (FB), Amazon (AMZN), Apple (AAPL), Netflix (NFLX), Alphabet (GOOG), and the S&P 500 TR. Bitcoin (BTC-USD) data was collected from Yahoo Finance, and the CRIX-Network provided the CRIX data.

Using Microsoft Excel and five daily data points, the standard deviations, average returns for the indices, FAANG stocks, and Bitcoin, and the average risk-free returns were calculated. The Sharpe Ratio was determined using the Bank of America Merrill Lynch 3-month Treasury bill returns. A total of 250 data points were obtained.

Data points were gathered daily for each set of comparisons. These points were exported into a Microsoft Excel spreadsheet. Using the data, the means, variances, and other risk-adjusted measures were calculated for each pair of data sets, then compared and analyzed.

Data Analysis Methods

Statistical analyses and hypothesis testing were used to analyze the data. The Kolmogorov-Smirnov test (KS-test) and Shapiro-Wilk test in SPSS were used to check for normality in each data set. If the data was found to be normally distributed, the *F*-test for two samples for variance was used to check for equal or unequal variances, followed by the appropriate *t*-test to check for significant differences between the means of the two paired data sets. If the data was not normally distributed, the non-parametric Wilcoxon Signed Rank test was used to test for significant differences between the means of the two data sets. The null hypothesis was rejected if the *p*-value was less than .05.

RESULTS

The results and findings of the study's hypothesis tests are presented below. They address the study's research question and are arranged in the same order as the hypotheses stated.

Descriptive Statistics

Table 1 (Hypothesis 1) presents a comparison of the mean daily returns, mean weekly Sharpe Ratios, standard deviations, and variances for Meta (FB) against Bitcoin (BTC) for the period January 2018-December 2022. The mean daily return for Meta was .008, which was lower than the Bitcoin return of .084. However, Meta's mean weekly Sharpe Ratio was .041, higher than Bitcoin's.039. The standard deviation and variance for Meta were higher than those for Bitcoin. Specifically, the standard deviation for Meta was .527; the variance was .277, while the corresponding values for Bitcoin were .395 and .157, respectively.

TABLE 1
META (FB) VERSUS BITCOIN (BTC) (JAN 2018–DEC 2022)

	Hypothesis Number	Period	Stock	Crypto	P-Value
	$H1_0$	Jan 2018 – Dec 2022	(FB)	(BTC)	
Number of Data Points			250	250	
Mean Daily Return			.008	.084	
Mean Weekly Sharpe Ratio			.041	.039	
Standard Deviation			.527	.395	
Variance			.277	.157	
P-Value					.927

In Table 2 (Hypothesis 2), a comparison is made of the mean daily returns, mean weekly Sharpe Ratios, standard deviations, and variances of Amazon (AMZN) and Bitcoin (BTC) for the January 2018-December 2022 period. Amazon had a lower mean daily return than Bitcoin, with a difference of .023. However, Amazon had a higher mean weekly Sharpe Ratio than Bitcoin, at .069 compared to .039 for Bitcoin. Additionally, Amazon had a standard deviation of .593 and a variance of .157, while Bitcoin had a standard deviation of .396 and a variance of .351.

TABLE 2
AMAZON (AMZN) VERSUS BITCOIN (BTC) (JAN 2018 – DEC 2022)

	Hypothesis Number	Period	Stock	Crypto	P-Value
	$H2_0$	Jan 2018 - Dec 2022	(AMZN)	(BTC)	
Number of Data Points			250	250	
Mean Daily Return			.061	.084	
Mean Weekly Sharpe Ratio			.069	.039	
Standard Deviation			.593	.396	
Variance			.157	.351	
P-Value					.704

Table 3 (Hypothesis 3) presents a comparison of the mean daily returns, mean weekly Sharpe Ratios, standard deviations, and variances of Apple (AAPL) and Bitcoin (BTC) for the January 2018-December 2022 period. Apple had a higher mean daily return of .124 than the mean daily return of .084 for Bitcoin. Additionally, Apple had a higher mean weekly Sharpe Ratio of .118 compared to .039 for Bitcoin. Apple's standard deviation was .529, and its variance was .280, while Bitcoin's standard deviation was .395, and its variance was .157.

TABLE 3
APPLE (AAPL) VERSUS BITCOIN (BTC) (JAN 2018 – DEC 2022)

	Hypothesis Number	**Period**	**Stock**	**Crypto**	**P-Value**
	$H3_0$	Jan 2018 – Dec 2022	(AAPL)	(BTC)	
Number of Data Points			250	250	
Mean Daily Return			.124	.084	
Mean Weekly Sharpe Ratio			.118	.039	
Standard Deviation			.529	.395	
Variance			.280	.157	
P-Value					.099

Table 4 (Hypothesis 4) presents a comparison of the mean daily returns, mean weekly Sharpe Ratios, standard deviations, and variances of Netflix (NFLX) and Bitcoin (BTC) for the January 2018-December 2022 period. Netflix had a higher mean daily return of .087 than the mean daily return of .084 for Bitcoin. Additionally, Netflix had a higher mean weekly Sharpe Ratio of .051, compared to .039 for Bitcoin. Netflix's standard deviation was .547, and its variance was .300, while Bitcoin's standard deviation was .396, and its variance was .157.

TABLE 4
NETFLIX (NFLX) VERSUS BITCOIN (BTC) (JAN 2018 – DEC 2022)

	Hypothesis Number	**Period**	**Stock**	**Crypto**	**P-Value**
	$H4_0$	Jan 2018 – Dec 2022	(NFLX)	(BTC)	
Number of Data Points			250	250	
Mean Daily Return			.087	.084	
Mean Weekly Sharpe Ratio			.051	.039	
Standard Deviation			.547	.396	
Variance			.300	.157	
P-Value					.764

Table 5 (Hypothesis 5) presents a comparison of the mean daily returns, mean weekly Sharpe Ratios, standard deviations, and variances of Alphabet (GOOG) against Bitcoin (BTC) for the January 2018-December 2022 period. Alphabet had a lower mean daily return of .068 than the mean daily return of .084 for Bitcoin. However, Alphabet had a higher mean weekly Sharpe Ratio of .081, compared to .039 for Bitcoin. Alphabet's standard deviation was .512, and its variance was .262, while Bitcoin's standard deviation was .396, and its variance was .157.

TABLE 5
ALPHABET (GOOG) VERSUS BITCOIN (BTC) (JAN 2018 – DEC 2022)

	Hypothesis Number	Period	Index	Index	P-Value
	$H3_0$	Jan 2018 – Dec 2022	(GOOG)	(BTC)	
Number of Data Points			250	250	
Mean Daily Return			.068	.084	
Mean Weekly Sharpe Ratio			.081	.039	
Standard Deviation			.512	.396	
Variance			.262	.157	
P-Value					.429

Table 6 (Hypothesis 6) compares the mean daily returns, mean weekly Sharpe Ratios, the standard deviations, and the variances for the S&P 500 Index TR against Bitcoin (BTC) for the January 2018-December 2022 period of the study. The mean daily return for the S&P 500 Index TR was lower at .049, compared to the mean daily return of .084 for Bitcoin. However, the S&P 500 Index TR had a higher mean weekly Sharpe Ratio of .161, compared to .039 for Bitcoin. The S&P 500 Index TR's standard deviation was .599, and its variance was .359, while Bitcoin's standard deviation was .395, and its variance was .157.

TABLE 6
S&P 500 INDEX TR VERSUS BITCOIN (BTC) (JAN 2018 – DEC 2022)

	Hypothesis Number	Period	Index	Crypto	P-Value
	$H4_0$	Jan 2018 – Dec 2022	S&P 500 Index TR	(BTC)	
Number of Data Points			250	250	
Mean Daily Return			.049	.084	
Mean Weekly Sharpe Ratio			.161	.039	
Standard Deviation			.599	.395	
Variance			.359	.157	
P-Value					.039

Table 7 (Hypothesis 7) compares the mean daily returns, mean weekly Sharpe Ratios, standard deviations, and variances of the S&P 500 Index TR and the Royalton CRIX Index for the January 2018-December 2022 period. The mean daily return for the S&P 500 Index TR was lower at .049, compared to the mean daily return of .186 for the Royalton CRIX Index. However, the S&P 500 Index TR had a higher mean weekly Sharpe Ratio of .161, compared to -.048 for the Royalton CRIX Index. The standard deviations and the variances for both indices were similar. The S&P 500 Index TR's standard deviation was .599, and its variance was .399, while the Royalton CRIX Index's standard deviation was .600, and its variance was .361.

TABLE 7
S&P 500 INDEX TR VERSUS ROYALTON CRIX INDEX (JAN 2018 – DEC 2022)

	Hypothesis Number	Period	Index	Index	P-Value
	$H1_0$	Jan 2018 – Dec 2022	S&P 500 Index TR	Royalton CRIX Index	
Number of Data Points			250	250	
Mean Daily Return			.049	.186	
Mean Weekly Sharpe Ratio			.161	-.048	
Standard Deviation			.599	.600	
Variance			.359	.361	
P-Value					.001

Results of the Study

Hypothesis 1

For the period of January 2018 to December 2022, representing 250 periods, weekly Sharpe ratios were calculated from daily returns for Meta (FB) and Bitcoin (BTC). The KS-test and Shapiro-Wilk test indicated that the distribution was not normal. Therefore, the Wilcoxon Signed Rank test for variance was applied as outlined in the study's methodology section. The calculated *p*-value for the period was .927. Based on these results, the null hypothesis was retained that the Meta Sharpe ratio is not significantly different from the Bitcoin Sharpe ratio for this period.

Hypothesis 2

Weekly Sharpe ratios were calculated from daily returns for Amazon (AMZN) and Bitcoin (BTC) for the period January 2018 to December 2022, spanning 250 periods. The KS-test and Shapiro-Wilk test revealed that the distribution was not normal; as a result, the Wilcoxon Signed Rank test for variance was applied as specified in the study's methodology section. The *p*-value for the period was .704. Based on these results, the null hypothesis was retained that the Amazon Sharpe ratio is not significantly different from the Bitcoin Sharpe ratio for the period.

Hypothesis 3

Weekly Sharpe ratios were calculated from daily returns for Apple (AAPL) and Bitcoin (BTC) for the period January 2018 to December 2022, spanning 250 data points. The KS-test and the Shapiro-Wilk test revealed that the distribution was not normal; as a result, the Wilcoxon Signed Rank test for variance was applied, as specified in the study's methodology section. The *p*-value for the period was .099. Based on these results, the null hypothesis was retained that the Apple Sharpe ratio is not significantly different from the Bitcoin Sharpe ratio for the period.

Hypothesis 4

Weekly Sharpe ratios were calculated from daily returns for Netflix (NFLX) and Bitcoin (BTC) for the period January 2018 to December 2022, spanning 250 data points. The KS-test and the Shapiro-Wilk test revealed that the distribution was not normal; as a result, the Wilcoxon Signed Rank test for variance was applied, as specified in the study's methodology section. The *p*-value for the period was .764. Based on these results, the null hypothesis was retained that the Netflix Sharpe ratio is not significantly different from the Bitcoin Sharpe ratio for the period.

Hypothesis 5

Weekly Sharpe ratios for Alphabet (GOOG) and Bitcoin (BTC) were calculated from daily returns for the period January 2018 to December 2022, representing 250 periods. The KS-test and the Shapiro-Wilk test indicated a non-normal distribution for the period, so the Wilcoxon Signed Rank test for variance was applied as described in the study's methodology section. The *p*-value for the period was .429. Based on these results, the null hypothesis for the period was retained, meaning that the Sharpe ratio for Alphabet is not significantly different from the Bitcoin Sharpe ratio for the period.

Hypothesis 6

Weekly Sharpe ratios were calculated from daily returns for the S&P 500 Index TR and Bitcoin (BTC) for the period January 2018 to December 2022, representing 250 data points. The KS-test and the Shapiro-Wilk test indicated a non-normal distribution for the period, leading to the use of the Wilcoxon Signed Rank test for variance, as outlined in the study's methodology section. The *p*-value for the period was .039. Based on these results, the null hypothesis for the period was rejected, indicating that the S&P 500 Index TR Sharpe ratio was significantly different from the Bitcoin Sharpe ratio for the period.

Hypothesis 7

Weekly Sharpe ratios were calculated from daily returns for the S&P 500 Index TR and the Royalton CRIX Index for the period January 2018 to December 2022, representing 250 data points. The KS-test and Shapiro-Walk test indicated a non-normal distribution for the period. As a result, the Wilcoxon Signed Rank test for variance was utilized as outlined in the study's methodology section. The *p*-value for the period was .001. Given these results, the null hypothesis of the period was rejected, indicating that the S&P 500 Index TR Sharpe ratio is significantly different from the Royalton CRIX Index Sharpe ratio for the period.

CONCLUSION

The results of this study indicated that, when considering risk-adjusted performance, the mean weekly Sharpe ratios for Meta (FB), Amazon (AMZN), Apple (AAPL), Netflix (NFLX), Alphabet (GOOG) were not significantly different from those of Bitcoin (BTC) over the period studied. However, the S&P 500 Index TR Sharpe Ratio was found to be statistically different from that of Bitcoin (BTC) and the Royalton CRIX index, with a *p*-value of .039 and .001, respectively. This suggests that the S&P 500 Index TR outperformed Bitcoin (BTC) and the Royalton CRIX Index on a risk-adjusted basis during the studied period.

Previous studies have indicated that Bitcoin may provide diversification benefits to a portfolio, but acknowledged that further research was warranted (Guesmi et al., 2019; Sudacevschi, 2021; Anyfantaki et al., 2021). Recent studies indicated that Bitcoin and other cryptocurrencies have been moving in sync with the overall market, which would ultimately negate its diversification attributes (Telesca, 2022; Zuckerman, 2022). Sheets and Wang (2019) found that cryptocurrencies may be the investment of choice for a risk-seeking investment style. Given the study results, there may be better assets of choice for a risk-averse investor for portfolio diversification than Bitcoin and other cryptocurrencies. As cryptocurrencies become more integrated into the financial system, the benefits of the asset class may change. Further investigation is warranted in the future.

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