CRYPTO CURRENCY RISK AND RETURN: A PORTFOLIO APPROACH

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ABSTRACT

This study explored the relationship between risk and return of selected crypto currencies. Four most traded crypto currencies which are bitcoin, ethereum, binance coin and ripple were selected and treated as portfolio in this study. Monthly data on crypto currencies were obtained from Coin Codex Exchange from January 2018 to March 2023 for this study. Result from trend analysis established the high volatility of crypto currencies. Also the result of the correlation analysis revealed the existence of a positive and significant relationship between portfolio risk and return in the crypto currency market. The study therefore recommended that investors frequently monitor price movement of crypto currencies, take advantage of newly introduced crypto and diversify the investments in their portfolio.

Keywords: crypto currency, Bitcoin, Binance coin, Ripple, Ethereum, correlation, portfolio

INTRODUCTION

Money has been transformed over the years from being commodity, coins, paper and electronic money to digital currency. This most recent form of money is known as digital currency which was made possible by the advancement in technology as supported by Keller and Scholz (2019) in their argument that innovation in information technologies, has made the financial industry experience a disruptive fintech revolution that crypto currency into limelight as a means of payment in the future. Ajayi, Oloyede and Oluwaleye (2022) described digital currency as the latest form of money which is referred to as crypto currency. It is a peer-to-peer version of electronic cash with aided by cryptography. Satoshi Nakamoto in 2008 launched the first crypto currency known as Bitcoin and since then, there are over fifteen thousand crypto currencies across the world.

Investment in crypto currencies have experienced remarkable increase over the years despite the high volatility rate and restrictions from the central banks of most countries of the world with global market capitalization of about $1.19 trillion in the first quarter of 2023 (Coin Codex 2023). The highest aggregate value of global crypto currency markets was over $3 trillion and fell below $1 trillion in 2022. This substantial declines in the price of crypto currency were experienced between 2011 and 2018 (Coin Codex 2023).

Returns on crypto currency can only be gotten from increase in price unlike other assets such as bonds or stocks. Hence, investment in crypto currency is based on speculations which are revealed by the volatility of the exchange rate (Kristoufek 2013). Also, Partanen (2018) argued that crypto currencies are not currency in the real sense but their values are gotten from real currencies. Investors in crypto currencies are exposed to more risk due to their high volatility nature. This

volatility stems partly from the fact that many crypto currencies are decentralized, limited in supply, and difficult to value, and partly from the observation that most are treated as speculative investment vehicles (Yermack 2015; Dong, Fang & Lin 2023). Whereas, Singh and Mattackal (2022) referred to the volatility in crypto currency market as crypto winters and categorized them in five before 2017 and three in 2021 meaning the period when crypto currency prices and investor sentiment are low with no evidence of systemic risk. (Liu & Tsyvinski 2021). However, Dong, Fang and Lin (2023) argued that the high volatility in the crypto currency prices may be due to factors like supervisory opinion on crypto currencies, high participation by retail investors can lead to more unpredictable price movement in crypto markets which may just be noise instead of cause of the risk.

Tremendous efforts have been made by scholars in the last decade to provide empirical studies on crypto currencies but more still need to be done in the area of risk and return of crypto currency especially in angle of portfolio.

LITERATURE REVIEW

In theoretical literature, the risk-return tradeoff plays a crucial role in the portfolio theory pioneered by Markowitz (1952). The modern portfolio theory assumed that investors are riskaverse and as such hold well diversified portfolios instead of putting all their eggs in a basket. Hence, the risk and return of the portfolio is considered rather than individual asset risk and return. The framework for the valuation of risky asset is referred to as capital market pricing model (CAPM) familiarized by William Sharpe in 1964. CAPM explained the relationship between risk and asset returns with an argument that the level of systematic risk or ß of stock determines their expected returns. At equilibrium, asset return is the sum of the risk free rate plus beta multiply by the excess return. The sensitivity of individual securities return to the market index return (beta) is the only way to measure risk of that stock. Arbitrary pricing theory (APT) was later developed by Ross (1976) to cater for the deficiencies of the CAPM. The Arbitrage Pricing Theory was seen as potential substitute for investment decision makers since it uses multiple factors to describe the relationship between risk and expected return instead of the single market index. According to Pandey (2010), the crucial logic about APT is that investors always embrace arbitrage anytime they find differences in the returns of assets with similar risk features.

Empirically, Abusharbeh and Sous (2016) examined the relationship between risk and return of the listed stocks in Palestinian exchange market and investigated the validity of capital assets in Palestinian stock market. The study employed Ordinary least square for data analysis. Result from the study showed that the intercept term of individual companies is insignificantly different from zero plus a slope that is equal to the excess of beta. Implying a significant relationship between risk and return. Also, by employing multiple linear regression to analyzed the monthly data gathered from largest market caps in Indonesia through 2020 to 2021, Ilham, Sadalia, IIrawati and Sinta (2022) investigated the risk and return on crypto currency in Indonesia. Results from the study revealed that crypto currency beta, inflation rate, and currency exchange have negative and significant impact on crypto currency returns. Furthermore, Vaziri and Adham (2015) studied the impact of operational risk on the expected returns on Tehran stocks. Correlation and logit regression test were used for data analysis. Findings revealed that the enterprises with high

operational risk have low expected returns and low prices volatility on their stocks. Chania, Sara and Sadalia (2021) also investigated the risk and return on ethereum with the aim of comparing LQ45 share prices and ethereum prices prior to and post Corona virus in Indonesia. The Kruskall-Wallis test and the Paired Sample t-test were used to analyze the data. Findings revealed that no significant difference between ethereum return and LQ45 stocks, while there was significant difference between ethereum risk and LQ45 stocks. Finally, there exist a significant difference between ethereum price and LQ45 shares with decrease in ethereum price with a decrease in average price of ehtereum and LQ45 shares after covid-19.

Meanwhile, the factors that influence crypto currency returns was examined by Liu and Tsyvinski (2021) by building a network of factors in relation to usage and invention factors of crypto currencies. Results from the study showed that crypto currency returns are affected by a combination of factors but not crypto currency production factors. They concluded that returns on crypto currency have little exposures to traditional asset classes. Keller and Scholz (2019) also examined the influencing factors of behaviours of crypto currency investors. ARDL was employed to analyze the data. Findings revealed that indicators like market sentiments, crypto currency-related and macro-financial fundamentals influence the behavior crypto currency investors. The study concluded that behaviour of traders in Bitcoin differ from others due to their arbitrary nature. While, the effect of the fluctuation in the geopolitical risk index on crypto currency return was investigated by Long, Demir, Będowska-Sojka, Zaremba and Shahzad, (2022) by employing cross-sectional return predictability via geopolitical beta. It was revealed that crypto currencies with the lowest geopolitical beta perform better than the ones with high geopolitical beta. They concluded that risk-averse investors must be motivated to invest in crypto currencies with low and negative geopolitical betas through additional reward. In addition, the co-movement between crypto and stock markets was investigated by Dong, Fang and Lin (2023) using granger causality tests and impulse response functions. Results from the study showed an increase in return correlation between crypto currency and the S&P 500 index in March 2020 which may be due to Fed's covid-19 response. Also, slight evidence of transmission of crypto shocks to share with a significant volatility spillovers in the opposite was observed in the study. The study concluded that institutional investors may be responsible for the high crypto-stock comovement after the pandemic due to their sensitivity to changes in the monetary policies. Finally, Kyriazis (2021) scrutinized the optimal methods of measuring returns and volatility of crypto currencies using an integrated survey of GARCH approaches on 67 crypto currency studies. Variations in the volatility of crypto currencies were better described by GARCH models that are highly sophisticated. Investors in crypto currency especially Bitcoin are found to be highly speculative which has improved the trade-off between risk–return their portfolios.

Evidence from the literature showed that majority of studies on risk and return of crypto currencies adopted different approaches and techniques to estimates the risk and return of crypto currencies however, this study treated crypto currency as portfolio of investment. This unique dimension gives room for the application of Markowitz portfolio theory in crypto currency.

RESEARCH METHOD

Monthly data on crypto currencies were obtained from Coin Codex Exchange from Jan. 2018 to March 2023 for this study. Four most traded crypto currencies (Bitcoin, Ethereum, Binance Coin and Ripple) were selected for this study and treated as Portfolio.

Model Specification

Modern portfolio theory (MPT) is a mathematical framework for calculating the expected return of portfolio while the portfolio risk is calculated by the variance of the portfolio.

$$E(R_p) = W_X E(R_X) + W_Y E(R_Y) \quad \text{.....1}$$

Where:

$E(R_p)$ = Expected return on portfolio

W_X = Weight of Security X

$E(R_X) =$ Expected return Security X

W_Y = Weight of Security Y

$E(R_Y)$ = Expected return Security Y

The portfolio risk is calculated using

$$\sigma_p^2 = w_X^2\sigma_X^2 + w_Y^2\sigma_Y^2 + 2w_X w_Y \sigma_X \sigma_Y p_{XY} \quad \text{.....2}$$

Where:

σ_p^2 = variance of portfolio

σ_X = standard deviation for security X

σ_Y = standard deviation for security Y

p_{XY} = Pearson correlation between asset X and asset Y

Therefore, the model for this study is:

$$E(R_p) = W_{\text{BTC}}E(R_{\text{BTC}}) + W_{\text{ETH}}E(R_{\text{ETH}}) + W_{\text{BNB}}E(R_{\text{BNB}}) + W_{\text{XRP}}E(R_{\text{XRP}}) \quad \text{.....3}$$

Where:

BTC = Bitcoin

ETH= Ethereum

BNB = Binance Coin

XRP = Ripple

The risk of the crypto currency is:

$\sigma_p^2 = w_{\mathrm{BTC}}^2\sigma_{\mathrm{BTC}}^2 + w_{\mathrm{ETH}}^2\sigma_{\mathrm{ETH}}^2 + w_{\mathrm{BNB}}^2\sigma_{\mathrm{BNB}}^2 + w_{\mathrm{XRP}}^2\sigma_{\mathrm{XRP}}^2$

$4w_{BTC}w_{\mathrm{ETH}}\ w_{\mathrm{BNB}}\ w_{\mathrm{XRP}}\ \sigma_{BTC}\sigma_{ETH}\sigma_{BNB}\sigma_{XRP}p_{BTC,ETH,BNB,XRP}$…..4

Estimation Techniques

This study will adopt trend analysis to examine the movement in the prices of crypto currencies, descriptive and correlation analysis to examine the relationship between portfolio risk and return. Monthly actual returns on crypto currency can be calculated by this formula:

R = (CP – OP) / OP

100…….5

Where:

R = actual return

CP = monthly closing price of crypto currency

OP = monthly opening price of crypto currency

RESULTS, CONCLUSION AND RECOMMENDATIONS

Trend Analysis

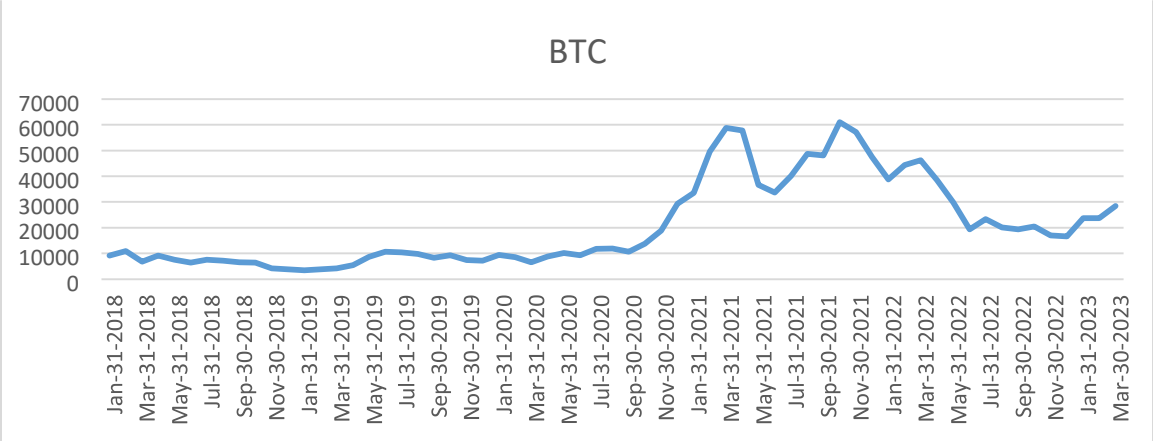

Figure 1.0 shows the Movements in the Price of Bitcoin from 2018 to 2023

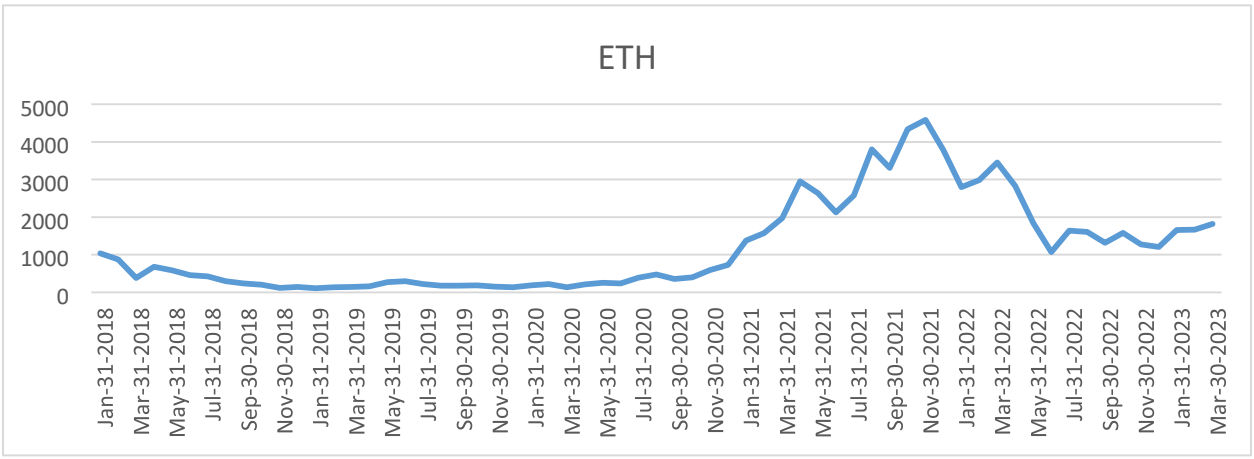

Figure 2.0 shows the Movements in the Price of Ethereum from 2018 to 2023

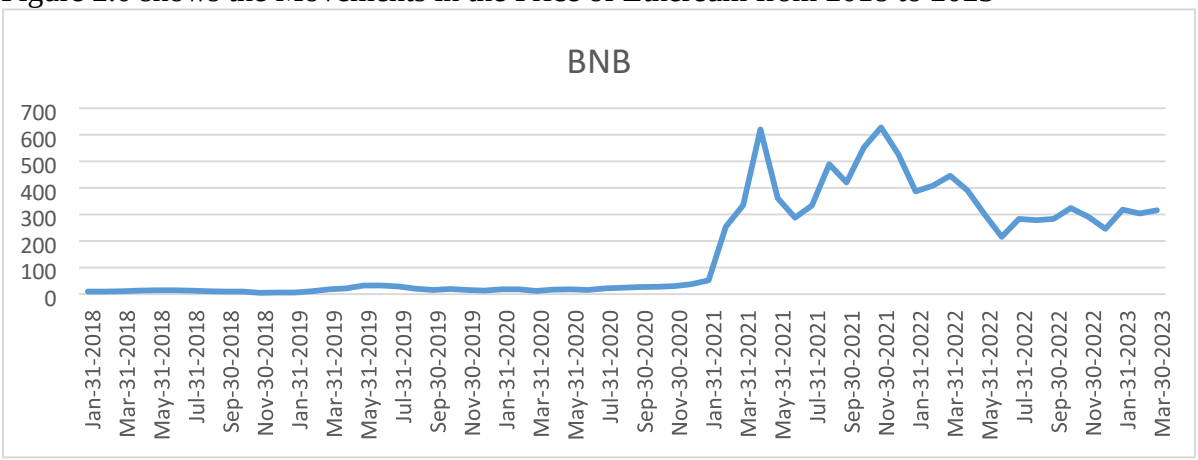

Figure 3.0 shows the Movements in the Price of Binance Coin from 2018 to 2023

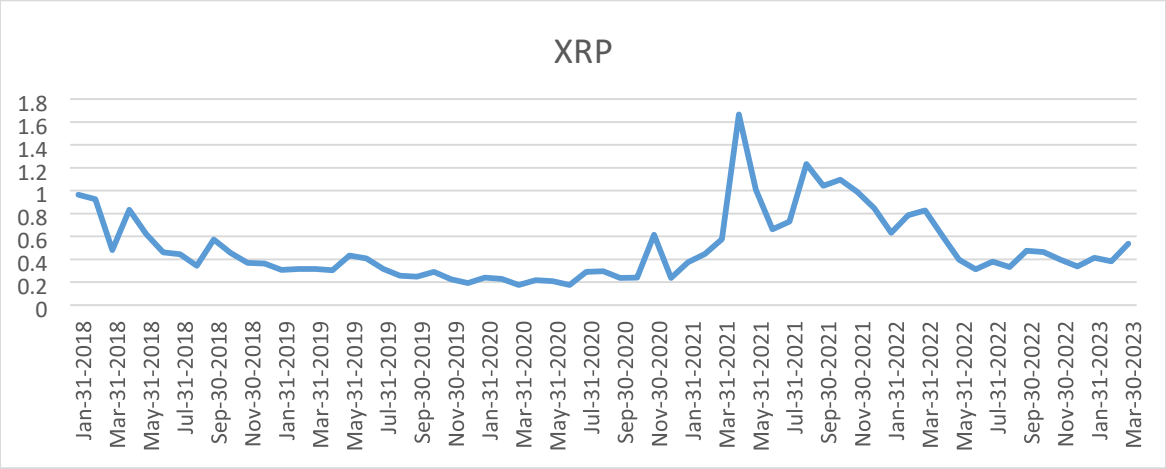

Figure 4.0 shows the Movements in the Price of Ripple from 2018 to 2023

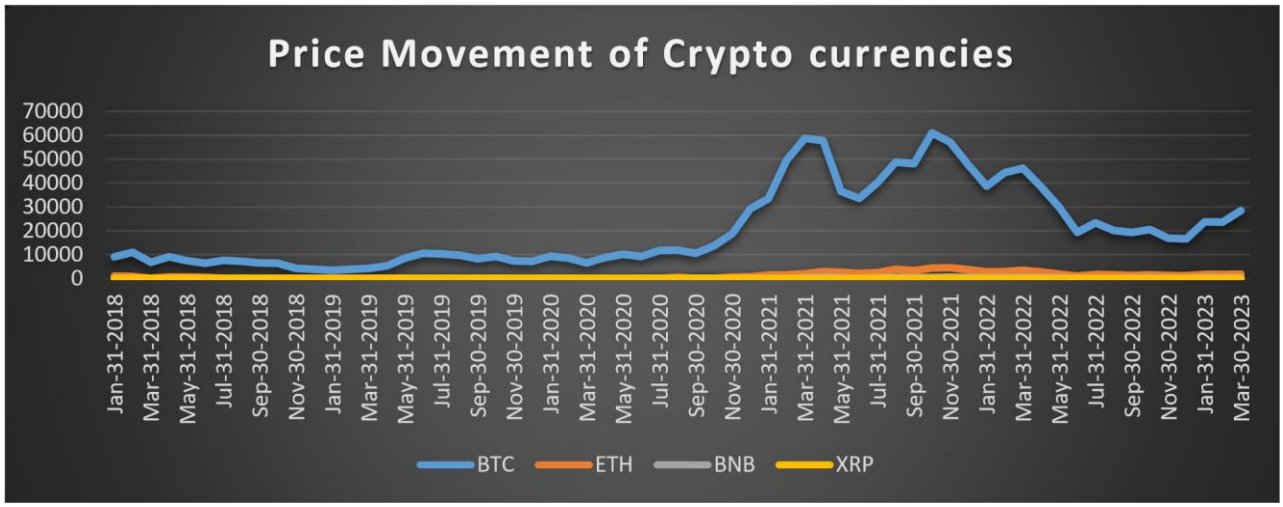

Figure 5.0 shows the movements in the prices of crypto currencies from 2018 to 2023

The figures above show the movements in the prices of crypto currencies from January 2018 to March 2023. In figures 1.0 to 5.0 above, the movement in the prices of bitcoin, ehtereum, binance coin and ripple exhibited slight upward and downward movements from 2018 up to 2020 with a dramatic upward movement in early 2021 up and dropped drastically toward the end of first quarter of 2021. It then begging to fluctuate up to March 2022 before another major fall was experienced in May 2022 and continue to fluctuate up to 2023. This movement in price depicts that crypto currency is highly volatile and the all experienced fluctuations almost the same period of the year.

Portfolio Result

This section examines the characteristics of the specified variables based on their mean, minimum/maximum values, standard deviation, skewness, kurtosis and Jerque Bera statistics. The results obtained based on these descriptive statistics are reported in Tables 4.1.

Table 4.1: Descriptive Statistics

Statistics	RETURN	RISK
Mean	0.681849	0.910067
Median	0.523540	0.793595
Maximum	2.815311	1.475797
Minimum	-0.672602	0.638639
Std. Dev.	1.473268	0.328326
Skewness	0.456910	1.231368
Kurtosis	1.821656	2.920143
Jarque-Bera	0.463242	1.264884
Probability	0.793247	0.531293

Source: Author's Computation, (2023)

The results depicted in Table 4.1 show that the average values of return and risk of the portfolio for the study period January 2018 to December 2022 are 0.681849 and 0.910067 respectively. It is overt that return has the lowest average value just about 68 percent while the risk displays the highest average value. The risk ranges from 0.638639 to 1.475797. This implies that the combination of the portfolio are both defensive and aggressive in nature. Return has a minimum value of -0.672602 meaning that there are tendencies of making loses on the portfolio from the market and the maximum value of return is 281.5311 percent which indicates that there is presence of active securities in the portfolio. The values of standard deviation on the table indicate that the return of the portfolio is more volatile than risk. Furthermore, it is shown that both return and risk are positively skewed but they are platykurtic. The values of skewness as indicated in the table are significantly different from zero. The probability values of Jerque Bera statistics for the risk and return are larger than 5 percent and this means that the variables are not normally distributed. The study proceeds to show the trend of the return and risk of the portfolio from 2018 to 2022.

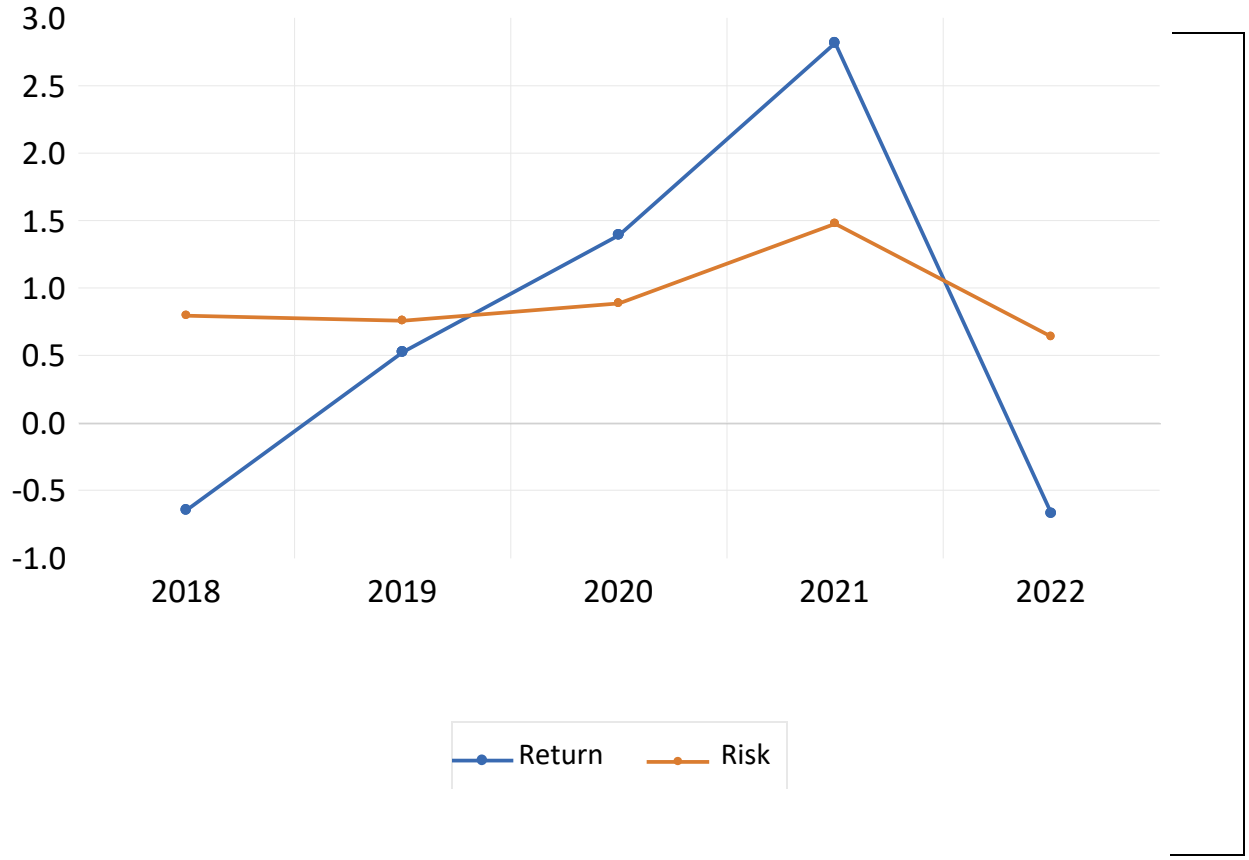

Figure 4.1 Trend Movement of Portfolio Risk and Return

The figure above shows the trend of movements in relation to return and. A visual examination reveals that return of the portfolio is more volatile than risk of the portfolio since the graph of the return fluctuate than the graph of risk. Moreover, the figure displays higher positive return in 2021 with a corresponding higher positive risk. This indicates that portfolio is very active in the year 2021 and this may increase the investor's net worth. On the other hand, the figure indicates that in the year 2018 and 2022, the return of the portfolio are negative and this indicates that the portfolios were inactive for the years. This means that there are incidences of loses bedeviling the market. Having described the characteristics of risk and return, the study proceeds to establish the relationship between the risk and return of the portfolio. The result is presented in the Table 4.2.

Table 4.2: Dependent Variable: Return

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RISK	4.025290	1.144868	3.515942	0.0390
Constant	-2.981435	1.094808	-2.723250	0.0724
R-squared	0.804711			
F-statistic	12.36185			
Prob(F-statistic)	0.039031			

Source: Author's Computation, (2023)

The result shows that portfolio risk has positive and significant effect on portfolio return in crypto currency market. This means a unit change in in the portfolio risk has significantly increase the portfolio return by 4.025290. Thus, this implies that the crypto currency market compensate investors for taking risk. The coefficient of determination shows a value of 0.804711 and it indicates that 80.71 percent variation in portfolio return could be explained by portfolio risk while the remaining 19.29 per cent variation in portfolio return could be explained by other factors which were not included in the study. In addition, the model is significant because the probability values linked with F-statistic were less than 0.05 and it proposed that a valid generalization could be brought out from the model estimation. It is established that the model was fit and it conformed to *apriori* expectation.

Discussion of Findings

It has been established that portfolio risk has a positive and statistically significant relationship with portfolio return in the crypto currency market. This validates the proposition of an investment theory by Markowitz (1952) that hypothesized a positive relationship between risk and return, implying that the higher the risk, the higher the return which is also in tandem with the convectional principle of Markowitz (1952). The implication of this is that the goal of an investment is to maximize return, and most investors demand high returns as an inducement to invest in high risky assets, which is why less risky investments are acceptable at lower rates of return. Thus, high return is the economic justification for high risky assets. In line with this finding, several studies document a positive and significant relationship between risk and return including but not limited to Abusharbeh and Sous (2016), who documented a positive and significant relationship between risk and return. Similarly, Liu and Tsyvinski (2019) found a positive and significant relationship between return and risk in the crypto currency in US and China. As a result of this, there is a positive and significant relationship between risk and return in crypto currency market, which is consistent with empirical findings and theoretical submissions in previous literature.

Conclusion and Recommendations

The study investigates the relationship between risk and return of crypto currency treating them as portfolio. Four most traded crypto currencies which include bitcoin, ethereum, binance coin and ripple are used for the study. Result from trend analysis established the high volatility of crypto currencies. There was upsurge in the price crypto currency in the first quarter of year 2021 with various degree of fluctuations. The findings of this study established a positive and statistically significant relationship between portfolio risk and portfolio return in the crypto currency market portfolio return in the crypto currency market. This study therefore recommended that investors in the crypto currency market should keep abreast of the movement in the price of crypto currency market. Most traded crypto currencies tend to be more volatile than the newly introduced crypto in which investors can take advantage of in the market. Diversification has been the best way of reducing portfolio risk, therefore investors can embrace it.

References

Abusharbeh, M. T. & Sous, S. J. (2016). Testing the validity of capital assets pricing model: Evidence from Palestinian exchange market. *Journal of Accounting, Finance and Economics. 6(*2), 99 – 107

Ajayi, F. I., Oloyede, J. A. & Oluwaleye, T. O. (2022) Cryptocurrency shock and exchange rate behaviour in Nigeria. *African Journal of Accounting and Financial Research*, *5*(2), 32-47 Coin Codex (2023) Today's Cryptocurrency Prices by Market Cap. Available at: https://coinmarketcap.com/

Chania, M, F., Sara, O., & Sadalia, I. (2021). Analisis risk dan return investasi pada ethereum dan saham LQ45. Studi Ilmu Manajemen dan Organisasi, 2(2), 139-150.

Dong, S., Fang, V. W. & Lin, W. (2023). Tracing contagion risk: From crypto or stock? Available at: https://ssrn.com/abstract=4371403 45-49

Ilham, R. N., Sadalia, I., IIrawati, N. & Sinta, I. (2022). Risk and return model of digital cryptocurrency asset investment in Indonesia. *Al Qalam: Jurnal Ilmiah Keagamaan dan Kemasyarakatan 16*(1), 357-376.

Keller, A. & Scholz, M. (2019).Trading on cryptocurrency markets: Analyzing the behavior of bitcoin investors. *Association of Information Systems AIS Electronic Library (AISeL)* Kristoufek, L. (2013). BitCoin meets Google Trends and Wikipedia: Quantifying the relationship between phenomena of the Internet era. Scientific Reports, 3, 7. doi:10.1038/srep03415 Kyriazis, N. A. (2021). A Survey on Volatility Fluctuations in the Decentralized Crypto currency Financial Assets. *Journal of Risk and Financial Management* 14: 293. https://doi.org/10.3390/jrfm 14070293

Liu, Y. and Tsyvinski, A. (2021). Risks and returns of crypto currency. *The Review of Financial Studies 34*(6), 2689-272.

Long, H., Demir, E., Będowska-Sojka, B., Zaremba, A & Shahzad, S. J. H. (2022). Is geopolitical risk priced in the cross-section of crypto currency returns? *Finance Research Letters Elsevier Inc. 49*.

Markowitz, H. M. (1952). Portfolio selection, *Journal of Finance*, 77-91

Pandey, I. M. (2010). *Financial management.* New Delhi, Vicas Publishing House. 106-110

Partanen, C. (2018).The viability of crypto currency in relation to the response of financial institutions and governments Thesis submitted to Helsinki Metropolia University of Applied Sciences.

Ross, S. A., (1976). The arbitrage theory of capital asset pricing. *Journal of Economic Theory*.13, 341-360.

Singh, M. & Mattackal, L. (2022). Cryptoverse: Is the End of the Bitcoin Winter Nigh? *Reuters*.

Vaziri, K. & Adham, A. (2015).The effects of expected stock returns and stock prices volatility on corporate operational risk (Tehran Stock Exchange). *Global Journal of Management and Business Research, 15*(3), 26-33.

Yermack, D. (2015). Is bitcoin a real currency? An economic appraisal. *Elsevier*, 31-43.

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