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Performance Analysis of Gold- and Fiat-Backed Cryptocurrencies: Risk-Based Choice for a Portfolio

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Abstract: This study aims to investigate the performance and behavior of fiat- and gold-backed cryptocurrencies to support stakeholders through the preparation of a portfolio from 1 January 2021 to 30 June 2022. Moreover, while searching for a hedge or a diversifier to construct a less risky portfolio with handsome returns, the prices of fiat-backed cryptocurrencies report high fluctuation during the sample period. ARIMA-EGARCH models have been employed to examine the volatile behavior of these cryptocurrencies. The empirical results are mixed as Bitcoin has been highly volatile during the economic recession. Due to its volatility, investors seek a safe haven. Ripple, on the other hand, shows low risk compared to Bitcoin. The results further reveal that PAX gold is more volatile than PM gold, while Bitcoin, being a highly traded cryptocurrency, is significantly correlated to other cryptocurrencies. The implications of this research showing the volatility of gold- and fiat-backed cryptocurrencies are equally important to stakeholders, such as investors, and policymakers.

Keywords: fiat-backed cryptocurrencies; gold-backed cryptocurrencies; volatility; ARIMA-EGARCH model

1. Introduction

After the global financial crisis, the rise of cryptocurrency gained significant attention from investors. However, being the first cryptocurrency, Bitcoin was well renowned in 2014 (Vigliotti and Jones 2020). Extensive research has discussed cryptocurrencies[1] as an emerging form of digital financial assets; it was possible to observe more than 7400 kinds of cryptocurrencies on 30 September 2020, with a market capitalization of USD 342.34 billion and more than 30,000 trading windows (Wasiuzzaman et al. 2022). Thus, a cryptocurrency market with this vast volume cannot be overlooked. Among these cryptocurrencies, almost 1900 types of cryptocurrencies are directly traded with the US dollar on different trading platforms. Therefore, the volume of cryptocurrencies reveals an uncertain trading volume with a sharp fluctuation in price. The behavior of cryptocurrencies has been studied as a price bubble (Kyriazis et al. 2020).

Some scholars have disclosed that Bitcoin acts as a hedge, a safe haven, or even as a diversifier[2] to reduce downside risk[3]. Moreover, adding Bitcoin to a portfolio can reduce risk, though not entirely eliminate it (Bouri et al. 2017a, 2017b). Despite having volatile behavior, these currencies have been frequently added to portfolios or hedge funds to diversify risk (Dunbar and Owusu-Amoako 2022). Additionally, these portfolios also contain gold as a safe haven[4]. Due to the internationally traded commodities, these assets attracted various investors, scholars, and stakeholders (Zhang et al. 2022). However, with globalization and the integration of global financial markets, cryptocurrencies are

vulnerable to systemic risks (Jalan et al. 2021). Moreover, the highly integrated financial markets absorb the contagion effect of financial turbulence, economic recession, and the pandemic (Bouri et al. 2019a). During the recent pandemic period of COVID-19, investors sought safe assets to invest in; thus, the market behavior of cryptocurrencies has been studied thoroughly (Katsiampa et al. 2022). The debate on cryptocurrencies as a hedge or diversifier has been expanded and empirically investigated with different econometric tools (Aharon et al. 2022; Apergis 2022).

Despite the by default risk factor present in cryptocurrencies, Bitcoin[5] is heavily traded. This risk is also associated with the trading platforms of cryptocurrencies and makes trading controversial, although it earns a high yield, especially during the last few years (Hu et al. 2019; Klein et al. 2018). While examining Bitcoin as a safe haven, hedge, or diversifier, gold is usually considered to be a safe-haven asset, and Bitcoin has been added to portfolios as a diversifier due to its volatile behavior and the criticism it has received from regulatory authorities (Urquhart and Zhang 2019). Bitcoin is termed fiat money, while gold-backed[6] cryptocurrencies are a niche novelty for investing in digital assets (Hu et al. 2019). Finance theory supports this as high-risk and high-return investment, yet the pandemic has increased sensitivity in investors' behavior. During the COVID-19 pandemic, gold has been explored as a safe-haven asset and has been compared with fiat money (Mnif et al. 2020). In addition, financialization has a significant nexus with environmental performance (Chandio et al. 2021; Irfan et al. 2022a, 2022b; Khan et al. 2022; Liu et al. 2022; Rehman et al. 2022).

Gold-backed cryptocurrency is a newer variant that physicalizes the cryptocurrency and is considered safe (Aloui et al. 2021). These coins are used against the tame volatility of dollar prices. These derivative assets contain the value of gold (Derrick 2020). Among these, PAX gold is the largest gold-backed currency. It attracted investors when the price jumped by 7.4% in 2022 and left the other cryptocurrencies behind[7]. Perth Mint Gold Token (PMGT), another gold-backed cryptocurrency, has become famous and commonly traded (Aloui et al. 2021). The efficiency level of conventional fiat-backed cryptocurrencies has been empirically investigated with gold and other commodities, and a significant role was found for the inclusion of cryptocurrencies in a portfolio in terms of diversifying risk (Hung 2022). These cryptocurrencies became more popular during the pandemic due to the economic crisis.

Contrarily, these cryptocurrencies were revealed to be more volatile during the pandemic[8] (Ahmed et al. 2020). Current research is exploring that how Bitcoin is volatile and whether it can be used as a hedging asset in a portfolio (Dunbar and Owusu-Amoako 2022). Moreover, gold- and conventional fiat-backed cryptocurrencies have been examined in academic research, especially during the pandemic period (Arfaoui and Yousaf 2022). However, little research has been conducted that finds the nexus between gold-backed and fiat cryptocurrencies (Jalan et al. 2021). Although gold-backed and fiat cryptocurrencies are built and traded on the same platforms, they are different and must be probed. This study focuses on the relationship between two fiat cryptocurrencies, Bitcoin and Ripple, and two gold-backed cryptocurrencies, PAX gold and the Perth Mint Gold Token (PMGT) (Wasiuzzaman et al. 2022; Yousaf and Yarovaya 2022). Figure 1 reflects the price fluctuation of fiat-backed and gold-backed cryptocurrencies during the period under study. The prices of Bitcoin and Ripple have decreased gradually, mainly due to the overall economic recession caused by COVID-19. In contrast, PM gold gained significant value during 2022 due to the belief held by investors that gold-backed cryptocurrencies are a safer investment than fiat-backed cryptocurrencies.
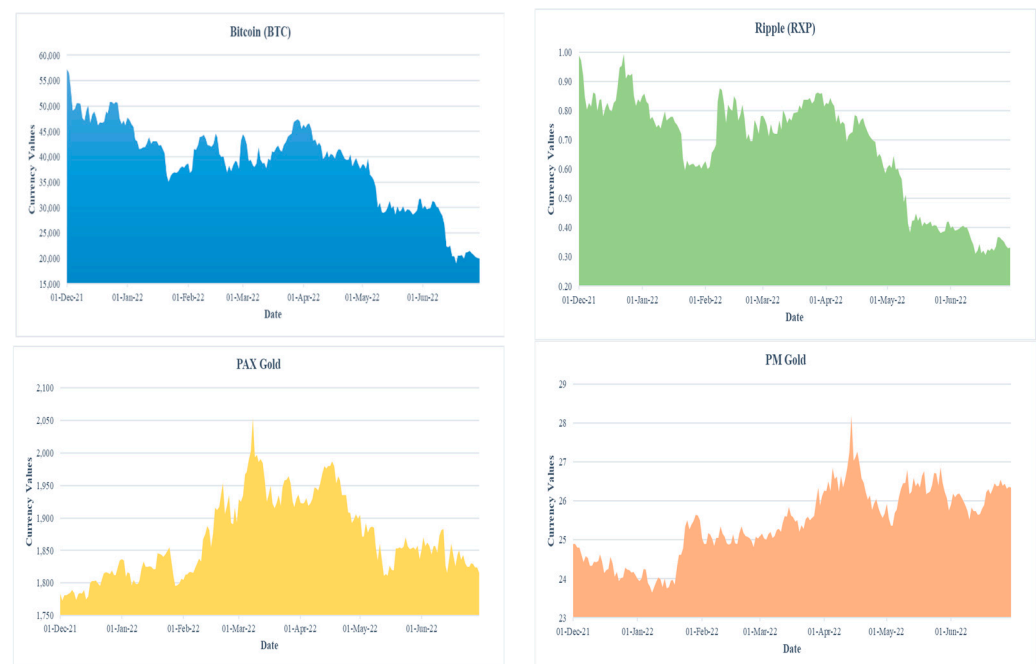
Figure 1. Fiat- and gold-backed currencies.

In the case of Tulipmania, it may have seemed to be a bubble, but bubbles require that prices be mutually agreed upon and also require underlying values to exist. During the so-called "Tulipmania", the futures contract prices had been formal but changed into the exercise prices for options (Thompson 2007). This means that information may be given a subjective value and integrated with the value of extrinsic incentives to make judgments, though the method is unclear. The conserved value calculations underlie multi-attribute and value-based choices related to seeking future knowledge and making rational decisions (Appel and Grabinski 2011; Bromberg-Martin et al. 2022).

This study contributes to the existing literature in several ways: Firstly, the unique combination of gold-backed and conventional fiat-backed cryptocurrencies is explored as an option for stakeholders seeking to invest in safe crypto assets. This study adds to the extant literature regarding the prices and volatility of fiat cryptocurrencies compared to gold-backed cryptocurrencies. Gold-backed cryptocurrencies differ in nature and properties from conventional fiat cryptocurrencies in terms of transparency, certainty, and stability (Aloui et al. 2021; Trabelsi 2019). Gold-backed cryptocurrencies are still unexplored in terms of volatility, hedging properties, and the extent to which they act as safe havens (Bouri et al. 2017a, 2017c). This study provides empirical evidence of the volatile nature, hedging properties, and safe-haven validity of gold-backed cryptocurrencies. However, there is a scant body of empirical evidence regarding the hedging or safe-haven characteristics of gold-backed cryptocurrencies. Secondly, an advanced econometric model, ARIMA-EGARCH, was used to meet the study objectives. Thirdly, the study aims to engage in the current debate about hedges or diversifiers. This study also provides evidence and implications regarding the diversification benefits of these currencies in a portfolio consisting of both gold-backed and conventional cryptocurrencies (Bouri et al. 2019b; Shahzad et al. 2019).

The rest of the study has been organized as follows: literature review and formation of the research hypothesis, data collection techniques, research methodology, data analysis, conclusion, and discussion. The limitations of this study and practical implications are provided at the end of the paper.

2. Literature Review

The volatile behavior of cryptocurrencies is revealed to have significant time-varying and clustering characteristics. It follows a set pattern of huge fluctuations in prices[9], which are followed by high fluctuations and vice versa (Ren et al. 2022). Some researchers have discussed the persistent volatility of cryptocurrency; for instance, other than the structural break, twelve cryptocurrencies, including Bitcoin, Dash, Bytecoin, Litecoin, Bitshare, Ethereum, Monero, Ripple, Stellar, Nem, Siacoin, and Tether, have a long memory and obey a pattern of persistent volatility (Palamalai et al. 2021).

Moreover, the volatility of cryptocurrencies differs with commuting spillover patterns, volatility clustering structures, and the market situation. An artificial price bubble may occur due to economic conditions in the overall market or an economic recession. In that case, the prices of cryptocurrencies show strange behavior, with Litecoin, Bitcoin, and Ethereum generally considered the most relevant cryptocurrencies (Gil-Alana et al. 2020). These cryptocurrencies serve as a path to link the other cryptocurrencies, especially those traded on the blockchain. Lately, the role of these cryptocurrencies has been challenged due to the high trading volume of crypto assets over time (Ciaian et al. 2018). The volatility and returns of major cryptocurrencies have been examined through high-frequency data from 15 min intervals; these cryptocurrencies include Bitcoin Cash, Bitcoin, EOS, Dash, Ripple, Ethereum, Iota, Ethereum Classic, OmiseGO, Zcash, Litecoin, and Monero, which were analyzed from 10 August 2017 to 23 June 2018. The results reveal that all the cryptocurrencies exhibit different volatility clustering over time due to economic conditions (Conlon et al. 2020).

Contrarily, another study explored the volatility clustering of cryptocurrencies with structural breaks and price bubbles. For this purpose, the price data of eight significant cryptocurrencies were obtained from 27 December 2013 to 25 February 2019. The findings report that multiple price bubble periods were observed in 2017 and early 2018. During these price bubbles, the cryptocurrencies showed high trading volume and higher volatility, while transactions were positively correlated with the price bubbles of different cryptocurrencies (Enoksen et al. 2020). Previous research has explored the volatility clustering of different cryptocurrencies during the COVID-19 pandemic and found a significant positive connection between the prices of cryptocurrencies and COVID-19 (Iqbal et al. 2021). The relationship has been investigated and is considered to be the financial turbulence of 2020. Transaction data were obtained in addition to the hourly price of cryptocurrencies from December 2019 to April 2020. The research findings show a dramatic hike in volatility clustering during March 2020 (García-Medina and Hernández C 2020).

The prices of cryptocurrencies showed a dynamic correlation during the pandemic, and the investigation found a negative investor sentiment impact during COVID-19. Moreover, trading volume was also reduced; however, in March 2020, a sudden rise in cryptocurrency returns and trading volume was observed (Corbet et al. 2020a). Furthermore, the erratic behaviors and distribution extremities were examined from the price data of fifty-one cryptocurrencies (Kumar et al. 2022). Their study revealed that during pre-COVID-19, the cryptocurrencies exhibited a homogeneous pattern in terms of volatility clustering, whereas in the COVID-19 period, the homogeneity of volatility clustering fluctuated. Thus, the association between cryptocurrencies was reduced. After the pandemic outbreak, volatility clustering increased sharply (García-Medina and Hernández C 2020), and the prices and trading volumes of cryptocurrencies showed a significant increase (Corbet et al. 2020a). Other analyses unveiled an outward shift of the return curve, and the average returns were unexpectedly high (Ciaian et al. 2018).

Several cryptocurrencies bore the shock of the COVID-19 pandemic and gained positive returns (Iqbal et al. 2021). While considering financial strategies to analyze the characteristics of cryptocurrencies as a hedge, some scholars found that Bitcoin is significantly correlated with other cryptocurrencies. To assess this association, sixteen cryptocurrencies were investigated with daily price data for 2013–2016, and it was found that these cryptocurrencies significantly correlated with each other in both the short and long term

(Kyriazis 2019). Therefore, including these cryptocurrencies in a portfolio may increase the portfolio's risk (Ciaian et al. 2018). However, the behavior of cryptocurrencies can be revealed when the market is said to be efficient. However, not only does the market present the mechanism of demand and supply, but the macroeconomic factors also significantly influence the prices of securities (Ghorbel and Jeribi 2021).

The cause-and-effect relationship between the instability and liquidity of cryptocurrency has been explored via price data at daily, weekly, and monthly frequencies, leading to the observation that digital currencies with higher volatility are the cause of high liquidity and can draw the attention of investors due to higher premiums (Mahdavi-Damghani et al. 2022). As far as the price fluctuation of cryptocurrencies is concerned, this unpredictability has heightened during the COVID-19 pandemic.

What is more, along with the other cryptocurrencies, a nexus was found with the commodities of the equity market (Wasiuzzaman et al. 2022). These commodities include oil, gold, copper, silver, and agricultural futures. The relationship has changed during the pandemic due to the sensitivity of investors. The stock markets have become more volatile and sensitive to financial turbulence (Ghorbel and Jeribi 2021). In that particular movement, scholars investigated assets in terms of their performance as a hedge, safe haven, or diversifier (Bouri et al. 2017a). A plethora of research has been conducted to explore fiat-backed cryptocurrencies such as Bitcoin, Ripple, Ethereum, Dogecoin, etc. These cryptocurrencies act as a hedge or diversifier (Bouri et al. 2017c; Shahzad et al. 2019) while gold acts as a safe-haven asset. Several studies have explored various aspects of cryptocurrencies. In particular, studies have been dedicated to conventional cryptocurrencies. These cryptocurrencies are found to be efficient and became acceptable, especially during the pandemic (Mnif et al. 2020).

Cryptocurrencies have built-in risk factors, and research has thus examined the volatility of cryptocurrency prices and their returns. GARCH models have been applied to address cryptocurrency volatility, while the substantial flow of cryptocurrency trade has reduced portfolio risk (Arfaoui and Yousaf 2022; Ghorbel and Jeribi 2021; Tien and Hung 2022). In examining the volatility spillover effect of cryptocurrency returns, cryptocurrency was found to have significant time-varying price volatility effects. The GARCH models, such as EGARCH and DCC-Garch, examine the volatility of cryptocurrency with the effect of time (Aloui et al. 2021; Apergis 2022; Klein et al. 2018). There has been an overall recession in financial markets, and a sharp decline has been observed in commodity prices (Aslanidis et al. 2022; Cao and Xie 2022). Bitcoin also faced a remarkable decline during the pandemic. During market upheaval, cryptocurrency investors often become anxious and overreact to unfavorable news. Cryptocurrencies have become more sensitive than the S&P500 index and gold (Tan et al. 2020). Additionally, some scholars have further disclosed the relationship between financial markets and the environment (Chen et al. 2022; Xie et al. 2022). They found that these financial assets have a significant connection with socioeconomic variables.

With the increase in gold prices, a relatively new form (gold-backed cryptocurrency) has been started (Mnif et al. 2022). Though there has been little research on gold-backed cryptocurrencies, these are gaining much attention. The volatility of both gold-backed and fiat-backed cryptocurrencies has been assessed and compared during the pandemic, and the returns of gold-backed cryptocurrencies are more volatile (Wasiuzzaman et al. 2022). However, gold-backed cryptocurrencies acted as safe-haven assets during the pandemic (Aloui et al. 2021; Wasiuzzaman and Haji Abdul Rahman 2021). The performance of gold-backed cryptocurrencies was discovered to be more vulnerable to volatility when gold prices are high. Fiat-backed currencies are comparable to Bitcoin because of their volatile nature, but newly developed cryptocurrencies cannot act as safe-haven assets in the same way as gold (Jalan et al. 2021). Before and during the COVID-19 pandemic, various studies investigated the hedge or safe-haven properties of gold and conventional cryptocurrencies (Conlon and McGee 2020). The spillover effect, the connectedness between gold and cryptocurrencies, multifactor analysis, and the GARCH models were investigated

(Ghorbel and Jeribi 2021). Gold is considered a safe haven due to very low volatility, while cryptocurrencies act as a hedge and, as per some other results, only as a diversifier (Klein et al. 2018; Shahzad et al. 2019; Urquhart and Zhang 2019). Bitcoin represents a significant portion of cryptocurrency trade but is still a decentralized digital asset. Furthermore, gold also acts as a hedging tool in addition to being a safe haven due to stability and less volatility in times of economic recession.

So far, a scant body of literature has been analyzed in relation to the exploration of gold-backed cryptocurrencies (Bouri et al. 2020). These cryptocurrencies have gained interest during the COVID-19 pandemic due to being digital, 100% backed by gold, and possessing the combined features of stablecoins and gold (Wang et al. 2020). Additionally, gold-backed cryptocurrencies were also discussed in the context of Islamic finance (Aloui et al. 2021; Yousaf and Yarovaya 2022). Investors are interested in research regarding Islamic investment and Sharia compliance (Wasiuzzaman et al. 2022). Gold-backed cryptocurrencies are now following blockchain technology and gold bugs are increasingly involved in the trade of cryptocurrencies (Aloui et al. 2021). Gold-backed cryptocurrencies have recently emerged as digital assets pegged to physical asset (gold) value (Yousaf and Yarovaya 2022). Gold-backed cryptocurrencies are also traded on the blockchain (the distributed ledger) and are easily approachable to investors. These cryptocurrencies have intrinsic value that is lacking in conventional cryptocurrencies (Díaz et al. 2022; Yousaf and Yarovaya 2022).

Additionally, with the escalated interest in stablecoins among investors, the media and financial regulators have launched a new digital currency complaint cell to facilitate investors per Sharia rules (Díaz et al. 2022). The Islamic cryptocurrency, backed by gold, is one of six "Rabawi" that Muslim investors are permitted to trade. The gold-backed cryptocurrencies are considered safe investments and less volatile than conventional cryptocurrencies (Yousaf and Yarovaya 2022). The connectedness between these cryptocurrencies and gold has been discussed according to Sharia compliance and these cryptocurrencies are deemed safer than conventional cryptocurrencies (Cao and Xie 2022; Hasan et al. 2022). Based on these arguments, this study examines whether gold-backed cryptocurrencies are less volatile than conventional cryptocurrencies, as well as which of these can be added to portfolios as a safe-haven asset. To address the research question, the ARIMA-EGARCH model was applied.

3. Data and Methodology

This research explores the estimation of conventional cryptocurrencies (Bitcoin and Ripple) and gold-backed cryptocurrencies (PM gold and PAX gold). Bitcoin was introduced after the global financial crisis when investors sought a new asset to invest in and gained proper attention in 2014, while Ripple was launched in 2012 and has traded a little since its birth. During the last few years, conventional cryptocurrencies have been debated due to investor interest in hedges and safe-haven assets. To physicalize cryptocurrencies, gold-backed cryptocurrencies have been launched with low management fees and smaller storage costs. Perth Mint gold (PM gold) and PAX gold have been traded as gold-backed cryptocurrencies. The assessment of both gold-backed and fiat-backed currencies is argued to gain a deeper understanding of the volatile behavior of both forms of cryptocurrencies. Bitcoin, the traditional cryptocurrency, has been used for analysis in this study due to its popularity in the literature. The recent literature suggests that gold-backed cryptocurrencies are more likely to be included in a portfolio to hedge cryptocurrency volatility. Therefore, cryptocurrencies have built-in volatility that must be investigated as a hedge or a diversifier.

The data on cryptocurrencies were obtained from coincodex.com from 1 January 2021 to 30 June 2022. The closing stock prices were considered for the analysis. The baseline regression and ARMA/ARIMA-EGARCH model were employed to address the research question. The ARIMA (m, n) model is given below.

$$P_t = c + \sum_{i=1}^{m} \delta_i P_{t-1} + \sum_{j=1}^{n} \varphi_j \varepsilon_{t-j} + \lambda D_{Bear} \tag{1}$$

The EGARCH (p, q) approach is applied to estimate the effect of a bear market on the volatility model that validates the asymmetries analysis. The EGARCH formula is presented below.

$$\log\left(\rho_t^2\right) = \partial + \sum_{j=1}^{p}\beta_j\log\left(\rho_{t-j}^2\right) + \sum_{i=1}^{q}\alpha_i\left[\left|\frac{\varepsilon_{t-i}}{\rho_{t-i}}\right| - E(|\varepsilon_t|)\right] + r\frac{\varepsilon_{t-1}}{\rho_{t-1}} + \gamma D_{Bear} \qquad (2)$$

where $\varepsilon_t = \rho_t\, z_t$ while $E\,(|\,\varepsilon_t\,|) = \sqrt{(2/\pi)}$.

P_t from Equation (1) represents the present-day prices that depend on its lag values, P_{t-1}, the shocks in lag values, and ε_{t-i}. The term c reveals the constant term, while ε_t indicates the error term in the model. The bear market period during the crises is shown by the dummy variable D_{Bear}, which holds the value of 1 if the time period falls within this period and 0 otherwise. The variance series $\log(\rho_t^2)$ in Equation (2) represents the effect of the leverage of an exponential equation. The constant α denotes the ARCH effects, r represents asymmetric properties, and β reflects effects for the GARCH model. Previous research has also applied some other technical approaches to observe the fluctuations in prices (Grabinski and Klinkova 2019, 2020).

4. Results and Discussion

4.1. Results

The descriptive statistics in Table 1 report the behavior of currencies. BTC (Bitcoin) and PAX gold means were higher than Ripple and PM gold, respectively. Additionally, the standard deviation of BTC is 18,986.500, whilst PAX gold has a standard deviation of 61.245. Bitcoin and PAX gold are more volatile than PM gold. The skewness of price data are between -0.5 and 0.5, indicating that price data distribution is relatively symmetrical. The data have low Kurtosis values, denoting that the data curve is flat. In addition, no first-order autocorrelation was found in the cryptocurrency price data.

Table 1. Descriptive statistics.

	BTC	XRP	PM Gold	PAX Gold
No. of Obs.	212	212	212	212
Mean	38,677.580	0.670	25.438	1868.896
SD	8191.568	0.185	0.906	61.245
Mean/SD	4.722	3.615	28.072	30.515
Min	18,986.500	0.308	23.650	1773.000
1st Quantile	20,111.300	0.321	23.780	1779.000
Median	40,039.050	0.748	25.505	1854.000
3rd Quantile	50,801.000	0.954	27.110	1993.000
Max	57,210.300	0.994	28.180	2054.000
Test of Normality				
Skewness	0.003	0.585	0.382	0.004
Kurtosis	0.606	0.536	0.538	0.012
Jarque-Bera	8.490	0.690	1.160	12.590
Probability	0.014	0.709	0.561	0.002
Test of Autocorrelation				
Statistics	623.745	523.876	648.952	550.438
p-value	0.000	0.000	0.000	0.000
Test of Heteroscedasticity				
Statistics	30.49	27.1	4.88	1.31
p-value	0.000	0.000	0.027	0.253

BTC and XRP are fiats, whereas PM Gold and PAX Gold are gold-back currencies.

Before employing the primary model, the stationarity of the time series data was checked. For this purpose, three-unit root tests (ADF, PP and KPSS) were employed to test stationarity. The outcomes of the ADF and PP tests reveal that the data series are stationary at I (1) by rejecting the null hypothesis of a unit root. In contrast, the KPSS tests reject

the null hypothesis of no unit root and validate the stationarity of the data series at a 1% significance level, as illustrated in Table 2. Furthermore, the outcomes of the run test are revealed in Table 3. According to the results, the alternate hypothesis of this test for a random walk is accepted at 1% for all four cryptocurrencies. This indicates that the prices of cryptocurrencies follow a random walk and are considered unpredictable during the sample period.

Table 2. Unit root test.

Variables	ADF		PP		KPSS	
	I(0)	*I(I)*	*I(0)*	*I(I)*	*I(0)*	*I(I)*
BTC	−1.160	−14.307 ***	−1.198	−14.307 ***	2.440 ***	0.091
XRP	−1.152	−14.979 ***	−1.152	−14.979 ***	3.040 ***	0.064
PM Gold	−1.759	−16.863 ***	−1.759	−16.863 ***	1.350 ***	0.036
PAX Gold	−2.006	−15.738 ***	−2.006	−15.738 ***	4.010 ***	0.033

BTC and XRP are fiats, whereas PM Gold and PAX Gold are gold-back currencies. Note: *** shows a significance level of 1%.

Table 3. Runs test.

Cryptocurrency	N	Positive Returns	Negative Returns	Expected Runs	Z-Value	*p*-Value
BTC	212	127	85	18	−12.160 ***	0.000
XRP	212	130	82	4	−14.160 ***	0.000
PM Gold	212	110	102	10	−13.350 ***	0.000
PAX Gold	212	90	122	11	−13.190 ***	0.000

Note: *** shows a significance level of 1%.

Figure 2 reveals the correlation between gold-backed and fiat-backed cryptocurrencies. Bitcoin is highly correlated with the prices of Ripple, while PM gold is negatively correlated. PAX gold has a low correlation with other cryptocurrencies. The volatile behavior of these cryptocurrencies has been revealed in their prices. To test the volatile behavior, the Arch effect was tested as an indicator of the prices of Bitcoin, Ripple, PAX gold, and PM gold. The ARCH-LM test was applied to test heteroscedasticity and an arch effect was found in the price data of cryptocurrencies. The chi-square value (13.714) is highly significant according to extant studies (Tormählen et al. 2021).
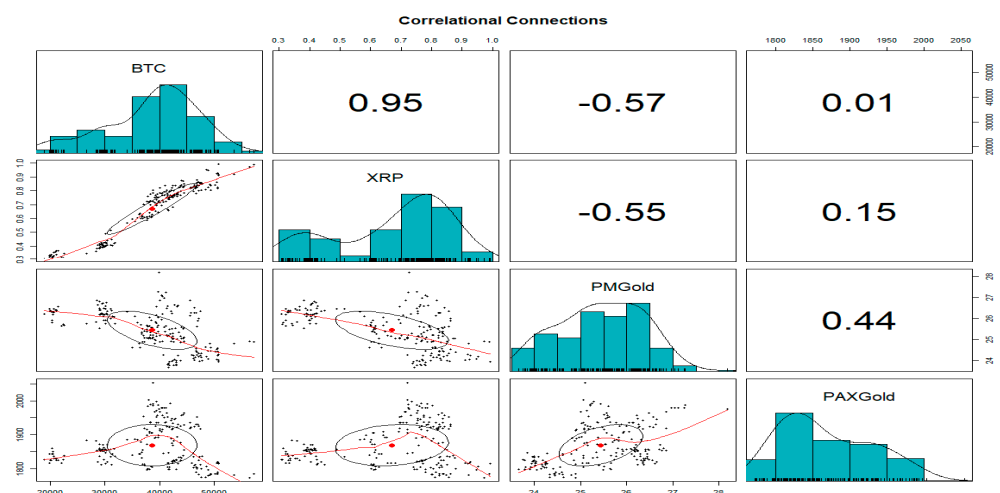

Figure 2. Binary relation scatter plot.

The volatile behavior of cryptocurrency prices is presented in Figure 3. The gold-backed cryptocurrencies PAX gold and PM gold show volatile behavior at the start of

the sample period, whereas a sharp decline in the price of Ripple at the cusp of the data was observed. However, strong fluctuation has been observed in the prices of Bitcoin. At the start of the period, the prices are lower than the average market price at the end of the time period. Next, the models, such as ARIMA (p, d, q) and EGARCH (p, q), were applied to estimate the volatile nature of gold-backed and fiat-backed cryptocurrencies. Table 4 provides an insight into heteroscedasticity (ARCH-LM test) in the price data of cryptocurrencies. The lag selection criteria for the EGARCH (p, q) model for gold-backed and fiat-backed cryptocurrencies were determined based on the Schwarz criterion (SIC) and Akaike information criterion (AIC).
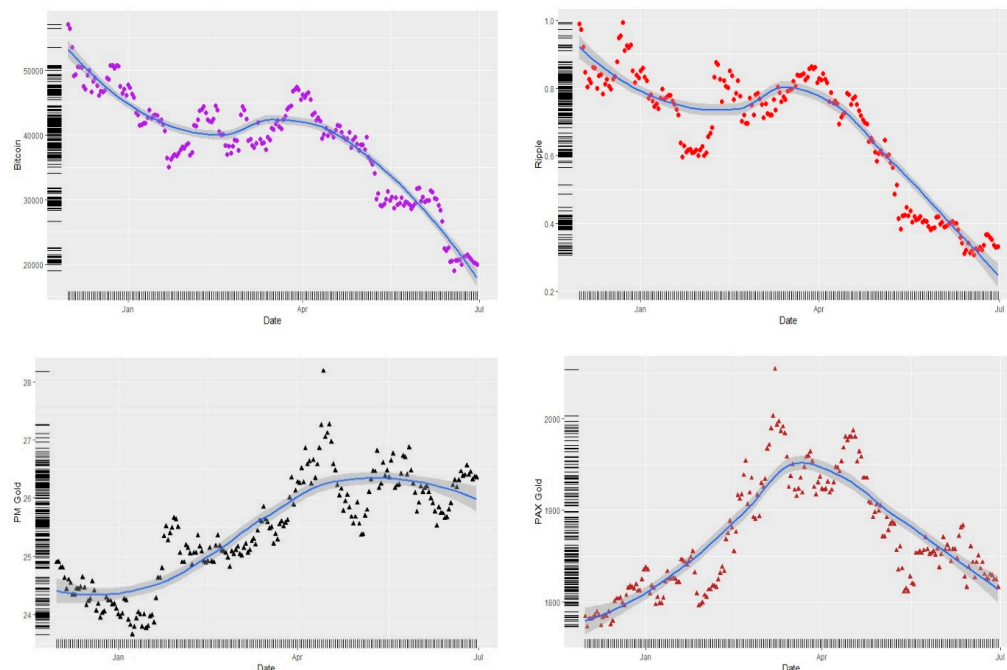

Figure 3. Scatter plots of the currencies.

Table 4. Arch Effect.

Chi-Square	Lags (p)	DF	*p*-Value
13.714 ***	1	1	0.000

H_0 = there is no arch effect. Note: *** shows a significance level of 1%.

The SIC and AIC values are shown in Table 5. Based on the chi-square values, the outcomes of the ARCH-LM technique are significant. The lags for the analysis were the following: Bitcoin, ARIMA (1, 1, 1); Ripple, ARMA (1, 0, 0); PM gold, ARIMA (1, 1, 1); and PAX gold, ARMA (1, 0,0). The EGARCH (1, 2) model was found to be more accurate when used for estimation. The results reported in Table 5 reveal the volatile behavior of the fiat-backed and gold-backed cryptocurrencies. The slope coefficient β shows the riskiness of crypto assets. Bitcoin has high volatility (33,033.75) compared to PAX gold (572.36), PM gold (10.62), and Ripple (−0.451). Moreover, the lambda values in the variance equation provide volatility insight. The implied volatility in Bitcoin, Ripple, and PAX gold is 0.75, −0.88, and −0.67, respectively. In contrast, PM gold (0.118) has a higher level of risk than the rest of the cryptocurrencies. The ARMA-EGARCH approach was considered to estimate conditional market risk due to the unexpected behavior of crypto assets.

Table 5. Outcomes of the ARIMA and EGARCH models.

Variables	BTC	XRP	PM Gold	PAX Gold
β	5.301	0.689 ***	−0.002	1868.037 ***
	(0.862)	(0.000)	(0.532)	(0.000)
AR_1	−0.142 ***	−0.328 ***	0.053	−0.270 ***
	(0.003)	(0.000)	(0.506)	(0.000)
MA_1	−0.949 ***		−0.965 ***	
	(0.000)		(0.000)	
$ARCH_1$	−0.207 ***	−0.226 ***	−0.097 **	−0.061
	(0.000)	(0.000)	(0.049)	(0.284)
p-value	0.000	0.000	0.000	0.000
Wald Chi^2	5640.260	32.080	3313.150	12.350
Arch Effect	*(1)*	*(0)*	*(1)*	*(0)*
Variance Equation				
β	33,033.750 ***	−0.451 ***	10.618 ***	572.360 ***
	(0.000)	(0.000)	(0.000)	(0.000)
μ	−0.751 ***	−0.877 ***	0.118 ***	−0.669 ***
	(0.000)	(0.000)	(0.547)	(0.000)
α	15.106 ***	−6.351 ***	−1.155 ***	7.287 ***
	(0.000)	(0.000)	(0.000)	(0.000)
p-value	0.000	0.000	0.000	0.000
Wald Chi^2	10,649.770	5032.930	317.340	393.490
N	212	212	212	212

BTC and XRP are fiats, whereas PM Gold and PAX Gold are gold-backed currencies. β is the slope coefficient, whereas μ denotes the value of lambda. Standard errors are denoted by parenthesis. Note: *** shows a significance level of 1%, while ** signifies 5% significance level.

4.2. Discussion

Investors seek safer assets in which to invest their money. For this purpose, this study aims to examine the volatility of two fiat-backed cryptocurrencies (Bitcoin and Ripple) and two newly evolved gold backed-cryptocurrencies (PAX gold and PM gold). After testing the stationarity and description of the data, ARMA/ARIMA and EGARCH were employed. In descriptive statistics, Bitcoin shows highly volatile behavior. The fiat-backed cryptocurrencies have a risk by default. Descriptive statistics reveal that the mean of Bitcoin is relatively high, followed by the mean of PAX gold. Contrarily, the mean of Ripple and PM gold is low. Moreover, Bitcoin represents a high risk compared to other cryptocurrencies. On the other hand, PAX gold is considered riskier. The price data distribution shows that the skewness of cryptocurrencies lies between −0.5 and 0.5, and the results indicate that the price data distribution is symmetrical. In contrast, data with a low kurtosis value denote that the kurtosis curve is somewhat flat.

The results reveal that the behavior of Bitcoin, the oldest cryptocurrency, performs well in regular market conditions. However, its performance hinders the overall market. Unstable behavior was observed in Bitcoin due to the uncertain market conditions; therefore, after the middle of 2021, the recovery of the pandemic started and cryptocurrencies regained investors' attention (Naeem et al. 2021).

The findings of this study are consistent with the results of existing literature, which shows that the prices of Bitcoin fell due to the outbreak of the pandemic. The results indicate uncertain behavior and a sharper decline than the S&P500 during the pandemic (Hung 2022). The other fiat-backed cryptocurrency had the lowest price mean during the period. The popularity of Ripple is low compared to Bitcoin. At the same time, the hedge, safe haven, or diversifier debate gained the judicious attention of academicians and investors (Qian et al. 2022). Cryptocurrencies behave positively in normal market conditions, while the literature indicates a sharp decline in the prices of crypto assets occurs under uncertain market conditions (Taheri et al. 2021). Therefore, as with other assets, cryptocurrencies lost value during the pandemic. It is important to remember that investors look for safe investments, especially during uncertain market conditions (Corbet et al. 2020b).

To physicalize cryptocurrencies, gold-backed cryptocurrencies were introduced. The newly evolved gold-backed cryptocurrencies are backed by gold, so investors consider them safer than conventional fiat-backed cryptocurrencies. Moreover, investors' sentiments are high during a market slump while the volatility of crypto assets increases (Chen et al. 2020). The presence of gold-backed cryptocurrencies can minimize portfolio risk (Díaz et al. 2022). The EGARCH model is applied to examine the volatility of gold-backed and fiat-backed cryptocurrencies for those seeking less volatile assets for investment. The EGARCH (1, 2) model was employed for estimation analysis. The volatility of the gold-backed and fiat-backed cryptocurrencies was explored, with the β coefficient showing the risk of crypto assets. The implied volatility in Bitcoin, Ripple, and PAX gold is low, whilst PM gold has a high risk compared to the other cryptocurrencies.

This study finds that gold-backed cryptocurrencies are not immune to bear market shocks. As far as volatility is concerned, this study finds that cryptocurrency volatility is also affected by the prevailing market conditions. In contrast, this study indicates that this effect differs according to the trustworthiness of the cryptocurrency. Among the fiat-backed cryptocurrencies, Bitcoin is heavily traded. As a result, Bitcoin's volatility is high. Existing research results align with the extant literature (Anwer et al. 2022; Mnif et al. 2020; Wasiuzzaman et al. 2022). Similarly, another piece of evidence suggests that investors became anxious during the pandemic. This again supports the results of existing research (Karim et al. 2022). There is no immunity to shocks in cryptocurrency markets (Bredin et al. 2015; Brik et al. 2022). However, the increased volatility of the gold-backed cryptocurrency PM gold is significant but low at 1%, whereas Bitcoin and PAX gold are enormously significant at 1%.

The substantial increase in the volatility of PAX gold and Bitcoin supports the results of existing research concerning volatility in cryptocurrencies. Bitcoin does not act as a safe haven or hedge and instead enhances risk in portfolios, especially during a market downturn (Urquhart and Zhang 2019). Due to being backed by gold, gold-backed cryptocurrency faces less or no risk during market recessions. Therefore, Bitcoin acts as a diversifier in a portfolio but does not act as a safe haven (Shahzad et al. 2019). Gold-backed cryptocurrency faces extreme losses during financial turbulence compared to its counterpart (Apergis 2022). Bitcoin is highly correlated with the prices of Ripple, PM gold is negatively correlated, and PAX gold has a low correlation with other cryptocurrencies (Yousaf and Yarovaya 2022).

According to existing research, cryptocurrencies seem to statistically qualify as safe-haven assets due to their properties, and their returns are negatively correlated or uncorrelated with the returns of other assets in a portfolio (Díaz et al. 2022; Klein et al. 2018; Wang et al. 2020). Considering that when the market is in shock the returns of Bitcoin and gold-backed cryptocurrencies become negative, PAX gold behaves positively even in financial turbulence (Yousaf and Yarovaya 2022). Moreover, cryptocurrencies are used to diversify the downside risk of a portfolio. Studies have found that these crypto assets also perform similarly to hedges, while gold-backed cryptocurrencies, even newly introduced ones, also joined the debate regarding hedges and diversifiers. However, a portfolio of gold-backed and fiat-backed cryptocurrencies does not offer diversification benefits to a portfolio (Wasiuzzaman and Haji Abdul Rahman 2021; Yousaf and Yarovaya 2022).

5. Conclusions and Policy Implications

After the global financial crisis, investors began to search for safe assets for investment. Gold has long been considered a safe haven, and according to the theory of finance, investors are interested in assets that offer high returns. Therefore, gold-backed cryptocurrencies did not behave well during the pandemic and could not gain much attention (Díaz et al. 2022). However, the role of gold- and Islamic-backed cryptocurrencies is being examined regularly (Aloui et al. 2021). This study aims to investigate the volatility of conventional fiat-backed and gold-backed cryptocurrencies for investors looking to invest in safe crypto assets. Two gold-backed and fiat-backed cryptocurrencies were selected

separately to meet these objectives. The price data were obtained from 1 January 2021 to 30 June 2022.

ARMA/ ARIMA and EGARCH statistical techniques were applied to address the question. The results of this study denote mixed results. According to the findings, Bitcoin is highly volatile in economic turndowns. However, the prices of Bitcoin declined throughout 2022. On the other hand, Ripple had lower mean prices and less volatility than Bitcoin. The results of this study show that PAX gold is more volatile than PM gold. At the same time, Bitcoin is significantly correlated to other cryptocurrencies.

The correlation between crypto assets shows that gold-backed cryptocurrencies are significantly connected with conventional cryptocurrencies. Therefore, it is not recommended that managers add these cryptocurrencies to portfolio investments. However, the correlation between gold-backed and conventional cryptocurrencies is insignificant. Thus, portfolio diversification advantages can be attained by adding these two types of crypto assets. Additionally, this study explores volatility in gold-backed cryptocurrency, as this crypto asset is new to investors and other stakeholders. As per the study of investors' sentiments, it is not easy to accept a new asset as a hedge. Economic uncertainty also pushes investors towards negative sentiments.

This study has implications for investors, academics, and portfolio managers. Firstly, this study provides insight into the risk–return properties of newly developed cryptocurrencies and compares these properties with those of other well-established crypto assets. Secondly, it shows that several market conditions influence some cryptocurrencies (e.g., during crisis periods). Thirdly, it focuses on the benefits of the inclusion of gold-backed cryptocurrencies as a hedge or a diversifier in a portfolio, which may be included to mitigate the influence of downturns. This study has some limitations in terms of methodology and the selection of cryptocurrencies as per the data availability and the time horizon of the sample period. This study used the ARMA/ARIMA and EGARCH models, though more sophisticated approaches could have been employed. The data on gold-backed cryptocurrencies have only been available since 2021 and no earlier data could be included. Furthermore, a data availability problem was observed, so the analysis in this study was limited to four cryptocurrencies.

Notes

[1] The cryptocurrency market has been represented by Bitcoin with a hike during the last few years due to its popularity in developed markets.

[2] Much of the research during the last two years, capturing the pandemic period, has explored how Bitcoin, Ripple, Ethereum, and other cryptocurrencies gained significant attention and became hedges or diversifiers.

[3] The risk that an investment could lose value.

[4] The debate surrounding safe havens, hedges, and diversifiers simultaneously consists of gold, oil, and cryptocurrencies in a portfolio (Bouri et al. 2017a).

[5] Bitcoin is constantly criticized from two perspectives. First is its outrageous instability; it is the case that Bitcoin is exceptionally unpredictable (not a steady coin). Somewhat whimsical value variances are not entirely due to the built-in qualities of Bitcoin;

practicality and volatile cost swings are, to a limited extent, brought about by legislature, banks, officials, and controllers running head first into reactions to Bitcoin and other coins. Second, Bitcoin has a supposed relationship with specific illegal exercises which can be firmly checked and discouraged by the establishment of appropriate regulations and laws.

6   Gold prices flared, and the pandemic has shaken the financial system; investors seek to invest in low-risk cryptocurrencies (Klein et al. 2018).

7   https://www.livemint.com/market/cryptocurrency/cryptoverse-gold-backed-cryptocurrencies-the-new-version-of-stablecoins-11650345566529.html (accessed on 8 August 2022).

8   In November 2001, the Bitcoin market declined and dropped to USD 18,000. In this scenario, investors are looking for safe asset classes for future investment (Karim et al. 2022).

9   This price fluctuation is influenced by reactions to news as the cryptocurrency market is susceptible and absorbs the impact rapidly. On the other hand, a sharp decline in the prices of cryptocurrencies was observed as bad news circulated (Urquhart and Zhang 2019).

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