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Correlation and Impact of Bitcoin with Other Cryptocurrency Portfolios

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Abstract: Bitcoin is a peer-to-peer form of digital currency proposed in 2008. Unlike other currencies, Bitcoin does not rely on a specific institution to issue it, it is based on a specific algorithm that generates it through a large number of calculations. In some countries, government agencies, central banks and academia regard Bitcoin is a virtual currency rather than a currency. This is because of Bitcoin's high volatility, which does not have the two basic functions of the unit of account and the store of value that are unique to the currency. In recent years, Bitcoin has seen increasing media coverage and other cryptocurrency portfolios, as well as the significant capital gains have been seen in the high volatility environment. In this paper, we shed light on the low correlation of Bitcoin with traditional investment assets, making Bitcoin a potentially high-quality source of portfolio diversification. The results of the finding suggest that Bitcoin investments offer significant diversification benefits and should be included in optimal portfolios. In addition to this, we find that hedging strategies involving gold, oil, stocks and Bitcoin significantly reduce portfolio risk.

Keywords: Bitcoin, portfolio diversification, portfolio optimization, volatility

1. Introduction

Bitcoin is one of the most popular new digital currencies these days. Like other currencies, Bitcoin can be used for payments, exchanges and storage. It is not bound to any individual, group or organization(e.g., government, corporation or financial institution) using a decentralized infrastructure to conduct transactions on a peer-to-peer basis. Bitcoin has three typical characteristics: (1) a limited supply of only 21 million Bitcoins forever, no increase or decrease, (2) easy to split, you can divide Bitcoins into countless parts, (3) a large globally distributed network of independently operated computers to track ownership of Bitcoins, ensuring that Bitcoins are durable.

In recent years, increasingly businesses have begun to adopt Bitcoin as an alternative payment method. Despite the fact that Bitcoin does not have the status of a legal tender, more and more regulators, media, academics and the public have started to take attention on Bitcoin. Federal Reserve Chairman Ben Bernanke has express attitudes on the issue of how to regulate Bitcoin that Federal Reserve's authority will closely monitor developments in Bitcoin even though it has limited power to directly regulate Bitcoin [1].

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Since Bitcoin's inception in 2008, its value has grown at a staggering rate. As of November 2021, the value of a single Bitcoin has exceeded $65,000 [2]. Bitcoin is accepted as a form of payment for products and services at thousands of businesses worldwide, including Microsoft and Dell, and is actively traded on more than 60 online exchanges [3]. The low transaction cost is where Bitcoin excels, but its usually high volatility as a virtual currency ca also be reflected in the transaction cost. In June 2020, the average transaction fee per Bitcoin stabilized at $1.039. Blockchain.com data shows the average Bitcoin transaction cost steadily declining from a high of $62.788 in April 2021 to an average $2 transaction fee in August by July 2021 [4].

In this paper, we describe the research on Bitcoin in recent years. Analysis of Bitcoin reports that Bitcoin's low correlation with traditional markets makes it a potentially optimal portfolio for investment portfolios. Bitcoin investments offer significant diversification benefits to portfolios, but given the high volatility that accompanies Bitcoin's unusually large returns, Bitcoin investments should be approached with caution.

2. Literature Review

With the growth of Bitcoin in recent years, some academics believe that Bitcoin should be included in an optimal portfolio. Conditional Value-at-Risk(CVaR) and Value-at-risk(VaR) are commonly used functions to measures risk. However as two measures of risk, CVaR have better properties than VaR [5].

Capital Asset Pricing Model(CAPM) is following:

$$ERi=Rf+\beta i(ERm-Rf)$$

$$ERi=expected\ return\ of\ investment$$

$$Rf=risk\text{-}free\ rate$$

$$\beta i=beta\ of\ the\ investment$$

$$(ERm-Rf)=market\ risk\ premium$$

CVaR has better mathematical properties compared to VaR, and risk management can be effectively performed through CVaR [6]. Eisl et al. claims to have taken a more cautions approach to portfolio optimization in terms of measuring risk CVaR methodology, and concludes that including Bitcoin in a portfolio increases both the expected return and the risk faced by the portfolio [1].

The recent article also mentions that Bitcoin's low correlation to traditional investment assets such as other currencies makes Bitcoin a potentially high-quality source of portfolio diversification [7]. Figure 1 plots the cumulative performance of the 13 assets and Table 1 provides descriptive statistics. Bitcoin's returns are astounding in many aspects, with an average annual return of 404%, but an annual volatility of 176%. The unusually high data not only reflect the very high average returns of Bitcoin but also show the risk of investing in Bitcoin. From Table 2, only gold and inflation-linked bonds have a significant correlation with Bitcoin, both at 14% [8]. This is easily understanding how a completely predictable supply of Bitcoin would be used as an inflation hedge and Bitcoin used for inflation hedging could also attract some investors [9]. Carpenter also claim that even if a substantial return chastisements is imposed on Bitcoin, it can substantially improve the return of risk ratio of an effective portfolio [3]. Bitcoin is an attractive investment for investors. In most cases, portfolio performance improves with the addition of Bitcoin. However, it is more due to increased returns rather than decreased volatility. According to Kajtazi and Moro, the volatility of the portfolio is reduced only with or without re-balancing the Chinese semi-constrained portfolio with re-balancing the US semi-constrained portfolio [10].

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Hedging strategies involving gold, oil, equities and bitcoin significantly reduce portfolio risk compared to a portfolio consisting of only a few underlying assets such as gold, oil and equities [11]. Guesmi et al. also claim that VARMA (1,1)-DCC-GJR-GARCH is the best model research to describe the dynamics of the association of different financial assets with Bitcoin [11]. Bitcoin may bring diversification and hedging benefits to investors because short positions in the Bitcoin market allow hedging of risky investments in different financial assets. Bitcoin and gold are both cash assets that investors can store in times of economic turmoil or political unrest. Because both Bitcoin and gold can act as a hedge against risk and diversify the price of oil [12].

The narrative of a Bitcoin is a bubble is very common. For example, the results of Chaim et.al.'s experiment display that there is a bubble in Bitcoin [13]. By the end of 2013, Bitcoin had risen nearly tenfold between October and December. At the beginning of October, Bitcoin traded at $125 then climbed to a peak of $1,160. Until December 18, the Bitcoin price plummeted again to $380. This situation confirms Frehen et.al. claim that assets associated with financial innovation are more prone to bubbles [14]. Asset pricing models suggest that financial bubbles occur in conjunction with periods of raising prices, and conversely falling prices burst the bubble [15]. It can be deducted that most of the Bitcoin bubble was created along with huge fluctuations in international events. Severe financial crises can lead to prolonged financial bubbles and spillover to other countries, as financial crises can create negative investor expectations of government-backed currencies [16].

3. Conclusion

Bitcoin is one of the most popular cryptocurrencies today, free from manipulation by any individual or group, acting as a currency and form of payment, thus eliminating the need for third parties to be involved in financial activities. Given the characteristics of bitcoin(e.g., the historical variability of its price or low correlation with traditional investment assets such as other currencies and unusually high returns and volatility) and the high level of media coverage. We elaborate on the relationship of Bitcoin to other currency portfolios and the significant mitigation of portfolio risk by Bitcoin's hedging strategy.

The article points out that CVaR, which has better mathematical properties than VaR, is used to measure optimized portfolios [6]. And Bitcoin is also included as an efficient portfolio in the optimized diversified portfolio. Bitcoin's very high returns and volatility (404% and 176% respectively) also emphasize the investment risk of bitcoin. In addition to this bitcoin's low correlation with other cryptocurrency investment assets (gold and inflation-linked debt securities show 14% only) makes bitcoin a high quality source of potential portfolio diversification. A model investigate using VARMA (1,1)-DCC-GJR-GARCH on Bitcoin and different financial assets found that Bitcoin allows hedging of risky investments in different financial assets.

In general, investors can reduce volatility by increasing their holdings of debt securities but this commonly leads to lower returns. Bitcoin's main advantage is that its low correlation to traditional markets makes it a quality source of portfolio diversification, but this cryptocurrency has significant instability. Until now, the use of Bitcoin as a medium of exchange has been more limited after excluding situations of illegal activity. Bitcoin is seen as a means of transferring assets outward (to traditional and unregulated spheres) and is also speculated to be a speculative investment opportunity [17]. As Yermack says, Bitcoin is more of a speculative investment than a real currency [18]. It is much more volatile than gold, a characteristics that may not be conducive to Bitcoin as a medium of exchange. And not all users understand the complexity and information asymmetry issues of Bitcoin. Given that the Bitcoin price bubble is influenced by speculative behavior, relevant government departments should help the public understand the nature of virtual currencies and avoid blind investments to stabilize the financial market system.

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Appendix

Table 1: Descriptive statistics.

	BTC	EUR	JPY	Stocks dvp	Stocks emg	Gvt bonds dvp	Gvt bonds emg	IL bonds wld	Corpo bonds wld	Gold	Oil	Real estate	Hedge funds
Mean	7.79%	−0.02%	0.11%	0.30%	0.09%	0.05%	0.11%	0.10%	0.12%	0.04%	0.20%	0.10%	0.03%
Annual mean	404.89%	−1.20%	5.93%	15.64%	4.91%	2.45%	5.88%	5.16%	6.38%	2.20%	10.24%	5.19%	1.75%
Median	3.32%	−0.01%	0.00%	0.43%	0.10%	0.07%	0.20%	0.05%	0.14%	0.19%	0.25%	0.22%	0.12%
Maximum	137.62%	4.17%	3.97%	8.27%	9.46%	2.25%	3.23%	2.28%	1.83%	7.14%	13.51%	5.91%	0.90%
Minimum	−41.78%	−3.19%	−3.55%	−8.81%	−11.62%	−2.85%	−5.90%	−3.51%	−2.55%	−7.11%	−14.57%	−9.04%	−2.49%
Standard deviation	24.43%	1.39%	1.31%	2.20%	2.58%	0.84%	1.04%	0.96%	0.70%	2.47%	3.56%	2.03%	0.46%
Volatility	176.15%	10.03%	9.43%	15.89%	18.61%	6.05%	7.53%	6.89%	5.06%	17.82%	25.68%	14.61%	3.33%
Skewness	1.85	0.31	0.14	−0.44	−0.28	−0.24	−1.07	−0.22	−0.29	−0.21	−0.17	−0.64	−1.35
Kurtosis	9.10	2.95	2.96	5.34	6.35	3.31	8.96	3.42	3.69	3.61	5.13	5.48	7.36
Sharpe ratio	2.30	−0.14	0.61	0.97	0.25	0.37	0.75	0.72	1.22	0.11	0.39	0.34	0.47
Observations	179	179	179	179	179	179	179	179	179	179	179	179	179

Notes: The table shows descriptive statistics(mean, annual mean, median, maximum and minimum returns, standard deviation, volatility, skewness, kurtosis and Sharpe ratio) for weekly returns in USD for traditional, Bitcoin and alternative assets for the period from July 23, 2010 to December 27, 2013. EUR and JPY, developed and emerging country equities(Stocks dvp and Stocks emg), developed and emerging country government debt(Gvt bonds dvp and Gvt bonds emg), world inflation-linked debt(IL bonds wld), world corporate debt(Corpo bonds wld), listed world real estate, gold, oil and hedge funds [8].

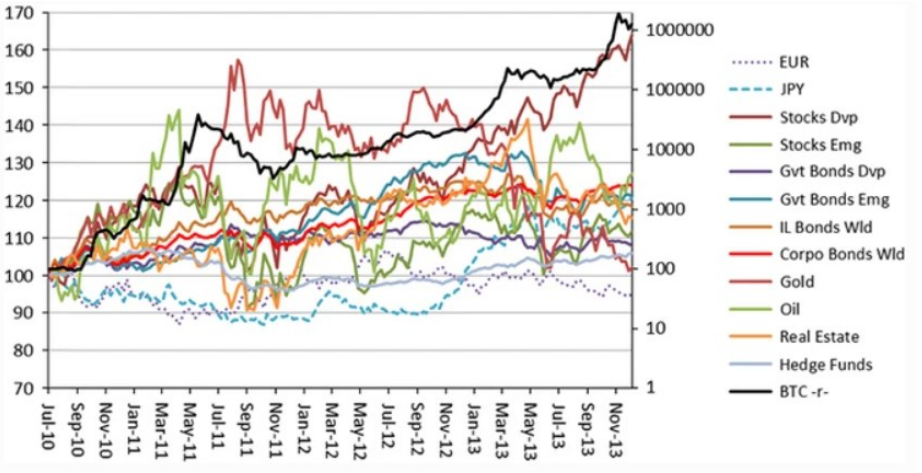

Figure 1: Performance of Bitcoin and traditional investment.

Notes: Investment performance of traditional investment vs. Bitcoin. This figure shows the dollars invested in Bitcoin(logarithmic right scale) versus traditional and alternative assets(left scale) between July 23, 2010 and December 27, 2013. EUR and JPY, developed and emerging country equities(Stocks dvp and Stocks emg), developed and emerging country government debt(Gvt bonds dvp and Gvt bonds emg), world inflation-linked debt(IL bonds wld), world corporate debt(Corpo bonds wld), listed world real estate, gold, oil and hedge funds [8].

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Table 2: Correlations(in %).

	BTCs	Euro	Yen	Stocks dvp	Stocks emg	Gvt bonds dvp	Gvt bonds emg	IL bonds wld	Corpo bonds wld	Gold	Oil	Real estate	Hedge funds
BTCs	—	—	—	—	—	—	—	—	—	—	—	—	—
Euro	−4	—	—	—	—	—	—	—	—	—	—	—	—
Yen	−6	21***	—	—	—	—	—	—	—	—	—	—	—
Stocks dvp	5	−53***	4	—	—	—	—	—	—	—	—	—	—
Stocks emg	4	−45***	6	80***	—	—	—	—	—	—	—	—	—
Gvt bonds dvp	8	−64***	−74***	16**	20***	—	—	—	—	—	—	—	—
Gvt bonds emg	3	−27***	−5	34***	53***	39***	—	—	—	—	—	—	—
IL bonds wld	14*	−60***	−44***	23***	30***	84***	48***	—	—	—	—	—	—
Corpo bonds wld	10	−70***	−38***	38***	49***	81***	61***	81***	—	—	—	—	—
Gold	14*	−38***	−36***	21***	31***	49***	31***	50***	48***	—	—	—	—
Oil	−1	−34***	−6	50***	47***	14*	20***	23***	21***	30***	—	—	—
Real estate	0	13*	15**	63***	66***	−11	46***	2	14*	0	28***		—
Hedge funds	9	−34***	15**	77***	71***	7	32***	23***	37***	17**	49***	60***	—

Notes: This table displays the correlation matrix between weekly dollar returns for 13 asset classes(Bitcoin and traditional investments) for the period from July 23, 2010 to December 27, 2013.EUR and JPY, developed and emerging country equities(Stocks dvp and Stocks emg), developed and emerging country government debt(Gvt bonds dvp and Gvt bonds emg), world inflation-linked debt(IL bonds wld), world corporate debt(Corpo bonds wld), listed world real estate, gold, oil and hedge funds. ＊, ＊＊ and ＊＊＊ indicate coefficient estimates that are significantly different from zero at the level of 10%, 5% and 1% [8].