Analysis of Cryptocurrency and Its Combination with Quantitative Transactions

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Abstract. In recent years, with the rapid development of science and technology today (especially blockchain techniques), a special currency cryptocurrency (also relatively known as digital currencies) was born in 2008 and has received a lot of attention. On account of its special nature and intrinsic, a large amount of investors often combine digital currencies and quantitative trading to make profits and earn extra returns based on the concepts. With this in mind, this study mainly describes the definition of digital currency and its development process and compares digital currency with ordinary currency to highlight its advantages and disadvantages. Subsequently, this research introduces the combined application of digital currency and quantitative transaction in general with some of the backtesting results. According to the analysis, this paper puts forward suggestions on the existing problems of digital currency and promotes its further development in the future. Overall, these results shed light on guiding further exploration of quantitative strategy designs for cryptocurrency.

1 Introduction

Digital currency is a broad and complex concept that has broad and narrow definitions. In its broad definition, it is an unregulated and virtual currency usually published and managed by miners. It is acknowledged and utilized as a form of electronic transfer, storage, or transaction by members of a certain virtual community. It could be divided into three different types. The first one is currencies that can only be used in a specific area, such as community-specific game coins; the second type can be purchased with real money to get online goods and services such as Facebook credit but cannot be exchanged for real money. The third is a virtual currency that can be exchanged with real money in proportion and goods or services can be purchased, such as Bitcoin [1]. The narrow sense of digital currency is the third one, refers to cryptocurrency. It is a virtual currency based on a node network and digital encryption algorithm, which be protected by Cryptography Theory [2]. In contrast to fiat currencies, which are issued and regulated by a central authority, cryptocurrencies use a decentralized process to track transactions and create new units. As a result, the process of cryptocurrency trading is highly special compared with traditional currency. First, through a process known as mining, which uses computing power to solve challenging mathematical problems, units of Bitcoin are created. Users then register an account on the trading platform and bond funds. Next, users can choose to buy Bitcoin from a broker, then store it in a digital wallet and spend it. After a cryptocurrency transaction is completed, the transaction record is recorded as a digital entry in an online database that describes a particular transaction. This database, a distributed public ledger known as a blockchain, is updated and maintained by the owners of the currency and is the basis of cryptocurrencies. He uses a decentralized mechanism to track transactions and create new units, rather than a central authority to issue or regulate them. For example, a creative system technology makes it possible for anyone, anywhere, to send and receive payments. When people attain cryptocurrencies, they don't own anything. It is a key that enables them to transfer cash turnover records from person to person without using a trusted third party [3]. Through the above transaction process, it can be concluded that there are many differences between digital currencies and ordinary traditional currencies.

Its history can be traced back to 2009, when Satoshi Nakamoto published a white paper that first proposed the concept of Bitcoin [4]. Although cryptocurrency was created very late, since its emergence in 2009, it has developed rapidly and become more and more prominent in the market. Assets related to it have started to appear in the portfolios and trading methods of numerous hedge funds and asset managers. In the meanwhile, the academic community made the same efforts to promote its research. This special virtual currency, based on cryptography rather than the user's credit, solves the problem of double payments by using a peer-to-peer distributed timestamp server to generate chronological and recorded electronic proof of transactions.

With the development of cryptocurrencies, It makes an excellent investment vehicle in many cases. According to CFR Senior Fellow Sebastian Mallaby, many investors believe it would go up rapidly in the future and new
chances would be born on the blockchain. The trend caused a large number of cryptocurrency trading [5]. Therefore, to maximize profits and reduce the risk of losing money, quantitative investment began to be combined with digital currencies. Quantitative trading, as an automated estimation transaction, uses advanced mathematical models to replace the subjective judgment of traders for large-scale asset management, and can use computer technology to screen out some large probability events that can bring excess returns from many historical data, and formulate relevant investment plans.

This study first introduces and defines cryptocurrency and highlights its uniqueness by comparing it with ordinary currencies, focusing on the application of quantitative trading in digital currencies, and specifically points out some widely used quantitative investment strategies, such as momentum strategy, grid trading strategy, multi-factor prediction strategy, and reversal strategy.

2 Descriptions of current status

There are many different cryptocurrencies in the world, with Bitcoin and NFTs being widely used by investors. As shown in Fig. 1, with the development of digitalization, the value of bitcoin has risen several times since its birth in 2008, and reached a record high in November 2021, approaching $69,000 for the first time, but then began to fall sharply, with a maximum decline of 12.8% [6]. By the middle of 2022, about 20 percent of U.S. adults surveyed by NBC News had bought, traded, or used cryptocurrencies.

According to Josh Howarth (seen from Fig. 2), early in 2023, it is obvious that the cryptocurrency market is in a bear market due to the sharp decline in asset prices and the exodus of investors. Many people call it "crypto winter." Similar bear markets have affected the market three times, each of which lasted more than 20 months and saw drops of more than 70%. The market cap has recently been at levels that are 65% below all-time highs reached in 2021. However, Positive tendencies are nevertheless beginning to emerge. Bitcoin was only 10% away from its 200-day moving average in mid-January [6].

In the meanwhile, there is another type of cryptocurrency named non-fungible tokens (NFTs). The pending resurgence of NFTs is another trend that crypto experts say they see on the horizon. Over the past five years, "non-fungible tokens" have seen a 1,000% increase in search attention. An NFT sold for $69 million in March 2021. When November 2022 rolled along, the market had fallen by 97%. The reasons for this include the current cryptocurrency bear market, significant inflation, the proliferation of frauds, and a lack of confidence in blockchain-related businesses. A report from Verified Market Research predicts the NFT market will reach $231 billion by 2030.
3 Comparisons of cryptocurrency and traditional currency

Since the concept of Bitcoin was proposed, digital currencies have been widely used. It uses blockchain as its underlying technical support and is characterized by decentralization, programmability, and secure verification based on cryptographic principles [7]. Next, this study will take Bitcoin as an example, comparing it with ordinary currency in terms of issuing body, storage form, circulation mode, credit guarantee, transaction cost, and transaction security [8].

First of all, the characteristics of decentralization mean that it has no issuing authority, and it does not have the characteristics of inflation. The value of bitcoin will increase due to its fixed quantity, the price of goods priced with it in the market will be lower and lower, which means that there can only be deflation but not inflation. It is one of the largest differences between Bitcoin and traditional currencies, which are both inflationary and deflationary.

Second, Bitcoin's commodity nature causes its price to change dramatically. In this regard, the precious metals that have withdrawn from circulation and entered the investment field are similar to Bitcoin, and investors are very interested in them. Here, one introduces the reflexive theory. The growth in price that comes with investing in Bitcoin brings with it the expectation of appreciation. By evaluating the trend, rational people increase its purchase, causing the price rises. When it grows to a certain level, most people have the desire to cash out after meeting the peak of their income expectations. When someone maliciously shorted, investors in the market would sell Bitcoin one after another, resulting in a significant decline in its price, so the price of Bitcoin is not stable.

At the same time, Bitcoin is not issued by the government and is not guaranteed by the good credit of the government, resulting in a lack of regulation. The privacy of Bitcoin transactions leads to the absence of intermediaries, which makes it possible to avoid taxes but also makes it difficult to regulate. In such a private transaction environment, Bitcoin is often used by criminals as a tool for money laundering [9].

Lastly, according to Igor Makarov in 2020, the price of Bitcoin varies between exchanges in different countries. In countries outside the United States and Europe, Bitcoin usually trades at a higher price than in the United States, and almost never below it. Because the world is a whole, the price fluctuation is pass-through, and the price deviation among countries has significant linkage, which means that Arbitrage spreads open and close simultaneously in countries [10].

4 Quantitative strategy

Momentum investing takes advantage of the frequent and violent fluctuations in the value of cryptocurrencies by predicting the trend of ups and downs, buying when the value is low, selling when the value is peak, and pocking the difference [11]. Due to the special characteristics of cryptocurrencies, it provides fertile ground for momentum trading strategies. To see the obvious effect in cryptocurrency markets caused by the momentum trading strategy, Oliver provides a thorough analysis of the momentum effect for the bitcoin market by taking into account various investing techniques represented by various data frequencies. In contrast to earlier research, he additionally presents a dynamic modeling approach for time-series momentum, allowing researchers to cover momentum durations ranging from a few minutes to several months for twenty different cryptocurrencies. The data should show how robust this financial market oddity is since different frequencies represent various market players with various investment strategies, which means that invest market would become more stable after the popular use of the momentum trading strategy [12]. From the above data analysis, he concludes that cryptocurrencies have more and longer momentum cycles than the stock market.

Guglielmo 2020 researches the cryptocurrency market's momentum effect after one day of anomalous returns using the data of Bitcoin, Ethereum, and Litecoin exchange rates from 2015 to 2019. Statistical testing, cumulative abnormal returns, and trading simulation approaches are some of the methodologies employed for the analysis. As a result, the findings imply that there is a considerable momentum impact present on days with abnormal price fluctuations and the next day [13]. Designing successful trading strategies based on the identified anomalies is feasible by establishing temporal parameters for these effects. The results have ramifications for traders who want to create effective trading strategies based on the potential presence of momentum effects, the timing of unusual returns, and the length of the anomaly. However, after identifying the existence of momentum benefits, Panagiotis conducted an experiment in 2020 and found that momentum trading strategies worked much better in the short term than in the long term [14].

Arbitrage is the process of trading multiple financial securities simultaneously in order to profit from price differences, including spatial arbitrage and merger arbitrage [15]. The first is to purchase and sell the same securities in different markets and the second one is to buy shares of the acquired company and sell shares of the acquired company. Cryptocurrencies are characterized by frequent and violent fluctuations in volume and price, which makes cryptocurrency become an excellent place for studying arbitrage and price formation. Several exchanges independently controlled by individuals have been established in various countries and regions. For example, arbitrage profits could be achieved by buying bitcoin in areas where the price is low (e.g., the United States) and selling it in areas where the price is high (e.g., South Korea). It is precisely because cryptocurrencies are so prone to price deviations that arbitrage strategies are profitable in the market. In the process of making a profit, carry traders increase the efficiency of financial markets.
When they buy and sell, the price difference between the same or similar assets Narrows. Lower-priced assets are bid up, while higher-priced assets are sold off. In this way, arbitrage addresses inefficiencies in market pricing and increases market liquidity. Thomas also researched Statistical Arbitrage in Cryptocurrency Markets in 2019 and successfully transferred an advanced statistical arbitrage method based on machine learning from the US stock market to a large universe based on minute classification data made up of 40 cryptocurrency coins [16]. Overall, the findings point to significant arbitrage opportunities in the cryptocurrency market. In addition, the conclusions also show that the quantity and intensity of arbitrage opportunities appear to have declined over time.

5 Limitations and prospects

Based on the characteristics of high profit, high risk and high liquidity of cryptocurrency, in-depth research on its advantages and disadvantages and its impact will lay a good foundation for large-scale promotion and application in the future.

First of all, the transaction cost of using cryptocurrencies is very low, the transfer of funds between two parties becomes easy, and the large fees charged by banks for online transactions on the Internet can be greatly reduced. There is a commission to use this system, but it only amounts to 0.1% of the transaction amount, which goes into the wallets of Bitcoin miners. Second, the maximum number of bitcoins is 21 million, and there is no way for any government or business to change the system, so the cryptocurrency will not be inflationary. In addition, the cryptocurrency system is decentralized. For example, the network of exchanges and mining computers around the world has no central control authority, which means that they are all an equal part of the system and central authority has no power to dictate rules for owners of bitcoins. This model enhances the system's ability to withstand stress, and even if some parts of the network have problems, the payment system in other areas can work normally. Easy to create and use is an advantage for cryptocurrency. In Ukraine, for example, the process of going to a bank to open an account for a company is complicated and sometimes be rejected for no reason. In this case, using Bitcoin can be very convenient. It only takes five minutes for a company to open a Bitcoin wallet, and they can use it right away and pay no commission. The most important benefit for cryptocurrency is security. There is no chance to use personal information for fraud. There are some essential flows of money in ordinary life such as using credit cards to make purchases. They pay by card, write card number, code and expiration date. This intimate information would circulate on the internet and easy to be stolen by bad people, to commit crimes. In contrast, Bitcoin transactions do not result in the disclosure of any personal information. Instead, there are two keys to protect, including the public keys and the private keys. The public key such as the BTC wallet's address is accessible to everyone, but the private key is solely known to the owner and needs a mathematical model to unlock it [17].

The biggest risk to the Bitcoin payment system is hacking. For instance, in the brief existence of Bitcoin, the company has seen over 40 thefts, some of which were worth more than $1 million USD. In the meantime, it also leads to the risk of money laundering, terrorist and other illegal activity financing. Another disadvantage is its strong volatility. Many countries do not recognize Bitcoin's legal status, which increases its volatility. Due to the small affordable environment, under the operation of capital and national policies, the currency is prone to boom or bust. With the gradual promotion and popularization of cryptocurrencies, his wide variety is easy to make investors speculative psychology, which is not conducive to the stable development of the currency [18].

In summary, in view of these shortcomings of the current cryptocurrency, the following suggestions are mainly put forward to promote its future development. Cryptocurrencies are currently not allowed under Chinese policy, suggesting that existing laws are insufficient to regulate the issues that arise in cryptocurrency. The judiciary should pay more attention to cryptocurrencies, clarify the problems he has in circulation and distribution, and create new laws to fill the gaps, rather than outright banning him in China. Cryptocurrency, as a special currency that relies on technology and mathematics, governments can increase their investment and research in blockchain technology. Secondly, a mature payment environment is indispensable for the development of digital currencies and can largely solve the problem of transaction security. Cryptocurrencies can only be used legally in more countries by patching up the loopholes. To train professionals in disciplines such as computing and finance to research a national legal digital currency and keep up with the world trend of digitization.

6 Conclusion

To sum up, the birth of cryptocurrency is inseparable from the development of the Internet and technology. As a new type of currency that emerged in 2009, he greatly impacted the world economy. So far, in the case of Bitcoin, for example, he has already experienced a positive upward trend in the value of the currency after a sharp rise and fall until January 2023. Compared to traditional currencies, cryptocurrencies have many differences, including the fact that they are not inflationary, are prone to huge changes in value and have different values on exchanges in different regions, and are often used as instruments of crime. Due to the aforementioned characteristics, many investors have entered the cryptocurrency market in the hope of making large profits from it through speculation. With the participation of more and more professionals, he gradually combined with quantitative trading strategies, through arbitrage strategies and momentum strategies. Investors use advanced mathematical models for asset management and profit from the circulation of funds through large
transactions. Cryptocurrencies have the advantages of low
transaction costs and speed, but they also bring shocks to
the financial and legal systems because of their lack of
regulation. He puts pressure on national currencies while
improving market efficiency. Therefore, the relevant
authorities should pay great attention to this, formulate
new laws to fill the existing loopholes in this field, and
increase the investment of innovation funds and talent
recruitment to promote its future development.

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