Chapter

The Economic Effect of Bitcoin Halving Events on the U.S. Capital Market

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Abstract

Bitcoin is a digital asset that was first mined in January 2009 after the global financial crisis of 2007–2008. Over a decade later, there is still no consensus across different market regulations on the classification, use cases, policies, and economic implications of bitcoin. However, there is an increasing demand for digital currency, as an alternative to fiat currency which would spur financial innovation and inclusion. This study reviews regulations on digital assets across countries. It further discusses some use cases for bitcoin to reduce financial risk and facilitate cross border transactions. The study also discusses challenges related to bitcoin such as: cryptocurrencies substitution, cross border financing, cyber risk and security, and benefits in terms of the effect of coronavirus on the speed of capital market innovation and hence bitcoin usage. The study concludes by examining the economic effect of bitcoin halving events on the U.S. capital market to better understand the influence of bitcoin on financial markets and key drivers of its intrinsic value. The empirical evidence from this study suggests that bitcoin halving events are associated with significant negative stock market reaction, signaling a trading tradeoff between cryptocurrencies and U.S. stock markets.

Keywords: Bitcoin, cryptocurrencies, halving event, crypto regulations

1. Introduction

Bitcoin emerged as an alternative source of fiat currency that is intended to be fast (i.e., electronic) and peer-to-peer that does not require the need of a third party (i.e., intermediaries like banks or governments). In his 2008 paper that marked the birth of bitcoin, Satoshi Nakamoto describes bitcoin as *"a system for electronic transactions without relying on trust"* [1]. Bitcoin is a *permissionless* system that is open to any user. To exchange bitcoin, blockchain technology, a distributed ledger technology (DLT), was developed as a medium of exchanging bitcoin. Blockchain technology, for example, is expected to transform many industrial sectors, reduce the processing costs, increase efficiency, eliminate intermediary costs, and decrease market frictions. Related, bitcoin, the leading cryptocurrency, has become widely traded as a borderless form of payment and is generally perceived as a store of value, such as gold. Unlike the fiat currency, bitcoin has been criticized for not being backed by trusted institutions, having high volatility, and a lack of correlations with other fiat currencies or stock indexes [2]. The present controversy over bitcoin challenges the notion that it is a "store of value".

Bitcoin can be visualized as a reward from solving a puzzle. Participants on the blockchain are usually connected to nodes/computers. To earn bitcoin, participants must solve a cryptographic problem using the "proof-of work" concept to reach consensus among nodes/computers and create a block. Once a block is created, bitcoin is generated as a reward. Every four years, the reward from mining bitcoin is reduced by half, a phenomenon called bitcoin halving. When bitcoin was first mined, the first chunk of mining reward was 50 bitcoin per block. Three halving events have happened since the inception of bitcoin, which were in 2012, 2016 and 2020. In 2012, the halving resulted in rewards from 50 to 25 bitcoin, and from 25 to 12.5 bitcoins after the 2016 halving event. The late halving event occurred on May 11, 2020, where the reward from bitcoin went down from 12.5 to 6.25 bitcoins per block. More interestingly, the trading price of bitcoin, which started around $0.0008 in July 2010, has reached over $40,000 in January 2021, raising the concerns and interests of various market constituencies including current and prospective traders, regulators, and policy makers (**Figure 1**).

In order to prevent inflation, there are only 21 million bitcoin that can be mined. As of February 2021, the total number of mined bitcoins is 18.5 million. To get to 18.5 million, it took roughly 10 years for miners. With 2.5 million remaining bitcoins to mine, it is uncertain whether the supply of bitcoin will stop at this point. Bitcoin is the first cryptocurrency, but it is not the last. Hundreds of cryptocurrencies are currently circulating in the market. In 2020, the market capitalization of cryptocurrencies went from $200 billion to $1 trillion. Bitcoin holders during COVID-19 witnessed the highest peak in prices since its inception. The rise in bitcoin prices during COVID-19 is claimed to be attributed to the slew of institutional investors who started to view bitcoin as the future of money. For example, MicroStrategy bought 70,000 bitcoins [3]. This unimaginable increase spurred speculation on whether this price surge is a bubble or simply a reaffirmation that it became more popular as a store of value. On December 17, 2017, bitcoin reached nearly $20,000 and a few days later, on December 22, 2017, the price dropped 45% to below $11,000.

The speculative nature of bitcoin has made it a lucrative investment opportunity for risk-takers as well as a threat to the stability of financial markets and innovation due to the high volatility of the ever-changing price. The controversy over the lack of intrinsic value of bitcoin, along with its ability to surpass gold, infused an uncertainty among market participants on whether it is a speculative short-term trading medium or an innovative new currency that is here for the long term. Therefore, regulators had to intervene to provide guidelines on the use, classification, and the trading of bitcoin. This chapter discusses bitcoin as an innovative venture tool of investment. More specifically, this chapter reviews global market

Figure 1.
Bitcoin historical prices (2010–2021).

regulations of bitcoin, classification, use cases, policies, and economic implications of trading bitcoin in the U.S. market. This chapter helps in understanding the nature of bitcoin, and its potential benefits as well as threats, not only to the U.S. market but also the global economy.

2. Market regulations for Bitcoin

2.1 Security versus currency

Is bitcoin a currency or investment instrument? The speculative nature of bitcoin, high volatility, low correlation with fiat currencies or gold, and vulnerability to cyber risk made regulators tend to classify it as an investment instrument rather than a currency. To be classified as a currency, bitcoin needs to have three functions: value storage, medium of exchange and account unit [2]. The International Securities Services Association (ISSA) classifies digital assets into four categories [4]: payment (i.e., cryptocurrencies), utility (i.e., provides digital access to an application), asset (i.e., security), and asset-backed (i.e., rights of ownership). Concerns about digital asset's nature, transparency, trading, and valuation have been the prime interests of policy makers and regulators. For example, trading on these assets requires an identification of whether these assets are considered as a "security" under federal jurisdiction. A security can be broadly defined as an investment contract or other instruments such as stocks and bonds. The U.S. Treasury has classified bitcoin as money services but not currency. That is, to subject bitcoin to market rules and regulations such as the Bank Secrecy Act and Anti Money Laundering Laws. For tax purposes, bitcoin is considered as a digital asset and thereby profits on trading bitcoins are taxable.

On April 3, 2019, the SEC released "Framework for 'Investment Contract' Analysis of Digital Assets" to determine whether a digital asset is a security under the Investment Company Act of 1940 and the Investment Advisers Act of 1940. The framework also made it possible to identify whether the security may no longer be a security. In the U.S., an investment contract exists if it meets the *Howey test*. According to the Howey test, an investment contract exist of there is an investment in an enterprise with attainable expectations of realized profits from the efforts of others [5]. This test extends to the facts and circumstances surrounding sale of digital assets (i.e., sale in the secondary market), if any. Sellers and offers of digital assets that qualify as security (i.e., investment contracts) must abide by the SEC's rules and regulations by either registering their securities or qualifying for an exemption, thereof. During the registration process, sellers would need to provide information about how managers plan to generate profit and exert efforts towards the successful continuation of the enterprise. This type of information provides *"full and fair disclosure"* to investors who seek investment contract and helps in reducing the asymmetric information among managers and prospective investors.

Elements of the *Howey test* include the following:

1. Investment of money through the sale of digital assets in exchange of value. This condition usually exists because there is always a sale of such assets as the first step of recognizing its existence.

2. Common enterprise must exist.

3. Reasonable expectation of profits derived from efforts of others. The efforts of others could be promoters, sponsors, or active participant. Under the Howey

test, price appreciation should not result solely from external market forces. Rather, reasonable expectation of profits comes from the capital appreciation that results from investment in the enterprise. Therefore, to meet the Howey test, the digital asset should give the investor the right to share profits (i.e., dividends) in the enterprise. The federal court examines other characteristics of digital assets such as the economic reality of transaction to identify whether there is reasonable expectation of profit derived from the efforts of others. Among these considerations are: (1) whether digital assets are fully developed, (2) whether holders of such assets can use it immediately, (3) whether the structure of digital assets meets the expectation of holders of such assets, and (4) whether it can be used as to make payments, in case of virtual currency.

A digital asset that meets the criteria of "security" is still a topic of interest by regulators because of the complex issues associated with after selling this security, such as valuation, classification in the balance sheet, and operational risk. For example, the below issues were raised by the SEC in a comment letter [6]:

1. Valuation: cryptocurrencies, for example, are highly volatile and new to the futures market. It is unclear how would managers assess the fair values of such assets.

2. Classification: how would digital assets be classified in financial statements (i.e., short vs. long term)?

3. Operational risk: how would manipulation in the digital asset prices in the financial market affect its trading?

The US federal securities laws and regulations also apply to Decentralized Autonomous Organization (DAO) that uses decentralized or distributed ledger such as blockchain technology. In July 2017, the SEC considered Slock.it UG digital asset as a "security", however, decided against pursuing enforcement action towards it. [7] Slock.it is a DAO, a virtual organization that is executed on a distributed ledger or blockchain. The virtual organization sold 1.15 billion DAO in exchange for 12 million ether (ETH) that was later valued at $150 million at the time of the sale. The SEC concluded that the co-founders of Slock.it promoted their DAO using various platforms, the company was audited by leading security audit companies, and solicited media interest. The DAO tokens that were issued in exchange for Ethereum (ETH), which gave holders certain voting and ownership rights and prospect of earning a return on investment. Therefore, the SEC deemed the DAO token as a security for the following reasons: (1) the SEC securities laws apply to virtual organization making use of distributed ledger technology, (2) investors in the DAO invested money, (3) there was a reasonable expectation of profits, (4) the assumed profits are derived from the managerial efforts of others because the efforts of the co-founders and the DAO's curators were essential to the enterprise.

Cryptocurrencies classification varies across countries. For example, in November 2019, digital assets were recognized as a property/commodity according to the UK Jurisdiction Taskforce [8]. More specifically, digital assets exhibit four characteristics: (1) definable, (2) identifiable by third parties, (3) capable in their nature of assumption by third parties, and (4) having some degree of permanence. The Financial Conduct Authority (FCA), the financial market regulatory authority in the UK, mandated that businesses dealing with digital assets to register with the authority by June 30, 2020, failing to register by the deadline would carry a penalty of case trading [9]. According to the FCA, digital assets can be classified as

regulated and unregulated tokens. Regulated tokens are security tokens and e-money tokens, and unregulated tokens are utility and exchange tokens. Rules of classifying tokens include prospectus and transparency requirements, manager's certification regime, and principles of business.

2.2 Bitcoin use cases

Because of Bitcoin's features (i.e., irrevocability, anonymity, and low transaction costs) along with the rise of decentralized finance (DeFi), bitcoin has become widely used as a fast payment tool in buying/selling, smart contracts, voting, collateral, donations, and a trading investment. For example, bitcoin can be used as a substitute to cash and as a peer-to-peer electronic cash system as initially envisioned by Satoshi Nakamoto. Bitcoin can be used in smart contracts, which are stored codes that can be automatically excused using bitcoin as the electronic cash. It can also be used as collateral on DeFi networks. Bitcoin is one of the best tools or solutions to cross-border transfer of money without the need of intermediaries and hence considerably reduces the transactions fees. It is widely known as a tool to facilitate internet of value.

2.3 Bitcoin policies and regulations

The global capital market regulators realized the need for fostering innovation in the capital market by embracing nascent technologies (i.e., blockchain) and flexible forms of ownership/payment (i.e., digital assets, cryptocurrencies). On the one hand, in line with expectations that global jurisdictions are embracing innovative technologies, regulators around the world (i.e., USA, Singapore, Thailand, Switzerland, and Hong Kong) are issuing guidelines and framework to facilitate exchange of digital assets [4].

On the other hand, the speculative nature of bitcoin and high volatility mandate regulatory government intervention and the subsequent issuance of guidance and rules on the classification and use of bitcoin. The intervention of government regulators is, however, sometimes perceived as a setback to the innovative nature of bitcoin and emergence as peer-to-peer tool that discards intermediaries. Hence, there are unintended consequences with government regulations. Market intervention in cryptocurrency trading, in general, may include communications from regulators and/or issuances of regulatory rules. For example, in September 2017, the Chinese government halted trading on cryptocurrencies and banned initial coin offerings (ICOs). In April 2017, Japan issued the Payment Services Act and the Financial Instruments and Exchange Act that was later revised in 2020 to tighten restrictions on cryptocurrency custodians, but meanwhile allowed the use of crypto as digital assets. Indeed, Japan was the lead country in Asia to allow cryptocurrency to be a safe haven asset. In August 2020, the UK approved its first digital stock exchange, Archax. David Lester, former chief strategy officer of the London Stock Exchange Group mentioned that: *"Blockchain and tokenization are innovations that can empower more frictionless and transparent markets which, combined with an FCA regulated exchange like Archax, can deliver what capital providers, business leaders and founders now really need"* [10].

In 2015, the U.S. classified bitcoin as a commodity. Realizing the need to adapt to flexibility in financial market innovations, the Securities and Exchange Commission (SEC) has been diligently working towards protecting investor's rights as well as fostering innovation in the financial market by allowing it to develop exponentially and at the same time expanding the SEC federal rules and regulations to include digital assets. Additionally, in the US market, the regulatory oversight over digital

assets have become more developed and geared towards simplifying the rules and regulations. For example, the SEC modernized the digital asset securities settlement and condensed its steps from four to three to reduce the operational risk for broker-dealer who operate alternative trading system (ATS) [11]. The four steps are: (1) the buyer and seller send orders to ATS, (2) the ATS matches the orders, (3) the ATS notifies the buyer and seller with the matching process, and (4) the transaction is bilaterally settled. The streamlined process involves only three steps: (1) the buyer and seller send orders to ATS and instruct their custodian to settle the transactions when the match is announced on the ATS, (2) the ATS matches the order, and (3) the ATS notified the buyer and seller with the matched and the custodians of the parties execute the instructions. However, digital assets regulations in the US market are not uniform across the states [12]. Some states (i.e., Wyoming, Colorado, Oklahoma) are "crypto-friendly" while others are not (i.e., Iowa). Crypto-friendly states promote bitcoin as a faster and more efficient payment system by reducing regulatory barriers and leveraging investment in the technology and allowing for a wider adoption among the community participants. For example, legislatures in Wyoming supported the initiation of a special purpose depository institutions to handle digital assets. Likewise, lawmakers in Colorado exempted cryptocurrencies from state securities regulations. While the SEC declared Bitcoin and Ethereum not to be securities, it used a double standard with XRP, the Ripple token, when it sued Ripple and two of its executive, claiming that Ripple sold unlicensed securities. Although Ripple has been in circulation since 2012, the SEC only initiated the lawsuit in late 2020, a few days before President Trump administration left SEC leadership, starting speculations about the interference of politics with cryptocurrency regulations. Ripple claims that the SEC suit caused XRP's price to plummet, accumulating in over $15 billion in losses. Notably, President Trump twitted in different occasions about cryptocurrency and bitcoin *"not a fan of highly volatile cryptocurrencies based on thin air that facilitate unlawful behavior,"* causing more volatility in the cryptocurrency market. The disagreement among regulators within the U.S. and outside it makes it more difficult to embrace blockchain technology and the power that digital assets (i.e., cryptocurrency) can bring to the market.

The study made by Park et al. [13] examine the exogenous shocks of local regulations on bitcoin prices and trading activities across six countries. Anecdotal evidence suggests that market regulations have a short-term impact on bitcoin price and a long-term suppressive trading effect. More interestingly, bitcoin prices vary across jurisdictions and although regulations have a short-term influence on bitcoin prices, the market for bitcoin is sought to be globally integrated and local frictions are weak to persist in the face of bitcoin's strong international network.

The size of the global cryptocurrency market is too big to regulate by one government. In fact, anecdotal evidence suggests that regulations on bitcoin create market frictions and long-term decline in trading activities. Bitcoin was invented to cross borders and barriers, facilitate fast payment, reduce market frictions and transactions costs. Global efforts are required to achieve the tangible benefits of bitcoin and lessen the unavoidable negative consequences that usually comes with innovative technologies in times of need such as the unprecedented COVID-19.

3. Challenges facing Bitcoin

3.1 Bitcoin substitution

When bitcoin was invented by Satoshi Nakamoto, he developed blockchain as the tool or medium to exchange bitcoin. You may think of bitcoin as the vehicle and

blockchain as the road. Hence, one can imagine the power and innovation that comes with the invention of the first vehicle on the road. Yet, the present status of the cryptocurrency industry is that there are thousands of vehicles "cryptocurrencies" invented after bitcoin, each with its own features that may be incremental or decremental to bitcoin in functions. Bitcoin represents roughly 69% of the total market capitalization of cryptocurrencies that reached a peak of over $1 trillion on January, 6 of 2021. For example, Ethereum (ETH) is an altcoin that is used in a smart contract on the Ethereum network. Another substitute to bitcoin is XPR, which is a Ripple token that is using network of nodes of participating banks and financial institutions. Litecoin is another cryptocurrency that is four times faster than bitcoin and offer four times the amount of bitcoin supply (i.e., the total supply of bitcoin is 21 million while Litecoin's supply is 84 million). While bitcoin will remain the first innovative cryptocurrency, it is difficult to speculate that it is the best one on the road.

3.2 Bitcoin cross border financing

As a peer-to-peer transaction, bitcoin defies the central government sole right to issue currencies and calls for a decentralized flow of currency. The market for bitcoin is concentrated in six major markets (the USA, Japan, China, Europe, UK, and South Korea) that roughly represent 99% of bitcoin trading activities with China taking over 88% of total bitcoin trading as of 2018 [13]. Therefore, it is likely that if there are cross border usage of bitcoin, it will happen mostly among these six countries. The lack of a centralized authority to regulate bitcoin along with its high tendency to be anonymous even though create an opportunity for faster and cheaper cross border transfer of currency, it opens another gate to illegal transfer of money. More specifically, one major risk associated with bitcoin is capital flight. The problem intensifies when bitcoin transaction is anonymized to cover cross-border money laundering. A study [14] examines bitcoin's capital flight from China to USA as the largest two originators of bitcoin transactions. It also examines whether market regulations can be effective in curbing the illegal transfer of bitcoin across countries. They use bitcoin-implied exchange rate discount as a proxy for bitcoin capital flight from China to the USA prior to China's announcement of regulations that banned financial institutions and payment companies from using bitcoin transactions. Further, they document that China's regulatory regime successfully halted this transaction. Therefore, the intervention of financial institutions in regulating bitcoin is becoming more crucial to reduce the likelihood of using it in illicit activities and improve transparency in trading.

3.3 Bitcoin cyber risk and security

Expectedly, bitcoin price variability across exchanges may involve illegal behavior and anomalies related to ask and bid prices [15]. The European Central Bank (ECB) Regulations on bitcoin are meant to curb illegal trading, reduce cyber-attacks, and protect investors. However, it is unclear whether individual bitcoin regulations across different jurisdictions can make a global impact on bitcoin trading activities. Additionally, bitcoin's virtual nature made it subject to lost and disappearance. For example, 20% of the 18.5 million circulated bitcoins are believed to be lost because owners of these bitcoins have lost their password to nearly $140 billion in bitcoins. In 2014, Mt. Gox trading platform in Tokyo went bankrupt [16] leaving 850,000 bitcoins owners clueless trying to find their passwords. James Howells from the UK mistakenly dumped his computer hard drive that includes 7,500 bitcoins that he mined in 2009. The fact that the identity of bitcoin developer

is anonymous also raises speculation on whether bitcoin was originally developed for the dark web. Bitcoin can be used for money laundry and can help perpetrators cover up their identities. Ransomware attacks in the digital age includes demands for bitcoin, which made bitcoin a tool used for cyber-attacks. It is estimated that bitcoin drives ransomware of $1.4 billion in the U.S. Cyber risk and security are one of the key barriers to bitcoin evolution as a mainstream digital currency.

3.4 Bitcoin other challenges

Another study [17] raised other concerns not addressed by the SEC in their framework such as whether digital assets traded by "Airdrop" are considered a security and the status of digital assets traded overseas. Lack of regulatory clarity of such important issues hampers the development of digital assets and blockchain technology. Challenges to securities service providers and their clients have been raised by [4] as obstacles towards getting the most out of tokenization. Some of these challenges include lack of common standards and interoperability after the introduction of new concepts by market participants. Issues regarding market stability from digital assets are also of great concerns to investors, regulators, activists, and various stakeholders. Barriers of entry (i.e., fiduciary obligation) of institutional investors into the digital asset world has slowed down the development of digital assets and underlying blockchain technology, at least this was the case before the onset of COVID-19. Among other impediment to the development of digital asset worldwide are various regulations across regulations, fraud, lack of scaling by blockchain technology and balancing scalability and security. Park, Sang, Lee, and Jang (2019) raised two critical issues related to digital assets: privacy and access by third party after death. Related, another study [18] questioned whether people should be able to inherit digital assets and whether to consider social media accounts (i.e., Email accounts, Facebook, Twitter, LinkedIn) as digital assets because they contain monetary value and are real.

4. The economic effect of Bitcoin halving events on capital markets

An interesting question on whether bitcoin came up with net economic benefits to the U.S. financial system is still unanswered. Anecdotal evidence suggests that bitcoin prices are influenced by the quality of financial system (governance and regulations) it exists at. Nevertheless, the major characteristics of bitcoin are its volatility and price unpredictability, two major factors that are more than enough to hinder its international recognition as an innovative payment system that has the potential of replacing fiat currencies. These features are, however, puzzling. Why would bitcoin prices decline by 50% on March 12, 2020 and go up by 36% on November 19, 2013, while the global stock indexes do not synchronize in movement in the same manner? Additionally, anecdotal evidence suggests that bitcoin prices vary across different markets due to differences in market infrastructure, financial frictions, regulatory oversight, and institutional investors [12, 19].

Although the market for bitcoin is dispersed worldwide, it is globally integrated by a diverse group of bitcoin holders. When the total market capitalization reached out a peak of $1 trillion on January 6, 2021, market participants started to contemplate on whether this unimaginable magnitude of the cryptocurrency market that is mainly sparked by bitcoin is frothy. In this section, I empirically test the economic consequences of bitcoin halving events on the U.S. capital market. More specifically, I examine the market reaction to bitcoin's first and second halving events that occurred over the past decade. There are three halving events occurred since 2009. The first

Pearson correlation coefficients											
	1st_E	**2nd_E**	**Δ BTC**	**Δ BCH**	**Δ ADA**	**Δ LINK**	**Δ ETH**	**Δ LTC**	**Δ XLM**	**Δ USDT**	**Δ XRP**
CAR	0.001[a]	0.002[a]	−0.002[a]	0.001[a]	0.004[a]	0.00[a]	0.003[a]	0.00	0.002[a]	−0.002[a]	−0.002[a]
1st_E		−0.00[c]	−0.00	−0.00	0.00	−0.00	−0.00	−0.00	−0.00	−0.00[a]	0.00
2nd_E			0.002[a]	−0.00	0.00	−0.00	−0.00	−0.00	−0.00	0.00[a]	0.001[a]
Δ BTC				0.254[a]	0.264[a]	0.200[a]	0.545[a]	0.45 1[a]	0.309[a]	0.068[a]	0.620[a]
Δ BCH					0.206[a]	0.058[a]	0.450[a]	0.241[a]	0.253[a]	0.113[a]	0.022[a]
Δ ADA						0.050[a]	0.467[a]	0.211[a]	0.772[a]	0.025[a]	0.042[a]
Δ LINK							0.097[a]	0.124[a]	0.066[a]	0.018[a]	−0.016[a]
Δ ETH								0.564[a]	0.462[a]	0.082[a]	0.183[a]
Δ LTC									0.237[a]	0.079[a]	0.236[a]
Δ XLM										0.068[a]	0.059[a]
Δ USDT											−0.026[a]

1st_E is an indicator variable for the first halving event that occurred on November 28, 2012, zero otherwise. 2nd_E is an indicator variable for the second halving event that occurred on July 9, 2016, zero otherwise. Δ BTC is the change in returns on bitcoin as measured by the difference in bitcoin prices in day t and day t-1. Δ BCH is the change in returns on bitcoin cash as measured by the difference in bitcoin cash prices in day t and day t-1. Δ ADA is the change in returns on Cardano coin as measured by the difference in Cardano prices in day t and day t-1. Δ LINK is the change in returns on ChainLink coin as measured by the difference in ChainLink prices in day t and day t-1. Δ ETH is the the change in returns on Ethereum coin as measured by the difference in Ethereum prices in day t and day t-1. Δ LTC is the change in returns on Litecoin as measured by the difference in Litecoin prices in day t and day t-1. Δ XLM is the change in returns on Stellar Lumens as measured by the difference in Stellar Lumens prices in day t and day t-1. Δ USDT is the change in returns on Tether coin as measured by the difference in Tether prices in day t and day t-1. Δ XRP is t the change in returns on Ripple token (XRP) as measured by the difference in XRP prices in day t and day t-1.

[a]*Significance levels at 1%.*

[b]*Significance levels at 5%.*

[c]*Significance levels at 10%.*

Table 1.

Summarizes the Pearson correlations among cryptocurrencies, returns and halving events.

halving occurred on November 28, 2012 and ended up with reducing the rewards from mining for bitcoin from 50 to 25 bitcoins per block. The second halving further reduced the reward to 12.5 bitcoins per block when it occurred on July 9, 2016. The last halving at the time of writing this study occurred on May 11, 2020 and reduced the rewards from bitcoin mining to 6.25 bitcoins per block. Due to lack of data on CRSP database post 2019 about stock prices, this study focuses on examining the stock market reactions to the first and second halving events that occurred in 2012 and 2016.

The halving event is intended to reduce bitcoin's inflation rate. It is usually scheduled when miners solve a certain number of blocks and happens every 210,000 blocks. The next halving will happen when miners reach out 840,000 blocks and it is scheduled to happened between February 2024 and June 2024. Litecoin rewards is also halved every four years but it does not sync with bitcoin halving events.

I started my sample by July 18, 2010 and ended on December 31, 2019 as CRSP database does not provide stock returns date for the year 2020 yet. This restriction in the available dataset will not allow the empirical testing of the third halving event as previously stated that occurred on May 11, 2020. To examine the economic effect of bitcoin halving events on the U.S. capital market, I first estimate stock returns using the Capital Asset Pricing Model (CAPM) and then calculate abnormal returns as the difference between actual and estimated returns. Then, I cumulate abnormal returns to calculate Cumulative Abnormal returns (CARs) around difference length of return windows, a short window (2 days) and long window (10 days).

I first ran a Pearson correlation among cryptocurrencies, halving events, and stock returns. The results of the correlation analysis are displayed in **Table 1** that shows positive and significant correlations at 1% between the two halving events (1st_E and 2^{nd}_E) under investigation and contemporaneous stock returns (R). The magnitude of the correlation is very weak. There is a negative significant correlation at 1% between contemporaneous stock returns (R) and change in bitcoin (ΔBTC), suggesting that an increase in BTC corresponds to a decrease in R. However, other altcoins, cryptocurrencies other than bitcoin, such as ADA, LINK, ETH, and XLM seem to be positively correlated with R.

The result of the event study on the effect of bitcoin halving events on the U.S. capital market is summarized in **Tables 2** and **3** and **Figures 2–5**. **Table 2** summarizes the results of CARs and lists its correspondence t-test with the level of significance for the test of the first halving event. As shown in Panel A, CARs around 2 days return window of the first bitcoin halving shows that the first bitcoin halving event has a significant negative market reaction on the event date. CARs shows a decline two days before the event date and then an increase starting from day +1. Panel B shows the results using 10 days return window and the results show large fluctuations around the halving event. The use of a large return window should be interpreted with caution since other market events may confound the results. **Figures 2** and **3** confirms the results displayed in **Table 2** by showing the negative market reaction on day zero (the event date). **Table 3** summarizes the results of CARs and lists its correspondence t-test with the level of significance for the test of the second halving event. Because the second halving event occurred during a holiday, I used July 11, 2016 as the event date when the market opened to capture the market reaction after the second halving event. Although the results in Panel (A) of **Table 3** show significant positive CARs on the event date, the CARs are significantly declining from day −1 to day 0 (the event day, suggesting that the second halving event still causes a downward abnormal stock returns but perhaps not with the same negative magnitude caused by the first halving event. Panel (B) of **Table 3** displays CARs around 10 days return window and as expected CARs fluctuates around the event and showing the lowest significant statistical decline on

CAR_{it} around the 1st Bitcoin Halving Event on Nov. 28, 2012					
Panel A: CAR_{it} around 2 days return-window					
Days	−2	−1	0	1	2
CAR_{it}	0.0041	0.0014	−0.0015	0.0022	0.0029
t-test	(7.44)***	(3.02)***	(−4.91)***	(5.05)***	(5.59)***
No. Obs.	6654	6655	6656	6653	6652
Panel B: CAR_{it} around 10 days return-window					
Days	−10	−5	0	5	10
CAR_{it}	−0.0034	0.0051	−0.0015	0.0030	0.0029
t-test	(−3.36)***	(7.16)***	(−4.91)***	(4.20)***	(2.63)***
No. Obs.	6644	6652	6656	6640	6631

**Significance levels at 10%*
***Significance levels at 5%*
**** Significance levels at 1%*

Table 2.
Displays the Cumulative Abnormal Stock Returns (CAR) around two event windows, 2 days as in Panel (A) and 10 days as in Panel (B) for the 1st bitcoin halving event.

CAR_{it} around the 2nd Bitcoin Halving Event on July 9, 2016					
Panel A: CAR_{it} around 2 days return-window					
Days	−2	−1	0	1	2
CAR_{it}	0.0080	0.0063	0.0031	0.0068	0.0046
t-test	(7.44)***	(3.02)***	(9.93)***	(5.05)***	(5.59)***
No. Obs.	7178	7173	7170	7204	7201
Panel B: CAR_{it} around 10 days return-window					
Days	−10	−5	0	5	10
CAR_{it}	0.0043	0.0084	0.0031	0.0050	0.0056
t-test	(−3.36)***	(7.16)***	(9.93)***	(4.20)***	(2.63)***
No. Obs.	7207	7186	7170	7188	7176

**Significance levels at 10%*
***Significance levels at 5%*
**** Significance levels at 1%*

Table 3.
Displays the Cumulative Abnormal Stock Returns (CAR) around two event windows, 2 days as in Panel (A) and 10 days as in Panel (B) for the 2nd bitcoin halving event.

the event date. **Figure 4** and **5** shows the market reaction around the second halving event and supports the main conclusion reached from **Table 3**.

I also ran an OLS regression by regressing stock returns (R) on the halving events, change in bitcoin, change in altcoin, and industry categorization to get a better understanding on the nature of the economic effect of the halving events on stock returns. The results are displayed in **Tables 4** and **5**. **Table 4** summarizes the OLS regression on the association between contemporaneous stock returns as the dependent variable in all models and 1st bitcoin halving event halving, changes in bitcoin, changes in cryptocurrencies, and industry categorization as the independent variables. The 1st bitcoin halving event (1st_E) is the independent variable of interest. The coefficient on this variable (1st_E) is expected to be negative and

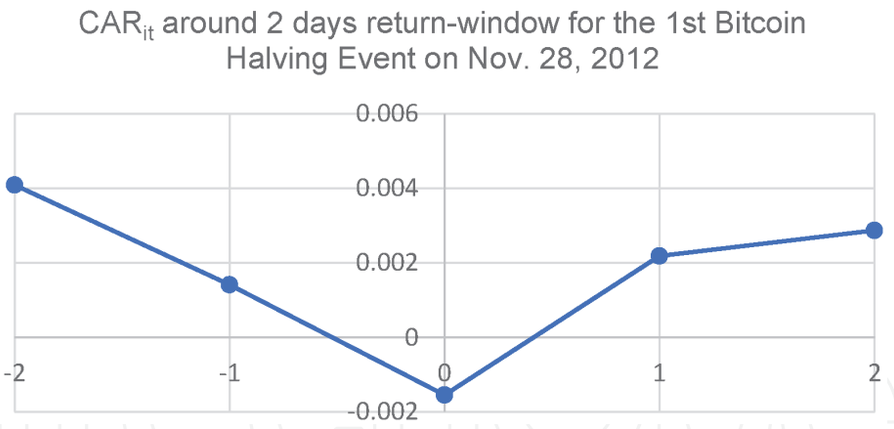

Figure 2.
CAR around 2 days return-window of the 1st Bitcoin Halving Event on November 28, 2012.

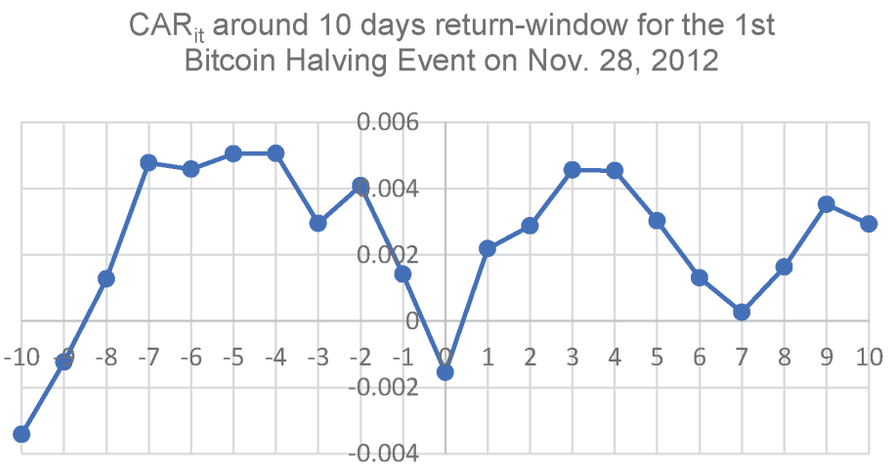

Figure 3.
CAR around 10 days return-window of the 1st Bitcoin Halving Event on November 28, 2012.

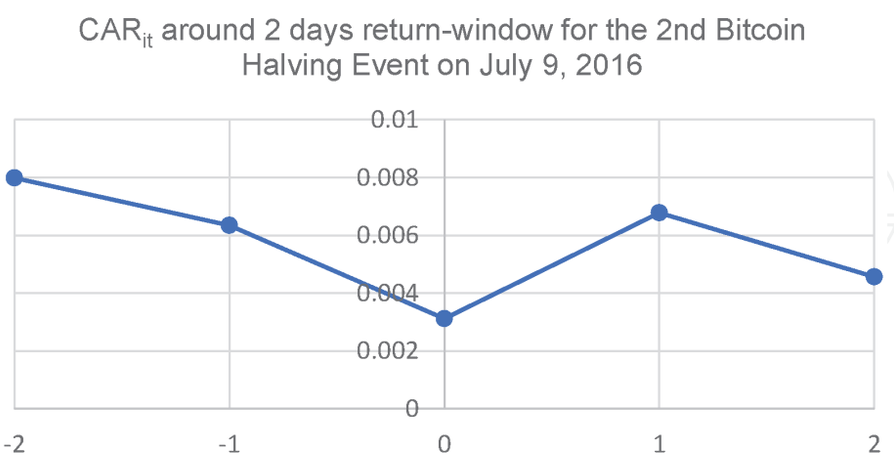

Figure 4.
CAR around 2 days return-window of the 2nd Bitcoin Halving Event on July 9, 2016.

significant, consistent with the documented results from the event study. As shown in **Table 4**, there is a significant negative association (coefficient = −0.00152) at 1% significance level between the first bitcoin halving event (1st_E) and stock returns (R). I used different variations of the regression model by regressing the contemporaneous stock returns on bitcoin, returns on other altcoins, industry categorization, and substituting cryptocurrencies returns with trading volumes as displayed in

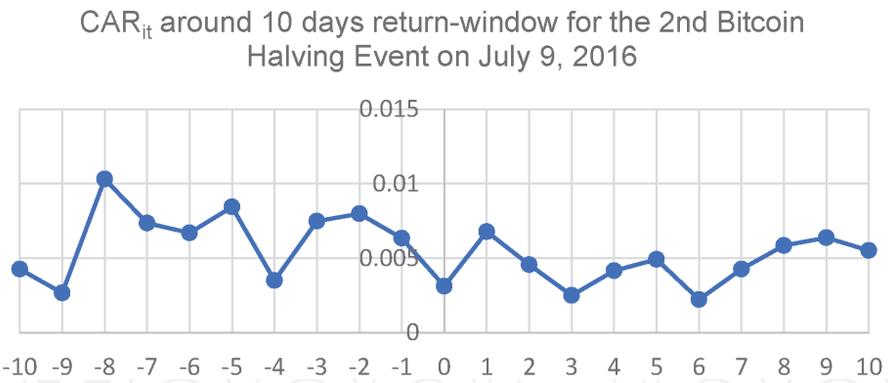

Figure 5.
CAR around 10 days return-window of the 2nd Bitcoin Halving Event on July 9, 2016.

models 1–7 and the results are still the same. **Table 5** summarizes the OLS regression on the association between contemporaneous stock returns (R) as the dependent variable and 2nd bitcoin halving event, changes in bitcoin, changes in cryptocurrencies, and industry categorization as the independent variables. The 2nd bitcoin halving event (2nd _E) is the independent variable of interest. The coefficient on this variable (2nd _E) is expected to be negative and significant, consistent with the documented results from the event study. The results in **Table 5** suggests the same conclusion from **Table 4** that the second halving event is statistically and significantly associated with negative stock returns. I used different variations of the regression model by regressing the contemporaneous stock returns on bitcoin, returns on other altcoins, industry categorization, and substituting cryptocurrencies returns with trading volumes as displayed in models 1–7 and the results are still the same. The results in this section suggests that bitcoin halving events, which eventually increased the demand on and price of bitcoin, are detrimental to the U.S. capital market because these events are associated with a downward abnormal stock returns around the announcement date.

5. Conclusions

It is indisputable that regulatory bodies across different countries lack harmony and agreement on bitcoin classification, use cases and policies. Even within the same country such as the case in the U.S., bitcoin regulations diverge widely across different states. And despite regulatory intervention, or lack thereof, across different jurisdictions, bitcoin stood against regulatory constraints in terms of financial performance in the cryptocurrency world. It showed steady increase over the past decade and most notably over the past several months, especially during COVID-19 era that hastened decades of innovation. However, it is unclear whether COVID-19 accelerated the need for financial innovation and hence contributed to a surge in bitcoin price or the market is presently experiencing a bubble. The conclusion from this study is that bitcoin scarce supply as measured by the decline in the reward from bitcoin is detrimental to the U.S. capital market because the halving events are significantly associated with negative abnormal stock returns around the announcement days. The results suggest that the second halving event has less of an impact on the stock market than the first halving event. Future research may study the market reaction to the third halving event and examine whether the results will remain the same.

The theoretical argument and conclusion from this study are of benefits to many market constituencies such as regulators, practitioners, research scholars, and

	Model (1)	Model (2)	Model (3)	Model (4)		Model (5)	Model (6)	Model (7)
				Dependent variable = R				
Intercept	−0.00002***	−0.00002***	−0.00002***	−0.00001	**Intercept**	−0.00002**	−0.00002***	−0.00002***
1st_E	−0.00152***	−0.00152***	−0.00153***	−0.00153***	**1st_E**	−0.00152***	−0.00152***	−0.00152***
Δ BTC		0.00000***	0.00000***	0.00000***	**Δ BTC_V**	0.00000***	0.00000***	0.00000***
Δ BCH			0.00000	0.00000	**Δ BCH_V**		0.00000***	0.00000***
Δ ADA			0.01236***	0.01236***	**Δ ADA_V**		0.00000***	0.00000***
Δ LINK			0.00081***	0.00081***	**Δ LINK_V**		0.00000***	0.00000***
Δ ETH			0.00001***	0.00001***	**Δ ETH_V**		0.00000	0.00000***
Δ LTC			0.00000**	0.00000**	**Δ LTC_V**		0.00000***	0.00000***
Δ XLM			−0.00336***	−0.00336***	**Δ XLM_V**		0.00000***	0.00000***
Δ USDT			−0.01586***	−0.01587***	**Δ USDT_V**		0.00000***	0.00000***
Δ XRP			0.00000	0.00000	**Δ XRP_V**		0.00000***	0.00000***
INDUSTRY	No	No	No	Yes	**INDUSTRY**	No	No	Yes
F-Ratio	15.69	28	57.89	29.12	F-Ratio	50.14	46.02	23.18
P-Value	<.0001	<.0001	<.0001	<.0001	P-Value	<.0001	<.0001	<.0001
# Obs.	16,621,212	16,621,212	16,621,212	16,621,212	# Obs.	16,621,212	16,621,212	16,621,212

1st_E is an indicator variable for the first halving event that occurred on November 28, 2012, zero otherwise. Δ BTC is the change in returns on bitcoin as measured by the difference in bitcoin prices in day t and day t-1. Δ BCH is the change in returns on bitcoin cash as measured by the difference in bitcoin cash prices in day t and day t-1. Δ ADA is the change in returns on Cardano coin as measured by the difference in Cardano prices in day t and day t-1. Δ LINK is the change in returns on ChainLink coin as measured by the difference in ChainLink prices in day t and day t-1. Δ ETH is the change in returns on Ethereum coin as measured by the difference in Ethereum prices in day t and day t-1. Δ LTC is the change in returns on Litecoin as measured by the difference in Litecoin prices in day t and day t-1. Δ XLM is the change in returns on Stellar Lumens as measured by the difference in Stellar Lumens prices in day t and day t-1. Δ USDT is the change in returns on Tether coin as measured by the difference in Tether prices in day t and day t-1. Δ XRP is t the change in returns on Ripple token (XRP) as measured by the difference in XRP prices in day t and day t-1.

**Significance levels at 10%.*

***Significance levels at 5%.*

****Significance levels at 1%.*

Table 4.

Summarizes the OLS regression on the association between stock returns and 1st bitcoin event halving and changes in crypto currencies.

	Model (1)	Model (2)	Model (3)	Model (4)		Model (5)	Model (6)	Model (7)
	Dependent variable = R							
Intercept	−0.00002***	−0.00002***	−0.00002***	−0.00001	**Intercept**	−0.00002**	−0.00002***	−0.00002***
2nd_E	−0.00314***	−0.00315***	−0.00316***	−0.00316***	**2nd_E**	0.00313***	0.00314***	0.00314***
Δ BTC		0.00000***	0.00000***	0.00000***	**Δ BTC_V**	0.00000***	0.00000***	0.00000***
Δ BCH			0.00000	0.00000	**Δ BCH_V**		0.00000v**	0.00000***
Δ ADA			0.01236***	0.01236***	**Δ ADA_V**		0.00000***	0.00000***
Δ LINK			0.00081***	0.00081***	**Δ LINK_V**		0.00000**	0.00000***
Δ ETH			0.00001***	0.00001***	**Δ ETH_V**		0.00000	0.00000
Δ LTC			0.00000**	0.00000**	**Δ LTC_V**		0.00000***	0.00000***
Δ XLM			−0.00336****	−0.00336***	**Δ XLM_V**		0.00000***	0.00000***
Δ USDT			−0.01586***	−0.01587***	**Δ USDT_V**		0.00000***	0.00000***
Δ XRP			0.00000	0.00000	**Δ XRP_V**		0.00000***	0.00000***
INDUSTRY	No	No	No	Yes	**INDUSTRY**	No	No	Yes
F-Ratio	72.23	56.39	63.60	31.98	F-Ratio	78.06	51.67	26.00
P-Value	<.0001	<.0001	<.0001	<.0001	P-Value	<.0001	<.0001	<.0001
# Obs.	16,621,212	16,621,212	16,621,212	16,621,212	# Obs.	16,621,212	16,621,212	16,621,212

2nd_E is an indicator variable for the second halving event that occurred on July 9, 2016, zero otherwise. Δ BTC is the change in returns on bitcoin as measured by the difference in bitcoin prices in day t and day t-1. Δ BCH is the change in returns on bitcoin cash as measured by the difference in bitcoin cash prices in day t and day t-1. Δ ADA is the change in returns on Cardano coin as measured by the difference in Cardano prices in day t and day t-1. Δ LINK is the change in returns on ChainLink coin as measured by the difference in ChainLink prices in day t and day t-1. Δ ETH is the the change in returns on Ethereum coin as measured by the difference in Ethereum prices in day t and day t-1. Δ LTC is the change in returns on Litecoin as measured by the difference in Litecoin prices in day t and day t-1. Δ XLM is the change in returns on Stellar Lumens as measured by the difference in Stellar Lumens prices in day t and day t-1. Δ USDT is the change in returns on Tether coin as measured by the difference in Tether prices in day t and day t-1. Δ XRP is t the change in returns on Ripple token (XRP) as measured by the difference in XRP prices in day t and day t-1. ΔBTC_V is the change in trading volume of BTC, ΔBCH_V is the change in trading volume of BCH, ΔADA_V is change in the trading volume of ADA, ΔLINK_V is the change in trading volume of LINK, ΔETH_V is the change in trading volume of ETH, ΔLTC_V is the change in trading volume of LTC, ΔXLM_V is the change in trading volume of XLM, ΔUSDT_V is the change in trading volume of USDT, ΔXPR_V is change in the trading volume of XRP.

**Significance levels at 10%.*

***Significance levels at 5%.*

****Significance levels at 1%.*

Table 5.

Summarizes the OLS regression on the association between stock returns and 2nd bitcoin event halving and changes in crypto currencies.

cryptocurrency traders. For example, current and prospective cryptocurrency traders should bear in mind that the price surge in cryptocurrencies that is mainly driven by the past, most recent bitcoin halving event in 2020, and the current pandemic is negatively associated with their investment in the U.S. capital market. Therefore, perhaps having a diverse portfolio to hedge the risk associated with investing solely in one market is a good investment strategy at the present time. Additionally, evidence suggests that the cryptocurrency market is highly volatile, if new traders would like to penetrate this unique market, they should wait until the price drops to a reasonable level they can afford and they should not put all their savings (i.e., pension funds, college savings) into this market. Likewise, it is always a good strategy to exit the cryptocurrency market "temporarily" when traders achieve certain level of profits (i.e., 30%) and then reinvest again when the market experience sudden decline and it will eventually happen because sharp volatility is a primary trait of cryptocurrency market. Regulators should be aware that the gigantic size of bitcoin and other cryptocurrencies is not going to vanish, and it would be beneficial for regulators to work with those in other jurisdictions on a local, national, and international levels to regulate this market. Regulating cryptocurrency market will come up with several tangible advantages. First, it will reduce the risk associated with cryptocurrencies' cyber-attacks. Second, it will stabilize the price of cryptocurrencies so that the market gets the anticipated benefits of using cryptocurrencies in blockchain applications. Scholars who would like to examine the risks and benefits of cryptocurrencies may attempt to investigate the economic consequences of corporate investment in cryptocurrencies on financial performance or financial reporting quality such as accounting conservatism and internal control quality. For example, a firm may use investment in cryptocurrencies to cover up its poor financial performance and signal a better performance. In early 2021, Tesla company invested $1.5 billion in bitcoin where the price was (and still) skyrocketing. Speculators believe that Tesla made between $0.29 to $0.98 billion profit just from investment in bitcoin during a very short period. Notably, Telsa's profit in 2020 per form 10-K was a modest $721 million. This previous example illustrates how some companies can make "everything" from trading in cryptocurrencies. Nevertheless, it does not rule out the possibility that everything can turn into "nothing" if the price of bitcoin tailspins to the opposite direction with the news of reopening the global market and getting vaccinated against the risk of exposure to coronavirus.

It is worthwhile to note that despite the increase in bitcoin in 2020, investors still consider it a venture tool of investment. Proponents of bitcoin argue that it shares characteristics with gold (i.e., scarce, mined, international) and can be used for hedging and diversifying asset. However, gold is "scientifically" not scarce as evidence [20] suggests that gold can be formulated instantaneously within a few tenths of a second in response to earthquakes. With the same token, it is reasonable to assume that bitcoin miners may be able to change its protocol and increase its supply. With too much uncertainty at stake, it is difficult to make a prediction that bitcoin is the future of money. Nevertheless, there is quite agreement that blockchain technology is valuable tool for many applications (i.e., supply chain management) and in order for blockchain to function, an efficient form of cryptocurrency (virtual money) is needed.

The question whether bitcoin will reach $500,000 per coin or dive into $1,000 a decade from today is not the correct answer at the present time. A relevant question would be whether bitcoin can improve our lives, decrease transaction cost, accelerate transfer of money, reduce market frictions, reduce cyber-attacks and fraudulent activities, and eliminate intermediaries' costs. Another interesting question is perhaps whether bitcoin is a safe haven against financial crises? The limited supply of

the total amount of bitcoin that can be circulated along with the mining reward that is split into half every four years made it, by definition, a scarce commodity. Using a simple equilibrium scenario, plotting the demand and supply of bitcoin shows that the price is poised to rise in the future, but this is under the assumption that bitcoin is the only cryptocurrency in the market, which is untrue. Related, it is not impossible to change the bitcoin protocol and increase the amount of its supply. Therefore, the economic as well as real benefits of bitcoin to the market still open for discussion and future research is needed to provoke in depth discussion about its assumed risk and benefits to market constituencies.

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