How the Pandemic Triggered a Sea Change in the Way Bitcoin Traded

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Prior to the Pandemic of 2020, Bitcoin provided a significant degree of diversification to equity-dominated portfolios even if it also was incredibly volatile on its own. There was a marked pattern shift during the Pandemic of 2020, when Bitcoin's association with equity indexes became exceptionally tight. The flood of emergency stimulus money into the U.S. economy coupled with the Pandemic-triggered work-from-home shift brought a large increase in active retail traders for stocks and cryptocurrencies. Both Bitcoin and equity indexes often traded in similar risk-on, risk-off cycles. As a result, the diversification potential from adding Bitcoin to an equity-dominated portfolio virtually disappeared with the Pandemic pattern shift. This research uses a time-varying parameter (TVP) methodology to identify, quantify, and illustrate pattern shifts between the daily returns of two instruments: Bitcoin and the S&P500® Index. To help appreciate why the pattern shifts occurred, we trace the history of Bitcoin's association with U.S. equities and build a narrative, taking Bitcoin from its birth and childhood, through its teenager years, to its more mature young adult phase. Each phase had a unique set of properties that were reflected in Bitcoin's evolving association with equity indexes. Our research suggests that the current association of Bitcoin and equity indexes may not necessarily persist.

Introduction

Bitcoin has evolved into a security whose prices move in a risk-on, risk-off fashion correlated with the major U.S. equity indexes. It was not always like this, and it might not stay this way. Market participants are very aware of the changing association of Bitcoin with equities,[1] yet it is important to understand why Bitcoin has been trading in similar patterns to equities since the Pandemic of 2020 to appreciate the changing risk-management role of Bitcoin in a diversified portfolio. Where Bitcoin once was a diversifying security, if highly volatile on its own, since the Pandemic of 2020, Bitcoin has lost most of its diversifying potential when added to equity-dominated portfolios.

From its birth in 2009 until the Pandemic of 2020, Bitcoin prices traded largely in a manner that was uncorrelated to the major U.S. equity indices. All that changed, abruptly, in the spring of 2020. The Pandemic caused major economic shocks, resulting in the U.S. federal government providing $5 trillion of fiscal stimulus, the Federal Reserve (Fed) lowering short-term rates effectively to zero and expanding their balance sheet with the purchase of $5 trillion of U.S. Treasury debt and mortgage-backed securities. Equally important, many jobs transitioned to "work from home" or WFH. With time on their hands and money in their pockets, many people became active retail traders in stocks as well as in cryptocurrencies. Almost overnight the relationship between Bitcoin prices and U.S. equities indices shifted from uncorrelated and unstable to highly correlated. In the lingo of investment theory, Bitcoin went from having a zero or highly unstable "beta" relative to the S&P500® index to an estimated beta close to or modestly higher than one, indicating that Bitcoin was trading in a risk-on, risk-off mindset mirroring the trading activity in U.S. equity indices.

In this research article, we will trace the history of Bitcoin's association with U.S. equities, from its birth and childhood, through its teenager years, to its more mature young adult phase. But first, we need to

describe our statistical methods of identifying the transitions in how Bitcoin has traded relative to U.S. equities and discuss the results. Then we will recount the key market infrastructure changes during the life phases of Bitcoin that set the stage for the Pandemic of 2020 to trigger a sea change in how Bitcoin was traded.

Estimating the "Beta" of Bitcoin Relative to Stocks

We would like to track the dynamic evolution of Bitcoin price behavior compared to a major U.S. equity index, namely the S&P500®. Accordingly, we chose a time-varying-parameter method (TVP) as our primary statistical tool, supplemented by traditional econometric methods to verify our empirical results.

What makes the time-varying parameter (TVP) estimation process appropriate for this research is that TVP methods allow for the time decay of the data such that more recent data carries considerably more weight in the statistical analysis compared to traditional regression techniques that assume that each data point has the same weight. When there is a significant pattern shift in the data, as there was with Bitcoin and U.S. equity indices, a TVP method helps to see when the pattern shift occurred and whether it was stable and persisted or whether it was a temporary aberration. The half-life of the time decay is similar to the concept used, for example, in tracking radioactivity, where half-life is defined as half of the explanatory weight coming from recent data and half from older data, using a smooth exponential decay process.[2]

The daily Bitcoin and S&P500® data come from Yahoo Finance. The Bitcoin price data series on Yahoo Finance starts in October 2014. TVP estimation methods require an initial period of estimation before the results become more reliable as the data series gets longer, hence our results are reported from the end of January 2016 through August 2025.

Since Bitcoin may have some very large and abrupt price swings, to make the ups and downs in daily returns symmetric, we chose to calculate daily returns as the change or first difference in the logarithms of each price series. The statistical results, however, are in no way dependent on this choice. That is, if one uses daily percentage changes, the results are very closely matched.

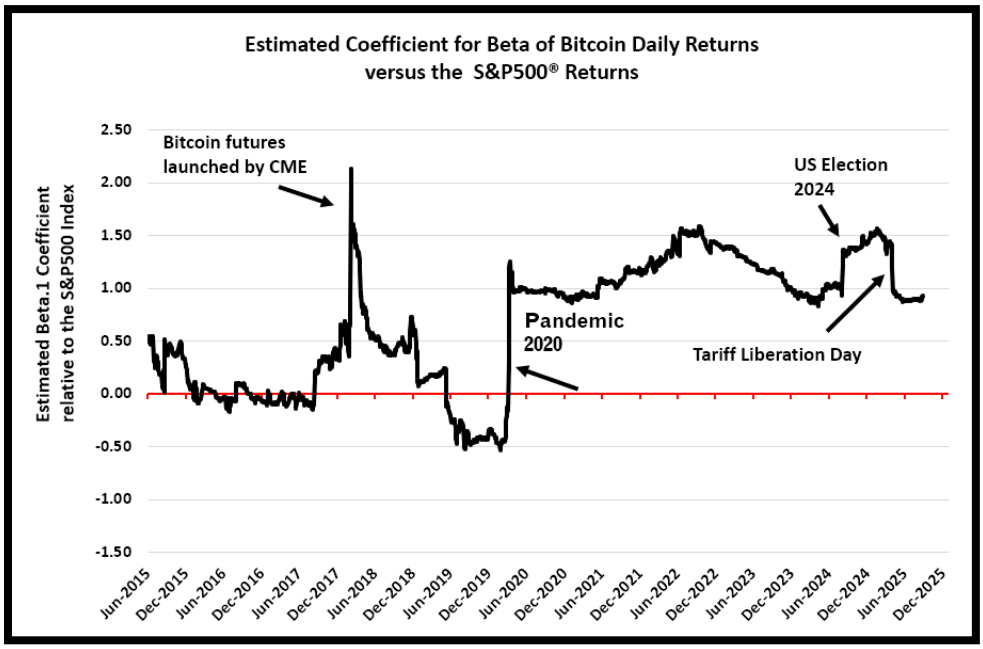
The estimation equation is very straightforward, as follows:

Bitcoin Daily Returns = Beta.0 * Constant term + Beta.1 * Equity Index Daily Returns + errors

In this estimation equation, the estimated coefficient, Beta.1, associated with the equity index daily returns is commonly known as the equity beta. A beta of one indicates that the security in question trades very similarly to equity indices. A beta greater than one would indicate that the security may magnify percentage changes in the equity indices, and a beta close to zero or highly unstable would indicate that the security is not linearly correlated and tends to dance to its own drummer with little regard as to the ups and downs in equity markets. As can be seen in Figure 1 on the next page, the evolving estimate for the beta coefficient for Bitcoin was highly unstable prior to the Pandemic of 2000, bouncing from negative to positive, shooting higher at the time when CME Group launched Bitcoin futures, and then quickly

receding. Post-pandemic the estimated beta coefficient has remained close to or a little above one, associated with very low evolving standard errors and highly significant t-statistics. See Table 1.

Figure 1
Bitcoin Estimated Beta Coefficients Through Time



Data Source: Yahoo Finance. Calculations: Blu Putnam and Peter Wang using a Time-Varying parameter method with a six-month half-life for an exponential data decay process.

Table 1
TVP Linear Regression Equation Results

Time-Varying Parameter Linear Regression Equation with S&P 500® Percent Change as the Dependent Variable			
	Period: Jan-2016 through Dec-2019		
	Average Estimated Beta Coefficient	Average Standard Error	Average T-Statistic
Bitcoin Percent Change	0.1186	0.2079	0.57
Constant	0.0043	0.0017	2.60
	Period: Jan-2021 through Aug-2025		
	Average Estimated Beta Coefficient	Average Standard Error	Average T-Statistic
Bitcoin Percent Change	1.1561	0.0709	16.31
Constant	0.0020	0.0008	2.40

To emphasize the statistical differences in the relationship of Bitcoin and the S&P500, one can compare the root mean squared errors for the period January-2016 through December-2019 to the April-2020 through August-2025 period, as in Table 2.

Table 2
Root Mean Squared Errors Analysis

Root Mean Squared Errors		
2016-2019	2021-2025	RMSE Reduction
0.0022	0.0016	36.35%

We experimented with other statistical methods to verify our results, and the results were unambiguously similar: Bitcoin underwent a major change in its association with the S&P500® Index early in the Pandemic of 2020.

Infrastructure Changes that Influenced Bitcoin Trading Patterns

While we are interpreting the pattern shift in how and when Bitcoin became more associated with equity trading as triggered by the Pandemic of 2020, it would not be correct in our view to assume causality. The narrative of the evolution of Bitcoin is considerably more complex. To tell the story, we divide the history of Bitcoin into its birth and infancy, childhood, teenager years, and then its more mature young adult phase. We do not think this last phase is permanent, as our framework for analysis suggests further evolution in the relationship of Bitcoin with equities.

Birth and Infancy

When looking back at the history of Bitcoin, it is important to set the context in terms of the development of digital markets. The advent and advancement of internet technology and infrastructure allowed for the creation of digital currencies.

Unfortunately, the technology that underpinned Bitcoin also had a dark side, especially the intersection of Bitcoin with the Silk Road (circa 2011-2013). The Silk Road was a marketplace for illegal goods on the dark web, and the adopted currency of the Silk Road realm was Bitcoin. The anonymous nature of Bitcoin transactions made it very attractive for the buying and selling of illegal drugs, as well as for use for ransoms, money laundering, and other criminal activity. But Bitcoin did record every transaction on the blockchain. Law enforcement officers eventually were able to analyze and trace blockchain transactions, and the investigations led to the arrest of Ross Ulbricht, the founder of the Silk Road, and also led to the conviction of James Zhong, a hacker who had exploited a flaw in the Silk Road blockchain and stole thousands of Bitcoins.

Childhood

When Bitcoin was launched and inaugurated the cryptocurrency movement, it was considered a fringe security by traditional institutional asset managers and investors. With only very few exceptions, in the early days, institutional asset managers, including pension funds, endowments, asset managers, and hedge funds chose not to add Bitcoin to their portfolios. Bitcoin was stored on the relatively new blockchain technology and was not tied to any physical asset, commodity, or national fiat money. Some of the Bitcoin trading platforms were highly suspect in terms of their security from cyber hacks and their fiduciary integrity. The regulatory community in the U.S. and the rest of the world was uncertain as to how to regulate cryptocurrencies. Was Bitcoin a security or currency? Which regulatory entity should be the primary authority? What rules might apply to Bitcoin trading?

The history of the institutionalization of Bitcoin trading is key to understanding why the Pandemic triggered a sea change in the way Bitcoin price patterns evolved relative to equities. Institutionalization matters because as the infrastructure around Bitcoin and cryptocurrencies in general developed, more and more traditional institutions slowly began to shed their cynicism and eventually started trading Bitcoin, bringing the potential for large, new customers to enter the emerging cryptocurrency sector. That is, the institutionalization process in the childhood years was dominated by the creation of successful Bitcoin and related cryptocurrency trading platforms and the ability of the cryptocurrency ecosystem to survive and then comeback from a few quite spectacular scandals, hacks, and implosions. Figure 2 provides a curated list of cryptocurrency platforms and when they were started. Figure 3 on the next page is a selective list of some of the more spectacular cryptocurrency scandals.

Figure 2
Selective List, and Definitely not All-Encompassing, of Cryptocurrency Trading Platforms and Their Founding Dates (apologies to the platforms omitted)

Bitstamp (2011)	Crypto.com (2016)
Coinbase (2012)	Binance (2017)
Robinhood (2013, 2018*)	KuCoin (2017)
Gemini (2014)	OKX (2017)

* Robinhood was a platform only for stocks until it launched cryptocurrency trading in February 2018.

The childhood years also saw the maturity of mobile devices, on which many Bitcoin transactions take place.[3] Retail investors hunger for convenience. When not actively trading, they research in a "mobile-friendly" way. Mobile technology allows the retail trader to consume information, discuss strategies on Reddit and other forums, and make trades, all just a few clicks away, at the comfort of their couches or during their lunch breaks at work. It is destiny that with the ubiquity of the internet, and when all things, including personal finance, move to online spaces, that an internet currency, for lack of a better word, should emerge as a favorite among retail traders.

Figure 3
Selective List of Cryptocurrency Trading Platforms Involved in Major Scandals

Bitcoin Savings and Trust ponzi scheme (2011-2012)
Mt Gox implosion (2013-2014)
Bitstamp wallets compromised (2015)
Bitfinex exchange hack (2016)
FTX (2022)

Teenager

Our main focus on what we have deemed as the teenager years is the launch of futures contracts on cryptocurrencies, starting with Bitcoin in December 2017. The launch of Bitcoin futures was a key milestone in the evolution of trading activity because it signified regulatory acceptance of cryptocurrencies, at least by the U.S. Commodity Futures Trading Commission (CFTC) that regulates U.S. futures exchanges.

To launch a futures product regulated by the CFTC, an exchange must be able to demonstrate that the reference index on which the futures contract will be priced and settled at the expiration of the contract is very hard to manipulate. The CME Group initiated its reference index for Bitcoin (BRR) in November 2016. The reference index was based on a weighted average of Bitcoin prices taken from a collection of established Bitcoin trading platforms. By using a collection of trading platforms, CME Group was able to argue that its index would be representative of actual Bitcoin trades and not dependent on any price manipulation that might, in theory, occur on any one of the constituent exchanges included in the index. After the BRR index had been live for a full year, CME Group considered that it had a long enough test period to validate its assumption that the reference index had integrity and could serve as the basis for settling the price of a Bitcoin futures contract at its expiration date. CME Group launched its Bitcoin futures contract in mid-December 2017.

As 2017 progressed, the probability of a Bitcoin futures launch caused considerable excitement among Bitcoin traders. In addition to serving as a milestone in terms of regulatory acceptance in the U.S., Bitcoin futures would be expected to bring a much wider array of market traders, including the possibility of some large traditional institutions starting to embrace and trade Bitcoin. A large new cohort of institutional traders would bring capital to the Bitcoin marketplace and was a key reason that the price of Bitcoin spiked upwards around the time of the launch of the futures contract.

Young Adult

While the successful launch of Bitcoin futures by CME Group was clearly a milestone, it was not sufficient to create the next infrastructure development on its own. We are talking about Exchange Traded Funds.

The Securities and Exchange Commission (SEC) was considerably less friendly and more skeptical of cryptocurrencies than was the CFTC's willingness to let CME Group launch its futures product.

Part of the explanation of differences between the attitudes toward cryptocurrencies at the CFTC versus the SEC has to do with the primary mandates of these two regulators.[4] The CFTC's primary charge is to sustain and ensure the integrity of the marketplace from scandal and manipulation. The SEC's primary charge, based on the agency's creation in the 1930s after the stock market crash of 1929, was to protect small investors and to encourage the development of equity markets. The SEC understood that once it approved exchange-traded funds (ETFs) based on Bitcoin, it was likely that a flood of retail investors would buy into these new ETFs. So, the SEC took the slow road. What pushed the SEC to approve ETFs for cryptocurrencies was the retail stock trading and cryptocurrency trading activity that surged during the Pandemic of 2020.

The Pandemic of 2020 was historic for many reasons, but for cryptocurrencies, it was a growth spurt that ushered in a massive increase in trading activity by retail traders on the various Bitcoin trading platforms. The powerful combination of work from home (WFH) and the huge emergency fiscal and monetary stimulus provided by the U.S. federal government to cushion the blow to the economy created a new army of traders, both for stocks and for Bitcoin. That is, more and more retail traders who focused on trading individual stock names embraced the trading of Bitcoin and other cryptocurrencies. Of course, the Pandemic shock would not have made such a big impact on Bitcoin trading if not for the previous growth of trading platforms and increasing institutional adoption that already happened up to that point. Importantly, for our research into the association of stock and Bitcoin trading activity, the techniques for market analysis and trading decisions took on similar features, especially as regards the risk-on, risk-off trading sentiment and mentality.

That is, when the Pandemic of 2020 hit, Bitcoin had reached a sufficient, if adolescent, level of institutional acceptance so that the new trading cohorts involved in Bitcoin trading were confident in the integrity of the markets and the safety of the accounts. This jumpstarted the pattern shift in how Bitcoin traded relative to equity indexes and also spurred the SEC to move toward authorizing cryptocurrency ETFs, further bonding Bitcoin trading with equity trading activity and market sentiment. The first Bitcoin ETF, symbol BITO, started trading in October 2021, and reached over $1 billion in assets in just two days. A new era of Bitcoin and cryptocurrency trading was on its way. To summarize, the sea-change pattern-shift to a high correlation between Bitcoin and U.S. equity indices and an estimated equity beta coefficient of one or higher that we observed empirically starting in the spring of 2020 was triggered by the Pandemic but made possible by the infrastructure development in previous years establishing well-capitalized trading platforms and regulatory approval associated with the launch of Bitcoin futures.

Final Words of Caution

Statistical patterns come and go. To develop confidence that a particular data-mined statistical pattern will prove persistent and reliable, we would argue that one needs a robust background theory and explanation for the observed patterns or noticeable shift in patterns. We have provided our narrative on the underlying forces, including the increasing institutional acceptance and massive financial stimulus of

the Pandemic period, that worked to shift Bitcoin trading from a diversifying security to one that mirrors the risk-on, risk-off trading in equities that we observed starting in the spring of 2020.

As more and more institutions, pension funds, endowments, asset managers and hedge funds include Bitcoin and other cryptocurrencies in their portfolios, it is critical to have reliable metrics to assess the degree of diversification provided. Prior to the Pandemic of 2020, Bitcoin clearly provided a significant degree of diversification to an equity-dominated portfolio even if it also was incredibly volatile on its own. The diversification potential from adding Bitcoin to an equity-dominated portfolio dramatically changed and virtually disappeared with the pattern shift in Bitcoin trading that emerged during the Pandemic of 2020 and persisted with the launch of Bitcoin ETFs.

Going forward, we expect new narratives for Bitcoin trading to emerge, including the possibility of whether a more protectionist era of global trade and questions about the independence of the Federal Reserve might shift Bitcoin price trends in the direction of hedging the risk of the U.S. dollar slowly losing its primary role as the world's reserve currency. This observation suggests a potential association of Bitcoin with gold. Gold has served as an anchor in the global monetary system for 5,000 years, and Bitcoin is part of a new challenge to sovereign currencies. Neither gold nor Bitcoin pays interest or generates any form of income, such as earnings or dividends; they exist on the trust they can build to challenge fiat money. To monitor the possibility of newly forming narratives that might anticipate pattern shifts and correlation changes, we will be looking at the behavior of Bitcoin prices compared to gold and the U.S. dollar, among other possibilities, not just equity indices.

Endnotes

1 For an example of market commentary, see Shore (2025).

2 For a more detailed explanation of why and how to use time-varying estimation methods, see Putnam *et al*. (2023).

3 As examples of mobile trading apps launched in this time period, Coinbase launched their iOS app in October 2013, Binance launched their multiplatform trading app in September 2017, KuCoin launched their trading app in November 2017, while Gemini launched their multiplatform trading app in December 2018.

4 See Phillips and Putnam (2016).

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