

Demystifying Cryptocurrencies: A Primer

ACADEMIC PERSPECTIVE

Bitcoin (BTC) price swings never fail to captivate our interest. During what might have been a restful Thanksgiving week, the digital currency's price slumped 13% to just over \$17,000 within days of having hit its record high of \$19,510. Then within a week, it bounced back from the slump and has since continued to advance, reaching new highs of more than \$22,000 by mid-December. In fact, BTC's price has more than doubled since September 30, 2020. Experts had been asking whether the Thanksgiving 2020 slump hinted at a rerun of BTC's dramatic collapse of 2017, and strong opinions persist on both sides about where BTC's price will head next.

BTC grabs most of our attention among the hundreds of cryptocurrencies out there trading. After all, it constitutes the largest market share with a circulating supply of over 18 million coins, a market cap of more than \$400 billion, and ubiquitous coin exchanges or trading platforms that promote BTC access.² Equally volatile this year have been the prices of Ethereum's popular cryptocurrency Ether (ETH) and Ripple's XRP, both of which use a similar decentralized open-source, or "distributed ledger," system to record trades as BTC.

Stablecoins are another special type of cryptocurrency getting lots of attention this year. They are designed to minimize the unique price volatility of BTC, ETH or XRP by tying their prices to a stable asset or basket of assets, such as fiat money (U.S. dollar) or exchange-traded commodities, like gold, silver or oil. For example, Tether (USDT) maintains a peg to the U.S. dollar by allocating the same amount of U.S. dollars to its reserves as backing for the USDT coins it issues to the marketplace.

Stablecoins seem like less wobbly variants of crypto assets. They are attractive as a faster, cheaper means of payment, and some observers see a promising future in that they can promote greater financial inclusion for the world's unbanked. But stablecoins are no less controversial than their cryptocurrency cousins because of worries over their potential scale and lack of regulation.

In response to a request from the G20, in October the Financial Stability Board (FSB) issued 10 high-level recommendations for the regulation, supervision and oversight of what it calls "global stablecoin arrangements" due to the financial stability risks these arrangements pose.³ The international group of financial policymakers has its sights on Facebook's Libra, a proposed global stablecoin set to launch in 2021. The estimated size of the Libra asset reserve of commercial bank deposits and short-term government debt from around the world could exceed \$3 trillion of assets.⁴ The financial stability threat from the growth of private stablecoin currencies has energized several central banks, including the European Central Bank, Monetary Authority of Singapore and People's Bank of China, to develop their own digital currencies to compete with them.

Whether it's the price volatility of cryptocurrencies or the potential threats that private stablecoin digital currencies pose to the global financial system that piques your interest, the time might be right for a brief primer to help frame the issues in the complex, opaque world that lies behind them. I also offer a tour of recent scholarly contributions on cryptocurrency fundamentals and the potential dark side to stimulate conversations you might be having with your clients.



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Crypto 101

Bitcoin is the original and best-known cryptocurrency. A cryptocurrency is a digital asset designed to work as a medium of exchange in which individual coin (or “token”) ownership records are stored in a “distributed ledger.” Such a ledger is a shared computerized database, akin to a cloud-based Smartsheet synchronized and accessible across different sites and geographies by multiple participants. To guard against manipulation, strong cryptography rules secure transaction records in the ledger to verify the transfer of coin ownership and, in general, to govern the number of coins that circulate. Decentralized control is the key feature of a cryptocurrency—that is, there is no central banking system, no central control over the coins or coin ownership.

Where the complexity and opaqueness of the operations come into play is in the mechanics of how the distributed ledger technology works. Blockchain technology is the most common way. A block chain is just a list of records, like transactions, organized into “blocks” and linked using cryptography (via a hash tag to the preceding transaction). Bitcoin was the first to use a blockchain to record and decentralize the ledger of ownership and transactions. Satoshi Nakamoto is the pseudonym of the creator(s) of Bitcoin who authored a 2008 white paper called “Bitcoin: A Peer-to-Peer Electronic Cash System,” which set forth the first blockchain database. It laid out the cryptography rules to ensure integrity of the system, especially to help avoid the so-called “double-spend problem,” or the risk that a digital currency coin could be spent twice.

Blockchain has many meanings and this mix of meanings creates confusion as aptly described in “The Trust Machine,” an October 2015 article in *The Economist*. “To understand the power of blockchain systems, and the things they can do, it is important to distinguish between three things that are commonly muddled up, namely the bitcoin currency, the specific blockchain that underpins it, and the idea of blockchains in general.”

Blockchains, in general, permit transactions to be gathered into blocks and recorded. They allow different servers (“nodes”) to access the resulting ledger, and they cryptographically chain blocks in chronological order. All nodes have some level of access to the ledger and node participants agree to a protocol that determines the true state of the ledger, something called “achieving consensus.” The cryptography element helps with the initiation and broadcasting of a transaction (through “digital signatures”), validation of a transaction (“proof of work”) and to chain the blocks.

The power of distributed ledgers run with blockchain technology comes down to trust. There must be trust among users in the protocol laid out by the founders or developers of the cryptocurrency.

For example, bitcoins are released slowly according to a pre-specified formula and distributed to nodes (run by “miners” who solve the cryptographic math-like puzzles) as a reward for verifying transactions in their decentralized ledgers. Think of the reward as a fee for an intermediating service. Basically, miners keep the network secure and well-functioning. Different cryptocurrencies have different protocols. Auroracoin (AUR), for example, is a cryptocurrency that launched with coins distributed freely and in equal amounts to all residents of Iceland.

What's important to understand, per *The Economist's* demystifying definition above, is the different things different cryptocurrencies can do. Coins are different from tokens, for example. Coins are mainly used as a medium of exchange or store of value, just like regular fiat currencies. Tokens are different as they are used like coupons or vouchers on specific sites for specific purchases. A firm wishing to embark on a project might raise money for the project through an initial coin offering (ICO) in which the token sold allows the holder to consume some good or service the project delivers.

For example, Zilliqa (ZIL) is a platform for making apps secure and affordable to develop. ZIL tokens can be used for gaming, facilitating digital advertising through automated payments and even international, low-fee payments. A successful ICO draws participants by means of a “white paper” (prospectus) that details the purpose of the offering and use of the funds raised. It also provides a homepage where the ICO takes place, and the homepage provides a bidding mechanism for the tokens. Ironic as it seems, many ICOs invite participants to bid for tokens by means of delivery of popular cryptocurrencies like ETH or BTC. Once launched, secondary market trading of both coins and tokens is active on various exchange platforms and in various jurisdictions. Most exchanges operate 24/7 every day of the year, using an open, electronic limit-order book, usually without centralized regulation or the usual rules and restrictions of equity market trading exchanges.

An increasing number of investors are dipping their toes into cryptocurrency coins and tokens and ICOs lured by the potential of high returns—notwithstanding the heightened volatility and non-existent yield—and encouraged by the growing presence of large trading firms from traditional markets. Indeed, hedge funds focused on cryptocurrencies have reported significant gains in 2020. These have sparked significant inflows from other major mainstream hedge funds and asset owners.⁵ But what does research say about the asset-pricing properties of cryptocurrencies? About their potential for portfolio diversification and risk assessment? And what about the potential dark side from their effectively unregulated structure?

Fundamentals of Cryptocurrencies as Assets

Truth be told, research on cryptocurrencies in top, peer-reviewed journals in finance is still new.⁶ To my knowledge, the first published article on Bitcoin price formation, the market forces of supply and demand and digital currency-specific factors at work, was authored in 2016 by the European Commission's Pavel Ciaian and d'Artis Kancs, and Catholic University of Leuven's Miroslava Rajcaniova in *Applied Economics*.⁷ The authors implemented conventional time-series analysis of five years' worth of daily returns on Bitcoin along with a correlative analysis using a variety of variables, such as Dow Jones Industrial Average Index movements and oil prices as well as the number of Bitcoins in circulation and their transactions and counts of nodes/addresses. They concluded it is the Bitcoin-specific factors that are much more importantly associated with Bitcoin price fluctuations. No factors related to macroeconomic or financial developments seemed to matter.

A 2019 study by Hu, Parlour and Rajan builds on this early effort by outlining a number of stylized facts on the asset-pricing properties of over 220 different cryptocurrencies and digital coins/tokens.⁸ Their study begins by documenting the remarkable skewness of the first month's returns across 64 ICOs, mostly during 2017. While the mean return over the first month following an ICO was an enormous +46.3%, the median return was -16.1%. Several large positive outlier returns are noted, with first trading-day returns above 1000%. The second part of the study considers the correlations among various cryptocurrencies with other assets, such as gold and the S&P 500[®] Index. The only "asset" for which cross-correlations were noticeably above zero is Bitcoin itself, which is not so helpful as it is another cryptocurrency. In fact, their global minimum variance portfolio across the top 50 cryptocurrencies in their efficient frontier analysis was weighted over 50% in Bitcoin alone. Correlations with respect to the S&P 500 and gold were zero.

Discouraging as the Ciaian et al. and Hu et al. studies may be about whether economic fundamentals potentially drive the price processes of cryptocurrencies, a newer 2020 working paper by Jiang, Rodriguez and Zhang offers a counterweight. Their evidence is of common trends, or long-run equilibrium relationships, among cryptocurrency and equity prices.⁹ The authors build from the first principles of a representative-agent model that allows for a "cointegrating" relation among real aggregate consumption growth, equity and cryptocurrency returns. The empirical findings uncover a long-run equilibrium relation in which Bitcoin contains a transitory component reflecting the high volatility of its prices, while S&P 500 prices and aggregate consumption contain a more permanent component. And what we see is innovations in consumption are able to predict both equity and Bitcoin prices, showing the primacy of macroeconomic fundamentals at work. One wonders whether other cryptocurrencies would be similarly influenced by such fundamentals.

My Cornell University colleagues, Maureen O'Hara, David Easley and Soumya Basu sought to drill down into the fundamentals of the mining-based structure of Bitcoin's blockchain in a recently

published study.¹⁰ They build a game-theoretic model to try to explain the market-based ecology factors that might lead to the emergence of transaction fees. The game is among blockchain miners and users, and it focuses on the mining rewards, transaction fees, prices, waiting times for processing transactions and dynamics of user participation on the blockchain. They predict that without transaction fees, the blockchain would not be viable as miners' revenues from posting blocks are determined by Bitcoin's predetermined protocol and are diminished over time by its reaching zero new coins by 2140. To be well functioning, these authors predict Bitcoin has had to migrate to a market-based system to survive. And encouragingly, it did so in a way that we might have predicted assuming the rational behavior of participants, like users and miners.

A Darker Side to Crypto?

There is no question policymakers and investors see the large fluctuations in cryptocurrency prices and form a belief that their volatility is due to speculative behavior by irrational agents. It was former Federal Reserve Chair Alan Greenspan in December 2013 who said Bitcoin prices were unsustainably high and it was not a currency in a normal sense. "You have to really stretch your imagination to infer what the intrinsic value of Bitcoin is," Greenspan said. "I haven't been able to do it. Maybe somebody else can."¹¹

Concerns about the speculative nature of Bitcoin were first posed in a still unpublished 2013 National Bureau of Economic Research working paper by NYU Stern's David Yermack.¹² In this insightful early study, Yermack empirically verifies that Bitcoin price volatility is much higher than that of widely used currencies, and the daily exchange rates with U.S. dollars exhibit virtually zero correlation with widely used currencies and gold, making it difficult for owners to hedge. The more provocative argument was that Bitcoin prices of consumer goods require many decimal places with leading zeros, which can be disconcerting to retail participants, and that it faces daily hacking and theft risks, given a lack of access to a banking system with deposit insurance guarantees. This evidence led Yermack to declare it more of a speculative investment than a currency. This early first impression stuck with many.

Intriguing newer evidence about Bitcoin's dark side comes in a recent study by the University of Sydney's Sean Foley and University of Technology Sydney's Jonathan Karlsen and Talis Putnins which was published in the May 2019 special volume on fintech in *The Review of Financial Studies* that I helped edit.¹³ The focus of this study is the considerable regulatory challenge created by the rapid growth in cryptocurrencies and, especially, the anonymity they provide users. The authors were keen to uncover how much cryptocurrencies like Bitcoin have facilitated the growth of online "darknet" marketplaces in which users trade illegal goods and services. Of special interest was one such marketplace, named the "Silk Road," in which a wide variety of illegal drugs, weapons and forgeries could be purchased using Bitcoin from 2011 until its shutdown by the FBI in 2013.

Foley, Karsen, and Putnins apply a type of network cluster analysis to identify two distinct communities in the Bitcoin blockchain, legal and illegal, by breaking down the pseudo-anonymity of the 26- to 35-character alphanumeric addresses of users and by linking them to identified Bitcoin seizures from news articles and U.S. court records by law enforcement agencies. What do they find? About \$76 billion of illegal activity per year involved Bitcoin, which constituted about 46% of all Bitcoin transactions. They show that the illegal share of Bitcoin activity declines with mainstream interest in Bitcoin and with the emergence of other opaquer cryptocurrencies.

Recall my mention earlier of the crypto-market-stabilizing effects of stablecoins, the cryptocurrencies that tie the price to an existing asset. This year, a new study by the University of Texas's John Griffin and his Ph.D. student Amin Shams in *The Journal of Finance* should cause some pause about just how stabilizing these stablecoins might be.¹⁴ These authors investigated whether Tether, the stablecoin pegged to the U.S. dollar, influenced Bitcoin and other cryptocurrency prices during the 2017 boom and bust. Using algorithms to deconstruct blockchain alphanumeric addresses, like Foley et al., they find purchases with Tether are timed following market downturns and these result in sizable increases in Bitcoin prices. The flows appear to cluster when Bitcoin prices dip just below round-number thresholds, which investors often use as buying signals. They also find negative returns in Bitcoin before month-end reporting, which they hypothesize is associated with Tether creators liquidating Bitcoin into

U.S. dollars to demonstrate sufficient reserves. Griffin and Shams infer that it is not demand forces at work, but supply constraints in inadequately backed digital coins that are contributing to inflated cryptocurrency prices.

A Final Thought About What May Come

The provocative conclusions of these teams of authors about the dark side of cryptocurrencies should help reduce regulatory uncertainty about potential consequences from this financial innovation. We need this research and much more to allow more informed policy decisions to weigh up the benefits and costs of ICOs, cryptocurrency exchanges and launching of private digital currencies. The timing could not be better.

On the one hand, S&P Dow Jones Indices recently announced plans to launch cryptocurrency index capabilities, which may provide investors an enhanced level of comfort.¹⁵ Almost simultaneously though, outgoing U.S. Securities and Exchange Commission Chair Jay Clayton, in recognizing that the Commission had rejected a number of proposals in recent years to develop exchange-traded funds linked to Bitcoin, confirmed its prevailing view that cryptocurrencies, like Bitcoin, are not securities. They are not pure stores of value, like gold, but just payment mechanisms, as their founders likely intended. Whether the new SEC chair and other regulatory bodies around the world become more open to the idea of crypto exchange-traded funds (ETFs) and other crypto investments is a question to which we all want the answer. Until we, as investors, get a little more clarity, it might be wise to just sit and wait.

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GLOSSARY

Correlation. Correlation measures the relationship between two investments—the higher the correlation, the more likely they are to move in the same direction for a given set of economic or market events. So, if two securities are highly correlated, they will move in the same direction most of the time. Negatively correlated investments do the opposite—as one security rises, the other falls, and vice versa. No correlation means there is no relationship between the movement of two securities—the performance of one security has no bearing on the performance of the other. Correlation is an important concept for portfolio diversification—combining assets with low or negative correlations can improve risk-adjusted performance over time by providing a diversity of payouts under the same financial conditions.

Dow Jones Industrial Average Index. An average made up of 30 blue-chip stocks that trade daily on the New York Stock Exchange.

Exchange-traded fund (ETF). Similar to a mutual fund, an ETF represents a group of securities, but an ETF trades on an exchange like an individual stock. An ETF generally follows the performance of an index, such as the S&P 500.

S&P 500® Index. The S&P 500® Index is composed of 500 selected common stocks most of which are listed on the New York Stock Exchange. It is not an investment product available for purchase.

ENDNOTES

¹ CoinMarketCap.com. Data as of 12/18/2020.

² CoinMarketCap.com. Data as of 12/18/2020.

³ See *Regulation, Supervision, and Oversight of Global Stablecoin Arrangements: Final Report and High-Level Recommendations* (Financial Stability Board, October 13, 2020).

⁴ See Table 2 of the European Central Bank report titled, *A Regulatory and Financial Stability Perspective on Global Stablecoins*, co-authored by Mitsutoshi Adachi, Matteo Cominetta, Christoph Kaufmann and Anton van der Kraaij (May 5, 2020). Section 4 uses the Libra initiative as an example due to the network effects of its global user base and significant resources available to support its launch. Their estimates, in turn, draw heavily on assumptions in the April 22, 2020, White Paper v2.0 issued by the Libra Association.

⁵ An Ignites.com report by Joe Morris, “\$5B Guggenheim Fund Wants Bitcoin Exposure,” (November 30, 2020), said Guggenheim’s Macro Opportunities Fund’s SEC Form N-1A disclosed that it “may seek investment exposure” in cryptocurrency by investing up to 10% of its net asset value in the Grayscale Bitcoin Trust, one of the first publicly quoted and SEC-registered Bitcoin and cryptocurrency investment vehicles.

⁶ As executive editor of the *Review of Financial Studies* in 2016, I took note of the dearth of research on fintech, in general, and on cryptocurrencies, in particular. To address that deficiency, I helped launch a competition among scholars via a novel registered-reports editorial process whereby they would submit research proposals for peer review toward publication in a future volume of the journal. This volume on fintech was published in May 2019 with my editorial, titled “To FinTech and Beyond” (with Itay Goldstein and Wei Jiang) and with four publications on Bitcoin, blockchain technology and cryptocurrencies.

⁷ See “The Economics of Bitcoin Price Formation,” *Applied Economics* 2016, Volume 48, Issue 19, 1799-1815.

⁸ “Cryptocurrencies: Stylized Facts on a New Investible Instrument,” by Albert Hu, Christine Parlour and Uday Rajan, *Financial Management* (2019), Volume 48, Issue 4, 1049-1068.

⁹ See “Macroeconomic Fundamentals and Cryptocurrency Prices: A Common Trend Approach,” by Xiaoquan Jiang, Ivan Rodriguez and Qianying Zhang, October 2020, *Florida International University Working Paper*.

¹⁰ See “From Mining to Markets: The Evolution of Bitcoin Transaction Fees,” *Journal of Financial Economics* (October 2019), Volume 134, Issue 1, pages 91-109.

¹¹ See “Greenspan Says Bitcoin a Bubble Without Intrinsic Currency Value,” *Bloomberg News*, December 4, 2013.

¹² See “Is Bitcoin a Real Currency? An Economic Appraisal,” (December 2013), *National Bureau of Economic Research Working Paper No. 19747*, Cambridge, MA 02138.

¹³ “Sex, Drugs, and Bitcoin: How Much Illegal Activity Is Financed Through Cryptocurrencies?” (May 2019), *Review of Financial Studies*, Volume 32, Issue 5, pages 1798-1853.

¹⁴ “Is Bitcoin Really Untethered?” by John Griffin and Amin Shams, June 2020, *Journal of Finance*, Volume 75, Issue 4, pages 1913-1964.

¹⁵ PR Newswire, “S&P Dow Jones Indices Builds Crypto Indexing Capabilities with Lukka,” December 3, 2020.

Diversification does not assure a profit, nor does it protect against loss of principal.

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