

AMUN

STATE OF CRYPTO





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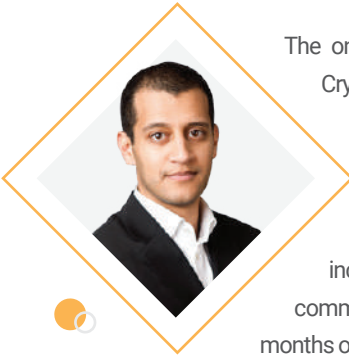
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Foreword

This report will provide an exhaustive overview of the state of crypto in the third quarter of 2019 – offering Amun’s own view on the industry, a recap of the most important news items of this quarter, a look at the performance of the most important crypto assets, and an overview of our current products. In addition, we have included two of our research reports: **Valuing Bitcoin** and **Portfolio Optimization With Crypto Assets**.

It goes without saying that the third quarter of this year has been a uniquely eventful one for the industry and we hope this report will help you understand it better.



The one word to describe the State of Crypto in the third quarter of 2019 is **validated**. This quarter was one filled with fervor as crypto assets continued their steady march towards becoming increasingly mainstream on both commercial and regulatory fronts. After months of waiting, Facebook finally revealed its crypto strategy to the world. Leading this effort has been none other than respected tech exec and former PayPal President David Marcus, in a sign of just how serious (and ambitious!) the world's largest social network is about their plans. It remains to be seen whether or not the project will ultimately be successful, or if it will even be allowed to launch in the first place. Regardless, the level of nuanced well-informed feedback from government officials and regulators has been incredibly encouraging. The space has already come a long way in just ten years.

While Facebook will likely struggle getting Libra launched under prohibitive American regulations, the world's largest cryptocurrency exchange Binance announced it would be releasing its own Libra-inspired product. With Asian roots and a European domicile, Binance is showing the benefits that companies in innovative jurisdictions can reap. Amun of course is further evidence of this, where we have listed half a dozen crypto products in Zürich while companies in other geographies have struggled to get a single Bitcoin ETF approved. Facebook wasn't the only large institutional innovator. Walmart, the world's largest retailer, filed a patent for its own stable-coin cryptocurrency, backed by the US Dollar. Furthermore Bakkt, a subsidiary of the New York Stock Exchange's parent company Intercontinental Exchange (ICE), has announced the launch of physically-delivered Bitcoin futures and a custody solution. It's been a busy quarter for sovereigns as well, led by announcements concerning the imminent launch of the People's Bank of China's (PboC) own government-backed digital currency.

In the midst of all of this sovereign and corporate interest in crypto, it's worth taking a step back and checking in on how decentralized crypto assets (like Bitcoin) have fared this quarter. Bitcoin was born in 2009 out of the ashes of the last financial crisis, largely as a protest against the excesses of 'trusted' third-parties like Lehman Brothers and AIG that had led to a public loss of faith in the financial industry.

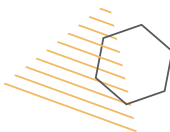
This is where Bitcoin stepped in. Like gold before it, Bitcoin was a scarce, trust-minimized, non-sovereign asset that promised a hedge against the financial market. Early adopters included populations in geographies with weak currency regimes; Turks, for example, are among the keenest Bitcoin advocates, with polls showing 18% of the total population have interacted with crypto. Adding to that are technophile millennials who have no reservations with crypto's virtual underpinnings and, unlike their parents, find no solace in gold. Even India, a country long seen as a barometer for global gold demand, has lost its strong appeal for the metal in recent years.

Framing all this is the extremely challenging macro environment we find ourselves in. At the moment of writing, there is more than \$15 trillion of negative-yielding debt that investors have purchased. European growth is slowing with the continent's largest economy, Germany, headed towards a recession. The China-US trade war shows no signs of abating. Numerous voices are sounding the alarm that we seem likely to be heading towards a cooldown and and it is possible that, after a decade of monetary easing, we may have lost many of the tools that could help us deal with such a situation. In such an environment, Bitcoin and crypto assets – already the most uncorrelated asset class vis-à-vis equities, fixed income, and commodities – should thrive. Early signs of this have proved promising, with positive upwards swings in the price of crypto during accelerations of the trade war and through the Dow Jones' worst falls this year. It is our belief that given these macro conditions as well as the intergenerational shift among millennials from gold to Bitcoin, it would be highly sensible to hold crypto in one's portfolio for at least the next five years.

But before that inevitable reality sets in, crypto needs to continue to build institutional grade tools as well as elucidate its key features to investors. Amun's product suite is a small part of the former; and we hope this publication, which we intend to publish quarterly, helps with the latter as well. It is our aim to, once every three months, wrap up the important news (among regulatory, technological, and business updates) in the space then dive deeper into advanced concepts studied by our research team. It is only when we are all both well-informed and in possession of the right financial infrastructural tools, that we will truly be ready for the economy's next paradigm shift.

Best Regards,
Hany Rashwan
CEO, Amun

Quarterly Updates



Business

After months of anticipation, **Facebook** and 27 other partners (including Visa, Mastercard, Paypal, Spotify, and Uber) shared plans of the Libra digital currency, a new currency linked to a basket of five major currencies. Facebook has argued that Libra could make it cheaper and easier to transmit money across borders, thus leveraging Facebook's massive 2.7 billion user base. Facebook plans to build a corresponding digital wallet, Calibra, while governance of the network will be handled by a Geneva-based independent foundation. The immediate feedback from regulators, governments, and politicians was overwhelmingly negative with many worrying about potential privacy, antitrust, and financial compliance issues associated with the project.

The world's largest crypto asset exchange, **Binance**, announced that it will launch an open blockchain project called Venus to develop regional stablecoins pegged to fiat currencies (or traditional currencies usually issued and backed by a government). The project has drawn comparisons to Facebook's Libra project.

“This is another step in providing an inclusive cryptocurrency trading platform catering to the needs of both advanced institutional traders and retail traders under one roof.”

Changpeng Zhao
CEO, **Binance**

Binance has also officially launched margin trading. The exchange was preparing to launch the service over the past few months. “This is another step in providing an inclusive crypto asset trading platform catering to the needs of both advanced institutional traders and retail traders under one roof,” said Binance CEO Changpeng Zhao. There are currently six supported crypto assets (Bitcoin, Ether, Ripple, Binance Coin, Tron, and Tether).

The **CME Group** announced that it will offer options on its Bitcoin futures contracts in Q1 2020.

A senior official at **China's central bank** announced at the China Finance 40 Group meeting on August 10 that the country will soon roll out its central bank digital currency (CBDC). Mu Changchun, Deputy Chief in the Payment and Settlement Division of the People's Bank of China (PBOC) stated that the CBDC prototype exists and the PBOC's Digital Money Research Group has already fully adopted a blockchain architecture for the currency. It was reported that China's CBDC will not rely entirely on a pure blockchain architecture as this would not allow the currency to achieve the throughput required for retail usage. According to Changchun, the currency has been in the research and development phase since 2014.

Bakkt, the Intercontinental Exchange's subsidiary, announced that it had acquired a New York state trust charter through the New York State Department of Financial Services (NYDFS). The approval clears the way for the company to begin offering its highly-anticipated physically-settled Bitcoin futures contracts on September 23.

Blockchain.com, which has created more than 40 million digital-asset wallets, is moving into the trading side of crypto assets with a new exchange. The Pit, a London-based exchange, will offer Bitcoin, Ether, Bitcoin Cash, Tether, Litecoin and the Paxos Standard.

Bitmain co-founder Jihan Wu's new project, **Matrixport**, is now live. The startup spun off Bitmain in February and has brought on a number of Bitmain employees. The company aims to be a one-stop shop for over-the-counter trading, lending, and custody for crypto assets.

Mark Carney, the current governor of the **Bank of England**, has offered a proposal that would replace the U.S. dollar with a digital currency similar to Facebook's Libra. During the U.S. Federal Reserve's annual meeting in September, Carney identified the dollar's status as the world's reserve as something that needs to be replaced by a form of digital currency similar to Facebook's Libra.

Term Sheet

BlockFi, the cryptoasset lending company, has secured an additional \$18.3 million in venture capital funding as they eye up an international expansion and the roll-out of new financial products. Investors include Morgan Creek, Galaxy Digital, Fidelity, and Valar Ventures.

Blockchain startup **Offchain Labs** has received \$3.7 million in seed round funding. The round was led by Pantera Capital, with participation from Compound VC, Raphael Ouzand of Blocknation, and Jack Seid of Stone Bridge Ventures.

Crypto exchange **Kraken** has acquired Dan Held's startup Interchange, which offers crypto accounting and reporting tools.

Canaan Creative, one of the biggest manufacturers of Bitcoin miners in China, has reportedly filed an application for a \$200 million initial public offering (IPO) in the U.S.

Algorand, the proof-of-stake based blockchain protocol, has raised over \$60 million in a token sale conducted on CoinList.

Anchorage, the cryptocurrency custody provider for institutional investors, has raised \$40 million in Series B funding. The investment was led by Blockchain Capital with further participation by Visa and Andreessen Horowitz.

Token, the open banking platform provider, announced a \$16.5 million round led by BNP Paribas's venture arm. Existing investors Octopus Ventures and EQT Ventures also participated in the round.

Altonomy, a Singapore-based market maker, has just raised a \$7 million seed round led by Polychain Capital.

Nebulous, the developers behind the Sia Network, raised \$3.5 million in a pre-Series A round. The investment was led by Bain Capital, with further participation from Bessemer Ventures Partners and Dragon Capital Partners.

Dapper Labs, the company behind CryptoKitties, raised \$11 million in a round led by Andreessen Horowitz.

Germany's financial regulator, **BaFin**, has given the green light to a blockchain-based real estate bond worth €250 million (≈ \$280 million). The bond, issued by Fundamental Group, is based on the Ethereum blockchain and is backed by a portfolio of German real estate properties.

Clause, the smart contract startup, raised \$5.5 million in venture funding in a round led by Galaxy Digital. Other investors in the round include DocuSign, Seedcamp, and Raptor Group.

Rain has raised \$2.5 million in seed funding round co-led by BitMEX Ventures and Kuwait-based cryptocurrency fund, Blockwater. Mike Komarnsky, founder of Cumberland Mining, and Bitcoin developer Jimmy Song, also participated in the round.

Digital Assets Data, a financial technology and data company, closed an equity funding round of \$3.2 million led by North Island Ventures.

Matcherino, a blockchain-powered esports startup, raised a \$1.5 million investment round from Wells Fargo and the Galaxy Digital EOS VC Fund.

Crypto asset company **Circle** is planning to raise a \$100 million venture capital fund for its equity crowdfunding platform SeedInvest.

CasperLabs, a startup building a blockchain aimed to scale without sacrificing decentralization, has raised \$14.5 million led by Terren Piezer and with further participation from Arrington XRP Capital and others.

Elliptic, a blockchain analytics firm that helps institutions manage money laundering risk, has raised \$23 million in a Series B round.

Elwood Asset Management, the investment firm owned by hedge fund manager Alan Howard, is planning to launch a \$1 billion investment vehicle to invest in other crypto asset funds.

Blockstack, the decentralized computing company, raised \$23 million in the first SEC-regulated token sale, as well as a further \$5 million from private Asian investors.



Regulations

New Zealand has become the first country to legally back companies that pay employees in crypto assets. The ruling by New Zealand's tax authority allows salaries and wages to be paid in crypto assets such as Bitcoin from September 1, as long as the payments are in regular, fixed amounts. The crypto asset of choice must also be pegged to at least one regular currency and must be able to be converted directly into a standard form of payment.

The **U.K. Financial Conduct Authority (FCA)** has finalized its guidance on crypto assets, clarifying which tokens fall under its jurisdiction. Most of the rules issued on Wednesday were proposed in consultation paper CP19, which was released for public comment in January. As expected, the final guidance does not drastically alter the regulatory landscape, instead specifying when certain types of crypto assets fall under existing categories. Crypto assets like Bitcoin and Ether, which the FCA classes as "Exchange Tokens," are not regulated, though anti-money-laundering rules apply.

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According to a Wall Street Journal report, the **Securities and Exchange Commission (SEC)** has approved a \$28 million Reg A+ offering for decentralized Internet company Blockstack. This appears to be one of the first SEC-approved token offerings on the market and will chart a way forward for US small business funding in the future. Founders Muneeb Ali and Ryan Shea told WSJ reporter Paul Vigna that they spent \$2 million to get approval for the sale. He wrote, "Mr. Ali said it took so long and cost so much because the company and the SEC had to start from scratch to create a protocol for a digital-token offering under Reg A+." The Reg A+ exemption lets companies raise up to \$50 million from retail investors as opposed to only from accredited investors.

Facebook's plan for its Libra cryptocurrency has already faced regulatory scrutiny as central banks, regulators, and politicians around the world have called for oversight on the project. For example, France's finance minister Bruno Le Maire said that Libra "can't and ... must not happen" and that "it is out of the question" for the cryptocurrency to "become a sovereign currency." Moreover, U.S. representative Patrick McHenry, senior Republican on the House Financial Services Committee, first asked for a hearing on Libra in a letter to committee Chairman, U.S. representative Maxine Waters. Later Rep. Waters called for a halt to Facebook's development of its digital asset.

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The latest filings in the New York Attorney General's suit against **iFinex** — the parent firm of Bitfinex and Tether — see the exchange fighting against the Office of the Attorney General's (OAG) claims of New York jurisdiction. The filings claim the OAG misled the court in its July 7 filings, making New York connections seem stronger than they are.

The United States's Securities Exchange Commission (SEC) has charged token sale platform **ICOB** with securities violation. The SEC has alleged that ICOBox and its founder, Nikolay Evdokimov, violated securities laws with its \$14.6 million token sale in 2017. In addition to the sale itself, ICOBox facilitated the sale of another \$650 million in tokens through its platform, thereby allegedly acting as an unregistered broker.

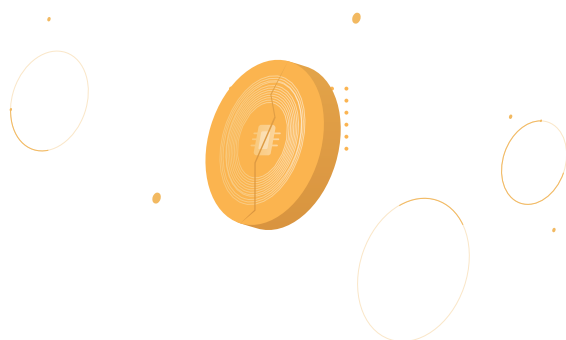


Technology

Telegram's blockchain project, TON, has entered the last preparation stage before going live. The code for running a blockchain node on its test network portal was released on Friday 6 September. The release had previously been scheduled for September 1 and will likely be followed by the launch of the TON blockchain by October 31 — the deadline for the project's launch. Telegram raised \$1.7B in a token sale in early 2018 for their TON blockchain.

In its application with the U.S. Patent and Trademark Office, **Walmart** touted the concept of a digital currency “tied to a regular currency” — what's commonly known as a stablecoin. The filing suggests that the proposed coin could help provide finance for those with limited access to banking services.

On August 5 **Litecoin** reduced its block reward for miners by half. The event, known as the halving, occurred at block height 1,680,000 on the Litecoin blockchain at approximately 10:16 UTC. The event marks a milestone for Litecoin miners as the Litecoin network is designed to reduce its mining rewards by half every 840,000 blocks (roughly every four years). For this halving, Litecoin's mining reward per block reduced from 25 LTC to 12.5 LTC.



Binance has rolled out a platform for developers called Binance X with the goal of boosting the mass adoption of crypto assets. Binance X helps developers learn and collaborate with the Binance Chain ecosystem, as well as its related application program interfaces (APIs) and its software development kits (SDKs).

The Chia Network, a cryptocurrency developed by Bram Cohen — the author of the peer-to-peer (P2P) BitTorrent protocol —, has published its technical white paper discussing the details behind their less energy-intensive alternative to Bitcoin. The white paper outlines efforts to replace Bitcoin's proof of work with a consensus algorithm using proofs of space and proofs of time.

Zooko Wilcox, CEO of Electric Coin Company (ECC) — the firm behind the privacy-focused cryptoasset Zcash —, has made an appeal for the creation of a new “Dev Fund” to support the future operations of the organizations supporting Zcash.

Ox and **StarkWare** have teamed up on a new system to scale decentralized exchange (DEX) trades by 20x. The teams announced the alpha release of a new proof system — dubbed StarkDEX — to the Ethereum blockchain, which aims to alleviate problems facing decentralized exchanges.

Did you know?

Zcash is a cryptocurrency aimed at using cryptography to provide enhanced privacy for its users compared to other cryptocurrencies such as Bitcoin.

The cryptocurrency uses powerful cryptographic techniques called Zero Knowledge Proofs to ensure the privacy of transactions on the Zcash network.

Zero Knowledge Proofs have a variety of use cases within the blockchain industry such as privacy and scalability.





Amun Launches

Amun AG announced on Friday July 5 that it has listed the first exchange-traded product (ETP) tracking the performance of Bitcoin Cash (BCH). The Amun Bitcoin Cash ETP (ABCH) is a fully collateralized product that is denominated in US dollars and has an annual investor fee of 2.5% that includes custody, insurance, and re-balancing charges. This new crypto investment instrument is seeded by Roger Ver, the executive chairman of Bitcoin.com, with 25,000 BCH, worth around than \$10 million at that date.

Amun AG announced on Wednesday June 26 that it had launched a new exchange-traded product (ETP) that will use the Bitwise 10 Select Large Cap Crypto Index as a benchmark. The Amun Bitwise Select 10 Large Cap Crypto ETP (KEYS) is a fully collateralized product that is denominated in US dollars and has an annual investor fee of 2.5% that includes custody, insurance, and re-balancing charges.

In addition, over the next two months **Amun AG** plans to launch several new products. The first is a Tezos ETP (AXTZ) which will be the world's first staking ETP. We will also be launching a Binance Coin ETP (ABNB) in partnership with **Binance**, the world's most popular exchange. Finally, we will launch an ETP tracking an index consisting of BTC and ETH in collaboration with **Bitcoin Suisse** (ABBA).

Key Quotes



“The world that Satoshi Nakamoto, author of the Bitcoin whitepaper envisioned, and others are building, is an unstoppable force.”

Patrick McHenry
U.S. Congressman

“Bitcoin is becoming increasingly a macro-hedge for investors against things that could go wrong. Rate cuts are adding liquidity. Liquidity is pushing money into all these risk assets and also hedges, which is helping Bitcoin.”

Jack Dorsey
CEO of Square and Twitter

“I won’t be talking about Bitcoin in 10 years, I can assure you that [...] I would bet even in five or six years, I’m no longer talking about Bitcoin as Treasury Secretary. I’ll have other priorities. [...] I can assure you I will personally not be loaded up on Bitcoin.”

Steven Mnuchin
U.S. Treasury Secretary

“Bottom line: You won’t have to trust Facebook to get the benefit of Libra. And Facebook won’t have any special responsibility over the Libra Network. But we hope that people will respond favourably to the Calibra wallet. We’ve been clear about our approach to financial data separation and we will live up to our commitments and work hard to deliver real utility.”

David Marcus
Head of Calibra at Facebook

“The increase in proliferation of digital asset projects outside the US, the movement of companies to leave the US and projects to get started outside the US is definitely getting people’s attention.

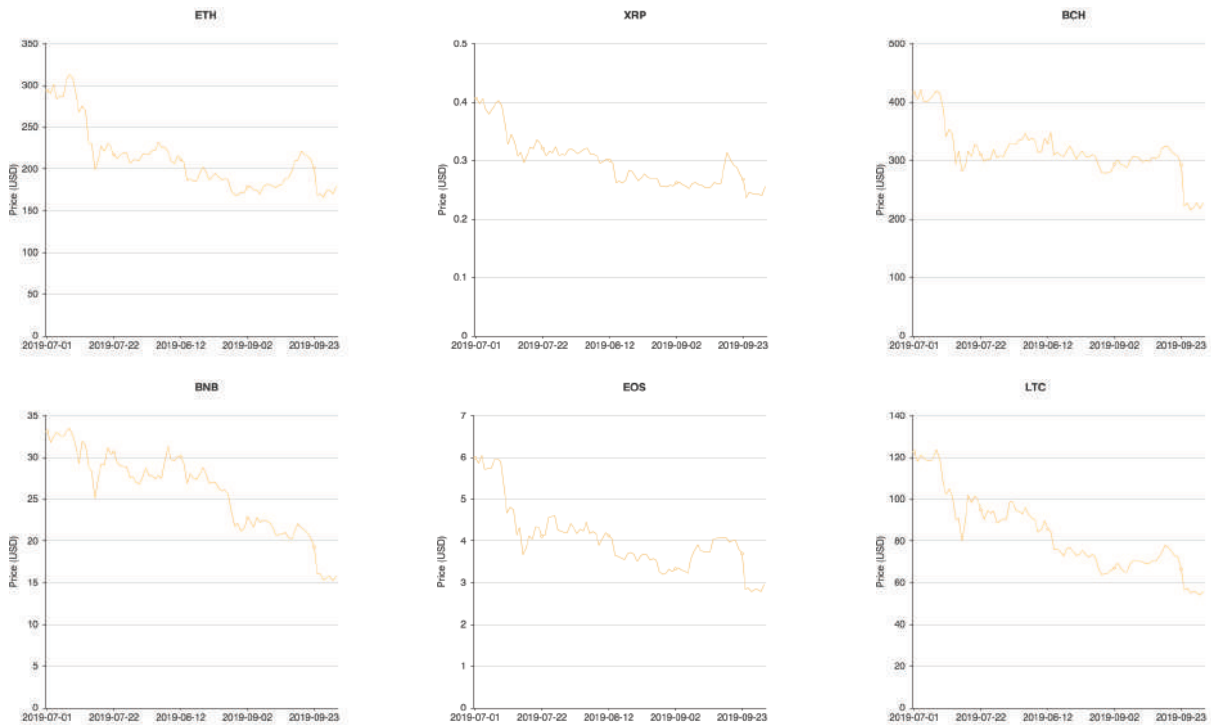
It is ultimately going to lead to legislative initiatives to try and ensure that there are appropriate safeguards and investor protections but also clarity, which is much needed to allow the technology and industry to flourish.”

Jeremy Allaire
CEO of Circle

Figure 1: Bitcoin (BTC) Performance



Figure 2: Ethereum (ETH), Ripple (XRP), Bitcoin Cash (BCH), Binance Coin (BNB), EOS (EOS), & Litecoin (LTC) Performance



HODL

Amun Crypto Basket Index ETP
Tracking the investment results of an index composed of top 5 crypto assets ranked by market capitalization.



ABTC

Amun Bitcoin ETP Bitcoin
Tracking the investment results of BTC.



KEYS

Amun Bitcoin ETP Bitcoin
Tracking the investment results of the Bitwise Select 10 Large Cap Crypto Index.



ABCH

Amun BCH ETP
Tracking the investment results of BCH.



AETH

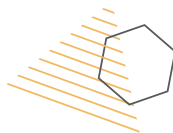
Amun Ethereum ETP
Ethereum Single Tracker
Tracking the investment results of ETH.



AXRP

Amun Ripple XRP ETP
Tracking the investment results of XRP.

Crypto Jargon



A **Blockchain** is an append-only, decentralized ledger that can be used to store data (such as transaction history) in a censorship-resistant way.

Crypto assets are digital assets whose global transaction history is stored on a blockchain. They include cryptocommodities (representation of digital resources), cryptocurrencies (alternatives to fiat), and cryptotokens (exchanged for digital goods and services).

A **Crypto Exchange** is a platform that enables the exchange of crypto assets for other crypto assets or fiat currencies.

A **Digital Wallet** is software that interacts with blockchains to facilitate the storage of crypto assets.

A **Halving Event** is when the number of new coins rewarded to miners per block is cut in half.

The **Hash Rate** is the combined number of computations (hashes) performed by all miners within a network per second.

A **Token Sale**, also known as an initial coin offering (ICO), is a fundraising mechanism for blockchain projects where tokens are generated and sold to investors.

Mining is a mechanism where individuals within a network solve computationally difficult proofs of work in order to confirm transactions and add new blocks to a blockchain.

On-chain refers to information and transactions that are executed and stored explicitly on a blockchain.

Proof of Stake (PoS) is a mechanism that selects block creators based on a participant's stake, such as the number of tokens they hold or how long they have participated on the network.

A **Proof of Work (PoW)** is a piece of data which is difficult to produce but easy for others to verify and which satisfies certain requirements. They are often used in the consensus mechanisms of crypto asset networks.

A **Smart Contract** is digital code typically programmed onto a blockchain that enforces a previously-agreed-upon transaction based on preset conditions.

Stablecoins are crypto assets which aim to have similar volatility to widely-used fiat currencies like the US dollar.

Zero-Knowledge Proofs (ZKPs) enable an individual to provide proof to a verifier that a certain asset or information exists without revealing details about the asset or information itself.

Binance Coin (BNB) is a crypto asset issued by the crypto exchange Binance and is used to pay service fees on the exchange.

Bitcoin (BTC) was created in 2009 and is the first and most popular crypto asset.

Bitcoin Cash (BCH) is a fork of Bitcoin and aims to be a medium for payments.

Ether (ETH) is the native crypto asset of the Ethereum blockchain and is used to pay for transaction and smart contracts fees on the network.

EOS (EOS) is the EOS.IO network token used to build and run decentralized applications on the network.

Litecoin (LTC) is a fork of Bitcoin with a focus on offering faster and cheaper transactions.

Ripple (XRP) is a token issued on the Ripple network that focuses on facilitating the transfer of fiat currencies via the network.

Tether (USDT) is a stablecoin pegged to the US dollar created by iFinex Ltd.

Tezos (XTZ) is a token issued by the Tezos network and is used to vote on Tezos governance decisions and pay for transaction and smart contract fees.

Zcash (ZEC) is fork of Bitcoin with an increased focus on privacy through the use of zero-knowledge proofs.

Valuing Bitcoin

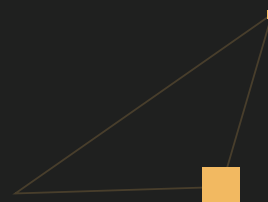
AN ANALYSIS OF METHODOLOGIES FOR VALUING BITCOIN



This research report will identify and analyse the different methodologies for valuing Bitcoin. We will use each of these methodologies to better understand the different trends in relevant data points for the crypto asset over time.

This report will focus on five unique metrics: the Network-Value-to-Transactions (NVT) Ratio, the Network-Value-to-Realized-Value (NVRV) Ratio, the Network-Value-to-Hash-Rate (NVHR) Ratio, the Active Addresses metric, and the Cost of Mining method.

In addition, we will analyse the various market sizing analyses done for Bitcoin including comparisons to the global remittances and gold markets. Finally, we will conduct an intrinsic valuation calculation for Bitcoin using the Equation of Exchange. As a whole, the metrics suggest that the Bitcoin bear market is truly over – with a further sustained drawdown extremely unlikely – and that Bitcoin's fundamentals are likely to support further growth in the market over the next 18 months.

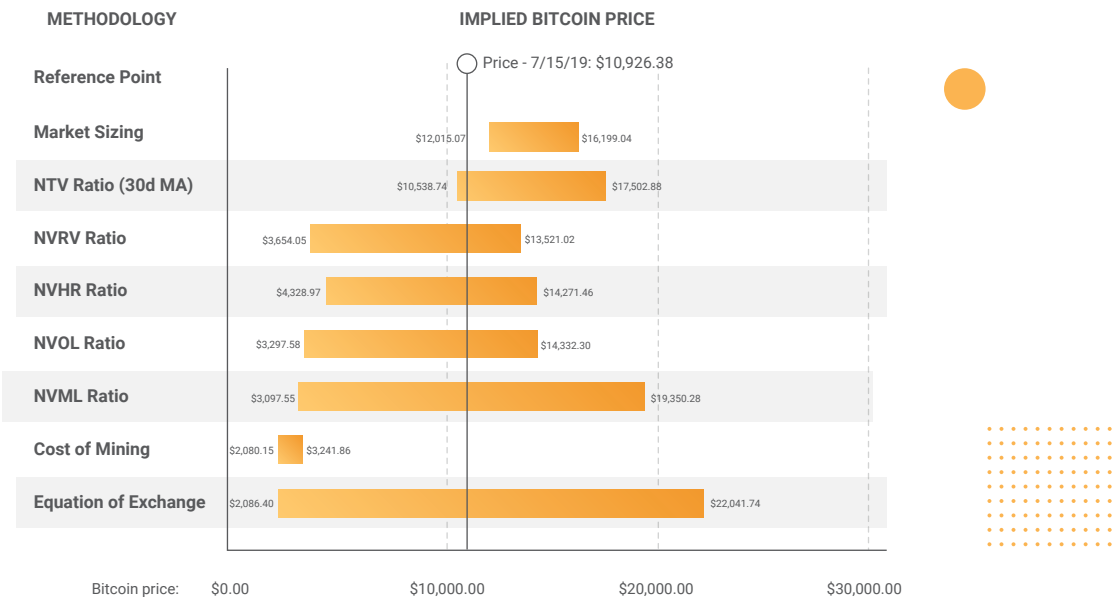


Summary

This report¹ aims to value Bitcoin in a similar way to the valuation methodologies available for traditional financial assets. This report builds on the wealth of research already carried out on valuing Bitcoin and uses the most credible methodologies — such as Market Sizing, the NVT Ratio, and NVRV Ratio — to ascertain price ranges for Bitcoin as shown below (Fig. 1).

Our key finding is that, based on the current valuation methodologies at our disposal, Bitcoin’s current price seems to be trading within an acceptable threshold based on its fundamentals. Given the nascent valuation methodologies and the crypto asset’s volatility, the price ranges shown by some of these new methodologies, such as the Equation of Exchange Method and the Cost of Mining, are quite wide or off the mark; nevertheless, we believe that certain valuation methodologies such as Market Sizing, the NVT Ratio — though a lagging indicator — and the NVRV Ratio are useful in better understanding the relationship between the market’s current pricing of Bitcoin relative to its fundamentals.

Figure 1: Valuations Price Ranges



Assumptions

For the NVT, NVHR, NVRV, Network-Value-to-Metcalfé’s-Law (NVML), and Network-Value-to-Odlyzko’s-Law (NVOL) Ratios, the implied Bitcoin ranges have been calculated by using the maximum and minimum values of the respective metric during the period July 15 2018 to July 15 2019, and then calculating the implied Bitcoin price assuming that the fundamental metric within the denominator of each ratio (transaction volume, hashrate, and realized value) was equal to its value on July 15 2019.

For market sizing, the implied Bitcoin range was calculated by taking the minimum and maximum values of the predicted Bitcoin prices on the date July 15 2020. Moreover, the Cost of Mining implied Bitcoin range was calculated by taking the minimum and maximum values of the implied calculated Bitcoin price under the method during the range July 15 2018 and July 15 2019. Finally, the implied Bitcoin range under the Equation of Exchange method was calculated using the maximum and minimum values for on-chain transaction volume in the twelve months prior to July 15 2019 which were then used as inputs in the Equation of Exchange model.

Traditional Valuation Methodology Overview

Traditional valuation typically uses one of three approaches to value a business or asset.

Cost approach

Simply stated, the cost approach is a valuation method that states the price of an asset should be equal to the costs incurred to build, replace, or procure that asset. The cost approach is a popular method for valuing assets like gold. Because many researchers believe that gold and Bitcoin share a similar roles as a store of value or as a tool for hedging, the cost approach may provide a strong framework for valuing Bitcoin. However, it is important to note that the intricacies of the concept of mining difficulty in Bitcoin may impact the effectiveness of the cost approach in valuing Bitcoin.

Market approach

The market approach values assets, also known as the relative value approach, by comparing the asset to others with similar characteristics or by using transactions of similar size in similar industries to derive its value. The two most common market approaches to valuation are:



Public comparable companies

The asset is valued by comparing a set of its relevant financial ratios to those of a set of comparable assets that are selected based on metrics like industries and geographies served, company size, etc. By comparing the asset to its peers, this approach can develop a price estimate or price range for the asset based on the best, worst, mean, or modal metric values for the peer group. Selecting the appropriate metrics and companies is of the utmost importance with this methodology, however, as unrelated assets or industries will produce values that have little relevance to the asset being valued.



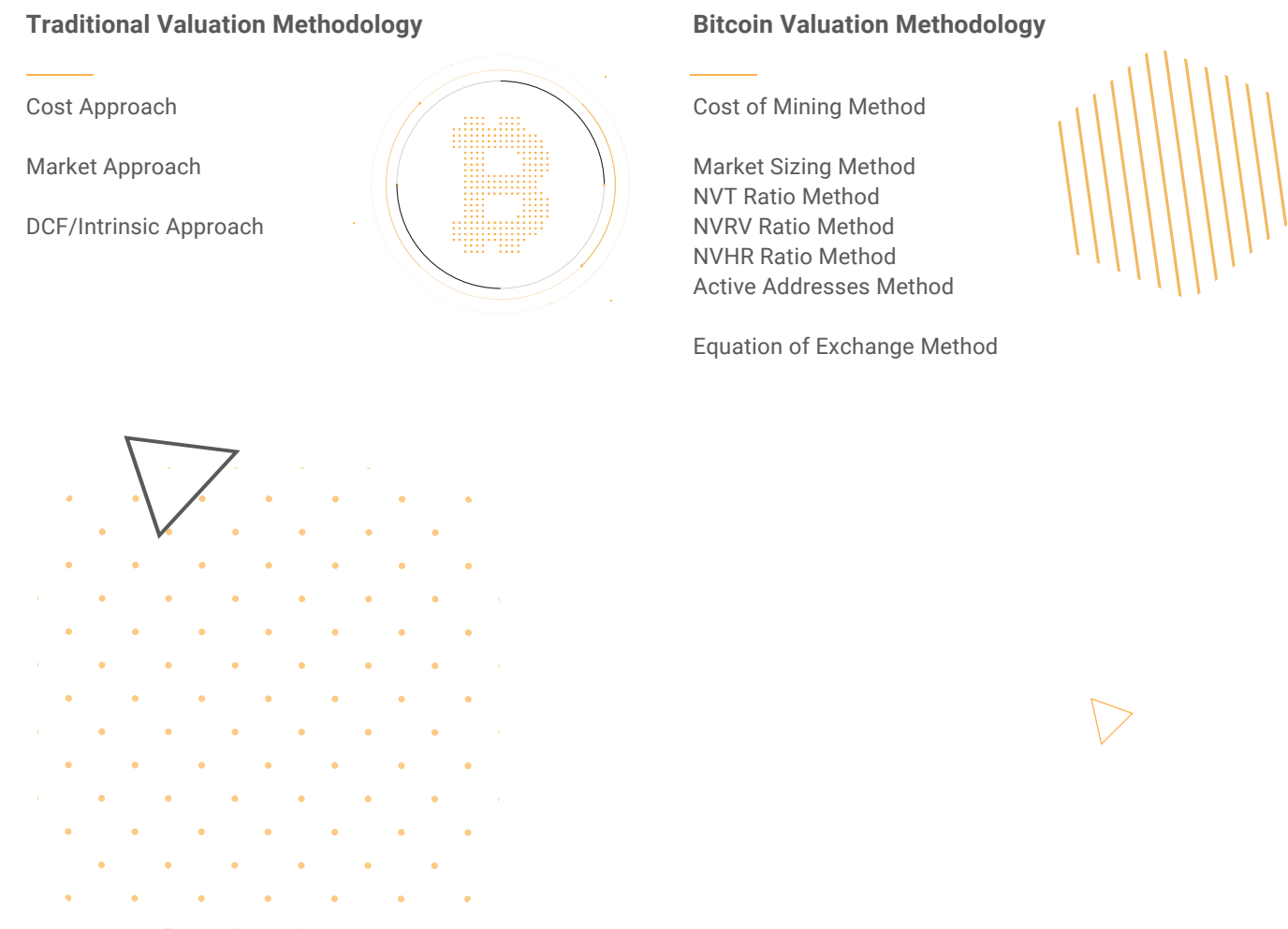
Preceding transactions

The asset is valued by analyzing the price paid for similar companies in past M&A transactions. For this reason, preceding transactions may also be referred to as M&A comps. This approach is useful because it considers the market's appetite for the asset and values the asset accordingly. One drawback to the preceding transaction approach, is that an acquirer in a preceding transaction may pay a premium for a particular asset that is not reflected in the asset being valued in this approach.

Discounted Cash Flow Approach

The discounted cash flow (DCF) approach, also known as the intrinsic value approach, posits that the value of an asset is the present value of its expected future cash flows. These future cash flows are the projected year-end cash flows for the asset after relevant costs and expenditures are subtracted from revenue.

The DCF approach values the asset by discounting these back to the present day using an appropriate discount rate. The DCF approach is one of the most widely used valuation methodologies in both professional and academic contexts thanks to its focus on the actual business environment a company or asset is operating in, which allows investors to determine whether an asset is properly valued. One must use caution when using the DCF approach, however, as unexpected economic changes and incorrect growth projections may produce valuations that diverge significantly from an asset’s actual real world value.



Market Sizing Method

Overview

We can use the Market Sizing method to compare the value of the Bitcoin market to other comparable markets such as global remittances (Fig. 2) and gold (Fig. 3). The price of an individual Bitcoin can then be calculated by dividing the total market value by its fully-diluted circulating supply. The global remittances market has generally been seen as an appropriate comparable for Bitcoin since the crypto asset could theoretically help solve some of the pain points of the industry – for example, high fees and the lack of efficiency. The gold market can also be seen as an appropriate comparable for Bitcoin given their similar functions as stores of values and their comparable properties – (quasi-) fungibility and scarcity, for example.

Market Sizing Method - by Chris Burniske & Arthur V. Laffer² (2015)

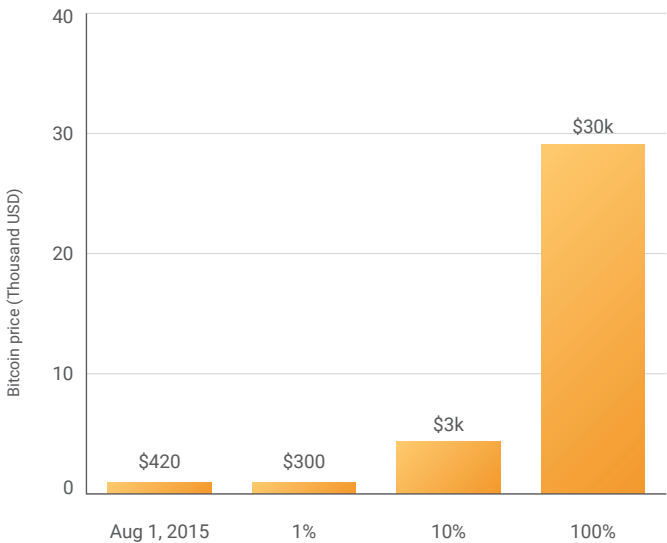
Burniske and Laffer argued that the remittances market, “characterized by high fees and slow settlements”, could be the market most ripe for disruption by Bitcoin. The World Bank³ estimated that money transferred to developing economies totaled \$436 billion in 2014. If the only function of Bitcoin were to exclusively serve the remittances market and the crypto asset were to take the various shares of the market as we have shown in Fig. 2, then the price of Bitcoin would be as shown. At a 1% penetration the Bitcoin price would be \$300, at a 10% penetration it would be \$3,000, and at a 100% penetration it would be \$30,000. However, we believe that this approach grossly underestimates the value of Bitcoin because Bitcoin’s value proposition is better suited for markets other than the remittances market. Established firms like TransferWise already provide an excellent service for remittances and it is unclear why Bitcoin’s other properties – censorship-resistance and decentralization – are valuable when the crypto asset is used as a facilitator of remittance payments. Our method for market sizing Bitcoin, instead, uses the total value of all mined gold – around 190,040 tons according to the World Gold Council⁴ – of \$8.7 trillion⁵.

Implied Bitcoin Price =

Level of penetration * Value of target market

Fully - dilluted Circulating Supply

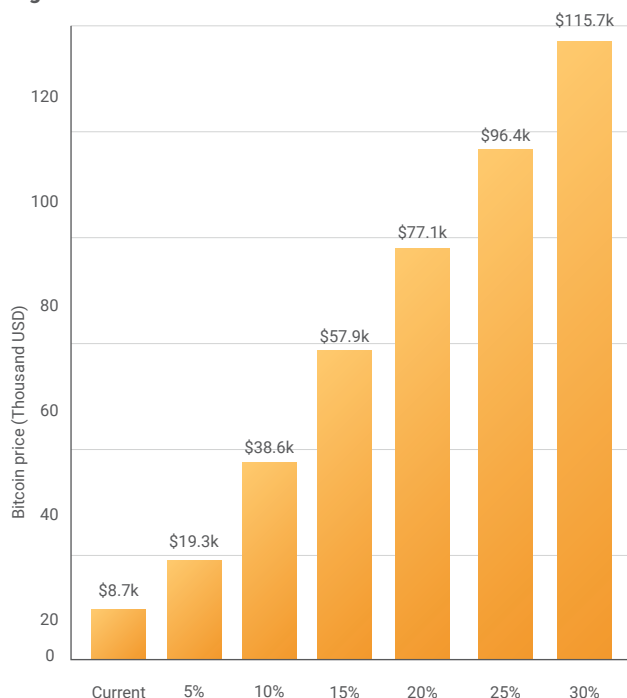
Figure 2: BTC vs Global Remittances



Value of target market - Market value of the market that Bitcoin has been predicted to capture
Level of penetration - The predicted proportion of the target market Bitcoin captures
Fully-diluted Circulating supply - The total number of units of Bitcoin that will ever exist

We believe that gold offers a much better comparable market than that of global remittances given the similarities shared between gold and Bitcoin, like its (quasi-) fungibility, censorship-resistance, and reliable monetary supply. In **Fig. 3** we have calculated the price of Bitcoin assuming different levels of penetration of the gold market. At a 5% penetration of the gold market, Bitcoin's price would be \$19,300 and at a 10% penetration of the gold market, its price would be \$38,600. Moreover, at a 20% penetration its price would be \$77,100, whilst finally at a 30% penetration its price would be \$115,700. We can see that our market sizing method leads to substantially higher values of the estimated price of Bitcoin which we see as more reasonable given the range the crypto asset has traded at over the last two years.

Figure 3: BTC vs Gold Market

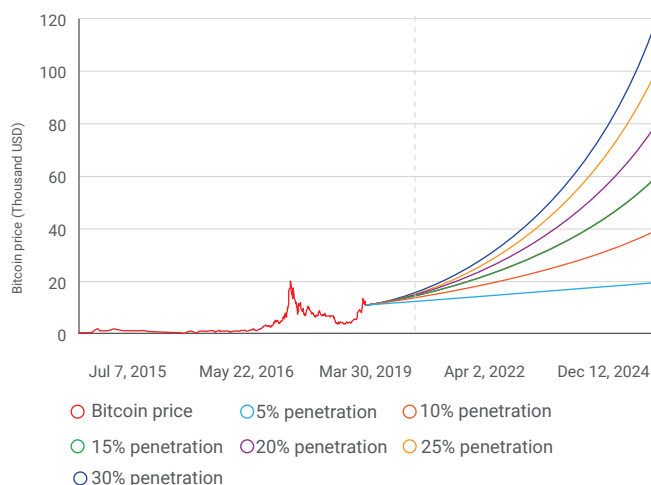


Analysis

In **Fig. 4** we have calculated the possible paths required for the Bitcoin price to reach the different gold penetration levels from July 15, 2019 to July 15, 2025. To reach the 10% penetration target price of \$38,600, Bitcoin's average daily rate of return would need to be 0.07%; to reach the 20% penetration target price of \$77,100 the average daily rate of return would need to be 0.10%; and finally, to reach the 30% penetration target price of \$115,700 the average daily rate of return would need to be 0.13%. We have chosen the year 2025 as it represents a year further enough in the future for Bitcoin to have made significant strides forward on its fundamental value proposition – in terms of improvements in its technological and financial infrastructure – such that the crypto asset could have plausibly captured a significant proportion of its target market. Unlike the majority of other valuation methodologies for Bitcoin, the market sizing method has an intuitive appeal for what Bitcoin's value could be at full maturity.

It is difficult to understand and predict the path the crypto asset will take to reach its indicated values at maturity. Crypto asset returns could be argued to be stochastic over short time periods and the predictions made for the price of Bitcoin fail to take that into account – therefore limiting this method's usefulness over shorter timeframes. While we believe that the gold market currently offers the best comparable market given Bitcoin's value proposition as a store of value, this could change due to microeconomic factors, like changes in technology or the emergence of viable competitors within the crypto asset space, or to macroeconomic factors, like unprecedented government action against crypto assets. In such cases, alternative markets such as peer to peer payments or more complex financial products may be better suited for comparison.

Figure 4: BTC Market Sizing Prediction, 2019-2025



NVT Ratio Method

Overview

The Network-Value-to-Transactions (NVT) Ratio^{6,7,8} measures the dollar value of on-chain transaction activity of a given crypto asset network relative to its Network Value. In the following example, we make use of a 30-day moving average to account for large variations in on-chain transaction activity.

$$\text{NVT} = \frac{\text{Network Value}}{\text{Value of On-chain Transaction Activity}}$$

Network Value - Total USD value of all the circulating units of a given crypto asset, which is equivalent to the market capitalization of a stock

Value of On-chain Transaction Activity - The dollar value of the transactions settled on the crypto asset's blockchain. In contrast, off-chain transactions are those such as when an exchange carries out a trade between two counterparties without the trade itself being settled on a blockchain

In simple terms, the ratio can be understood as the dollar amount an investor can expect to invest in Bitcoin corresponding to one dollar of value being transmitted on the Bitcoin blockchain. All things being equal, an NVT higher than the historical mean suggests that the market is placing a premium on Bitcoin's ability as a transactional medium, which is ostensibly one of its primary functions. Conversely, an NVT lower than the historical mean suggests that the market is placing Bitcoin's ability as a transactional medium at a discount. In the long term we expect Bitcoin's NVT to trend towards its historical mean, therefore the ratio can be used as an indicator of Bitcoin being undervalued or overvalued. We show Bitcoin's NVT over

time with its peak (112.97), trough (26.02), and mean (57.29) indicated ([Fig. 5](#)).

The NVT ratio shares similarities with the Price-to-Earnings (PE) Ratio used in equity markets (e.g. like the way the PE ratio indicates the dollar amount an investor can expect to invest in a company to receive one dollar of that company's earnings). In a similar manner to how earnings should be seen as the key performance indicator of a mature company, the amount of value transmitted on Bitcoin's blockchain is the most important signal to suggest it is in fact being used as a medium of exchange and a store of value.

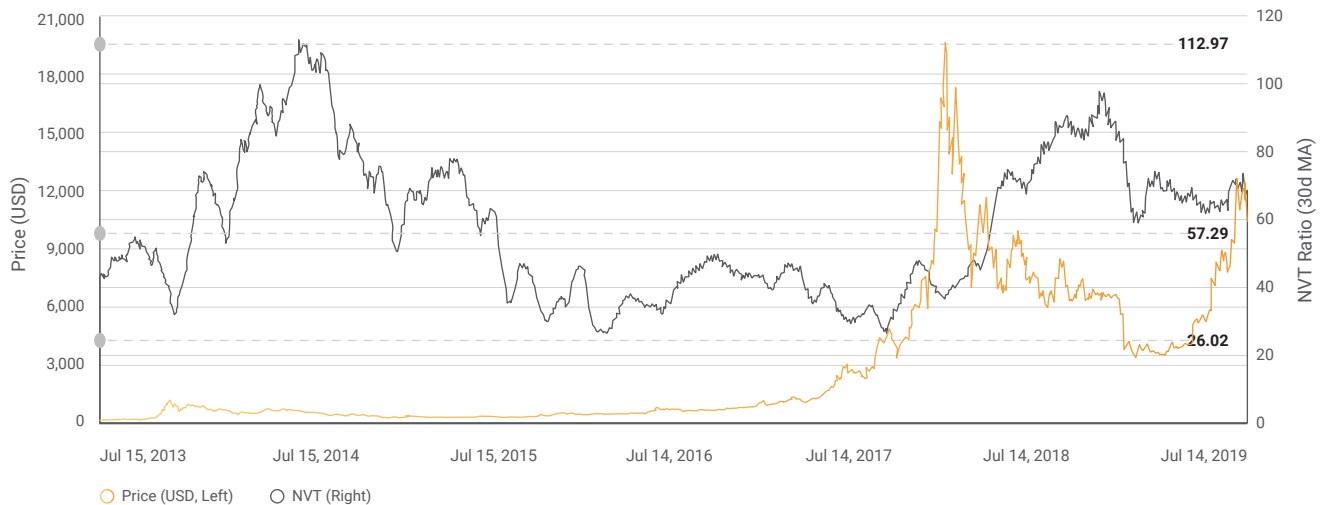
Figure 5: BTC NVT, 2013-2019



Analysis

Graphing Bitcoin's price and NVT during the Bitcoin bubbles of 2014 and 2017 (**Fig. 6**) demonstrates that NVT is a lagging indicator of both periods of overvaluation and undervaluation.

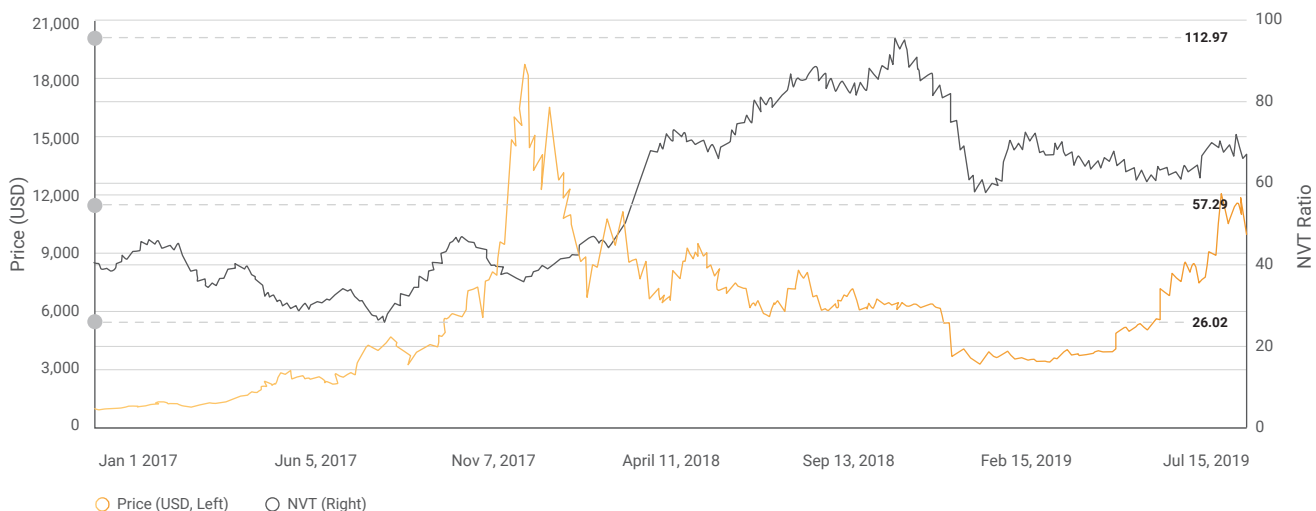
Figure 6: BTC NVT vs Price, 2013-2019



The peak Bitcoin price during the 2013 bubble was \$1,334.93 on December 4, 2013 – though the 30-day MA NVT did not peak until it hit 112.97 nine months later on August 3, 2014. The exact same pattern emerged during the 2017 bubble, when the peak Bitcoin price was \$19,451.70 on December 16, 2017. In this case, the NVT peaked 10 months later at a value of 96.80 on October 7, 2018 (**Fig. 7**).

Conversely, the bottoming out of the NVT in the aforementioned periods at 22.2 on March 7, 2014 and 26.02 on August 2, 2017 preceded both periods' price lows by large timeframes. As of July 15, 2019, Bitcoin's NVT of 66.65 is trending not too far from its historical mean, suggesting that the market is currently pricing Bitcoin close to its NVT-based fair value (**Fig. 5**, previous page).

Figure 7: BTC NVT vs Price, 2017-2019



There are intuitive reasons why the NVT ratio is appealing as a valuation indicator. It helps investors understand the value trend of Bitcoin as a transaction medium, as well as the price that the market assigns to this function. The chart (Fig. 8) calculates the implied Bitcoin Price assuming that Bitcoin's NVT was equal to its mean value of 57.29. The implied Bitcoin price has been a relatively strong indicator of the actual Bitcoin price therefore showing that NVT does have some bearing to Bitcoin's fundamentals.

However, the NVT ratio does have several limitations – namely the fact that it is a lagging indicator – and it cannot be used as the only way to value Bitcoin. For example, the average percentage difference of the implied Bitcoin valuation and the actual Bitcoin price was around 27.24%.

This percentage difference arises because the metric tends to overestimate the Bitcoin price during market highs, as shown in the Bitcoin bull market of 2017 where the implied Bitcoin price reached \$24,062.58 while the actual Bitcoin price peak during the same period was \$19,451.70.

Moreover, on a conceptual level the metric could be said to slightly undersell the value proposition of Bitcoin. Whilst NVT measures Bitcoin's utility as a payments medium, it cannot properly account for Bitcoin's usefulness as a store of value. As such, a metric like NVRV could be better suited for such a purpose, as it accounts for the lengths of time over which Bitcoin has been held by investors – a proxy for its store of value property.

Figure 8: BTC NVT vs Price, 2013-2019



NVRV Ratio Method

Overview

The Network-Value-to-Realized Value (NVRV)⁹ Ratio measures the dollar value of a crypto asset's Realized Value relative to its Network Value.

$$\text{NVRV} = \frac{\text{Network Value}}{\text{Realized Value}}$$



Network Value - The total dollar value of all the circulating units of a given crypto asset, which is equivalent to the market capitalization of a stock

Realized Value (Fig. 9) - An alternative way to measure Network Value where, instead of aggregating all circulating Bitcoin equally at the asset's current price, each Bitcoin is aggregated and assigned a price based on the market price at the time when each Bitcoin was last transferred to a new address (or, technically, when the unspent transaction output (UTXO) for the given Bitcoin was last spent)

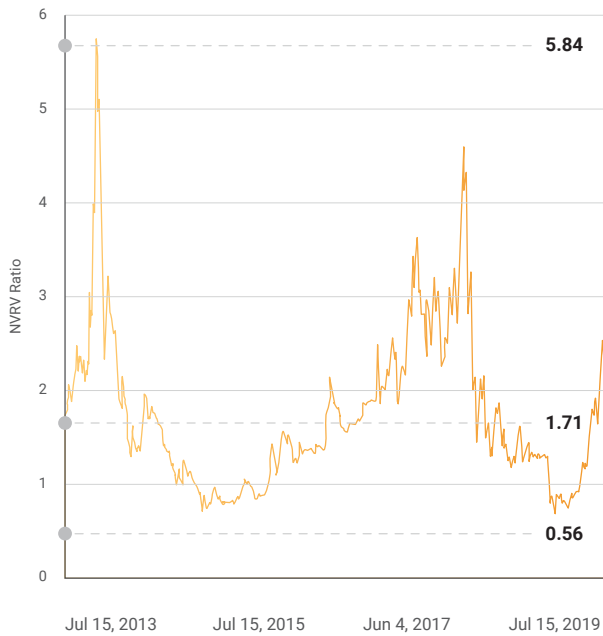
In simple terms, the ratio can be understood as the relationship between high time preference-related use of Bitcoin during certain periods compared to use of Bitcoin by those with lower time preferences.

In simple terms, the ratio can be understood as the relationship between high time preference-related use of Bitcoin during certain periods compared to use of Bitcoin by those with lower time preferences. All things being equal, a higher NVRV than the historical mean suggests that Bitcoin's price is being primarily determined by investors with high time preferences (such as speculators and short-term traders). Conversely, a NVRV lower than the mean suggests that Bitcoin's price is being determined by investors with low time preferences (such as long term investors). During the Bitcoin bubbles of 2014 and 2017, Bitcoin's NVRVs reached highs of 5.84 and 4.64 on November 18, 2013 and December 7, 2017 respectively (Fig. 10).

Figure 9: BTC Network Value vs. Realized Value, 2013-19



Figure 10: BTC NVRV Ratio, 2013-2019



Analysis

It appears that the NVRV gives an indication of the floor for Bitcoin's network value at any given point. It is unlikely that Bitcoin's NVRV would be lower than 1 for any extended period of time, as this would require long term holders to sell their investments at a loss.

There are two distinct periods wherein Bitcoin's NVRV was below 1: October 2014 – October 2015 and November 2018 – March 2019.

There are two distinct periods wherein Bitcoin's NVRV was below 1: October 2014 – October 2015 and November 2018 – March 2019. During these periods the average NVRV value was 0.853 and 0.846 respectively (Fig. 11). Noticeably, Bitcoin's NVRV had recently been lower than 1, suggesting that the crypto asset is unlikely to dip down to price levels seen between December and April of 2019.

As of July 15, 2019, Bitcoin's NVRV was around 2.08 which means that it is entirely plausible that its market value could multiply by over 2x before Bitcoin's NVRV reaches levels seen during the previous two bubbles. Such a situation is possible if the market reaches a point in the future where the level of retail and speculative interest matches that of the 2017 bubble.

The NVRV Ratio's main strength is that it is seen as a leading indicator for Bitcoin price bottoms following Bitcoin bull markets – the ratio has provided an excellent indicator in both 2014 and 2017. However, the ratio is less useful for predicting future bull markets as both its component variables can increase in lockstep – therefore leaving the ratio constant – during the early periods of a bull market. We expect that as speculative activity drops over time the network value will extend less above realized value.

Figure 11: BTC NVRV Below 1, 2013-2019



NVHR Ratio Method

Overview

The Network-Value-to-Hashrate (NVHR) Ratio measures the dollar value of the crypto asset's mining power or hashrate underlying its economic security – measured in terahashes per second (TH/s) – relative to its Network Value.

$$\text{NVHR} = \frac{\text{Network Value}}{\text{Network Hashrate}}$$



Network Value - The total dollar value of all the circulating units of the given crypto asset. It is equivalent to the market capitalization of a stock

The Network Hashrate (Fig. 12) - The amount of computational power being used by Bitcoin miners to mine blockchain on the Bitcoin blockchain and therefore help maintain Bitcoin's economic security

While there is no straightforward equivalent for hashrate within traditional equity and bond markets, the hashrate is comparable to the security spend of a financial services company. The ratio can be interpreted as the dollar amount an investor can expect to invest in Bitcoin corresponding to a Bitcoin mining hashrate of 1 Terahash per second (TH/s). As such, a higher value of NVHR suggests that an investor is willing to pay more to receive the economic security granted by Bitcoin's current hashrate.

Conversely, a lower value of NVHR suggests that an investor is willing to pay less for the economic security granted by Bitcoin's cumulative hashrate.

Conversely, a lower value of NVHR suggests that an investor is willing to pay less for the economic security granted by Bitcoin's cumulative hashrate. The reason for this is that Bitcoin's value proposition as a medium of exchange and a store of value is inextricably connected to the total amount of computational work used by miners to mine blocks. The mining process ensures that transactions (and blocks of transactions) are extremely difficult to reverse by an attacker as they would be required to generate at least 51% of Bitcoin's hashrate –

which would be extremely expensive. As such, Bitcoin's hashrate is a key indicator of its blockchain's integrity and resilience against fault. We would expect the market to value Bitcoin more highly as its hashrate increases, though the two share a reflexive relationship as a higher price of Bitcoin is likely to also drive its hashrate up, as the prospect of increased profits incentivizes miners to mine more.

Figure 12: BTC Mining Hashrate, 2013-2019

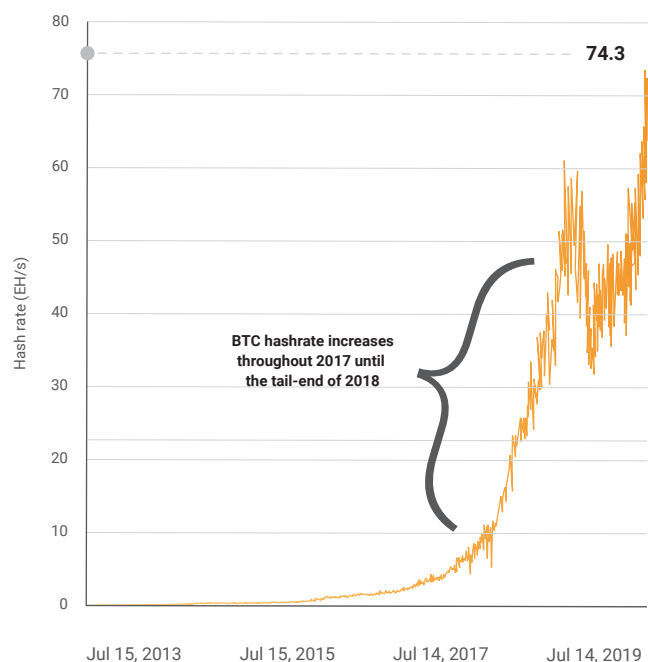


Figure 13: BTC NVHR Ratio, 2017-2019

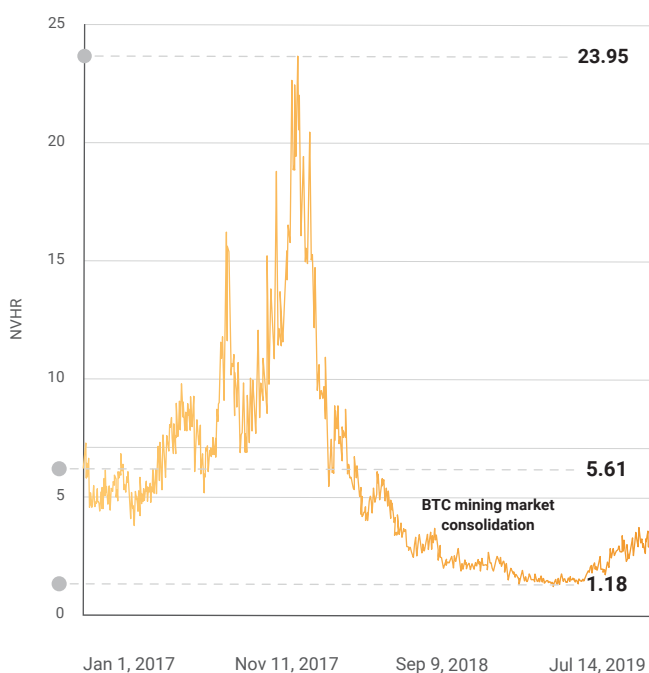
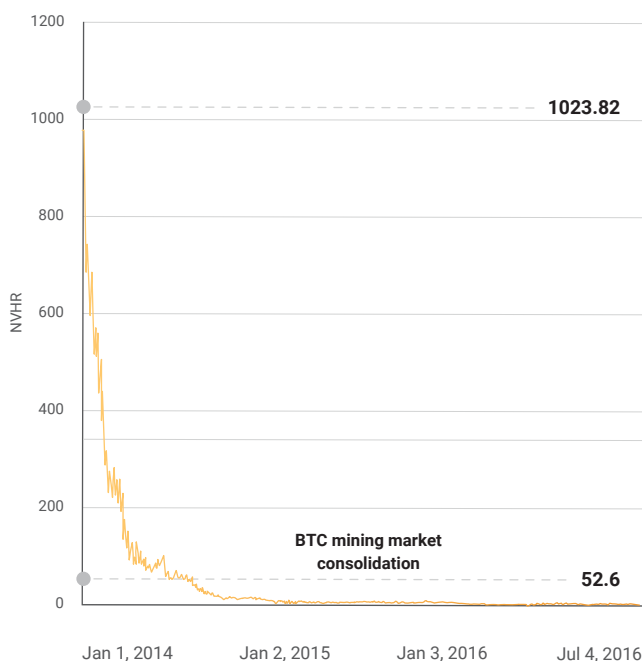


Figure 14: BTC NVHR, 2014-2017



Analysis

We show Bitcoin's NVHR from 2017 to 2019 before, during, and after the Bitcoin bull market of 2017. During this period Bitcoin's NVHR peaked at 23.95 on December 16 2017 and the lowest NVHR value was 1.18 on February 7 2019. The NVHR ratio also allows for an analysis of the different stages of maturity of Bitcoin's mining industry and how that affects the overall valuation of the crypto asset. For example, between 2014 and 2017 Bitcoin's NVHR dropped massively from an average value of 255 in the first six months of 2014 to an average value of 6 in the second half of 2016 ([Fig. 14](#)). This was the result of a massive increase in Bitcoin's hashrate from June 2016 as the mining industry matured and professionalized.

The major strength of the NVHR ratio comes in its ability to easily quantify the relationship between Bitcoin's value and its economic security – using the proxy of its hashrate.

The major strength of the NVHR ratio comes in its ability to easily quantify the relationship between Bitcoin's value and its economic security – using the proxy of its hashrate. In a case where the NVHR ratio reached levels comparable to that of 2013 – 2016 this would indicate that the market is perhaps grossly overvaluing Bitcoin for the economic security it provides. As such, the NVHR ratio can be seen as a proxy for the overall economic security of Bitcoin and, if Bitcoin is to continue to grow as a store of value, we would expect the NVHR ratio to continue to decrease over time. A failure for the NVHR ratio to substantially decrease over time would present existential risks to Bitcoin's ability to function as a store of value.

However, the NVHR ratio is not without its limitations. As we have seen, the range of values from the NVHR ratio has varied significantly as Bitcoin's market value grossly outstripped the amount of hashrate used within the mining process. This fact makes it difficult to do credible comparisons of Bitcoin's NVHR over periods greater than 2 years since, for example, the NVHR ratio in 2014 was over 114 times its value in 2019. As such, this metric is undeniably affected by the stage of maturity of Bitcoin's mining industry, so the large difference in its value between 2013-2016 and 2016-2019 can be, in part, put down to the professionalization of Bitcoin mining during the latter period.

Active Addresses Method

Overview

The Active Addresses metric measures the unique number of individual Bitcoin addresses – equivalent to an account from which a user can send and receive Bitcoin – which have either transact or receive Bitcoin within a given time period. This metric can be understood as sharing similarities with the daily active user (DAU) metric and measures the amount of user activity. The Active Addresses metric is a proxy for fundamental user interest in using Bitcoin and therefore is closely related to Bitcoin's value. As we can see in **Fig. 15**, the metric peaked at a value of 1,290,36 on December 14 2017 which was at a similar time to when Bitcoin's price peaked. There are two ratios which can be derived from Bitcoin's Active Addresses: the Network-Value-to-Metcalfes-Law (NVML) Ratio and Network-Value-to-Odlyzko's-Law (NVOL) Ratio.

$$\text{NVML} = \frac{\text{Network Value}}{(\text{Active Addresses})^2}$$

$$\text{NVOL} = \frac{\text{Network Value}}{(\text{Active Addresses}) * \log(\text{Active Addresses}) * 1000}$$

Network Value - The total dollar value of all the circulating units of the given crypto asset. It is equivalent to the market capitalization of a stock

Active Addresses - The unique number of individual Bitcoin addresses which either transaction or receive Bitcoin within a given time period

The two ratios make use of the two well known computer laws – Metcalfe's Law¹¹ and Odlyzko's Law¹². Metcalfe's Law states that the value of a network is proportional to the square of the size of the network; Odlyzko's Law states that the value of a network is proportional to the logarithm of the size of the network multiplied by the size of the network. These laws have been used in the past to understand and predict the value of networks (like social or telecommunication networks) based on the amount of users or nodes using them. It is for this reason, we think that these laws can form the basis for metrics which help investors understand whether Bitcoin is overvalued or undervalued. The denominator of the NVOL equation was multiplied by a constant factor of 1000 in order to make the data easier to read. For both these metrics, a lower value than the mean would suggest an increased probability that Bitcoin is being underpriced by the market and vice versa for a value higher than the mean.

Figure 15: BTC Active Addresses, 2013-2019

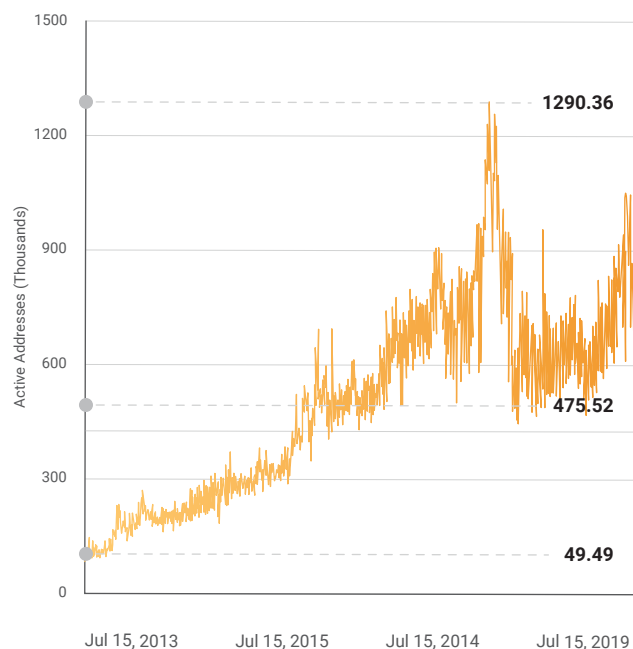


Figure 16: BTC NVML Ratio, 2013-2019

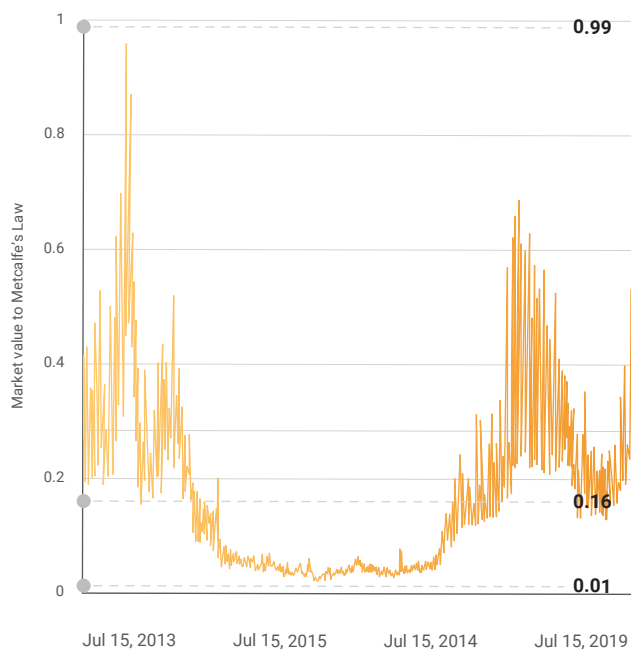
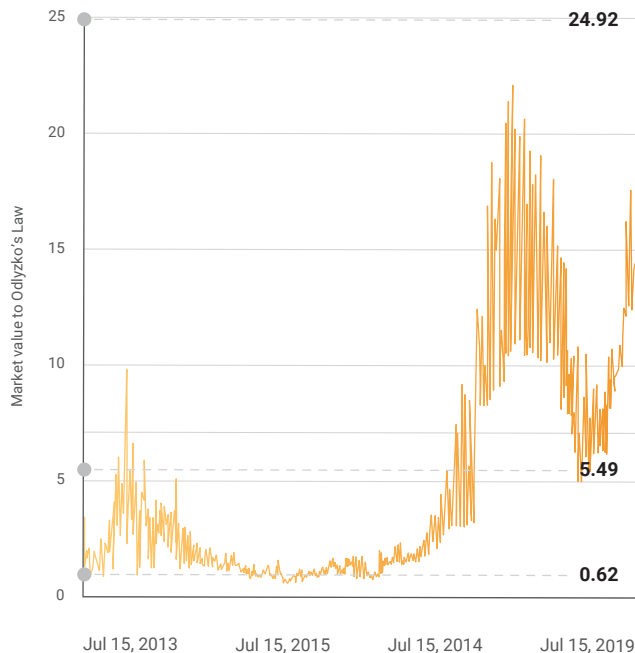


Figure 17: BTC NVOL, 2013-2019



Analysis

Bitcoin's NVML (**Fig. 16**) peaked on January 1, 2014 at a value of 0.99, and its minimum NVML value was 0.0124 on February 2, 2016 – whilst its average value has been 0.163. Conversely, Bitcoin's NVOL (**Fig. 17**) peaked on July 7, 2019 at a value of 24.92 and its minimum value was 0.623 on February 2, 2016.

NVML seems to emphasize the Bitcoin bubble of 2013 to a much larger extent than NVOL does.

NVML seems to emphasize the Bitcoin bubble of 2013 to a much larger extent than NVOL does. Both formulations of the Active Addresses metric are useful as they link the number of "users" on the Bitcoin network to its ostensible value – in a way which can easily be compared to the daily active users metric.

However, there are issues in working out whether NVML or NVOL provide a better formulation of the metric and whether Bitcoin's value can be better understood as being proportional to the square of the size of its network (n^2) or proportional to the log of the size of its network multiplied by the size of its network [$n \cdot \log(n)$].



Cost of Mining Method

Overview

The Cost of Mining Method¹³ says that the cost of Bitcoin production represents the theoretical value around which Bitcoin market prices could be argued to gravitate, under the assumption that the price of a Bitcoin should be valued off the total cost to mine it. The argument for such an approach relies on the fact that mining employs computational effort, which in turn uses electrical consumption by miners. The cost of electricity per kWh, the efficiency of mining as measured by watts per unit of mining effort, the market price of Bitcoin, and the difficulty of mining, all help determine whether a miner will produce or not. If we assume that Bitcoin production is a competitive market then miners will produce until their marginal costs equal their marginal product. The following equation summarizes the theoretical Bitcoin price as calculated by the Cost of Mining method where the cost of mining per day is represented as E_{day} (**Fig. 18**):

$$\text{BTC/day}^* = \frac{\theta(\beta * \rho)}{\delta}$$

$$E_{\text{day}} = (\text{price per kWh} * \theta * W \text{ per G H/s}) * \left(\frac{\rho}{1000} \right)$$

$$\rho^* = \frac{E_{\text{day}}}{\text{BTC/day}}$$

BTC/day* - The expected amount of Bitcoin one can expect to earn per day.

Network Value - The total dollar value of all the circulating units of the given crypto asset. It is equivalent to the market capitalization of a stock.

ρ - The hash power employed by a miner, set at ρ = 1,000 x 10⁹ Hashes per second.

δ - The Bitcoin mining difficulty.

θ - Is a constant representing the normalized probability of a single hash solving a block divided by the number of seconds in a day $\frac{2^{32}}{3600 * 24}$

Price per kWh - The average cost of electricity.

W per GH/s - The efficiency of the mining equipment used.

β - The reward for mining a block.

The above equations represent the various inputs which must go into our model to solve for ρ*, the Bitcoin price.

Fig. 19 presents the ρ*, the implied Bitcoin price against the actual Bitcoin price between July 15, 2013 and July 15, 2019. You can find more details about our model¹⁴ in the endnotes section.

Figure 18: BTC/Day* vs EDAY*, 2013-2019

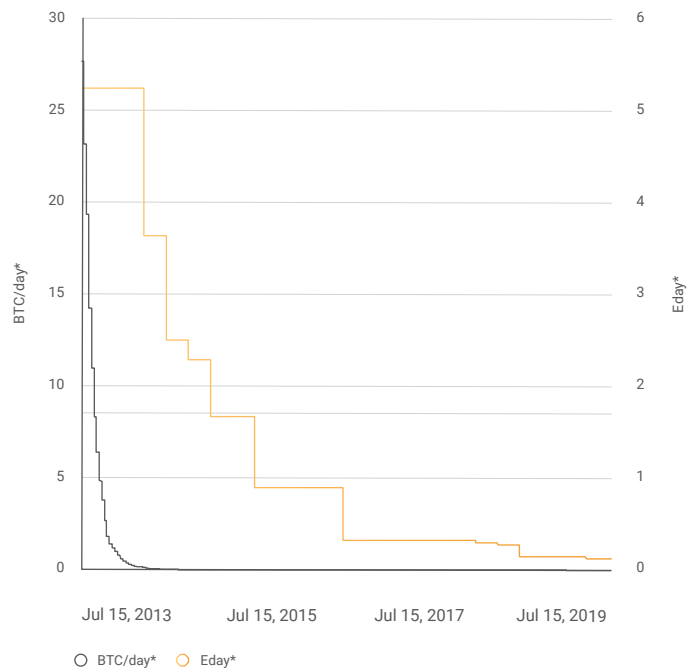
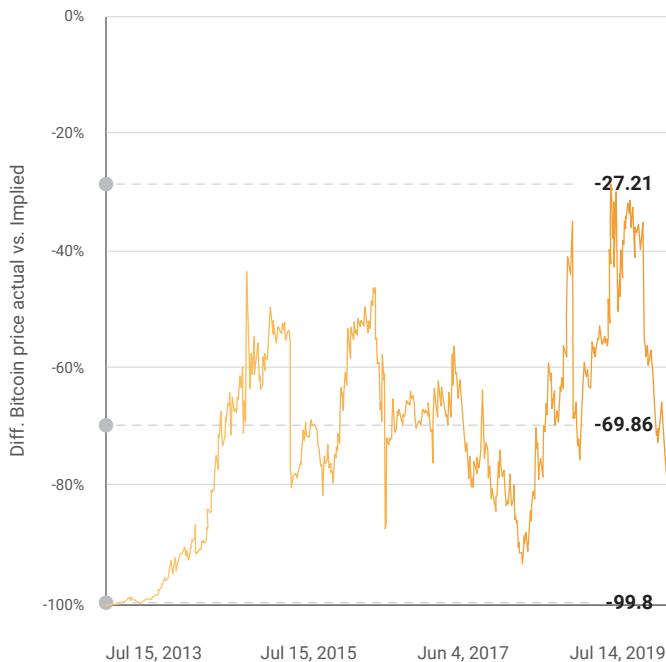


Figure 19: BTC Price vs. Implied Price, 2013-2019



Figure 20: Diff. BTC Price vs. Implied Price, 2013-2019



Analysis

Fig. 19 and **Fig. 20** both show how the implied price from the cost of mining method is always a factor below that of the actual Bitcoin price, with an average difference of -69.86%. The difference between the market price and the implied price reduced the most in the bear market that followed the Bitcoin bull market of 2017 – reaching -27.21% on February 16, 2019.

The appealing thing about the cost of production method of Bitcoin valuation is that it shares similarities with traditional valuation methodologies which rely on an asset's cost of production. However, the cost of mining method is inherently insufficient as a means to value Bitcoin due to its treatment of δ as an exogenous variable which can be used as an input into calculating the price of Bitcoin.

This effort is misguided given the fact that Bitcoin's difficulty at any particular point is determined by the total amount of hash power generated by miners in a given two week period – a variable which is in turn influenced by the expected profits miners have for mining and therefore Bitcoin's price. As such, the cost of production relies on a circularity which inherently leads to erroneous conclusions.



Intrinsic Valuation Methodology

Overview

Unlike traditional assets valued under intrinsic methods like DCF, Bitcoin does not generate cash flow. As a result, it is extremely difficult, if not impossible, to value Bitcoin using a traditional DCF approach, and alternative intrinsic valuation methods must be explored. One approach that has gained traction for intrinsically valuing Bitcoin is the use of the Equation of Exchange, which is defined as:

$$MV = PT$$

M - Money supply, or size of the asset base

V - Velocity of money, or the frequency with which the asset changes hands

P - Price level, or price of the digital resource

T - Transaction volume, or quantity of the digital resource

Derived by economist John Stuart Mill in the 19th century, the Equation of Exchange simply describes the relationship between these four variables. In general, the equation shows that increases in the money supply lead to increases in prices if velocity of money and transaction volume are held constant. By manipulating the equation to isolate any individual variable, one can determine things like the demand for money or the price of a currency. As an asset that shares some similarities with other currencies, Bitcoin can be intrinsically valued using the Equation of Exchange. By pairing readily available public information from reputable data sources with carefully crafted assumptions about the current or future state of the Bitcoin market, the Equation of Exchange provides the ability to put an intrinsically valued price on Bitcoin in the absence of the traditional cashflows used to estimate stock prices for traditional companies.

Point-In-Time Estimate

Unlike the ratios we've already used to value Bitcoin, intrinsic valuations build upon existing data with estimates of future growth for the relevant variables to provide present day valuations. The Equation of Exchange allows us to determine a point-in-time at either the present date or at some point in the future estimate based on the data we select to input for each variable.

Breaking Down the Equation

Using basic algebra, we can rearrange the Equation of Exchange to solve for the Price Level, P, with the equation

$P = MV/T$. It is important to note that with this equation we are solving for the price level related to the Transaction Volume, T, and not the actual price of Bitcoin. However, if we examine the relationship between Transaction Volume, Money Supply, M, and Velocity of Money, V, we see that we can determine a price estimate for Bitcoin itself by dividing T/MV , which is the inverse of the Price Level equation derived above. This equation effectively provides us with the price per transaction, which in this case is the price per Bitcoin. Since we are solving for P, Price Level, we will need to define values for Money Supply, Transaction Volume, and Velocity.

M - Money Supply: This variable is fairly straightforward, as the total number of Bitcoin in circulation will suffice. For our valuation, we used the supply of Bitcoin as of July 15 2019, which was just under 17.8 million Bitcoin.

T - Transaction Volume: Because it represents the actual value of goods traded in Bitcoin per year, transaction volume may be the trickiest variable to develop assumptions for since Bitcoin is not widely utilized as an exchange medium. While some researchers utilize creative methods like estimating the size of black market payments compared to total global GDP to forecast T, we used a more straightforward approach and simply used the average daily on-chain Bitcoin transaction volume, which represents the amount of Bitcoin actually used for transactions, in the 12 months ending July 15 2019, to forecast annual transaction volume. This volume of about \$729.4 billion represents 0.9% of 2017's \$80.9 trillion in global GDP.

V - Velocity: Since velocity is the frequency with which an asset changes hands, we can calculate velocity dividing the supply of Bitcoin by the number of on-chain Bitcoin transactions. As of 15 July 2019, the daily velocity of Bitcoin was relatively high, due in large part to the present Bitcoin rally at 2.1%. This implies that each Bitcoin in supply would change hands about 7.6 times a year, which makes sense intuitively as Bitcoin has yet to see mass adoption as a payment method.

Figure 21: Implied BTC Price, On-Chain Transaction Volume

Value	Transaction Volume (USD)	Implied BTC Price (USD)
Max	\$5,936,469,301	\$22,041.74
Min	\$561,927,513	\$2,086.40
Mean	\$1,559,472,810	\$5,790.22
Prior 30 Days Mean	\$3,190,787,104	\$11,847.19
Actual	\$3,221,988,468	\$10,926.38

Values calculated using data from the following time periods:

Max, Min Mean - 12 months ended July 15, 2019

Prior 30 Days Mean - 30 days ended July 15, 2019;

Actual - closing values on July 15, 2019

Source: Coin Metrics

Valuation Results

To arrive at a price for Bitcoin, we analyzed how variations in on-chain transaction volume affect projected Bitcoin prices.

Considering that Bitcoin's total volume will eventually be capped at about 21 million Bitcoin and that the reward for each block posted to the Bitcoin blockchain will gradually decrease, we believe that the price of Bitcoin will rise if it sees greater adoption as a medium of exchange. As such, on-chain transaction volume can be seen as a good proxy for the demand of Bitcoin for payments.

When analyzing transaction volume, we determined prices for the value of Bitcoin using the maximum, minimum, and mean number of on-chain transactions in the 12 months prior to July 15, 2019. In addition, we also looked at the transaction volume for the 30 days leading up to July 15, 2019 to examine the impact of the recent Bitcoin rally on our intrinsic valuations. In general, we saw a correlated relationship between transaction volumes and projected Bitcoin prices. As seen in **Fig. 21**, higher transaction volumes led to higher implied Bitcoin prices.

This intuitively makes sense, as an increase in on-chain transactions would lead to an increase in demand for Bitcoin and raise prices. In addition to examining the effect of transaction volume on projected Bitcoin prices, we examined the relationship between velocity and price of Bitcoin.

Unlike our transaction volume analysis, our velocity analysis showed an inverse relationship between the projected price of Bitcoin and the velocity of Bitcoin, and lower velocity resulted in higher Bitcoin prices, as shown in **Fig. 22**. In this scenario, a low Bitcoin velocity means that Bitcoin is less readily available in the market, and consumers wishing to conduct transactions in Bitcoin would need to pay a higher price to obtain those Bitcoin.



Figure 22: Implied BTC Price, BTC Velocity

Value	Velocity	Implied BTC Price (USD)
Max	12.2	\$2,623.70
Min	2.2	\$14,311.04
Mean	5.5	\$5,790.22
Prior 30 Days Mean	5.9	\$5,417.11
Actual	6.0	\$10,926.38

Values calculated using data from the following time periods:
Max, Min Mean - 12 months ended July 15, 2019;
Prior 30 Days Mean - 30 days ended July 15, 2019;
Actual - closing values on July 15, 2019
Source: Coin Metrics

Analysis

Under our assumptions, the Equation of Exchange method produced an implied price range of \$2,086.40 - \$22,041.74 for Bitcoin. When conducting our sensitivity analysis where we changed either the volume or velocity figures for the Equation of Exchange, each method produced a range between which the actual price of Bitcoin fell as of the valuation date.

In fact, the implied Bitcoin price using the average transaction volume of the 30 days prior to July 15 was within \$1,000 of the actual Bitcoin price on that date. While sensitivity analysis for the on-chain transaction values produced a higher maximum price projection than the sensitivity analysis for velocity, it also produced a wider range of values.

Although our intrinsic valuation of Bitcoin using the Equation of Exchange may look promising, it does have some shortcomings that must be considered to improve the accuracy of the projections. With a volatile asset like Bitcoin, selecting the most appropriate and relevant data to use for projections is of paramount importance. Furthermore, the data may actually understate the value of Bitcoin, as seen with the implied price using the on-chain transaction volume for the 30 days leading to July 15.

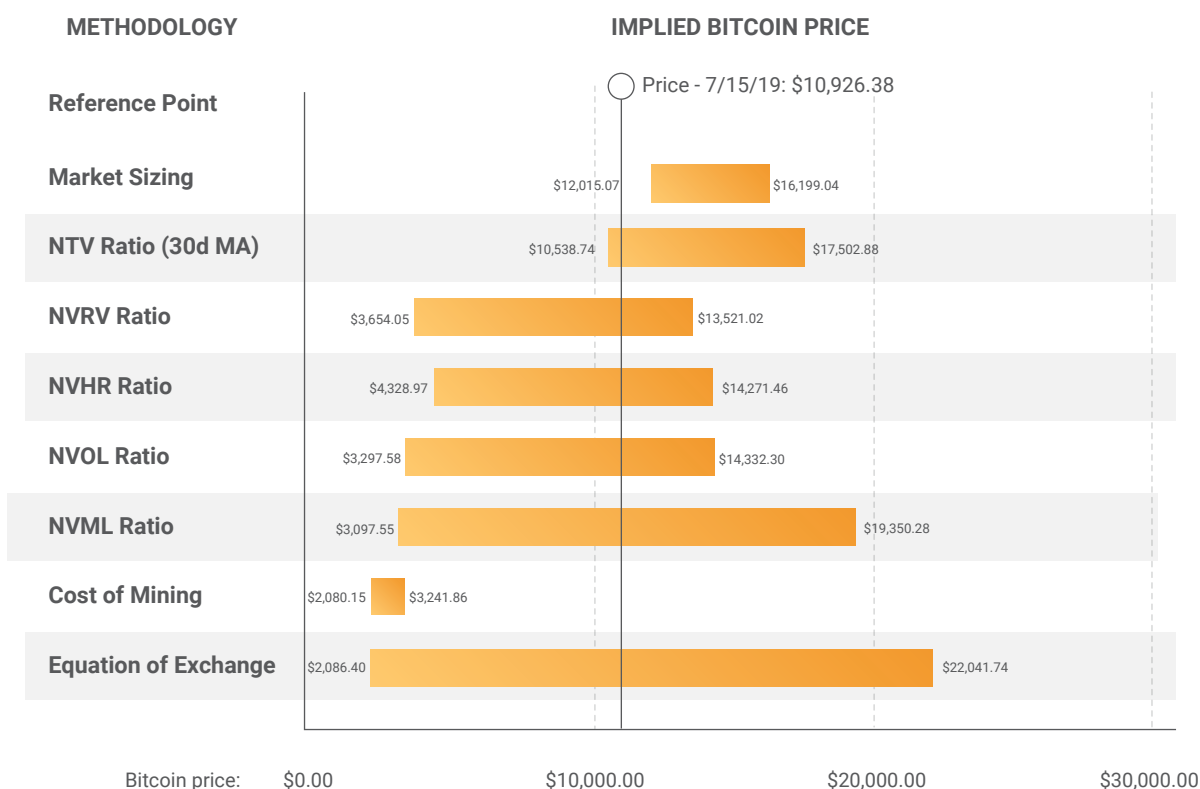
Although the implied price we calculated for Bitcoin using this volume nearly equaled the actual Bitcoin price on July 15, our price was calculated using an assumption that provided for a lower amount of on-chain transactions yet resulted in a higher implied Bitcoin price. This indicates that using on-chain transactions could slightly overvalue Bitcoin.

Conclusion

This research report has identified and analysed the different methodologies for valuing Bitcoin. Throughout this report we looked the most important methodologies for valuing Bitcoin to better understand the different trends in the relevant data points for the crypto asset over time — focusing on five unique metrics: Network-Value-to-Transactions (NVT) Ratio, the Network-Value-to-Realized-Value (NVRV) Ratio, the Network-Value-to-Hash-Rate (NVHR) Ratio, the Active Addresses metric, and the Cost of Mining method.

In addition, we analysed the various market sizing analyses done for Bitcoin including comparisons to the global remittances and gold markets. The chart (**Fig. 23**) below plots the implied price ranges of Bitcoin for our various metrics. Whilst the various methodologies — which we summarize again on the next page — do produce quite wide ranges, the metrics which we consider the most useful — Market Sizing and the NVRV Ratio — all suggest that Bitcoin is currently trading within acceptable ranges.

Figure 23: Valuations Price Ranges



Valuing Bitcoin Overview



	Description	Comments
Market Sizing	Estimate the total addressable market (TAM) for Bitcoin via a comparable market such as gold or global remittances and calculate the different likely proportions of the TAM Bitcoin is likely to capture, as well as the corresponding Bitcoin price.	The most popular comparable markets for Bitcoin have been the global remittances and gold markets. Gold offers the best comparison to Bitcoin due to their similarities and respective functions as stores of value in the traditional finance and crypto asset industries.
Network-Value-To-Transactions (NVT) Ratio	Network Value of Bitcoin divided by the value of transactions on its blockchain. As the value of all on-chain transactions, the Network Value for a crypto asset is equivalent to the market capitalization of a stock.	The ratio is a lagging indicator of overvalued or undervalued periods. When the NVT ratio is high, the market is placing a premium on Bitcoin's viability as a transaction medium and vice versa when NVT is low.
Network-Value-To-Hash Rate (NVHR) Ratio	Network Value of Bitcoin is divided by the hashrate of Bitcoin measured in Terahashes per second (TH/s). The Hashrate is the total computational power employed by miners to mine blocks on the Bitcoin network.	This metric can be used to understand how resilient Bitcoin is to economic attacks and therefore a proxy for understanding Bitcoin's ability to act as a censorship-resistant store of value. The lower the NVHR Ratio the less likely it is that Bitcoin's economic security will ever be compromised.
Active Address Metric	The Active Addresses metric measures the amount of individual Bitcoin addresses which have either sent or received Bitcoin within a given time period. Metcalfe's Law and Odlzyko's Law are two different metrics used to form a relationship between the Active Addresses metric and Bitcoin's Network Value.	Both metrics are useful for understanding the relationship between Bitcoin user activity and Bitcoin's value. The higher the NVML and NVOL, the higher the premium the market places on a given level of user activity on the Bitcoin network and vice versa for a lower NVML and NVOL.
Cost of Mining Method	The cost of mining method involves finding the theoretical break-even point for Bitcoin mining, or the point at which the marginal costs of mining a Bitcoin equals the marginal revenues of mining a Bitcoin. This implied price can be argued to be Bitcoin's price floor.	The usefulness of this metric is limited given the erroneous assumption made that mining difficulty can be seen as an exogenous variable, when it is in fact an endogenous variable. However, the implied price can be understood as the price floor within any given two week period before the Bitcoin mining difficulty adjustment.
Intrinsic Valuation Method	The Equation of Exchange method can be used to provide an intrinsic valuation of Bitcoin in the absence of the traditional cash flows required to produce a Discounted Cash Flow (DCF) analysis. The variables involved in an Equation of Exchange can be rearranged to come up with an implied price of Bitcoin.	The Equation of Exchange method can produce a wide implied price range when considering a range calculated using the maximum and minimum values of a variable over time. Variables used for calculation seem to produce more appropriate valuation ranges when the variable sample size is smaller and more recent.

Endnotes

01. All data is sourced from Coin Metrics unless stated otherwise.
02. <https://research.ark-invest.com/Bitcoin-currency>
03. "Payment Systems and Remittances Overview," The World Bank, Accessed August 2015
04. <https://www.gold.org/about-gold/gold-supply/gold-mining/how-much-gold>
05. <https://goldprice.org/>
06. <https://coinmetrics.io/an-introduction-to-mtv/> . Within this report we use Adjusted Transaction Volume as reported by Coin Metrics.
07. <https://charts.woobull.com/Bitcoin-nvt-ratio/>
08. <https://twitter.com/cburniske/status/861248756762771458?lang=en>
09. <https://medium.com/adaptivecapital/Bitcoin-market-value-to-realized-value-mvrv-ratio-3ebc914dbaee>
10. <https://coinmetrics.io/realized-capitalization/>
11. https://en.wikipedia.org/wiki/Metcalfes_law
12. <http://www.dtc.umn.edu/~odlyzko/doc/metcalf.pdf>
13. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2580904
14. Full model can be found here: <https://bit.ly/2IMHlrb>



Portfolio Optimization With Crypto Assets

AN ARGUMENT FOR AN ALLOCATION OF CRYPTO TO A INVESTOR'S PORTFOLIO



This research report will show that the addition of a crypto asset such as Bitcoin (BTC) to an institutional investor's portfolio can drastically improve risk-adjusted returns. Within this report, we construct several portfolios with varying amounts of Bitcoin and backtest their performance since 2014. By all measures — Annualized Returns, Annualized Volatility, and Sharpe Ratio — portfolios which add amounts of between 2.5 – 10% of Bitcoin outperform more traditional portfolios. The reason for this, as this report shows, is the excellent performance of the crypto asset market over the last few years, coupled with the uncorrelated nature of crypto assets with traditional financial assets.

Introduction

When one considers investing in a given asset class – and subsequently a specific asset – there are two primary questions that should be asked:

1

What proportion of my portfolio should be allocated to this asset class given my current financial goals and constraints?

2

What is the investment case for this asset class?

This report will provide the answer to 2. At its core, the question is one of optimal portfolio construction and the risk management of said portfolio for a given set of constituents. For the sake of brevity, we will assume the reader has a good understanding of basic Modern Portfolio Theory, but perhaps is less familiar with crypto asset terminology and as such will define and expand on concepts where deemed necessary.

Our report's key argument is that – at the very least – adding a modest amount of crypto asset exposure (primarily Bitcoin) to one's portfolio will lead to superior risk-adjusted investment outcomes due to their unique property of having largely unrelated risks compared to all other asset classes. In the correlation visual (**Fig. 1**) we compare the correlation of returns¹ for several popular exchange-traded funds (ETFs), as well as Bitcoin (BTC). The ETFs chosen represent a variety of asset classes and risk profiles and are as follows:

- **EFA** – The iShares MSCI EAFE ETF seeks to track the investment results of an index composed of large- and mid-capitalization developed market equities, excluding the U.S. and Canada.
- **GLD** – The SPDR Gold Shares ETF seeks to track the investment results of an index tracking the price of gold bullion.
- **SPY** – The SPDR S&P 500 ETF seeks to track the investment results of an index tracking S&P 500.
- **TLT** – The iShares 20+ Year Treasury ETF seeks to track the investment results of an index composed of U.S. Treasury bonds with remaining maturities greater than twenty years.
- **VNQ** – The Vanguard Real Estate ETF seeks to track the investment results of an index composed of stocks issued by REITs, and companies that purchase office buildings, hotels, and other real property.

FIGURE 1: ASSET CORRELATION MATRIX

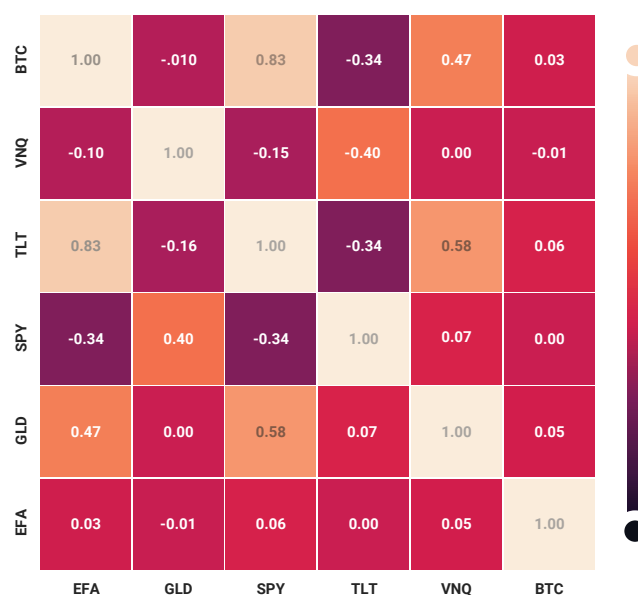
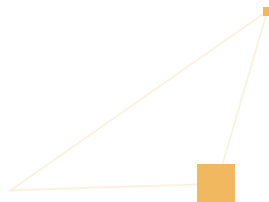
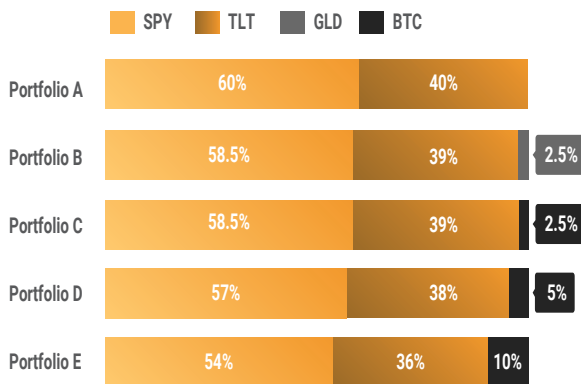


FIGURE 2: PORTFOLIO ALLOCATIONS

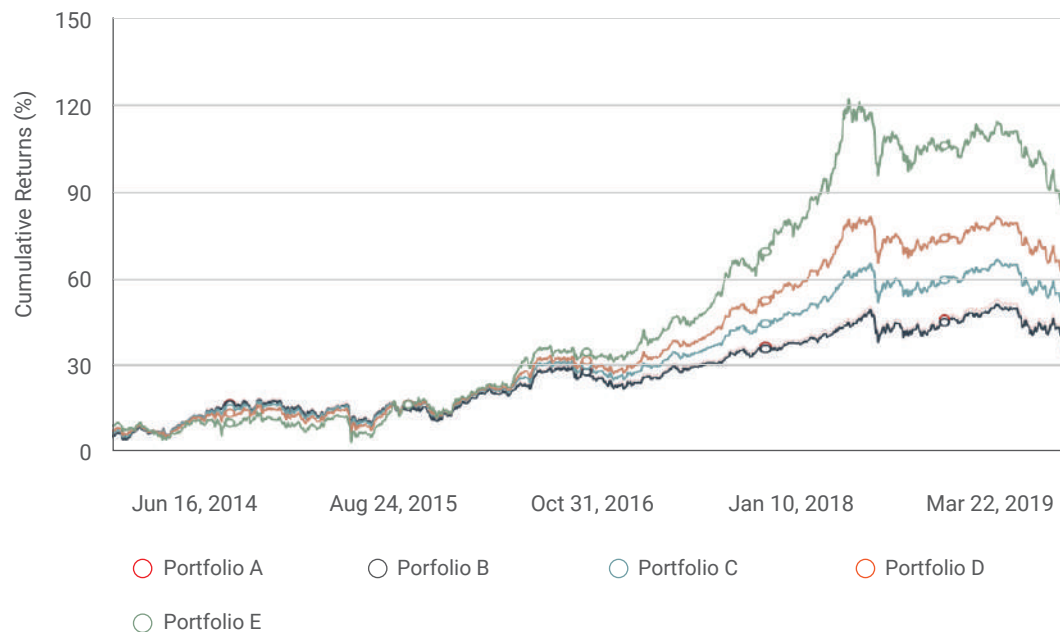


Out of all the assets, Bitcoin is by far the most uncorrelated – even more so than gold (GLD). For example, Bitcoin’s correlation with SPY is 0.06 compared to GLD’s correlation with SPY of -0.16 and 0.00 for TLT compared to GLD’s TLT correlation of 0.40.

This report will help explain the significance of this fact and elucidate what implication it has for investing. Moreover, aside from the extent to which Bitcoin is uncorrelated with most other asset classes, the results of adding it to a portfolio are phenomenal. The below chart (Fig. 3) plots the returns of five daily-rebalanced portfolios with the following compositions (Fig. 2) from 2014-06-16 to 2019-06-14.

Based on this example alone, adding a small amount of Bitcoin has a noticeable effect on the return profile of a given portfolio. However, the chart does not paint a complete picture of the risk profile of crypto assets nor does it completely explain the role crypto assets can play in portfolio optimization.

FIGURE 3: PORTFOLIO PERFORMANCE



Modern Portfolio Theory

Overview

Modern Portfolio Theory (MPT) is an approach wherein asset allocators are able to quantify the best way to efficiently allocate assets by quantifying the amount of risk taken in achieving a given amount of return. We can summarize the three important aspects of MPT on which this report will focus:

- The integral role that covariance and diversification play and the general rule that uncorrelated assets produce greater risk-adjusted returns by reducing the overall variance of the portfolio's returns
- Standard deviation is used as a proxy of portfolio risk which allows for mathematical models to be developed for understanding the role of risk in a given portfolio
- The development of the Efficient Frontier which gives investors a systematic way to select portfolios based upon MPT's given assumptions and certain parameters



TABLE 1: PORTFOLIO TEARSHEET

	Portfolio A	Portfolio B	Portfolio C	Portfolio D	Portfolio E
Annualized Returns	9.2%	9.0%	11%	12.9%	16.6%
Cumulative Returns	54.9%	53.6%	68.7%	83.4%	115.7%
Annualized Volatility	7.8%	7.6%	7.8%	8.3%	10.1%
Sharpe Ratio	1.17	1.17	1.38	1.51	1.57
Daily Value at Risk	-0.9%	-0.9%	-0.9%	-1.0%	-1.2%
Max Drawdown	-11.0%	-10.7%	-11.9%	-12.8%	17.6%
Alpha	0.04	0.04	0.06	0.07	0.11
Beta	0.48	0.46	0.47	0.47	0.46
Omega Ratio	1.22	1.22	1.27	1.29	1.31
Sortino Ratio	1.66	1.66	1.96	2.17	2.32

Crypto assets have a unique profile compared to 'traditional' asset classes, which helps explain why their risk profile is also quite different. For example, unlike a stock which may trade on an exchange regulated by FINRA, such as NYSE, crypto assets can be bought in a variety of other ways often cut off from traditional financial infrastructures – like on a decentralized exchange, for example. Other differences include the relative recency of their creation (just over ten years ago) and the peculiarities of the inception of asset classes (the first was created by a pseudo-anonymous developer and they exist solely in the digital realm). These properties ensure things like use-case adoption, regulatory development, and technology improvements are the fundamental value-drivers for the

crypto asset industry. Let's consider several more tools within the arsenal of MPT to analyze several other portfolios with certain amounts of Bitcoin added. Here we compute tear sheets (**Tab. 1**) for the five aforementioned portfolios. These statistics^{2,3} give a clearer picture of the risks and benefits of an allocation of Bitcoin to one's portfolio with daily rebalancing.

However, there is a wider range of rebalancing strategies than a simple daily one; moreover, given the relatively limited liquidity of crypto asset markets (compared to other markets), daily rebalancing may be difficult to carry out and incur large amounts of fees and suboptimal spreads.

Rebalancing

We tested (**Tab. 2**) two types of rebalancing strategies for Portfolio D (SPY – 57%, TLT – 38%, BTC – 5%):

1

Time-Based Rebalancing – wherein the portfolio is rebalanced on a predetermined basis; for example, quarterly or annually. In the following example we rebalance once a month

2

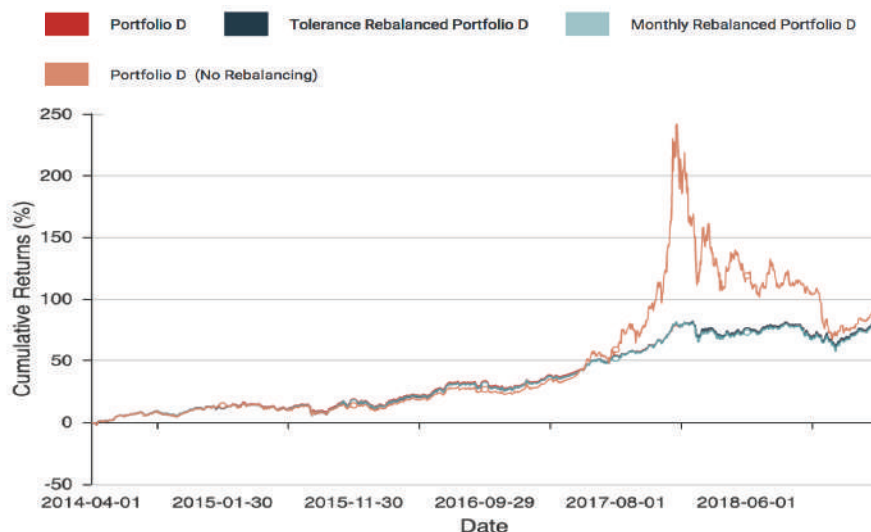
Tolerance Rebalancing – wherein the portfolio is rebalanced when a given allocation of a constituent moves away from a target by a predetermined amount. In the following example we rebalance when the weighted mean of the ratios for the constituents deviates by more than 5% from its predetermined value.

TABLE 2: PORTFOLIO TEARSHEET

	Daily Rebalance	Tolerance Rebalance	Monthly Rebalance	No Rebalance
Annualized Returns	13%	13%	12%	14%
Cumulative Returns	81%	81%	79%	90%
Annualized Volatility	8%	8%	8%	21%
Sharpe Ratio	1.46	1.48	1.45	0.72
Daily Value at Risk	-1%	-1%	-1%	-3%
Max Drawdown	-13%	-12%	-13%	-52%
Alpha	0.07	0.07	0.07	0.10
Beta	0.47	0.47	0.46	0.47
Omega Ratio	1.28	1.28	1.28	1.18
Sortino Ratio	2.11	2.13	2.10	1.06

The benefits of rebalancing are obvious by looking at the portfolio with no rebalancing. Whilst the lack of a rebalancing strategy did mean that portfolio D (**Fig. 4**) gained considerable Bitcoin exposure at a favourable time (second half of 2017), the lack of risk management led to a subsequent drawdown period of around 50%. It can be argued that daily rebalancing is unrealistic, but even so, both Monthly and Tolerance-based rebalancing strategies offer considerable risk management benefits – as the tear sheet above shows.

FIGURE 4: PORTFOLIO PERFORMANCE



Asset Allocation Simulation

Overview

We can use the logic of MPT’s Efficient Frontier to simulate (and also compute) the optimal portfolio from our available basket of constituents. Below we run a random walk (Fig. 5) on portfolio weightings 25,000 times in order to discover portfolios which produce optimal values for Sharpe Ratio and Annualized Volatility. The colour coding represents the Sharpe Ratio of the given portfolio. Two portfolios are highlighted: MSI, the portfolio producing the Maximum Sharpe Ratio, & MVI, the portfolio producing the minimum amount of volatility. The constituent weightings of MSI and MVI are as follows (Tab. 3). It’s interesting to note that both portfolios include noticeable amounts of Bitcoin – with the portfolio producing the best Sharpe Ratio containing around 14% Bitcoin. Even in the case of the minimum volatility portfolio, there is a small allocation to Bitcoin of 0.9% due to its abnormally uncorrelated returns when compared to the other constituents.

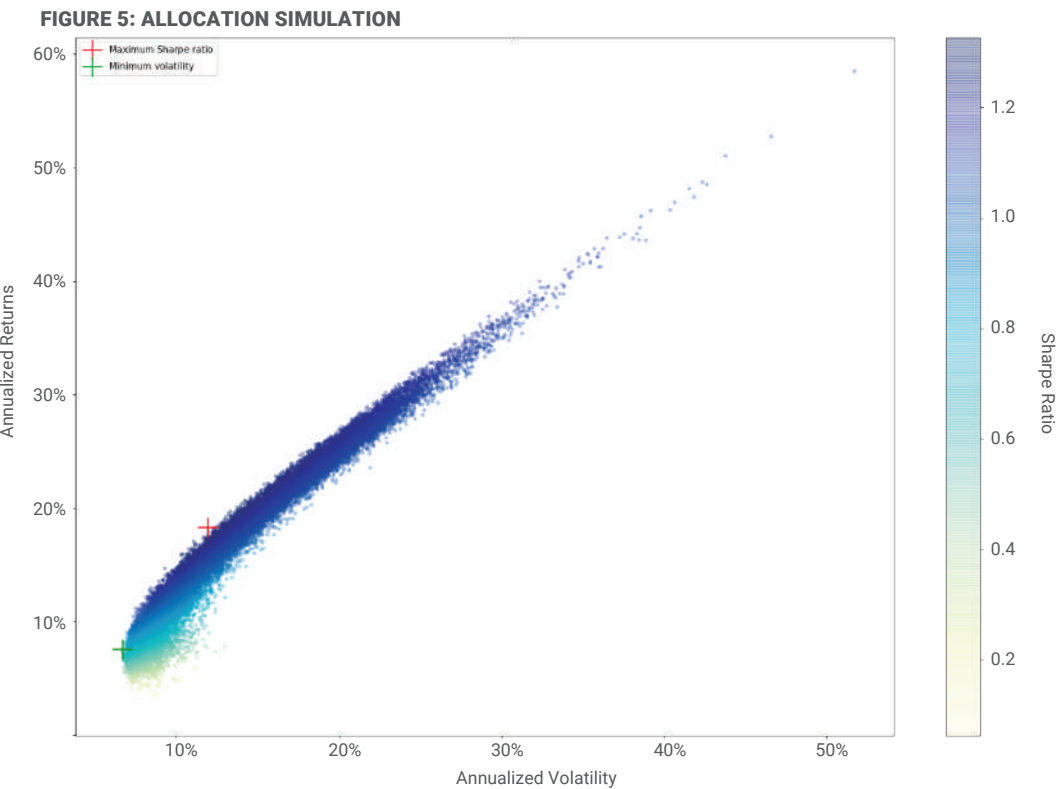
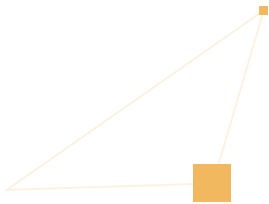


TABLE 3: PORTFOLIO ALLOCATIONS

	MSII	MVII
Annualized Returns	18%	7%
Annualized Volatility	12%	7%
EFA Allocation	0.43%	11.46%
GLD Allocation	1.6%	11.82%
SPY Allocation	36.17%	32.03%
TLT Allocation	43.22%	42.54%
VNQ Allocation	4.2%	1.26%
BTC Allocation	14.38%	0.9%



We can take this Efficient Frontier analysis a step further by calculating (Fig. 6) optimal portfolios given the constituent options (as opposed to finding the simulated best). Similarly, two portfolios are highlighted: MSII – the portfolio producing the Maximum Sharpe Ratio –, and MVII – the portfolio producing the minimum amount of volatility. The constituent weightings (Tab. 4) of MSII and MVII are as follows:

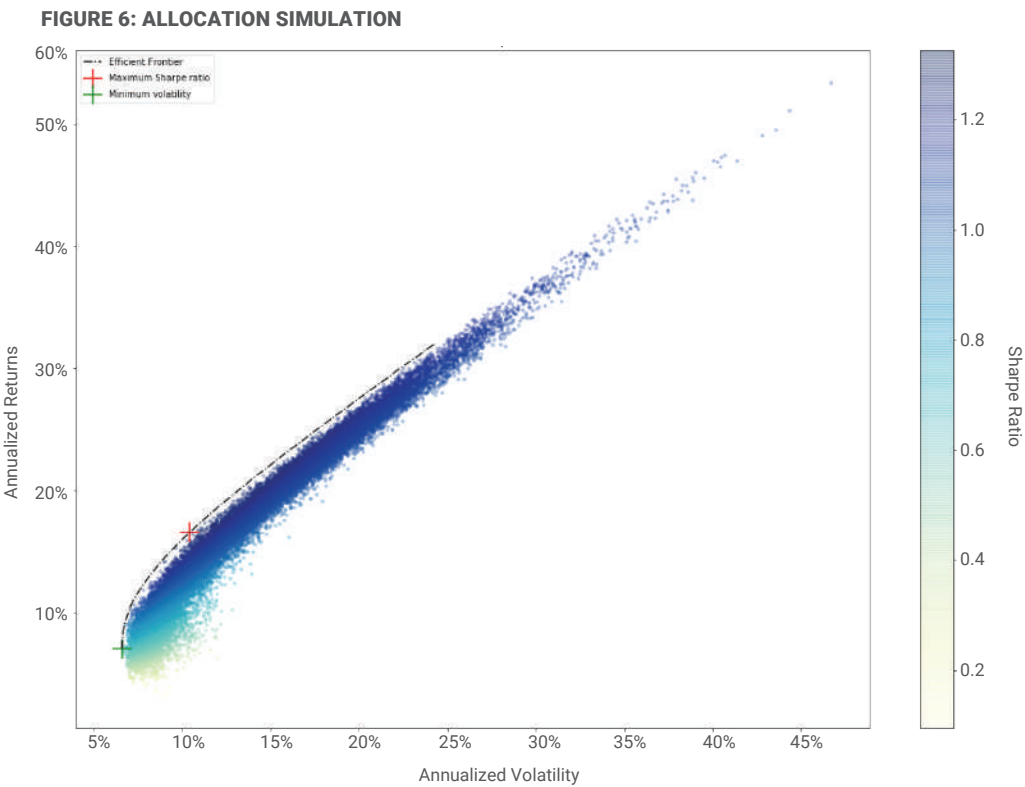


TABLE 4 : PORTFOLIO ALLOCATIONS

	MSII	MVII
Annualized Returns	17%	7%
Annualized Volatility	10%	7%
EFA Allocation	0%	9.54%
GLD Allocation	0%	18.68%
SPY Allocation	46.09%	30.75%
TLT Allocation	42.52%	40.28%
VNQ Allocation	0%	0%
BTC Allocation	11.39%	0.75%



It is possible that there are investors who may want to minimize their exposure to BTC as much as possible insofar as they benefit from some amount of the upside of a portfolio allocation to BTC. In the graph below (**Fig. 7**), we show a sliding scale of allocations of BTC to a portfolio from 0% to 100% – highlighting the various portfolios' Annualized Returns and Volatility, as well as their Sharpe Ratios. Here, the colour coding represents the given portfolio's allocation of BTC. The following simulation creates 25,000 portfolios with varying allocations of BTC but allocations of SPY and TLT which remain in a constant proportion of 60:40. Given the aforementioned constraints, we've highlighted (**Tab. 5**) the portfolios which produces the maximum Sharpe Ratio, MSIII, and the minimum volatility, MVIII.

The simulation suggests that the ideal allocation of BTC to a “traditional portfolio” when one wants to maximize the portfolio's Sharpe Ratio is around 9.34% and when one wants to minimize the portfolio's Annualized Volatility, the optimal allocation is around 0.79%.

FIGURE 7: ALLOCATION SIMULATION

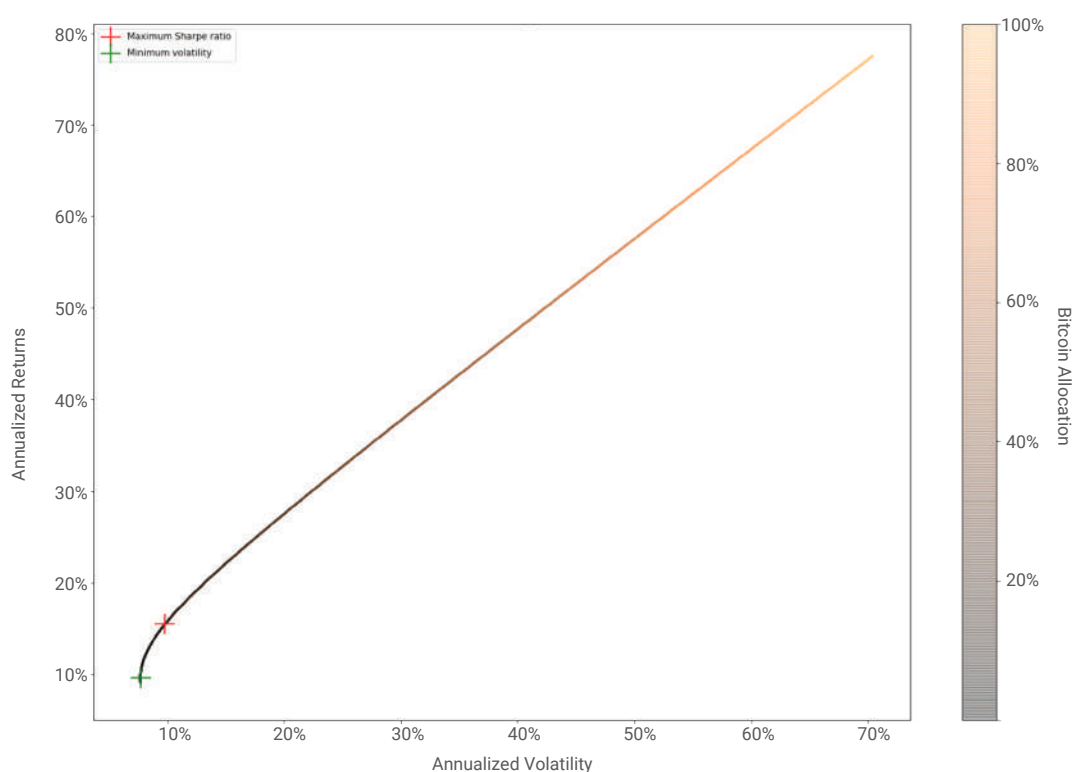


TABLE 5: PORTFOLIO TEARSHEET

	MSIII	MVIII
Annualized Returns	15%	10%
Annualized Volatility	10%	8%
SPY Allocation	54.39%	59.53%
TLT Allocation	36.26%	39.69%
BTC Allocation	9.34%	0.79%

Diversification within Crypto Assets

Overview

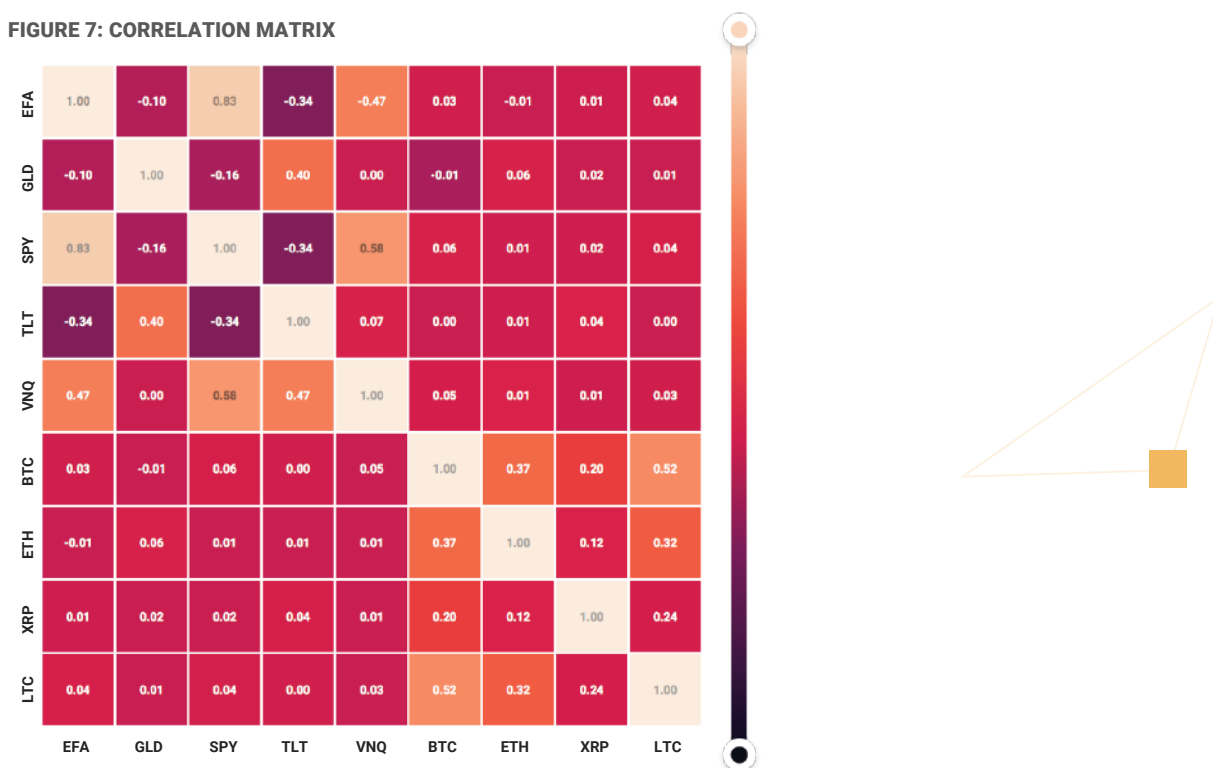
Thus far this report has focused solely on the diversification benefits of Bitcoin and ignored other crypto assets. However, there is evidence to suggest that other crypto assets – with slightly different value and risk drivers to that of Bitcoin – would offer further diversification benefits. Below we plot both a correlation matrix (**Fig. 7**) of Bitcoin (BTC), Ether (ETH), Ripple (XRP), & Litecoin (LTC) with the aforementioned ETFs over the period 2015-08-10 to 2019-06-14.

TABLE 6: PORTFOLIO ALLOCATIONS

	MSIV	MVIV
Annualized Returns	50%	14%
Annualized Volatility	23%	8%
EFA	6.98%	8.37%
GLD	14.39%	27.71%
SPY	23.85%	8.59%
TLT	16.52%	25.73%
VNQ	11.8%	25.04%
BTC	10.37%	2.6%
ETH	8.77%	1.39%
XRP	2.49%	0.49%
LTC	4.82%	0.09%

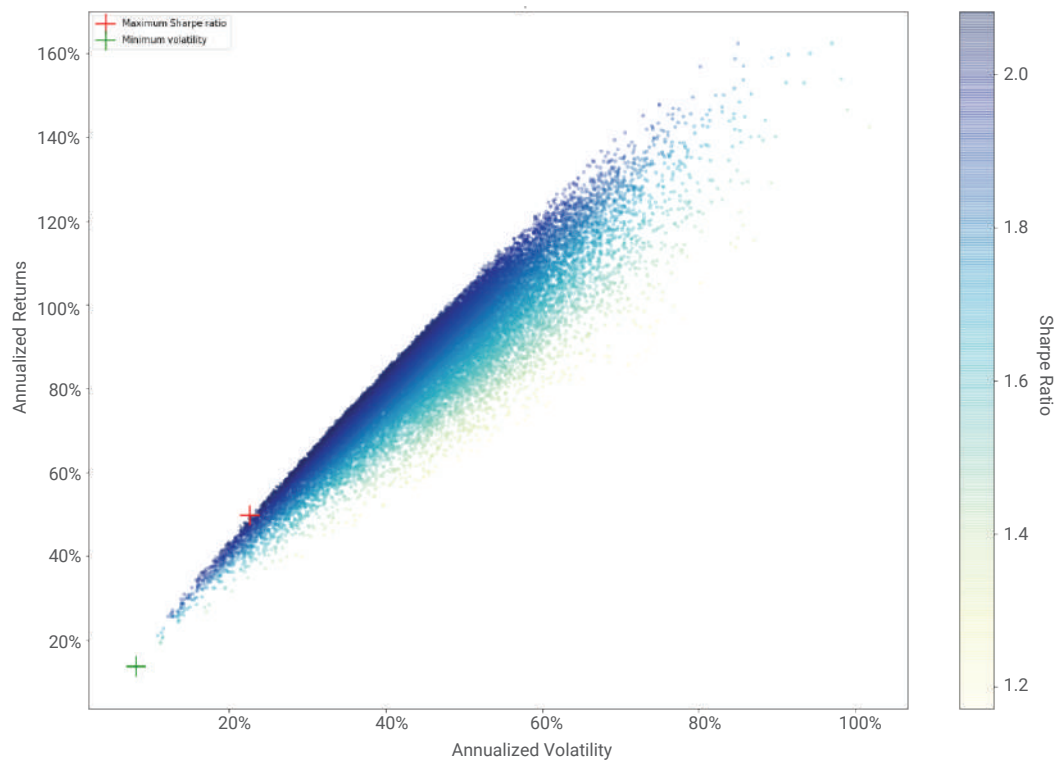
As we can see, the crypto assets BTC, ETH, XRP, and LTC all are equally as uncorrelated with the more traditional financial assets as each other. This demonstrates how crypto assets have fundamentally different value drivers from equities, bonds, and gold which means that a wide range of crypto assets have the potential to act as excellent ways for an investor to diversify their portfolio.

FIGURE 7: CORRELATION MATRIX



Crypto assets are exposed to a certain amount of systemic risk which, by definition, cannot be diversified away such as regulatory issues. However, all three additional crypto assets show similarly uncorrelated returns with each 'traditional' asset comparable to that of Bitcoin. Below, we run a simulation to estimate the optimal portfolio with the additional constituent options. Two portfolios are highlighted (**Fig. 8**) below: MSIV – the portfolio producing the maximum Sharpe Ratio – and MVIV – the portfolio producing the minimum amount of volatility. The constituent's weightings of MSIII and MVIII are shown on the previous page (**Tab. 6**).

FIGURE 8: ALLOCATION SIMULATION



Conclusion

This report has, through the lens of Modern Portfolio Theory, demonstrated the benefits of allocating a portion (2.5% to 10%) of one's portfolio to crypto assets such as Bitcoin.

The core reason is historical evidence supporting the fact that crypto assets give investors a chance to further diversify their portfolio and maximize risk-adjusted returns. This is driven by the unique dynamics of the crypto asset industry which ensure that the key value drivers for a given crypto asset bear little relationship to the value drivers of stocks, fixed income, or alternative investments. When one considers an investment in an asset class it is essential that it is not done through a myopic lens.

What makes crypto asset investing extremely interesting is its potential to improve the risk profile of a traditional investor's portfolio by magnitudes. As such, the often-volatile risk profiles of crypto assets must be judged as just one part of an investor's whole portfolio. If an investor considers investing in crypto assets in this way the benefits are self-evident.

However, theoretical portfolio allocation is only one aspect of the investment process one must go through before making an investment; this report has purposely avoided associated topics such as trade timing, liquidity, and valuation as these will be covered in later reports. Nevertheless, this report has laid bare the evidence to support paying increased investment attention to crypto assets, especially for institutional investors looking to improve their portfolio's risk profiles.

Endnotes

- 01.** All data is sourced from Coin Metrics and Yahoo Finance unless stated otherwise.
- 02.** For metrics such as Alpha and Beta, our benchmark is the SPY exchange-traded fund.
- 03.** Throughout this research report we assume the risk-free rate is 0%, in accordance with the calculation used within the Pyfolio library which was used to calculate all the metrics.



Disclaimer

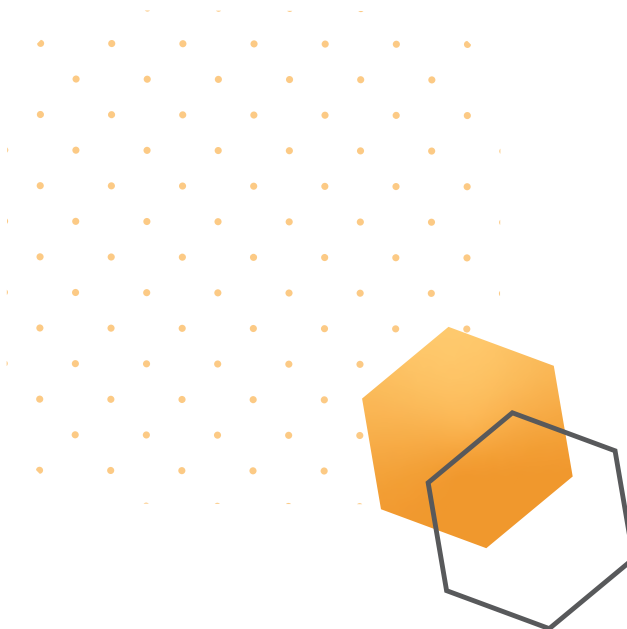


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