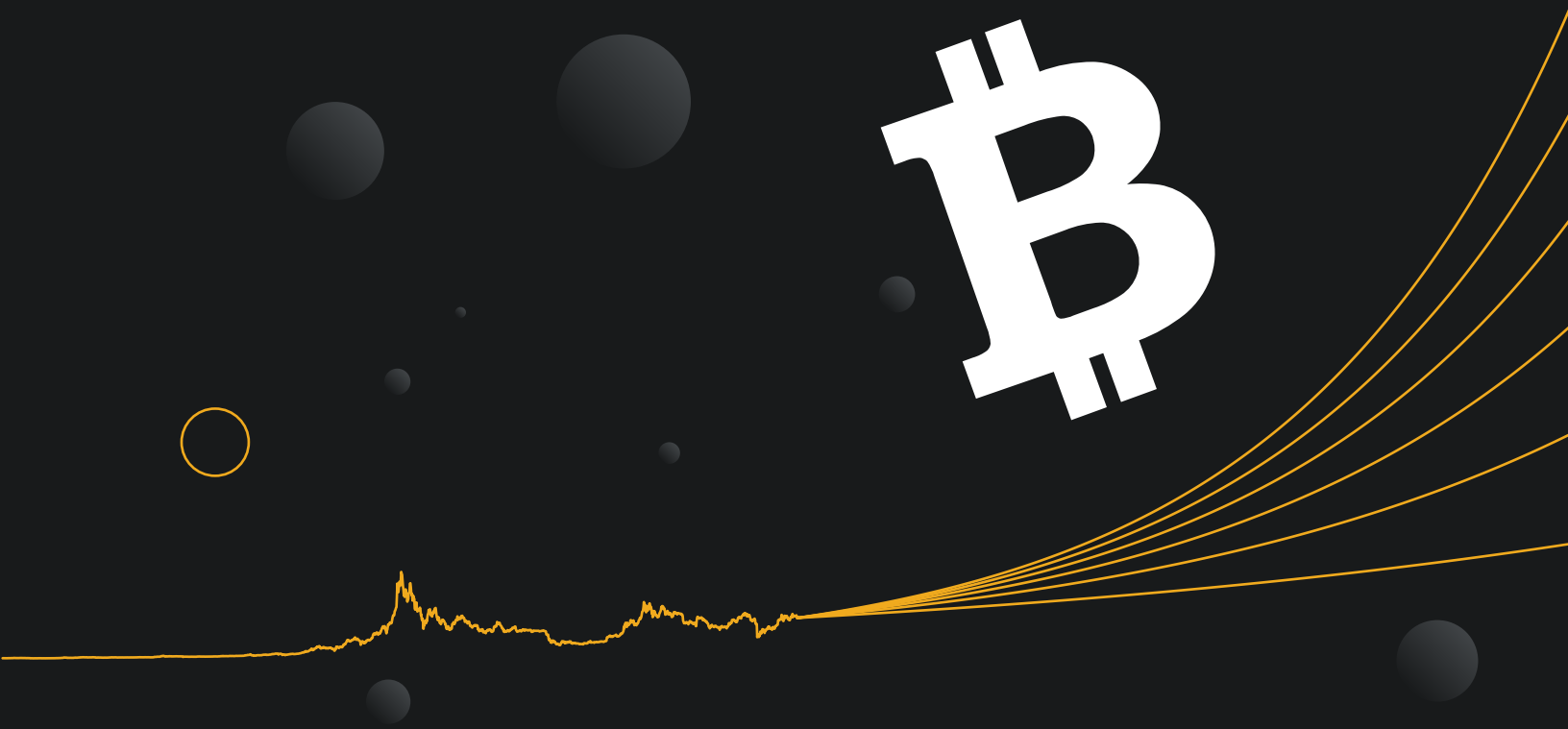
Research Report

Valuing Bitcoin

This research report will identify and analyze 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 cryptoasset over time. Understanding the different approaches to valuing Bitcoin is key to truly comprehending its role as an emerging store of value. This report touches on a number of the most important valuation techniques for Bitcoin and establishes a lower bound for its value.

DATA AS OF JULY 15, 2020



Valuing Bitcoin

Summary

This report[1] aims to value Bitcoin in a similar way to the valuation methodologies available for traditional financial assets. It builds on the wealth of research already carried out on valuing Bitcoin and uses the most credible methodologies — such as Market Sizing, the Network-Value-to-Transactions (NVT) Ratio, and Network-Value-to-Realized Value (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 methodologies and the cryptoasset's volatility, the price ranges shown by some of these are slightly 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.

Assumptions

For the NVT, NVHR, NVRV, Network-Value-to-Metcalfe's-Law (NVML), and Network-Value-to-Odlyzko-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 2020 to July 15 2021, and then calculating the implied Bitcoin price assuming that the fundamental metric within the denominator of each ratio (transaction volume and realized value) was equal to its value on July 15 2020. 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 2021. 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 2020. The charts throughout this report use data from July 15 2013 onwards.

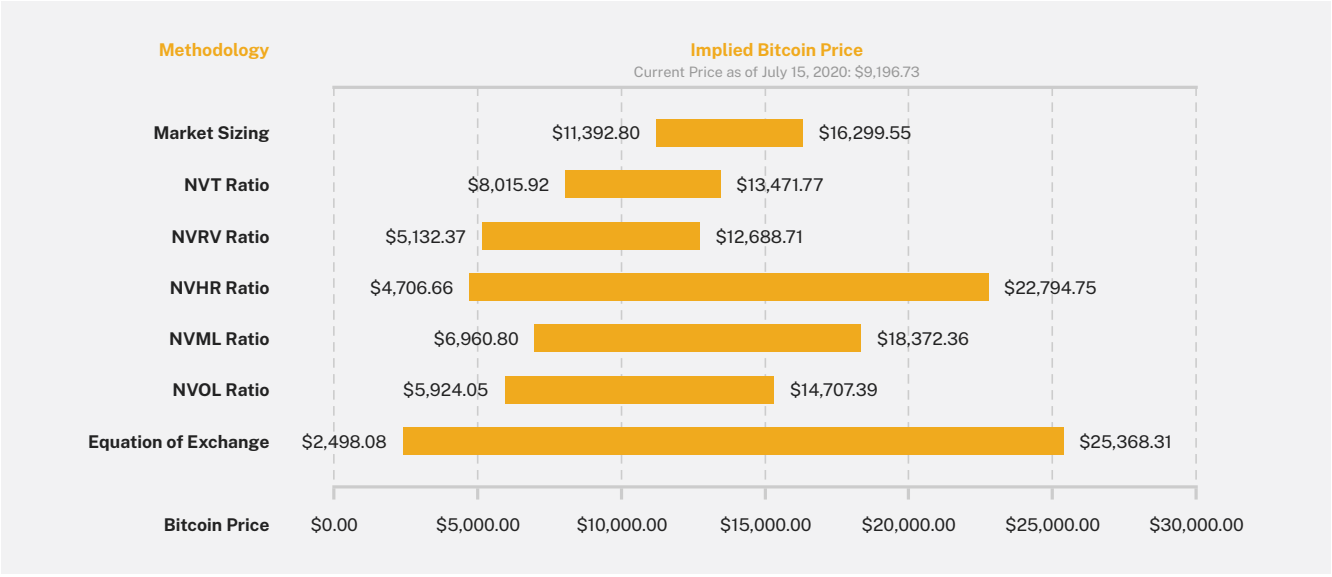


Figure 1: Valuation Price Ranges

Valuing Bitcoin

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 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 as follows.



Public Comparables (“Comps”)

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 and company size. 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.



Precedent 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 transactions 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.

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.

Traditional Valuation Methodology	Bitcoin Valuation Methodology
Cost Approach	Cost of Mining Method
Market Approach	Market Sizing Method NVT Ratio Method NVRV Method NVHR Method Active Addresses Method
DCF/Intrinsic Approach	Equation of Exchange Method

Valuing Bitcoin

Market Sizing

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 cryptoasset 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 equivalent properties — (quasi-) fungibility and scarcity, for example.

Market Sizing Method — Chris Burniske & Arthur V. Laffer[2] (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 Bank[3] estimated that money transferred to developing economies totaled $436 billion in 2014. If the only function of Bitcoin were to serve the remittances market and the cryptoasset 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. Using the 2014 World Bank numbers and Bitcoin's circulating supply of just under 18.5 million. At 1% penetration the Bitcoin price would be $237, at 10% penetration it would be $2,365, and at 100% penetration it would be $23,652. 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 cryptoasset is used as a facilitator of remittance payments. Our method for market sizing Bitcoin, instead, uses the total value of all mined gold — around 197,576 tons according to the World Gold Council[4] — of $11.28 trillion[5].

$$\textbf{Implied Bitcoin Price} = \frac{\textbf{Level of penetration * Value of target market}}{\textbf{Fully-diluted Circulating Supply}}$$

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.

Analysis

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 $26,846 and at a 10% penetration of the gold market, its price would be $53,691. Moreover, at a 20% penetration its price would be $107,383, whilst finally, at a 30% penetration its price would be $161,074. We can see that our market sizing method leads to substantially higher values of the estimated price of Bitcoin, which we view as more reasonable given the range the cryptoasset has traded at over the last two years.

In Fig. 4 we have calculated the possible paths required for the Bitcoin price to reach different gold penetration levels from July 15, 2020 to July 15, 2025. To reach the 10% penetration target price of $53,691, Bitcoin's average daily rate of return would need to be 0.0966%; to reach the 20% penetration target price of $107,383 the average daily rate of return would need to be 0.135%. Finally, to reach the 30% penetration target price of $161,074 the average daily rate of return would need to be 0.157%. We have chosen the year 2025 as it represents a year far enough away 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 cryptoasset 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 cryptoasset will take to reach its indicated values at maturity. Cryptoasset 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 time frames.

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 cryptoasset space, or to macroeconomic factors, like unprecedented government action against cryptoassets. In such cases, alternative markets such as peer to peer payments or more complex financial products may be better suited for comparison.

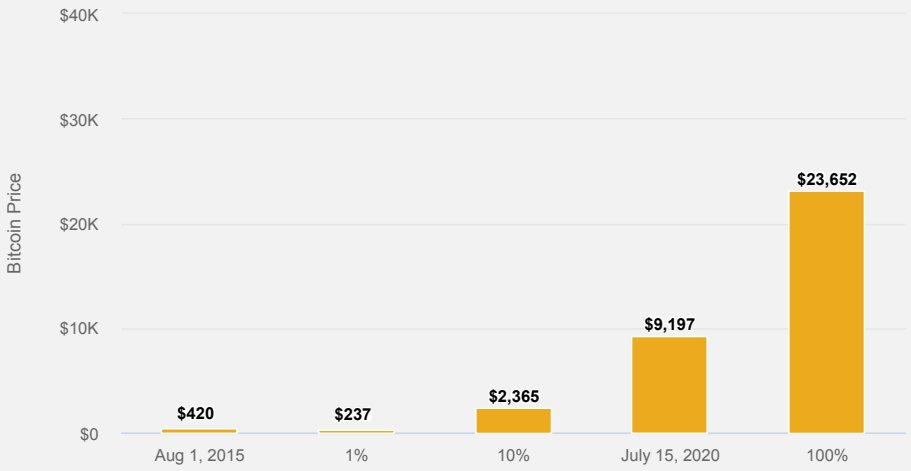


Figure 2: Bitcoin vs. Global Remittances

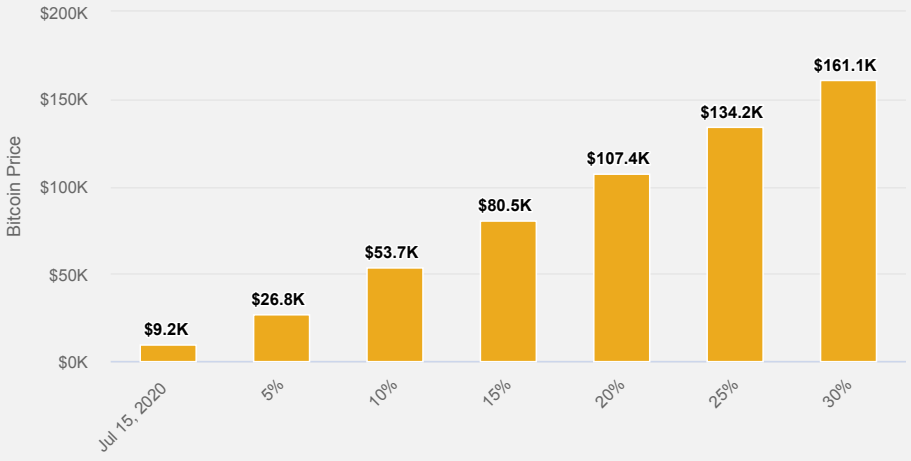
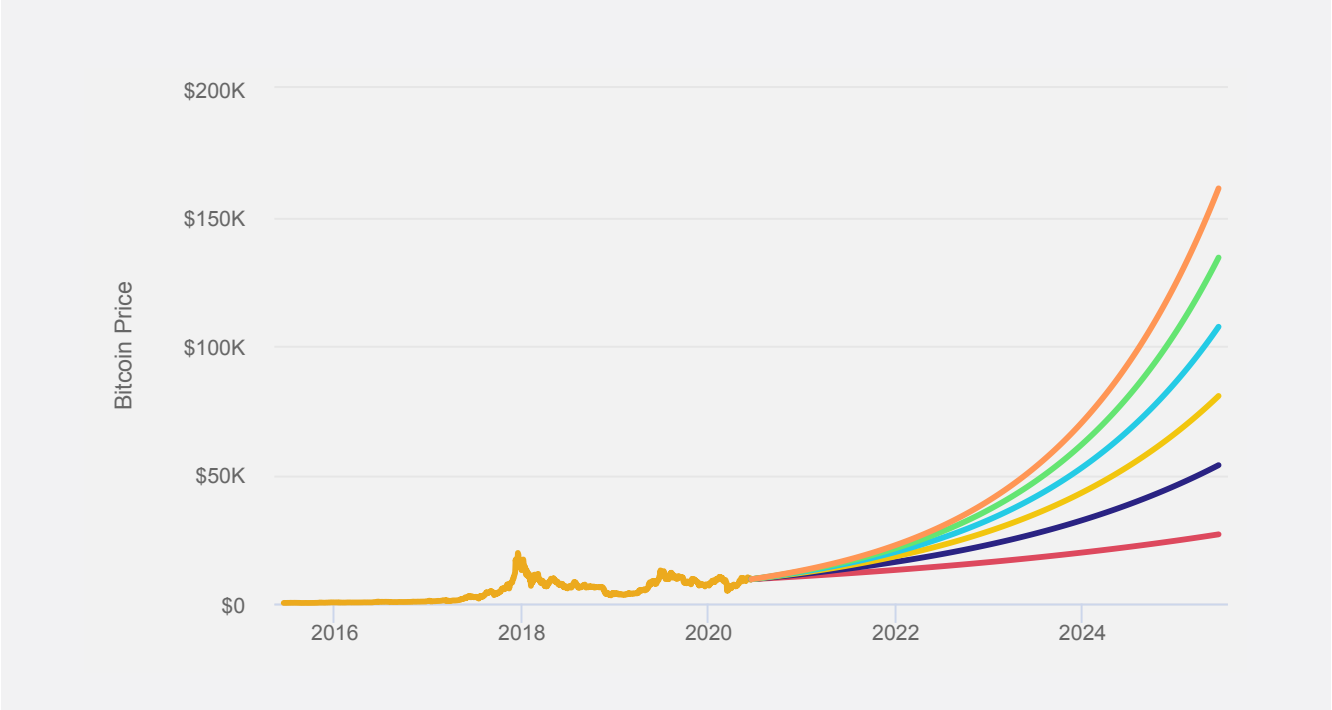


Figure 3: Bitcoin vs. Gold Market

The exceedingly large number for the potential price of Bitcoin — using the several different estimates for the amount of the gold market that Bitcoin is likely to capture — helps demonstrate the expansive total addressable market for the asset. There remains the possibility that Bitcoin could, in fact, capture even more of the gold market than just 30%. In either case, its current valuation can easily be justified, and higher levels can be supported on an intellectual level if only some of the capital currently invested in gold transfers to Bitcoin. Such an exercise is useful at explaining a long-term investment view of Bitcoin, but its usefulness diminishes over shorter time periods, especially due to Bitcoin's high level of volatility.

Figure 4: Bicoin Market Sizing, 2020–2025



Valuing Bitcoin

NVT Ratio

Overview

The Network-Value-to-Transactions (NVT) Ratio[6,7,8] measures the dollar value of on-chain transaction activity of a given cryptoasset 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 — The total dollar value of all the circulating units of the given cryptoasset. It is equivalent to the market capitalization of a stock.

Value of On-chain Transaction Activity — The dollar value of the transactions settled on the cryptoasset'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 (61.74) 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: NVT, 2013–2020

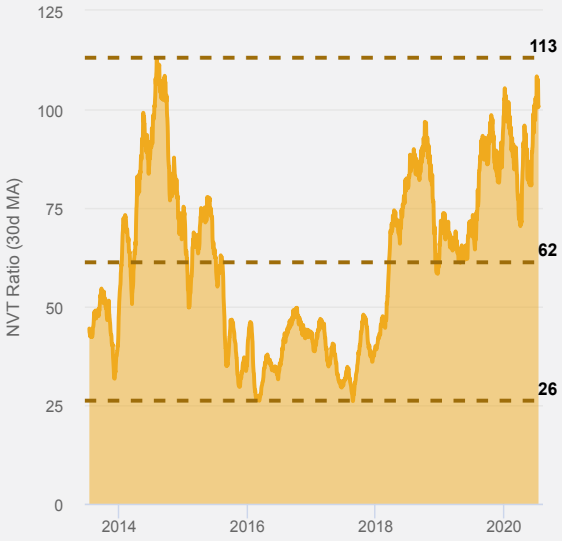
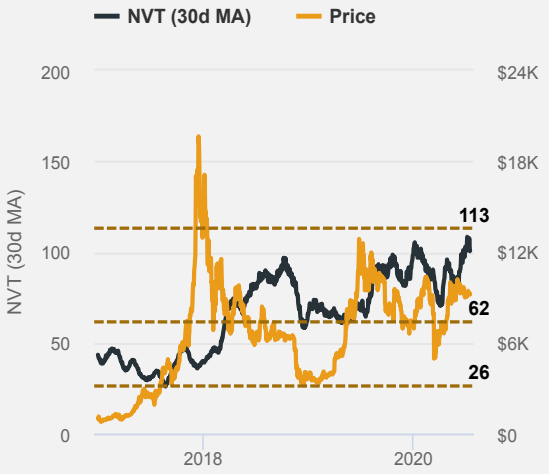


Figure 6: NVT vs. Price, 2013–2020



Figure 7: NVT vs. Price, 2017–2020



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.

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).

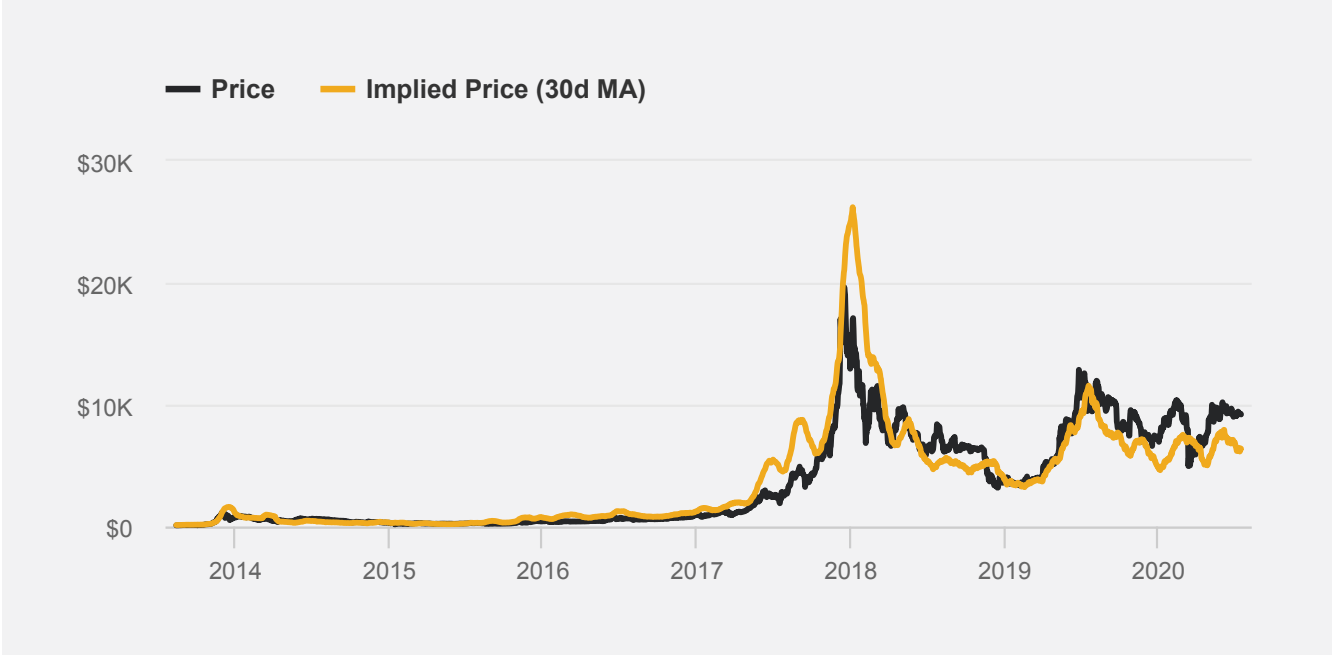
Conversely, the bottoming out of the NVT in the aforementioned periods at 22.2 on March 7, 2014 and 26.02 on August 2, 2017 preceded both periods' price lows by large timeframes. As of July 15, 2020, Bitcoin's NVT of 100.77 is trending noticeably higher than historical mean, suggesting that the market is currently pricing Bitcoin at a premium to its NVT-based fair value (Fig. 5).

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 61.74. The implied Bitcoin price has been a relatively strong indicator of the actual Bitcoin price therefore showing that NVT does have some bearing on Bitcoin's fundamentals.

However, the NVT ratio does have limitations — including 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 20.03%. 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 $20,848 while the actual Bitcoin price peak during the same period was $19,640.

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: Price vs. NVT-implied Price, 2013–2020



Valuing Bitcoin

NVRV Ratio

The Network-Value-to-Realized Value (NVRV)[9] ratio measures the dollar value of a cryptoasset'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 the given cryptoasset. It is equivalent to the market capitalization of a stock.

Realized Value[10] (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 the 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 5.88 and 4.71 on November 18, 2013 and December 7, 2017 respectively (Fig. 10).



Figure 9:Market Cap. vs. Real Cap., 2013–2020

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 on average.

There are three distinct periods wherein Bitcoin's NVRV was below 1: October 2014 – October 2015, November 2018 – March 2019, and March 12 – March 18 2020. During these periods the average NVRV values were 0.853, 0.841, and 0.934 respectively (Fig. 11). Noticeably, Bitcoin's NVRV has recently been lower than 1 during the March 12 flash crash, suggesting that the cryptoasset is unlikely to dip down to price levels seen during March anytime soon.

As of July 15, 2020, Bitcoin's NVRV was around 1.57 which means that it is entirely plausible that its market value could multiply by around 3x before Bitcoin's NVRV reaches levels seen during the previous bubble. 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 10: NVRV Ratio, 2013–2020

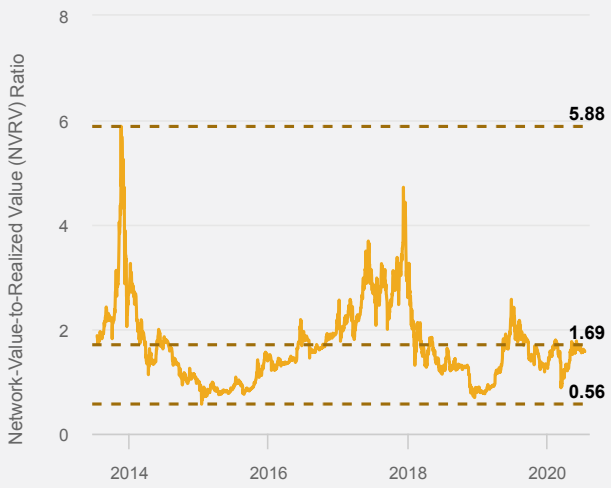
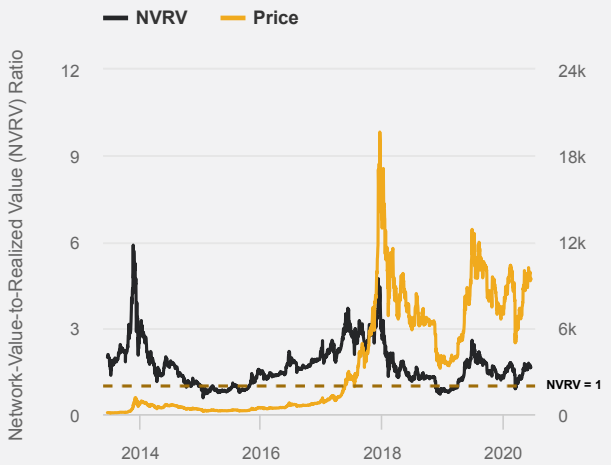


Figure 11: NVRV Below 1, 2013–2020



Valuing Bitcoin

NVHR Ratio

The Network-Value-to-Hashrate (NVHR) ratio measures the dollar value of the cryptoasset'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 cryptoasset. It is equivalent to the market capitalization of a stock.

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.

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.

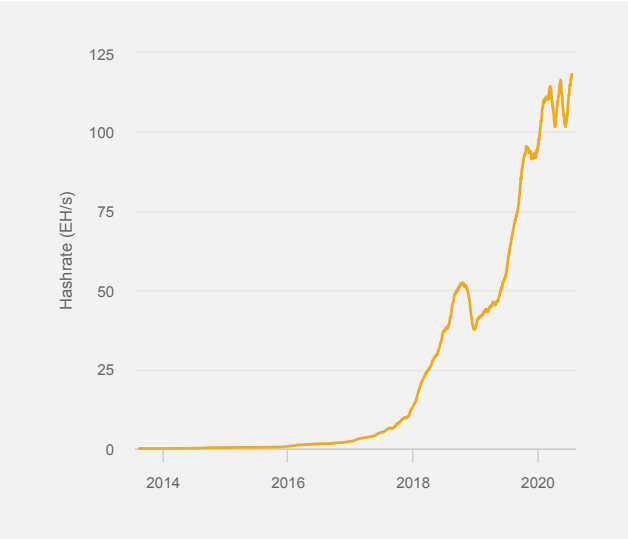


Figure 12: Hashrate, 2013–2020

Analysis

We show Bitcoin's NVHR from 2017 to 2020 before, during, and after the Bitcoin bull market of 2017. During this period Bitcoin's NVHR peaked at 24.32 on December 16, 2017 and the lowest NVHR value was 0.73 on March 12, 2020. 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 cryptoasset. 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.

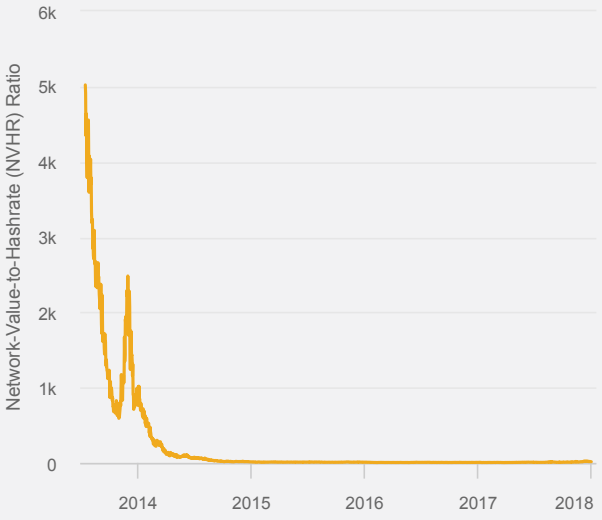
The major strength of the NVHR ratio comes in its ability to easily quantify the relationship between Bitcoin's value and its economic security — using the proxy of its hashrate. In a case where the NVHR ratio reached levels comparable to that of 2013–2016 this would indicate that the market is perhaps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

However, the NVHR ratio is not without its limitations. The range of values from the NVHR ratio has varied significantly as Bitcoin's market value grossly outstripped its hashrate. This makes it difficult to do comparisons of Bitcoin's NVHR over periods greater than 2 years since, for example, the NVHR ratio in 2014 was over 70 times its value in 2019. As such, this metric is undeniably affected by the stage of maturity for Bitcoin's mining industry, so the large difference in its value between 2013–2016 and 2017–2020 can be put down to the professionalization of Bitcoin mining during the latter period.

Figure 13: NVRV Ratio, 2017–2020



Figure 14: NVRV Ratio, 2013–2018



Valuing Bitcoin

Active Addresses

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 conducted Bitcoin transactions 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 1,096,515 on December 24, 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-Metcalfe's-Law (NVML) ratio and Network-Value-to-Odlyzko-Law (NVOL) ratio.

$$\text{NVML} = \frac{\text{Network Value}}{(\text{Active Addresses})^2} \qquad \text{NVOL} = \frac{\text{Network Value}}{(\text{Active Addresses}) * \log(\text{Active Addresses}) * 1000}$$

Network Value — The total dollar value of all the circulating units of the given cryptoasset. 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 ratios make use of two well-known computer laws — Metcalfe's Law[11] and Odlyzko's Law[12]. Metcalfe's Law states that the value of a network is proportional to the square of the network's size. Odlyzko's Law states that the value of a network is proportional to the logarithm of the network's size multiplied by network's size. These laws are used to understand the value of networks based on their number of users. We think that these laws can form the basis for metrics which help investors understand the value of Bitcoin. The denominator of the NVOL equation was multiplied by 1000 in order to make the data easier to read. For both metrics, a value lower 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.

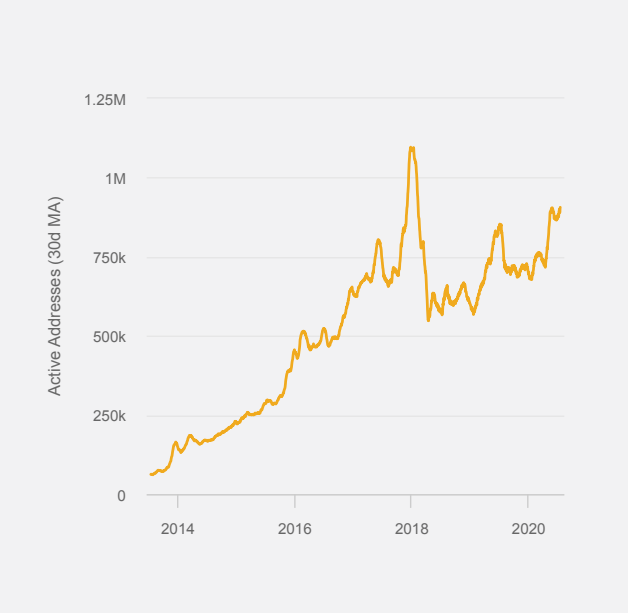


Figure 15: Active Addresses, 2013–2020

Analysis

Bitcoin's NVML (Fig. 16) peaked on November 29, 2013 at a value of 0.726, and its minimum NVML value was 0.00223 on February 9, 2016 — whilst its average value has been 0.179. Conversely, Bitcoin's NVOL (Fig. 17) peaked on December 12, 2017 at a value of 22.39 and its minimum value was 0.851 on August 24, 2015. Bitcoin's average NVOL value was 6.896.

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*log (n)].

Figure 16: NVML Ratio, 2013–2020



Figure 17: NVOL Ratio, 2013–2020



Valuing Bitcoin

Intrinsic Valuation

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 monetary base
V — Number of times 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 estimate at either the present date or at some point in the future 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 essentially 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, 2020, which was just under 18.5 million Bitcoin.

Value	Transaction Volume (USD)	BTC Price (USD)
Max	$6,322,498,970	$25,368.31
Min	$767,195,973	$3,078.29
Mean	$1,977,449,444	$7,934.29
Prior 30 Days Mean	$1,835,961,666	$7,366.59
Actual	$2,292,416,832	$9,196.73

Max, Min, Mean — 12 Months ended July 15, 2020
Prior 30 Days Mean — 30 days ended July 15, 2020
Actual — Closing values on July 15, 2020

Source: Coin Metrics

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, 2020, to forecast annual transaction volume.

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, 2020, the daily velocity of Bitcoin was slightly higher than average with a daily value of 0.015. This value would imply that Bitcoin would change hands approximately 5.48 times a year.

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 supply is capped at 21 million Bitcoin and that the reward for each block produced 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, 2020. In addition, we also looked at the transaction volume for the 30 days leading up to July 15, 2020 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 the table on this page, 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 the table on the next page. In this scenario, a low Bitcoin velocity means that Bitcoin is less readily available in the market, and consumers wishing to conduct transactions on the Bitcoin network would need to pay a higher price to obtain those Bitcoin.

Value	Velocity	BTC Price (USD)
Max	15.68	$2,498.08
Min	1.77	$22,180.83
Mean	4.58	$8,551.29
Prior 30 Days Mean	3.91	$10,014.12
Actual	4.94	$9,196.73

Max, Min, Mean — 12 Months ended July 15, 2020
Prior 30 Days Mean — 30 days ended July 15, 2020
Actual — Closing values on July 15, 2020

Source: Coin Metrics

Analysis

Under our assumptions, the Equation of Exchange method produced an implied price range of $2,498.08 – $25,368.31 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 velocity 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 method 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 overstate the value of Bitcoin, as seen with the implied price using the on-chain transaction volume for the 30 days leading to July 15 which was noticeably lower than Bitcoin's current price.

Although the implied price we calculated for Bitcoin using this volume was noticeably below the actual Bitcoin price on July 15, our price was calculated using an assumption that provided for a slightly lower amount of on-chain transactions and resulted in a significantly lower implied Bitcoin price. This indicates that using on-chain transaction volumes may understate the value of Bitcoin as an emerging store of value.

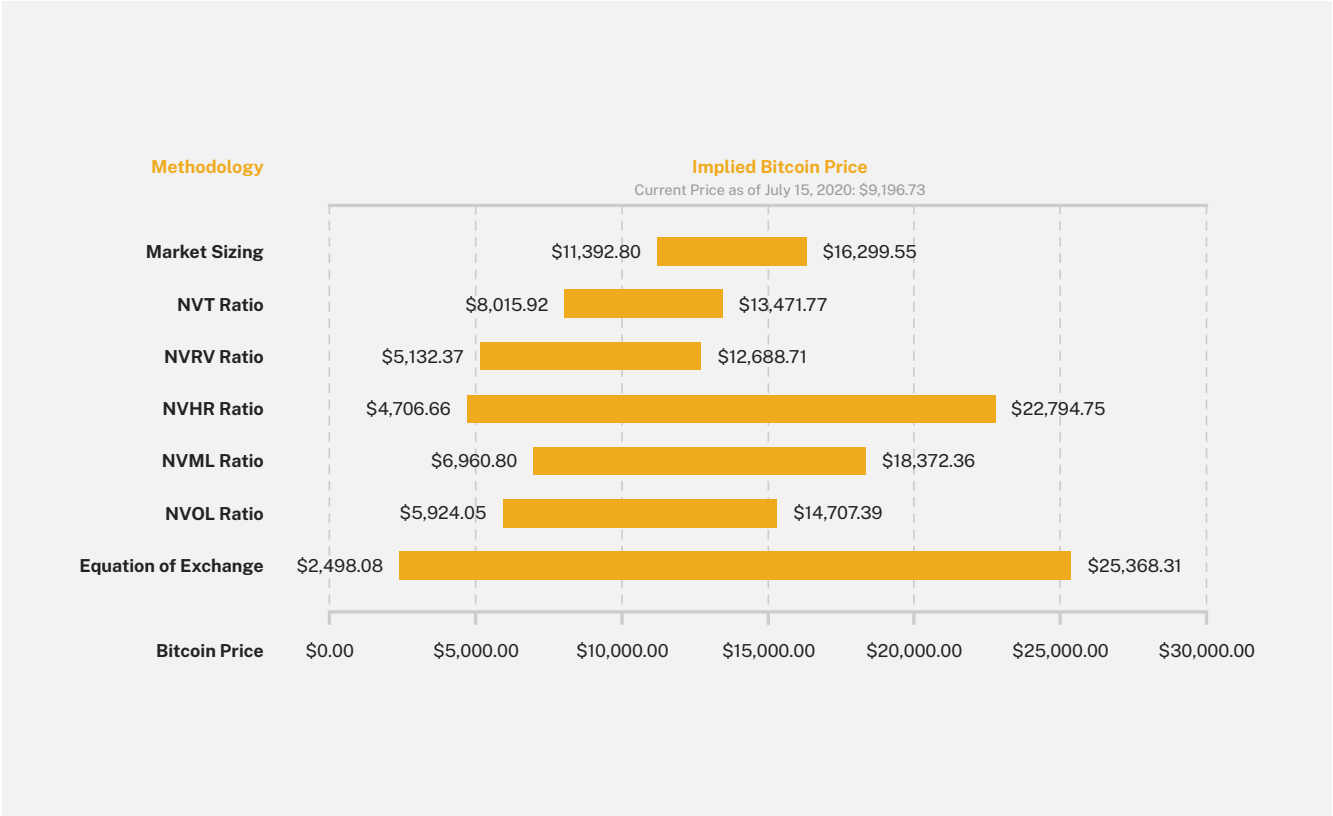
Valuing Bitcoin

Conclusion

This research report has identified and analyzed the different methodologies for valuing Bitcoin. Throughout the report we looked at the most important methodologies for valuing Bitcoin to better understand the different trends in the relevant data points for the cryptoasset over time — focusing on four unique methodologies: Network-Value-to-Transactions (NVT) ratio, the Network-Value-to-Realized-Value (NVRV) ratio, the Network-Value-to-Hash-Rate (NVHR) ratio, and the Active Addresses metrics.

In addition, we analyzed the various market sizing analyses done for Bitcoin including comparisons to the global remittances and gold markets, and conducted a fundamental valuation using the equation of exchange. The chart (Fig. 18) below plots the implied price ranges of Bitcoin for our various metrics. Whilst the various methodologies 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 with significant upside.

Figure 18: Implied Price Ranges of Bitcoin



Valuing Bitcoin

Overview of Valuation Techniques

Metric	Description	Comments
Market Sizing	Estimates the total addressable market (TAM) for Bitcoin via a comparable market such as gold or global remittances and calculates 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 cryptoasset 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 cryptoasset 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 Metrics	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.
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.

Valuing Bitcoin

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