

How to Value Bitcoin

Research & Insights

MONOCHROME ASSET MANAGEMENT

0.50 CPD Hours | FPA Accredited

Learning Outcomes

Bitcoin is many things to different people. In this session, you will learn about the different Bitcoin valuation models and frameworks used by professionals and academics of different perspectives, as well as critiques of these frameworks. They include:

- 1 Traditional network valuation frameworks, such as Metcalfe's Law.
- 2 Cost-of-Production Modelling.
- 3 Regression models, like Stock-to-Flow.
- 4 Market Size / Total Addressable Market Valuation.
- 5 Valuing Bitcoin as a tech startup.

Note: This activity meets the guidelines for qualifying CPD, and has been accredited for continuing professional development by the Financial Planning Association of Australia (FPA). This does not constitute FPA's endorsement of the activity.

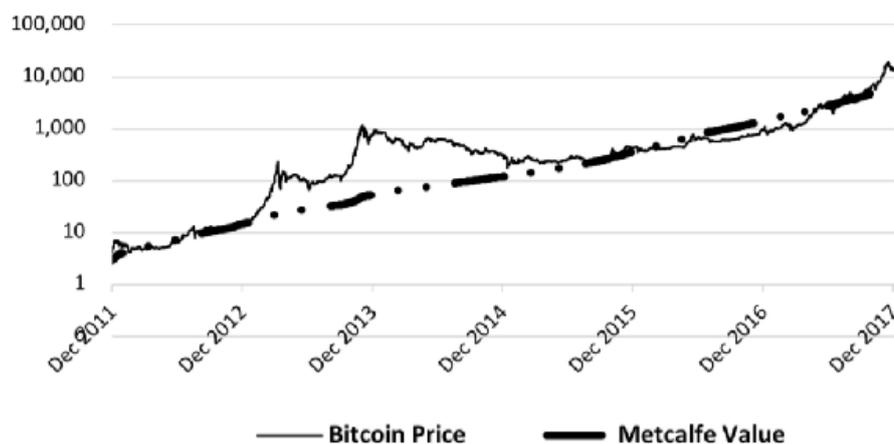
1.1 Foreword

In a canonical July 2010 Bitcointalk.org forum post by Satoshi Nakamoto, Bitcoin’s creator, they said “*Sorry for being a wet blanket. Writing a description for this thing for general audiences is bloody hard. There’s nothing to relate it to.*”¹ Because Bitcoin is so hard to describe, define or contextualise, people can barely agree on what Bitcoin is, let alone how to value it. By default, all frameworks we attempt to apply to Bitcoin will fall short, simply because Bitcoin isn’t “just” a network, software, commodity, or financial asset; it is all of the above, and potentially more. In short, the following valuation methods in isolation are unsuitable for valuing Bitcoin, but when taken together, can be quite useful.

1.2 Network Effects (Metcalf’s Law)

Proponents often view Bitcoin as a network, and look to value it as such. Metcalfe’s law is a concept used in telecommunications in which a network’s inherent value is equal to the square of the number of nodes in its network.² Using the example of fax machines, there is no value in owning a fax machine unless there is another to communicate with. The connections between cryptocurrencies and people can hence be quantified by the increase in their adoption.³

According to Timothy Peterson’s work in Metcalfe’s Law as a Model for Bitcoin’s Value, the model requires three datasets: wallets, number of bitcoins created, and Bitcoin price.⁴ As Metcalfe’s law was seen to be too optimistic a figure, Peterson incorporated a method used to measure mobile phone usage.⁵ Peterson’s data can be found below, including Metcalfe value against Bitcoin price.⁶



¹ S Nakamoto, ‘Re: Slashdot Submission for 1.0 (mnchr.me/2ZgMH6z)’, [online forum post], Bitcoin Forum, 5 July 2010, accessed 20 September 2021.

² B Metcalfe, ‘Metcalfe’s Law after 40 Years of Ethernet’, IEEE, 2013, 46(12):26-31, doi:10.1109/MC.2013.374.

³ Wheatley et al., ‘Are Bitcoin Bubbles Predictable? Combining a Generalized Metcalfe’s Law and the LPLS Model’.

⁴ Chartered Alternative Investment Analyst Association (CAIA), ‘Metcalfe’s Law as a Model for Bitcoin’s Value (https://caia.org/sites/default/files/metcalfeslaw_websiteupload_7-5-18.pdf)’, CAIA, 2018, accessed 14 September 2021.

⁵ Islam et al., ‘Modelling multinational telecommunications demand with limited data’.

⁶ CAIA, op. cet.

Peterson found the model's price to be approximately 85% correlated with the market price of Bitcoin. It is important to note, however, that it isn't a "comprehensive valuation model in the strictest sense".⁷

1.2.1 Criticism

No Agreed Upon Exact Figure for Users

This model refers to users as the number of wallets, which is not necessarily an indicator of the number of users. The latest industry data from Crypto.com currently estimates 114 million users, dwarfing Peterson's estimate.⁸ This model also fails to consider which type of users are successfully contributing to a network effect - as there are inactive users, users with no balance, and users who do not trade with another that are included. Most importantly, Bitcoin is not "just" a network, and therefore, is difficult to measure solely on that basis.

1.3 Cost of Production Model by DataDater

Since the creation of new bitcoins requires electricity consumption via computational power, Hayes (2016) suggests Bitcoin can derive intrinsic value from its cost of production. The nature of competition in the Bitcoin Mining space is near-perfect due to, among other things, its commodity-like nature, low barriers to entry and exit, large number of buyers and sellers, and high mobility.¹⁰ Due to this level of competition, we can expect marginal revenue of mining firms to eventually equal marginal cost in long-term equilibrium. The cost of production of Bitcoin is fundamentally a strong benchmark for its absolute floor price, as a rational miner will choose to simply buy Bitcoin instead of mine if mining is unprofitable. It also illustrates how market price gravitates towards its cost as commodities tend to do, outlined in Satoshi Nakamoto's work.¹¹

Do Other Commodities Derive Intrinsic Value from Mining?

The demand for gold and desire to hold gold as a hedge drive its price. It is not gold mining that gives it value, but the factors forming why people want gold. Bitcoin is the same. People mine Bitcoin because other people want it, with market price being indicative of how many and how much people want it.

Mining Efficiency Increase Does Not Decrease Price

Hayes states that as mining efficiency increases due to technological progress, it is expected to negatively influence the price as it decreases the cost of production.¹² Whilst it may indeed decrease

⁷ CAIA, op. cet.

⁸ Crypto.com, 'Global Cryptocurrency Adoption Doubled Since January (<https://mnchr.me/39xaGQK>)', Crypto.com website, 29 July 2021, accessed 10 September 2021.

⁹ A Hayes, 'Bitcoin price and its marginal cost of production: support for a fundamental value (<https://mnchr.me/3i33WPs>)', Applied Economics Letters, June 2018, accessed 14 September 2021.

¹⁰ H McCook, 'Projecting Bitcoin's Future Energy Use (mnchr.me/2XYTlxY)', Bitcoin Magazine, 28 June 2021, accessed 23 September 2021.

¹¹ S Nakamoto, 'Re: Current Bitcoin economic model is unsustainable (mnchr.me/3CK6j1h)', [online forum post], Bitcoin Forum, 21 February 2010, accessed 20 September 2021.

¹² A Hayes, 'A Cost of Production Model for Bitcoin (<https://mnchr.me/2XYRRno>)', The New School for Social Research, February 2015, accessed 12 September 2021.

cost of production, Bitcoin supply is highly inelastic, and decreased cost of production simply leads to more competition. Further, this hasn't been illustrated in the real world as of yet. Despite improvements in processing power, it cannot have an effect on price, only react to it. If the cost to mine is lower than price, hash rate - the collective processing power of the network - will increase.¹³

1.4 Stock-to-Flow (S2F)

Another way to value Bitcoin can be as a Store of Value (SoV) commodity. This value store is attributed to scarcity created by its underlying code; a maximum issuance of 21 million coins, with a predetermined diminishing supply. This allows Bitcoin to be valued using stock-to-flow (S2F) ratios primarily used for SoV commodities.¹⁴ It should be noted that this is one of the most contentious valuation models, even within the Bitcoin community, with critics and supporters.

	Stock (tn)	Flow (tn)	SF Supply Growth		Prize \$/Oz	Market Value
Gold	185,000	3,000	62	1.6%	\$1300	\$8,417,500,000,000
Silver	550,000	25,000	22	4.5%	\$16	\$308,000,000,000
Palladium	244	215	1.1	88.1%	\$1400	\$11,956,000,000
Platinum	86	229	0.4	266.7%	\$800	\$2,400,000,000

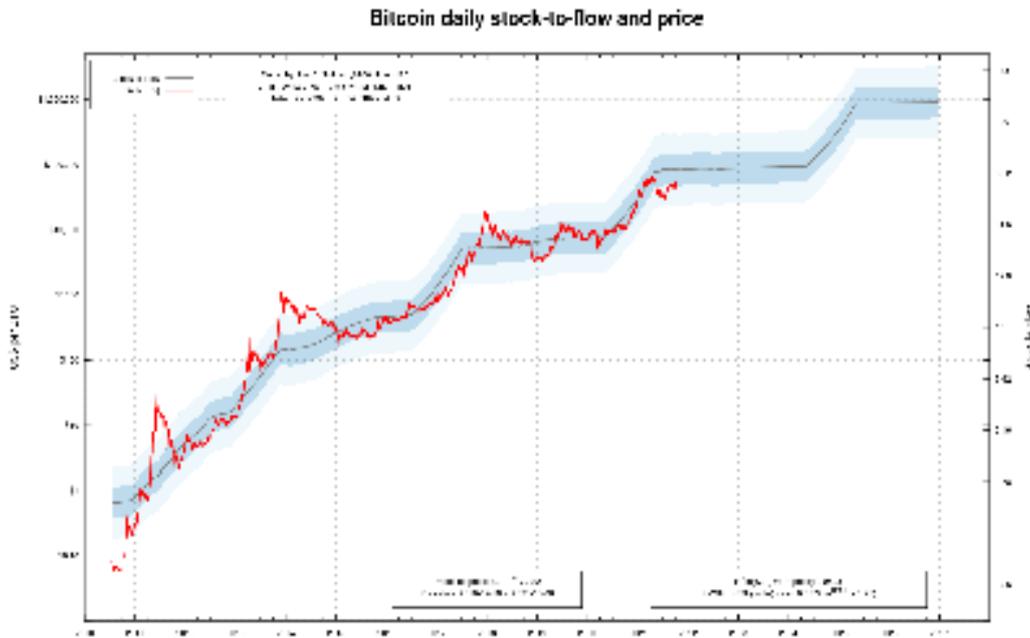
The S2F ratio is the stock of the resource divided by the amount of new production, or flow. Referring to the table above, gold currently has the highest ratio of 62 - meaning 62 years of production to amass the current amount available.¹⁵ Due to the nature of Bitcoin's fixed supply schedule, "flow" is trivial to determine, and most interestingly, Bitcoin's "flow" is programmed to cut in half roughly every 4 years, until eventually flow becomes zero when the 21 million coin limit is achieved. Each of these events is known as a "halving", with the most recent one occurring in May 2020. Bitcoin's S2F ratio has been around ~57 since the last halving, and will double to ~120, far higher than gold, after the next halving in 2024.¹⁶ This ratio is useful for commodities like gold as they show the amount of supply that enters the market relative to its total supply. Proponents of this theory claim a higher S2F ratio indicates superior store of value properties in the long-run, and apply this rationale to Bitcoin.¹⁷

¹³ H McCook, 'Bitcoin Mining Competitive Economics 101 - The Oversimplified Version (<https://mnchr.me/2XGTZQj>)', Medium website, 16 January 2019, accessed 23 September 2021.

¹⁴ Differs to fiat currencies as governments preset an amount of inflation while bitcoin has a changing issuance rate.

¹⁵ PlanB, 'Modeling Bitcoin Value with Scarcity (<https://medium.com/@100trillionUSD/modeling-bitcoins-value-with-scarcity-91fa0fc03e25>)', Medium website, 13 March 2019, accessed 10 September 2021.

¹⁶ Look Into Bitcoin, Stock-to-Flow Model (<https://mnchr.me/3EKJPiB>), Look Into Bitcoin website, 2019, accessed 12 September 2021.



This value can be written as a power law function, plotted in the graph above.¹⁸ The modeled price on the 29th of September 2021 was approximately US\$84,650.91, exhibiting a difference of about 104% more than the closing price of US\$41,454. The market and S2F price of Bitcoin reveals a statistically significant relationship of approximately 94% correlation.¹⁹ Factors that are said to inhibit this correlation include regulation, cyber attacks, and other news. This reinforces the idea that a predominant factor influencing value is captured with S2F.

1.4.1 Criticism

Efficient Market Hypothesis (EMH)

EMH is an economic theory which outlines that markets are information processing systems that deliver the best price discovery. There are three forms of EMH. Weak EMH states historical price data has been priced in. Semi-strong EMH refers to prices factoring in public news, while strong EMH is where all information, public or private, is priced in.²⁰

S2F is based on publicly available information; the supply trajectory and stock to flow, and therefore must be already priced in. Some argue that few capital controls and dwindling opportunities for arbitrage suggest that Bitcoin has a reasonably efficient market. However, by definition, there is a lack of a universally agreed upon definition of and valuation model of Bitcoin that pricing entities agree upon, so efficiency is difficult, if not impossible, to achieve.

The EMH is viewed as an equally contentious model as S2F amongst the Bitcoin community.

¹⁷ Genesis Block, 'What is Stock to Flow Ratio (S2F)?' (<https://genesisblockhk.com/what-is-stock-to-flow-ratio-s2f/>), Genesis Block website, 8 March 2021, accessed 24 September 2021.

¹⁸ R Wolfram, 'Daily updated charts of Bitcoin's stock-to-flow vs price' (<https://s2f.hamal.nl/s2fcharts.html>), Hamal website, 2021, accessed 24 September 2021.

¹⁹ D Okorafor, 'Stock to Flow Analysis Shows Bitcoin Could Reach \$288K This Year' (<https://finance.yahoo.com/news/stock-flow-analysis-shows-bitcoin-102500022.html>), Yahoo Finance, 2021, accessed 20 September 2021.

²⁰ EF Fama, 'Efficient Capital Markets: A Review of Theory and Empirical Work', *The Journal of Finance*, 1970, 25(2):383-417, doi:10.2307/MC.2325.486.

Infinite Value

The S2F model assumes that mining bitcoins will continue until 2136. When the final block is mined, the value will theoretically be infinite, as there will be no denominator in the S2F ratio to base the model on.²¹ In reality, the price will likely continue to be subjected to supply and demand factors while miners continue to compete in validating transactions.²² In line with this criticism, technical infinity can be also achieved in the event of a collapse or devaluation of the US Dollar, since the price of Bitcoin is expressed in USD.

Demand

This model indicates demand but does not directly include it in its predictions. Although supply is consistent, it cannot be changed to meet demand. In the event of a sharp increase in demand, new supply cannot rise to meet it.²³ Regulations and laws surrounding cryptocurrencies or other factors can also influence demand in ways that the S2F cannot account for.²⁴

Broad Range

The S2F model is not useful for horizons of a quarter or less. During extreme bull market phases such as the 2013 and 2017 peaks, the market price of Bitcoin traded at over 4 times the predicted price. Similarly, during the depths of the 2014-2016 and 2018-2020 bear cycles, the price can be observed to be as much as half the predicted value. The range of error is too wide.

1.5 Market Size Approach

The Market Sizing method can be used by valuing the Bitcoin market against comparable markets, including global remittances and gold. This approach is well suited for gold given the similarities.²⁵ The implied Bitcoin price can hence be calculated as the level of penetration multiplied by the value of the target market divided by the fully-diluted circulating supply (how much will exist). A penetration rate is a proportion of what Bitcoin captures and changes depending on its usage. Lanre Ige and Michael Gotimer from Amun have forecasted paths required for the Bitcoin price to reach gold penetration levels until mid 2025.²⁶ At 10% penetration, Bitcoin will generate a target price of \$38,600. This figure increases to \$115,700 at 30% penetration. This timeframe is selected to represent an adequate advancement made in Bitcoin's underlying technology and infrastructure. As Bitcoin grows in value

²¹ S2F Ratio = units of asset in reserve divided by units produced per year.

²² A Hayes, 'What Happens to Bitcoin After All 21 Million Are Mined?' (<https://mnchr.me/2W8a9BP>), Investopedia website, 28 February 2021, accessed 14 September 2021.

²³ River Financial, Bitcoin and the Stock to Flow (S2F) Model (<https://mnchr.me/3i2ZfoK>), River Financial website, n.d., accessed 24 September 2021.

²⁴ S Flynn, The Stock-to-Flow Model: What Cryptocurrency Investors Should Know (<https://mnchr.me/3o4cqch>), Coin Central website, 28 July 2021, accessed 22 September 2021.

²⁵ Reliable monetary supply, store of value, (quasi-)fungibility.

²⁶ L Ige and M Gotimer, 'Valuing Bitcoin: An Analysis of Methodologies for Valuing Bitcoin' (<https://mnchr.me/3CEkHIA>), Amun Research, n.d., accessed 14 September 2021.

The earliest stage was the pre-seed round, or 1st reward era (2009-2012). This period saw an extreme risk of failure where the earliest developers used both sweat equity and funds from the market to bootstrap the startup. The earliest developers can be very easily compared to the early equity employees of Google. The next round (seed round) saw the first VCs entering, investing in Bitcoin companies or Bitcoin itself.

For a typical “Series A” round, companies opt for funding to improve their user base and product offerings.²⁹ Bitcoin was improved through protocol optimisations like SegWit, which allowed for the possibilities of the Lightning Network.³⁰ A startup then uses funding in the Series B round to meet new and increased levels of demand. (Remember there isn’t any actual formal fund-raising or allocation done as Bitcoin is not a company.) The investment-to-utility lifecycle presented in the figure above suggests that it is simply a distributed network of Bitcoiners, who started off by building sweat-equity in a project they were passionate about, increasing the utility of the platform, thereby drawing in more participation, investment, and ultimately, additional utility over time. In Bitcoin’s case, after a “raise”, as people are busy at work and out of the limelight, price has tended to settle down to a natural floor over a protracted bear market. In the world of startups, this would be referred to as “burn rate”.³¹

In startup terms, scarcity will then become a prominent element in its 5th reward era (Series C) until 2028. This Series’ funding allows people to use their influence to promote Bitcoin and increase the amount of people who buy Bitcoin. Finally, running into the 6th Reward Era (2028 - 2032), Bitcoin can be compared to an IPO. Beyond this, it can be expected to resemble a blue chip, with a relatively stable price and inflation nearing zero.

1.6.1 Criticism

Bitcoin is most certainly not a start-up company, and should not be valued as one. However, taking the multi-round approach shows how much of a part increasing utility and growth narratives play in raising money for and valuing startup companies and digital assets.

1.7 Conclusion

Valuing Bitcoin can be a challenge as, due to its abstract nature, there is “nothing to relate it to.”³² However, by shifting the lens through which we view Bitcoin, we can arrive at compelling theories through S2F, cost of production, Metcalfe’s law and relating it to a start-up. Each model also hosts criticisms, accommodating for improvements and adaptations. Ultimately, Bitcoin’s speculative nature calls to attention the need for more understanding of its various methods of valuation.

²⁹ N Reiff, ‘Series A, B, C Funding: How it Works (mnchr.me/3ENEMOJ)’, Investopedia website, 31 May 2021, accessed 24 September 2021.

³⁰ J Frankenfield, ‘SegWit (Segregated Witness) (https://www.investopedia.com/terms/s/segwit-segregated-witness.asp)’, Investopedia website, 22 March 2021, accessed 20 September 2021.

³¹ Corporate Finance Institute (CFI), ‘Burn Rate - The rate of depletion of a company’s cash pool (mnchr.me/3o3tKyM)’, CFI website, n.d., accessed 24 September 2021.

³² S Nakamoto, ‘Re: Slashdot Submission for 1.0 (mnchr.me/2ZgMH6z)’, [online forum post], Bitcoin Forum, 5 July 2010, accessed 20 September 2021.

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