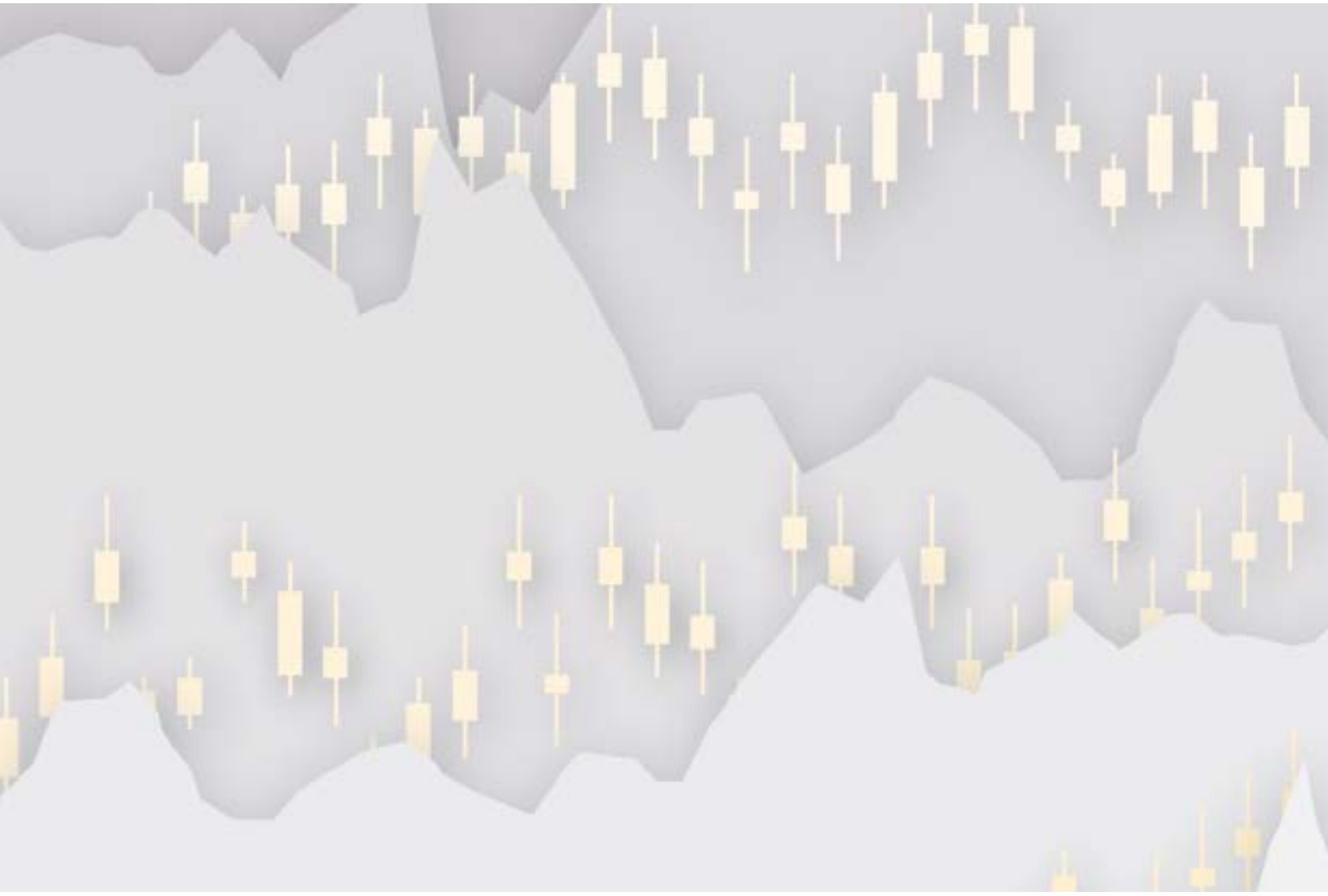
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CRYPTO'S NEW FUNDAMENTALS

Metrics and methods for valuing crypto assets

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INTRODUCTION

Most investors can't begin to say whether bitcoin is a currency, a commodity, a security or something else entirely. Economists note that bitcoin's value suffers from what they call "indeterminacy": "it rests on what are called self-fulfilling beliefs and that the set of beliefs that can be self-fulfilling is huge."[1] In other words, the fundamental drivers of the price of bitcoin might as well be sun spots.

A narrative has emerged for bitcoin as digital gold. This narrative helps explain why bitcoin is attractive to investors, and how its historic returns and non-correlation make it a sensible portfolio component. Still, investors are a long way from being able to say why $10,000 is a good price, or explain what causes its off-the-charts price swings.

A narrative has emerged for bitcoin as digital gold, but investors are a long way from being able to say why $10,000 is a good price, or explain what causes its off-the-charts price swings.

This vacuum may present an obstacle to investing in crypto assets, but it also presents an opportunity for analysts ambitious enough to attempt to define new valuation methods and identify new fundamentals. This white paper is written for those analysts and their colleagues, presenting an introduction to concepts and metrics that can support a better understanding of crypto asset valuation. We don't presume to provide formulas; innovative investors and analysts will gain their edge by building on concepts like the ones we introduce here. Our overview is not meant to be comprehensive – the field of crypto analysis is evolving at a rapid pace, and new metrics and methods emerge almost weekly; this is just one of the many factors that make this sector so compelling for analysts and professional investors.

You can find this white paper and more research like it at coindesk.com/intro-to-crypto-investment, where we are building a library of research for early adopters among institutional investors in crypto assets. To keep up with developments and trends in crypto asset valuation methods, subscribe to our weekly *Institutional Crypto* newsletter. We welcome your comments and questions; the author can be reached directly at galen@coindesk.com.

1 Rodney Garratt and Neil Wallace, "Bitcoin 1, Bitcoin 2, … : An Experiment in Privately Issued Outside Monies," *Economic Inquiry,* Vol. 56, Issue 3, July 2018, pp. 1887-1897

BITCOIN AND ETHER AS COMMODITIES

In this section, we'll look at value propositions for bitcoin and ether (the crypto asset native to the ethereum network) and describe how narratives are taking hold that rest on analogies from commodity investing. These analogies provide a path to valuing bitcoin and ethereum's currency, ether, in terms of supply and demand: understanding supply curves and the fundamentals that drive demand can lead to a quantifiable valuation.

Bitcoin as digital gold

Bitcoin's potential uses in global commerce and in digitalized investment contracts are noted, but in 2019, sentiment has crystallized around bitcoin as "a digital store of wealth that is difficult to seize, freeze or devalue."[2] Investors understand the global demand for such an asset, given the propensity of governments in nations large and small to inflate away domestic debt in times of financial crisis.[3] Bitcoin, with comparatively negligible costs of storage and transfer, is simply gold for the digital age. Fundamentals behind the price of gold, such as supply-demand and macroeconomic indicators, are well understood.

There are any number of shortcomings that make bitcoin less desirable as a substitute for gold; chief among them its brief history, compared to gold's longstanding status as a store of value. One simple way to think about what "bitcoin-as-gold" should be worth is what its implied market cap might be if it captured some percentage of the demand for gold.

Figure 1. Bitcoin's long road to gold
Bitcoin vs gold, implied market cap



Source: nomics.com, World Gold Council, Money Metals Exchange, retrieved July 22, 2019

Ether as digital oil

Bitcoin divides up the task of governing money supply, and farms it out to computers across the globe; ethereum does the same for computing. Instead of hosted on private servers, the data and logic behind an application are "decentralized." So-called "decentralized applications," or "DApps," run on ethereum's protocol connecting a global network of computers. Ether itself is a payment currency used to buy processing capacity on this network. Those who anticipate an increase in demand for ether are betting that decentralized applications will

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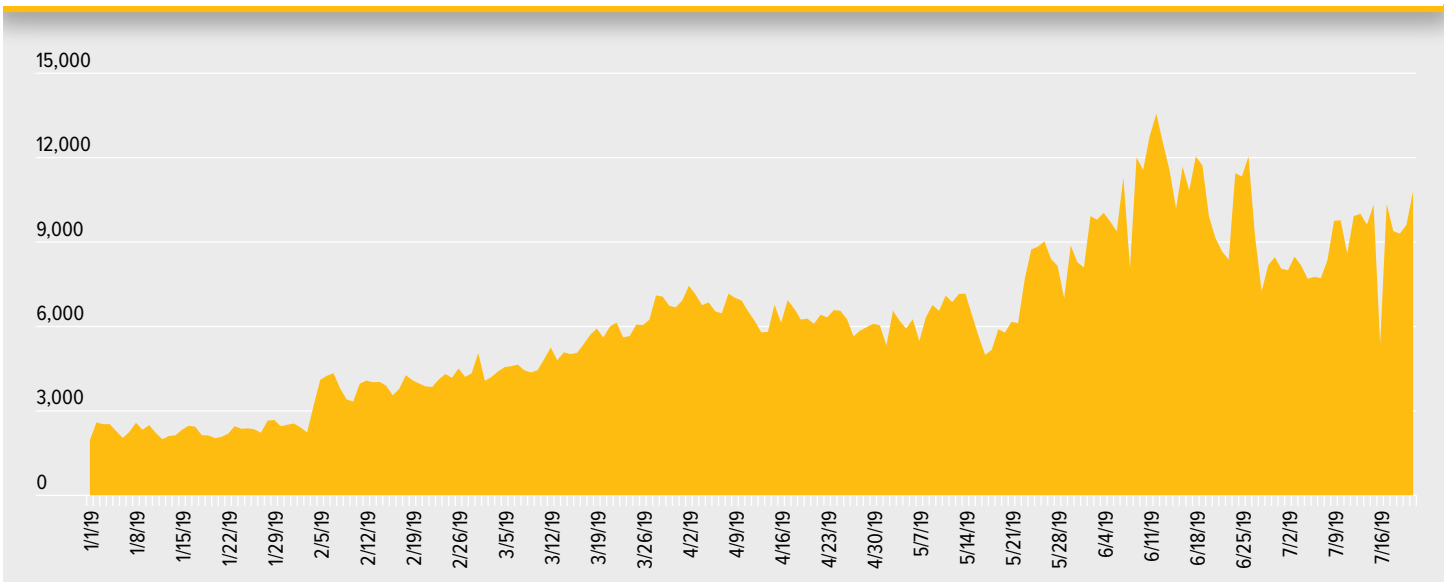
2 Galen Moore, "Custody: an Introduction," *CoinDesk*, August 2019

3 Carmen Reinhart and Ken Rogoff, "This Time Is Different," [Princeton: Princeton University Press, 2011], pp. 129-136

have advantages over centralized incumbents. This could happen if, for example, anti-Facebook sentiment pushes users to seek alternative social networks that provide more user-level control of data and stronger privacy guarantees. In other words, ether might be the oil of the information economy.

Much as FAANG stocks are measured by subscribers or active users, a similar fundamental metric could be applied to ethereum and its several competitor DApp platforms. Because transactions over these networks are public, this data can be measured in real time. So far, there's little evidence that any DApp built on ethereum is generating user demand at a level equivalent to Facebook or the other FAANG companies.

Figure 2. Growing demand for ethereum's data "oil"?
Combined daily active users (DAU) on the current top 10 ethereum dApps vs. time



Source: DappRadar; "top 10" retrieved July 22, 2019

Metrics to track demand for digital gold

Like commodities, bitcoin and ethereum do not generate income, and therefore must be evaluated in terms of supply and demand. Analysts are continuing to develop and refine new metrics to be used on either side of that equation. Price and market cap are not enough. In some cases, they can be misleading. Below are some of those emerging metrics, explained in terms of their application to bitcoin. (Most are also applicable to ether and to other crypto assets.)

Metcalfe's Law

Named after Bob Metcalfe, who pioneered the ethernet cable, it posits that the effect of a network is proportional to the square of its number of participants. In other words, a network's value to its users increases logarithmically, not linearly, with each new user. The classic example is the fax machine: two fax machines enable one potential path for communication; four fax machines enable six. Proof is found in Facebook, where revenue growth has indeed been proportional to the square of the number of users.

The number of active addresses is not correlated with bitcoin's price.

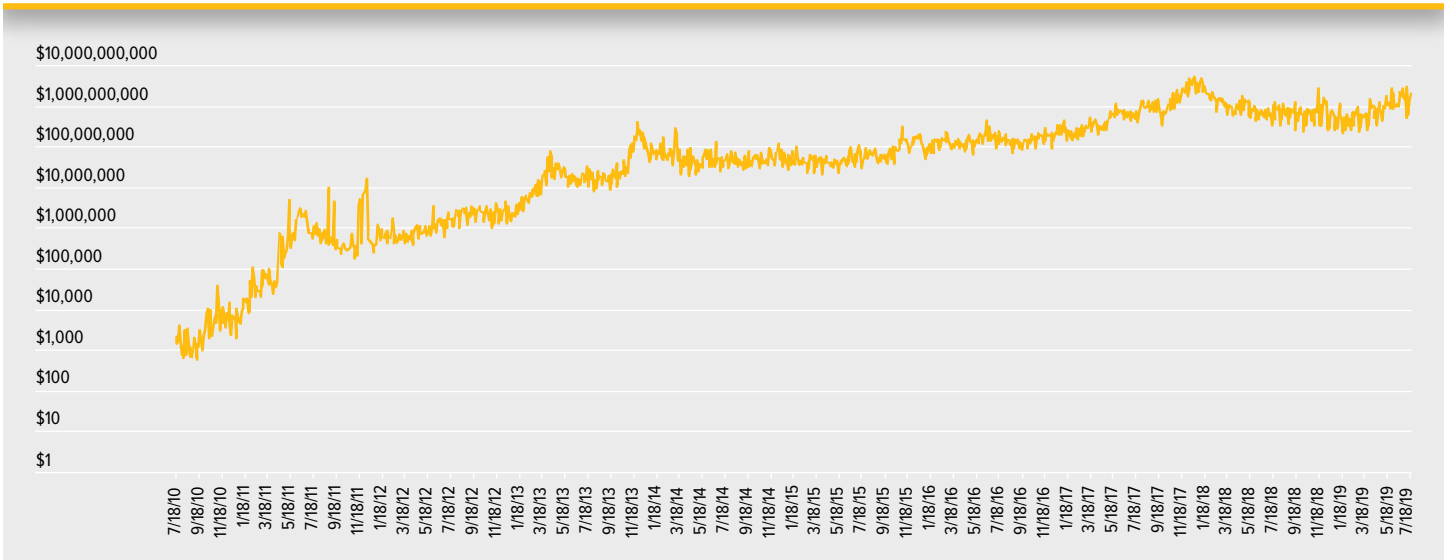
Unfortunately, the same logic does not apply to crypto assets. The number of active addresses is not correlated with bitcoin's price.[4] It shouldn't: Metcalfe's Law deals in *effect*, not value. A larger network of fax machines improves the effectiveness of each machine on the network; it does not indicate a higher value for each individual machine, or for telecommunications services. To determine the value of a bitcoin requires a more nuanced understanding of how bitcoins are being traded and held.

Transaction volumes

Transactions are one measure of bitcoin use. In this, bitcoin is frequently compared unfavorably to more scalable payment networks, like Alipay, SWIFT and the VISA network. However, we are discussing bitcoin as a store of value, similar to gold. Gold is not used to buy coffee. Bitcoin processes fewer transactions than more established commercial payment methods, but its average transaction is much higher in value. The chart below shows bitcoin's daily transaction volume growth (24-hour on-chain transaction volume X closing BTC price) on a logarithmic scale.

Gold is not used to buy coffee.

Figure 3. Bitcoin transaction volume is in the billions, but not the 10s of billions



Source: DappRadar; "top 10" retrieved July 22, 2019

Bitcoin Days Destroyed

Transaction volume is interesting, but not necessarily indicative of real economic activity. Users may move large volumes of bitcoin from one account to another, for security and convenience, for example. First proposed in 2011, "bitcoin days destroyed" is a measure of the extent to which long-held bitcoin balances are moving.[5] When a user moves 100 BTC after holding them for, say, 1,000 days, that's 100,000 bitcoin days destroyed. The number is the same, even if the bitcoin are sent to multiple addresses. That can eliminate some of the noise of transactions that amount to internal account management, providing a more accurate indicator of real economic activity.

Realized Cap

Besides transaction volume, it's useful to measure how much wealth is stored in bitcoin. In equities, this is accomplished through "market cap," multiplying the share price by the number

4 Alex Woodward, "Market Outlook Fundamentals vs. Price," *Good Audience,* Dec. 27, 2018, retrieved July 24, 2019

5 ByteCoin, "Re: Bitcoin Transaction Volume," *Bitcointalk*, April 20, 2011

of shares outstanding. The same math is frequently applied to bitcoin and other crypto assets, overlooking significant amounts that are lost, inaccessible or otherwise excluded from the market – as much as 3.7 million BTC, according to Chainalysis, a crypto asset forensics firm.[6]

Using the same data source as Bitcoin Days Destroyed, analysts at Coin Metrics, a crypto asset data firm, propose a metric they call "realized cap."[7] Realized cap is a market cap based on the value of each bitcoin at the time of its last transaction. This number is reflected in the price on the date each ownership record is created. For example, if a user bought 100,000 BTC on July 1, 2011 and has held onto them since then, realized cap measures her bitcoin holdings at the BTC price on July 1, 2011, i.e., $15.40.[8]

6 Chainalysis, "Bitcoin's $30 Billion Sell-off," June 8, 2018, retrieved July 24, 2019

7 Nic Carter, "Bitcoin as a Novel Market Institution," third-party transcript of a presentation at Baltic Honeybadger Conference, September 2018, retrieved July 22, 2019

8 Source: CoinDesk BPI

‘UTILITY TOKENS’: VALUING CRYPTO ASSETS BEYOND BITCOIN AND ETHER

Bitcoin may resemble digital gold, and ether may resemble digital oil, but what about the hundreds of other crypto assets? Some purport to offer improvements on the bitcoin and ethereum models, and may be evaluated using some of the same metrics listed above. Others more closely resemble proprietary currencies, like game tokens, casino chips or scrip. Decentralized applications exist with native tokens for everything from file storage to dentistry. Stocks and bonds represent claims on future earnings, and thereby capture turns in issuers’ fortunes quite well. What relationship can a game token have to the earnings of Chuck E. Cheese?

Some early crypto analysts have sought to answer this question and describe how crypto assets can capture value in a decentralized application. Below are a few examples of their work.

Crypto assets as tokens

A firm captures value flowing through the business via its ability to charge more for a product than it costs to make. Decentralized applications may have similar value flows, but they have no point of value capture. This may eliminate a rent-seeking middleman or reduce counter-party risk, but the crypto asset used to enforce incentives on such a network may have no cash flows tied to it. Instead of discounted cash flows, some observers have proposed to value these so-called “utility tokens” as proprietary currencies, treating a network of asset holders as an economy unto itself, and applying the monetary equation of exchange, expressed as $mv=pq$. In this equation, m is the supply of money, v is its velocity (how frequently it changes hands), p is the “price level” (measured in the U.S. using the Consumer Price Index) and q is the quantity of new goods and services in the economy.

This equation has been part of crypto asset analysis since early days, but was ignored by many issuers of “utility tokens” during the 2017 ICO boom. They neglected to carefully examine how value might be captured by a proprietary currency. In the equation of exchange, increased transaction activity (“velocity”) is a measure of how quickly people get rid of the currency they hold. In other words, high velocity is associated with declining value in a currency. Low velocity indicates a propensity to hold it. Unlike gold, nobody over the age of 15 will hoard a Chuck E. Cheese token.

High velocity is associated with declining value in a currency. Low velocity indicates a propensity to hold it.

Crypto assets as taxi medallions

As one example of a more sophisticated understanding of value capture, some investors have proposed to look at utility tokens not as media of exchange, but as licenses to do work. Asset holders are suppliers in a proprietary two-sided market, and must “stake” tokens (post them as a bond) in order to supply work for payment, which can be effected in any form. Fund managers at Multicoin Capital, a crypto-focused venture firm, call this a “work token” and note that this model supports network usage as a fundamental driver of crypto asset value.[9]

Crypto assets as governance

Building on the notion that crypto assets are a license to do work, some investors propose a new, more participatory form of investment. Traditional finance disregards participatory rights, such as voting rights, pricing stock solely based on rights to expected cash flows.[10] However,

9 Kyle Samani, “New Models for Utility Tokens,” Multicoin Capital blog, Feb. 13, 2018, retrieved July 22, 2019

10 Luigi Zingales, “The Value of the Voting Right: A Study of the Milan Stock Exchange Experience,” *The Review of Financial Studies,* Spring 1994 Vol. 7. No. 1, pp. 125-148

the managers at CoinFund and Placeholder Ventures, two crypto-focused funds, propose "generalized mining," a way for investors to use other kinds of rights, conferred by ownership of a crypto asset, in order to generate returns.[11] In the taxi medallion example, an investor holding tokens in a decentralized Uber might apply data science to determine the most profitable locations to operate ride-hailing cars. The investor earns a return in the form of profit on her operation of a business providing a service on the network. As that operation increases the number of cars and the ride-hailing activity on the network, it grows the "assets under power," which Placeholder proposes as a metric for fundamental analysis.[12]

Investors identify new ways to use rights conferred by ownership of a crypto asset, in order to generate returns.

The term "generalized mining" comes from bitcoin, in which "miners" must expend resources in order to earn rewards for validating transactions. Other crypto network designs require validators to "stake" assets, in order to earn such rewards. These forms of work are active, participatory ways for investors to earn a return.

Skeptics have noted that speculative investors are just as likely to take short positions as long. Participatory models may invite forms of participation that are not intended to increase the value of the asset.[13] That argument lets alone the question of whether professional investors outside of the venture capital category will be willing to roll up their sleeves and drive taxicabs or mine coins.

11 Brady Dale, "Crypto Funds Say 'Generalized Mining' Is the New Way to Invest," *CoinDesk*, February 13, 2019

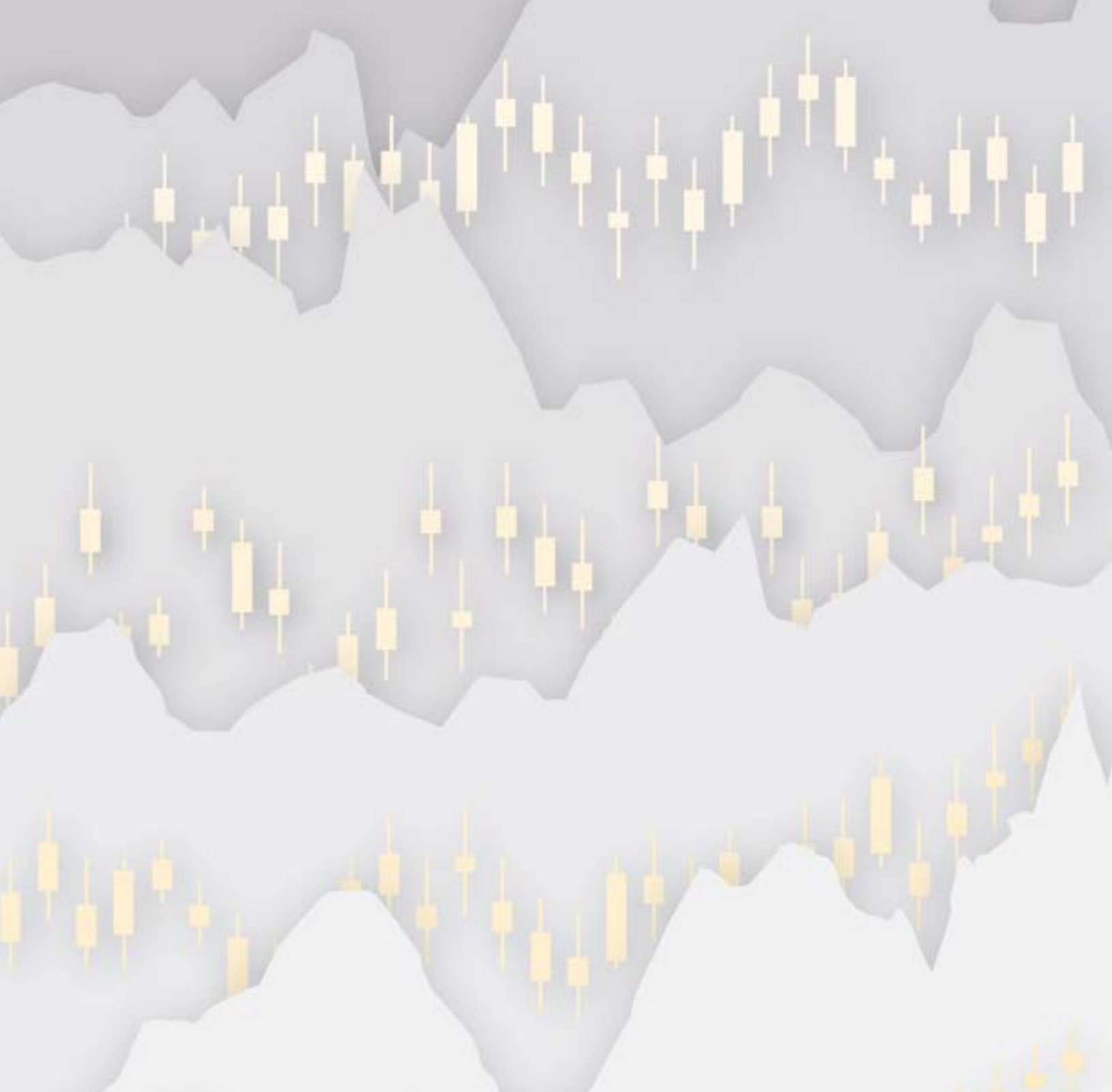
12 Joel Monegro, "Cryptonetwork Governance as Capital," Placeholder Ventures blog, February 19, 2019, retrieved July 22, 2019

13 Meltem Demirors, "The Truth About the Crypto Crisis," CoinShares Blog, November 20, 2018, retrieved July 22, 2019

CONCLUSION

It's clear from this review that the concepts advanced by crypto's early adopters present a compelling challenge to innovators in investment. The fundamentals of crypto asset valuation have a long way to go before they will be acceptable to the majority of professional investors.

The goal of this paper is not to promote them or to debunk them, but to present them objectively, as a resource for the institution that is considering crypto asset investment. Perhaps some of those institutions will generate ideas that will become paradigms for evaluating these assets in the future; we look forward to incorporating those ideas into future editions of this resource. Please look for those future editions at coindesk.com/intro-to-crypto-investment, keep up to date with our weekly newsletter, and respond directly with your feedback and questions to galen@coindesk.com.



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