coinbase ASSET MANAGEMENT

# In Math We Trust

## The Digitalization of the World Economy and its Monetary System

Where does digital money fit into your portfolio? It is the question all asset allocators are asking but afraid to answer. It is oddly polarizing. Our goal is to provide a framework that supports portfolio solutions. We evaluate digital currencies in a macroeconomic context, provide a framework for their valuation, and quantify their role in portfolios. Digital

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# IN MATH WE TRUST

## INTRODUCTION:

We are living through a quiet revolution led by the digitalization of the world economy.
Growth in innovation in the past decade has been the fastest of our lifetimes with the biggest leap in China. Market forces are pushing in the same direction placing a huge premium on intangible scalable assets.[1] There is a wall of money chasing scalable intellectual property; old-economy bricks & mortar companies are hitting a brick wall, struggling to find affordable capital for fixed investment. You know the stories. Tesla versus Ford. Uber versus Hertz. Airbnb versus Hilton. Bitcoin versus Gold.

The revolution is pounding on the gates of an antiquated monetary system. It starts with Bitcoin. Where it ends will depend on the collective ingenuity and energy of its community by virtue of its decentralized, inclusive nature. Have a great idea in banking? It is most likely to be lost in translation of a web of incumbent bureaucracy. Great idea in decentralized banking? Put it in the digital startup ecosystem and prove it.

The analog money system builds on centralized trust. No more evident is faith-based money than in the words on the back of physical US dollar notes: "In God We Trust." Digital money is built on math. It is there for everyone to see. For everyone to criticize. For *anyone* to improve upon.
Digital money and its vast future derivatives are the missing assets that will help solve today's portfolio problems. This paper builds the case in four sections:

- Section 1 explores the Bitcoin protocol in a macro context of monetary and fiscal policies.
- Section 2 walks through a valuation approach for digital assets.
- Section 3 explores the role that digital assets can play in institutional portfolios.
- Section 4 looks at the future growth of the digital age.

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[1] In 2018 the top five US companies' intangible assets were valued at $21 trillion, five-times tangible assets. In 1975 the situation was the reverse with tangible assets of $600 billion or 5-times the value of intangible assets. The companies? Today: Apple. Alphabet. Microsoft. Amazon. Facebook. 1975: IBM. Exxon Mobil. Procter & Gamble. GE. 3M.

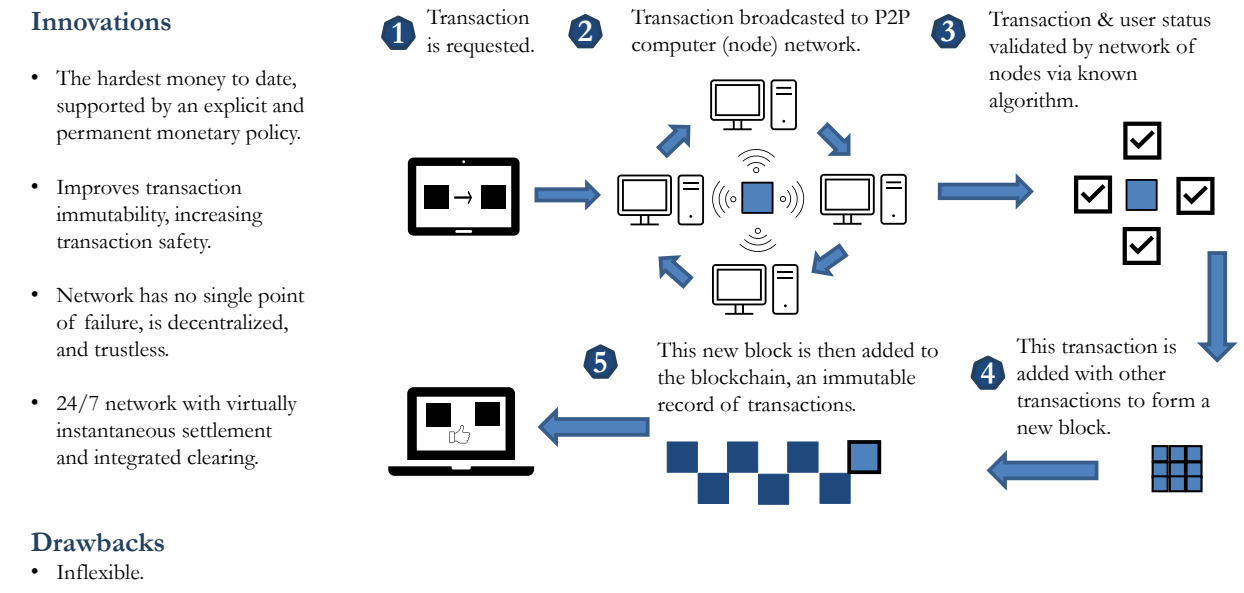
## I. DIGITAL AGE – MACRO MEGA-TREND

The digital age demands digital money, a mechanism for transferring value efficiently and immediately. The Bitcoin protocol is not the first nor the only protocol that allows for this digitalization. But it is the global benchmark. It is in the right place at the right time, brilliantly simple to use and complex enough to spur endless scholarly debate.

Think of this as the monetary layer of the internet – the internet's money. Technology to accommodate the broad adoption of websites and browsing was the last leap in layers of the internet from its humble Ethernet start in 1974. There are generations for whom the Ethernet and Darpa are to be studied for their role in the history of computer science. For them, digital assets are a natural layer to the internet, and Bitcoin provides the protocol.

Figure 1 shows the steps of a blockchain protocol with key elements of innovation. A user, with only a digital wallet and internet connection, requests a transfer. That request is broadcast to the peer-to-peer network. There is no singular, trusted entity monitoring this transaction. The transaction is subjected to a validation process via known algorithms. Peer-to-peer computers compete to confirm the solution. The validated transaction is broadcast to all computer nodes, thereby keeping a record of the transaction. When enough transactions occur or enough time passes, the group of transactions form a "block". This block is itself added to an existing historic ledger of all past transactions, thereby creating a chain of blocks, or blockchain. The transfer of value is complete and the blockchain validates the ownership of the monetary units.

**Figure 1: Digital age needs digital money – the Bitcoin protocol.**




Source: Blockgeeks.com. A Step-by-Step Guide for Beginners.

There are three notable features of the protocol.

First, it is decentralized. Anybody can participate in the network.
Second, the blockchain of record is immutable. Settlement is final and almost instant.

Third, and most powerful, the Bitcoin protocol integrates a monetary and payment system.

Satoshi's original paper does not mention the word Bitcoin outside of the title; the monetary unit was not the point of emphasis. It is the unit of account used to track the ownership ledger. The innovation of the protocol was its integration of payment, settlement, and monetary systems. There was less emphasis on the monetary unit or its monetary policy, though it dominates attention today. Much as the internet was created for one purpose, the Bitcoin protocol will be leveraged for others over time.

Bitcoin's monetary policy is run by a well-defined algorithm. Monetary units are created as a reward for the validation of transactions. As the system matures, the supply is programmed to slow via the "halving process", asymptotically approaching 21 million units.

Bitcoin's monetary unit achieved digital scarcity. Bitcoin's protocol achieved a decentralized network of transferring value between people over the internet.

It is entirely fair to question its adoption, security, its exchange value, and the like.

But the innovation is unequivocal.

Its genius is described in eight short pages and only 14,000 lines of initial code (Linux is more than 14 *million* by comparison).

### *Spotlight Shining on Bitcoin*

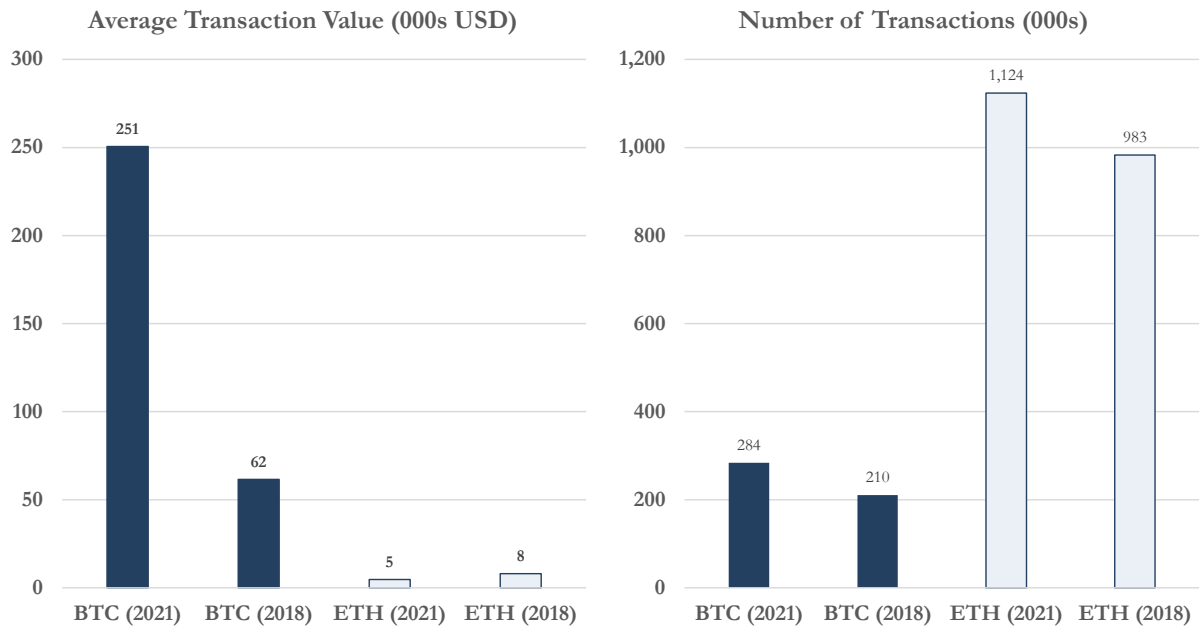
Why is Bitcoin getting so much attention?

We contemplate two broad reasons.

The first is the technology. We are required to trust the math and the math works! We are approaching 700,000 blocks in the chain with thousands of transactions per block.
The attributes of those transactions are striking. Figure 2 illustrates the average transaction value and the number of transactions on January 21, 2021 and three years ago.[2]

[2] Bitcoin transactions are effectively immutable. To re-write the ledger, a rouge actor would need to control over 50% of the network. At the time of writing, the estimated cost of a one-hour 51% attack on the Bitcoin network is more than $700,000. In contrast to Bitcoin immutability, the fiat payment system introduces frictions that allow for transactions to change. Bitcoin's instantaneous settlement and immutability improve overall financial efficiency and security, an underappreciated point in our view.

**Figure 2: Digital money as a technology is working.**




Source: bitinfocharts.com. January 21, 2021 and January 21, 2018.

Bitcoin's average transaction value has surged to more than $250 thousand with more than 284 thousand transactions per day. That is more than $800k per second. This also understates the confidence users are building in the protocol. The median transaction value is less than $1k. There are a small number of enormous transactions.

No doubt, the largest BTC transfer to date by value was $1.1 billion in April 2020 (161,500 BTC, worth more than $8 billion at current market prices). That is trust in math! It is worth emphasizing that the fee was less than one basis point of the transaction (less than fourteen dollars).

What about other coins? Is Bitcoin a special case?

Ethereum is an interesting comparative. It is immediately apparent that the Ethereum protocol is built for a different use-case. Ethereum is a higher transaction, lower average value protocol. The total value transfer is substantial at more than $5 billion per day.

But it is less than half of Bitcoin, transactions occur with more velocity, and a more substantial cost (0.22% average transaction fee on January 21, 2021). The details of the protocol, implied use-case, and adoption matters will be critical for investor consideration.

Macro policy is the second reason for rising attention on Bitcoin. Increasingly investors may focus on the interaction of sovereign debt and interest rates – particularly in the United States with the US dollar at the center of the global financial system – and the role that Bitcoin can play.

Government debt is high and rising. Think back a decade ago. US government debt was projected to rise to 62% of GDP to the present time. Now, those same projections are nearly double, with government debt expected to increase well beyond 100% of GDP over the next decade.

This is also a *conservative* representation of the debt burden. For one, such projections assume policy sticks to its current path without further easing. Additionally, it does not take into consideration unfunded entitlements such as pensions, which are now more than double current debt.

Fiscal orthodoxy is being discarded for new frameworks.

Only five years ago, a common focus was on the perils of too much debt. The Fall 2016 Fiscal Monitor from the International Monetary Fund focused on the prudent use of government debt, cautioning that the risk of inaction on debt sustainability would be costlier in the long run. Former US Treasury Secretary Rubin and former OMB Director Orszag collaborated in 2016 with a pointed, powerful opening: "The U.S. federal budget is on an unsustainable path." They concluded in favor of fiscal rules and advocated for broad political support. In January 2021, these same two collaborated to reject fiscal rules, instead suggesting a flexible policy that bypasses such anchors ("Fiscal Resiliency in a Deeply Uncertain World," PIIE).

Yes, we can and should look to the 2020 pandemic response as a shock-and-awe moment, where fiscal restraint was permanently rejected. But the philosophical shift is deeper, and more related to political economy. Debt is borne by many; wealth has accrued to the few. Standing up in favor of fiscal orthodoxy is political suicide.

This is not especially new. There is a long history of local-currency debt adjustments in major economies. Figure 3 presents stylized facts from 15 historic examples. It shows average annual outcomes for per capital GDP growth, inflation, and primary balances in the 15 years after the peak in government debt-to-GDP ratios.

The plan is simple enough – a very long period of modest growth and moderate inflation are high-level characteristics of government debt deleveraging cycles. The absence of indexation of the tax system will eventually cure debt ills; targeting interest rates well below growth in nominal GDP helped accelerate the deleveraging process in many instances.

Less advertised is the general fiscal position. The fiscal balance excluding debt interest costs – the primary balance – was in surplus in all cases on average during the 15-year deleveraging period, steeply so in most cases. None of the historic periods saw countries grow out of their debt with an expansionary fiscal policy, as has become vogue in the more recent past.
The historic analog is equally clear on inflation's role in debt deleveraging.

**Figure 3: High debt is corrected in a benign manner historically…but a few fat tails.**

**Episodes with an Overall Reduction in Debt to GDP over 15 Years**

| Country | Start Year | Change in Debt to GDP (%) | GDP Growth (% per capita) | Inflation (%) | Primary Balance (% of GDP) |
|---|---|---|---|---|---|
| Germany | 1918 | -129 | 1.2 | $1.4x10^{10}$ | … |
| Japan | 1942 | -96 | 0.7 | 91.4 | 3.8 |
| Ireland | 1986 | -74 | 6.1 | 2.8 | 3.5 |
| Italy | 1942 | -68 | 2.8 | 41.5 | … |
| United States | 1946 | -68 | 1.4 | 3.0 | 1.7 |
| Greece | 1931 | -57 | -2.8 | 90.0 | 3.5 |
| Belgium | 1940 | -55 | 2.2 | 3.1 | 0.7 |
| Italy | 1919 | -43 | 0.1 | 2.7 | 2.0 |
| Spain | 1898 | -27 | 1.1 | 0.3 | 3.9 |
| Israel | 1977 | -22 | 2.2 | … | … |
| Belgium | 1921 | -22 | 1.3 | 4.8 | 0.8 |
| Canada | 1995 | -18 | 1.7 | 1.9 | 2.0 |
| Netherlands | 1887 | -15 | 0.1 | -0.2 | 1.3 |
| France | 1884 | -13 | 1.7 | -0.6 | 3.3 |
| Italy | 1992 | -2 | 1.3 | 2.8 | 2.8 |
| Average | | -47 | 1.4 | $1.0x10^{9}$ | 2.4 |
| Average excluding Hyperinflation (>40%) | | -33 | 1.8 | 2.1 | 2.2 |

Source: International Monetary Fund. October 2012 World Economic Outlook, Chapter 3.

Most of the time, a long period of a little bit of inflation does the trick, with the average across the 15 countries very close to central bank current targets. The exceptions are extreme – a fat right tail of hyperinflation.

Demographics and government safety nets are materially different from those historic norms, and far more alarming. The IMF estimates government debt to include pension and health care obligations implied by current policy. US general government debt is comfortably above 300% of GDP on those net-present-value estimates, second only by a sliver to Japan.

The interplay between local currency debt and real interest rates is definitive: higher debt brings lower real rates with a cooperative central bank. The alternative is politically untenable.

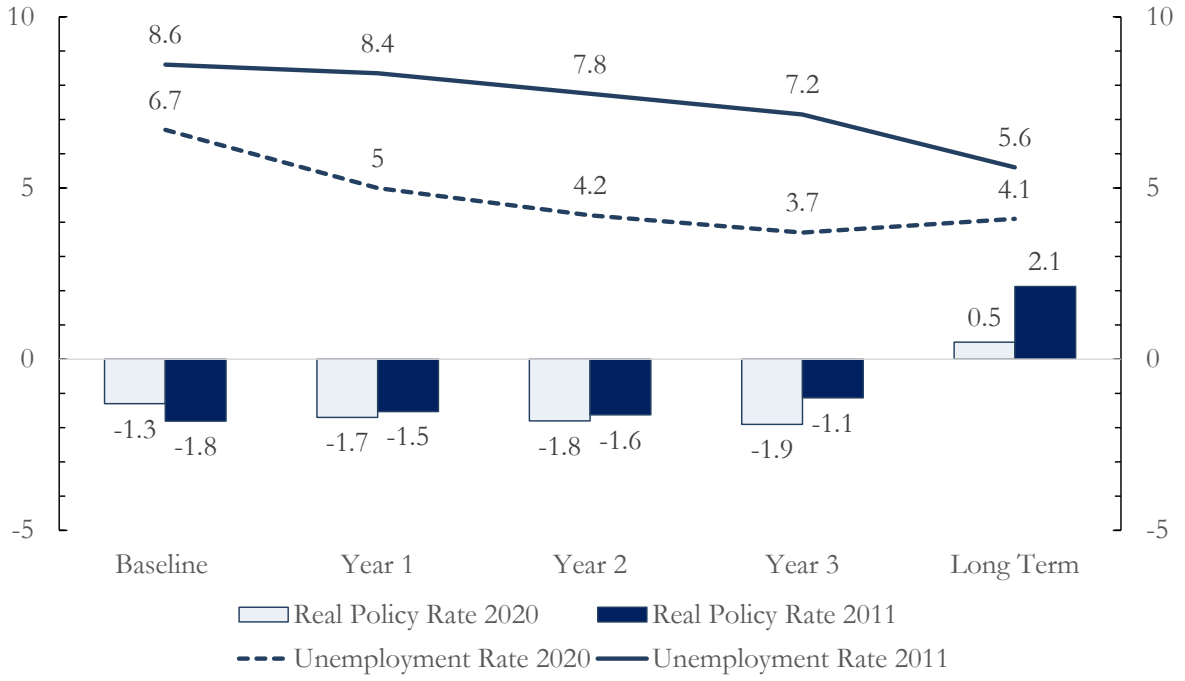
Policies to reinforce low real interest rates have not generated the consumer inflation many feared. They have most certainly contributed to a massive rise in asset valuations, a more vicious depreciation in the purchasing power of capital.

Those who own assets that benefit from capital inflation have maintained strong purchasing power – think Amazon stock. Those dutifully saving for future investment are left behind. The macro policy backdrop is compelling corporate treasury demand for digital assets precisely for this reason.

***Inflection point: Debt is cured with a (very) long period of negative real rates.***

Is macro policy really at an inflection point? The data point to an unequivocal yes.

**Figure 4: Policy guidance is explicit for a very long period of negative real interest rates.**




Source: Federal Reserve Open Market Committee December 2020 and January 2012 projections. The baseline for January 2012 projections is the fourth quarter of 2011.

This is readily apparent in the signalling from the Federal Reserve Open Market Committee. Figure 4 shows two periods of long-term projections when the policy rates were pinned to the zero-lower boundary – December 2020 and December 2011. We are in an entirely new regime.

In the 2011 case, real policy rates were projected to rise as the unemployment rate declined and gradually approached its longer-term anchor. By the third year, real policy rates were planned to rise by 75 basis points even with the unemployment rate 1.5 percentage points above the estimated longer-term sustainable level. Monetary policy was set to the forward expectation of inflation. In the event, both the unemployment rate and inflation surprised to the downside.

At the end of 2020, we see the FOMC new regime in action. The unemployment rate is projected to fall rapidly to 3.7% by the end of 2023. This is almost half the three-year projection from 2011 and puts the unemployment rate below the Fed estimates of the sustainable long-term level. Even so, rates are projected to remain pinned to their nominal floor. In fact, this leaves real policy rates at the lowest levels of the cycle, at –1.9%.
In the long term we may all be dead, but at least policy rates will poke their head from the grave with a +0.5% projection.

The signalling is clear. Government bonds may be a safe-haven asset and the US dollar may be the reserve currency of choice, but investors are going to be paying for that privilege for the foreseeable future. Expectations of real interest rates normalizing with economic activity are wholly misplaced.

Negative real interest rates are part of the solution, not the problem. In fact, causality is running from sovereign debt to real interest rates. This is counter to what one would see with countries or corporations whose capacity to repay obligations is in doubt. A rise in real borrowing costs imposes an orthodox outcome in those instances – a difficult, enduring rise in free cash flows used to deleverage. That is not the relevant case here. Instead, rising indebtedness and declining real interest rates have become self-reinforcing. Fiscal authorities do not see the immediate consequence of added debt and the central bank stands prepared to make sure it stays that way.

The Fed could change their minds. They could signal a more rapid rise in real interest rates and concern about an overshooting of inflation. This could force fiscal contraction, last seen in the early 1990s. Policy super-tankers do not turn with that degree of precision. The recent change in policy mix was years in the making. We are at an inflection point in macro policy – there is no obvious way of turning back. This dynamic is driving interest in digital assets.

The trajectory is highly reflexive.

Consider a scenario where central banks introduce their own digital currencies. There are deep challenges around financial stability in such a paradigm. A central bank digital currency would need to yield less than a commercial bank deposit. Otherwise, in a time of crisis, individuals could rush away from bank deposits and into central bank digital currencies thus shifting their liability direction away from private banks and to the central bank. Central bank digital wallets will, thus, need to trade at a penalty rate relative to commercial bank deposits. Today, that would translate into a steeply negative policy rate.
Bitcoin becomes more attractive in that scenario.

A period of undershooting in inflation is a scenario that would be met with a more aggressive policy response than in recent decades. Central bank digital currencies are also a tool for more targeted fiscal policies, potentially funded by central banks.
The Automatic BOOST to Communities Act provides one creative example where the Federal Reserve would fund cash to Americans through the Treasury General Account. This was introduced into stimulus legislation in the US House, though removed by the US Senate. It is not the last of such proposals.

With sufficient vigor, there is little doubt such policies would achieve the desired rise in inflation. The potential for such outcomes only validates the recent rise in demand for digital assets.

## II. FIAT INFINITY versus DIGITAL SCARCITY

Being useful and innovative is not sufficient for an asset to have value.

Think of open-source Linux operating system. Nobody owns it. Nobody controls it. And nobody pays for it. It is extremely useful, and the only way of investing in that use was through other supply chains in personal computers, including competitors like Microsoft. There was a time when the enterprise technology world could not imagine building computer operating systems where nobody was in charge. That changed. Of course, many digital assets could bear similar investment prospects to Linux.

There are various ways in which digital assets gain and retain value. Chief among them is creating digital scarcity. It is not an intuitive starting point for thinking about digital things. A photocopy of DaVinci's Mona Lisa is worthless no matter the precision.

The Bitcoin protocol achieves digital scarcity, a key feature of its ability to retain value.

***Bitcoin: an integrated monetary-payment system that meets the standard of money.***

Bitcoin protocol is an integrated monetary and payments system. The work being done to validate transactions is rewarded with a token (Bitcoin). The value of that token is measured via its exchange rate against other monies around the world, with the US dollar a natural benchmark given its reserve currency status.

Bitcoin is money.

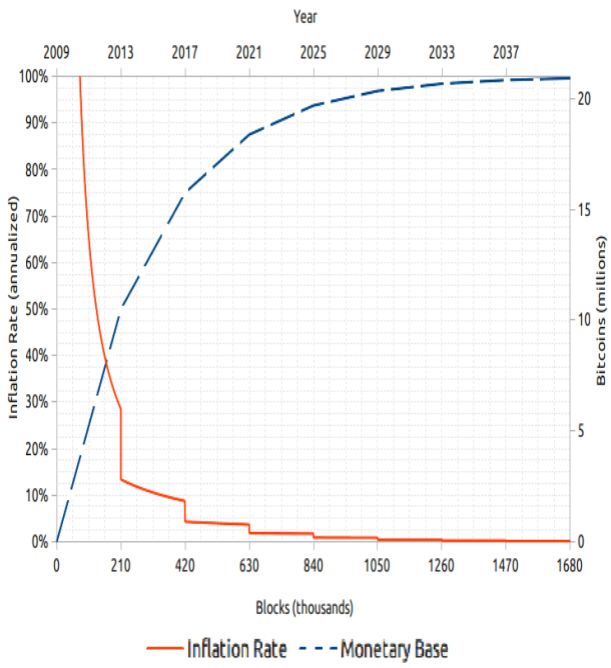
It is money with a monetary policy that is anchored to price stability, an algorithm that converges to a fixed supply. No inflation. Of the historic features that define money, Bitcoin scores highly, and higher on average than others in modern history (Figure 5).
It is young, and immature. Investors need to judge Bitcoin as a precocious child with the scope for incredible breadth as it matures. Its track record is too short to be judged widely against other potential monies, especially gold with its long tradition in monetary systems.

One could derive a ranking on the importance of money to trivialize the relevance of Bitcoin by extrapolating recent history. Several key policy officials provided those arguments at 2018 Fintech Forum emphasizing the volatility of bitcoin was too high, payment processing too slow and energy consumption problematic.

These are undeniable traits of Bitcoin's first decade. But those characteristics cannot be extrapolated. As the market value of Bitcoin rises and the ownership curve flattens, the importance of any individual in the network will lessen and volatility will decline.

Secondary applications to the base-layer protocol are also emerging in response to use-case demand. The Lightning Network tied to the Bitcoin protocol greatly reduces processing times for small-value transactions at the expense of security and could/should be used by central bank digital currencies in the future.

**Figure 5: Bitcoin price stability and monetary features.**




| Attribute | Bitcoin | Gold | Fiat Currencies |
|---|---|---|---|
| Scarce | A+ | A | C- |
| Portable | A+ | D | B |
| Fungible | B | A | B |
| Verifiable | A+ | B | B |
| Divisible | A+ | C | B |
| Established History | C | A+ | C |
| Censorship Resistant | A | C | D |
| Volatility | C | B | A |

Source: The Bullish Case for Bitcoin (Vijay Boyapati, 2018). Why Does Bitcoin Have Value (Jeffrey Tucker, December 2020). Nakamotoinstitute.org.

Reasonably, there are also concerns about the use of Bitcoin by nefarious actors. Yet, the immutable nature of the blockchain ledger has worked to the great advantage of law enforcement officials for tackling criminal behavior (Kathryn Haun's journey at the Department of Justice is a terrific example). Forfeiture of digital assets is also far more successful than with cash criminal activity. No doubt, the US government seized roughly 70,000 Bitcoin from the Silk Road case last November, or more than $3 billion at current values.

Digital assets are entering mainstream banking and Bitcoin is the leader. History shows private actors drive changes in money by a convergence to a new consensus, not by policy decree. Policy follows, it does not lead. The same is demonstrated today, with central banks racing to catch up to private actors with the creation of central bank digital currencies. These actions validate the technology.

Bitcoin is money, and it is rapidly moving into the mainstream. Where does it get its value, can it be retained, and what is the root of its volatility? We turn to these issues next.

***Value #1: Bitcoin by production costs.***

The first way of valuing Bitcoin is akin to a commodity. In a market with fluid supply, the lower boundary of its price is the marginal cost of production. If prices were to fall below that level, new supply declines to raise prices back to the marginal cost and vice versa.

**Figure 6: Bitcoin's value estimated by production costs.**


Source: Cambridge University. Charles Edwards "Bitcoin Energy Value Equivalence."

Cambridge University maintains data estimates on the energy used by Bitcoin miners, creating a benchmark for valuation models. This is broadened to include operating costs, such as labor, and mining capital expenditures, including the technology hardware that have shorter-horizon expenditures than a traditional commodity market (18 months in the case of Bitcoin mining).

Energy efficiency of mining hardware has improved immensely in the past ten years. Cambridge estimates that computer energy efficiency used in Bitcoin mining improved by more than 100,000 times. However, the number of computations required to solve the algorithm, confirm a block, and earn the mining reward has increased even more, thus elevating the cost of production.

The production-cost approach does a good job of capturing the trend in the price of Bitcoin (Figure 6). It is also useful as a thought-experiment. If there were no community support, miners would leave the ecosystem and the cost of mining Bitcoin would plunge; this would obviously coincide with a demand-led decline in Bitcoin's market price as the community abandoned it.

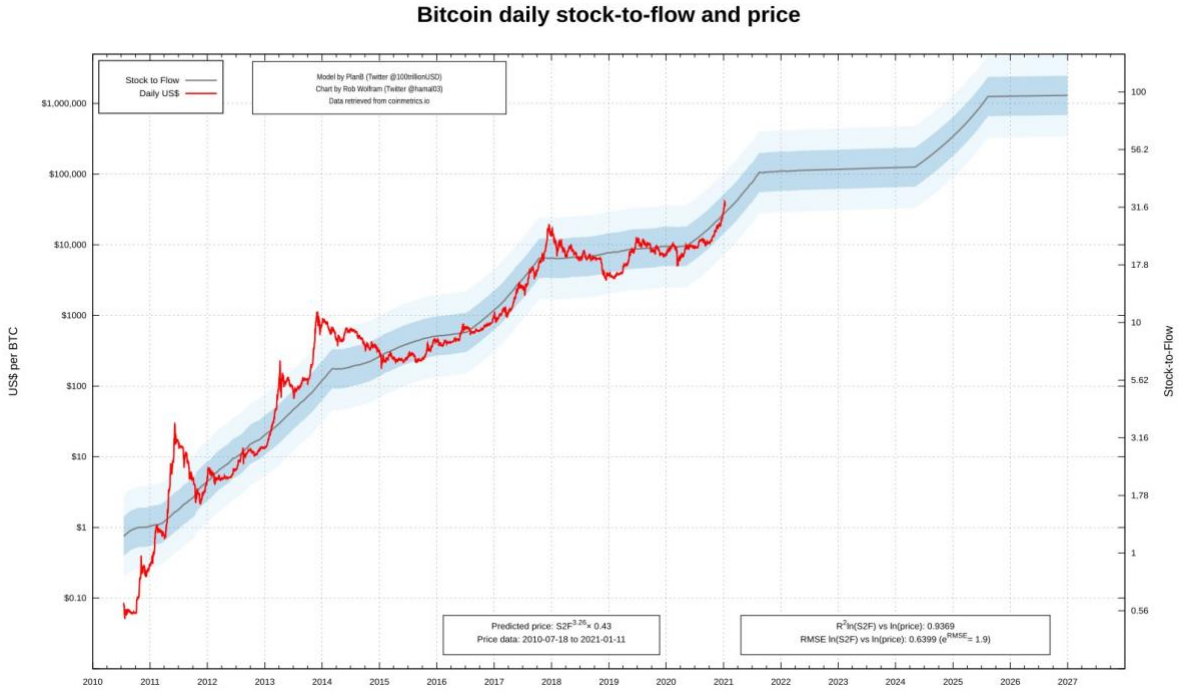
It is also interesting to consider the case of high inflation in the United States. This would see the dollar-cost of energy rise substantially, and with it the cost of production for Bitcoin. A rise in nominal energy prices would be appropriately captured in the costs and, in turn, the appreciation in the price of Bitcoin. Energy units is Bitcoin's nominal anchor.
But the production-cost framework is also clearly incomplete. There are long stretches of time between 2011 and 2015 where the price of Bitcoin was well below the supposed floor of production costs, even when defined more broadly to include hardware and labor costs. Bitcoin traded more than 50% below model estimates.

Any model is a simplification of a more complex reality. The cost of production model relies on a lot of data, and no statistical fitting. Data availability, particularly on a timely basis, is constrained. We do not know the true efficiency of hardware used to mine Bitcoin, amongst other things. These are approximations; the limitations encourage additional benchmarks for measuring Bitcoin's value.

***Value #2: Digital scarcity.***

Quantifying digital scarcity is a second method of estimating Bitcoin's dollar valuation.
Figure 7 illustrates the predicted price of Bitcoin through the most used benchmark for digital scarcity, stock-to-flow or S2F (released March 22, 2019 by an anonymous investor under the pseudonym Plan B). The S2F model starts with a simple question – at the current rate of production, how long would it take to replenish the entire stock of the asset? The longer the time, the greater the scarcity, and the higher the potential scarcity value.

**Figure 7: Stock-to-flow methodology of measuring scarcity.**




Source: https://100trillionusd.github.io/. Bitcoin Stock-to-Flow Cross Asset Model.

The calculation for Bitcoin is easy enough. New Bitcoin supply is created when a block is completed. The protocol calls for a block to be created roughly every ten minutes of the day, each day. 24 hours in a day, 6 ten-minute increments per hour means 144 blocks created per day. Right now, the Bitcoin monetary policy supply algorithm rewards 6.25 Bitcoins to the miner that solves the math puzzle when confirming a block. 900 new Bitcoins are created each day.

At the time of writing, there are 18.6 million Bitcoins in circulation. It would take a bit more than 56 years at the current pace of Bitcoin supply to replenish that stock. The upward trajectory of the model is driven by the high scarcity premium of the Bitcoin monetary policy. Every four years,

the Bitcoin reward paid to miners for confirmation of a block is cut in half (the last Bitcoin halving was May 11, 2020 and the next is estimated March 12, 2024).

This articulation of scarcity is easily applicable to other assets. For instance, the stock-to-flow in gold is 62 years, slightly longer than the current S2F for Bitcoin. However, the Bitcoin S2F is programmed to rise over time, whereas innovations in gold production can see that number decline sharply. Clever applications have also been applied to various housing markets, with S2F in US residential housing estimated at 95 years.

Unlike the commodity model of Bitcoin, statistical gymnastics are required to translate S2F into a Bitcoin valuation. The historic S2F is estimated to have an exponential relationship to the value of Bitcoin. The chart demonstrates that the historic fit is quite strong. No doubt, the framework rightly argued for a rapid appreciation with the halving of the new Bitcoin supply in 2020.

But we must be attuned to its limitations. Statistical relationships are not enduring. They are useful for local approximations. Bitcoin's supply algorithm means that the S2F model places the price of Bitcoin on a path to infinity. Bitcoin is many things – infinity translates to Bitcoin consuming all other sources of value. Society is not going to organize itself around Antminer hardware to perform trivial calculations with no purpose.

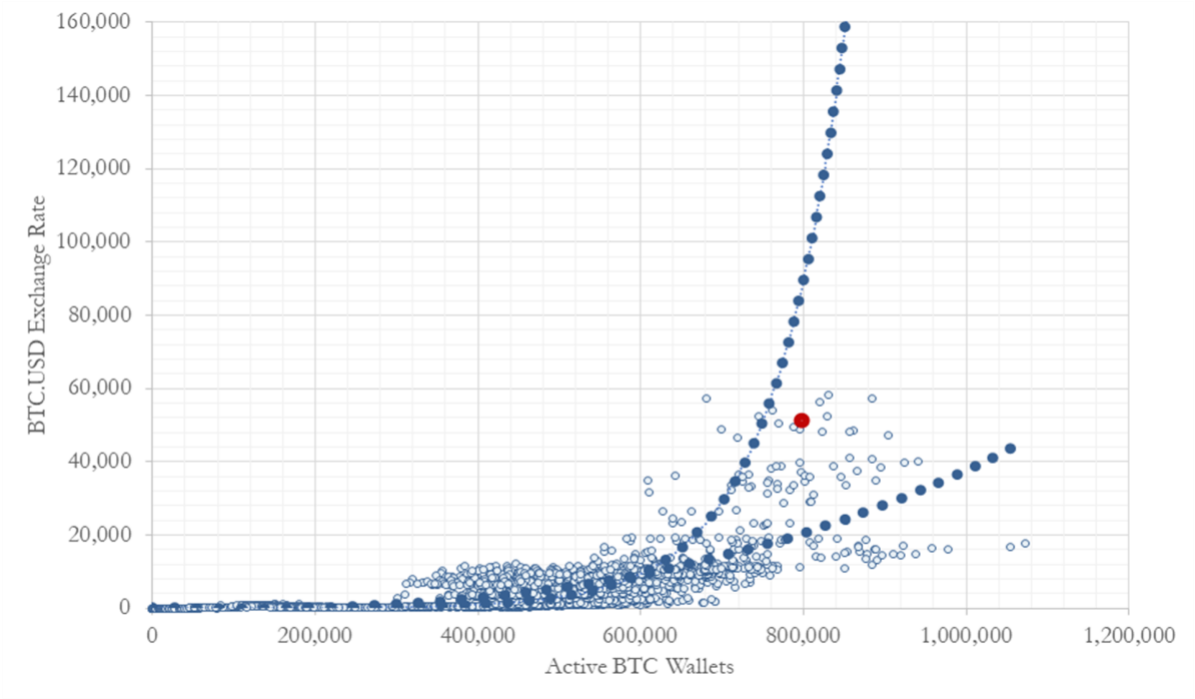
We must appreciate S2F for what it is – a local, statistical representation of digital scarcity, not a singular truth.

***Value #3: Network effects as a store of value, a long-term anchor.***

A third method of valuing Bitcoin is through its network effects. This can really be thought of as the long-term anchor to the project. If there is no network interest in Bitcoin, demand disappears, miners vanish, the cost of production declines to a trivial level, and S2F metrics start mapping statistical relationships to a price level that is close to zero. It is *all* about the network.

The simplest representation of network effects is Metcalfe's Law. The number of potential connections in a network is exponential to the number of network nodes. The popular example is that of the telephone. Two telephones in a network have one potential connection. Four telephones can make six connections. Twelve can make sixty-six connections. This simplifies to N(N-1)/2 where N is the number of unique connectors in the network. Easy.

**Figure 8: Network effects have value, careful not to extrapolate.**




Source: Quandl.com. Bloomberg LP. Authors' Calculations.

Metcalfe's law was dusted off with the expansion of the internet. In 1995, there were 16 million users of the internet. Ten years later the network rose to 16% of the world's population, more than a billion people. We are now approaching 5 billion users. Inexpensive satellite internet will bring the world to near-full internet penetration. The network effects are clearly staggering.

Facebook is monetizing those network connections. In 2005 there were 5.5 million Facebook users, less than 1% of the number in the internet network. Last year, this figure rose to nearly 3 billion, or two-thirds of internet users. The speed of the network expansion is notable. *S*-curve relationships on technological adoption have turned more into "r" curve rocket launches – a rapid and forceful exit from the earth's atmosphere followed by a smooth and low-energy orbit.

Naturally, there is applicability to the network of digital assets. Figure 8 illustrates the number of active Bitcoin wallets on the x-axis against the Bitcoin exchange rate to the US dollar on the y-axis for the past decade. The red dot is Waldo, where we currently are in March 2021. The relationship is clearly non-linear, but also wide ranging. The two trend lines are different non-linear fits to the data that have vastly different forward-looking extrapolations.

Like other valuations, the trend lines illustrate its limitations. Digital assets and the wallets associated with activity are not equal nodes on a telephone network. The connectors of the network are not equal, not even close to it. The institutionalization of Bitcoin will invite larger sources of demand. The MicroStrategy Treasury Department and One River may represent the same number of connectors in the Bitcoin network; the implications of our connections do not.

The institutionalization of digital assets will result in a vast change in the nature of the network. A rise in price will induce large, concentrated holders to satisfy new demand by selling their holdings and diversifying into other assets. Who enters the network will matter greatly. It is our judgment that increased institutional activity is at an inflection point. The advancement in that network can be rapid – far more so than the *S*-curve adoption rates of the past – because this new technology is a natural layer to one that is very familiar by now: the internet.

***Volatility and market correlations: speculative demand.***

None of the valuation approaches will do a particularly good job of capturing the volatility in the prices of digital assets. To tackle issues of volatility, we must go back to the roots of any nascent market – its microstructure. The volatility in digital assets can be traced back to speculative demand.

In mature markets, such as foreign exchange, speculative activity accounts for a fraction of liquidity provision. It is largely a footnote that can be very relevant for brief moments in time, leading to a symbiotic relationship with institutional investors. Like a fly on buffalo travelling across a great plain, they need one another to end up at the same place but their journeys and functions are vastly different. Speculators are the buzzing fly in foreign exchange, responsible for less than 1% of trading volume but having the nimbleness to provide clues on big changes.

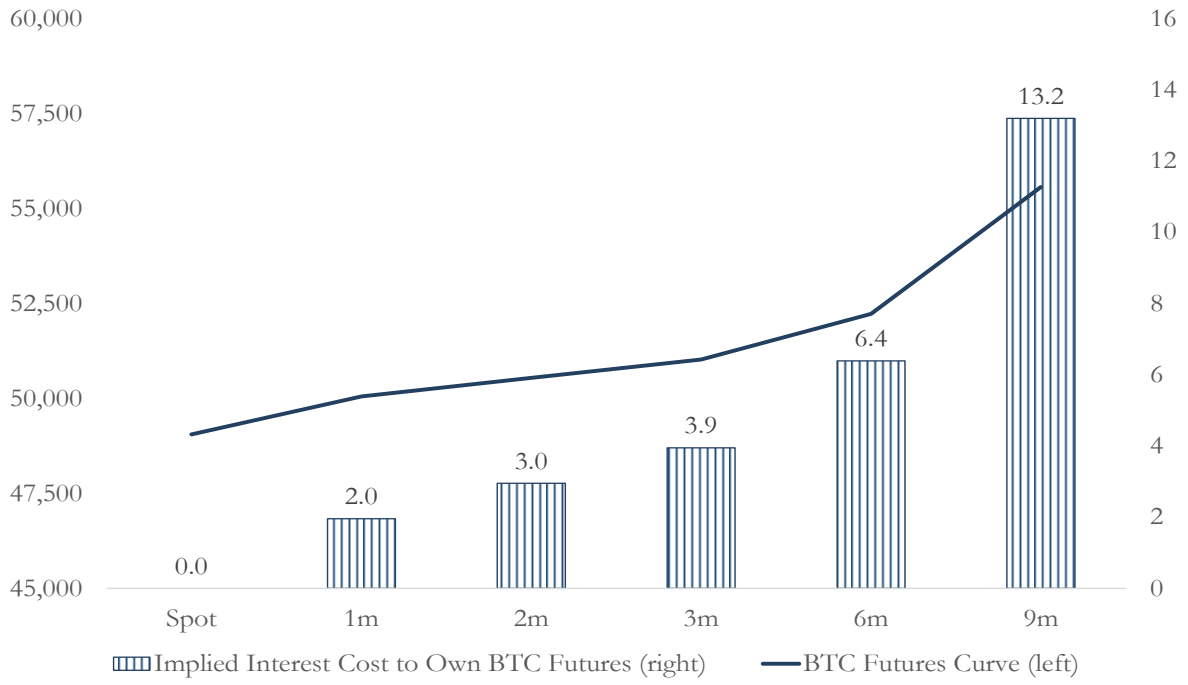
Bitcoin is not there…yet.

Bitcoin speculators are the size of buffalos and they trip when trying to dart like flies. It is not a structural feature of Bitcoin as suggested by many. Taking recent volatility and features of the market to infer that the volatility of digital assets precludes it from institutionalization misses the point. Its present and historic volatility is evidence of its maturation stage, not a fatal flaw in the design. It is much simpler for an individual to engage in Bitcoin than for an institution. Risk tolerance is almost surely higher for the individual.

The broadest metric for tracking speculative demand is the interest rate cost of funding leveraged long exposures. Figure 9 shows this for the CME futures contract in Bitcoin on March 5, 2021. The value of the futures contract is the ability to leverage exposure. The slope of the forward curve tells you the cost of that leverage. Of course, high demand for leveraged exposure to BTC increases the futures price to attract sellers and raises the implicit interest rate over the period of the contract. This rate was a substantial 6.4% over six months. That is, the price of Bitcoin would need to rise 6.4% over that five-month period for the owner of the contract to make money. This gives you a sense of forward expectations.

The over-the-counter market is even more vibrant. The benchmark for funding costs is an eight-hour window over a twenty-four-hour period. The perpetual swap trades at the spot price with the funding rate being the one where buyers and sellers clear the future market at the current spot price. The funding rate is like the sales tax paid at the register; it is not included in the sticker price.

**Figure 9: Funding rates capture speculative demand, and drive liquidity shocks.**




Source: Bloomberg LP. Authors' Calculation. March 5, 2021.

Funding rates tell us a lot about speculative imbalances. The striking feature of the sudden-stop in March 2020 was captured in funding rates. One-month annualized rates fell below –100% for a moment in time, and those willing to buy Bitcoin on a forward basis were doing so at a meaningful discount instead of the usual premium.

The degree of that deeply negative funding rate was not an error, nor an outlier that needs to be scrubbed from the data. It was the product of a liquidity fracture in the market, the same dynamic that led to a shuttering of exchange traded futures and Treasury ETFs trading at a 10% discount to net asset value during that period. What happened? Margin calls for leveraged long players who could not find the liquidity. The price needed to decline to find a buyer, and that was at a handsome interest rate (negative funding rate).

The March 2020 downturn correlated to the equity and bond crash. Is one to conclude that Bitcoin has equity-like features as a matter of structural design? No way. When leveraged long positions are stretched in any market and there is a liquidity freeze, look out below. The only hedge to a liquidity shuttering is…liquidity. It should by now be understood that those events are brutal, but also brief. Take on leverage with care.

***What's the limit? Bitcoin becomes the trusted, global benchmark for value.***

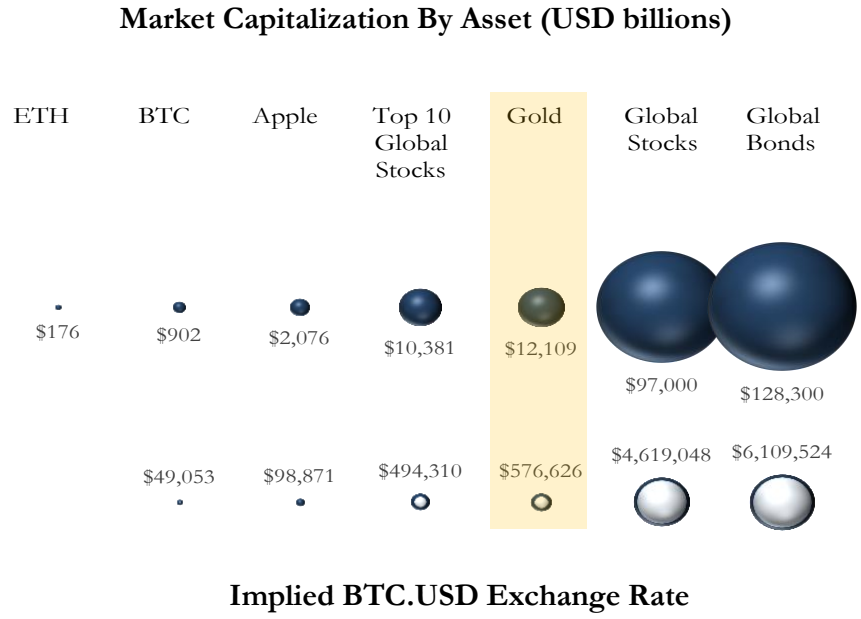
Let's conclude the discussion on valuation with rough benchmarks.

Figure 10 illustrates the value of Bitcoin if it were to become the large value transfer benchmark for various asset classes. This is a translation exercise, pure and simple. It is an exercise that others have done with eloquence. Hal Finney announced a potential value of $10 million per coin in receiving the first Bitcoin from Nakamoto. Vijay Boyapati expanded on this bullish case for Bitcoin in 2018 with a range of outcomes based on future capitalization.

Take the current US dollar market capitalization of various assets and translate it into a Bitcoin price based on 21 million units of supply. If Bitcoin supplants gold as the reserve asset of choice, its price will need to rise to nearly $577,000 based on current market values. In Hal Finney's thought experiment where Bitcoin becomes a dominant system for value transfer, the currency value is in the millions.

The asymmetry speaks for itself. Today's volatility is trivial in that context.

**Figure 10: Bitcoin price under different market capitalization scenarios.**




Source: Coinmetrics. ICMA Group. Statista. Authors' Calculations. BTC supply held at 21 million across scenarios for ease of comparison. March 5, 2021.

## III. PORTFOLIOS: BONDS, WE'VE GOT A PROBLEM.

Financial assets have performed extremely well in recent history.

Balanced portfolios illustrate the point. A 60-40% equity-bond portfolio has averaged a solid 9% annual return in the past three decades. Balanced portfolios with leveraged bond exposure – risk parity – have done even better. It is not just that returns have been strong. Leverage bond exposures greatly reduced portfolio drawdowns. The problem is that performance cannot be extrapolated. But old habits die hard.

Low bond yields and high asset valuations translate into low expected future returns. Asset managers are mandated to achieve future returns that resemble historic norms. Those with underfunded positions resort to taking more risk. Bonds have been the risk of choice and they can no longer fill that role. Real rates will be negative for a very long time and the benefits of bonds have vanished. The market downturn in 2020 was a harsh reminder as both stock and bond prices fell sharply. February 2021 reinforced the point.
The big-picture problem is that the uniform rise in asset valuations has generated an illusionary wealth dynamic. The generation experiencing the rise in asset valuations is doing so merely at the expense of future generations. Compounding the challenge, market participants have been trained to believe that any rapid downturn in asset prices will be met with increasingly aggressive monetary and fiscal stimulus. The newfound coordination of monetary and fiscal policies means whatever market correlations we grew up with will not endure.

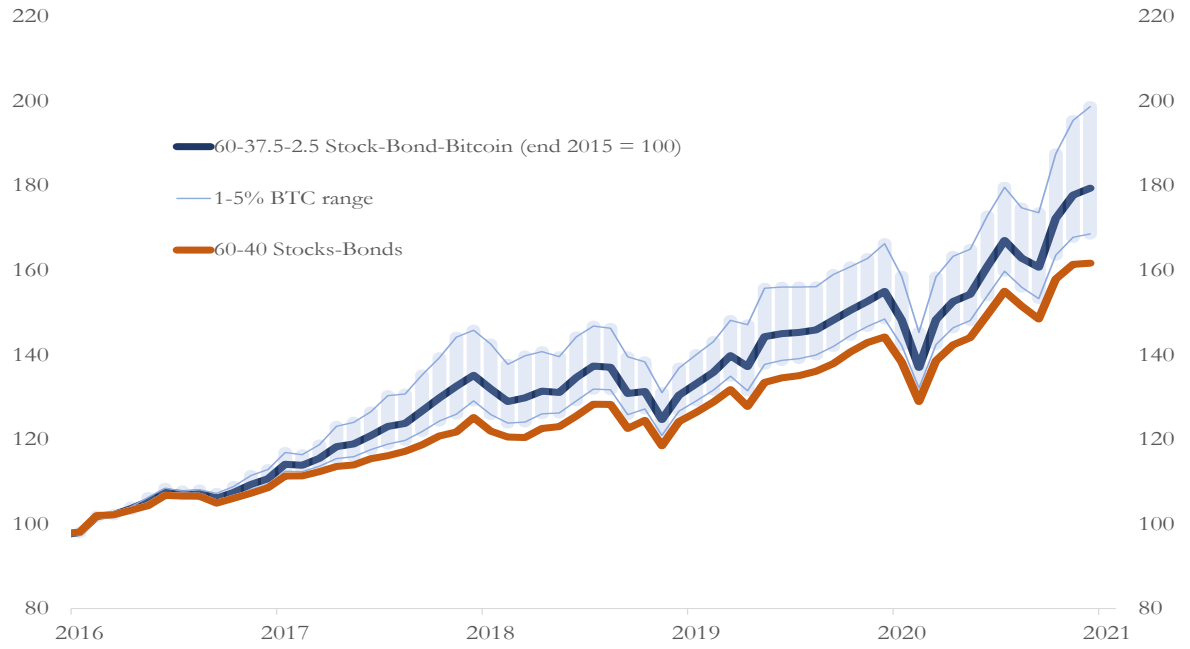
Bitcoin's role in portfolios is couched against this backdrop. The wisdom of crowds is hunting for a new nominal anchor to guard against illusionary asset and income gains. Bitcoin can provide this function because its supply is constrained and its nominal value is anchored to something real – units of energy, the cost of production. This is the most common forward-looking case for the inclusion of digital currencies in portfolios – the preservation of value.

We take a glance in the rear-view mirror in this section to illustrate how Bitcoin interacted with balanced portfolios in the familiar period of recent history. Even a small amount of Bitcoin made a big difference as a replacement to fixed income. There is no free lunch in the end – the volatility of Bitcoin mirrors the upside optionality of the technology. It can be managed, not feared.

***How to protect real capital? Digital assets are already playing a role.***

Bitcoin has already demonstrated its capacity to protect real capital. Figure 11 shows a 60-40% stock-bond portfolio. We calibrate an alternative portfolio in the past five years with Bitcoin exposure in a range of 1-5%, at the expense of bonds. The portfolio is recalibrated monthly to the fixed weights. Each month, the investor returns the portfolio back to benchmark.

**Figure 11: Digital assets have already played a role in protecting real capital.**




Source: Bloomberg LP. Authors' Calculations. Figures are based on month-end prices. Latest observation is January 14, 2021.

The visualization sends a clear message: Bitcoin beta has been the alpha. In fact, the performance of a 60-37.5-2.5% portfolio mirrored that of a 60-140% leveraged bond portfolio, where the bond leverage is a crude proxy for investors moving out the risk spectrum. Put differently, 2.5% exposure to Bitcoin generated the same risk-return attributes as 102.5% bond exposure.

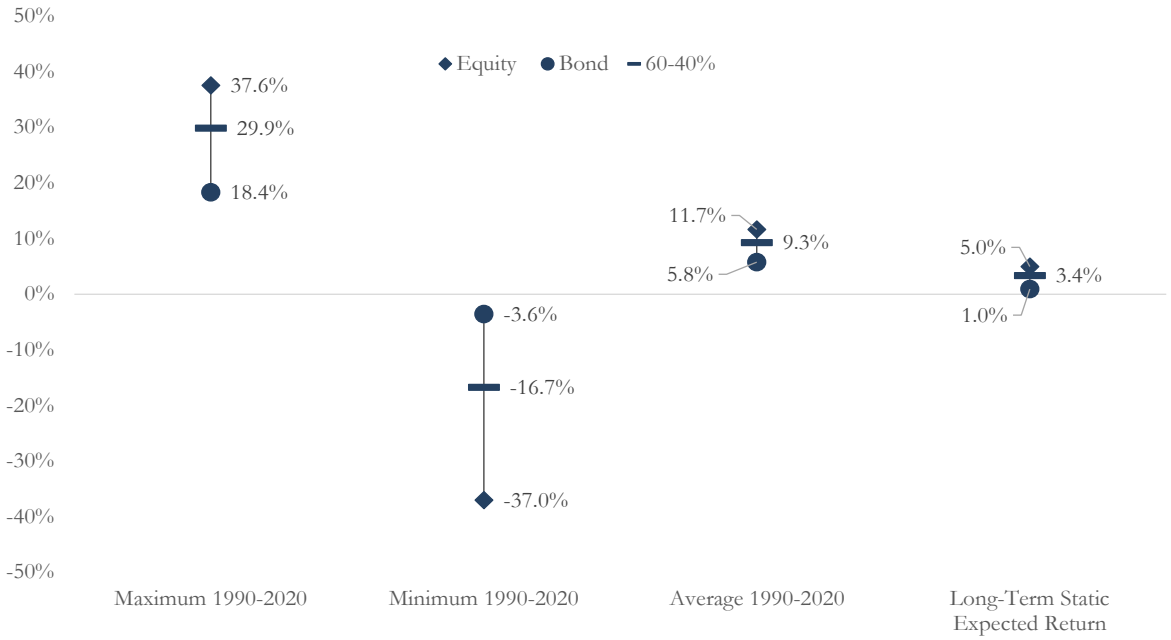
The risk profile of Bitcoin's portfolio inclusion is equally clear. The March 2020 drawdown was more severe for the Bitcoin portfolio than the balanced stock-bond one. This is not something endemic to digital currencies. March was a global liquidity shock. Margin calls could not be met. Market prices fell to find liquidity providers. A classic crash dynamic.
Leverage is the more relevant observation. The absence of leverage allows investors to maintain positions. The leverage dynamic in digital markets was a key driver in March. Digital asset markets did not break in March 2020; they worked brutally and spectacularly well at quickly redistributing loss and risk, as markets should.

The absence of leverage was key to crystalizing Bitcoin's alpha. Leveraged bond and Bitcoin exposure suffered the same fate – a forced closing of positions at low values.

***Low yields create a portfolio problem: Expected returns are very low.***

Take a step back and contemplate the bigger picture portfolio problem. The challenge and its interaction with macro policy can be summarized in very simple terms – abysmal future returns. There is no escaping the math: High Debt + Low Yields + High valuations = Low Future Returns.

**Figure 12: Balanced portfolio past performance means low future returns.**




Source: Bloomberg LP. Authors' Calculations.

The problem is illustrated in Figure 12. It shows a 30-year history of returns in equities, bonds, and unleveraged balanced portfolios. The worst performance for balanced portfolios was 2008, down 16.7% alongside a 37% decline in equities. Bonds cushioned that decline with a 13.7% return, well above historical averages.

The worst year for bonds was 2009, the early stages of a recovery. It is telling for its modesty, with only a 3.6% decline. This speaks to the appeal of bonds in balanced portfolio – historic returns have been strongly asymmetric. The danger of extrapolating those returns is equally clear. This same bond index is down 3.8% in 2021 through the first week of March.

On average, the performance of a 60-40% total return portfolio from 1990 to 2020 is a solid 9.3%. Great news. State pensions only need 7% to meet pension obligations. If we were to extrapolate the past, there is no problem. As recent bond history shows, we cannot make that extrapolation.

Valuations of asset markets – stocks, bonds, real estate, fine art, baseball cards – are sky-high. The inflation in capital markets matters greatly to expected future returns and incomes. A rise in asset valuations today benefits the current generation at the expense of the future one – more of expected future returns are capitalized in today's price. It is not a free lunch. Past returns cannot be extrapolated.

Equally, a high valuation does not necessitate a market crash. There is a historic tendency for narratives supporting high asset valuations to come crashing down. But there is also nothing deterministic in the outcome. The forces behind a crash are excess speculation with investors

borrowing to enjoy the lofty returns of the rising asset. Market crashes are about margin calls, risk-taking, and liquidity more than asset valuations.

We can easily cut through market-timing noise by looking at an expected return over a long horizon. Figure 12 illustrates a static scenario. Nominal GDP growth averages 4% in the next ten years, corporate earnings capture a stable share of growth, dividend yields reflect lower interest rates at 1%, and the bond index tracks its current 0.96% yield. This is a static long-term expectation. No valuation adjustment in equities. No decline in corporate profit margins. Bond markets follow the forwards. This is an optimistic scenario. And the long-run return on a balanced portfolio, at 3.4%, still falls well short of the needs for asset managers.

This is where the portfolio problem and policy intersect. Both desire a material rise in real incomes. Both are confronted with the reality that it is unachievable. Real portfolio and policy issues can be addressed with investors accepting lower return targets and the electorate accepting lower future entitlements. The most politically palatable outcome is to advocate for a lift in nominal incomes, even if it only creates an illusion of a solution. Attracting people to rising nominal values can lead them to forget that their real returns are being handicapped in the process.

The search for shelter to this money illusion is bringing investors to digital assets, much the way emerging market investors are attracted to US dollars when policies become untenable.

***Bonds are a displaced asset. Negative real yields are a capital tax for 'safe-haven' status.***

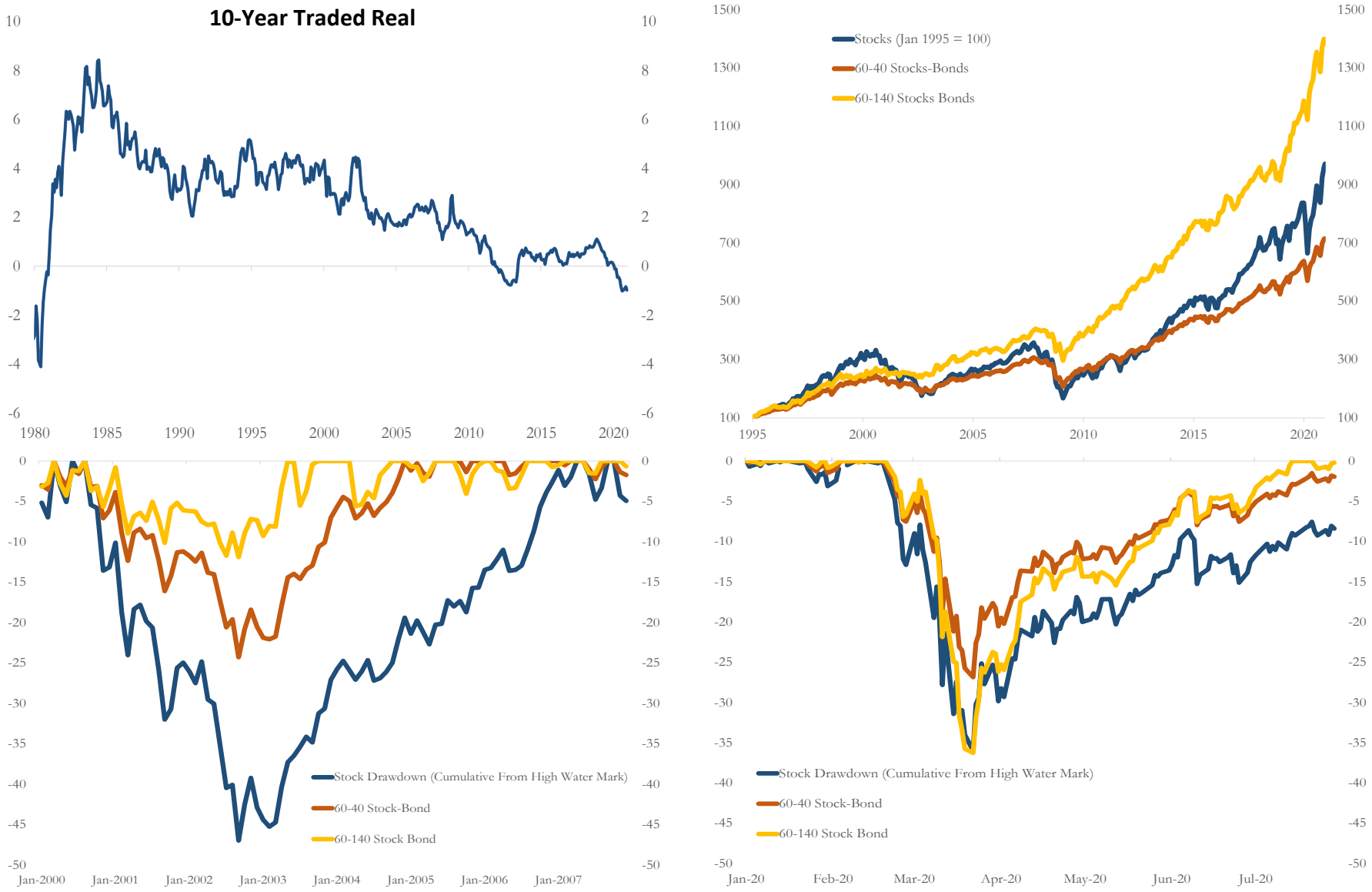
Bonds have been a huge contributor to portfolio returns in the recent past, driven by the secular decline in real interest rates. 10-year real bond yields averaged 0.4% in the 1970s, ranging from more than 3% to negative 5% (10-year government bond yield less CPI inflation). Central bankers had enough. Paul Volcker's time at the helm of the Federal Reserve is legendary for putting the United States on a low-inflation trajectory. A brief period of monetary targeting produced a huge rise in real interest rates. 10-year real government bond yields increased to nearly 10% through the mid-1980s. Bond stars were born thereafter with a simple strategy – be long.

It was not without its harrowing moments. Policy rates never got close to the 20%+ levels that were seen in the Volcker period, though every rapid tightening cycle was met with expectations of a potential super-spike in rates. Policy rates jumped to more than 10% in Greenspan's first tightening cycle in the late 1980s. The tightening cycle in 1994-1995 crested at a bit over 5%.

The gentler tightening cycles were a byproduct of inflation expectations being tamed. Investors were trained to believe in fast, brutal tightening cycles and slow, long easing cycles since the late 1970s. By the mid-1990s, the opposite pattern emerged – telegraphed, slow tightening cycles and rapid easing. Bond returns exhibited a similar asymmetry that worked wonders in portfolios, especially when leveraged.

The top-left chart in Figure 13 illustrates the decline in real 10-year government bond yields that drove the remarkable performance of balanced portfolios in the top-right chart (**next page**).

**Figure 13: Risk benefits to balanced portfolios are a thing of the past, bonds no longer providing drawdown protection.**




Source: Bloomberg LP. Authors' Calculations. Traded real yields are interpolated between 1979 to 2002 based on the relationship to Treasury yields less CPI inflation from 2003-2020. Drawdowns are measured by the cumulative percentage decline from the peak portfolio value prior to the start of the drawdown.

The contribution of bonds to balanced portfolios goes well beyond their return contributions. The risk attributes of balanced portfolios have also been terrific in the recent past.

The bottom left chart illustrates this feature through the 2000-2007 brutal equity drawdown. Balanced portfolios including bonds led to a much smaller drawdown and a faster recovery. Including leveraged bond exposure produced even better results.
The positive risk attributes of balanced portfolios have disappeared. The bottom right chart shows that the drawdown features of a balanced portfolio in 2020 were no better than just owning stocks. The compression of real interest rates is the driver. This structural force adds to the attraction of digital assets, despite similar risk features in the 2020 drawdown.

Bonds are a stranded asset class. Negative real interest rates ensure that over the longer-term government bonds are a tax on capital allocations. At very low levels of interest rates and with a regime shift towards inflationary policies, it is also an asset class that is prone to steep negative tail risk. Banks own government bonds by regulatory decree. Central banks own them as a default of reserve accounting and financial repression. Government bonds at these yields should be avoided by all those who are not required to own them.

Investors are hunting for alternatives. Digital assets at these valuations are uniquely positioned to be just that.

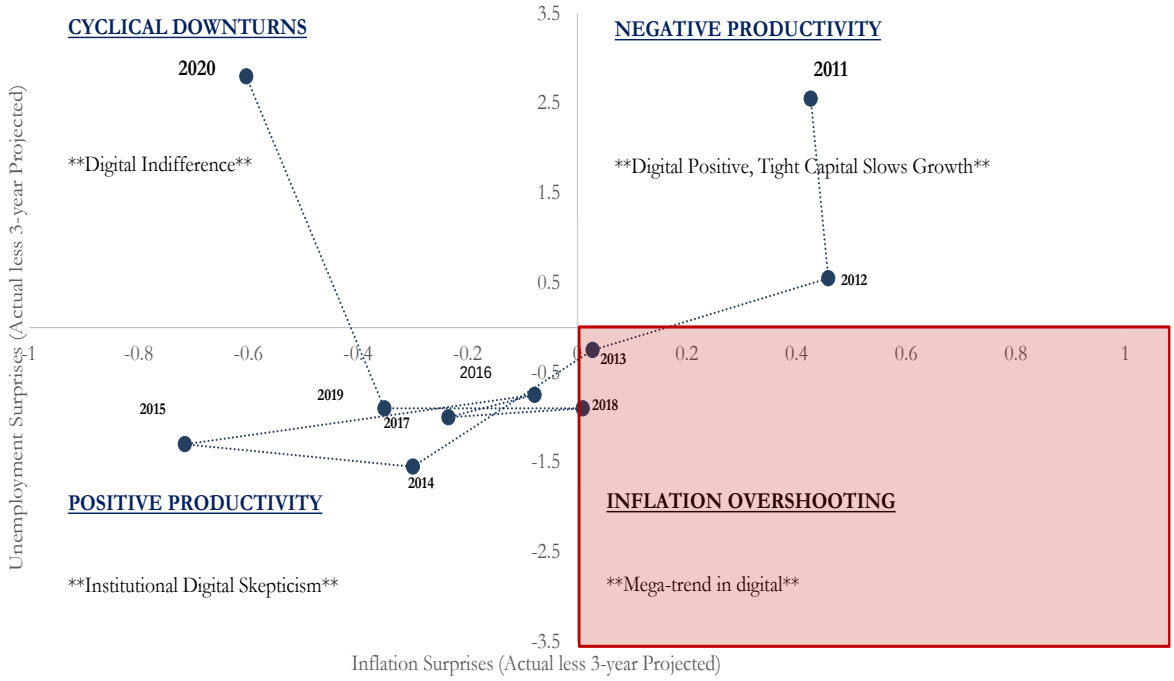
***Investors have not spent enough time contemplating the "Inflation Overshooting".***

Investors are not prepared for the macro policy shift that is unfolding. This is a statement more on human behavioral biases than a blockage. Central banks and central governments are committing to an entirely new regime of cooperation with steeply negative real interest rates to accommodate a fiscal experiment.

The bond market believes it – real interest rates are priced to be negative over the next 25 years. Bank analysts believe it – banks are expected to trade mostly around their book values with interest margins and regulations constraining profitability growth. But there remains strong faith in a return to the old-normal. Longer-term inflation expectations, for instance, are below shorter-term ones. The market presumes macro policy will get it just right, which is an unrealistic presumption of precision and control.

We illustrate the point through a basic matrix of macroeconomic outcomes in Figure 14. The x-axis measures inflation surprises and the y-axis measures unemployment surprises with the date corresponding to the year of the surprise. We evaluate actual outcomes against longer-term projected outcomes to capture broader, unexpected shifts in macro trends.

**Figure 14: Inflation-unemployment nexus, policy calibrating for an inflation quadrant.**




Source: FOMC projections materials. Bureau of Economic Analysis. Bureau of Labor Statistics. Authors' calculations.

Take the 2011 dot as an example. The inflation surprise was +0.4%. Actual inflation was 1.9% in the fourth quarter while the Federal Reserve estimated 1.5% three years' earlier during the 2008 recession. Inflation's rise in the early stages of the expansion was unexpectedly strong. This occurred with unemployment 2.5% higher than expected. The mix of higher inflation and higher unemployment is typical of poor productivity.

The transition over the 2009-2020 cycle presents a striking image. The 2011-12 phase of poor productivity was brief, with the economy moving into a more favorable outcome of lower inflation and lower unemployment. We can look across the macro quadrants to appreciate broader trends.

We have spent the most time in the 'positive-productivity' quadrant in the latest cycle (lower left Figure 14). It is the nirvana quadrant – unexpectedly low inflation and unemployment. Passive investments win, the trend of a 60-40% or 60-140% portfolio is your friend. Institutional skepticism of macro strategies and digital assets is high in this scenario as investor performance in simple, balanced portfolios is very strong. There is little interest in seeking new investment opportunities as bonds and equities both perform well.

Weaker inflation and higher unemployment – the upper left quadrant – occur with an unexpected cyclical downturn. This is very familiar to investors. We should expect policy to ease aggressively, as it did in 2020. It is rare for investors to be proactively prepared for an economic downturn, and investment strategies are often reactive in reducing risk. This is especially true in leveraged areas, where margin calls are tougher to make. New investments are an afterthought.

The upper right quadrant is reminiscent of the 1970s and the introduction of misery indices: high unemployment and high inflation. We experienced this briefly in early stages of the 2009-2010

expansion. It was led by investment in China, commodity prices surged, and emerging markets barely noticed the US downturn. While the US financial system was entering a long phase of healing with a deleveraging cycle, China demand drove the quick return of inflation.

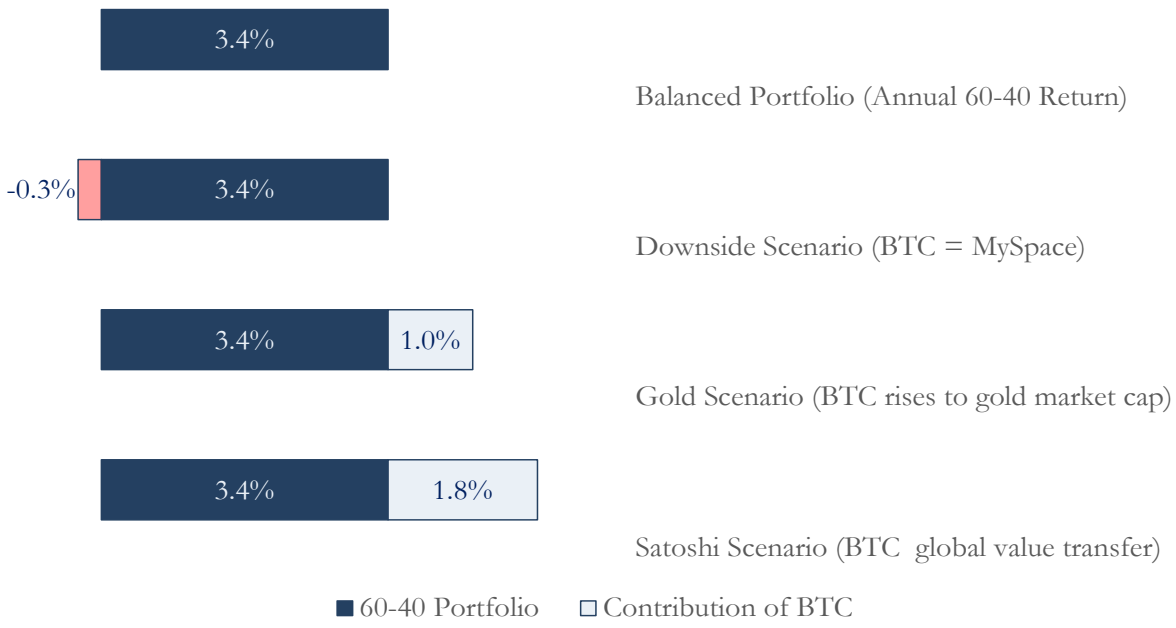
Inflationary overshooting is the least familiar to investors, the lower right quadrant of higher inflation and lower unemployment. Policy is now targeting this quadrant. Naturally, the goal is not to see a 10% rate of inflation. Officials are confident such an outcome can be avoided, and perhaps overly so. The cost of avoiding the outcome as it is realized may be deemed to be even greater.

The key point is more that investors are least experienced in this quadrant, particularly in recent history. It is where macro alpha such as inflation, commodities and currencies perform. It is also where the mega-trend in digital assets may take form.

***What's the right digital currency exposure? Ten-year scenarios illustrate asymmetries.***

It is best to evaluate scenarios for how Bitcoin can contribute to a portfolio. Portfolio theories that rely on historic correlations are interesting but are also limited given the nascent stage of the digitalization of finance. We run a simple exercise of comparing 10-year returns from a 60-40% stock-bond portfolio with one that includes 2.5% Bitcoin in different scenarios (Figure 15).

**Figure 15: Scenarios of longer-term returns including Bitcoin in a portfolio.**




Source: Bloomberg LP. Authors' Calculations.

The baseline scenario sees a balanced portfolio return an annualized 1.0% over the next ten years. Bitcoin is then included into the portfolio at a 2.5% weight, reducing bond exposure to 37.5%. Projections are annual and rebalancing happens at the end of each period, conservatively

assuming that Bitcoin gains are monetized and reallocated to the balanced portfolio despite low returns.

In the downside scenario, network effects of Bitcoin fade as they did for MySpace in social networking platforms. This would lead to a modest drag to a portfolio at a 2.5% weight. (We stimulate a stable price of bitcoin for the first two years, and then a decline to less than 5,500 through the decade; portfolio rebalancing is the most meaningful part of the performance drag.)

Evaluating the downside gives a clearer picture to the upside asymmetry. If Bitcoin were to gain reserve status, the 2.5% contribution to Bitcoin could add 1.8 percentage points to a balanced portfolio per year. Rising to a market capitalization of gold could add 100 basis points per year over the next ten years, mirroring the contribution of the remaining 97.5% of the portfolio.

Small allocations can make a big difference.

Yet, digital currencies are a marker to the future digital age of finance. The investment opportunities are far broader than currencies, and we explore some of those next.

## IV. NOT ALL MONEY IS CREATED EQUAL

It is important to place the monetary component of the digital age in a broader context. It is a gateway to digital finance, not an endpoint. Today, Bitcoin is in a leadership position as the digital reserve asset in many respects because of the breadth of the network, the depth of the blockchain and its increasingly rapid adoption into the mainstream investment community.

It is a start.

### *Digital reserve currency Winner-Take-All?*

Bitcoin may or may not take a broader reserve role in the global monetary system. Its retention of scarcity and reserve value is critical to its longer-term success for institutional investors. The future is bright in our estimation.

But it is neither certain nor absolute! Investors must also contemplate the possibility that other digital currencies may have some monetary reserve value (much like silver has some monetary value even though gold is dominant in that respect). Ether can be that currency, in our view, given its adoption in the digital asset ecosystem.

Ultimately, the digital reserve currency, like the monetary equivalents of the past, is likely to be Winner-Take-All. Figure 16 illustrates that it is also likely to have overlapping periods of power.

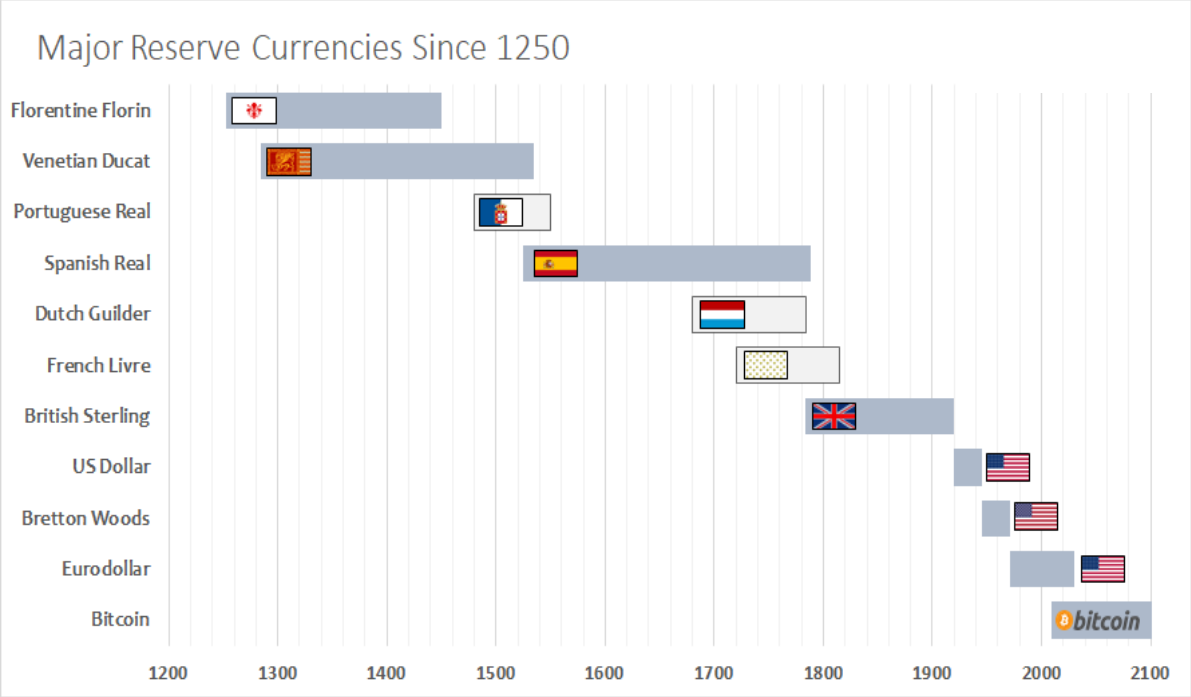
Importantly, most of monetary history was anchored to a 'hard currency,' at least in part. The US dollar after the Bretton Woods period is the exception, anchored by qualitative, prudent policy coined as the Eurodollar era. The macro landscape is challenging this historical narrative.

The international balance sheet makes the math unequivocal. The US net international liability has ballooned to a deficit of more than 14 trillion dollars, a staggering 65% of GDP from less than 10% of GDP in 2007. Long gone are the days of gentle US dollar depreciation, where the rise in US international assets was so substantial to make the build of international liabilities irrelevant.

How does the US clear its international obligations? International debt jubilees? High US real interest rates and a return to fiscal orthodoxy? Or a meaningful devaluation of the US dollar?[3] All should be evaluated and contemplated. The most likely path of the political economy can be left unsaid.

[3] A decline in the US dollar reduces the market value of the net international liability position. From 2002-2007, the US ran a cumulative current account deficit of roughly 40% of GDP and the net international liability did nothing. US international assets outperformed because of a weaker US dollar and outperformance of foreign markets. That is the solution.

**Figure 16: Progression of past reserve currencies, nothing is forever.**




Source: BTCM Research.

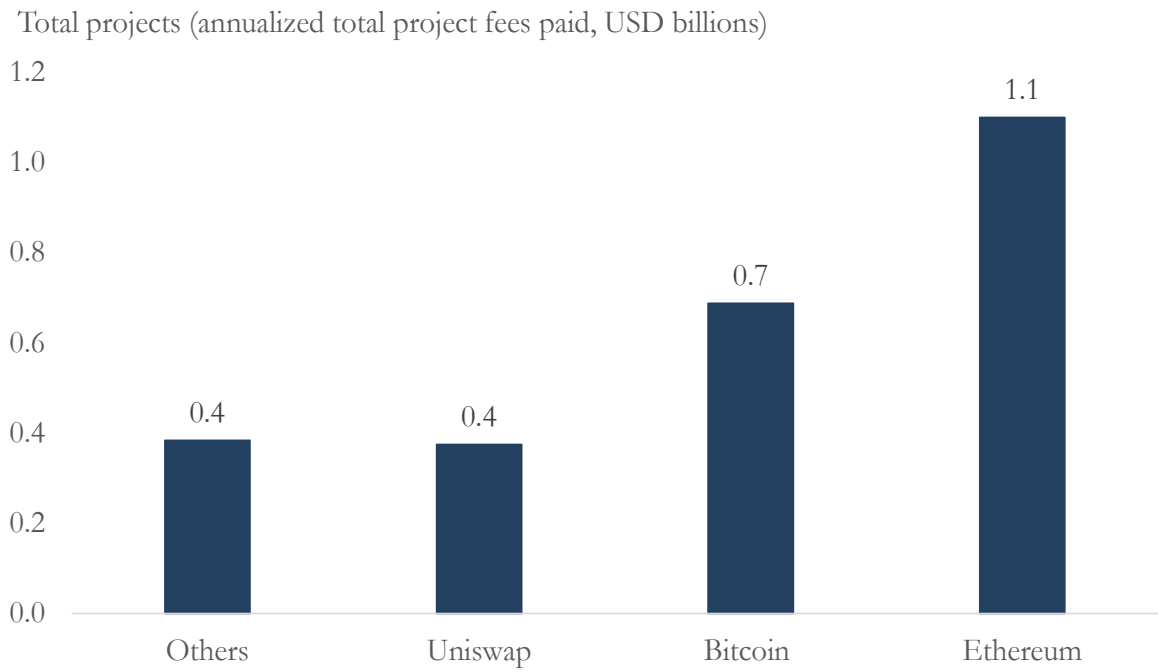
***Digital ecosystem is tied to ETH. Investment in ETH is a gateway into that ecosystem.***

The different utilization of Bitcoin versus Ethereum speaks to the future of the ecosystem (Figure 17). The average value transfer of ETH is tiny compared to BTC. It has also declined in the past three years versus a 4-fold increase in BTC. Yet, ETH has a very high number of transactions.

The higher rate of velocity lessens the valuation of Ether compared to Bitcoin. Intuitively, a low velocity implies that it is more difficult to acquire an asset. Its owners are less inclined to turn it over. In turn, it takes a larger price rise for a rise in demand to be met by an increase in supply. A higher velocity means there is more of the asset sloshing around the monetary system at any point in time, making it easier to acquire.

Importantly, velocity is endogenous and reflective to investor behavior. The more monetary value an investor places on an asset, the lower the velocity. This is not the current function of Ethereum, though it could mature into this role. This is especially true if the coming wholesale revision to the protocol proves effective (version 2.0 plans to retain its flexibility, realign incentives of growth in decentralized applications, and a mechanism for reducing future supply).
Either way, there is no question of Ethereum's importance to the digital asset ecosystem. Ethereum's flexible protocol makes it an attractive foundation for the development community to build digital applications. The revenues for those projects are tracking more than one billion dollars annualized, nearly double that of Bitcoin.

**Figure 17: Ethereum is the leader in revenue from decentralized finance projects.**




Source: Coindesk

***Growth in digital age, crypto currencies are merely a starting point.***

The scope for growth in the digital economy is nothing short of remarkable.

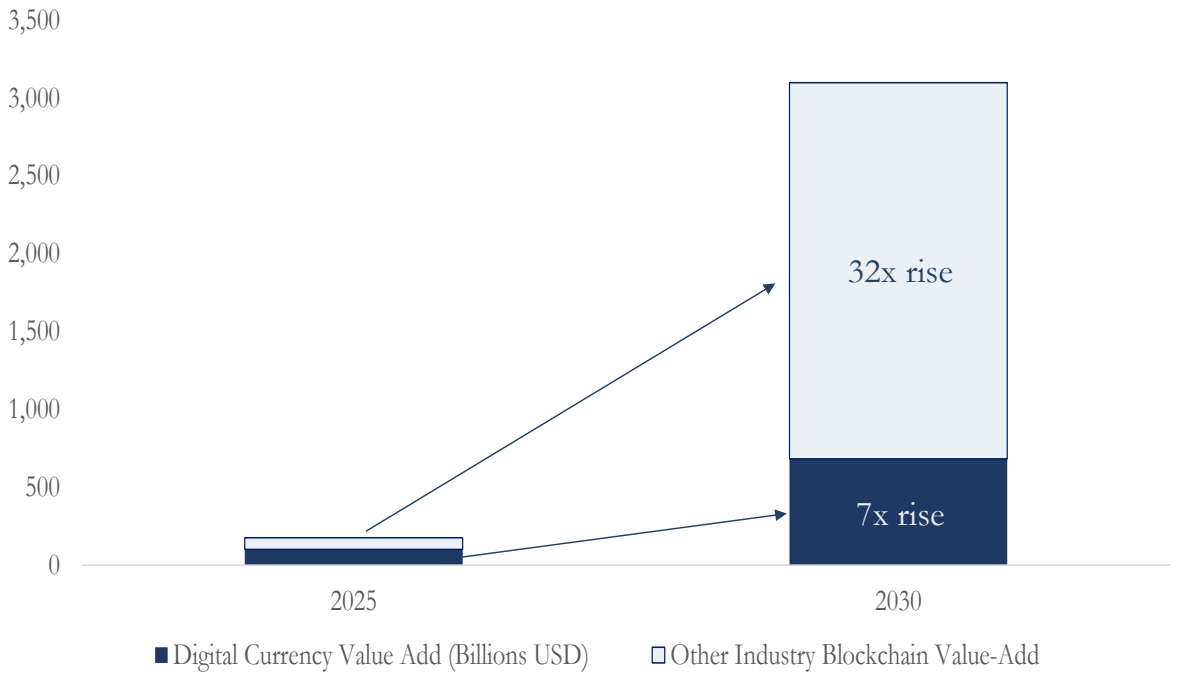
Gartner, a technology research company, has carefully evaluated the scope for the digital age to extend to industries well beyond the narrow currency role that is currently the focus.

They estimate the blockchain value-add will rise to more than $3 trillion in the next decade, from virtually nothing today. In the next five years, the growth will be all about currencies, we estimate. Digital currencies are expected to account for nearly 70% of the value-add of blockchain through 2025. Then, in the following five years, the value-add from non-currency areas is expected to increase 32-times (Figure 18).

What is the value of Ethereum? Today, the market is placing a high premium on its monetary value. This is somewhat counter to its high rate of velocity, reflecting a low demand to hold the currency. But Ethereum is the most likely gateway to innovations in the digital ecosystem.

This is already the case. Stablecoin, which has allowed for the efficient transmission of digital dollars to move capital and exploit arbitrage opportunities, is built largely on the Ethereum protocol. Ethereum and its uses give investors a window into that future, and it could very well be that those are the true sources of value-add.

**Figure 18: Growth in value-add tied to blockchain over the next ten years.**




Source: Gartner

## V. END OF THE BEGINNING

2008 was a year to remember.

Investors and policymakers were in the eye of the storm of the financial crisis at the time when Satoshi Nakamoto published a paper on a peer-to-peer e-cash system. It is a fitting timestamp. Macro policies have since blazed a trail to new orthodoxy with consequences that have accelerated interest in digital assets.

The innovation of digital currencies cannot be overstated. The ability to transfer value to anybody, anywhere at any time without a centralized oversight is a remarkable achievement. Most importantly, the technology is working.

The trickle-down benefits of Bitcoin's adoption are evident in the growth of new product developments outside of the original protocol, including the rapid growth in digital dollars in the investment ecosystem. The environment is ripe with fresh opportunity and innovation.

We arrive at digital assets through a top-down, macro lens. There is inescapable tension between macro policy objectives, initial economic conditions, and the tools available to reach those objectives. Old theories are being resurrected as new orthodoxy, arguing in the extreme that debt does not matter when you can print currency to lessen its burden.
2008 was an inflection point to a bailout culture. Whether it was intended is beside the point. Stretching out losses over longer horizons was deemed more palatable than the risk of immediate

loss of unknown magnitude. Policy is programmed to financial loss avoidance. The associated change in private behavior has led to a surge in asset valuations.

The rise of institutional interest in digital assets is inseparable from these macro policies. Digital assets provide a scalable alternative to bonds that will secure steeply negative real interest rates by policy design. Commit to taxing real capital and capital allocators will look for alternatives to minimize that cost.

The first-mover advantage of investing in Bitcoin is being better understood. The risk-reward skews materially to the upside. The institutionalization of digital currencies will not be met by new supply; existing holders will need to be persuaded to sell their stakes and diversify into other assets. There is no supply response to a rise in prices. This is scarcity. Price responses to rising institutional demand will be highly non-linear.

Digital currencies are the start. One River is poised to be a leader in the integration of digital assets into institutional portfolios. We look forward to the journey with our trusted partners.

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