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## Investing in Cryptocurrency



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Bitcoin is back in the headlines after a three-year respite. It's discussed on CNBC daily, and political figures, financial gurus and regulatory officials are repeatedly asked for their opinion. At this point, much attention has been focused on what Bitcoin is and how it works, but that in some ways, is the easy part. Assuming the underlying blockchain technology works, is Bitcoin or any other of the cryptocurrencies something investors should consider for their portfolios? That's the more difficult question.

Our March 17 special report, "[The Case for Cryptocurrency as an Investable Asset Class in a Diversified Portfolio](#)," discusses how cryptocurrencies are slowly gaining mainstream acceptance—it explores increasing regulatory guidance, an abundance of new products, rapid adoption by major financial institutions and expanding liquidity. This report builds on "[Bitcoin: A New Technology](#)," which is published monthly in Morgan Stanley Wealth Management's ChartBook under "Client Conversations & Primers." This report also reviews the basics: How do cryptocurrencies work? How are they different? What is a blockchain, a miner and "consensus?" Ultimately, we are more interested in how cryptocurrency fits into the bigger financial picture than how the technology works. There are many resources to review beyond this primer, including Morgan Stanley & Co. research and "Cryptoassets: The Guide to Bitcoin, Blockchain, and Cryptocurrency for Investment Professionals," a January 2021 publication from the CFA Research Foundation.

For additional information about the risks of cryptocurrencies, please see the Important Information in the Disclosure section of this report.

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## INVESTING IN CRYPTOCURRENCY

Investors' reasons for interest in Bitcoin and other cryptocurrencies typically center on one or more of three investment theses.

First, Bitcoin could act as digital gold, a "safe haven" from fiat currency debasement. The March special report discusses how pandemic-driven government deficits, aggressive monetary policy and a lack of appropriate alternatives has made this argument more convincing to many. Investors with similar thinking might review the valuation section that compares the valuation of Bitcoin to the valuation of gold and the case study of gold's 18-year rise from an illegal investment to part of a conventional portfolio in the 1980s.

Second, some view cryptocurrency as a new asset class that will increase in value as more institutional investors incorporate it into their portfolios. The special report highlights the four pillars of institutional adoption: new products, expanding regulatory framework, deep pools of liquidity and the need for portfolio diversifiers. Advocates of this theory see the rise of Bitcoin in the light of the disruption occurring in other sectors and industries. When penetration in a large addressable market is low, an investment in a disruptive innovator can have attractive returns as long as market penetration continues to increase. The adoption-focused thesis is prevalent in technology stocks, which are less dependent on valuation and more reliant on the trend of adoption. These investors might be interested in valuation based on operating metrics such as network value to transactions that value Bitcoin based on the pace of adoption.

Third, some see Bitcoin and other cryptocurrencies as an uncorrelated, volatile asset appropriate for diversification under Modern Portfolio Theory. In our March 17 special report, we showed hypothetically how a small Bitcoin allocation to a conventional portfolio of 60% stocks and 40% bonds would have fared from 2014 through September 2020. A number of firms (CoinShares,<sup>1</sup> Bitwise,<sup>2</sup> Galaxy<sup>3</sup>) have performed variations of this analysis in the past several years using different Bitcoin allocations, different time periods and different rebalancing frequencies. In general, they found that small allocations of Bitcoin tended to improve hypothetical performance of a traditional portfolio. A key assumption with these analyses is that correlations remain low. Our examination of the bitcoin halving cycle might help explain why its low correlations to other assets are likely to endure.

The list of risks related to cryptocurrency is extensive. Some of the risks—product dynamics, volatility and uncertain valuation frameworks—are familiar. There are also unique risks that other assets don't have. For example, a cryptocurrency's encryption could be breached. Or it could have a catastrophic software bug—there have already been two severe bugs in Bitcoin<sup>4</sup> and many more in other cryptocurrencies. It could become the object of a disruptive cyberattack by a foreign government. Finally, from an

environmental perspective, "mining," or creating, cryptocurrency requires enormous processing power, hence has an outsized impact on global energy consumption. Growth of mining might require greater electrical output than would otherwise be necessary.

Our report starts with a short history of Bitcoin. The second section explains cryptocurrencies and how Bitcoin, the largest cryptocurrency, works. We include explanations of Bitcoin's important breakthroughs, the mining process and how the cryptocurrency networks reach consensus on valid transactions. The next section discusses methods to value Bitcoin, which includes relative value and replacement value. The fourth section introduces Bitcoin's unique four-year halving cycle, and why it might be an important reason for Bitcoin's low correlations with other assets. In the fifth section, we examine the parallels between the rise of gold as an investable asset to the rise of Bitcoin currently. Section six discusses the considerable environmental impact of Bitcoin mining. The final section highlights some of the main risks associated with investing in Bitcoin and other cryptocurrencies.

## Bitcoin Case Study: Maturation of an Asset Class

The original Bitcoin white paper was published in a cryptography group on Halloween 2008.<sup>5</sup> The code began running on Jan. 3, 2009, and on Jan. 12, the first transaction took place. On May 22, 2010, what is famously known as "Bitcoin Pizza Day," a software developer hoping to promote Bitcoin as an everyday transactional currency offered to pay 10,000 bitcoins (\$530 million today) for two pizzas.<sup>6</sup>

After that, Bitcoin transactions caught the attention of those interested in a low-cost money transfer system that was both "permissionless" and anonymous—open to anyone with a computer and connection. Unsurprisingly, some people interested in permissionless, anonymous currencies were using Bitcoin on the dark web for illicit transactions.<sup>7</sup> Even so, Bitcoin demand grew and, due to the limited supply, prices began to increase. New users began to see the currency as a kind of digital gold: more as a store of value than as a payment system.

Bitcoin first appeared in the mainstream media in 2013 as concerns about Cyprus' banking system made the idea of a stateless currency more attractive.<sup>8</sup> Later that year, the price of one bitcoin topped \$1,000 for the first time, and regulators began to examine it more closely. The Internal Revenue Service (IRS) provided tax guidance,<sup>9</sup> and states such as New York<sup>10</sup> began to add regulations. This led to the first burst of a Bitcoin bubble—an 84% drop in price. Even so, the number of transactions continued to grow. Other cryptocurrencies such as Ethereum emerged, drawing on the

## INVESTING IN CRYPTOCURRENCY

design of Bitcoin to run code that could do more than send and receive currency. The 2016 halving slashed Bitcoin supply and started a second bubble. By this time, cryptocurrencies were disrupting the traditional way venture capital was raised by making it possible for tech startups to raise money through initial coin offerings (ICOs).<sup>11</sup>

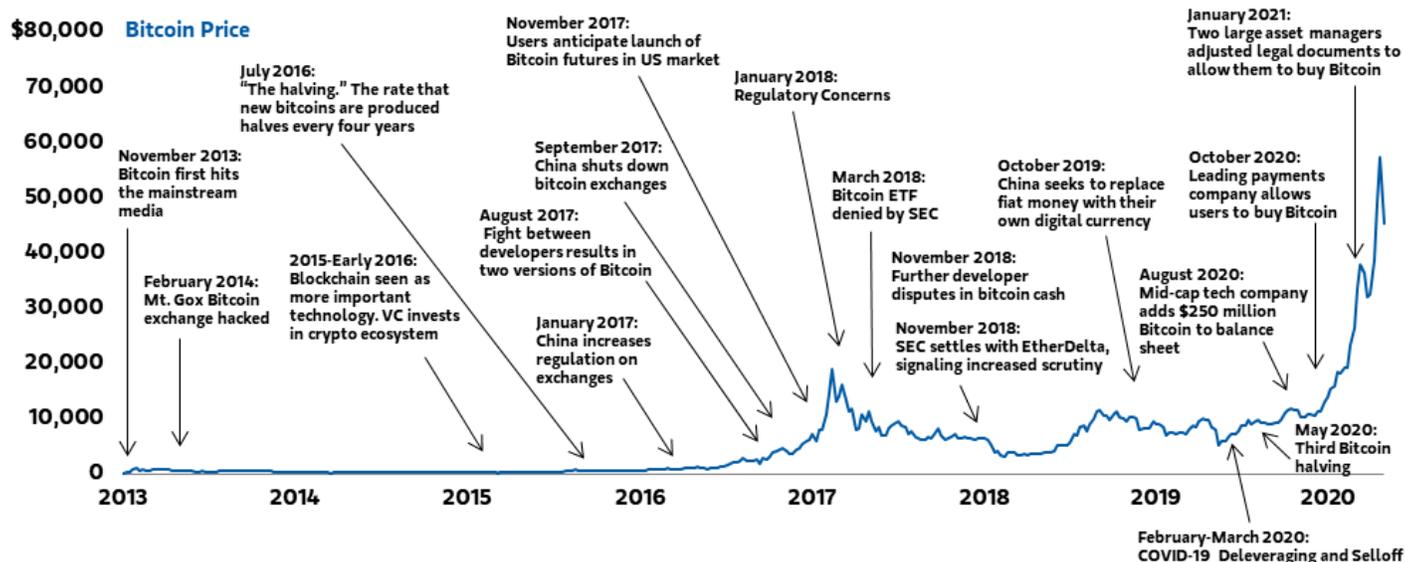
If the 2013 bubble was about a self-sovereign store of value and payment system, the 2017 bubble was about Bitcoin as an investment. Early in 2017, the Securities and Exchange Commission (SEC) issued the first of many denials for a Bitcoin exchange-traded fund (ETF).<sup>12</sup> Later, at the end of 2017, the Chicago Mercantile Exchange (CME) launched Bitcoin futures, providing a way for Wall Street firms to participate in the market.<sup>13</sup> Again, the parabolic price advances captured headlines as retail investors hoped to beat the Wall Street firms to a new asset class. Regulators began to clarify which ICOs were securities<sup>14</sup> and enforcement officials went after some of the worst actors of the second cryptocurrency bubble. In the end, despite the arrival of futures, most of Wall Street never arrived, and adoption declined in 2018.

In 2019, Bitcoin had survived its second global bubble. Institutions such as the Intercontinental Exchange (ICE) and Fidelity Investments that had announced products during the bubble year slowly built out new cryptocurrency offerings and a financial infrastructure for cryptocurrency, including tricky issues such as custody.<sup>15</sup> Leading up to the third halving in May 2020, many debated whether the supply restriction was already priced in—there had been a big spike in mid-2019—or whether there would be a third bubble.

Then, just before the halving, the COVID-19 pandemic changed the narrative again as central banks began to print money to support the economy and governments began to run up record deficits. Concerns about currency debasement and inflation spiked, and investors began to look for hedges. A few institutional investors gravitated toward Bitcoin. In May 2020, the halving cut supply growth by 50% just as demand was increasing for macroeconomic reasons, resulting in a perfect storm: Since the March 2020 low, Bitcoin has risen twelvefold. Was it the halving that cut supply? Was it the macroeconomic backdrop that boosted demand? That debate is not likely to be resolved until the next halving takes place in 2024. In December 2020, Bitcoin surpassed its old 2017 high, leading many who had written it off to take another look (see Exhibit 1).

When institutions gave Bitcoin a second look, much had changed since 2017. To start with, Bitcoin liquidity has increased sharply. Greater regulatory guidance has enabled more products, more risk-mitigation strategies and more arbitrage opportunities. Futures and options have allowed for more hedging, retail-focused platforms have brought more potential buyers online and the institutional adopters have filled large orders. By February 2021, liquidity at the largest exchanges was over \$25 billion in daily average volume versus only \$5 billion in late 2017 (see Exhibit 2). More liquidity has allowed more institutions to enter the market (see our March 17 special report).

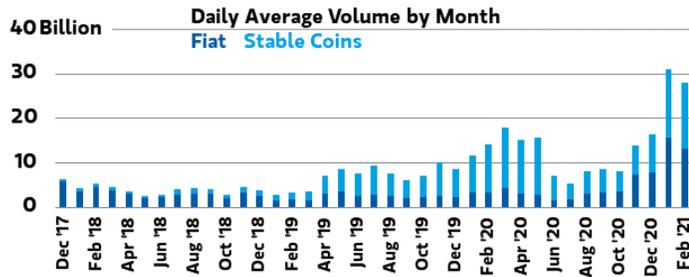
Exhibit 1: Bitcoin's Volatile Journey to \$1 Trillion Market Cap



Source: Bloomberg, Morgan Stanley Wealth Management Global Investment Office as of Feb. 28, 2021

## INVESTING IN CRYPTOCURRENCY

**Exhibit 2: Bitcoin Volume Has Increased Since the 2017 Peak**



Note: Fiat includes USD, GBP, EUR, KRW, CNY StableCoins include USDT (Tether), USDC (USD Coin), GUSD (Gemini Dollar)  
Source: CryptoCompare as of Feb. 28, 2021

At this point, it seems unlikely that Bitcoin and other cryptocurrencies will disappear unless the code fails and can't be repaired. Placing a valuation on cryptocurrency is difficult now and may always be challenging, given the extreme volatility of the asset. Another 85% drop would take the price back below \$10,000. Yet, after surviving three bubbles, recovering from them and going on to new highs, Bitcoin will likely remain a fixture on the investment scene.

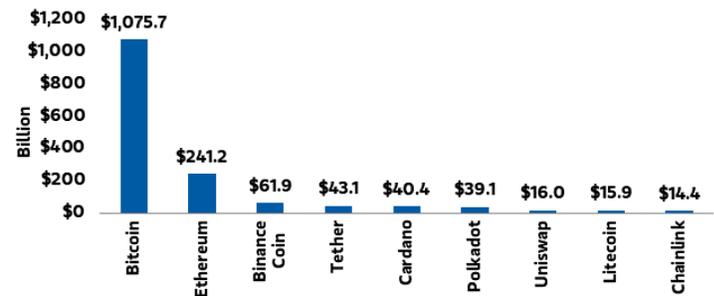
## What Is Cryptocurrency?

Cryptocurrencies are virtual currencies with no physical form that operate on a peer-to-peer basis without a central authority. They are digital and, unlike the US dollar, they have no physical form and no central repository. The decentralized nature of cryptocurrencies requires computers to use cryptography, computerized encoding and decoding of information to verify transactions and prevent counterfeiting. Unlike traditional currencies, which use a trusted third party such as a credit card company or bank to verify that the funds are available to complete a transaction, cryptocurrencies rely on a network of computers to confirm the transaction and that the spender has the coins to transfer. When a transaction is initiated, it is broadcast to the network where it awaits verification from computers that solve an algorithm to determine if the transaction is legitimate.

While Bitcoin is by far the largest cryptocurrency, there are 10,000 alternatives including nine over \$14 billion in market capitalization.

The largest cryptocurrencies are created through mining, which involves using computer power to solve complicated algorithmic problems to create coins. Bitcoin was the first cryptocurrency, designed in 2008 by an anonymous person or group named Satoshi Nakamoto, and launched Jan. 3, 2009. Today, there are thousands of cryptocurrencies, crypto assets and crypto commodities, though Bitcoin still accounts for roughly 55% of the value of the entire asset class (see Exhibit 3). Importantly, Bitcoin demonstrated how a decentralized store of value and payment system could replace a centralized systems.

**Exhibit 3: Bitcoin Is by Far the Largest Cryptocurrency**

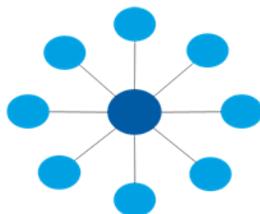


Source: Coinmarketcap.com as of April 7, 2021

A decentralized payment system is fundamentally different than a traditional payment system. Instead of all transactions being routed through a central party (such as the Federal Reserve or a bank payment network), transactions are routed in a decentralized manner through nodes that anyone can set up by downloading and running software. Because anyone can run the software, it is called "permissionless," and because the network is made up of many nodes that are equal to each other in influence, it is "decentralized" (see Exhibit 4). If one node has an issue, it does not affect the other nodes.

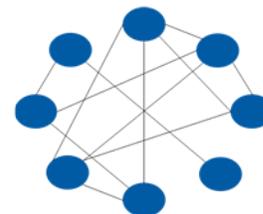
**Exhibit 4: How Value Transfer Works in Traditional and Crypto Worlds**

### Value Transfer in the Traditional World



**Centralized and Permissioned Network**

### Value Transfer in the Crypto World



**Decentralized and Permissionless Network**

Source: CFA Institute Research Foundation "Cryptoassets: The Guide to Bitcoin, Blockchain and Cryptocurrency for Investment Professionals," January 2021

## INVESTING IN CRYPTOCURRENCY

Three important conditions have allowed cryptocurrencies to flourish:

They're "trustless." Apart from the open-source software, investors do not have to trust any entity at any step in the transaction. The only way to move a cryptocurrency is for the user to input their "private key," or password. Economic incentives and mathematical checks keep actors honest, because the reward for honesty is so much greater than the potential gains from dishonesty, and the mathematical checks make it easy to find dishonest participants.

They're "permissionless." Anyone can access the network as a miner or user with minimal computing and connectivity requirements. There are no accounts or approvals needed, allowing anyone to participate.

There's a limited supply. Before crypto, text, music and movie files could all be copied. There was no way to know who had the original copy of anything and no easy way to create scarcity. Using a distributed blockchain, only new assets explicitly authorized by the code can be created. No entity has the power to change the code; it is instead adopted by universal consensus. Finally, it is easy to detect invalid copies of the assets by tracing each asset's history on the blockchain.

When combined, these three characteristics are unique. Digital scarcity such as the rights to a trademark, a song or a movie has been enforced by the courts, a centralized and permissioned system. On the other hand, cash is a permissionless asset, but it had all the limitations of a physical object. It cannot be sent instantly or stored on a phone or computer. It, too, required trust in the courts or in law enforcement to remove counterfeit bills from circulation. Bitcoin and other cryptocurrencies do not need a judicial

system to work and cannot be copied, yet they retain the flexibility of a fully digital asset that can be moved within minutes and stored on any device with computing power.

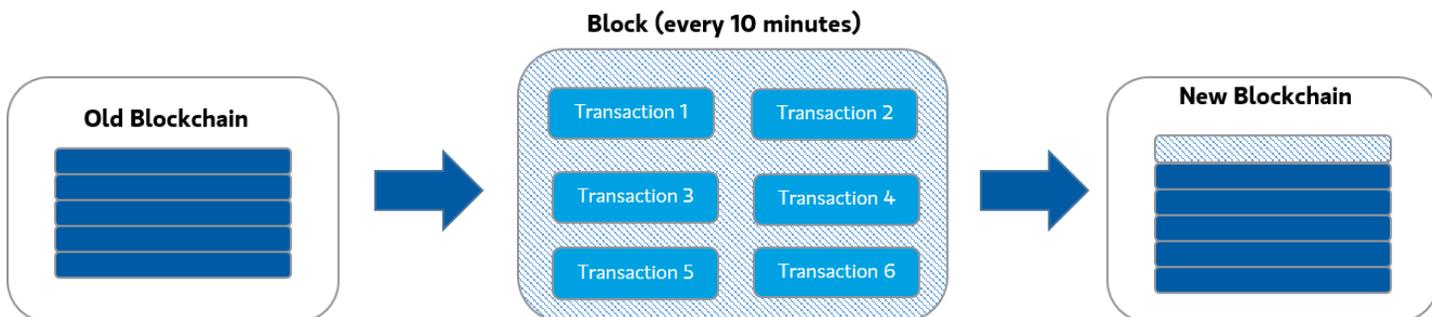
Bitcoin is the scarcest asset—if it works. Digital scarcity enforced by code is unique. As the rate of Bitcoin inflation falls, it has the potential to become the most scarce, fungible asset on the planet—that is, one bitcoin is the same as another. Bitcoin has the potential to be something completely new, an asset for which supply can never increase faster than its predetermined schedule.

Many cryptocurrencies have an almost zero supply response. Miners can't step up production too much because supply growth is strictly enforced by code. It's true that higher prices encourage people to spend more resources (electricity or cash) to mine or buy cryptocurrency, but these transactions do not affect supply. Put differently, spending more will change a miner's share of coins mined, but won't impact the number minted. So far, 18.6 million coins have been mined and a maximum 21 million will be reached around 2140. With the recent halving in May 2020, Bitcoin's annual supply increases only about 2% per year, roughly the same as gold. After the next halving, which should occur in 2024, Bitcoin supply will grow less than half the rate of gold. Thus, if the code doesn't fail—and that's a big if—it could become the first truly scarce, fungible and divisible asset in history.

Cryptocurrencies such as Bitcoin use different techniques to process transactions and keep track of the balances owned by each address, but they have a few common elements (see Exhibit 5).

### Exhibit 5: Bitcoin Uses Blockchain for Transaction Verification

The Bitcoin blockchain is a record of all the Bitcoin transactions that have ever occurred. Each account balance at any point in time and each transaction between two accounts is stored. There are thousands of copies of the file on computers around the world. As long as a copy of the blockchain exists, the Bitcoin system can function. Since there is no one server or computer that holds a master copy, a hacker, government or other organizations would have to alter the data in multiple locations. However, this does not entirely insulate the process from theft, as third parties such as exchanges and wallets that interface with blockchain technology have been hacked recently.



Source: CoinDesk, Blockchain.info, Morgan Stanley Wealth Management Global Investment Office

## INVESTING IN CRYPTOCURRENCY

For Bitcoin, there is a block of transactions processed roughly every 10 minutes. These blocks are comprised of unspent transaction outputs, that is, a certain number of bitcoins (or fractions of bitcoin) have moved from one address to another. The blockchains allow the tracking of each coin as it was created, sent, divided, aggregated and sent again. When all these blocks are stacked in chronological order, it shows a chain of custody of every bitcoin ever mined.

In the Bitcoin system, block producers are called “miners.” The miners run code that checks to make sure all the transactions in a block follow all the rules. No coins can exist in more than one place, and the total number of coins must match the coins expected. If someone sends a bitcoin, that bitcoin must have been in that user’s address. If the transactions meet all the checks, a new block of transactions are added to the blockchain. An important design consideration for cryptocurrencies is how to select which producer produces each block. In Bitcoin, block producers race to be the first to perform the checks and are rewarded with newly created (mined) coins (see Exhibit 6). Currently, a block producer gets a 6.25 bitcoin block reward (\$350,000-\$400,000) plus transactions fees (about 10%-15% of the block reward) for each successful block.

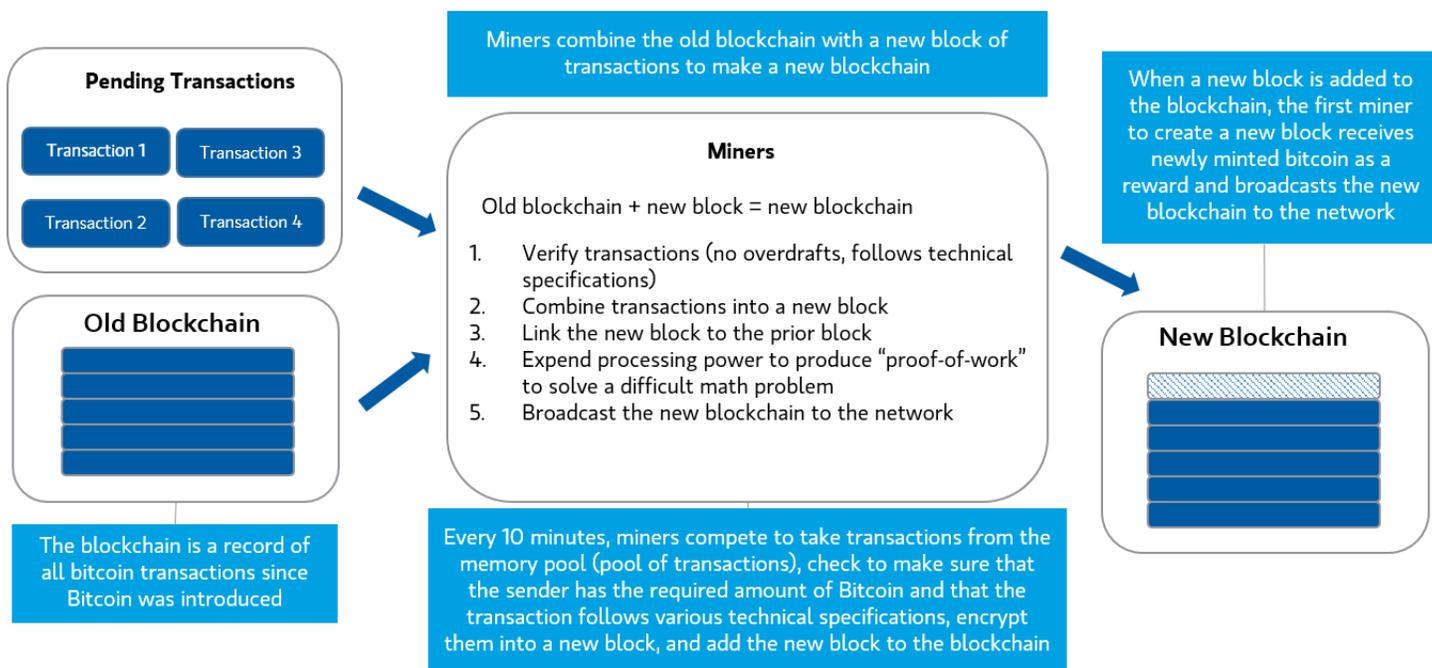
Different blockchains have different rules for who can produce a block. This allows users to reach a consensus on which is the valid blockchain—and which are incorrect or even fakes. For Bitcoin, the first entity to find an encrypted number that meets all the rules and happens to start with a

certain series of numbers is allowed to produce the block and earn the block reward. The only way to find a number is through trial and error, which requires a miner spend heavily on computing power and equipment.

The high upfront costs incentivize miners to process blocks correctly so they can earn a reward. This process is called “proof of work.” It means a block producer must prove they spent real resources on performing a difficult task in order to be paid. The official chain is the longest chain with the most work (calculations). Other blockchains reach consensus by awarding blocks randomly to block producers that have a certain amount of the underlying cryptocurrency deposited in escrow (which is known as “proof of stake”), or who are on a list of “approved” block producers.

There are various ways for producers to become “approved”; some are centralized and some are decentralized such as winning a lottery, meeting various technical requirements or winning a vote of coin holders. Cryptocurrencies rely on cryptography to make changes to the blockchain, to connect blocks, and to ensure they stay in the correct order and to encrypt the users’ passwords when they are requesting transactions. Encryption enforces that if one person sends cryptocurrency from one account to another, the instructions cannot be intercepted and rerouted to a third account, unless a user has the key (password) or has cracked the encryption.

### Exhibit 6: Miners Are the Computers Behind the Bitcoin Network



Source: CoinDesk, Morgan Stanley Wealth Management Global Investment Office

**Exhibit 7: Bitcoin Is Decentralized as No One Party Controls Entire Network**

The decentralized nature of Bitcoin means no one party controls the entire network. There are complex economic relationships between various parties that may encourage users to follow the rules. However, some portions of the network are more centralized (software developers, miners, fiat gateways) than others, potentially increasing concentration risks. Below we compare the various stakeholders.

Stakeholder	What They Do	How Decentralized?
Software Developers	All bitcoin software is open source. Bitcoin Core software, the most popular version, verifies transactions (no overdrafts, follows technical specifications), and includes a wallet to store coins. Anyone can contribute, test, or verify the code but roughly 100 developers contribute to “Core”	Roughly 98% of nodes (computers connected to the network) run “Bitcoin Core” nodes, but there are six teams with more than 25 nodes and at least 12 versions of software
Node Operators	Nodes (computers connected to the network) hold complete copies of the blockchain, run software that validates for issues like double spending, and relay transactions to miners	There are over 10,000 public nodes on the Bitcoin network. Node operators choose which developer’s Bitcoin software to run
Miners	Anyone can theoretically download free software and mine bitcoin. Miners take transactions from nodes, verify transactions, combine them into blocks, and broadcast the new blockchain to the network	Processing power and electricity are the main inputs to mining. Currently, 10 groups mine ~91% of the blocks with the largest group mining ~15%
Fiat Gateways	Fiat gateways allow currency to be electronically exchanged for bitcoins. Fiat gateways include domestic and international exchanges, bartering sites that allow people to meet up and exchange cash for bitcoin, and bitcoin ATMs	The top 10 exchanges globally account for around 85% of bitcoin trades versus all fiat currencies – roughly \$13 billion is traded per day
Owners	Bitcoin owners store their money in a “digital wallet.” Owners can store bitcoin with third parties such as exchanges or wallet providers, hardware wallets similar to USB drives, or on their computers or mobile devices	Bitcoin ownership is hard to estimate because people can have many different accounts. Based on data from the two largest wallet providers there are 65+ million accounts

Source: Coin Dance, Blockchain.info, Morgan Stanley Wealth Management Global Investment Office

**Is There Any Way to Value Bitcoin?**

An often heard complaint about cryptocurrency is there is no way to value it. We do not believe this is true. There are multiple ways to value cryptocurrencies—there’s less consensus over which is the “best.” Given crypto’s emergence as a new asset class, we expect a debate about valuation. That said, it is helpful to place valuation techniques into several broad categories.

**Relative Value Approach**

Relative value approaches are used in valuing equities and lend themselves to valuing Bitcoin. Using a relative value approach for equities, an analyst identifies similar companies and uses that to benchmark the valuation. There are sub-categories of relative value, market-cap relative value and operating-metric relative value. For example, when comparing market caps between different car companies, one might find that an automobile company is worth about \$10 billion; on average; therefore, an above-average automobile company should be valued at more than \$10 billion. Alternatively, another analyst might use an operating metric, such as earnings. An analyst may value auto companies at a multiple of earnings, or a multiple of sales, or a multiple of an

operating metric such as annual production relative to peer companies. Using this approach, the value of bitcoin is sometimes valued relative to gold or to the value of the money supply of a country.

Gold is the most popular relative benchmark on a market-cap basis. It’s also popular with those investors who are attracted to Bitcoin as a hedge against the debasement of fiat currencies. Bitcoin has often been described as “digital gold” or “gold 2.0.” Valuing it that way, the market sees that gold has the added benefit of a simple valuation framework.

If you think of Bitcoin as a commodity, gold has many of the same properties (see Exhibit 8). Both are scarce, both have supply growth around 2% a year, and both are divisible and “fungible”—one bitcoin or one ounce of gold are the same as any other. Both make it easy to store large amounts of value in small places. Bitcoin is easier to store, move globally and break into smaller pieces, which some advocates say make it better than gold. Gold has been around longer, works without electricity, has a more stable regulatory framework and is not subject to hacks, code bugs or the failure of encryption technology—all of which, say gold’s advocates, make it superior to Bitcoin.

## INVESTING IN CRYPTOCURRENCY

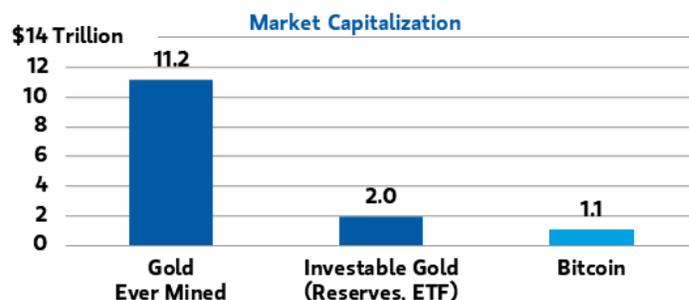
### Exhibit 8: Comparing Cryptocurrencies and Precious Metals

	Cryptocurrencies	Precious Metals
<b>History</b>	The largest cryptocurrency was invented in 2008	Precious metals have been used as a store of value for centuries
<b>Mining</b>	The largest cryptocurrency creates new coins through mining, a software process	Thousands of tons of precious metals are mined each year
<b>Scarcity</b>	Cryptocurrencies typically have a fixed supply. For example, 21 million bitcoins can be created	Precious metals are finite resources; amount depends on the natural environment
<b>Usability</b>	Transfer or pay electronically using software	Store of value, medium of exchange, industrial applications
<b>Volatility and Liquidity</b>	Cryptocurrencies are more volatile and have less liquidity	Precious metals are less volatile and have more liquidity
<b>Risks and Drawbacks</b>	Limited acceptance and potential for further declining acceptance; potential technology flaws; regulatory oversight uncertainty; concerns around account security; relies on electricity and internet connectivity; market manipulation potential; highly speculative and risk of substantial loss in short amount of time	Storage/transportation costs; physical property is stolen; changing regulations

Source: Bitcoin.org, CoinDesk, Morgan Stanley Wealth Management Global Investment Office

What's gold's market cap? Gold held by exchange-traded funds (ETFs) and by governments as currency reserves together come to around \$2.4 trillion—more than three times greater than Bitcoin's current total valuation. The most optimistic take would be to compare Bitcoin to all the gold ever mined. According to the World Gold Council, total above-ground gold—including jewelry, reserves, private holdings and other fabrications—comes to 201 kilotonnes. At today's prices that would suggest an \$11 trillion market cap of gold—or 10 times more valuable than Bitcoin (see Exhibit 9).

### Exhibit 9: Bitcoin Market Capitalization Is One-Third That of Investable Gold



Source: Bloomberg, Haver Analytics, coinmarketcap.com, World Gold Council as of April 13, 2021

### Exhibit 10: Is Bitcoin "Money" as Traditionally Defined?

Characteristic	Bitcoin	US Dollar
<b>Durability</b>	● Bitcoin is digital and able to be kept online or offline. It has lasted 11 years but could break at any time	● Paper money is durable and can last a long time. The dollar has lasted 48 years since leaving the gold standard
<b>Portability</b>	● Able to transfer online or download to USB device	● Able to carry easily or transfer dollars
<b>Divisibility</b>	● Currently can be divided up to eight decimal places	● Various denominations
<b>Uniformity</b>	● All bitcoins are uniform	● Certain denomination is uniform in shape and value
<b>Limited Supply</b>	● The current code caps the supply at 21 million and could only be changed through a "fork"	● Controlled by the Federal Reserve
<b>Acceptability</b>	● Currently not widely accepted but able to be converted to other currencies in some venues	● Widely accepted
<b>Other Characteristics Do Not Argue for Bitcoin's Use as a Currency</b>		
<b>Volatility</b>	● Much more volatile than US dollar and even emerging market currencies	● Little volatility versus other developed markets currency
<b>Regulatory Uncertainty</b>	● Illegal in some countries, different regulations globally	● Mostly recognized as "legal tender" globally; established regulatory environment
<b>Universal Acceptance</b>	● There are no regions where it is universally accepted	● Accepted universally in home country
<b>Backing</b>	● Not backed by anything other than faith in the code	● Backed by faith in the US government, foreign currency reserves and gold
<b>Hacking</b>	● No recourse if you are hacked	● Can be insured by bank or credit card company

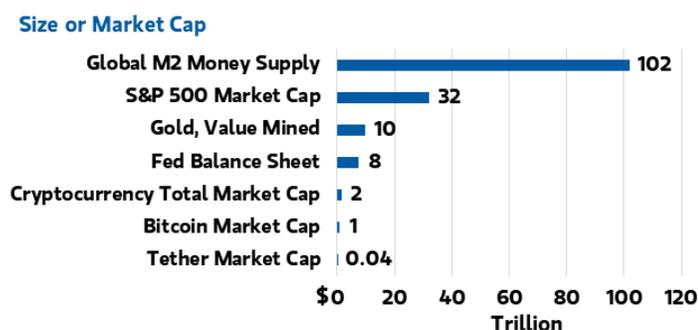
● Yes ● Partial ● No

Source: Federal Reserve Bank of St. Louis, Bitcoin.org, Morgan Stanley Wealth Management Global Investment Office

## INVESTING IN CRYPTOCURRENCY

If you think about Bitcoin as a currency, it should be compared to the value of the money supply. Since both Bitcoin and most money is electronic in nature, M2 money supply seems a better proxy than M1. M2 includes M1 (currency and coins held by the nonbank public, checkable deposits, and travelers' checks) plus savings deposits (including money market deposit accounts), small time deposits under \$100,000 and shares in retail money market mutual funds. If Bitcoin was the currency of a country, its valuation would be similar to the M2 money supply of Russia. Morgan Stanley & Co. Research calculated that cryptocurrency total market cap is about 2% of global M2 (see Exhibit 11).

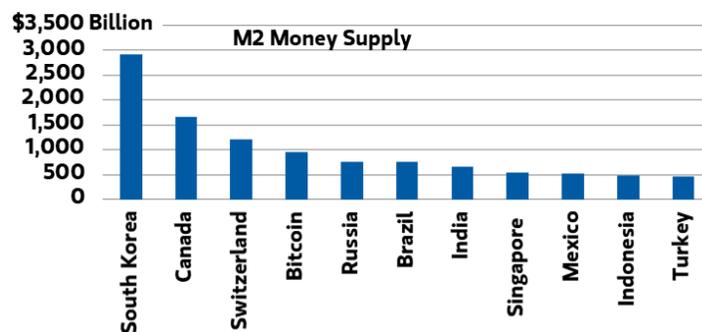
### Exhibit 11: Bitcoin Is Valued at About 2% of Global M2 Money Supply



Source: Macro Bond, Morgan Stanley & Co. Research as of March 4, 2021

How can we determine if a currency like Bitcoin should be more or less valuable than the Russian ruble, the Canadian dollar or the Swiss franc? We would look at population growth, GDP growth, liquidity, volatility, supply growth and the history of the central banks. Did Bitcoin have a stronger or weaker monetary policy than Russia historically? Which has a better history of not over increasing supply? Which is more volatile—the Russian economy or Bitcoin? Is Bitcoin growing faster than Canada or Switzerland? What's the yield of a Bitcoin-denominated savings account versus a Swiss savings account? Currently, the value stored in Bitcoin is between the value stored in Russian rubles and the value stored in Swiss francs (see Exhibit 12).

### Exhibit 12: Bitcoin's Market Value Is Greater Than That of the Russian Ruble



Source: Haver Analytics, Bloomberg as of Jan. 31, 2021

## How Would an Economist Look at Bitcoin as a Country?

If we think about Bitcoin as a country, it imports electricity and exports digital gold (used for Bitcoin savings accounts). That's a pretty simple economy.

Start with Bitcoin's GDP, which would be mining profits, especially if a three-year compounded annual growth rate is used to smooth out the cycle. Moving digital gold from one person to another nets out to zero impact on GDP; only the mining of new digital gold is additive. To use a different analogy, mining new digital gold is closer in nature to the impact of new home sales on the economy than existing home sales. Is Bitcoin GDP growing faster or slower than other countries? It's certainly volatile. As with all commodity-producing countries, GDP is dominated by the price of its chief export.

Next, consider Bitcoin's "population," which is the number of addresses, or users. If a country's population is increasing, it generally has higher demand for money.

Finally, look at Bitcoin's money supply, which would be the total supply of Bitcoin. Bitcoin held at a custodian is more like vault cash (currency held in the vault) or a savings account (some actually pay interest). Bitcoin held directly by a holder is more like M1 cash in circulation.

If we use these metrics when comparing Bitcoin's valuation to the M2 money supply of other countries, Bitcoin looks quite favorable (see Exhibit 13).

Exhibit 13: Bitcoin “GDP” Is Growing Fast Due to “Population” Growth

Country	M2 (\$ billion)	M2 Growth Year Over Year (%)	GDP Growth (%)	Population Growth (%)	25 Yr. vs. US Dollar (%)
South Korea	2,881	10	2.3	0.1	-30
Canada	1,676	19	2.0	1.2	8
Switzerland	1,192	7	1.5	0.7	29
Bitcoin	860	3	13.6	11.1	n/a
Russia	755	14	2.9	0.0	-94
Brazil	716	29	1.6	0.6	-78
India	663	20	3.3	0.8	-55
Singapore	542	11	1.3	1.2	5
Mexico	515	13	-0.3	1.0	-63
Indonesia	480	12	5.0	1.2	-83

Note: GDP for countries is 2019 GDP Growth - a "normal" year. GDP Growth for Bitcoin is Mining Profit 3 yr CAGR from Dec 17 - Feb 18 to Dec 2020 - Feb 2021  
Source: CEIC Data, Bloomberg, BitinfoCharts

## Operating Metrics Approach

Comparing total network value to average daily transaction value is another valuation method. It makes sense that the value of daily transactions would capture how much a network is being used. Higher daily transaction value should mean the network is more valuable because it is more widely used in the same way that a widely used credit card processing network is more valuable than a smaller network.

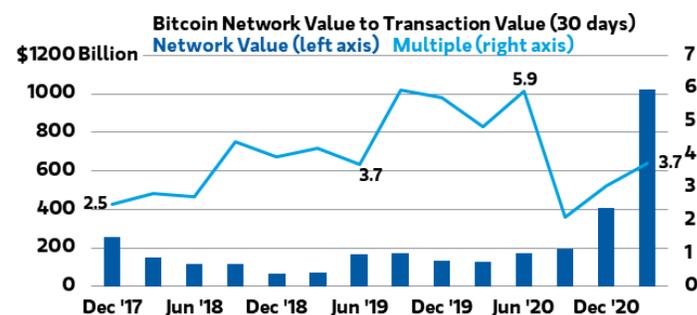
If someone buys bitcoins at a higher price today than yesterday, the daily transaction value increases alongside the price as each transaction is valued higher. Next, assuming the multiple remains the same, this higher daily transaction volume is used to justify a higher total network value, which, in turn, implies a higher price for each individual coin. Finally, as buyers bid up the price of each bitcoin, it trades at a lower network/transaction value multiple, kicking off the process again. It’s similar to valuing a stock using the average daily dollar volume of shares traded. As trading volume rises, the valuation method would justify higher stock prices.

While this network value to transaction framework wouldn’t work well for equities, it does make sense for currencies. A currency that is widely used and very liquid is more valuable than a little-used currency with lower volume and less liquidity. If a majority of the daily transaction value transfers represent real economic activity, it makes sense that the network should trade at a consistent multiple of its usage over time (see Exhibit 14). Monitoring this network value-to-transaction multiple can help an investor know whether they are buying bitcoin at a high price or low price given its daily usage. It can also show whether an investor is buying at a high or low price versus its history.

One potential flaw in this metric is that changes in technology and adoption can alter the ratio of network value

to transaction value. If new users hold bitcoin through trusts or derivatives, their transactions might not show up in the Bitcoin blockchain as user transactions shift to futures exchanges or other trading venues.

Exhibit 14: The Bitcoin Network Trades at 2017 Multiple of Transactions



Source: BitinfoCharts as of March 31, 2021  
Network value divided by 30-day Average Transaction Value.

## Replacement Value Approach

Analysts of some commodities such as oil and gold often use replacement value or cost-of-production frameworks.<sup>16</sup> In theory, a commodity’s price should not remain below its cost of production, which includes a fair profit on the capital employed—otherwise producers would withhold supply until prices recovered. For Bitcoin, analysts track miners’ profitability to assess the cost of production. That cost is variable because the algorithm that enables Bitcoin production continuously estimates how long it took to produce 2,016 blocks. If it took longer than 10 minutes per block, the system’s “difficulty adjustment” will make the next block easier, meaning each block will use less electricity—and

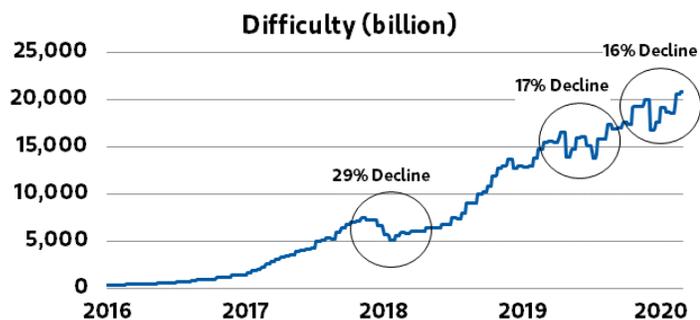
## INVESTING IN CRYPTOCURRENCY

the mining becomes more profitable. When the formula is more difficult, more electricity is used and profitability drops. This automatic adjustment ensures that blocks occur roughly every 10 minutes, leading to a steady amount of Bitcoin produced by the miners even if new miners join or old miners leave the network.

The difficulty adjustment is an interesting market-timing indicator.<sup>17</sup> The Bitcoin price tends to peak when difficulty increases but mining profitability declines, and it tends to trough when difficulty falls for an extended period, resulting in unprofitable miners leaving the market. The last time miners quit in large numbers was the fourth quarter of 2018. Estimating the profitability of the entire mining industry is difficult because of miner's variable costs for electricity and equipment—and their operational know-how. Many data providers try to estimate the mining profitability of the network.

Some Bitcoin analysts try to estimate how much the adjustment will change based on how fast recent blocks have been found. A rising difficulty adjustment suggests that some miners, perhaps with the best equipment or the lowest electricity cost, are able to produce blocks for less than they can sell the mined Bitcoin. A falling difficulty adjustment means price is less than some miner's costs. Because miners generally do not sell below costs, a falling difficulty adjustment could be a sign a price bottom is near. The last three sustained declines in the difficulty adjustment were in November and December 2018, near the recent multiyear bottom in price; in July 2020, after the halving; and early November 2020, when miners moved from locations with cheap hydropower during the rainy season to locations that were cheaper year round. While mining machines were transported, the network slowed and difficulty dropped, but prices continued to rise because the miner difficulty drop was due to a temporary regional phenomena rather than industry structural profitability (see Exhibit 15).

### Exhibit 15: Bitcoin Difficulty Adjustments Can Signal Turning Points or Disruptions



Note: Mining difficulty represents the estimated number of random attempts a miner must try before solving a mathematical equation. A difficulty of 20,000B means a miner expects to try 20 trillion numbers before arriving at a valid answer.

Source: Blockchain.com as of March 1, 2021.

## Cyclical/Technical Approach

In currency markets, various technical or cyclical indicators are sometimes used for shorter-term projections. Cyclical techniques are particularly good for Bitcoin because its four-year cycle is known in advance. Comparing Bitcoin's progress in this cycle to its previous ones can be a helpful indicator (see Exhibit 16).

### Exhibit 16: So Far, This Cycle Looks Similar to the Prior Two



Note: Chart begins at the halving date and shows price versus the halving price. After 300 days bitcoin is trading at six times the price of the most recent halving but was trading at four times the 2017 halving price in 2017 and 44 times the 2013 halving price.

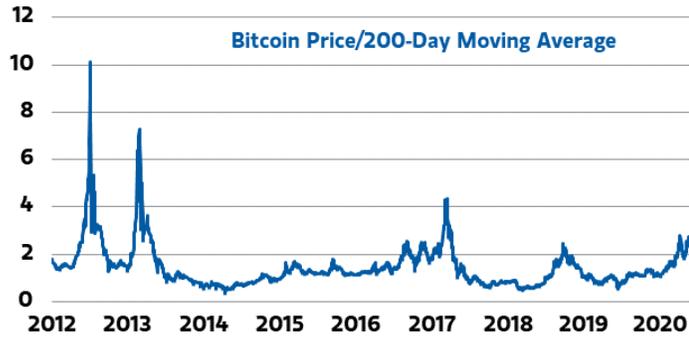
Source: Bloomberg as of March 27, 2021

In the current cycle, the price seems to be rising faster than in 2016 but slower than in 2012. However, there is no reason that should continue. Prior to this cycle, some Bitcoin advocates expected each cycle to appreciate at a slower pace than the previous cycle, as the rate of appreciation in 2016 was slower than 2012. Nevertheless, a comparison to previous cycles illustrates that this cycle has already lasted longer than the 2013 cycle though only two-thirds as long as the 2017 cycle.

Another cyclical indicator is the price to the 200-day moving average. On average, Bitcoin trades at 1.5 times its 200-day moving average; currently, though, it's trading at 2.3 times. In 2017, 2019 and earlier this year, large corrections occurred from this level. However, in the last three price peaks in March 2013, December 2013 and December 2017, the 200-day average was more than 4.0 (see Exhibit 17).

**INVESTING IN CRYPTOCURRENCY**

**Exhibit 17: On Average, Bitcoin Has Traded Close to Its 200-Day Moving Average**



Source: Bloomberg as of March 28, 2021

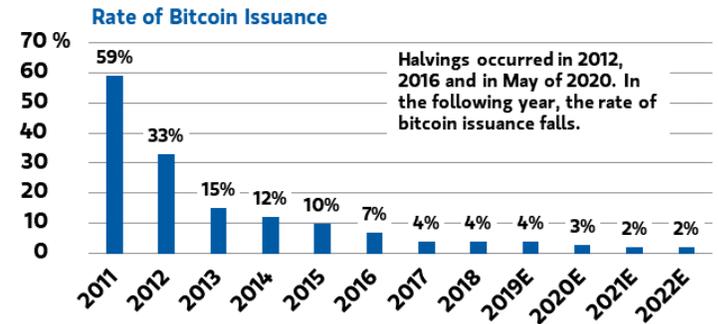
**The Bitcoin Cycle**

What is behind the recent appreciation of Bitcoin? In our view, the best explanations are: the Bitcoin cycle is favorable; arguments about Bitcoin as an answer to currency debasement are more persuasive today; growing institutional adoption makes it easier for the next step to be taken. We'll examine each argument.

One of the unique aspects of Bitcoin is its four-year "halving" cycle. A parabolic spike has followed each of the three halvings so far. Although there are only three data points, it is starting to seem like the halving causes the Bitcoin cycle of a price spike followed by a collapse.

Bitcoin's code creates an artificial shortage every four years that is meant to reward early adoption. After each halving, the reward to miners for producing a new block in the blockchain is cut in half, thereby reducing the supply of freshly minted Bitcoin entering the system (See Exhibit 18).

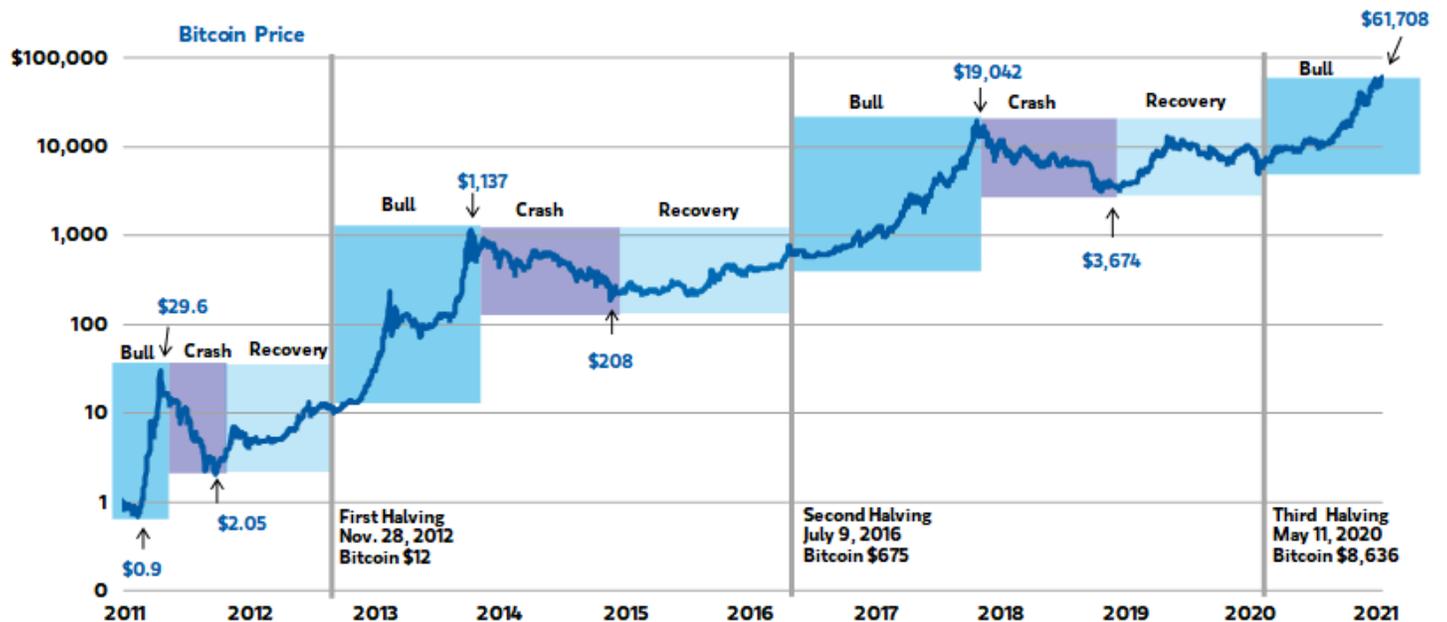
**Exhibit 18: By Design, the Rate of Bitcoin Issuance Decreases Every Year**



Source: Blockchain.com, MSWM estimates as of April 8, 2021

Bitcoin's fourth cycle has just begun and some clear patterns are starting to emerge (see Exhibit 19). There are three phases of each cycle: a normal bull market/recovery (2011- 2012, 2015-2016, 2019-2020), a parabolic bull market (2012-2013, 2016-2017, 2020-2021) and a catastrophic bear market (2013-2014, 2017-2018). (See Exhibit 20).

**Exhibit 19: Bitcoin Appears to Be Beginning Fourth Cycle**



Source: Bloomberg as of March 13, 2021

Exhibit 20: Will Bitcoin's Third Halving Cycle Look Like the First Two?

Cycle	Parabolic Bull			Catastrophic Bear			Recovery Bull
	Price at Halving	Price at Peak	Return (days)	Price at Trough	Return (days)	Price at Halving	Return (days)
First Halving Nov. 28, 2012	\$12	\$1,137 Nov. 29, 2013	+9,375% 366 days	\$183 Jan. 14, 2015	(84%) 411 days	\$663	+262% 542 days
Second Halving July 9, 2016	\$651	\$19,783 Dec. 17, 17	+2,939% 526 days	\$3,156 Dec. 14, 2018	(84%) 362 days	\$9,740	+209% 514 days
Third Halving May 11, 2020	\$8,636	????	+607%?? 332+ days	????	????	????	????

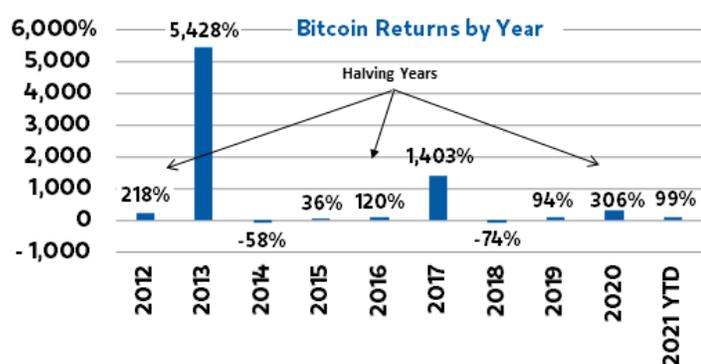
Source: Bloomberg, CMC Markets as of April 8, 2021

While we do not know whether the cycle will continue to repeat, it does help explain why Bitcoin's correlation to other asset classes is so unique. We believe investors should be aware of the halving cycle even if it does not repeat because it is an important reason why Bitcoin has low correlation to other assets (see Special Report). A simple strategy during the past eight years was to be long Bitcoin in the halving year as well as the year preceding and following it and be short the fourth year of the cycle. Simple strategies rarely continue to work and are eventually priced into the market. However, the strategy would have worked in 2020 and 2021, suggesting it may not be priced in yet. Even if this simple system works in the future, it doesn't help today; Bitcoin may have already seen its four-year peak in March 2021 at \$62,000, triple the prior high.

### Halving's Effects on Supply and Demand

As with all commodities, cutting the supply in half will create a supply shock and a price spike—and that's essentially what the halving cycle does (see Exhibit 21).

#### Exhibit 21: Why Is the Halving Cycle Important?

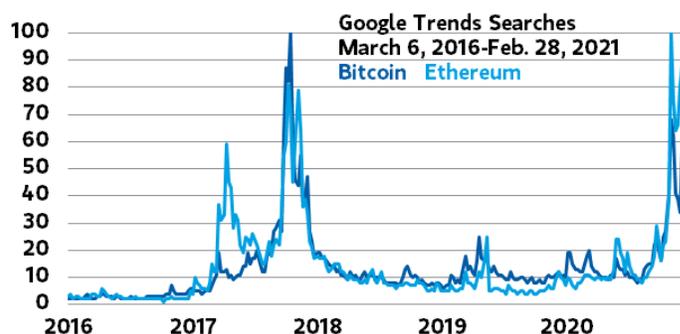


Source: Coindesk, Bloomberg as of April 8, 2021

However, Bitcoin is unique in two ways. First, the supply cannot increase faster than its predetermined code. Second, with most commodities, higher prices decrease demand, as people may drive less or eat less beef and more chicken. In Bitcoin, higher prices have increased demand as positive momentum drew more buyers. Equities sometimes see increased demand due to momentum, but not supply shocks. The supply shocks of the commodity world and the momentum elements of the equity world combine in Bitcoin to create a very volatile asset.

A product in which demand increases with price is called a "Veblen good."<sup>18</sup> The term is reserved for luxury cars or items that provide a status associated with ownership of the item. When the price starts increasing, fewer holders sell and more momentum buyers enter the market, causing an accelerating price curve. Unlike other commodities, Bitcoin miners cannot increase production (see Exhibit 22). We have observed that Google searches for Bitcoin increase as its price rises, which seems consistent with a Veblen good.

#### Exhibit 22: Most Google Cryptocurrency Searches Are for Bitcoin and Ethereum



Note: The y-axis indicates the popularity of Bitcoin/Ethereum searches versus all Google searches between 2016 and 2021. The value 100 indicates that the time the point of maximum popularity versus other searches between 2016 and 2021.

Source: Google Trends

## INVESTING IN CRYPTOCURRENCY

Momentum eventually stops and reverses when prices can go no higher, and momentum buyers turn into panicked sellers. Sometimes a shock kicks off a bout of downward momentum. Once prices begin their decline, it is impossible to know when it will end and at what price. In the last two down cycles, it took around a year to trough, and went down 84% peak to trough. Bitcoin hit \$61,243 on March 12. If that was the cycle peak, a similar cycle decline could take Bitcoin below \$10,000.

### 2020 Halving Cycle—Average Peak, Lower Peak or Higher Peak?

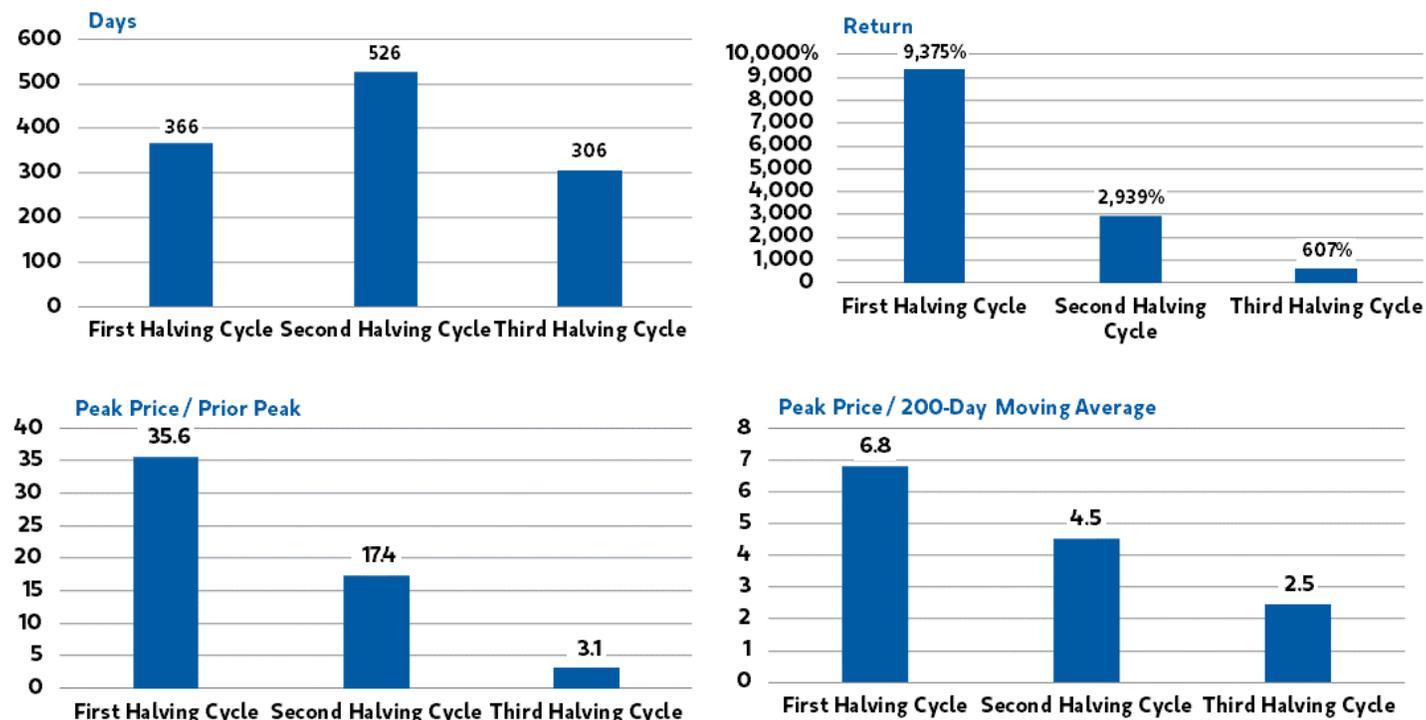
The halving cycle does seem to be occurring again. Perhaps it is a coincidence and the pandemic is the major driver of this cycle. For now, there is no way to know if a new cycle would have occurred without the pandemic. It's likely that debate that will continue in the years leading to the next halving in 2024. There are three schools of thought regarding the length and magnitude of the current cycle: Is it small, average or is it a supercycle? This debate matters because the small cycle advocates believe the cycle might already be over. The cycle is approaching the length in days of the first cycle, and if returns decline each cycle, the return this cycle may have peaked. On the other hand, supercycle advocates point to the unprecedented money supply growth and the one-time

nature of institutional adoption (see Exhibit 23).

**Small Cycle Theory.** Some expect these parabolic moves to be one-time events and for crypto to revert to the return profile of other assets. As Bitcoin's market cap grows, it takes more money to lead to the same returns, and each bull market should get smaller. The 2017 bubble had a lower return than the 2013 bubble, though it lasted longer. Plus, with each halving, the impact of newly minted coins on total supply diminishes. In the first halving, the production of new coin dropped to 15% inflation from 33% inflation, an 18% reduction in supply. In the second halving, annual production fell to 4% from 7%, a 3% reduction, which had a lesser impact on the price. The third halving only reduced supply to 2% from 3%, a 1% decline. Small cycle adherents believe the current cycle will see less appreciation than the 2017 cycle. Eventually, as the total supply grows, the impact of a smaller supply associated with future halvings might be barely noticeable.

**Average Cycle Theory.** Some expect this cycle to play out in the same way as the prior two cycles. If so, it should last between 60 and 220 more days (from March 31) and should peak between 2,939% and 9,375% of the halving price versus only a 630% gain currently. Under this theory, Bitcoin prices would reach in excess of \$100,000. While possible, making predictions based on two data points is a risky endeavor.

Exhibit 23: Thus Far, This Cycle Looks Smaller Than the Previous Two



Note: Days of cycle chart assumes peak occurred March 13, 2021 at \$61,078. On March 13, the 200-day moving average was \$24,793 versus \$31,187 today.  
Source: Bloomberg as of April 8, 2021

## INVESTING IN CRYPTOCURRENCY

**Supercycle Theory.** This theory posits that Bitcoin's increased penetration and adoption coincides with the steepest ascent in valuation. Further, given the vast amounts of currency printed by global central banks, the Bitcoin cycle may be much bigger than expected as fiat currencies depreciate. Moreover, others argue that because owners of cryptocurrencies can now borrow against holdings, they will be more likely to hold on and avoid selling and thus, trigger taxable events.

We take no position on whether this cycle will be a small, average or super cycle. But it is important to understand the various arguments. In our experience, cycles that last too long inevitably lead to leverage and eventually forced selling, causing the cycle to unwind swiftly as levered holders sell.

### What Would the Emergence of a New Asset Class Look Like?

In thinking about why Bitcoin has been appreciating, we considered three explanations: the Bitcoin halving cycle, the global macro environment and institutional adoption. In addition to all the institutional adoption developments of 2020 and 2021 outlined in the special report, we can also look to the past. The last major asset class incorporated into portfolios was the rise of gold in the 1970s and 1980s. Some argue that the institutionalization of emerging markets or commodities in the '80s, '90s or '00s are other examples, but those were just different types of stocks or different types of hard assets. Gold was the first non-income-asset to be added to portfolios and offers a good case study. Importantly, once the process of institutionalization was kicked off with gold futures in the 1970s, there were two large bubbles over an 18-year period of growing institutional adoption. The introduction of CME Bitcoin futures in December 2017 could have been a similar watershed moment that made the rise of institutionalized cryptocurrency much more probable.

Paul Tudor Jones, a well-known macro trader, advocated Bitcoin in his May 2020 investor letter. He compared its rise to the rise of gold as an investable asset in the 1970s. Recall that gold as an investment was illegal in the US until 1974, which is also when COMEX gold futures began trading. The gold price had been fixed at \$35 an ounce since 1933<sup>19</sup>, but was \$184 by the end of 1974.<sup>20</sup> Then, a two-year bear market set in, and the price was nearly halved. By January 1980, gold touched a daily high close of \$850, a record that would stand for more than 25 years. From the mid-1970s to the early 1980s, gold became widely available through brokerage firms and retail-oriented products. In 1989, "Gold and Gold Stocks as Investments for Institutional Portfolios" was published by Wharton's Jeffrey F. Jaffe in the *Financial Analyst Journal*.<sup>21</sup> Gold had completed its 18-year transition from a new investable asset to a recognized element of institutional portfolios.

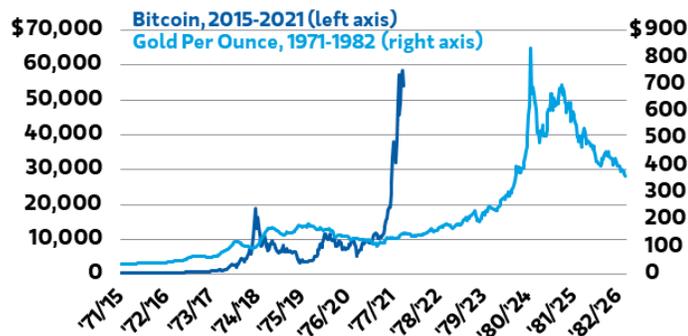
The similarities between the rise of gold and the rise of Bitcoin are striking. While Bitcoin launched in 2009, it was fairly obscure until 2013, when the price hit \$1,000 for the first time. In 2014, the first Bitcoin bubble unwound, and it was mostly forgotten after an 85% peak-to-trough decline. Even so, in the same way the Coinage Act of 1965 that removed silver from US coins foreshadowed the eventual breakdown of the gold standard and fixed exchange rates, the Bitcoin bubble had captured the imaginations of technologists, developers and a few pioneering financial institutions. The macroeconomic backdrop was also important. Money supply growth in the 1970s was in the low teens, which was unprecedented then, yet less than today's growth. Investors everywhere were looking for ways to beat rampant inflation and prompted some investors to consider a new investment. Retail investors were entering the market in earnest as the deregulation of the SEC in 1975 abolished fixed rate commissions and opened the door for discount brokers, the Robinhoods of that day. A new generation of baby boomers was less tied to old styles of investing and were open to something new. Now, M2 growth, which has been as high as 26%, is raising the same kind of concerns about inflation while growth in millennial investors is allowing new products to gain traction.

For Bitcoin in 2015, as with gold in 1970s, a growing number of people were using the new asset. The next Bitcoin bubble, in 2017, was driven by the idea that there might eventually be an exchange-traded fund (ETF) and there were additional signs of institutional adoption. Although hopes for an ETF were dashed in early 2017, soon Bitcoin futures came along. Interestingly, the introduction of Bitcoin futures near the peak in December 2017 resembled that of the gold peak in 1974, when COMEX futures were first introduced. Both peaks were followed by bear markets that lasted more than a year before the resumption of a bull market. More institutions were involved and there were many ways for investors to get exposure to the new asset.

The next bull market in gold lasted a little more than three years (August 1976-January 1980), while the Bitcoin bull market has lasted between one and two years, depending on if you count the bottom at March 2020 or December 2018. Bears might say that Bitcoin has already risen higher than the 1970s' gold bull market and "the end of the bubble is nigh." On the other hand, there are reasons to think the bull market could last at least as long as gold's 1970s run. While Bitcoin has made large strides this year, relatively few financial institutions have holdings. So there is a long way to go there. Furthermore, gold started out from a higher base: It was a known asset in 1971 and had been used as a store of value for millennia. An upstart new technology-based asset is certain to take longer to gain broad institutional adoption than one of the oldest assets in the world (see Exhibit 24).

## INVESTING IN CRYPTOCURRENCY

**Exhibit 24: Crypto's Maturation as an Asset Class Has Been Twice as Fast as Gold's**

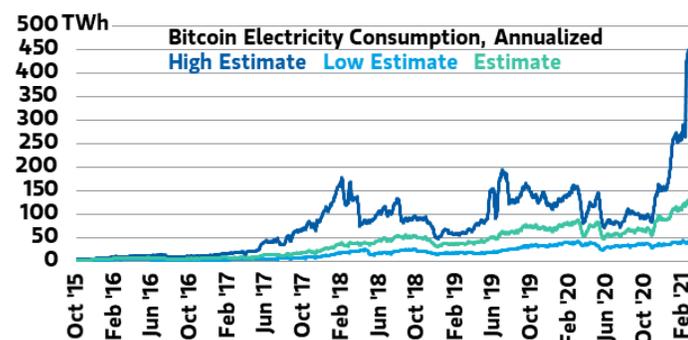


Source: Bloomberg, Morgan Stanley Wealth Management Global Investment Office as of April 8, 2021

## ESG Impact a Cause for Concern

Bitcoin is not just controversial from an investment point of view. Since mining Bitcoin takes a massive amount of electricity, there is an environmental issue, too.<sup>22</sup> Bitcoin has been criticized by environmental, social and governance (ESG) advocates who are focused on energy conservation. Estimates of annual energy usage to maintain the Bitcoin network (see Exhibit 25) range between 50 and 300 Terawatt hours (TWh) of electricity. By comparison, China's Three Gorges Dam, the world's largest power station in terms of installed capacity, is about 100 TWh, according to MS & Co. Research.<sup>23</sup> Bitcoin proponents say that most miners use some renewable energy sources, notably hydroelectric power.<sup>24</sup>

**Exhibit 25: Estimates Vary on Bitcoin's Electricity Consumption**



Source: <https://cbeci.org/>, Cambridge Bitcoin Electricity Consumption Index as of March 4, 2021

Bitcoin's design requires large amounts of energy. A key aspect of Bitcoin mining is "proof of work"—the idea of being rewarded in bitcoin if you manage to solve the complex algorithm. The proof of work is set up as a competition that requires millions of computers globally to expend electricity

performing mathematical calculations. The more successful Bitcoin becomes, the higher its price; the higher its price, the more competition for bitcoin; and thus the more energy is expended to mine.

As the price of Bitcoin rises, more and more energy is likely to be used to maintain the network as more miners join. Bitcoin advocates argue crypto mining requires less energy than US laundry dryers, an estimated 7% of energy consumption. They also remind critics that 39% bitcoin energy consumption is renewable because it has the lowest kilowatt-per-hour cost—after large upfront costs are paid. Advocates suggest that bitcoin mining can make wind power and solar power more economical because it can be used at night or in the fall and spring when typical electricity-generating capacity is underutilized. Critics counter that once money is spent on a mining machine, it needs to run whether or not the sun is out or the wind is blowing: If renewable energy isn't available, miners will turn to conventional sources. The energy consumption debate is not likely to be resolved soon, and could become part of the broader policy debate over bitcoin. New regulations may restrict energy usage in Bitcoin mining operations or force miners to use only renewable power—with penalties for power from fossil fuels.

## Risk of Crypto Investments

Cryptocurrencies are a nascent asset class, with no guarantee that any particular currency will last. Volatile price movements, lack of support from central banks and no physical collateral could ultimately be a detriment.

While there are an abundance of risks, in our view the three biggest risks for Bitcoin and other cryptocurrencies are:

**Encryption breaks.** Increased processing power and new techniques such as quantum computing could eventually crack the encryption. According to Computer World, software designers hope their encryption will last at least 20 years,<sup>25</sup> but given how cumbersome upgrades to the Bitcoin software can be, they aim for longer. It is likely that the encryption backing Bitcoin will one day be broken, opening the possibility that owners' "wallets" will be hacked. Future developers could upgrade the encryption, and coin tracking services might be able to catch hackers as they try to spend their crypto cash. Regardless of how it may happen, bitcoin would likely suffer a serious price decline even if encryption only appears to be broken. While the chances are low in any given year, over 100 years, the risk is likely to emerge.

**Flawed code.** Bitcoin had two bugs that resulted in inflation—meaning more coins minted. The first incident was in August 2010, which allowed 184 billion unauthorized bitcoin to be minted. This flaw was discovered quickly, purged from the supply and the code was patched. Another less severe bug appeared in 2018, allowing malicious miners to

## INVESTING IN CRYPTOCURRENCY

create two transactions with the same transaction ID in the same block, and thus were able to spend money twice. This bug was never exploited. Such events have happened only twice in 11 years and have had limited impact; nonetheless, they expose a significant risk. Other cryptocurrencies, such as Ethereum, have also had transactions that were rolled back.

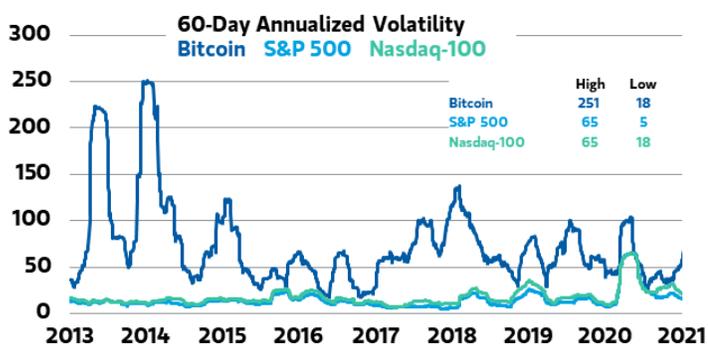
**Government action.** There is also risk of a government attack on Bitcoin and other cryptocurrencies. Because the Bitcoin network is global, actions by a single large country or a group of countries could disrupt the working of the network. This could occur through regulations or an outright attack. A regulatory offensive could take place, possibly banning the use of Bitcoin or imposing high taxes on Bitcoin transactions. A direct attack might find a sovereign country trying to corner the market on mining power. Such attacks would be costly.

In addition to those severe risks, there are other risks that could wreak havoc on the network:

**Volatility.** Bitcoin is among the most volatile of assets. While its beta may be low due to its low correlation (and sometimes negative correlation) with the broader market, its historical realized volatility is among the highest of all assets. Although Bitcoin's 60-day annualized volatility has fallen from levels as high as 251% in late 2013 to 88% currently, it remains significantly elevated compared with the S&P 500 Index (12%) and the Nasdaq-100 Index (18%). Notably, in 2019, Bitcoin's 60-day annualized volatility spiked from 29% to 101% in less than four months (see Exhibit 26). In our view, investors should expect volatility in excess of 100%, even if recent volatility has been much lower.

**Liquidity mismatch.** Some cryptocurrency product offerings trade less frequently than the underlying asset. Thus, there is no guarantee that a secondary market or buyer will exist even if the asset continues to trade. As a result, investors may misprice increases or be unable to make a timely redemption due to the frequency and timing of a product's subscriptions or redemptions that do not match the underlying asset.

### Exhibit 26: Crypto Volatility Is at Least Three Times That of Stocks



Source: Bloomberg, Morgan Stanley Wealth Management Global Investment Office as of Feb. 24, 2021

**Product selection.** The number and types of Bitcoin offerings are limited and products that are available currently may be less favorable as new structures are approved.

**Lack of central governance.** Bitcoin does not have a governing body, which presents challenges when users face issues or theft. If a user loses their encryption key, there is no one that can help them retrieve their coins, even if they are the rightful owner.

**Valuation risk.** The lack of time-tested valuation framework makes fundamental research difficult.

**Environmental concerns.** Concerns about Bitcoin mining's carbon footprint could lead it to be controlled or regulated. Notably, some 39% of bitcoins are mined with renewable or "stranded" electricity such as a hydroelectric dam or an unused windmill. However, limitations on less environmentally friendly energy sources such as coal-fired plants could reduce the security of the network, by limiting those who can mine.

**Association with illegal activities.** Cryptocurrency has known use in illegal activity, including drug dealing, money laundering, human trafficking, sanction evasion and other forms of illegal commerce as well as a payment network for ransomware (software that forces users to pay a ransom to regain access to their computer). Industry compliance firm Chainalysis<sup>26</sup> found that illicit transactions accounted for only 0.34% of total cryptocurrency activity last year. However, this number could rise if cryptocurrency becomes more widely used.

**Internet reliability.** Cryptocurrency networks are dependent on the internet, and a global or even regional disruption could affect the ability to transfer assets.

If a coin is deemed a security by the SEC it could reduce the liquidity and price for that cryptocurrency. The SEC has argued that some cryptocurrencies are securities and may have been sold or traded in an illegal manner. The law on securities is vague and susceptible to many interpretations and ultimately courts will make case-by-case decisions that can be appealed. The chair of the SEC testified that Bitcoin was not a security and suggested that Ethereum was no longer a security but other cryptocurrencies might be considered securities and could have restrictions placed on trading, suppressing their liquidity.

**Forking risk.** The acceptance of a controversial software upgrade by a large minority could result in a "fork" in the network,<sup>27</sup> resulting in multiple networks with cryptocurrencies having different values. If network participants choose to run incompatible versions of the software, the Bitcoin network could split two rival networks. Each network would have its own cryptocurrency. The value of these two new cryptocurrencies could be smaller or larger

## INVESTING IN CRYPTOCURRENCY

than the original investment, and some of the resulting assets may be less liquid than the larger assets. Typically, one of the networks retains most of the users and is the more valuable cryptocurrency, but the uncertainty around which cryptocurrency is more valuable could add to volatility until a consensus is reached.

**Governance risk.** The Bitcoin network is open source, so there may be no consensus about how to face certain challenges that require code changes.

**Competitive risk.** A rival cryptocurrency could gain share of adoptions or mining power, leading to a decline in the original cryptocurrency and possibly, a less-secure network.

**Concentration risk.** The 95 largest Bitcoin addresses hold about 14% of total coins.<sup>28</sup> Many of these are financial institutions and cryptocurrency exchanges. If one or more of these addresses was forced to sell its assets or had their bitcoin stolen and sold, it could impact the price.

Cryptocurrencies face significant barriers to scaling to a larger base of users. Blockchains have limited capacity per block. If the capacity is reached, transaction fees are typically used to allocate scarce capacity. Heavy usage could result in high fees, slow transactions and lead to users exit the network for a

higher capacity alternative.

**Risk of 51% attack.**<sup>29</sup> Bitcoin's unique software depends on consensus to operate. If a malicious group attempts to disrupt the blockchain, it might be able to reverse transactions, erase transactions or double-spend bitcoins. The group would need to control more than 50% of the mining power to make this gambit effective. However, a large number of miners with ample computing power around the world could make such an attack feasible.

**Processing risk.** If the rewards for miners are not high enough to cover their mining cost, there might not be enough miners on the network to process transactions in a timely manner or it might become easier to perform a 51% attack. Closure or temporary stoppages in large cryptocurrency exchanges due to fraud, technological failure, hacking or legal rulings could reduce liquidity and value of cryptocurrencies or make it harder to transact.

**Unforeseen risk.** Because cryptocurrencies are relatively new, there may be unforeseen risks in the future that are not evident now. ■

### Frequently Asked Questions

**Why are people investing in cryptocurrency?** We see advocates gravitate toward three main investment theses: Bitcoin is digital gold, a place to hide from currency debasement; cryptocurrencies are a new asset class that institutional investors are increasingly using in their portfolios; cryptocurrencies are uncorrelated, albeit volatile assets that can work in a diversified portfolio.

**How do you value cryptocurrency?** While there is no agreed-upon way to value Bitcoin and other cryptocurrencies, we review some methods that are in use. Relative value, the mainstay of equities, is the most developed framework. We consider Bitcoin versus gold and Bitcoin versus the value of the money supply of smaller countries. As eyeballs became an “official” metric for internet companies in the 1990s, another area we review is Bitcoin versus transactions and users, two ways to measure usage. Lastly we look at replacement cost.

**How are cryptocurrencies created?** For the largest cryptocurrencies, “miners” must apply prodigious amounts of computing power with state-of-the-art microchips—and the electricity to run these computers—to solve complex algorithms. Once coins are mined, the blockchain tracks ownership and transactions. With Bitcoin, the underlying code rewards miners with newly minted coins that they can sell to pay for their operating costs, but only 21 million coins will ever be minted.

**Why do Bitcoin headlines seem to come back every few years?** In 2020, Bitcoin had its third “halving”—an automatic reduction of the supply of newly minted coins that happens every four years. In the past, these halving cycles created temporary shortages, positive price action, parabolic advances and ultimately, at least two catastrophic declines. The cycle is important for understanding why Bitcoin and other cryptocurrencies could continue to have low correlations to other asset classes. It’s also a warning sign because by some measures the cycle seems to have peaked.

**Has an asset ever come from out of nowhere like this?** Yes and no. There are some similarities to the way gold went from being illegal in the early 1970s to an asset that was considered important to institutional portfolios by the late 1980s. Gold, specifically coins, bars and certificates, only became legal for US citizens to own in the early 1970s. In 1974, the introduction of gold bullion futures marked the end of the first leg of the bull market in gold, but the second leg, which started a few years later, was ultimately bigger.

However, there are important differences between gold and Bitcoin: Gold, as an asset and currency, has existed for millennia. Bitcoin started trading in 2009.

**Who regulates cryptocurrencies?** Cryptocurrencies are regulated by many entities. Business that deal in cryptocurrencies must follow anti-money laundering laws and “know your clients” laws enforced by the US Treasury Department. Gains in cryptocurrency are taxed as property, according to the IRS. Some cryptocurrencies—but not Bitcoin—are considered securities by the SEC. Bitcoin derivatives such as futures are regulated by the Commodity Future Trading Commission. States have their own laws and regulations regarding cryptocurrencies.

**How could the Bitcoin as “digital gold” thesis prove to be flawed?** While M2 money supply is growing fast today, that could change quickly. As pandemic-driven needs recede, the federal budget deficit should improve. Note that gold has not performed well recently; it peaked in August 2020, and is down 18% since. If budget deficits shrink in the years ahead and the Fed tightens monetary policy, this thesis could quickly lose adherents.

**How could the “increasing adoption” argument prove to be flawed?** Institutional adoption could reverse sharply. In 2018, banks were opening trading desks and gearing up to handle the first Bitcoin futures, but the negative price action led many to scrap their plans. Regulatory scrutiny also put pressure on parts of the market. A certain level of institutional adoption might already be anticipated in the current bitcoin price. If the pace of institutional adoption slows or stops, prices might need to decline or stagnate because adoption is not happening as fast as some investors have assumed.

**How could the MPT argument prove to be flawed?** Some assets famously have low correlations until a crisis. We’ve recently seen what happens when bonds and stocks start trading in the same direction. Correlations could rise as more institutions adopt cryptocurrency. Events such as the halving and regulatory uncertainty have likely contributed to low correlations. As the halving becomes better understood, it might become priced in, thereby dampening Bitcoin’s unique cycle. And as the regulatory picture becomes clearer, regulatory developments may have less impact on Bitcoin. Thus, cryptocurrencies might lose the diversification benefits they have demonstrated over the past seven years. Finally, the analyzed period included strong appreciation in Bitcoin’s value. A more muted or even negative return might have led us to a different conclusion.

## INVESTING IN CRYPTOCURRENCY

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# Disclosure Section

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### Important Information

*Buying, selling, and transacting in Bitcoin or other digital assets, and related funds and products, is highly speculative and may result in a loss of the entire investment.* Risks and considerations include but are not limited to:

- Bitcoin and other digital assets have only been in existence for a short period of time and historical trading prices for Bitcoin and other digital assets have been highly volatile. The price of Bitcoin and other digital assets could decline rapidly, and *investors could lose their entire investment*.
- Certain digital asset funds and products, including Bitcoin funds and products, allow investors to invest on a more frequent basis than investors may withdraw from the fund or product, and interests in such funds or products are generally not freely transferrable. This means that, particularly given the volatility of digital assets, including Bitcoin, an investor will have to bear any losses with respect to its investment for an extended period of time and will not be able to react to changes in the price of the digital asset once invested (for example, by seeking to withdraw) as quickly as when making the decision to invest. Such digital asset funds and products, including Bitcoin funds and products, are intended only for persons who are able to bear the economic risk of investment and who do not need liquidity with respect to their investments.
- Given the volatility in the price of Bitcoin and other digital assets, the net asset value of a fund or product that invests in such assets at the time an investor's subscription for interests in the fund or product is accepted may be significantly below or above the net asset value of the product or fund at the time the investor submitted subscription materials.
- Certain digital assets, apart from Bitcoin, are not intended to function as currencies but are intended to have other use cases. These other digital assets may be subject to some or all of the risks and considerations set forth herein, as well as additional risks applicable to such other digital assets. Buyers, sellers and users of such other digital assets should thoroughly familiarize themselves with such risks and considerations before transacting in such other digital assets.
- The value of Bitcoin and other digital assets may be negatively impacted by future legal and regulatory developments, including but not limited to increased regulation of Bitcoin or such other digital assets. Any such developments may make Bitcoin or such other digital assets less valuable, impose additional burdens and expenses on a fund or product investing in such assets or impact the ability of such a fund or product to continue to operate, which may materially decrease the value of an investment therein.
- Due to the new and evolving nature of digital currencies and the absence of comprehensive guidance, many significant aspects of the tax treatment of digital assets including Bitcoin are uncertain. Prospective investors should consult their own tax advisors concerning the tax consequences to them of the purchase, ownership and disposition of Bitcoin and other digital assets, directly or indirectly through a fund or product, under U.S. federal income tax law, as well as the tax law of any relevant state, local or other jurisdiction.
- Over the past several years, certain Bitcoin exchanges have experienced failures or interruptions in service due to fraud, security breaches, operational problems or business failure. Such events in the future could impact any fund's or product's ability to transact in Bitcoin if the fund or product relies on an impacted exchange and may also materially decrease the price of Bitcoin, thereby impacting the value of your investment, regardless of whether the fund or product relies on such an impacted exchange.
- Although any digital asset product, including a Bitcoin-related product, and its service providers have in place significant safeguards against loss, theft, destruction and inaccessibility, there is nonetheless a risk that some or all of a product's digital asset, including Bitcoin, could be permanently lost, stolen, destroyed or inaccessible by virtue of, among other things, the loss or theft of the "private keys" necessary to access a product's digital asset, including Bitcoin.
- Investors in funds or products investing or transacting in Bitcoin and/or other digital assets may not benefit to the same extent (or at all) from "airdrops" with respect to, or "forks" in, the Bitcoin (or other relevant digital asset's) blockchain, compared to investors who hold Bitcoin (or such other relevant digital asset) directly instead of through a fund or product. Additionally, a "fork" in the Bitcoin blockchain could materially decrease the price of Bitcoin.
- Digital assets such as Bitcoin or other digital asset product is/are not legal tender, and is not backed by any government, corporation or other identified body, other than with respect to certain digital currencies that certain governments are or may be developing now or in the future (of which Bitcoin is *not* one). No law requires companies or individuals to accept digital currency as a form of payment (except, potentially, with respect to digital currencies developed by certain governments where such acceptance may be mandated). Instead, other than as described in the preceding sentences, Bitcoin's and other digital asset products' use is limited to businesses and individuals that are willing to accept them. If no one were to accept digital currencies, Bitcoin and other virtual currency products would very likely become worthless.
- Platforms that buy and sell Bitcoin or other digital assets can be hacked, and some have failed. In addition, like the platforms themselves, digital wallets can be hacked, and are subject to theft and fraud. As a result, like other investors have, you can lose some or all of your holdings of digital assets, including Bitcoin.
- Unlike US banks and credit unions that provide certain guarantees of safety to depositors, there are no such safeguards provided to digital assets, such as Bitcoin, held in digital wallets by their providers or by regulators.
- Due to the anonymity Bitcoin and other digital assets offer, it has known use in illegal activity, including drug dealing, money laundering, human trafficking, sanction evasion and other forms of illegal commerce. Abuses could impact legitimate consumers and speculators; for instance, law enforcement agencies could shut down or restrict the use of platforms and exchanges, limiting or shutting off entirely the ability to use or trade Bitcoin or other digital asset products.
- Bitcoin and other digital assets may not have an established track record of credibility and trust. Further, any performance data relating to Bitcoin, Bitcoin-related products or other digital asset products may not be verifiable as pricing models are not uniform.
- Investors should be aware of the potentially increased risks of transacting in digital assets, including Bitcoin, relating to the risks and considerations, including fraud, theft, and lack of legitimacy, and other aspects and qualities of digital assets, before transacting in such assets.
- The exchange rate of Bitcoin or other virtual currency products versus the USD historically has been very volatile and the exchange rate could drastically decline. For example, the exchange rate of Bitcoin versus the USD has in the past dropped more than 50% in a single day. Bitcoin may be affected by such volatility as well.
- Digital asset exchanges have limited operating and performance histories and are not regulated with the same controls or customer protections available to more traditional exchanges transacting equity, debt, and other assets and securities. There is no assurance that a person/exchange who currently accepts a digital asset as payment will continue to do so in the future.
- The regulatory framework of digital assets is evolving, and in some cases uncertain, and digital assets themselves may not be governed and protected by applicable securities regulators and securities laws, including, but not limited to, Securities Investor Protection Corporation coverage, or other regulatory regimes.

## INVESTING IN CRYPTOCURRENCY

- Morgan Stanley Smith Barney LLC or its affiliates (collectively, "Morgan Stanley") may currently, or in the future, offer or invest in digital asset products, services or platforms. The proprietary interests of Morgan Stanley may conflict with your interests.
- The foregoing list of considerations and risks are not and do not purport to be a complete enumeration or explanation of the risks involved in an investment in the any product or fund investing or trading in Bitcoin and/or other digital assets.

### Index Definitions

For index definitions referenced in this report please visit the following: <https://www.morganstanley.com/wealth-investmentsolutions/wmir-definitions>

### Glossary

**Correlation** This is a statistical measure of how two securities move in relation to each other. This measure is often converted into what is known as correlation coefficient, which ranges between -1 and +1. Perfect positive correlation (a correlation coefficient of +1) implies that as one security moves, either up or down, the other security will move in lockstep, in the same direction. Alternatively, perfect negative correlation means that if one security moves in either direction the security that is perfectly negatively correlated will move in the opposite direction. If the correlation is 0, the movements of the securities are said to have no correlation; they are completely random. A correlation greater than 0.8 is generally described as strong, whereas a correlation less than 0.5 is generally described as weak.

**M2** is a measure of the money supply that includes all elements of M1 as well as "near money." M1 includes cash and checking deposits, while near money refers to savings deposits, money market securities, mutual funds and other time deposits.

**Volatility** This is a statistical measure of the dispersion of returns for a given security or market index. Volatility can either be measured by using the standard deviation or variance between returns from that same security or market index. Commonly, the higher the volatility, the riskier the security.

### Risk Considerations

#### **Hypothetical Performance**

**General:** Hypothetical performance should not be considered a guarantee of future performance or a guarantee of achieving overall financial objectives. Asset allocation and diversification do not assure a profit or protect against loss in declining financial markets.

Hypothetical performance results have inherent limitations. The performance shown here is simulated performance not investment results from an actual portfolio or actual trading. There can be large differences between hypothetical and actual performance results.

Despite the limitations of hypothetical performance, these hypothetical performance results may allow clients and Financial Advisors to obtain a sense of the risk / return trade-off of different asset allocation constructs.

Investing in the market entails the risk of market volatility. The value of all types of securities may increase or decrease over varying time periods.

This analysis does not purport to recommend or implement an investment strategy. Financial forecasts, rates of return, risk, inflation, and other assumptions may be used as the basis for illustrations in this analysis. They should not be considered a guarantee of future performance or a guarantee of achieving overall financial objectives. No analysis has the ability to accurately predict the future, eliminate risk or guarantee investment results. As investment returns, inflation, taxes, and other economic conditions vary from the assumptions used in this analysis, your actual results will vary (perhaps significantly) from those presented in this analysis.

The assumed return rates in this analysis are not reflective of any specific investment and do not include any fees or expenses that may be incurred by investing in specific products. The actual returns of a specific investment may be more or less than the returns used in this analysis. The return assumptions are based on hypothetical rates of return of securities indices, which serve as proxies for the asset classes. Moreover, different forecasts may choose different indices as a proxy for the same asset class, thus influencing the return of the asset class.

**Investing in foreign markets** entails greater risks than those normally associated with domestic markets, such as political, currency, economic and market risks. **Investing in currency** involves additional special risks such as credit, interest rate fluctuations, derivative investment risk, and domestic and foreign inflation rates, which can be volatile and may be less liquid than other securities and more sensitive to the effect of varied economic conditions. In addition, international investing entails greater risk, as well as greater potential rewards compared to U.S. investing. These risks include political and economic uncertainties of foreign countries as well as the risk of currency fluctuations. These risks are magnified in countries with **emerging markets and frontier markets**, since these countries may have relatively unstable governments and less established markets and economies.

**Investing in commodities** entails significant risks. Commodity prices may be affected by a variety of factors at any time, including but not limited to, (i) changes in supply and demand relationships, (ii) governmental programs and policies, (iii) national and international political and economic events, war and terrorist events, (iv) changes in interest and exchange rates, (v) trading activities in commodities and related contracts, (vi) pestilence, technological change and weather, and (vii) the price volatility of a commodity. In addition, the commodities markets are subject to temporary distortions or other disruptions due to various factors, including lack of liquidity, participation of speculators and government intervention.

**Physical precious metals** are non-regulated products. Precious metals are speculative investments, which may experience short-term and long term price volatility. The value of precious metals investments may fluctuate and may appreciate or decline, depending on market conditions. If sold in a declining market, the price you receive may be less than your original investment. Unlike bonds and stocks, precious metals do not make interest or dividend payments. Therefore, precious metals may not be appropriate for investors who require current income. Precious metals are commodities that should be safely stored, which may impose additional costs on the investor. The Securities Investor Protection

## INVESTING IN CRYPTOCURRENCY

Corporation (“SIPC”) provides certain protection for customers’ cash and securities in the event of a brokerage firm’s bankruptcy, other financial difficulties, or if customers’ assets are missing. SIPC insurance does not apply to precious metals or other commodities.

**Equity securities** may fluctuate in response to news on companies, industries, market conditions and general economic environment.

Companies paying **dividends** can reduce or cut payouts at any time.

An investment in an **exchange-traded fund** involves risks similar to those of investing in a broadly based portfolio of equity securities traded on an exchange in the relevant securities market, such as market fluctuations caused by such factors as economic and political developments, changes in interest rates and perceived trends in stock and bond prices. Investing in an international ETF also involves certain risks and considerations not typically associated with investing in an ETF that invests in the securities of U.S. issues, such as political, currency, economic and market risks. These risks are magnified in countries with emerging markets, since these countries may have relatively unstable governments and less established markets and economics. ETFs investing in physical commodities and commodity or currency futures have special tax considerations. Physical commodities may be treated as collectibles subject to a maximum 28% long-term capital gains rates, while futures are marked-to-market and may be subject to a blended 60% long- and 40% short-term capital gains tax rate. Rolling futures positions may create taxable events. For specifics and a greater explanation of possible risks with ETFs, along with the ETF’s investment objectives, charges and expenses, please consult a copy of the ETF’s prospectus. Investing in sectors may be more volatile than diversifying across many industries. The investment return and principal value of ETF investments will fluctuate, so an investor’s ETF shares (Creation Units), if or when sold, may be worth more or less than the original cost. ETFs are redeemable only in Creation Unit size through an Authorized Participant and are not individually redeemable from an ETF.

*Please consider the investment objectives, risks, charges and expenses of the fund(s) carefully before investing. The prospectus contains this and other information about the fund(s). To obtain a prospectus, contact your financial advisor. Please read the prospectus carefully before investing.*

**Derivatives and Leverage.** Derivatives are financial contracts whose value depends on the value of underlying assets, reference rates or indices. The use of derivatives involves risks that are in addition to, and potentially greater than, the risks associated with investing directly in securities and other more traditional assets. These include imperfect correlation between the value of the derivative and the underlying asset, risks of default by the counterparty to certain transactions, magnification of losses incurred due to changes in the market value of the underlying asset, and risks that the transactions may not be liquid. Certain derivative transactions may give rise to a form of leverage, which can magnify the potential for gain and/or the risk of loss and could thus have a disproportionate impact on the performance of the fund. Leverage associated with derivative transactions may cause a fund to liquidate portfolio positions to satisfy its obligations when it may not be advantageous to do so, or may cause a fund to be more volatile than if it had not been leveraged. Commonly used derivative instruments and techniques include:

**Futures.** A futures contract is a standardized, exchange-traded agreement to buy or sell a specific quantity of an underlying instrument or commodity at a specific price at a specific future time. Futures contracts may be offered on agricultural commodities, energy commodities such as crude oil and natural gas, as well as on a vast array of financial instruments, including currencies, government securities, and stock indices. In addition to the derivatives risks discussed above, the prices of futures can be highly volatile. They are affected by many factors, including changes in overall market movements, speculation, real or perceived inflationary trends, index volatility, changes in interest rates or currency exchange rates and political events. Using futures can lower total return, and the potential loss from futures can exceed a fund’s initial investment in such contracts.

**Options.** Options are contracts giving the holder the right to buy or sell a specific amount of the underlying instrument or futures contract on the underlying instrument at an agreed-upon price. Like futures, the prices of options can be highly volatile and they are impacted by many of the same factors. The use of options can also lower total returns.

**Investing in smaller companies** involves greater risks not associated with investing in more established companies, such as business risk, significant stock price fluctuations and illiquidity.

**Stocks of medium-sized companies** entail special risks, such as limited product lines, markets, and financial resources, and greater market volatility than securities of larger, more-established companies.

**Value investing** does not guarantee a profit or eliminate risk. Not all companies whose stocks are considered to be value stocks are able to turn their business around or successfully employ corrective strategies which would result in stock prices that do not rise as initially expected.

**Growth investing** does not guarantee a profit or eliminate risk. The stocks of these companies can have relatively high valuations. Because of these high valuations, an investment in a growth stock can be more risky than an investment in a company with more modest growth expectations.

**Asset allocation and diversification** do not assure a profit or protect against loss in declining financial markets.

The returns on a portfolio consisting primarily of **environmental, social, and governance-aware investments (ESG)** may be lower or higher than a portfolio that is more diversified or where decisions are based solely on investment considerations. Because ESG criteria exclude some investments, investors may not be able to take advantage of the same opportunities or market trends as investors that do not use such criteria.

Because of their narrow focus, **sector investments** tend to be more volatile than investments that diversify across many sectors and companies. **Technology stocks** may be especially volatile. Risks applicable to companies in the **energy and natural resources** sectors include commodity pricing risk, supply and demand risk, depletion risk and exploration risk.

**Rebalancing** does not protect against a loss in declining financial markets. There may be a potential tax implication with a rebalancing strategy. Investors should consult with their tax advisor before implementing such a strategy.

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The **indices** are unmanaged. An investor cannot invest directly in an index. They are shown for illustrative purposes only and do not represent the performance of any specific investment.

The **indices selected by Morgan Stanley Wealth Management** to measure performance are representative of broad asset classes. Morgan Stanley Smith Barney LLC retains the right to change representative indices at any time.

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