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Bitcoin: A Perspective

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Summary and Conclusions

Bitcoin is classified as a digital currency.¹ Bitcoin exists, but only in the sense that dollars in a bank account exist. Unlike conventional currencies, bitcoin does not circulate as bills and coins. Bitcoin can be purchased and sold only by dealing directly with a rapidly expanding group of bitcoin owners or through a growing network of dealers, custodians, and payment companies.

The architecture of the bitcoin payment system that is set forth in this memorandum is truly artful in three respects. First, a record of every bitcoin transaction that has ever taken place since the establishment of bitcoin in 2009 is recorded in blocks of a continuous chain contained on the Bitcoin Network. Second, every registered entity on the Bitcoin Network has access to this Blockchain. However, the apparent transparency is limited to the extent that the full identities of Network users is not revealed, which has been a concern of government regulatory authorities. Third, in order that there not be one authority that controls the validation of bitcoin transactions and therefore the addition of blocks to the blockchain, a competition is established among large users known as Miners to determine which Miner will validate the next block of transactions. The competition entails solving a mathematical problem, the solution to which depends more on massive computer processing power than on math knowledge and expertise. This means no one user or group of users can dominate the payment system. In short, the bitcoin payments system seems to be thoughtfully designed and it works.

The future of bitcoin is highly uncertain. This memorandum will discuss many reasons why bitcoin is unlikely to achieve currency status. It may become a recognized investable asset because of the investment firms, financial institutions, and similar entities that are allowing clients to hold bitcoin. However, unlike most investments there really is no way to ascertain the underlying value of bitcoin. As Robert Shiller stated in an excellent article on the digital currency, bitcoin “doesn’t really solve any sensible economic problem.”² In other words, bitcoin lacks purpose, which I believe is crucial to its long-term survival.

The surge in prices of bitcoin and other digital currencies in the past 18 months has been astonishing. As of May 7, 2021, the market value of all digital currencies amounted to around \$2.4 trillion, of which bitcoin represented 45% or \$1 trillion. When the market value of an asset bears no relation to its economic value, a bubble has developed. The digital currency bubble is being fueled daily by press reports, the brokerage and payment firms permitting trading, the institutions allowing customers to hold such assets in accounts, and recognized corporations that have purchased bitcoin. If the SEC approves the 11 bitcoin ETFs that are currently in registration, a significant boost would be given to bitcoin ownership. While further price increases in bitcoin and other digital currencies are certainly possible, the current situation strikes me as “irrational exuberance” in its most extreme form.

Bitcoin as an Investable Asset

Bitcoin is clearly not a typical investable asset. The qualities such assets generally possess are pricing stability, a relatively broad and deep market for buyers and sellers, and the potential for realizing an investment return. One very large asset class that does not satisfy these criteria is cash as it will almost always produce a negative return after adjusting for inflation. Nevertheless, there are good reasons why investors hold cash either temporarily prior to investing in other assets or for longer periods when other

¹ Bitcoin is frequently referred to as a cryptocurrency. That is because cryptography is used to encode each transaction to prevent double spending of bitcoin. More on this in the discussion that follows.

² Robert J. Shiller, “In Search of a Stable Electronic Currency,” New York Times, March 1, 2014.

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investable assets are at risk of declining in value. Investors buy bonds in the expectation of realizing real rates of returns from interest. Common stocks are purchased on the basis that stockholders own a proportionate interest in a company's future stream of income from which dividends will be distributed. Investors purchase real estate, oil and gas properties, timber, farmland and similar assets for their current or future income producing potential. Commodities are owned by investors generally in the belief that their value for food, fuel, industrial applications, jewelry, etc. will increase over time. Most investors do not invest in currencies, although there are highly specialized investors and traders who purchase positions in the expectation that exchange rates will widen or narrow thereby generating profits.

Unlike most of the investable assets cited above, bitcoin has no intrinsic value. It has no claim on profits or the credit of any party. Bitcoin is convertible into dollars provided there is a market. Its value over the past couple of years has been very volatile. As a result, conducting commerce with bitcoin is challenging because businesses do not know how to price goods and services. Unlike commodities, bitcoin has no use value. One could argue that the value of gold is largely supported by investors because its industrial, decorative, and jewelry applications are insufficient to support the price. However, since ancient times, gold has been regarded as a precious metal that will retain value when currencies are debased. Bitcoin has only existed since 2009.

Bitcoin is not a currency in the general understanding of the term. All currencies are issued by governments that are expected to support their value relative to other currencies. Especially important monetary authorities conduct "open market operations"³ with their currencies to stimulate employment and to control inflation. By design, there is no government standing behind bitcoin.⁴

A national currency is widely accepted as a means of exchange for the purchases of goods and services and the satisfaction of obligations. In this role, bitcoin has virtually no role. It is unlikely that governments will ever hold their reserves in bitcoin.

The total number of bitcoin to be issued is fixed at 21 million of which 18.7 million are currently in circulation.⁵ Hence, the only way bitcoin can expand in use is through price appreciation and increased fractionation. While this is possible,⁶ varying microscopic units to achieve a specific value will be confusing and challenging for most consumers. Bitcoin holders cannot look to any known party, not even established dealers and brokers, to provide liquidity and to support the value of bitcoin. This is not a problem currently when there is substantial buying but consider the consequences if there is widespread selling of bitcoin. In short, calling bit coin a "currency" is potentially misleading to the less sophisticated.

³ Open market operations entail the purchase and sale of government securities to expand or contract the money supply. It is possibly the most important function of the Federal Reserve.

⁴ The underlying objective giving rise to bitcoin was to create a currency not controlled by a government or any authority. The contention is that governments will ultimately devalue currencies through reckless and relentless issuance. It is well known that the purchasing power of the dollar has declined because of inflation over the last 100 years by more than 90%, which gives credence to this view. But critics forget that this was only bad if one held his assets in cash. Over this period, the United States has become significantly wealthier, and the standard of living has risen dramatically because GDP growth was much higher than the rate of inflation.

⁵ Bitcoin has a stipulation, set forth in its source code, that it must have a limited and finite supply. That number was determined to be 21 million bitcoins. <https://www.investopedia.com/tech/what-happens-bitcoin-after-21-million-mined/>

⁶ The smallest unit of bitcoin is a "satoshi" which absurdly small, equal to 0.00000001 of a bitcoin.

In the end, the only reason to purchase bitcoin is the belief that it will continue to rise in value. In this regard, it is a highly speculative investable asset.

The size of the bitcoin market, bitcoin prices, and bitcoin liquidity

The intraday price on May 13 for bitcoin was around \$49,000. The total value of the bitcoin market is around \$1 trillion. For an asset that was virtually worthless when it was created in 2009, a valuation of \$1 trillion is an astonishing achievement! Refer to the chart of Bitcoin prices over the past 5 years on the next page.

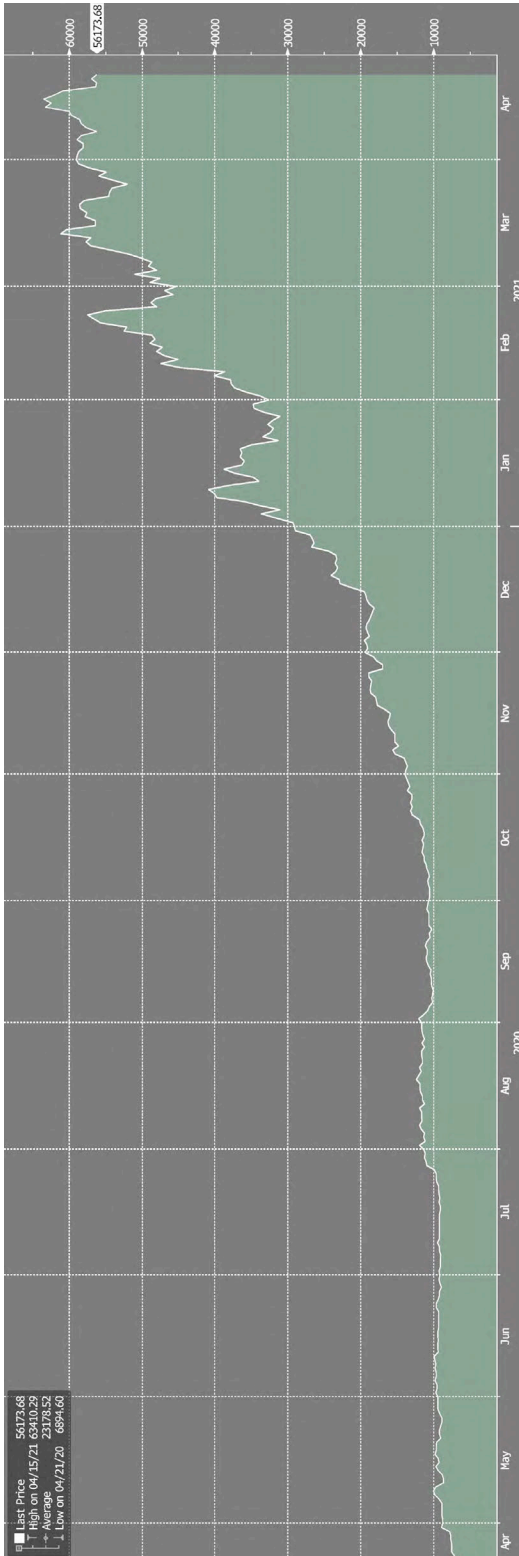
Table 1			
Size of Selected U.S. Asset Markets			
Asset	Outstanding \$ Billions	Growth 2020	Avg Annual Growth 1997-2020
Equities	\$46,922	22.0%	9.2%
Residential Real Estate	\$41,272	7.4%	5.7%
Treasury Securities	\$20,946	26.0%	8.3%
Commerical Real Estate	\$20,914	3.9%	7.0%
Corporate Bonds*	\$6,551	9.1%	8.5%
Farmland	\$2,569	0.9%	5.3%
High Yield Corp Bonds**	\$1,652	25.0%	7.1%
* Investment grade.			
** Unrated			
Source: Federal Reserve, Financial Stability Report, May 2021			

Table 1 shows the market value of major U.S. investable assets. The growth rates shown provide an indication of how rapidly this asset class is expanding, which is only partially related to the returns of each asset class. The market capitalization of equities is the largest at \$46.9 trillion followed by residential real estate. The total market value of all digital currencies is estimated at \$2.4 trillion⁷, which means that this asset class is probably already significantly larger than the high yield bond market.

Yet for an asset that some boosters hope will become a viable currency, this is not a lot of money. The U.S. money supply (cash and checking deposits) is currently approaching \$20 trillion. Estimates of the supply of gold in the world are over \$7 trillion. The supply of most investable assets expands over time. This is not the case with bitcoin because of the limitation on issuance. The future growth in the total value of bitcoins will depend almost entirely on bitcoin appreciation.

⁷ <https://coinmarketcap.com/> This web site provides a listing of all marketable digital currencies, current price, market capitalization, and historical pricing data. I do not know who the sponsor of this web site is or whether the data displayed are accurate.

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Name & Symbol	Rank	Price	Market Cap (Millions \$)	% Total	Cumu- lative	% Gain, Year to Date
Bitcoin BTC	1	\$58,110.00	\$1,089,977.80	45.4%	45.4%	102.7%
Ethereum ETH	2	\$3,536.53	\$411,717.40	17.2%	62.6%	424.7%
Binance Coin BNB	3	\$639.88	\$98,598.00	4.1%	66.7%	1625.1%
Dogecoin DOGE	4	\$0.61	\$79,089.60	3.3%	70.0%	16362.5%
XRP XRP	5	\$1.61	\$58,721.44	2.4%	72.4%	564.7%
Tether USDT	6	\$1.00	\$54,684.17	2.3%	74.7%	0.0%
Cardano ADA	7	\$1.67	\$54,015.31	2.3%	77.0%	770.3%
Total Market Capitalization	5011		\$2,400,000.00	100.0%		756.6%
Source: https://coinmarketcap.com/						

The digital currency market is highly fragmented. There are 5,011 different currencies that are traded on 372 exchanges. Table 2 shows the top seven digital currencies whose market capitalization exceeds 2% of the total. Bitcoin and Ethereum dominate with 62% of the total market. The 11th digital currency (not shown in the table) has less than a 1% share.

According to the Wall Street Journal, Dogecoin, ranked number 4, was created as “a joke”.⁸ In 2021, this digital currency rose from a value of \$0.004 on January 1 to currently \$0.61 per coin with a total market value of \$79.1 billion. There is no rational explanation to account for this meteoric rise.

The last column of Table 2 shows the appreciation of each currency from January 1, 2021, through May 7. The data indicate that Bitcoin has underperformed other leading major digital currencies. The exception is Tether, a digital currency that is tied to the dollar.⁹

The bitcoin market in the United States has been compared to the over-the-counter market for common stocks in which the bids and offers of dealers determine the price of bitcoins. The liquidity of bitcoin currently seems favorable. Based on May 2021 data, daily volumes are running at over \$670 million, equivalent to around \$240 billion per annum involving an estimated 100 million transactions. Reference is made to Table 3 on page 7.

⁸ “Dogecoin, Once Joke, Moves Mainstream,” Ostroff & McCabe, Wall Street Journal, April 19, 2021.

⁹ Tether is a token backed by actual assets, including U.S. dollars and euros. The website notes that its currency is “tethered” to real world currencies without the volatility of cryptocurrencies. It is not clear what advantages “tether” offers over holding dollars and euros directly. Tether has a troubled history. <https://tether.to/>

Table 3		
Bitcoin Data		
Market Price/Bitcoin (May 5)	\$53,242	4-May
Total Circulating Bitcoin (Millions)	18.70	4-May
Market Capitalization (Billions \$)	\$1,000.70	4-May
Daily Exchange Trade Volume (Millions \$)	\$674	3 May, 30 day average
Estimated Per Annum (Billions \$)	\$246	
Confirmed Transaction per Day	274,524	3 May, 30 day average
Estimated Per Annum (Millions)	100.2	
https://www.blockchain.com/charts#market		

Why are bitcoin prices rising?

Bitcoin prices are rising because demand is soaring while in the short-run the supply is virtually fixed.¹⁰ Probably the most important factor underlying demand is the series of announcements by financial institutions and businesses strongly suggesting that bitcoins are an investable asset.

There are around 11 exchange traded funds (ETFs) in registration including Wise Origin Bitcoin Trust, an ETF sponsored by Fidelity. These ETFs will track bitcoin prices, enabling investors to participate in bitcoin ownership while providing for immediate liquidity. Although the SEC has not approved any ETF, action is expected in the near future. One entity, the Grayscale Bitcoin Trust owns bitcoins and issues shares that are priced in accordance with its bitcoin holdings. The Trust intends to convert to an ETF as soon as SEC approval is obtained.

Fidelity and Morgan Stanley have made it possible for advisors and wealth management clients to purchase bitcoin on their platforms. Goldman, Sachs and Bank of New York Mellon will offer bitcoins and other cryptocurrencies to their clients in the near future. Other banks and investment firms are actively considering how to handle digital currencies.

Square has allowed Cash App users to trade bitcoin since 2017. PayPal permits customers to buy, sell and hold bitcoin in their digital wallets. There are digital currency companies like Coinbase Global Inc. that allow customers to buy and sell, and to hold bitcoins and other digital currencies in their accounts.

Recognized investors such as Paul Tudor Jones, Stanley Druckenmiller, and Howard Marks have let it be known that they have purchased bitcoins for their own accounts.

U.S. corporations that have announced the purchase of bitcoins include Tesla, which purchased \$1.5 billion. It is understood that buyers will be able to pay for their Teslas with bitcoin. Mass Mutual recently purchased \$100 million bitcoin for its account and made a \$5 million investment in NYDIG, a sponsor of one of the bitcoin ETFs.¹¹

¹⁰ But this is not unlike common stocks, where at any point in time the number of shares issued by a company is fixed.

¹¹ <https://www.massmutual.com/about-us/news-and-press-releases/press-releases/2020/12/institutional-bitcoin-provider-nydig-announces-minority-stake-purchase-by-massmutual>

As the number of participants in the bitcoin market increased, the demand for bitcoin expanded dramatically, resulting in a steep rise in bitcoin prices. The SEC approval of the ETFs in registration as well as investment firm and bank approval of bitcoin accounts will give an important lift to bitcoin by enabling investors to participate in the bitcoin market more easily and efficiently.

How is bitcoin created and how do bitcoin transactions take place?

The structure of the bitcoin payments system was developed by Satoshi Nakamoto in a white paper that was published in 2009.¹² The system he outlined contained the following components: electronic cash would be paid and received on a peer-to-peer network, meaning there is no trusted third party or government overseeing the integrity of the payments process; the prevention of double spending of the electronic cash would be solved by time-stamping transactions cryptographically on a block chain of prior transactions that cannot be changed; and to ensure no prior spending of a coin, all parties on the network would be made aware of all transactions.

Bitcoin transactions only take place on the Internet-based Bitcoin Network (Network), which is comprised of registered Users and Miners. Both Users and Miners conduct operations according to rules contained in the Bitcoin Network Cryptographic Protocol using special Network software that is open-source and downloadable by any party. The software allows Users and Miners to obtain a Network address or wallet, which has a unique public and private key pair. Users and Miners buy and sell bitcoin over the Network. Miners, in addition, validate the transactions that take place on the Network.

In order for a transaction to take place, the Network must recognize the payor's public key, determine that the payor's public key bitcoin wallet balance exceeds the transaction amount, and that the payor's private key is valid. To receive bitcoin, the recipient must only provide a valid public key. The transaction is then transmitted using the Network software where it is aggregated with other pending transactions. There is a transaction fee payable.

The pending transactions must be validated by a Miner. Miners either individually or in groups compete for the privilege of validating the pending transactions and creating a new "Block" to be added to the Blockchain. The competition entails solving a mathematical problem with a unique numerical solution called the "nonce" that is generated in accordance with the Bitcoin Network Protocols. Miners arrive at the solution by applying massive computational power, not their mathematical prowess. One astonishing characteristic of this competition is that once the answer has been disclosed by the winning Miner, all Miners on the network can immediately confirm that the solution arrived at is correct. The winning Miner is paid a fee per transaction contained in the Block¹³ plus 6.25 new bitcoins, currently having a value of over \$340,000. In the end, the Miners or group of Miners with the most computer processing power will consistently earn the most money.

Miners must be able to easily ascertain whether a wallet has adequate bitcoins to make the requested payment. This means that the software must enable Miners to quickly aggregate all transactions involving a public key to determine its wallet's current balance. The size of the Bitcoin block chain as of May 4 was 342.8 gigabytes. The storage on my computer is over 900 gigabytes. The point is that Miners can search out the bitcoin balance status of a public key very quickly.

¹² Satoshi Nakamoto, "Bitcoin: A Peer-to-Peer Electronic Cash System," 2009.
<https://bitcoin.org/bitcoin.pdf>

¹³ Transaction Fees have fluctuated from \$0.35 December 2019 to a peak of \$62.79 April 21, 2021.

Overall, however, the process of transacting in bitcoins and recording transactions is cumbersome, time consuming, and requires a vast amount of miner processing power.¹⁴ One of the biggest hurdles of bitcoin is scalability as evidenced by the limited number of transactions that can be processed in a given period. Compared to credit cards and digital payment systems such as PayPal, Venlo, Zelle and others, bitcoin payments are slow.

Table 4		
Bitcoin Data		
Total Blockchain Size (GB)	342.80	3-May
Block Size Average (MB)	1.34	3 May, 30 day average
Average Transactions/Block Over 24 Hours	2,002	3 May, 30 day average
Transactions Pending Miner Action (MB)	72.75	
Median Confirmation Time per Transaction (Minutes)	11.16	3 May, 30 day average
Number of Wallets Created Since Inception (Millions)	72.46	3-May
https://www.blockchain.com/charts#market		

How safe is bitcoin and what are the risks of bitcoin ownership?

In the absence of ETFs, the best way to own bitcoin is through a custodian such as PayPal, Coinbase Global or Gemini Exchange among others. The main risk of owning bitcoins directly is the danger of losing the private key, which makes the corresponding bitcoin permanently non-transferable. Here is a reference to five stories of people who lost their private key.¹⁵

It is impossible to evaluate how secure the cryptography underlying bitcoin is. The Network and bitcoin exchanges have been hacked. It is not clear whether bitcoin owners lost money as a result of these mishaps. We know that if a commercial bank account or credit card account is hacked, the financial institution is obligated to make the depositor and credit card holder whole. It is not clear whether the same will hold true for a bitcoin account. Bitcoin is not covered by the insurance offered through the Federal Deposit Insurance Corporation (commercial banks) or the Securities Investor Protection Act (brokerage firms)."

The stability of bitcoin is another concern. Under special circumstances the protocol governing the Network can be modified. If a modification is not accepted by all Users and Miners, then the dissenters may secede and form a new network. Such separation is known as a fork. In 2017, three forks took place. It is not clear that these and other forks had any meaningful impact on the Network and the value of bitcoin, but they do underscore that instability is possible.

¹⁴ BAC ML estimates that every \$1 billion inflow to Bitcoin is equivalent to 1.2 million additional cars on the road. Later in the article it was noted that energy consumption has surged to 135 terawatt hours, doubling in the past year, according to the Cambridge Bitcoin Electricity Consumption index. That is more consumption than Sweden or the Ukraine consume in a year. (Barron's April 12 Issue)

Digiconomist stated that the bitcoin network may consume as much energy as all data centers globally. Hard to believe! <https://digiconomist.net/bitcoin-energy-consumption/>

¹⁵ <https://john-mecke.medium.com/5-stories-about-people-who-lost-their-bitcoin-cdaaa329468>

Table 5	
Geographic Distribution of Bitcoin Miners	
China	65.10%
Russia	6.90%
Kazakhstan	6.20%
Iran	3.82%
United States	7.40%
Other Countries	10.58%
Total	100.00%
Source; University of Cambridge	
https://cbeci.org/mining_map	

It is worth noting the distribution of miner computer processing on the Network. Table 5 indicates that most of the miner processing power is located in China and over 80% in countries not particularly friendly to the United States. It is hard to know what influence or power the Chinese government could have on the Network or the Protocols.

There are competitive risks to the value of bitcoin. As noted previously, more than 5,000 digital currencies have emerged in recent years to challenge the primacy of bitcoin. It is not clear that bitcoin has a competitive advantage beyond being the first mover in this digital currency space. The Federal Reserve is currently evaluating digital currency systems including the possibility of issuing its own “central bank digital currency,” which if ultimately issued could have serious adverse consequences for private digital currencies such as bitcoin.¹⁶ It seems highly likely that as the digital currency market grows in time, the Fed will impose regulations which could adversely affect the value of bitcoin.

One final concern has to do with compensating miners after the maximum number of bitcoin has been issued: 21 million in 2040. Miners will not be compensated with new bitcoin but will have to rely on transaction fees. In order not to increase transaction fees to a prohibitively expensive level, blocks may have to contain more transactions. This in turn could slow down the process of validating transactions. How these issues will be sorted out in a manner that will not jeopardize the value of bitcoin is not known. If miners abandon their role in supporting bitcoin, the system could ultimately collapse and lead to horrific losses.

¹⁶ Federal Reserve Governor Lael Brainard commented on this subject in general terms in “An Update on Digital Currencies,” August 13, 2020, <https://www.federalreserve.gov/newsevents/speech/files/brainard20200813a.pdf> As we have not heard further from the Fed on this matter, one can infer that the institution is moving very slowly.