Impact of Digital Currencies on Corporate Business Operations in the United States

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Abstract

This research seeks to provide a large-scale overview of the cryptocurrency markets for institutional investors seeking to gain involvement in the cryptocurrency industry. As such, the main focus of this discussion involves the value proposition of virtual currencies to institutional investors across different industries, and organizations of varying types and sizes. While the empirical data presented relates primarily to businesses and industries within the United States, extrapolations to the global economy and to international markets are made where appropriate.

Key frameworks and methodologies used in this discussion include a growth rate analysis of some of the most prominent cryptocurrencies by market cap, liquidity and risk-management analyses, and an NPV assessment and long-term value forecast for different investor classes under various proposed circumstances. Alternative methods of entry into the cryptocurrency markets are also discussed for investors of varying risk profiles and capital allocations, such as cryptocurrency-based ETF's, direct investment into cryptocurrency Initial Coin Offerings (ICO's), and involvement in the R&D processes behind the underlying blockchain technologies of most modern decentralized cryptocurrencies today. Additionally, best practices for physical, digital, and financial security are also discussed in order to aid readers in making informed long-term decisions with regards to maximizing gains and mitigating risks.

The research concludes with a brief survey of the prospective long-term uses for some of the most prominent cryptocurrencies and an outlook for the industry at-large.

Facts and findings are presented regarding the sustainability of the current uses for cryptocurrencies, along with relevant suggestions for improving the integrity, profitability, and efficiency of the industry. Possible uses for funding and resources from institutional investors in academic and research-based settings are also discussed, including ways in which strategically allocated funds could be used to yield highly profitable outcomes in the forms of intellectual property and licensable hardware- and software-based solutions. A final note is made about the potential for the cryptocurrency markets to drive inclusion and prosperity within global society at large, with suggestions on how institutions can help to ensure that this is ultimately the case.

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Chapter I.

Future Value Proposition of Virtual Currencies to Institutional Investors

Background

The true value proposition of virtual currencies (cryptocurrencies) to retail investors has been a topic of heated debate arguably since the very inception of the first mainstream decentralized cryptocurrency (Bitcoin), in 2008. While the concept of *virtual* currencies is actually not new (as they have in fact been in existence since the creation of e-Gold in 1996), the meteoric growth of *decentralized* virtual currencies (and hence their market valuations) in recent times has merited heightened levels of attention and scrutiny from institutional investors, many of whom are now seeking to gain share in what is rapidly becoming an increasingly crowded and highly attractive financial market.

The increased attention gained from institutional investors in the virtual currency markets has posed an interesting set of economic circumstances for the newly minted decentralized virtual currencies themselves to exist in, as many of the institutional investors seeking to profit from the rising value of such cryptocurrencies are in fact members of the very *centralized* financial institutions that the virtual currencies were initially designed to circumvent. Interestingly, however, the increased attention given by retail investors to the cryptocurrency markets has essentially created a newfound *need* for greater institutional involvement and regulation within the industry, in order to provide the level of security and infrastructure necessary to smoothly and reliably execute financial transactions within the virtual currency markets.

The potential for a balance to coexist between institutional and retail investors, in turn, poses an interesting value proposition (and a potential entry point) for the virtual currency markets to opportunistic institutional investors who were previously uninterested in the industry for many years, given that many institutional investors may now be in a prime position to occupy a leading role in a new and evolving field that may one day come to replace the role that is currently held by traditional banks and other centralized financial institutions. The purpose of this discussion will be to uncover, in further detail, the actual and perceived value proposition of the decentralized virtual currency markets to institutional investors; additionally, this research will also seek to determine the types of financial institutions for which involvement in the virtual currency markets makes the most sense, to what capacity different types of institutional investors should get involved in decentralized virtual currency markets, and the best time for such involvement to occur.

Timing and Means of Market Entry

In regards to the best time for institutional investors to enter the virtual currency markets, the volatility and behavioral trends exhibited by the market valuations of most decentralized cryptocurrencies is highly uncharacteristic of most other financial assets. Despite aspirational promises of cryptocurrencies to replace the traditional financial system and to become the new method of choice for day-to-day transacting, much of the infrastructure of day-to-day transacting in the real world is still currently supported by centralized financial institutions using conventional fiat currencies. While decentralized cryptocurrencies are seeking to replace this existing infrastructure with a decentralized network of transaction-validating computer nodes (in a process known as *cryptocurrency*

mining), the sustainability and integrity of such a system remains largely untested and highly questioned.

Nevertheless, the level of excitement (and hence buy-in) garnered by retail investors (who constitute a very large group of the people that actually complete day-to-day transactions) regarding cryptocurrencies creates a level of risk for institutional investors on two levels, which will be discussed in further detail in Chapter III. On the surface, however, these risks include the following: (1) In the event that the decentralized financial system successfully displaces the centralized incumbent one, the role for banks and other financial institutions could become disrupted and thrown into question, creating large levels of instability and unrest among incumbent financial markets; or (2) in the event that that the decentralized system is *un*successful, firms that invested early could be placed at a competitive disadvantage, with large amounts of capital occupied by a technological infrastructure and/or cryptocurrency-backed corporate treasuries that are now obsolete and heavily depreciated.

While the risk management aspect of this tradeoff will be discussed and analyzed in further detail later, these risk factors play an important role in effectively assessing the tangible value proposition of virtual currencies to institutional investors, because different firms will naturally be optimally positioned to seek involvement in the virtual currency markets in different ways. Strategic positioning in this manner can help to mitigate risks for some firms by deliberately maximizing the potential for financial gain and long-term competitive advantages across a broad spectrum of possible outcomes for the cryptocurrency industry itself, whether the existing mainstream virtual currencies are successful or whether the industry takes a different path. A good example of a type of

firm that would be well-positioned to execute a move such as this would be a fintech organization, which can allocate different uses to the same (or similar) technological infrastructure by repurposing their existing computing nodes, security systems, and cloud-based computing resources. Nevertheless, banks and other more conventional financial institutions could also be in a position to secure large gains if they, too, can manage to position themselves strategically by using different methods.

Value Proposition of Centralized Banks to the Virtual Currency Markets

An article by Sebastian Schich (2019) provides an engaging dialogue in regards to the potential for virtual currencies to displace the role currently held by centralized banks. An issue of particular interest posed by Schich (2019) involves the current legal and economic protections enjoyed centralized banks in the current financial markets under what is referred to as "the support structure afforded by the financial safety net (FSN)" (p. 93). The potential for banks to be shielded from competition by virtual currencies will likely have long-term limits, however, in much the same way that the taxi industry was unable to seek protection from ride-hailing services or car dealerships were unable to seek permanent protection from automakers deciding to sell directly to consumers (see **Figure 1** for potential disruption in the FSN). Inevitably, financial markets (particularly in the United States) must ultimately function meritocratically, with the best products and services ultimately prevailing for the greater good of the consumer and of the global economy.

Nevertheless, such initial protection under the FSN could buy banks and more conventional centralized institutions some much needed time to become strategically acclimated to the virtual currency markets, by creating a new role for themselves that will

cement their position as integral players, both in the centralized and decentralized financial systems (see **Table 1** for current roles held by banks in the incumbent financial system). A rudimentary example of how such strategic involvement could occur would involve the purchasing of cryptocurrency mining hardware for a company like Visa or Mastercard in order to protect their existing role in the verification of financial transactions. Upon further reflection, however, this may not be the best (or only) possible way for such a firm to capitalize on the value proposition offered by the cryptocurrency industry, for a number of reasons: namely, the cost and energy used by cryptocurrency mining can take a heavy toll on operating expenses, particularly for a larger public company with heavy shareholder scrutiny (such as Visa and Mastercard), which also lacks the experience of more nascent cryptocurrency-mining firms that have been involved in such cryptocurrency mining since the early inception of decentralized virtual currencies. More established firms might, however, seek to establish their own new semi-decentralized cryptocurrencies with greater real-world utility, reliable purchasing power, and more efficient transaction-validation methods (although gaining trust for a newly-created "decentralized" currency owned by a centralized bank has always been—and is still—a daunting, risky, and cost-prohibitive proposition). There has, however, been the creation of cryptocurrency-based ETF's in recent years, in an attempt to conform the volatile behaviors of the cryptocurrency markets to more standardized investing methods, along with the drafting of "smart contracts" (code-based, self-enforcing financial contracts), which are intended to bolster the integrity of a decentralized financial network.

Tools such as cryptocurrency ETF's and smart contracts, while still relatively early in the stages of their development and real-world implementation, can also offer greater value to institutional investors that are required to make highly-scrutinized decisions involving large sums of capital with regulated levels of acceptable risk. As such, alternatives like cryptocurrency ETF's could make decentralized virtual currencies more attractive and investable to risk-constrained institutions by offering new and functional methods of investment diversification through risk-controlled exposure to virtual currencies.

Liquidity, Herd Investing, and Whales

While there are many attractive methods of entering into the virtual currency markets for institutional investors, there is still one other particularly interesting phenomenon that could pose a potentially negative impact on the value proposition of new cryptocurrency markets to financial institutions: Exploitation by whales and herd investing behaviors. In established financial markets, billions of dollars can be moved with relative ease and have minimal impact on overall market stability. For newer markets (particularly those involving nascent virtual currencies with smaller market capitalizations), however, large institutional investments (known as "whales") can have a particularly poignant impact on the valuation of individual currencies in times of market distress. The susceptibility of smaller virtual currency markets to whale investors can create a particularly time-sensitive investment window for some firms, whereby many large investors seeking to gain access to the industry could simultaneously drive rampant inflation among the prices of various virtual currencies (whose decentralized markets lack any regulations on insider trading or other unethical trading practices such as

account-churning or pump-and-dump behaviors); likewise, many large investors seeking to *exit* the industry at the same time could also pose equally massive risks to liquidity, and in turn, create potentially large transitory barriers to market entry and exit—not to mention the potential for these barriers to be compounded for retail investors with smaller financial wherewithal, in much the same way that a run-on-the-bank caused panic in the Wall Street crash of 1929.

While the volatility and liquidity of the virtual currency markets will be discussed in further detail in Chapter II, the potential for exploitation by "herding"—large groups of retail investors ignoring objective data and instead following the perceived consensus of the market—can also have a profound impact on the long-term value proposition and stability of cryptocurrencies for institutional investors. In 2018, Obryan P. Calderón performed a study in which he analyzed the extent to which the prices of different cryptocurrencies were driven by herding practices based on a behavioral convergence test using an empirical herding model. Calderón's findings concluded "that investors frequently deviated from the rational asset pricing benchmark, and instead follow the consensus in market stress situations" (2018, p. 27).

If timed correctly, however, whale investments and herd investment behaviors could actually provide an advantage to institutional investors on two levels: (1) by providing a basis for predictive analytics, serving as a leading market indicator that can allow savvy institutions to implement anticipatory computerized trading methods (artificial intelligence) that act *ahead* of the market adoption curve (see **Figure 2** for a diagram of this curve) and purchase cryptocurrencies at lower prices before the herding behaviors of retail investors can take full effect in smaller markets; and (2) by some large

bank-like institutions (that is, whales) choosing to serve as custodians in nascent cryptocurrency markets, synthesizing stability and preserving market integrity within smaller cryptocurrency markets by buying and selling large amounts of currencies in order to counterbalance overheated market behaviors—in much the same way that countries' central banks serve as custodians by working to preserve the value of their respective fiat currencies (such as the Federal Reserve Bank in its regulation of the value of the U.S. dollar)—it is possible that some governments might choose to subsidize such activities.

Chapter II.

Growth Rate, Volatility, and Path to Success

Valuation Trends of Virtual Currencies: "Easy Come, Easy Go"

When Bitcoin was established as the first decentralized virtual currency in 2008, it was launched with a starting price of $0, and the cryptocurrency received minimal attention from anyone other than niche technological enthusiasts and highly speculative financial investors. However, Bitcoin began experiencing sudden jumps in its price and market capitalization as early as 2010, when the value of the cryptocurrency jumped from just fractions of one cent, to $0.09. The cause of the first spike in price of Bitcoin is not officially known, but it has been largely attributed to hype from retail investors, herding market behaviors, and the fear-of-missing-out (FOMO) among large groups of amateur investors, otherwise known as groupthink. Since the initial spike in the price of Bitcoin, Bitcoin has been experiencing exponentially larger sudden jumps in price, followed by equally large stalls and unexpected price corrections, repeating every few years (or sometimes as often as every few months) in stochastic cyclical intervals. Other cryptocurrencies have also more recently come into existence after Bitcoin, and have followed similar patterns of price irregularity, such as Ethereum, as early as 2015.

One major reason for the tendency of the prices of various cryptocurrencies to follow one another is the fact that Bitcoin is often perceived as the leader of all other virtual currencies, and it is significantly larger than any other virtual currency in existence by a substantial margin. Bitcoin is also often referred to as the "digital gold" of the virtual currency age, and it is the most widely accepted currency in the virtual currency markets, while other lesser known currencies are still perceived as more

speculative and less safe than Bitcoin. Aside from the correlation among the prices of major cryptocurrencies, however, the overall behavior of the cryptocurrency market has proven quite difficult to predict and remains heavily disconnected from the behaviors of many other traditional asset classes such as real estate, bonds, and stocks. (The only exception to this is physical gold which "receives [a] substantial amount of shocks from cryptocurrency market" (Kurka, 2017, p. 4).) Despite mild resemblance to the pricing of precious metals, however, the inconsistency in the pricing behavior of the cryptocurrency markets has not helped the cryptocurrency industry, as virtual currencies were once predicted to be a good hedge to inflation and to volatility in the markets of traditional assets, given that the initial purpose of decentralized cryptocurrencies was to serve as a more stable, incorruptible, and decentralized replacement to fiat currencies. While the hedging capacity of virtual currencies has proven to be somewhat underwhelming, the cryptocurrency markets still have continued to experience meteoric growth, coupled with frequent crashes, that have on-balance vastly outperformed traditional asset classes.

From the perspective of an institutional investor, therefore—and for a firm that could have tolerated the risk of frequent crashes in the cryptocurrency markets—a cryptocurrency-based asset portfolio would have reaped handsome rewards over the past ten years in comparison with one that was instead comprised of traditional asset classes. Moreover, the birth of cryptocurrency-based ETF's for more risk-averse traders may help to hedge the natural volatility of the cryptocurrency markets, particularly as other institutions begin to get involved in these markets, and as the growing market capitalizations of cryptocurrencies continue to reduce the impact of questionable investing behaviors such as herding and whales. While the effectiveness of such ETF's

remains to be seen (with the oldest one only dating back to October 2021), it is safe to conclude that institutions will soon have more stable and lucrative options for entry into the virtual currency markets, and that further research in this area is likely to be worthy of further attention for most financial- and technology-focused institutions.

Liquidity in Virtual Currency Markets

While the historical growth rate of virtual currencies over time is highly attractive, and the prospective utility of virtual currencies in future years is quite broad, a major concern for institutional investors with large amounts of assets under management is the liquidity of cryptocurrencies as a sustainable long-term investment, and as a stable medium of currency exchange. The brief history of most cryptocurrencies leaves little track record for the behavior of the virtual currency markets in the event of a crisis (for example, a financial recession, a global pandemic, *et cetera*). Therefore, an inevitable concern with having a substantial portion of a company's (or nation's) corporate treasury backed by cryptocurrencies is the stability and liquidity of such an investment in the event that a sudden withdrawal of capital were to be necessary.

Recent evidence of cryptocurrencies successfully serving as long-term stores of value and as valid mediums of currency exchange include the adoption of virtual currencies as a method of legal tender in the developing countries of El Salvador (2021) and the Central African Republic (2022), as well as the deference to cryptocurrencies made by the citizens of Venezuela following the four thousand percent spike in inflation of the country's native currency, the Bolivar. Additionally, companies such as Visa, Mastercard, and SoFi have all recently released cryptocurrency-based credit cards that

now enable the seamless transition between fiat and virtual currencies as a valid and reliable methods of currency exchange.

Despite these early efforts of adoption and promising signs of long-term liquidity, however, virtual currencies still have many drawbacks in regards to liquidity, with price swings of as much as 10% in the market capitalization of Bitcoin in one day. Most cryptocurrency-based credit cards are also accompanied by high fees that undermine the novelty and convenience of purchasing tangible goods with cryptocurrencies, and the long-term ramifications of adopting virtual currencies as a country's legal method of tender remain to be seen. The untested liquidity limits of cryptocurrencies pose a high barrier to entry for more conservative institutional investors such as older banks and large hedge fund managers for pension funds and insurance companies. Nevertheless, the initial adoption efforts towards cryptocurrencies on an institutional level may open doors to industry entry within the domestic operations of certain American businesses, such as major fintech companies and the U.S.-based automaker Tesla, which recently invested $1.5B of its corporate treasury into Bitcoin in 2021. The results of these initial ventures may later help to pave the way for entry into virtual currency markets by more risk-averse institutional investors over time, perhaps once the stability of the virtual currencies themselves (as well as risk-management alternatives such as cryptocurrency-based ETF's) have been thoroughly tested and effectively scrutinized from a financial, legal, and ethical perspective.

Many corporate entities that could not afford to bear the full risk of investing large sums of money in a single cryptocurrency such as Bitcoin could instead choose safer alternative methods for asset diversification and cryptocurrency exposure, such as a

more multifaceted approach to market entry. Research from Liew and Hewlett (2017) indicates "that the institutional investor should seriously consider cryptocurrencies for inclusion into their portfolios at the 1-2% allocation range" (p. 16), with the outsized returns of cryptocurrencies providing substantial benefits to conventional portfolio performance while adding minimal levels of risk to long-term investment stability (see **Figure 3** for a comparison of a traditional 60/40 stock-and-bond portfolio's performance to the performance of a comparable asset portfolio with a 2% cryptocurrency allocation, and **Table 2** for an accompanying full list of risk-adjusted optimal portfolio allocations).

Strategies for Successful Cryptocurrency Investing

Observable patterns within the meteoric, yet volatile, paths to success for cryptocurrencies such as Bitcoin can provide meaningful insights about the best ways to get involved in such cryptocurrencies for different types and sizes of investment institutions. An important characteristic to bear in mind regarding cryptocurrency investments is that, in their current state, many of such currencies have minimal real-world applications and are primarily valued based on what someone else will (presumably) be willing to pay for them at a later point in time. While this is a characteristic that may likely change in the distant future—with the advent of semi-tangible assets such as digital artwork (non-fungible tokens, or NFT's) and purchasable parcels of virtual reality (VR) real estate—current approaches to active institutional investment in the cryptocurrency markets must take into account that the historical volatility levels in these decentralized currency markets will likely proceed into the duration of the foreseeable future.

For particularly risk-averse investors, a new (and perhaps more investable) phenomenon involves the diversification of assets into the *stablecoin* subsection of the cryptocurrency markets. Stablecoins represent special types of cryptocurrencies that are specifically designed to function as *stable* long-term stores of value. While stablecoins are generally less attractive in terms of real-world utility and growth potential, stablecoins typically have a value that is pegged to a stable and well-regarded fiat currency or to a combination of collateralized commodities, such as the U.S. dollar and/or a combination of precious metals, oil, and real estate assets. Stablecoins function much like mutual funds, which have fixed values proportionate to underlying fiat currencies based on a net asset value (NAV). Stablecoins can thereby provide added utility in cases where mutual funds alone might have otherwise been used as a singular store of value.

In certain cases, a blend of stablecoins and mutual funds might provide a similar level of economic stability to a purely mutual fund-based portfolio while adding to asset diversity and thereby increasing the long-term growth potential of the total assets under management. (It should be noted that the risk of "breaking the buck" for stablecoins in times of severe economic turmoil remains to be seen, with the oldest stablecoin (BitUSD) only dating back to 2014.) While the concept of stablecoins is not new, stablecoins could also prove useful for institutional investors at a future point in time by opening the gateway for governments to mint their own cryptocurrencies (such as China's digital yuan, known as e-CNY). Government-backed stablecoins would seek to offer greater levels of regulation and centralized economic stability while still allowing for some of the added benefits and flexibility of being able to participate in the same markets with other decentralized virtual currencies.

The blockchain technologies that make decentralized cryptocurrencies possible also have many uses outside of decentralized currency markets. The security, versatility, and stability of blockchain technologies represent a largely untapped source of innovation and long-term value, which companies such as Microsoft, AMD, and IBM have only just begun to scratch the surface of. Security systems and quantum computing applications for blockchain technologies could potentially provide vast competitive advantages for institutional investors within a broad range of technology companies through R&D funding for patentable discoveries with substantial long-term benefits and high real-world applicability. Smaller technology companies and startups without the fiscal resources to invest in cryptocurrency-mining infrastructure—or the risk-appetite to invest directly in cryptocurrencies—also could seek to invest in larger, publicly traded firms that have established positions in the blockchain space, in order to provide an opportunity to profit in the long-term from innovations that are developed within the blockchain environment, while incurring minimal risks or upfront investment costs.

Chapter III.

Concerns, Constraints, and Risk Management

Antitheft and Anticorruption Strategies for a Decentralized Economy

While there are many concerns and uncertainties that could be expressed in regards to entering any new industry from an institutional perspective, perhaps one of the biggest universal concerns experienced with entry into a new industry involves the integrity and security of the newly invested assets. For the decentralized cryptocurrency industry, in particular, there has long been a perception that very little can be done to recover lost or stolen assets on the cryptocurrency markets, and that minimal security measures are currently available when transacting in these markets due to the lack of traceability and centralized governance across the many nodes and virtual exchanges over which these currencies are transacted. While this is true to a degree, there were similar concerns and constraints in the early days of the Internet (among many other new technologies), most which have largely faded in severity and likelihood of occurrence over time. The key to success as an early adopter within the cryptocurrency markets, therefore, becomes the ability to implement an investment strategy that maximizes the potential for gain through early adoption, while effectively mitigating the risks of the insufficient security standards present in the early days of the industry. Fortunately there are many ways in which to do this, most of which are surprisingly affordable and can be implemented by even the most rudimentary of retail investors with minimal time commitment.

The first, and most important, way to reduce the likelihood of losing capital in the decentralized cryptocurrency markets is a matter of what can be referred to as practicing

good “digital hygiene.” In much the same way that people should be mindful of suspicious hyperlinks and phishing attacks, and be wary of to whom they transmit private information over the internet, many of the same basic principles apply to transacting within the decentralized cryptocurrency markets. Similar to the manner in which information that is released over the Internet can be rapidly distributed and is difficult to retract after publishing, transactions that take place in cryptocurrencies are difficult to trace and therefore hard to reverse or retract once completed. This is especially true in an environment where cryptocurrency wallets (the virtual currency equivalent of a bank account) all have multiple keys/addresses (the virtual currency equivalent of a bank account *number*). Cryptocurrency wallets and addresses can be extremely difficult—and in most cases, currently impossible—to track down and withdraw erroneously/maliciously transferred funds from. (See **Figure 4** for a full comparison of traditional digital hygiene versus cryptocurrency best practices.)

Because of the natural intractability of cryptocurrency-based transactions, it is currently common practice for ransomware requests to dictate that bounties be paid to them in denominations of cryptocurrencies, most notably Monero (a cryptocurrency that is most infamous in black markets for being the hardest track). As Usman Chohan (2022) concludes, “thefts and shutdowns [on cryptocurrency exchanges] speak to the pressing need for a more comprehensive and robust accountability and oversight architecture,” (p. 11). While the level of security measures and recovery methods currently available for ransoms paid in denominations of cryptocurrency still has much to be desired, the prevention of ransomware attacks is still—by and large—predominantly a matter of taking the same preventative measures that existed before cryptocurrencies were ever

introduced. Having multiple secure backups of important data files, a strong security system, and a well-rehearsed plan-of-action in the event of an attack are still best practices for preventing against all types of ransomware attacks, including those involving cryptocurrencies. The likelihood of bad actors to request payments in cryptocurrencies, therefore, should not prohibit new prospective institutional investors from taking share in the many profitable opportunities to be had through participation in the new and rapidly growing field of decentralized virtual currencies.

In addition to standard security practices, however, there are a few important tools that can be particularly useful in securing decentralized cryptocurrency-based digital assets. The vast majority of virtual currency funds that become misappropriated are lost or stolen online, using virtual currency exchanges. While such exchanges are initially necessary in order to procure cryptocurrencies, they are not needed (or recommended) as a secure medium of long-term storage for valuable digital assets such as cryptocurrencies. Rather, a special tool exists for this purpose, known as a *hardware wallet*, which is a physical device (similar to an external hard drive) that plugs into a computer and can safely store digital currencies offline. The advantage of having such a wallet—which can store vast amounts of cryptocurrencies and is relatively inexpensive to buy (typically under $1,000)—is that a hardware wallet enables digital assets to be stored offline, where they cannot be accessed (or even discovered) until the hardware wallet is plugged into the owner's computer and properly authenticated. Hardware wallets also eliminate the risk cryptocurrencies getting lost or stolen, even in the event that the exchange that was originally used to purchase the assets becomes corrupted or compromised. Similarly, two-factor authentication practices (which are already commonly used to access an

organization's private information) can also be used to secure digital assets whenever an online cryptocurrency exchange must be used to buy, sell, or transfer capital. All digital wallets—online and hardware-based—can also be secured with a *recovery seed*, which is a secure string of random words that can be used to recover a digital wallet in the event that its authentication credentials become lost or stolen (this is particularly useful in the event that a company's digital asset manager leaves the firm, or in the event an exchange becomes unavailable for any reason). Recovery seeds also add a layer of redundancy to hardware wallets, in particular, so that the digital assets stored on the wallet can still be easily recovered even if the physical device itself is lost, stollen, or destroyed.

Loss Prevention and Hard versus Soft Forks

In addition to securely storing cryptocurrencies, digital currencies must also be procured and managed for factors that could erode the intrinsic value of the currencies themselves, in much the same way that fiat currencies can lose value over time due to factors such as inflation and weaknesses within the governing authority of the currency's parent country. In regards to cryptocurrencies specifically, while inflation is significantly less of a concern than it is for traditional fiat currencies, cryptocurrencies have their own potential susceptibilities and weaknesses, most notably (1) a process known as *forking* and (2) competition with other cryptocurrencies. Both of these weaknesses stem largely from the fact that decentralized cryptocurrencies, unlike fiat currencies, are privately owned asset classes.

As a privately owned asset class, the owners of a particular cryptocurrency can, with consent from key governing constituents, collectively vote to change the underlying digital protocol of the cryptocurrency, thereby altering any number of characteristics

about that currency, including its supply, its decentralized blockchain ledger, and the ways in which the currency can and cannot be transacted. Changes to the digital protocol of a cryptocurrency are known as *forks*, of which there are two types: Hard forks and soft forks. In cases where all owners unanimously agree to make the same changes to a cryptocurrency's underlying digital protocol, that currency undergoes a *soft* forking event, in which the entire blockchain must be overhauled, all transactions re-validated, and all tokens of the currency must now abide by the currency's new characteristics (soft forks generally requires a lot of computing power and take a long time to do, but result in minimal impact to holders of the currency). There also may be cases, however, in which "a protocol change may be approved by some validators but not others, which may result in a [*hard*] fork in the blockchain, which may have the consequence that the cryptocurrency will fork into two competing currencies" (Østbye, 2017, p. 19). In the event that a cryptocurrency undergoes a *hard* forking event, (meaning the owners did *not* all unanimously agree to make the same changes), any new transactions involving that cryptocurrency will abide by the new characteristics set forth by the owner(s) of the asset class; all old denominations of the currency will then become a separate and newly competing form of cryptocurrency with its own risk and reward characteristics.

A notable example of a hard forking event was the separation of Bitcoin into two currencies, in 2017: Bitcoin (BTC) and Bitcoin Cash (BCH). This event resulted from disagreement among the owners of Bitcoin as to whether the size of the blockchain should be increased to improve the scalability of the cryptocurrency. Today, both cryptocurrencies can be purchased separately as competing entities, and both cryptocurrencies have subsequently undergone multiple *soft* forking events without any

further changes to the names or denominations of the currencies themselves. Hard forking events have also occurred in Ethereum and in many other popular cryptocurrencies, most of which have been minor and had minimal impact on holders of the parent cryptocurrencies (see **Table 3** for a full list of all hard forks, with known market capitalizations, that have occurred for Bitcoin, the world's largest cryptocurrency by market cap).

In the event of a hard fork, holders of the original currency could see their assets lose value, as hard forks generally create instability in the prices and values of the parent and child cryptocurrencies. Holders of the original currency must decide for themselves whether to keep their existing stake in the original currency, or whether to exchange their holdings for currencies denominated in the new (and competing) form of cryptocurrency at their own risk, based on the competing characteristics of the two new denominations of cryptocurrency. Hard forking events can cause confusion and concern for institutional investors seeking to invest risk-constrained capital in cryptocurrencies as a long-term store of value, particularly due to the pricing instability that hard forking events can create. However, investment in more stable cryptocurrencies can reduce the risks of hard forking over time, and participation in stablecoins and cryptocurrency-backed ETF's can also aid in mitigating the impact of hard forking risks almost entirely. Nevertheless, the impact of hard and soft forking remains a valid concern for investors in more risky forms of cryptocurrencies—particularly newly minted cryptocurrencies with smaller market capitalizations and lesser market experience.

In addition to managing the risks posed by hard and soft forking events, however, institutional investors must also remain cognizant of the consequences posed by

competition among existing cryptocurrency asset classes. Similar to the manner in which fiat currencies compete with one another—and can strengthen and weaken in their exchanging power against each other—cryptocurrencies can also vary in regards to their liquidity and buying power against other cryptocurrencies. While legislation regarding the exchange power of cryptocurrencies against each other remains quite limited, and is a subject in need of further research and development, general best practices to hedge against risks in this area include the following: (1) building a diversified cryptocurrency asset portfolio with large market-cap cryptocurrencies and (2) as Dr. Asress Gikay (2018) suggests, using government-issued, or other forms of centralized "cryptocurrencies, run by private entities, coupled with a mandatory obligation to use intermediaries to transact in cryptocurrencies" (p. 35). Despite the reduced potential for growth exhibited by Dr. Gikay's approach, investing in a manner that reduces currency-exchange risks through cryptocurrencies whose purchasing power will change more predictably over time may be particularly suitable for banks and other larger institutions that regularly trade in fiat (and virtual) currencies at scale and/or on an international level.

Chapter IV.

Cryptocurrency Market Valuation and NPV Analysis

Long-Term Valuation of Virtual Currencies

Most decentralized virtual currencies are notoriously volatile: A critical aspect of determining the future value proposition of this asset class over time, therefore, involves the need for an effective process for empirically determining the long-term valuation of such currencies over time (NPV analysis), in order to properly assess their projected impact on the operations of institutional investment agencies within the United States and the global economy at large. By assessing the long-term valuation of the decentralized virtual currency asset class across a range of most probable scenarios, combining this with the current cryptocurrency market environment, and multiplying the respective future valuations by the likelihood of actual occurrence, an effective Net Present Valuation (NPV) analysis for the asset class can be effectively approximated and rationally acted upon. The first portion of this chapter will be dedicated to a high-level assessment of the long-term valuation of the cryptocurrency asset class, followed by an NPV analysis based on the synthesis of those results with current market conditions, and ending with actionable insights to be taken on the basis of the available empirical evidence.

The long-term valuation of the cryptocurrency asset class is a function of the long-term valuations of the asset class's constituent sectors, which can be best assessed when taken into consideration on an individual basis. The virtual currency markets are comprised primarily of three sectors, the first of which will be referred to here as *dominant cryptocurrencies*. Dominant cryptocurrencies are the decentralized virtual

currencies that are most well-known, and make up the vast majority of the cryptocurrency markets by market cap. Dominant cryptocurrencies, for purposes of this research, will be defined as cryptocurrencies with market capitalizations above $100 billion. This sector currently consists only of Bitcoin and Ethereum. The second sector will be referred to as *stablecoins* which, as discussed in Chapter II, are cryptocurrencies with stable values pegged to denominations of other physical asset classes (for example, gold, oil, reserve currencies, *et cetera*). The third, and final sector, is what will be referred to as *speculative cryptocurrencies*. These make up the more than eighteen thousand other cryptocurrencies with highly unstable prices, minimal market history, and nominal or unknown market valuations. (See **Figure 5** for a pie chart breakdown of the market shares held by these three cryptocurrency market sectors.)

When the cryptocurrency industry is considered as a composite of three sectors, the easiest sector to determine a long-term valuation for is the stablecoin sector, because its valuation will change in a highly predictable manner based on the underlying physical assets, and because there are currently less than forty stablecoin cryptocurrencies in existence. Stablecoins (when managed correctly), should behave much like the underlying fixed assets to which their valuations are pegged, in much the same way that a mutual fund's valuation would behave as a predictable function of its underlying net asset value (NAV).

From there, the second easiest sector to determine a long-term value for is the dominant cryptocurrency sector. This is because the dominant cryptocurrency sector is comprised solely of two cryptocurrencies, both of which are well-known and heavily traded, and already have large positions in the portfolios of institutional and private

investors. The dominant sector is unlikely to fail at any point in the near or distant future, and so it can be considered a safe *long-term* investment to make based on current market conditions. Dominant cryptocurrencies do, however, experience considerable short-term volatility when compared with conventional asset classes, with price swings in excess of ten percent on any given market day. This severe volatility is due partly to the fact that the sector has experienced significantly higher growth than any other conventional asset class, among other factors, such as the fact that the sector is also still considerably newer than most other asset classes like stocks and other physical assets. While dominant cryptocurrencies cannot be easily traded in the short-term, they are likely to increase significantly over time due to their limited supply and as a result of what is known as the *halving effect*, a process by which the payment received for *mining* cryptocurrencies within this sector (providing the computing power needed to validate transactions on their respective blockchains) decreases progressively over time. As a result (although the full complexity of cryptocurrency mining and the exhaustive mechanisms behind the halving effect are beyond the scope of this research), Meynkhard (2019) describes the long-term impacts of the halving effect as follows:

> [By] reducing remuneration every four years for each found transaction block, halving simultaneously reduces the overall issuance of new bitcoins twofold, which leads to an increase in the market value of cryptocurrency. Analysis of the effect that halving Bitcoin issuance has for the periods of 2011-2015 and 2015-2018 clearly shows that in both cases, it took the cryptocurrency five months to properly react to the halving that had occurred. (p. 83)

Consequently, it is highly likely that the long-term value of the dominant cryptocurrency asset class will continue to increase steadily over the long-term on the merits of the halving phenomenon alone, among other factors. Moreover, it should be noted that the halving effect also applies to Ethereum, as well as a number of other non-dominant cryptocurrencies, but to varying extents.

Determining the long-term valuation of the speculative sector of the decentralized virtual currency markets, lastly, is in turn perhaps the most challenging undertaking, given the myriads of speculative cryptocurrencies in existence within this sector and the anonymity exhibited by its many constituents. While there are currently almost twenty thousand speculative cryptocurrencies in existence, the long-term value of such currencies and their sustainability into the distant future remains highly questionable. As such, it is sufficient to surmise that most members of this sector will have minimal long-term value to the typical institutional investor without extensive knowledge about the particular currency(-ies) into which he/she is considering investing, and/or substantial extenuating circumstances to demonstrate a viable long-term investment path.

Net Present Valuation (NPV) of the Virtual Currency Markets

After performing a comprehensive segmented analysis of the long-term valuation of the cryptocurrency markets, it is important to also consider the relevant market conditions and changing macroeconomic circumstances in order to effectively determine the Net Present Value (NPV) of the virtual currency industry at large from the standpoint of an American institutional investor. Relevant market conditions to consider for the cryptocurrency industry differ in a number of important ways from those that would otherwise be considered for more traditional asset classes, as the correlation between

valuation trends among conventional assets versus cryptocurrencies being minimal-to-nonexistent in most cases.

Every time a new cryptocurrency is introduced into the market (for the exception of a *hard fork*, discussed in Chapter III), the new currency must undergo what is called an Initial Coin Offering (ICO), a process which resembles the IPO procedure for traditional stocks in some ways, but differs from it in a number of important aspects, as well. An ICO allows the inventors of a new cryptocurrency to raise funds by essentially printing money in denominations of the newly minted currency that they now own. While there is no company in which to actually purchase equity during an ICO (as there is in an IPO), different cryptocurrencies can have a vast number of desirable attributes written into their underlying code (see Chapter V for more detail on the potential uses for these attributes), which can make the new cryptocurrencies attractive to various asset holders for different reasons.

While the ICO of a new cryptocurrency would generally place that new currency into the speculative sector of the cryptocurrency industry, participating in a new cryptocurrency's ICO as an institutional can offer significant benefits to the right type of seasoned investor, thereby drastically boosting the NPV of that particular cryptocurrency to that unique investor. Fisch and Momtaz (2020) observe that an institutional investor's "superior screening… and coaching abilities… enable them to partly overcome the information asymmetry of the ICO context and extract informational rents from their ICO investments…. Overall, our results highlight the importance of institutional investors in the ICO context" (p. 1). In other words, whereas an investment in a speculative cryptocurrency would normally be a precarious move for a typical institutional investor

to make with a large sum of investable funds, the right type of seasoned institutional investor's direct participation in a new currency's ICO can have strong positive effects on the long-term performance of that particular cryptocurrency due to the knowledge and relevant experience that the seasoned investor brings to the venture.

On a macro level, however, the introduction of too many new ICO's into the cryptocurrency industry at one time could be a sign of an overheated economy. Moreover, the lack of legislation in the decentralized virtual currency markets leaves exposure to risks in investor fraud and specious cryptocurrencies with easily exploitable source code—the impacts of which can be particularly poignant in an industry in which the long-term value proposition of most of the new features being written into new cryptocurrencies remains poorly understood and largely untested. Further legal protections and a standardized method of reporting virtual currency performance and stability may make the macroeconomic impact of ICO's more favorable in the long-term. The ease with which a new cryptocurrency can be created also leaves room for significant exploitation in the field by any individuals that have the minimal technological resources required to create what purports to be a new cryptocurrency, even if they lack sufficient knowledge of finance or virtual numismatics necessary to produce a high-quality product.

While large-scale investments into properly researched ICO's can add significant value to the NPV of the cryptocurrency industry for some American institutional investors (particularly within the speculative sector of the cryptocurrency industry), educated institutional investors must also remain cognizant of the susceptibility of many cryptocurrencies to succumb to manipulation over time through dubious buying behaviors, such as herd investing and whales (see Chapter I for more information

regarding the long-term impact of these behaviors). Although dubious buying behaviors like these in cryptocurrency markets can oftentimes be exploited by large institutional investors themselves through arbitrage and other similar techniques, there is still the possibility for adverse effects to occur if such an investment move is not timed and executed strategically, or if it is impacted by other unforeseen market circumstances such as changing industry trends or cross-correlations with the pricing behaviors of other related decentralized virtual currencies.

Chapter V.

Short- and Long-Term Prospective Utility of Virtual Currencies

Current Uses of Virtual Currencies

As discussed in Chapter II, the two most important current uses of virtual currencies in the real-world are (1) to serve as purchasing agents for some form of good or service and (2) to function as long-term stores of value. While the purchasing power of most cryptocurrencies—including Bitcoin—remains limited due to a lack of widespread acceptance and bottlenecks in the speed and security of cryptocurrency payment-processing methods, there are a number of solutions currently being discussed to resolve these issues, which will likely become available in the near future. One of the most potentially transformative solutions to scalability challenges in the current ability to transact in Bitcoin and other cryptocurrencies over blockchains is called the *Spider-routing protocol*, a program which solves the issue of relying on currently available payment channel networks (PCN's) that can only process transactions on a piecemeal (one-at-a-time) basis. Sivaraman (2019) observes that the Spider-routing protocol "requires less than twenty-five percent of the funds needed by state-of-the-art approaches to successfully route over ninety-five percent of the transactions across a wide range of synthetic and real topologies," functioning as a faster and cheaper alternative to the currently available PCN's for cryptocurrency payment processing, while increasing the ability to utilize cryptocurrencies as long-term stores of value (p. 3).

There are also lesser-known (fringe) applications for cryptocurrencies in their current state, which can be of particular importance both when determining which cryptocurrencies to invest capital in, as well as in finding unmet needs to be addressed by

future cryptocurrencies through institutional investor-backed ICO offerings and R&D initiatives. One particular fringe application of cryptocurrencies that could substantially increase the utility and value proposition for transacting in cryptocurrencies involves what are known as *non-fungible tokens (NFT's)*. An NFT is a special type of digital asset that can be custom-designed with unique intrinsic attributes (similar to cryptocurrency tokens themselves), but cannot be replicated due to a digital certificate of authenticity. NFT's can be used to digitize original copies of artwork, moments in time (through GIF's), and even digital pieces of real estate in augmented reality (AR) and virtual reality (VR) metaverse environments. As a purely digital asset, an NFT can only be purchased using cryptocurrencies, which enables NFT's to serve as catalysts for cryptocurrencies to become both the sole method of exchange in a growing digital world, as well as the primary store of value for digital assets such as original artwork, intellectual property, and many other emerging classes of semi-tangible virtual assets. The growth rate of NFT's and the metaverse environment is quite remarkable, to the extent that virtual skeuomorphs of video games, gymnasiums, art museums, meeting rooms, and even physical storefront environments all already exist within it, and can currently function as alternative proxy methods of purchasing actual goods and services within the real world.

The growth of the metaverse presents many investable opportunities for institutional investors within the cryptocurrency markets on three levels (1) support of dominant cryptocurrencies that currently have a large market share and will continue to grow as uses for virtual currencies increase (2) support of speculative cryptocurrencies designed exclusively for functionality in the metaverse, such as Decentraland (MANA) and Sandbox (SAND) (currently the two most popular cryptocurrencies for NFT- and

VR-based purchases); and (3) direct investment into the development of the VR real estate and metaverse experiences themselves, which will promote further purchases using both new and existing cryptocurrencies of all kinds (companies such as Microsoft and Meta are already hiring workers to serve as VR and mixed reality developers). Of these three investment options, the first involves the least risk and the third involves the most; however, different companies within different industries may find themselves uniquely positioned to add value and in one particular area over another, and institutional investors in these respective institutions stand to benefit accordingly.

Prospective Uses of Virtual Currencies

Beyond the current uses of cryptocurrencies, there is also significant debate on the future long-term applications of decentralized cryptocurrencies to serve in a broader capacity toward facilitating American business operations in general. Such speculative (that is, not currently implementable) uses include healthcare, commercial cybersecurity, and environmental science, among many others. This discussion will take a brief look into such areas, and it will offer opportunities for further research and development to be made by relevant institutional investors at a later point in time.

In the healthcare and commercial cybersecurity industries, for example, there is ongoing research regarding the possibility for decentralized cryptocurrencies (and their underlying blockchain technologies) to eventually serve as the basis for universal healthcare coverage on a national—and possibly even global—scale, by dissolving extant transnational financing barriers to equitable capital access. A proposal by Till, Peters, Afshar, and Meara (2017) suggests that "cryptocurrencies could enable universal access to financing mechanisms by removing third-party financial intermediaries and offering

transparent, secure and accountable means for global health financing" (p. 1). While such a ubiquitous and transformative implementation of decentralized cryptocurrencies and blockchain technologies in their present state is largely theoretical from a feasibility standpoint, there is an opportunity for further research and development on this topic on at least three key levels: (1) The ability of decentralized cryptocurrencies and blockchains to enable access to financing at a national/global level, without the need for third-party intermediaries that would otherwise charge additional fees to perform this function; (2) the opportunity for cryptocurrencies (or their underlying blockchain technologies) to facilitate the creation of novel multilateral financing systems that improve access to capital markets at a broader level; and (3) the potential for improved institutional cybersecurity systems through blockchain-based validation methodologies (including possible quantum computing applications). While such application areas for virtual currencies are broad and currently poorly understood, these areas do serve as clear indications of the long-term potential for cryptocurrencies and the blockchain to assist across many different industries and demographics.

In addition to healthcare, there is also long-term potential for cryptocurrencies to aid in energy conservation as well as within the environmental sciences, by helping to conserve energy through reduced transacting costs. While current dominant cryptocurrencies, such as Bitcoin and Ethereum, are notorious for their heavy energy consumption and high environmental costs required to validate transactions on their blockchains through current computer-based mining methods, ongoing research suggests the potential for new cryptocurrencies to exist that could be specially designed for day-to-day transacting with minimal energy consumption required to verify payments and

capital exchanges. An example of one such cryptocurrency is the concept known as *SpaceMint*, a hypothetical cryptocurrency whose transaction proofs could be based on proofs of *space* (hard disk space within a cryptocurrency mining node), rather than proofs of *work* (a complex problem that has been solved by a cryptocurrency mining computer after many hours of energy-intensive processing). Meiklejohn and Sako (2019) suggest that "SpaceMint's design solves or alleviates several of Bitcoin's issues: most notably, its large energy consumption. SpaceMint also rewards smaller miners fairly according to their contribution to the network, thus incentivizing more distributed participation" (p. 480). Although the concept of a theoretical cryptocurrency such as SpaceMint as a means of effective energy conservation remains far from feasible within the scope of the present environment, the notion of such a cryptocurrency's existence still serves as another promising application area in need of further research and development by companies and scholarly organizations with the relevant experience and fiscal resources to do so.

Concluding Remarks

The decentralized virtual currency industry has made meteoric progress since its initial public debut, with the launch of Bitcoin, in 2008. As such, the cryptocurrency markets have started to garner attention from larger institutional investors (such as financial and technology companies) at an accelerated pace, during a time when the industry itself could greatly benefit from the attention of more seasoned investors with greater economic experience and resources. If executed correctly, institutional investment into the virtual currency markets (and related fields) has the potential to benefit both the decentralized virtual currency industry itself, as well as institutional investors across a

spectrum of different markets and demographics within the scope of both American and global business operations.

Before determining how and when to invest in the virtual currency markets, however, it is important to first perform due diligence in areas such as future value proposition, volatility and liquidity, risk management, and NPV analysis. This research endeavors to offer meaningful insights into each of these key areas for institutional investors and for professional researchers across a broad range of different interests and industries. The topics covered within this research are intended to serve as a springboard for further research and development into the field of decentralized virtual currencies, while raising awareness regarding the existence of cryptocurrencies, the potential profits to be made in the virtual currency markets, and the positive real-world impact to be achieved. Particular focus is paid to the many different methods of active and passive investment that can be used in the industry with varying levels of risk and growth potential to suit the needs of different investors, from startup fintech companies to hedge fund managers seeking to complement their existing actively managed asset portfolios.

Areas in greatest need of further research include the potential for decentralized virtual currencies to be more secure and efficient through the creation and implementation of newly developed tools and resources over time, ranging from technological innovations to legislative methods of enforcing greater accessibility to capital markets, transactional integrity, and corporate social responsibility on a national and global scale. Even incremental progress in areas such as these can have massive benefits to both the growth of the cryptocurrency industry, as well as to the relevance and accessibility of decentralized virtual currencies to retail investors and citizens of

developing economic environments in which alternative payment methods to depreciating national fiat currencies are desperately needed. Other opportunities for further research and development in the decentralized virtual currency markets include the possibilities of cryptocurrencies someday aiding in universal access to healthcare, energy conservation, and commercial cybersecurity—the boundaries and potential impact of which still remain largely untapped. By investing into further research and development in the decentralized virtual currency markets (or into the virtual currency markets directly), however, institutional investors both within the United States and around the world can have a much greater impact on the causes that mean the most to them, while reaping substantial financial rewards and securing future-proof asset diversification to lead to prosperity and long-term strategic and competitive advantages in years to come.

Figures

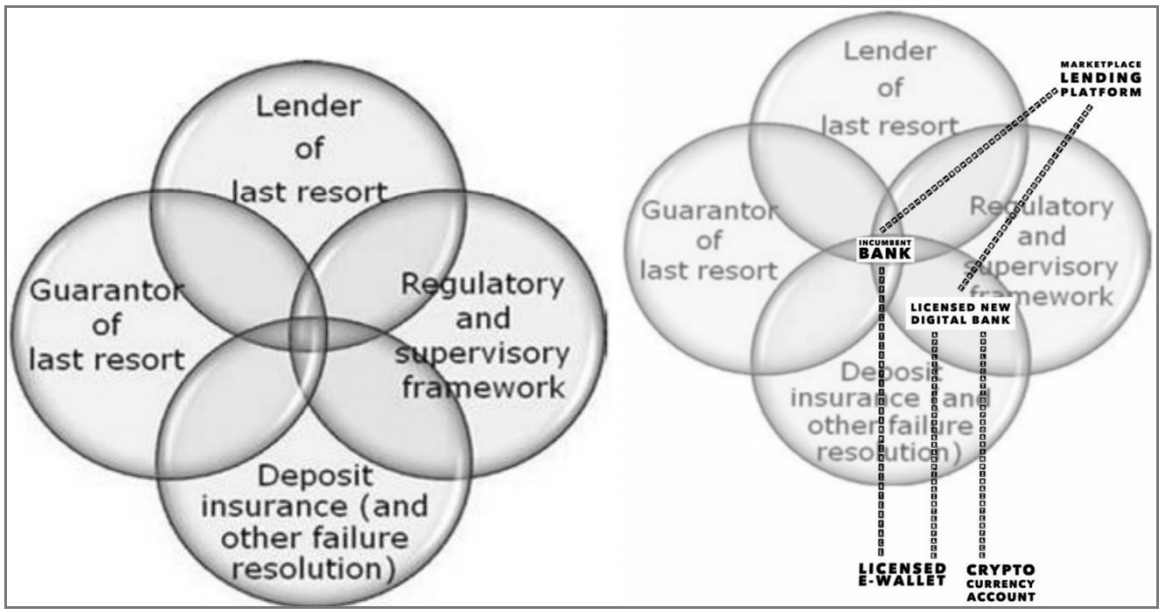

Figure 1. Potential for Disruption in the FSN.

Adapted from "Do Fintech and Cryptocurrency Initiatives Make Banks Less Special?"

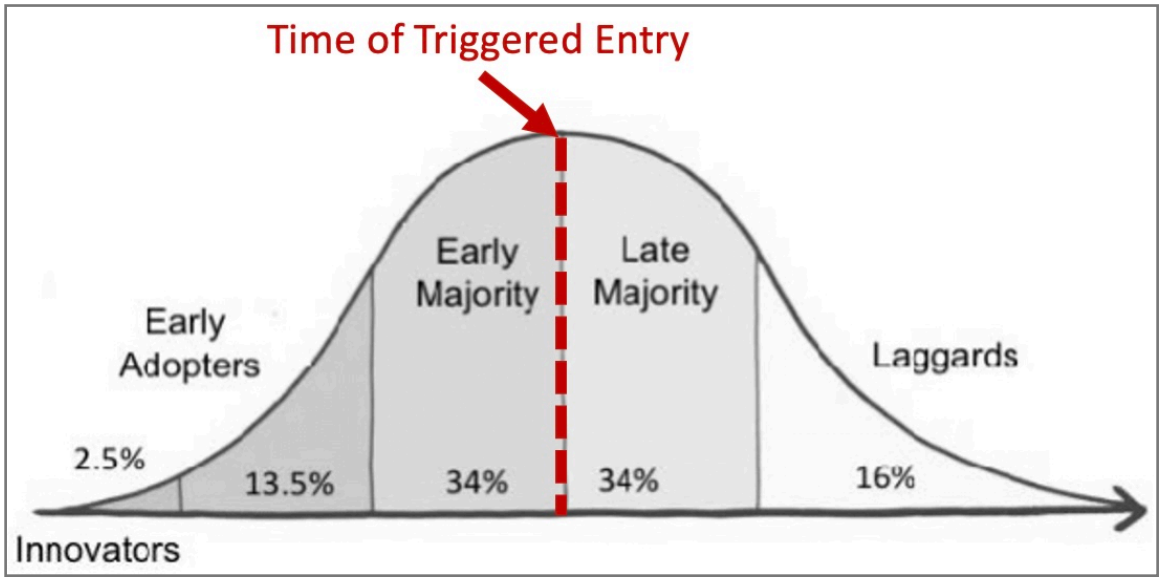

Figure 2. Roger's Adoption Curve and Timing of Ideal Market Entry.

By using artificial intelligence (AI) to enter a particular cryptocurrency market before herding behaviors have a chance to take full effect, institutional investors stand to enjoy large potential profits through predictive analytics and early investing.

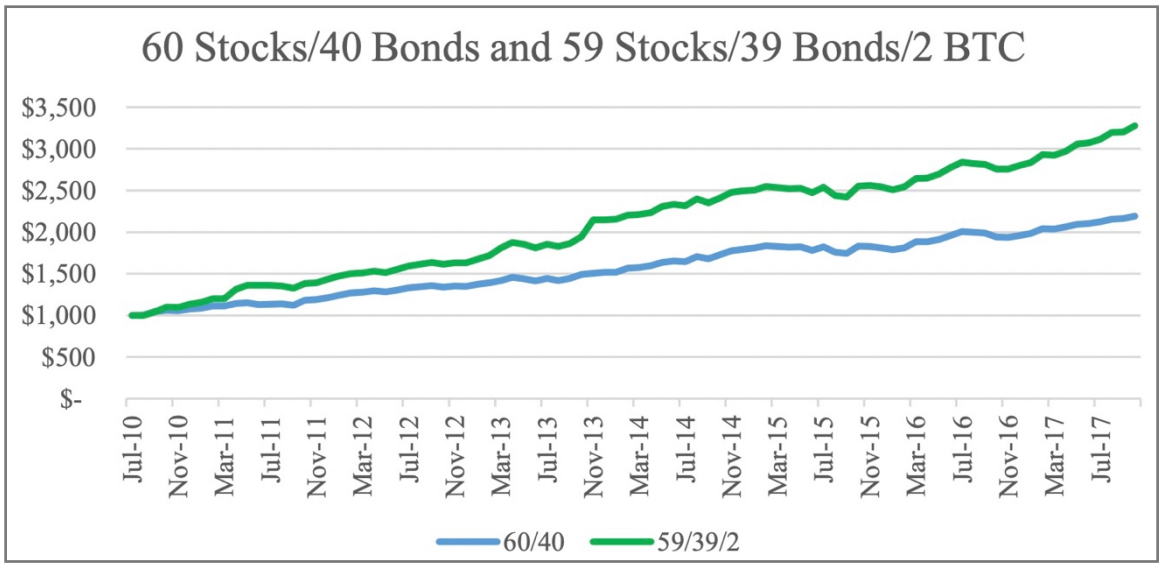

Figure 3. 60/40 Stock-Bond Portfolio versus Portfolio with 2% Crypto Allocation.

Adapted from "The Case for Bitcoin for Institutional Investors: Bubble Investing or Fundamentally Sound?"

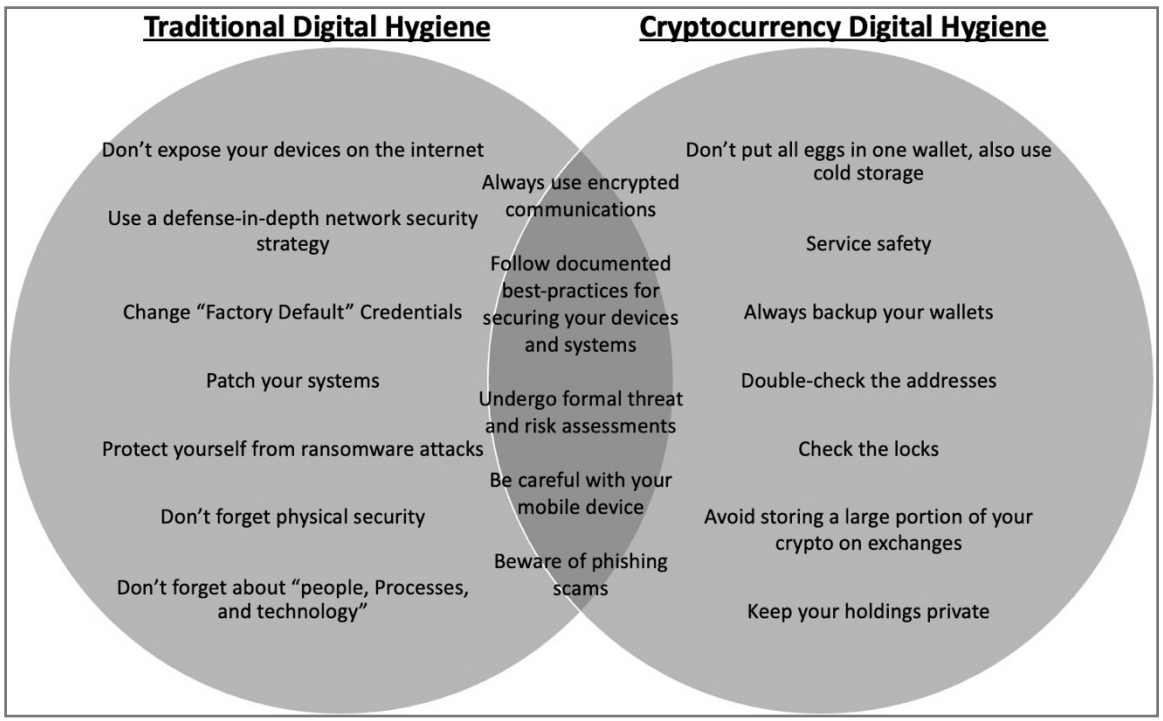

Figure 4. Traditional Digital Hygiene versus Cryptocurrency Best Practices.

A lot of the traditional best practices for maximizing online safety and protecting conventional IP within a firm can also apply to cryptocurrency storage.

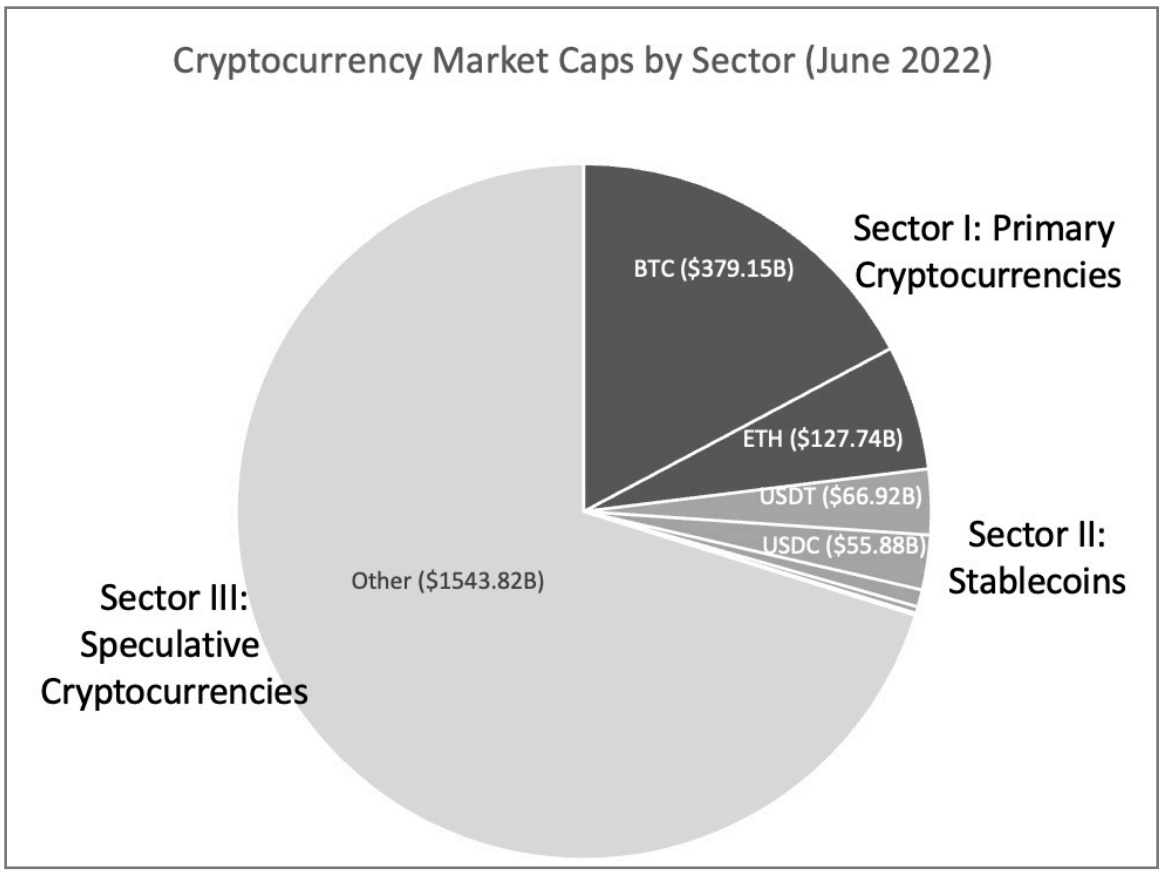

Figure 5. Large Cryptocurrency Market Capitalizations Listed by Sector (June 2022).

Dominant cryptocurrencies account for a quarter of the market, while offering less risk than members of the speculative sector. Stablecoins, while the smallest sector, also offer reasonable gains with risk levels comparable to more conventional asset classes.

Tables

Table 1. Current Roles of Banks in the Incumbent Financial System.

Core functions of the financial system	Core functions of banks	Related activity
Provides a payment system for the exchange of goods and services	Transaction accounts (redeemable in cash on demand and at par)	Deposit taking
Provides a mechanism for the pooling of funds to undertake large-scale indivisible enterprise	Transaction accounts	Deposit taking
	Delegated monitor	Lending
Allows to transfer economic resources through time and across locations	Transaction accounts	Deposit taking
	Providing liquidity services	Lending
	Delegated monitor	Lending
Facilitates the management of risk	Transaction accounts	Deposit taking
	Providing liquidity services	Lending
	Delegated monitor	Lending
Provides price information that helps co-ordinate decentralized decision-making	Delegated monitor	Lending
	Conduits for Monetary policy transmission	Lending

Provides ways to deal with asymmetric information	Delegated monitor	Lending

Adapted from "Do Fintech and Cryptocurrency Initiatives Make Banks Less Special?"

Table 2. List of Risk-Adjusted Optimal Portfolio Allocations.

Optimal Investment Allocations	(1) Exclude BTC	(2) Include BTC	(3) Include BTC with LT Govt Bonds <= 40%
BTC		1.30%	1.31%
US Large Stock	44.29%	37.52%	38.89%
US Small Stock	8.51%	11.30%	9.68%
US LT Corp	0.00%	0.00%	10.12%
US LT Govt	47.19%	49.88%	40.00%
US IT Govt	0.00%	0.00%	0.00%
FTSE NAREIT	0.00%	0.00%	0.00%
CS Hedge Fund	0.00%	0.00%	0.00%
CS Managed Futures	0.00%	0.00%	0.00%
US TIPS	0.00%	0.00%	0.00%

MSCI EAFE	0.00%	0.00%	0.00%
S&P GSCI	0.00%	0.00%	0.00%
Gold	0.00%	0.00%	0.00%
Sum	1.0	1.0	1.0
Ann.Ret	10.5%	13.9%	14.1%
Ann.Std	5.4%	6.4%	6.5%
Sharpe Ratio (Rf=1%)	1.76	2.03	2.02

Adapted from "The Case for Bitcoin for Institutional Investors: Bubble Investing or Fundamentally Sound?"

Table 3. BTC Hard Forks with Known Market Caps, Listed in Chronological Order.

Hard Fork Name	Decentralized exchange (DEX) Code	Market Cap of New Currency (as of 16 June 2022)	Date of Hard Fork
CLAMs	CLAM	$5.397 M	12 May 2014
Bitcoin Cash	BCH	**$2.137 B**	1 August 2017
Bitcoin SV	BSV	**$1.492 B**	1 August 2017
Bitcoin Gold	BTG	$282.6 M	24 October 2017

BitCore	BTX	$1.322 M	2 November 2017
Bitcoin Diamond	BCD	$28.46 M	24 November 2017
BitClassic Coin	BICC	$0.0166 M	12 December 2017
BitcoinX	BCX	$54.76 M	12 December 2017
Bitcoin God	GOD	$37.28 M	27 December 2017
Bitcoin Interest	BCI	$0.1164 M	20 January 2018
Bitcoin Atom	BCA	$2.491 M	24 January 2018
MicroBitcoin	MBC	$0.3042 M	28 May 2018

*Of the 105 Bitcoin hard forking events that have occurred since inception, most have been minor and had minimal impact on investors in the parent cryptocurrency; soft forks are executed without any asset splitting at all. Forks with known market caps above $1B are listed in **bold**. Sources: forkdrop.io, CoinMarketCap.com, and coin360.com*

Appendix 1.

Annotated Bibliography

Calderón, O. P. (2018). *Herding behavior in cryptocurrency markets.* (arXiv Working Paper No. November). arXiv at Cornell University Tech. https://arxiv.org/pdf/1806.11348.pdf

Calderón (2018) offers a critical look at how Bitcoin and other cryptocurrencies have achieved their meteoric growth in recent years. He suggests that the growth of such tokens may have been (in whole or in part) impacted by large investors known as whales, whose funds have been used to manipulate the broader cryptocurrency markets through the deliberate restriction of supply and demand for particular cryptocurrencies.

The methodology used involves the gathering of empirical evidence from other sources. The data are then presented in a manner that suggests that cryptocurrencies may not perform like other comparable markets as a result of their above-average participation of whale investors, whose involvement was likely used to manipulate the growth rate of the cryptocurrency markets to otherwise inconceivably high levels.

Despite its skeptical approach to the subject at hand, the article offers value to this research by presenting another potential explanation for the abnormal growth rate of the cryptocurrency markets as compared to other similar asset classes. The impact of whale investors and so-called ‘cryptocurrency herding’ can then be evaluated in the larger context of other potential contributing factors.

Chohan, U. W. (2018). The problems of cryptocurrency thefts and exchange shutdowns. SSRN. http://dx.doi.org/10.2139/ssrn.3131702

Chohan (2018) discusses security issues in the cryptocurrency markets, with a focus on Bitcoin and the vulnerabilities of the existing public cryptocurrency exchanges. The article describes the dangers of anonymized cryptocurrency theft and widespread cryptocurrency exchange shutdowns, making references to the damage that such occurrences have caused in recent years and begging the need for future reform.

Chohan (2018) focuses on a compilation of cases from recent years, in which thefts and exchange shutdowns on cryptocurrency exchanges have wiped investors out of large sums of money. He then draws on the results of such cases to highlight the need for increased accountability and administrative oversight regarding the cryptocurrency sector at large.

The paper seeks to address some of the key security concerns in the cryptocurrency space. It is unique in its coverage of the subject in the sense that it addresses the concern that—even with institutional investor involvement—the security of the decentralized currency space still has much to be desired.

Fisch, C., & Momtaz, P. P. (2020). Institutional investors and post-ICO performance: An empirical analysis of investor returns in initial coin offerings (ICOs). *Journal of Corporate Finance*, 64. https://reader.elsevier.com/reader/sd/pii/S0929119920301231?token=75C930FCCD6D6BA45E640C8303D7470FB33A3EF24D34FB7EA6E6CC9FDD44D5D6

A2B21F292BACA5E7A95C7EAFA344867E&originRegion=us-east-1&originCreation=20220623015528

Fisch and Momtaz (2020) describe the new and exciting financial phenomenon known as the Initial Coin Offering (ICO). They then describe its meaning in an institutional investor context, as distinct from the IPO of a publicly traded stock, and make inferences about what this might mean for retail investors, institutional investors, and the financial industry at large.

The article seeks to assess the influence of institutional investor involvement on post-ICO performance through an analysis of buy-and-hold abnormal returns across a sample population of 565 cryptocurrency ICO's. It then evaluates the results with respect to the authors' hypothesis regarding whether the knowledge and research done by institutional investors allows them to overcome the novelty and ambiguity implied by the ICO context.

The article addresses a critical part of the cryptocurrency value proposition to institutional investors that is not commonly understood: The value to be gained from institutional involvement in ICO's. It demonstrates that institutional investor backing of a particular ICO can benefit both the coin (by boosting its popularity) as well as the investor's long-term ROI through higher post-ICO performance of the token (as a result of their initial support).

Gikay, A. A. (2018). Regulating decentralized cryptocurrencies under payment services law: Lessons from the European Union. *Case Western Reserve*, 9(1). https://scholarlycommons.law.case.edu/jolti/vol9/iss1/1

Gikay (2018) describes key concerns regarding the lack of regulation in cryptocurrency markets. He points to issues such as ease of money laundering and theft, and cites cases in which this has occurred but could have been prevented through proper regulation. He then explains why cryptocurrencies cannot be regulated by a traditional regulatory body, such as the EU, and goes on to propose two possible solutions to this problem—one of which would require regulation by private institutional entities, and the other of which would involve the implementation of state-run virtual currencies that are governmentally controlled.

The source is based on a root-cause analysis of the EU's inability to legislate *crypto*currencies under its existing legal framework for *currencies* since (1) a cryptocurrency cannot be defined as a currency, and (2) it would be infeasible to design new laws that regulate cryptocurrencies due to their decentralized nature.

The article offers potential relevance to this research because it implies that institutional participation within cryptocurrency markets (among other things) is a potential way to introduce much-needed regulation into the realm of decentralized currencies without curbing their essential features of privacy and decentralization.

Kurka, J. (2017). *Do cryptocurrencies and traditional asset classes influence each other?* (IES Working Paper No. 29/2017). Institute of Economic Studies at Charles University. https://doi.org/10.1016/j.frl.2019.04.018

The article seeks to identify any potentially causal relationships between the performance of cryptocurrencies other asset groups. A particular focus is placed

on the liquidity and volatility of Bitcoin, and the potential for its performance asymmetries to 'spillover,' or be transmitted, to more stable and tangible asset classes such as publicly traded stocks and physical gold.

Kurka (2017) performs his analysis by comparing the impact of what he refers to as 'shocks' (market corrections) in the performance of various cryptocurrencies, such as Bitcoin, to the performance of a wide variety of more conventional asset groups spanning a range of liquidity and volatility profiles—such as foreign exchanges, stocks, and precious metals.

The article can be used provide insight regarding the trajectory of cryptocurrencies' rapidly increasing role within the global economy, and can assist in forecasting the likely outcome that the performance of digital assets will have on the stability and value of other more conventional asset classes. Conjectures can then be drawn regarding the best way for institutional investors to safely anticipate and prepare for such changes before they occur.

Liew, J. K., & Hewlett, L. (2017). The case for Bitcoin for institutional investors: Bubble investing or fundamentally sound? SSRN. http://dx.doi.org/10.2139/ssrn.3082808

Liew and Hewlett (2017) utilize commercial investment analysis techniques such as Sharpe Ratio and other portfolio optimization calculations to determine whether cryptocurrencies should be a part of institutional investor assets. Their conclusions are based on a broad comparison of the volatility of certain mainstream cryptocurrencies (such as Bitcoin) to the disruptiveness of blockchain technology as a whole, and the potential threat posed by blockchain technology to governments and incumbent financial institutions.

The article is written from the perspective of a potential institutional investor and seeks to provide quantitative evidence to support the financial benefits from adding cryptocurrencies to institutional asset portfolios. Recommendations are made regarding the optimal amount of virtual currencies to hold in an institutional portfolio, based on risk tolerance and investment objectives.

The article bears relevance to this research by evaluating the prospective value proposition of cryptocurrencies to institutional investors from an evidence-based view. This could prove useful in offering a predictive analysis of how much investment activity will likely be undertaken by such investors over a long-term period.

Meiklejohn, S., & Sako, K. (2019). SpaceMint: A cryptocurrency based on proofs of space. In *Financial cryptography and data security: 22nd International Conference, FC 2018, Nieuwpoort, Curacao, February 26 – March 2, 2018, revised selected papers* (pp. 480-499). Springer Nature. https://doi.org/10.1007/978-3-662-58387-6_26

The article discusses a new method of mining cryptocurrency based on disk space allocation instead of computing power. It argues that, by removing reliance on computing power, the energy requirements of existing blockchains can be significantly reduced. As such, a more sustainable *and* efficient blockchain system for validating transactions could be developed—one which finally allows cryptocurrencies to achieve their original goal of being used as everyone's default payment method worldwide.

The methodology employed involves the proposed creation of a new type of cryptocurrency altogether, entitled *SpaceMint*. The prototypical token involves a 1 TB minimum mining stake, and its prospective effectiveness is then evaluated according to various principles of game theory. Despite the non-existence of the hypothetical cryptocurrency, the mathematical calculations and theorems that are applied suggest that the potential development of such a coin could be a disruptor in the cryptocurrency markets.

The concept of using more environmentally sustainable methods for transaction validation on a blockchain is certainly relevant to the future implementation and long-term success of cryptocurrencies at large. If nothing else, SpaceMint could be used to pave the way for newer and more sustainable cryptocurrencies in years to come—ones with broader real-world applicability and greater problem-solving potential.

Meynkhard, A. (2019). Fair market value of Bitcoin: Halving effect. *Investment Management and Financial Innovations,* 16(4), 72-85. https://pdfs.semanticscholar.org/c3a0/6dcc40c78d09c74d9db1dac8b3f4e5d1f7b7.pdf

Meynkhard (2019) addresses two key factors in the abnormal growth rate of cryptocurrency prices: Scarcity and Inflation. It explains a phenomenon known as *halving*, whereby the reward received by the *nodes* (computers maintaining a particular blockchain) is periodically cut in half to maintain the scarcity and value of the cryptocurrency as more *blocks* (new cryptocurrency tokens) are 'mined' (discovered and validated) on the blockchain. The impacts of cryptocurrency

halving are then compared to the effects of inflation on commonly held fiat currencies, and used to suggest future ramifications.

The article utilizes the Kendall rank correlation method to quantitatively evaluate the impact of reducing cryptocurrency miner remuneration every four years (the period between Bitcoin halving events) on the fundamental value-storing and transactional capabilities of the cryptocurrency. Other commonly used digital currencies and fiat currencies are then compared to provide additional points of reference.

By presenting new factors behind the historic growth rates of cryptocurrency prices, the article offers a new perspective on the advancements made by Bitcoin and other cryptocurrencies in recent years. In doing so, it provides balance against some of the more cynical explanations in circulation, such as money laundering and herding by whale investors.

Østbye, P. (2017). The adequacy of competition policy for cryptocurrency markets. SSRN. http://dx.doi.org/10.2139/ssrn.3025732

Østbye (2017) discusses the need for adequate competition policy within the cryptocurrency markets. He observes that, because most cryptocurrencies are intended to supplement or replace traditional fiat payment systems, their presence could pose a threat to public policy without the presence of a central bank cryptocurrency of some sort to function as a counterbalance.

The article draws evidence from past claims made by business professionals in other industries in regards to the need for regulation and antitrust legislation—that every industry will claim itself to be unique, and therefore

'above the law' in some regard or another. Østbye (2017) argues that, while the conventional profit-maximization framework for anticompetitive behavior may prove ineffective here, other models such as network competition and spatial competition can and should be used—but are currently severely underdeveloped for this use case.

The article brings attention to the fact that, as more institutional investors become involved in cryptocurrency markets, the opportunity will naturally be created for such investors to create their own cryptocurrencies, whose market capitalizations can easily come to rival those of conventional fiat currencies or even entire GDP's, thereby creating national security concerns and threatening the stability of the global economy if left undeterred.

Schich, S. (2019). Do fintech and cryptocurrency initiatives make banks less special? *Macrothink Institute,* 9(4), 89-116. https://doi.org/10.5296/ber.v9i4.15720

Schich (2019) discusses the role of cryptocurrency in enabling the fintech industry to now fulfill three roles that were once reserved for banks: (1) depositing and withdrawing money on demand; (2) lending money to grant liquidity to other parties; and (3) serving as the conduit for its own payment system. He raises an interesting argument about whether the role of banks will ultimately wane in future years, which he then supplements by counterarguments about other new roles that banks might have and how they might proceed to do things differently.

The methodology used is essentially a comparison of the historical functions of banks to the current uses of cryptocurrencies in real-world

applications. Inferences are then drawn from a comparison/contrast discussion, so as to arrive at new insights regarding how the two financial instruments might ultimately impact one another.

The article presents the current uses of cryptocurrency in a way that emphasizes both its significance and its potential impact on other incumbent sectors within the financial industry. This could shed light on ways that existing financial market participants might seek to protect themselves in an era of unprecedented disruption, as well as the potential future of cryptocurrencies at large.

Sivaraman, V. (2019). *High-efficiency cryptocurrency routing in payment channel networks* [Master's thesis]. https://hdl.handle.net/1721.1/124129

Sivaraman (2019) discusses a more efficient method of validating transactions through the blockchain protocol. Whereas traditional blockchains would require every transaction to be individually routed through the blockchain for verification (a tedious process that can sometimes take days to complete), the new process—known as *spider routing*—boosts network throughput by splitting transactions across multiple nodes, so as to better balance the load across the network and improve efficiency.

The concept of spider routing is not new, but its applicability in the realm of cryptocurrencies and the blockchain is not fully understood. Sivaraman (2019) draws from his years of research in the areas of router congestion and online traffic management to propose a system in which better load balancing across multiple blockchain nodes can result in greater validation efficiency and a more

viable framework for cryptocurrencies to be used in everyday purchases.

The article is germane to the current uses and constraints of cryptocurrencies, as it addresses an area where there is a desire to use cryptocurrencies for day-to-day purchases, but existing blockchain technologies fall short due to massive bottlenecks in their transaction verification speeds (currently a fraction of what can be otherwise accomplished by traditional payment processing companies).

Till, B. M., Peters, A. W., Afshar, S., & Meara, J. G. (2017). From blockchain technology to global health equity: Can cryptocurrencies finance universal health coverage? *BMJ Global Health,* 2(4). https://gh.bmj.com/content/2/4/e000570

Till et al. focus on the capability of cryptocurrencies and blockchain technology in solving the global health crisis. They also discuss the possible relevance of cryptocurrency in ameliorating other previously unsolvable issues regarding criminal justice and financial corruption, through reliance on a secure and immutable ledger. A brief summary is then provided on some actions that are currently being taken to achieve this outcome.

The authors set out to answer four key questions regarding the feasibility of cryptocurrencies and the blockchain in the healthcare sector, emphasizing the need for the collective action of institutional bodies in ensuring that cryptocurrencies are used for benevolent purposes rather than malfeasance, so that they can reach their fullest potential in areas such as patient monitoring and fraud prevention.

The article underscores the applicability of cryptocurrencies and

underlying blockchain technologies in new and seemingly unrelated industries, such as healthcare. As such, the source could be used to highlight the current under-utilization of cryptocurrency and the blockchain in solving real-world problems, and the significant growth potential of such technologies in the future.

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