POTENTIAL FOR CRYPTOCURRENCY TO FUND INVESTMENT IN SUSTAINBLE REAL ASSETS

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Executive Summary

Over the past few years, cryptocurrency - virtual currency that uses blockchain technology as its backbone - and Initial Coin and Token Offerings, have emerged as new funding mechanisms for firms looking to raise money for ventures and projects. This paper is an exploratory study of the potential for this technology to be used to increase investment in sustainable real assets.

The first section of this paper provides an overview of real assets and sustainable real assets. It also identifies the current investor landscape for these types of opportunities. This landscape is dominated by high net-worth individuals and institutional investors, primarily as a result of the high cost of entry and complexity of transactions. I also look at recent technological and regulatory changes that have allowed for smaller investors to get exposure to real asset investment opportunities through crowdfunding.

The second section gives an overview of blockchain technology and cryptocurrency. It also reviews Ethereum, Initial Coin and Token Offerings, and addresses some of the potential risks of this new technology.

In the third section, I examine two firms developing blockchain based technology, that will potentially allow for the sale and purchase of real assets on their platforms.

In the fourth section, I analyze the features and attributes of blockchain and cryptocurrency that can potentially reduce the barriers to investing in real assets and sustainable real assets. Examples include smart contracts, ERC-20 tokens, and tokenization.

In the final section of the paper, I conclude that blockchain is a revolutionary technology that can reduce the barriers to investing in sustainable real assets and I identify different business models that can be used to do so. However, I recommend a "wait and see strategy" until there is more clarity concerning regulations and policies and that there have been fully implemented use cases.

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1. Introduction

1.1. Problem Definition

In an era filled with concerns about the preservation of scarce resources, climate change, and the environment, investing in and protecting assets related to sustainability and the environment has become an area of greater focus and increased importance to the general population and the investment community. One way of investing in this area is through "sustainable real assets."

Real assets are defined as assets that are "tangible or physical in nature" that generate a financial return on investment and include assets such as real estate, silver, gold, agriculture, infrastructure, timberlands, agriculture, infrastructure, and oil and gas royalties.[1,2,3] Sustainable real assets are real assets that generate both financial and environmental returns on investment, such as sustainable timberland and green real estate.

Due to the high cost of investment and complexity involved with the transactions, the ability to diversify and invest in real assets has historically been limited to institutions and high net worth individuals. Utilization of blockchain technology can potentially reduce both the costs and complexity for investing in sustainable real assets and bring greater access to those who may have interest in these types of investment opportunities.

A blockchain is a cryptographically secured distributed database that maintains records of digital transactions across a synchronized network of computers, each of which houses a replica of the database.[4] Attributes of blockchain technology allow

individuals and groups to trust each other in transactions, without the need for a trusted third party to act as an intermediary.

The past few years, new vehicles for raising capital for investments and projects, using blockchain technology as their backbone have come to be – these include cryptocurrency and Initial Coin Offerings (ICOs) or Initial Token Offerings (ITOs), collectively known as "token sales."[5] These offerings allow firms to issue virtual currency, coins, or tokens, also known as cryptocurrency or cryptotokens, instead of using conventional debt or equity, to raise funds for a given project.[6] This gives individual investors the opportunity to take fractional ownership in investment projects.[7] In a way, token sales are a type of crowdfunding that eliminate the historically high barriers to entry to being able to invest in arenas such as sustainable real assets.

1.2.   Methodology

The research for this paper starts with a literature review of the current state of the market for real assets and sustainable real assets, followed by a literature review and desk research regarding blockchain, cryptocurrency, and token sales, in order to give greater clarity on the technology and how it can act as a funding mechanism. I then analyze two use cases of cryptoventures that have been funded by Initial Token Offerings to develop platforms with the intent of enabling additional investment in real assets. Next, I evaluate how certain attributes of the technology have the potential to increase access and improve efficiency concerning real asset investment opportunities. I then use this analysis to propose similar mechanisms and platforms that can potentially be applied to investment in sustainable real assets.

Given the early stage of using cryptocurrency and token sales as funding mechanisms and the limited number cryptoventures that have moved past the funding stage, there has been limited research and analysis done in the field making the research and analysis in this paper exploratory in nature.

2. Defining Investment in Sustainable Real Assets

2.1.   Real Assets and Sustainable Real Assets

Recent years have seen an increase in overall impacting investing and more specifically in real assets.[8] Studies have shown that investments in sustainable real assets typically produce attractive returns that are comparable with those received from similar real assets in conventional markets, and that these sustainable investments have measurable social and environmental returns.[9,10,11]

For the purpose of this paper, investment in real assets that focus on environmental and social returns will be called "sustainable real assets." This term is defined by Sonen Capital, one of the first firms to launch a Sustainable Real Asset Fund as: "…real assets that incorporate social and environmental sustainability as a way to maximize potential returns. They relate largely to environmental themes including sustainable timberland, sustainable agriculture, green real estate, land and water ecosystems and green infrastructure."[12]

Real asset investments are characterized as illiquid and have low volatility.[13] The majority of the transactions that take place are private, generally localized, have high transaction costs, high investment costs, a number of middlemen, and low information

transparency in that the buyer only has the information given to them by the

seller.[14,15,16,17] They are also highly regulated with laws that vary by jurisdiction.

2.2.   Market Figures and Trends

Total sustainable and impact investment in the USA grew 135% from 2012-2016 (Figure 1) and accounted for $8.8 trillion in investment dollars in 2016, indicating there are funds available for the right investment opportunities.[18]

Figure 1: Impact Investment in the United States

Sustainable, Responsible and Impact Investing in the United States 1995–2016
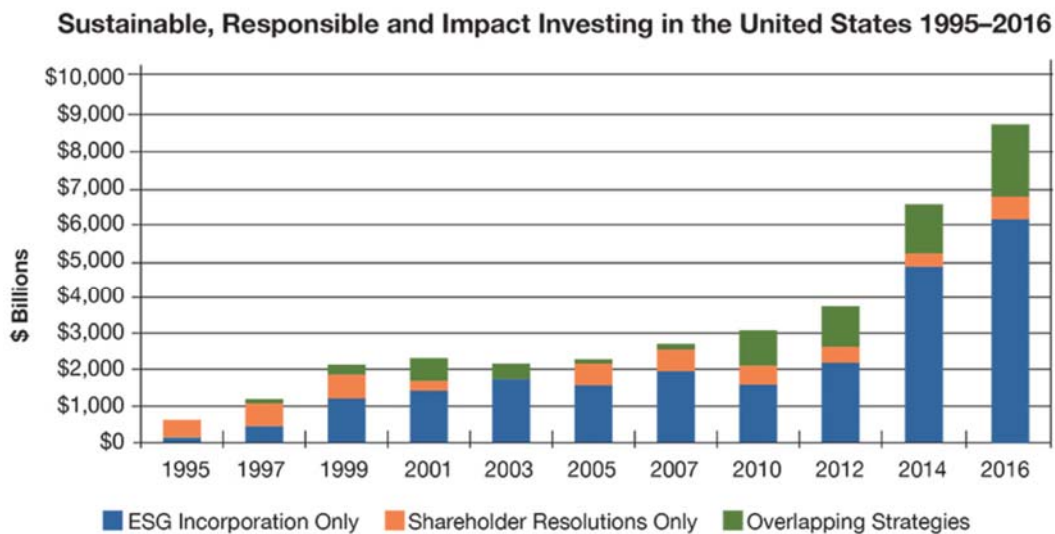
SOURCE: US SIF Foundation.

Source: US SIF Foundation[19]

In 2017, a breakdown of $113.7B made in impact investing assets showed that approximately 22% ($25B) of those funds went towards real assets.[20] And a 2016 survey of 209 impact investors found the firms invested a total of $22 billion in approximately 8,000 impact investments in 2016 and expressed the intent to increase capital invested in 2017 by 17% and the total number of investments by 20%.[21] Real

assets accounted for 22% ($4.84) billion of the $22 billion. This data supports that sustainable real assets are a growing investment area.

Trends and macroeconomic forces that are contributing to the growth of investment in sustainable real assets include:

- Resource scarcity.[22]

- Climate change.

- Increasing levels of urbanization which will bring an greater focus on affordable housing.[23]

- Population growth and changing diets that will result in an increased global demand for food.[24]

- Increasing consumer demand for organic and sustainable agricultural products.[25]

- Changing laws and regulations.

- Increased international focus on sustainability (e.g. the Paris Climate Accord).

- Growth in environmental commodity markets.[26]

- A millennial population with greater demand for investment in environmentally conscious goods and services from firms they buy from or engage with. Money managers project that millennials will invest with more of an impact lens than previous generations.[27]

2.3.   Current Investor Landscape

The current investor landscape for real assets and sustainable real assets is dominated by institutional investors, high net worth individuals, and family offices. However, recent technological innovations and regulations have given smaller investors access to these alternative investment opportunities through crowdfunding platforms.

2.3.1.   Institutional Investors

Institutional investors are the primary investors in real assets. Examples of these types of investors include but are not limited to: pension funds, insurance companies, hedge funds, university endowments, sovereign wealth funds, and foundations.[28,29]

2.3.2.   High Net-Worth Individuals and Family Offices

High net-worth individuals and family offices are another group with investments going into sustainable real assets.[30] Though these individuals and offices generally don't make investments directly, often going through funds and advisors, they do make their investment criteria clear to those investing on their behalf and are increasingly including environmental and social impact in their investment requirements.[31]

2.3.3.   Individual Investors: Crowdfunding

Crowdfunding is defined as, "the practice of funding a project or venture by raising many small amounts of money from a large number of people, typically via the Internet."[32] Crowdfunding is a mechanism that can act as an additional source of

external financing for a project, bringing in funds from a large number of smaller backers and giving those backers access to new investment opportunities. It has proven to be an effective means of fundraising with $34B being raised globally through crowdfunding, in 2015.[33] Of that $34B, $25B was for person-to-person lending, $5.5B was for donations and rewards, and $2.5B was for equity financing.[34]

Over the past few years, crowdfunding platforms have begun to have success in raising funds for investment in real assets, primarily real estate. In 2012, the real estate crowdfunding market was only approximately $12M; however, this investment vehicle grew to over $1B by 2014 with an average deal size of $800,000 (ranging from under $100K to over $25M) while offering an investor to invest as little as $100 to gain exposure to a project.[35,36,37] This indicates that there is a strong appetite from smaller individual investors to have the ability to diversify into these types of investment opportunities as long as efficient investment vehicles are put in place.

As the popularity of equity crowdfunding grew, so did awareness that regulations at the time were not structured to address these types of capital raises. As a result, regulations in many jurisdictions were amended or created to allow for these securities to be sold to both accredited and non-accredited investors, within specific regulatory frameworks.[38]

For example, in the United States, with the passing of the 2012 Jumpstart Our Business Startups Act (JOBS Act), and later revisions to the Act, as seen in **Figure 2**, both accredited and non-unaccredited investors were given the legal right to invest in certain alternative investments, including securities, through equity crowdfunding platforms.[39]

Figure 2: 2012 JOBS Act Regulations and Investment Opportunities Enabled

	506b	506c	Regulation A+		Title III*
			Tier 1	Tier 2	
You can do today	Yes	Yes	in 60 days		No
Max to raise:	No Cap	No Cap	<$20M	$20M - $50M	$1M
General Solicitation Allowed	No	Yes	Yes		Yes
Online Crowdfund Platforms Allowed	No	Yes	Yes		Yes
Unaccredited Investors Allowed	Up to 35	No	Yes (but can only invest up to 10% of annual income or net worth)		Yes (but can only invest up to 10% of annual income or net worth)
SEC Registration	Only file Form D	Only file Form D	Yes	Yes	Only file Form D
State (Blue Sky) Registration	Yes	Depends	Yes	No	No
SEC Review	No	No	Several Weeks		21 days
Annual Audit/Financial Reports	No	No	No	Yes	Yes
Estimated Costs	$25-$75K	$25-$50K	$50-$75K	$75-$150K	$5-$25K
Investor Accreditation	Self	Issuer Verified	Self		Self
Suitable for	Seed, Scale, Growth	Seed, Scale, Growth	Growth		Seed, Scale

Source: Crowdfund Intermediary Regulatory Advocates [40]

3. Defining the Technology

I will first briefly review blockchain, the underlying technology that allows for trusted transactions between parties who have never met. I will then discuss Bitcoin – the protocol for the first digital currency, "bitcoin," to use blockchain – as well as a general overview of cryptocurrency. I will then move onto more detail on how blockchain

works and the cryptography behind it. I will next review Ethereum, the blockchain most

Initial Coin and Token Offerings are run off of and how it enables Smart Contracts. I will

follow this by reviewing Initial Coin Offerings and Initial Token Offerings and the types of

tokens and coins. I will finish this section by looking at the regulatory issues and other

potential risks associated with the technology.

3.1.   Blockchain and Cryptocurrency

The Blockchain process is outlined in Figure 3. A blockchain is a

cryptographically secure distributed ledger that allows for exchange of ownership and

verification of ownership without needing a trusted third party to act as a middleperson.

Figure 3: Bitcoin Blockchain Process
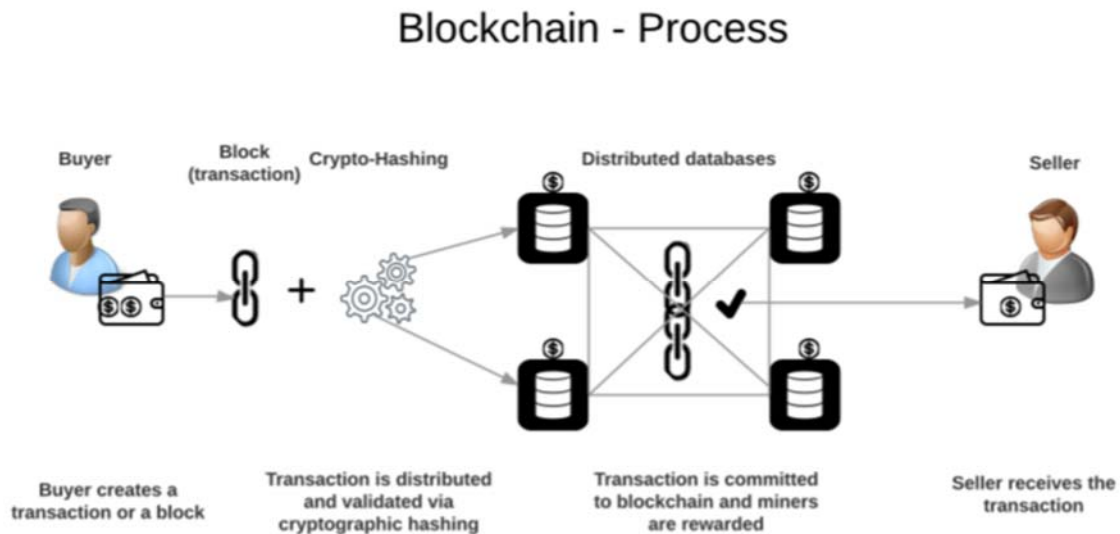
Source Wikimedia.org[41]

A blockchain can be public, where it is open source, and anyone can access the permissions (e.g., Bitcoin or Ethereum); or, it can be private, where it has been built for organization or company use, and permissions are limited.[42] Each blockchain operates off of a protocol, "the software that governs rules, operations, and communication between network nodes," including the rules for validating transactions.[43]

As the uses for blockchain technology have evolved, the definition of blockchain has as well. However, with respect to this paper, blockchain will be defined as a publicly distributed and decentralized ledger focusing on implementations and transactions using cryptocurrency.

In 2008, Satoshi Nakamoto released a paper titled "Bitcoin: A Peer-To-Peer Electronic Cash System," detailing a new mechanism, leveraging cryptography, for exchanging electronic cash from one party to another and eliminating the need for a trusted third part such as a financial institution.[44] He called this new mechanism "Bitcoin" and introduced the first decentralized distributed cryptocurrency- "bitcoin"- using a public blockchain as its foundation.[45] As of January 2018, Bitcoin had a market cap of $231.8B which is 37.6% of the overall cryptocurrency market. [46] This makes bitcoin the cryptocurrency market cap leader but is a significant decrease from the 80% market share it held in January of 2017.[47] Blockchain is described in detail below.

Cryptocurrency is a 'digital' or 'virtual' representation of value that uses encryption to secure, document, and facilitate the processes involved in generating units of digital currency and conducting and verifying transactions made with them.[48,49] They are viewed as alternative currencies, non-legal tender that are generally tolerated

by governments and other institutions but are not minted by a central government or considered official currency.[50]

Earlier work in cryptocurrency focused on algorithms (cryptographic methods) and privacy but had not solved for a way to create trust and remove the need for trusted third parties.[51]

3.1.1. How it Works

Transaction Initiation

A blockchain transaction is initiated when two parties decide that they are going to exchange data, whether it's money, a contract, a deed, et al.[52] Let's use an example on the Bitcoin blockchain. In this scenario, Sara wants to send 1 bitcoin (BTC) to Joe. Sara uses the digital wallet holding her Bitcoin and inputs that she wants to send 1 BTC to Joe's public address (this will be discussed in more detail below).

Broadcast to the Blockchain

At this point, based on the rules of the given blockchain, also known as the protocol, the transaction is either automatically verified or placed in a list of pending transactions.[53] In the case of Bitcoin, the transaction is broadcast to the Bitcoin blockchain's decentralized peer-to-peer network - a network of computers and servers known as "nodes" – and sets off an automated request to the nodes to verify that Sara owns the 1 BTC and has not already spent it.[54] The transaction is then timestamped and placed with other outstanding transactions in the transaction pool as an unconfirmed transaction before being collected by the "miners." A miner is a node on the network with the appropriate computing power and software needed to validate and secure transactions.

Mining and Validation

Transactions (like the one between Sara and Joe) are grouped together by miners onto a candidate 'block' with a number of other transactions that have occurred

in a given time period. The time period for the generation of each new block varies by blockchain. Examples are the Bitcoin protocol producing a new block approximately every 10 minutes and Ethereum's protocol producing a new block approximately every 12 seconds.[55] Each new block must be validated in order be placed on the blockchain. The validation requirements vary by blockchain, depending on the cryptographic consensus protocol used. The most common consensus protocol for validation is Proof-of-Work (PoW), which relies on miners finding the answer to a cryptographic puzzle.[56]

One of the primary purposes of the Proof-of-Work protocol is that it prevents double spending and forgery.[57] Double-spending is the ability to duplicate a piece of digital currency that would allow it to be spent or transferred by the same party, after they've already spent it once. Double spending enables fraud and can create a lack of trust in the system. Proof-of-Work incentivizes the miners to validate and secure the transactions since they are awarded coins or tokens by mining for cryptocurrency or through fees for processing transactions.

In Bitcoin's Proof-of-Work protocol, once the transactions are pushed out to the network (including the 1 BTC transfer from Sara to Joe), miners each form their own candidate blocks and compete to solve a complex cryptographic puzzle, whose solution is needed in order to validate and add the next block to the blockchain. Miners compete to be the first to solve the algorithm, by finding a valid solution to the cryptographic puzzle – an arbitrary number called a nonce, that when combined with data from the block, provides a specific result.[58] The miner then relays it to the network.

After a majority (51%) of the network verifies that the parties involved in the transactions on the candidate block can make those transactions and that the solution

to the algorithm is legitimate, the block becomes a valid block and the miner who initially solved the algorithm receives a reward (e.g. currently 12.5 BTC and a transaction fee, on the Bitcoin network).

Inclusion on the Blockchain

The block is then time stamped and added to the blockchain. This is also when the transactions on the block convert from unconfirmed transactions to confirmed transactions. In our example, this is when Joe would receive the 1 BTC.

Each block added to the blockchain contains a hashed reference (a cryptographic hash function is a one way function that takes one input and produces one output, this will be discussed in more detail further in this paper) to the block preceding it, making it possible to trace every transaction that has occurred on the ledger.[59] The chain is then updated across all nodes in the network, ensuring each node has an identical copy of the ledger.[60,61] For example, each transaction on the Bitcoin ledger is recorded and stored by every user running the Bitcoin software on their computer. This also allows anyone who logs onto the network to be able to view and validate that a given transaction took place.[62] Additions to the blockchain cannot be reversed without the consensus of the majority of the network

This process enables a "trustless-trust" transfer. If someone attempts to publish a duplicate transaction on the blockchain, it will immediately be denied because the original transaction has already been validated and recorded.[63] "Trustless" transactions are transactions that don't require intermediaries since the network, via its miners, is now responsible for transcribing and maintaining the ledger of transactions.[64]

Public Key Infrastructure

On many blockchains (e.g. Bitcoin), transactions between parties make use of public-private keys (Public Key Infrastructure) and digital signatures for validation. A private key is only known by the owner of whatever is being transacted. Each private key has a corresponding public key that allows a party to prove ownership without revealing the private key. When a party wants to make a transaction, they sign the transaction with their private key, approving the transaction to move forward.[65] This transaction is then broadcast onto the network with the public key, allowing the transaction to be validated by the network without revealing the private key to everyone. These keys cannot be forged or duplicated because there is only one public key that will ever be associated with a given private key so as long as the private key is not shared.[66]

Cryptographic Hash Functions and the SHA-256 Hash

A cryptographic hash function is a one-way function (it can't be decrypted back) that takes any input and produces a fixed size output. In the case of the Bitcoin, this output is a 256-bit output.[67] This output comes from running the transaction through a cryptographic hash function called SHA-256 hash. Any small change to the input will result in a drastically different output, making it impossible for an individual to make even the slightest change to the input or an adjustment to the block and have the same resulting hash.[68]

An example of a slight change and a very different output is running the phrases "Hello world" and "Hello world!" through a SHA-256 calculator[69]:

Input	Output
Hello world	64ec88ca00b268e5ba1a35678a1b5316d212f4f366b2477232534a8aeca37f3c
Hello world!	c0535e4be2b79ffd93291305436bf889314e4a3faec05ecffcbb7df31ad9e51a

In the case of Bitcoin, after each individual transaction is run through a SHA-256 hash function, every two hashes are grouped into pairs, concatenated, and hashed. This continues until there is a single root hash left, forming a "Merkle Tree" (Figure 4). The final single root hash is called the "Merkle Root" or "Tx_root."[70]

Figure 4: Bitcoin Merkle Tree and Block Header[71]
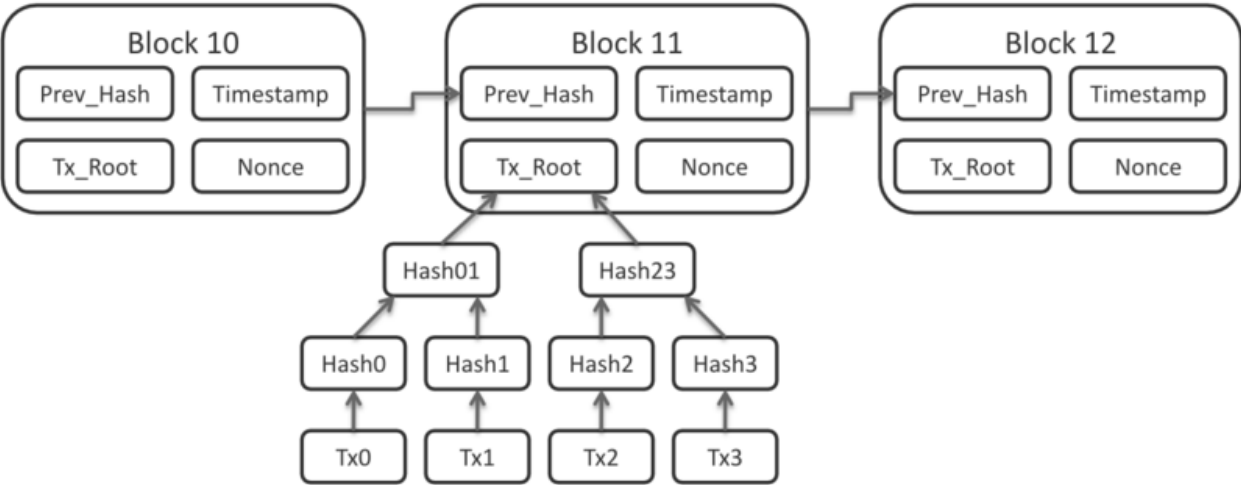
This structure makes it easy to track down an individual transaction since one only has to follow the trail of hashes that leads back to the transaction.[72]

Each block on the Bitcoin blockchain has a header that contains the version, a hash of the previous block header, hash of the Merkle Root of the block, a nonce,

number of bits, and a timestamp. The body of the block contains the transactions. The

hash of the previous block header being embedded in the current block header links it

to the previous block and secures the blockchain. This linkage that runs through the

blockchain ensures that no transaction can be altered without first changing all of the

transactions that took place after it.

3.1.2.　　Attributes of Public Blockchains

Public blockchains have a number of attributes that allow separate parties to trust

each other to make a transaction without the use of an intermediary outside of the

blockchain.[73] Robinson identified these attributes as having a distributed network, being

accessible, being transparent, being permanent and immutable, and being secure.[74]

- **Digital distributed ledger**: There is no centralized server and all valid transactions are stored on all computers or "nodes" that are a part of the decentralized peer-to-peer network.[75] This distribution ensures that there can be no single point of failure in the system since it's replicated across many computers.[76] 51% of nodes must verify a transaction is valid in order for it to be transcribed onto a block.[77]

- **Accessible**: Anyone can download the open source software needed to operate can run, free of charge – this increases participation by lowering barriers to entry and democratizes whatever process is being documented by each given blockchain. [78]

- **Transparency**: Any transactions that has ever taken place on the blockchain can be seen by anyone who participates on the network – since everyone on the network can see every transaction because of the public-private key structure, fraudulent transactions would be impossible to post.[79,80]

- **Permanent and immutable**: After a transaction is validated, it is nearly impossible it to be changed or removed from the blockchain.[81] This generates additional trust and allows for trustless-trust since others know that when a transaction is recorded, it cannot be changed fraudulently. An exception to this would be if an individual or group somehow got control of 51% (called a 51% attack) of the nodes on the network and was able to make retroactive changes because it takes 51% of the network to do so.[82] However, this would be

incredibly difficult because an individual or group would have to take control of more than 51% of the nodes on the network for this to occur.

- **Secure**: Since the blockchain uses it encryption, it is essentially impervious to an outside attack except in a situation like a 51% attack.[83,84]

3.2.   Ethereum and Smart Contracts

Bitcoin is a blockchain that offers "bitcoin," a cryptocurrency that can be exchanged for a good, service, fiat currency, or other cryptocurrency. Ethereum, on the other hand, is a blockchain based technology that operates as an open-source, public, decentralized platform that runs smart contracts and allows developers to build their own applications on the Ethereum blockchain. This allows for more complex transactions to take place via smart contracts that allow for a string of conditional transactions.[85] An example of how Ethereum can be used is money being automatically sent from one party to another, but only if a set of conditions or certain criteria take place.[86] Whenever a transaction takes place on the Ethereum blockchain, it requires a fee for the computation to be made with the fee being determined by the complexity required to solve the computation.[87] This payment is referred to as "gas" and is paid in "ether," Ethereum's currency.

Ethereum was conceptualized in 2013, crowdfunded in July of 2014, and officially released in March of 2016. Like Bitcoin, Ethereum uses a Proof-of-Work protocol for consensus. However, there are plans for Ethereum to move to a Proof-of-Stake (PoS) protocol called Casper, in the near future. Proof-of-Stake achieves consensus through "stakers" or "minters" who lock their coins in specialized wallets (put in "escrow") - this is also known as "staking."[88] These stakers will be rewarded with transaction fees and the

more coins they stake, the higher probability of being selected to "nominate" the next block.[89,90] Essentially, the more coins or tokens owned by a staker, the more blocks that staker will be given to validate.[91] If a block is nominated that contains an invalid transaction, the staker will lose the tokens that were put in the specialized wallet.[92] This will significantly reduce the computing power needed and therefore amount of energy needed to maintain the Ethereum blockchain.

The Ethereum blockchain allows for three types of transactions: the ability to send ether from one account to another, the ability to create smart contracts, and the ability to execute smart contract codes.[93]

The Ethereum platform has become the platform of choice for most token sales since it allows developers to utilize Ethereum's Virtual Machine instead of having to develop and build out their own blockchain.[94] This is much less costly and takes less time than developing a blockchain from scratch. The applications built on Ethereum are called decentralized applications (DApps) and their backend code runs on the open, Peer-to-Peer Ethereum network. They use Ethereum's protocol – ERC-20 standards – to launch and operate their cryptoventure.[95] By using this protocol, it allows tokens generated by DApps to be exchanged and used interoperability with other tokens launched using the ERC-20 protocol.[96]

3.3. Initial Coin Offerings and Initial Token Offerings

An Initial Coin Offering or Initial Token Offering, collectively known as "token sales," "involve the opportunity for individual investors to exchange fiat currency such as U.S. dollars or cryptocurrencies in return for a digital asset denoted as a coin or token". Initial Coin and Token Offerings currently act as unregulated mechanisms to fundraise for new cryptoventures.[97,98] They are also often jointly called "token sales" which is the terminology that will be used for the rest of this paper. These token sales can be seen as a type of crowdfunding that can offer potential benefits or returns to those who purchase the coins or tokens.[99] These benefits vary based on the token or coin being sold with some tokens offering access to services or products and others acting as investment vehicles.

The value of any given token being sold via a token sale is based on its utility value and speculative value.[100] The fact that young cryptocurrencies derive 80% of their value from speculation makes accurate valuations difficult.[101,102]

Other important factors to look at in determining whether or not to make an investment in a token sale is the strength of the development team, the token issuance model and what percentage of the tokens are being kept by the founding team, the problem or issue being solved, and how this solution proposes to help with the problem.[103,104]

A coin is a type of cryptocurrency that has its own blockchain such as bitcoin or ether.[105] A token is a type of cryptocurrency that runs its application of a blockchain protocol that is not its own such as ERC-20 token standards attached to the Ethereum blockchain.[106]

Token sales have seen rapid growth as reflected in that there were only 44 completed raises, for over $100,000, in 2016 compared to the 519 completed raises in 2017, most of which were in the latter part of 2017 (Figure 5).[107,108] Because of the cryptocurrency market's significant volatility, market capitalization is not stable and cannot be accurately projected, but was estimated at $525 billion, in December 2017.[109]

Figure 5: Number of Offerings per Month (minimum $100K)
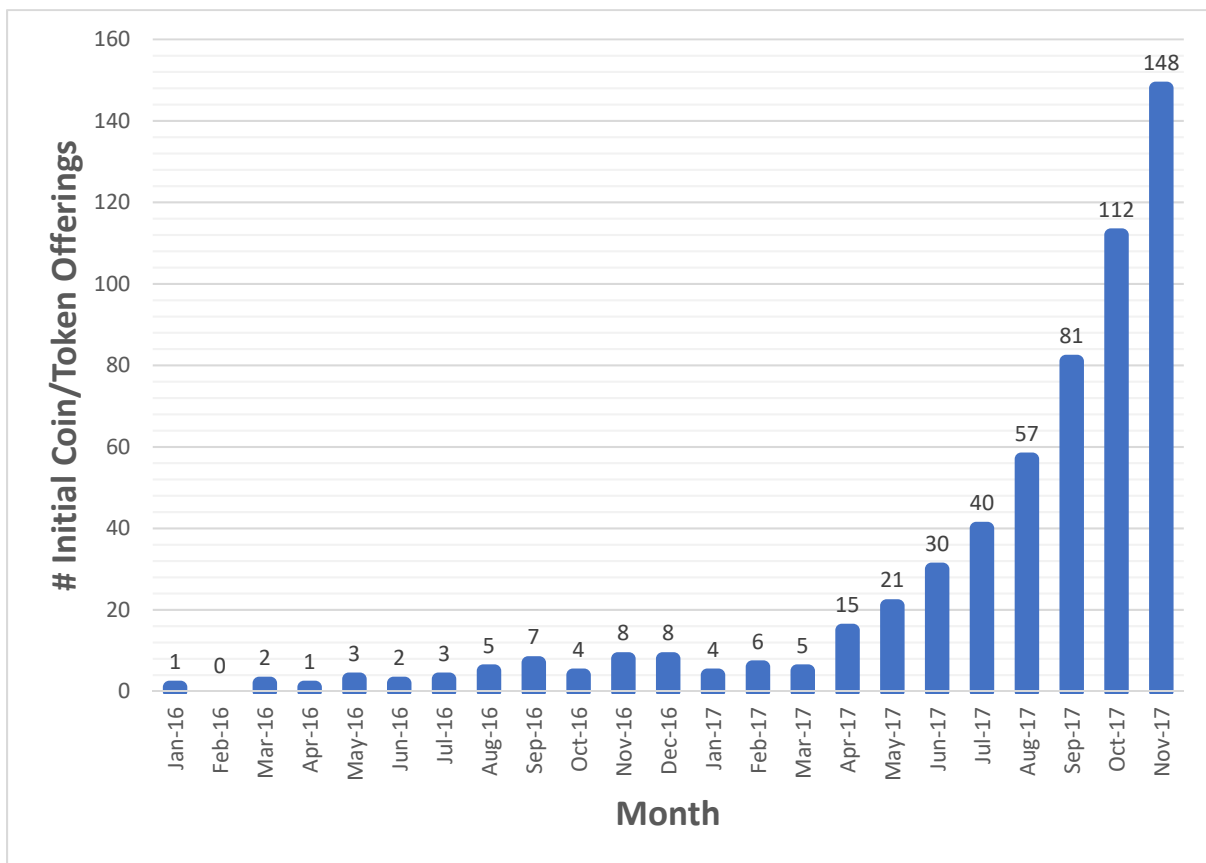
Source: Elementius [110]

In 2017 (through December 10), token sales raised over $4.27B, an amount that dwarfed the $231M raised in 2016 and $8M raised in 2015.[111] Funds raised through token sales exceeded investment from US venture capital firms in blockchain and almost outpaced angel and seed equity fund all tech and angel seed deals (Figure 6).[112]

Figure 6: Tech angel seed equity funding vs ICO funding
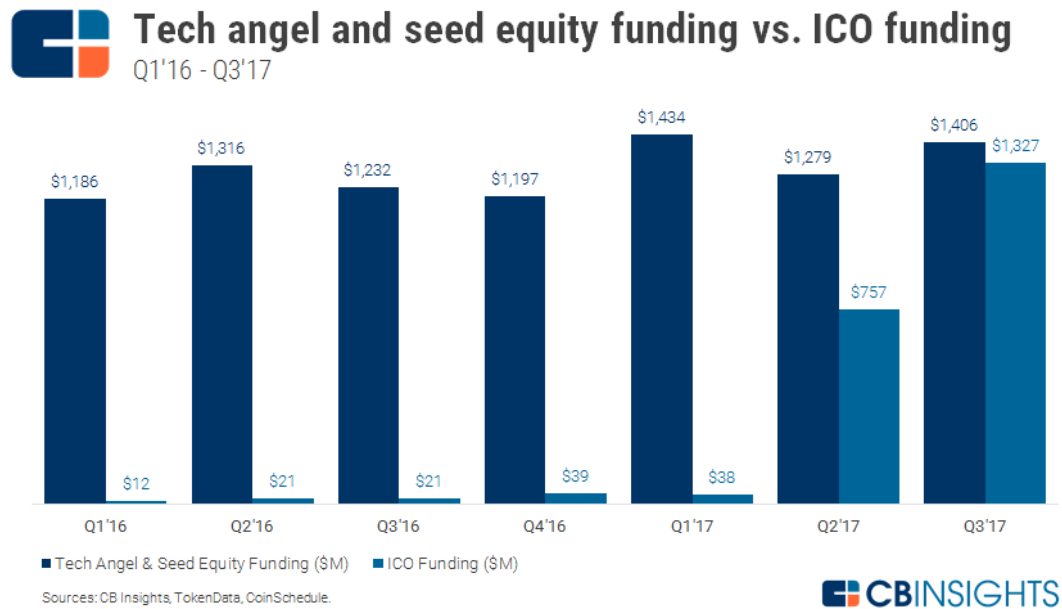
Source: CB Insights [113]

The bulk of cryptoventures funded by token sales have been focused on core blockchain technology but there has been a recent shift of more investment into cryptoventures focused on financial markets, investment products, media, and social uses (Figure 7).[114]

Figure 7: Initial Coin and Token Offering Raises by Industry
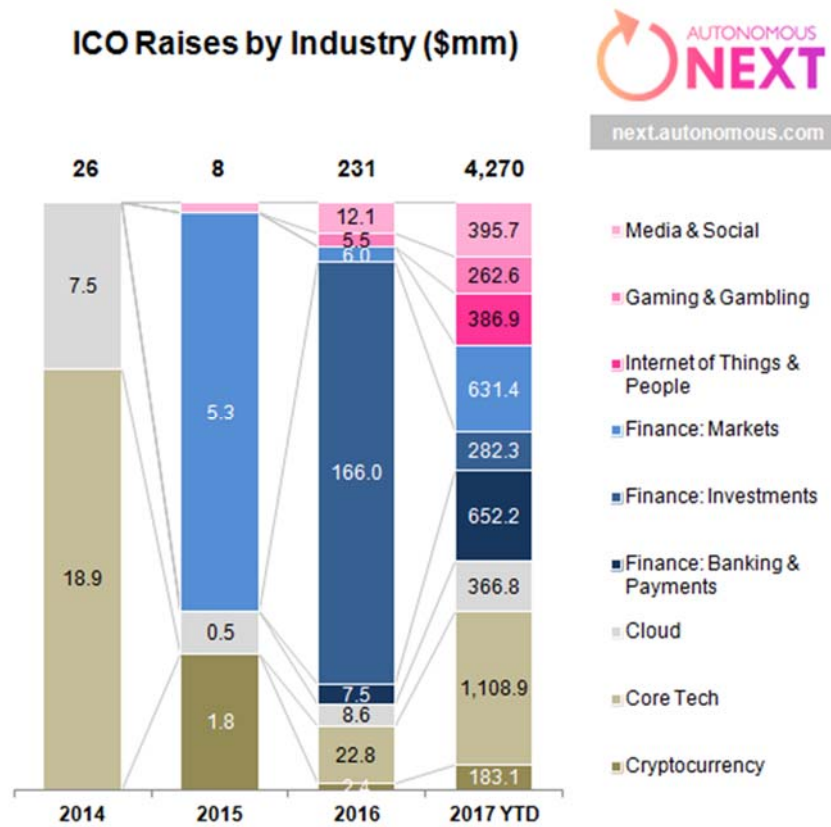
Source: Autonomous Next[115]

Though billions of dollars have been raised, few projects have been fully developed. In December 2017, Ernst & Young performed an analysis of 372 cryptoventures that had issued a successful token sale and found that only 5% were up and running, 11% were in the prototype stage, and 84% were still in the idea stage.[116]

EY determined that this was in part because most projects have a planned launch that is 1-2 years after the token sale, assuming the firms stick with their timelines, and were predominantly funded in 2017. This would indicate that there will be more funded projects out of Proof of Concept and fully operational in 2018 and 2019.

3.3.1. Types of Tokens

Given the decentralized development of cryptocurrency and token sales, lack of any formalized governance, and globalized nature of the evolution of this field, there is no generally accepted classification of different token types. However, there are a number of proposed typologies.[117]

For the purposes of this paper, it is important to differentiate between "security" or "asset backed" or "equity" tokens and "utility" or "app" tokens.

- **Utility Token**: This type of token gives access to current or future services or products and does not act as an ownership vehicle so it is not considered a security.[118, 119]

- **Security Token**: This type of token acts as an ownership vehicle/security. The tokens represent ownership and economic rights proportional to the share of tokens owned and has value in that it can return profit to the token holders through dividends or other profit sharing.[120] These tokens can be exchanged for the asset.[121] In the United States, security tokens are defined as passing the Howey test[A] and are then regulated as securities. Being regulated as a security is something most firms are doing everything they can to avoid as it will limit their ability to fundraise in the United States and other countries.

[A] The Howey test is what the US government uses to determine whether or not an investment offering or contract is considered a security. One would be considered a security if the investors 1) investor money; 2) with the expectation of profit; 3) from a common enterprise; 4) depends on the effort of others. An investment has to meet all four of the points to be considered a security. Source: https://www.sec.gov/Archives/edgar/data/1522690/000119312511196626/filename8.htm

3.3.2.   Typical Roadmap to Launch a Token Sale

With the current lack of regulation and absence of a central authority governing these issuances, there are no requirements to issue a token sale, but there are some generally accepted best practices outlined in Figure 8.

Figure 8: Initial Coin and Initial Token Offering Roadmap

Announcement and Pre-Offer	Offer	Marketing & Public Relations	ICO/ITO Launch
The future offering is announced on various cryptocurrency websites such as Reddit and contains an executive summary with relevant information on project goals, team, and other information used to generate interest from potential investors. This summary is drafted with the intent of collecting comments/feedback on the project and adjust the project, if needed, before writing a "whitepaper" on the new venture. Whitepaper is then developed and published for the project. Clarifies underlying framework, information on expected returns, et al.	Terms of the offering are released. These include the information on the project, number of tokens that will be issued, date for Pre-sale, date for Main sale, length of sale, pricing, and information on the token and rights that will be associated with the token. Most firms release a 1-2 minute video explaining the concept.	Marketing and public relations campaign begins in order to garner buzz for the project and bring in investors. Some firms hire public relations firms to assist with this. General marketing tactics involve attending trade shows, setting up bounty programs to engage influencers, conferences, and online events. Leverage social media and give interviews. Typically lasts 1-2 months.	Pre-sale takes place a few days before the Main sale. A successful Pre-sale is useful for building buzz for the Main sale. Depending on the structure of the project, coins/tokens are immediately released or held until the platform or product it was intended for is ready to be released.

Sources: Deloitte and the Token Book [122,123]

3.3.3.   Regulatory Uncertainty and Other Risks

Regulation of cryptocurrency and token sales is inherently difficult as current regulatory frameworks were not designed with them in mind and because of the lack of clarity as to what cryptocurrency is defined as (e.g. in the United States: the Commodities Futures Trading Commission has defined it as a commodity; the IRS has labeled it property; and the SEC has noted it can sometimes be a security).[124] As a result, regulation of token sales and cryptocurrency is in its infancy with individual jurisdictions each exploring how to best define what they are regulating, how it all might fit into current regulatory frameworks, and other issues they might need to consider in regulating this emerging asset class.[125]

To date, no jurisdiction has released and enforced a comprehensive framework for defining and regulating cryptocurrency and token sales but the most common response has been for regulatory and legislative bodies to release comments, guidance, and announcements on the topic.[126] Much of what is being released touches on the potential risks to individual investors, that these offerings are important trends and worthy of consideration, and that there are different types of tokens and coins being offered which requires that each token sale be looked at on a case by case basis.[127] Additionally, many of the regulatory bodies in these jurisdictions have issued responses which note that many tokens are securities, even though those putting out the offerings claim they aren't.[128]

One of the most significant regulatory issues for companies looking to offer a token sale, individuals looking to invest in one, or individuals looking to trade or use

tokens, is whether or not the offering or token can potentially be labeled a security offering or a security, which will open it up to more stringent regulation.

Jurisdictions that have put out warnings about some token sales being viewed as security offerings include the United States and Hong Kong. In the United States, a token will be considered a security if it passes the Howey test and will be looked at on a case by case basis. In Hong Kong, the Securities and Futures Commission said it will look at the substance rather than the form of the token sale to determine if the token sold is a security or a virtual commodity.[129] If classified as a security, in the United States, the token would be subject SEC security regulations that limit who funds can be raised from, and how much can be raised from them. This places restrictions on transferability of securities and requires specific mandatory information to be provided to investors, significantly increasing transaction costs. However, as noted in Section 2, there are opportunities to use the exemptions provided for by the 2012 JOBS Act.

Some companies issuing token offerings are trying to work around regulatory requirements by calling token sales "crowd sales" instead of coin or token "offerings" or by creating different types of consensus protocols that they claim ensure their token is not a security.[130] Whether or not these tactics are adequate to resolve the issue is not yet known. Other token sales simply do not allow for investors from the United States, out of concern that it will eventually be labeled a security by the SEC. The bulk of the recommendations coming from the cryptocommunity are that coins and tokens that likely fall into the security category, should preemptively follow any regulation required by the jurisdictions they are operating in or selling to.

Other risks of token sales and cryptocurrency are:

- Potential vulnerability for investors in situations like hackers getting access to wallets or trading platforms.

- Not all blockchain technology is created equally and not all cryptotokens launched on platforms like Ethereum are either. There are no standards so every blockchain product or service needs to be evaluated individually.

- Fraudulent token sales can act as deterrents for investors as they can potentially reduce trust in the technology since this is still a new funding mechanism.

- No clear valuation methodology.

- Significant market volatility.

- Anonymity which can enable criminal activities and reduce trust in the technology.

- Massive amounts of energy consumption in cryptocurrency mining when Proof-of-Work is the underlying protocol.

4. Use Cases

After performing a literature review and desk research on real assets and blockchain technology, I'm now going to do a deep dive on two use cases of cryptoventures that have completed token sales with the intent of offering blockchain platforms that will operate as exchanges for investing in real assets (predominantly real estate). However, due to the newness of this funding mechanism, they are still in Proof-of-Concept stages and have not formally launched. Therefore, instead of using a fully operational model to build out a use case, I've used whitepapers, information from cryptocurrency blogs and websites, company websites, and publicly available interviews with the founders and other employees of the projects to show how these platforms can potentially increase access and improve efficiency in funding investment in real assets.

4.1. BankEx

BankEx is a blockchain financial technology company that was founded in 2016 and is based in New York City. The firm is developing Banking-as-a-Service[B] blockchain technologies that will offer an infrastructure for financial technology providers, traditional financial institutions, and asset owners to sell assets through its Proof-of-Asset (PoA) Protocol. [131,132,133,134] This protocol is a standard that allows for the confirmation and evaluation of an asset.[135] BankEx completed its token sale in December 2017 and raised $70.6M, making it one of the twenty largest token sales to have taken place, as

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[B] Banking-as-a-Service is a process that ensures completed execution, from start to finish, of a financial service offered through the internet

of February 2018.[136] After the token sale, the firm issued BKX tokens, utility tokens that will be used as the fuel for powering transactions on the BankEx platform (like ether does for Ethereum). BankEx is developing its platform on the Ethereum blockchain and will offer ERC-20 compatible tokens.[137]

The BankEx platform will have a number of applications but for the purpose of this paper, I am specifically looking at its capability to allow for the tokenization and trading of real assets. Tokenization is "the process of converting rights to an asset into a digital token on a blockchain."[138] BankEx proposes to facilitate this process through the creation of "Smart Assets" through "Initial Smart Asset Offerings," using the BankEx Proof-of-Asset Protocol.[139] Examples of what can be tokenized into a Smart Asset include but are not limited to stores, farms, Instagram accounts, residential real estate, shares in non-public companies et al.[140] Depending on the type of asset being tokenized and the jurisdiction the asset is located in, there is a chance that the firm will need to bring in third parties like escrow agents, for certain types of transactions.

The process for bringing these assets to market has four stages: Digitization, Tokenization, Asset Trading, and Dealing (Figure 9).[141]

**Figure 9: Initial Smart Asset Offering Process**

The process includes four stages:

1. Digitization	all available information regarding the asset is collected and verified by BANKEX before it is placed into the Smart Contract; at this stage all the legal and accounting issues are addressed, analyzed and if required, resolved.
2. Tokenization	Step 1 - The gathered information is placed into an Ethereum Smart Contract. Step 2 - The Ethereum Smart Contract is transformed into a Smart Asset. During this step BANKEX provides escrow services. A token is created.
3. Asset trading	Step 3 - The newly created token goes to market. The token has to comply with a set of trading rules in order to be listed on the market, i.e. it has to pass a set of filters that are vital for verification.. Step 4 - Here the price is adjusted based on to the market offer. The smart contract is put on the BANKEX market.
4. Dealing	During this step it is important to make sure that the Token is guaranteed to be delivered to the supplier (investor). This process is carried out by Proof of Mining.The result of this stage should be the successful delivery of the product token to the supplier (investor) and the token should be stored in the supplier's wallet. Meanwhile, the BANKEX token will be delivered to the originator, i.e. asset owner.

Source: BankEx Whitepaper[142]

BankEx will verify that the Smart Asset is backed by an actual asset through its "Smart Asset Caterpillar" defined as a "series of smart contracts that serve to validate and exchange assets."[143] The smart contracts involved will vary based on the requirements of the given asset and the regulations of the jurisdiction the asset is located in (Figure 10).

BankEx is developing their own exchange for third parties looking to tokenize and sell assets on a BankEx asset-backed exchange or on an exchange organized by the owners of the asset and powered by BankEx.[144,145]

Figure 10: BankEx Proof-of-Asset Protocol
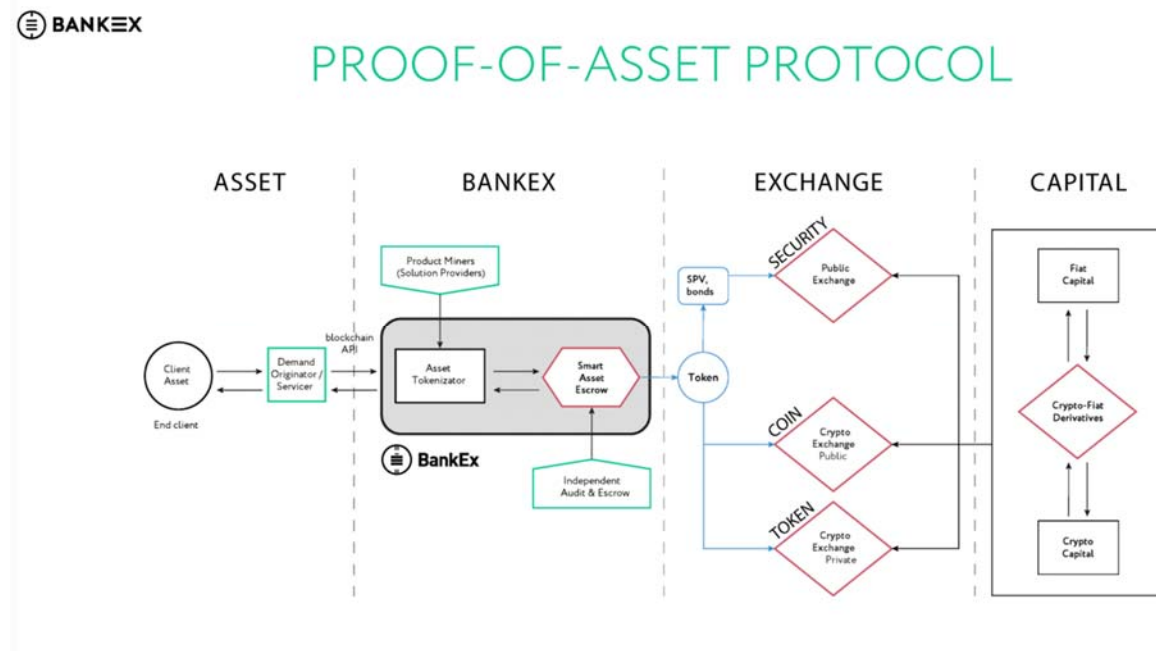
Source: BitcoinTalk[146]

BankEx is exploring a number of Proof-of-Concept cases for its services. One of these cases is looking into tokenizing a real estate investment project in Hong Kong for an international bank with a presence in 60 countries.[147] In this scenario, they would tokenize an unbuilt apartment complex with each Smart Asset Token being backed by a given number of square meters of a future apartment. First, BankEx would validate that the bank actually has the property rights through its Proof-of-Asset protocol.[148] Once that is validated, BankEx and the bank would determine the number of tokens they would like to sell, how much each token would sell for, and any smart contracts that

would have to be developed in order to protect both the bank and any individual investor. Let's call them APT tokens that cost $1000 per token, with 1000 APT tokens being sold, and each APT token being backed by 10 meters of property rights. The project would then be tokenized and the actual asset put in escrow. After the asset is tokenized, the APT tokens would immediately be available for purchase by individual investors who can either hold them or resell them on Third Party exchanges that are compatible with ERC-20 tokens.[149] The APT tokens will then presumably appreciate in value as the project comes to completion.[150] Individual investors would be able to keep tabs on the project's development through Internet-of-Things sensors that would document the projects process on the blockchain.[151]

While this example is fairly straight forward, it's important to note that anything that can be put in a contract can be put in a smart contract, not just the basics – for example, dividend payouts.

4.2.   Brickblock

Brickblock is a cryptoventure developing a platform that will run on the Ethereum network. It will act as an interface that lets individuals trade and purchase tokens that represent different assets, including real estate. Each token purchased entitles the owner of the token to the legal benefits of property ownership with respect to the asset. Brickblock uses a proof-of-asset (PoA) protocol giving investors the ability to trade tokens that represent a variety of assets on ERC-20 compatible markets. Fund managers (properties must be bought through a Real Estate Fund interested in listing their investment opportunities on the platform will be thoroughly vetted by Brickblock

and each opportunity will be audited by an outside party like Ernst & Young. The shares of the Real Estate Fund are then broken down into pieces and tokenized.[152] These shares are sent to a custodian and the assets backing the PoA are stored in a digital trust fund. The trust fund will hold the name number of shares as tokens and so now each token is backed with a share of the REF.[153] Individual investors can then purchase the tokens which will give them exposure to the asset that has been tokenized.

5. Analysis on How Blockchain Technology Can Increase Investment in Real Assets

Many characteristics of the market for real asset investment, as identified in the literature review on real assets, are barriers to entry for investment in these types of projects. Using the technology literature review, desk research, and use cases, I will now explore how blockchain technology can potentially reduce these barriers to entry and increase investment.

Figure 11: Barriers to Entry and Technology

Barrier to Entry	Attributes of Technology	Potential Benefits
High transaction costs	Smart contracts, digital exchanges, public distributed ledger and network consensus	Reduction in transaction costs would decrease the cost of investment
Limited awareness of opportunities	Digital exchange, publicly distributed ledger	Increase in awareness can bring in an increase in investment
Low liquidity	ERC-20 protocol, tokenization of assets	Increasing liquidity can bring in investors who would prefer more potential liquidity in their investment choices
Low information transparency	Digital exchange, smart contracts	Additional information can potentially increase trust and therefore investment
High investment cost per unit	Tokenization of assets	Reduce the amount needed to invest could bring in more investors

Barrier to Entry: High transaction costs

Benefit of Technology: The potential to reduce transaction fees will decrease both the cost of investing for investors and the cost of raising capital for project owners.

- Smart Contracts – The use of Smart Contracts can eliminate the need to use third parties for processes such as sending funds, executing contracts, facilitating the distribution of dividends, et al. By eliminating the need for these intermediaries, there are significant potential savings with respect to both time and money. An example of a potential cost reduction can be seen in an analysis showing that the use of blockchain for real estate title insurance was estimated to have allowed for potential savings of up to $700M, based on 2016 figures.[154]

- Digital Exchanges – Exchanges on the blockchain, like those to be offered by BankEx and Brickblock, can potentially reduce fees paid to individuals such as real estate brokers as it will allow those looking for funds to go directly to potential investors. In the US, in 2017, real estate brokerage fees accounted for $158.4B in revenue.[155]

- Public distributed ledger blockchain and network consensus – Given the immutability of tracking transactions, the costs of performing due diligence on an asset and the cost to perform an audit of an asset can both potentailly be reduced.

Barrier to Entry: Limited awareness of investment opportunities

Benefit of Technology: Increasing access to investment information and information about investment opportunities can bring in new investors. This can also potentially increase the confidence of current investors who might then be inclined to invest more.

- Digital Exchanges on a Publicly Distributed Ledger – Exchanges on the blockchain allow for investors around the world to be made aware of the investment opportunities. The transparency of information held on the blockchain can also help assure current and future investors that their investment is secure and that the investment opportunity is legitimate.

Barrier to Entry: Low liquidity of market

Benefit of Technology: Potentially increasing the liquidity of assets can bring in investors who do not feel as comfortable with the long holding time typically required when investing in real assets.

- ERC-20 Protocol – Use of the ERC-20 Ethereum protocol for the tokens gives investors the opportunity to list and sell their tokenized assets on secondary exchanges that are compatible with ERC-20 tokens – this increases the potential liquidity as it opens up the market.
- Tokenization of Assets – Selling a fraction of a real asset versus a full project opens the door to more buyers and thus increases the chance of selling the token as there are more buyers able to purchase a fraction of a project than a full project. This increases the potential liquidity of the investments.

Barrier to Entry: Low information transparency

Benefit of Technology: Increasing trust can increase investment dollars.

- Public distributed ledger blockchain - With the use of a public blockchain distributed ledger, once the asset is placed on the blockchain, it's easy to

verify that the asset or holding exists and its cash flows can be seen in real time. This can increase trust in the system.

Barrier to Entry: High investment cost per unit

<u>Benefit of Technology</u>: Reducing the cost per unit of investment in real assets brings down a significant barrier to entry in that it gives investors who are interested in exposure to real assets but either don't have or don't want to invest the amount typically required for real asset exposure.

- <u>Tokenization of Assets</u> – Tokenization of assets, as seen in the BankEx use case, allows for fractional ownership and gives investors real asset exposure at a lower cost. There is interest in this as evidenced by the significant growth of real estate crowdfunding discussed in Section 3.3.3.

6. Conclusion

In this paper, I looked into whether there is potential for blockchain technology and cryptocurrency to lower the barriers to entry for investment in sustainable real assets which would, in turn, increase investment. Based on my literature review, desk research, use cases, and analysis, I determined that the technology does exist to potentially lower the barriers to entry for additional investment in sustainable real assets. Potential mechanisms for raising additional investment through blockchain and cryptocurrency include: a) developing a new blockchain that specifically focuses on allowing the trade and sale of sustainable real assets; b) building a decentralized application focused on the trade and sale of sustainable real assets on the Ethereum

blockchain or another blockchain that that allows for applications to be built on top of it; or c) use platforms that are currently being developed such as BankEx or BrickBlock.

However, while the technology does exist, the application of blockchain technology and cryptocurrency is in its infancy with respect to tokenizing real assets. Given the lack of clear regulations or policy concerning cryptocurrency, there are still significant risks associated with anyone buying or selling real assets through these platforms. Additionally, it remains to be seen as to whether or not asset owners or investors are willing to use these new funding mechanisms to raise money or invest their money.

In conclusion, while blockchain is a revolutionary technology that has the potential to reduce complexity and increase access to opportunities, I recommend that using the technology with respect to investing in sustainable real assets be put on hold until these risks and others are mitigated and that there are actually implemented use cases.

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