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by

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Should All Blockchain-Based Digital Assets be Classified under the Same Asset Class?

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Abstract:

The literature is well aware that blockchain-based digital assets would constitute a new asset class. However, it has been rather silent about the distinction among them. This paper discusses the digital tokens' differences and similarities by their (i) creation and initial distribution; (ii) intended properties; (iii) actual usage; and (iv) behaviors. Although the digital tokens are indistinguishable in some aspects, they differ in the way they are created and initially distributed. Some of them have distinguishable risk and return profiles. Therefore, we take a view that the digital tokens take (or will take) different roles in the financial systems; should be classified under different asset classes; and should be subject to different sets of regulations (although some may overlap).

Keywords: Blockchain, Cryptocurrency, Initial Coin Offering, Digital Tokens

JEL Codes: G12, O31, G32

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1. Introduction

The Bitcoin blockchain, has been established in 2009 per the methodology outlined in the "Bitcoin White Paper" (Nakamoto 2008). Along with the Bitcoin blockchain, its native digital asset, the Bitcoin, has also been created. Since then, several other blockchains and several other "digital tokens" – digital assets created on blockchain – have also been created and deployed. (In this paper, we will classify "cryptocurrencies" as a type of "digital tokens" called "payment tokens.") Currently, there are more than 2,000 digital tokens listed on coinmarketcap.com with the total market cap of approximately USD 310 billion (as of 8 August 2019).

Recently, Facebook made a formal announcement about the Libra project – a cryptocurrency project that is anticipated to have a considerable impact on the existing financial system. Although at the time of the writing the project is currently on hold (due to regulatory complications), the characteristics of the digital tokens to be created under this project are still worth mentioning. There are actually two types of digital tokens to be created under this project. The first one is the widely discussed "Libra Coin" – a stablecoin (digital token that has its value pegged to other fiat currency or other assets) that is supposed to be used as a medium of exchange. The other one, not as widely discussed, is the Libra Investment Token. It appears that the founding members will receive "incentives" from putting money into the project as initial reserve (the minimum investment is USD 10 million).[4,5] The two types of digital tokens mentioned in the Libra project actually are just representatives of the various types of the digital tokens that are already in existence. (We will discuss the digital tokens in detail in the next Section.)

The literature is well aware that these blockchain-based digital tokens would constitute a new asset class since they are uncorrelated with other typical asset classes that we currently have. See Baur and Lee (2018); Symitsi and Chalvatzis (2019); Hu, Parlour, and Rajan (2018); Liu and Tsyvinski (2018); Chuen, Guo, and Wang (2017); and Pele et al., (2019).

However, at the moment, the literature has been rather silent about the distinction among the digital tokens themselves and whether each type of them should be classified under the same or different asset classes. To the best of our knowledge, this paper is the first to analyze this issue.

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[4] https://www.coindesk.com/theres-a-second-token-a-breakdown-of-facebooks-blockchain-economy
[5] https://libra.org/en-US/about-currency-reserve/#the_reserve

The paper contributes to the literature by pointing out the distinction among them and raising the questions whether they actually take the same roles in the financial system. If they, in fact, do not take the same roles, then they should be classified under different asset classes. They should also be subject to different sets of regulations (although some may overlap) and perhaps by different regulators. We will examine the differences and similarities of these digital tokens by (i) how they were created and initially distributed (Creation and Initial Distribution); (ii) intentions of their creator(s) (Intended Properties); (iii) how they are actually used/treated by market participants (Actual Usage); and (iv) what can be implied from their secondary market price data series (Behaviors). We will also discuss policy implications and recommendations.

The paper is structured as follows. Section 2 discusses the various types of digital tokens in detail. Section 3 discusses the theoretical framework. Section 4 explains the data. Section 5 outlines the methodology. Section 6 provides the analyses and discusses the main results. Section 7 concludes the paper, discusses policy implications, and suggests future research directions.

Understanding the nature and the behaviors of the digital tokens is important. We hope that our paper will provide new insights on the digital tokens that have not yet been examined thoroughly in the existing literature. The better the understanding we have about the digital tokens, the better decisions we make regarding relevant policies and how we should regulate them.

2. The Digital Tokens

The "digital tokens" are digital assets created on blockchain to serve certain purposes intended by their creator(s).[6] There are many terms that are currently in use such as "digital tokens," "digital coins," and "cryptocurrencies." However, since there is currently no formal standardization of the terms and definitions, different people may have different interpretation for

[6] We acknowledged that the term "Blockchain-Based Digital Assets" have a broader definition than just "Digital Tokens." There are other types of Blockchain-Based Digital Assets such as the tokenization of the physical assets and items created for fun like CryptoKitties. But these assets/items are currently out of the scope of this paper. In this paper, our main focus is the "Digital Tokens." (We consider "Cryptocurrencies" a subset of "Digital Tokens.") However, we decided to use the term "Blockchain-Based Digital Assets" in the title because some people may think that "Cryptocurrencies" are excluded from our analyses if we used the term "Digital Tokens" in the title.

each of the terms. In this paper, we will use the terms "digital tokens" and "digital coins" interchangeably.[7] Moreover, we may refer to "cryptocurrencies" as "payment tokens" which is a subset of "digital tokens."[8]

There are various ways to classify these digital tokens. The following sub-sections will discuss several plausible classifications in detail. Note that there is currently no standardized consensus on how the digital tokens should be classified.

2.1 Classification by Creation, Initial Distribution, and Feature

This sub-section discusses how the digital tokens can be categorized by creation, initial distribution, and feature. Specifically, they can be classified as (i) ICO vs. Non-ICO; (ii) Native vs. Non-Native; and (iii) Mineable vs. Non-Mineable.

2.1.1 ICO vs. Non-ICO

One way to classify the tokens is to examine how they were created and initially distributed. Some digital tokens were created via an Initial Coin Offering (ICO) process. An ICO process is a method of fundraising in which companies issue digital tokens to investors in exchange for their fund investing into the companies or the companies' project. In this paper, we will refer to these digital tokens that are created via an ICO process as "ICO tokens." On the other hand, "non-ICO tokens" are the digital tokens that were not created via an ICO process. They could have been mined (created during transaction verification process that usually involves solving mathematical problems) and rewarded like Bitcoin or could have been initially distributed via an "airdrop" process (given out for free to certain group of people – usually with existing wallets).

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[7] We acknowledged that some people do not consider "Token" and "Coin" as equivalent. For example, coinmarketcap.com defines "Token" as "A digital unit designed with utility in mind, providing access and use of a larger cryptoeconomic system. It does not have store of value on its own, but are made so that software can be developed around it" and defines "Coin" as "A cryptocurrency that can operate independently." However, we think these definitions can be better understood if the terms "Non-Native Digital Token" and "Native Digital Token" are used instead of "Token" and "Coin."

[8] Note our definition of the term "Digital Token" is somewhat different from the one used in Thailand's Digital Asset Business Decree (2018).

2.1.2 Native vs. Non-Native

Another way to categorize these digital tokens is to verify whether they are native digital assets of a particular blockchain or not. "Native digital tokens" are digital tokens that have their own blockchain. Thus, they are native digital assets of that blockchain and can operate independently. "Non-native digital tokens" are digital tokens that do not have their own blockchain. Thus, they have to reside on other blockchain (usually on Ethereum blockchain) and cannot operate independently without that other blockchain. [9] Figure 1 illustrates examples of native digital tokens and non-native digital tokens. Bitcoin and Ethereum are native digital tokens that have their own blockchain. On the other hand, MaidSafe, Tether, FoldingCoin, and GetGems are non-native digital tokens that reside on Bitcoin blockchain (Omni protocol and Counterparty protocol). In addition, Bancor, Basic Attention Token, Golem, Status, and Storj are non-native digital tokens that reside on Ethereum blockchain.[10]

2.1.3 Mineable vs. Non-Mineable

In addition, the tokens can be classified as "mineable" or "non-mineable." Mineable tokens are digital tokens that can be "mined" – created during transaction verification process (usually involves solving mathematical problems). Non-mineable tokens are digital tokens that cannot be mined. Bitcoin is an example of mineable token whereas Ripple (XRP) is an example of non-mineable token.

Figure 2 illustrates the classification by how the tokens are created and initially distributed. In addition, sub-classifications can be added in terms of the characteristics and features of the tokens such as native vs. non-native, and mineable vs. non-mineable. Under this setting, the tokens can be classified into 6 groups, namely, (i) ICO/Native/Mineable; (ii) ICO/Native/Non-Mineable; (iii) ICO/Non-Native; (iv) Non-ICO/Native/Mineable; (v) Non-ICO/Native/Non-Mineable; and

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[9] Our "native digital token" is "coin" under coinmarketcap.com's definition and our "non-native digital token" is "token" under coinmarketcap.com's definition.

[10] In fact, most of the non-native digital tokens reside on Ethereum blockchain.

(vi) Non-ICO/Non-Mineable. Note that non-native digital tokens are non-mineable except for some very special cases.

2.2 Classification by Function

Digital tokens can also be classified by functions. It appears that FINMA (The Swiss Financial Market Supervisory Authority) and the U.S. SEC (U.S. Securities and Exchange Commission) have acknowledged the digital tokens by their functions.

2.2.1 FINMA Classification

FINMA specifically classifies the tokens by their economic functions as follows (FINMA 2018):

(i) Payment Tokens (or Cryptocurrencies) are tokens used as means of payment for [general] goods and services; or means of money/value transfer. The payment tokens should give anyone no claims against their issuers.

(ii) Utility Tokens are tokens used to provide access to [specific] digital applications or services on blockchain. In other words, the tokens can be used to exchange for goods and services on blockchain (as pre-determined by the creators/issuers).

(iii) Asset Tokens are tokens used as debt or equity claims against the issuers. FINMA specifically stated that "In terms of their economic function, therefore, these tokens are analogous to equities, bonds or derivatives."

FINMA acknowledged that the classification is not mutually exclusive. For example, some utility tokens or asset tokens may also become payment tokens if they are widely accepted as medium of exchange.

2.2.2 U.S. SEC Classification

On the other hand, while the U.S. SEC did not specifically spell out the three types. However, it appears to have acknowledged the various types which could somewhat coincide to those of FINMA (some with different names). For example, the U.S. SEC appears to have

acknowledged that cryptocurrencies are designed to "enable purchases, sales and other financial transactions."[11] At the very least, Bitcoin and Ethereum should fall under this category.[12] The term "utility tokens" has been mentioned in their documents.[13] However, their main focus is to emphasize that just because certain things are labeled as "cryptocurrencies" or "utility tokens," it does not mean they are not "securities." In fact, the U.S. SEC is known to use the "Howey Test" to determine whether certain digital tokens are securities or not. Examples of digital tokens that were deemed as "securities" by the U.S. SEC are the DAO tokens (no longer exist), Paragon Coin, and AirToken.[14] Recently, the U.S. SEC issued a framework for "investment contract" analysis of digital assets outlining the detail on how an ICO token could be deemed security.[15] Basically, a digital token would constitute an investment contract under the Howey Test (thus, is a security under U.S. Securities Law and is subject to U.S. SEC regulations) when all these conditions are met:

(i) There is the investment of money;
(ii) In a common enterprise;
(iii) With a reasonable expectation of profits to be derived from the efforts of others.

Figure 3 illustrates the classification of digital tokens by function. Note that when the tokens are classified by function, it does not matter how they were created and initially distributed. For example, Ethereum had an ICO back in 2014. However, since it is currently widely accepted as payment tool in the blockchain economy, many would consider Ethereum as a payment token (or cryptocurrency).[16] On the other hand, Bitcoin which is another widely accepted payment token (or cryptocurrency) never had an ICO and is created only via the transaction verification process (proof-of-work).

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[11] https://www.sec.gov/news/public-statement/statement-clayton-2017-12-11
[12] A speech by a U.S. SEC director stated that, due to their sufficiently decentralized networks at the current state, Bitcoin and Ethereum should not be considered securities even though some of the Ethereum were initially issued via ICO (Initial Coin Offering) fundraising. (https://www.sec.gov/news/speech/speech-hinman-061418)
[13] https://www.sec.gov/ICO
[14] Note that there have recently been discussions about Security Token Offering (STO). We consider STO to be relevant to this category of tokens.
[15] https://www.sec.gov/corpfin/framework-investment-contract-analysis-digital-assets
[16] Ethereum could also be mined.

2.3 Other Special Types of Digital Tokens Worth Mentioned

There are other special types of digital tokens that are worth mentioned separately. (In fact, in our view, they may also be included in some of the categories already mentioned in Sections 2.1 and 2.2.) This sub-section will discuss Stablecoins, Central Bank Digital Currencies (CBDCs), and Security Token Offerings (STOs) in detail.

2.3.1 Stablecoins

Stablecoins are digital tokens that have their value pegged to other fiat currency or other assets. Typical cryptocurrencies suffer from substantial price volatility; therefore, stablecoins were created to overcome the price volatility weakness. With stable price, stablecoins can perform better in terms of being "unit of account," "store of value," and "medium of exchange." There are currently 3 types of stablecoins as follows: (See Blockchain 2019 for updated information on stablecoins currently in existence.)

(i) Fiat-Collateralized Stablecoins are stablecoins that are backed by fiat currency or other assets. Usually they are created upon receiving fiat currency deposit of an equivalent amount. Examples of them are: Tether, TrueUSD, Gemini Dollar, and USD Coin. (Libra Coin would fall under this category, if created.)

(ii) Crypto-Collateralized Stablecoins are stablecoins that are backed by other cryptocurrencies. Since other cryptocurrencies are volatile, usually the deposit amount required is larger than the value of the stablecoins created and issued. Examples of them are: DAI (on Maker), bitUSD, bitEUR, bitCNY, bitGold, bitSilver, and bitBTC (on Bitshares)

(iii) Non-Collateralized Stablecoins are stablecoins that are not backed (or only partially backed) by fait currency or other assets. However, to maintain the stable price, certain policies or algorithmic techniques are used. Examples of them are NuBits[17], Carbon, and Basis

In our view, stablecoins could also be included in some of the categories already mentioned in Sections 2.1 and 2.2.

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[17] NuBits was able to maintain its peg with 1 USD for some time but now the peg has already been broken.

Under Section 2.1, the digital tokens are classified into 6 groups, namely, (i) ICO/Native/Mineable; (ii) ICO/Native/Non-Mineable; (iii) ICO/Non-Native; (iv) Non-ICO/Native/Mineable; (v) Non-ICO/Native/Non-Mineable; and (vi) Non-ICO/Non-Mineable. Currently, the existing stablecoins are non-ICO[18] and non-mineable. Therefore, stablecoins could belong to either Group (v) or Group (vi) above. (Libra Coin would belong to Group (v), if created.)

Under Section 2.2, the digital tokens are classified into (i) Payment tokens or cryptocurrencies; (ii) Utility tokens; and (iii) Asset or security tokens. Stablecoins would be the closet to Group (i) Payment tokens or cryptocurrencies.

2.3.2 Central Bank Digital Currencies (CBDCs)

Central Bank Digital Currencies are (CBDCs) are digital tokens issued by the central banks. From our understanding, all of the existing CBDC projects are blockchain-based. Most of them are wholesale CBDCs which are digital tokens used for large settlements between the central banks and the local financial institutions. Notable projects are Project Jasper (Bank of Canada), Project Ubin (Money Authority of Singapore (MAS)), Project LionRock (Hong Kong Money Authority (HKMA)), and Project Inthanon (Bank of Thailand). It is recently reported that People's Bank of China will launch its own project very soon.[19]

The wholesale CBDC projects can be extended to cover cross-border payment transactions. At the time of this writing, MAS announced its successful cross-border payment experiments with Bank of Canada.[20] In addition, it is reported that Bank of Thailand and HKMA recently signed an MOU to explore the possibility of cross-border payment transactions between them.[21,22]

In general, central banks also have the potential to issue retail CBDCs – digital tokens used for retail payments (by individuals and businesses). However, whether the central banks would or

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[18] The existing stablecoins are non-ICO tokens. (Usually people need to bring in fiat currencies or other cryptocurrencies to exchange for the stablecoins – but we would not call this ICO). However, the associated tokens that are created along with the stablecoin projects may be ICO tokens.
[19] https://www.cnbc.com/2019/08/12/china-central-bank-close-to-releasing-digital-currency-pboc-official.html
[20] https://www.mas.gov.sg/news/media-releases/2019/central-banks-of-canada-and-singapore-conduct-successful-experiment-for-cross-border-payments
[21] https://www.bot.or.th/Thai/AboutBOT/Activities/Documents/MOU_HKMA_BOT_fintech_E.pdf
[22] https://www.bot.or.th/Thai/PressandSpeeches/Press/News2562/n3962e.pdf

should launch this type of project would be up to their discretion. Recently, it is reported that Sweden's central bank has studied such possibility (the E-krona Project) but has not made its decision yet whether its retail CBDC should actually be issued or not.[23]

It appears that CBDCs (either wholesale or retail) are supposed to be pegged to a certain value (most likely the central banks' local currency). Therefore, one may consider them as having similar properties to those of stablecoins. However, the main distinction between CBDCs and other stablecoins (actually, the main distinction between CBDCs and other digital tokens in general) is that CBDCs are sovereign. Therefore, CBDCs should be considered legal tender and can be used to pay debts according to laws. Other digital tokens are not legal tender even though some people may use some of them as medium of exchange.

2.3.3 Security Token Offerings (STOs)

There are recent discussions regarding Security Token Offerings (STOs) – procedures in which financial securities are issued in the form of digital assets (i.e., security tokens). In our view, STOs are similar to ICOs except that the digital tokens issued are debt or equity claims against the issuers. (Digital tokens that have properties similar to derivatives could also be created.) In fact, some of the tokens previously issued via the ICO process were deemed "security" by U.S. SEC (e.g., DAO (no longer exist), Paragon Coin, and AirToken). Therefore, we take a view that STO is merely a subset of ICO. However, we do acknowledge that the actual process of intentionally issuing the "security tokens" via the STO process may require more regulatory steps, requirements, and attract more scrutiny than the regular ICO process. Currently, STOs are still in their initial stage. Examples of STOs that have recently been issued are tZero, Provenance, etc.[24]

In our view, STOs could also be included in some of the categories already mentioned in Sections 2.1 and 2.2.

Under Section 2.1, the digital tokens are classified into 6 groups, namely, (i) ICO/Native/Mineable; (ii) ICO/Native/Non-Mineable; (iii) ICO/Non-Native; (iv) Non-

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[23] https://www.riksbank.se/en-gb/payments--cash/e-krona/

[24] Since they were recently issued, we were not able to find their secondary price data. Therefore, we were not able to include them in our analyses.

ICO/Native/Mineable; (v) Non-ICO/Native/Non-Mineable; and (vi) Non-ICO/Non-Mineable. Currently, the existing security tokens are non-mineable. Therefore, STOs could belong to either Group (ii) or Group (iii) above. (Libra Investment Token would belong to Group (ii), if created.)

Under Section 2.2, the digital tokens are classified into (i) Payment tokens or cryptocurrencies; (ii) Utility tokens; and (iii) Asset or security tokens. STOs would belong to Group (iii) Asset or security tokens.

2.4 Other Plausible Ways to Classify

Usually, the creator(s) of the digital tokens will write the white papers (i.e., technical documents) and make them available to the public. The white papers usually explain the tokens, the underlying technology, and the companies/staff involved in the project. Not all digital tokens have white papers but most of them do. Some other plausible classifications can be derived from the information contained in the white papers. For example, some may classify the tokens by their relevant industries (e.g., gaming, advertisement, cloud storage, gambling, IoT, payment, etc.). Some may classify the tokens by the location and type of the issuers. Note that there is no standardized format for the white papers. Some white papers may contain substantial technical information whereas some white papers may contain merely marketing information. Some white papers are very long and some are very short. Therefore, some tokens may not be properly classified due to inadequate information revealed in their white papers.

3. Theoretical Framework

The literature is divided on how the digital tokens should be modeled. One branch of the literature treats the digital tokens (mostly payment tokens or cryptocurrencies) as "money." Schilling and Uhlig (2019) proposed a theoretical model in which Bitcoin can compete with a fiat currency like the Dollar. Benigno, Schilling, and Uhlig (2019) showed a theoretical outcome that fits cryptocurrencies into a monetary economics framework. Applying the money demand and money supply concept, Ciaian, Rajcaniova, and Kancs (2016) empirically showed that Bitcoin prices are mostly affected by the money demand variables and the crypto-market attractiveness

measure. Pernice et al. (2019) used monetary policies to explain how some stablecoins can keep their prices stable.

Another branch of the literature views the digital tokens (mostly ICO tokens) as investment vehicles and tries to compare them with "securities." Lyandres, Palazzo, and Rabetti (2019) argued that theories developed for IPO (Initial Public Offering) for equities can be applied for ICO (Initial Coin Offering) for tokens. Howell, Niessner, and Yermack (2018) confirmed certain similarities of ICO and IPO. Many papers also have proposed various theoretical models to explain the ICO process. (See for example, Bakos and Halaburda 2019; Malinova and Park 2018; Chod and Lyandres 2018; Cong, Li, and Wang 2018; and Catalini and Gans 2018.)

In this paper, we look at a broader picture and take a view that the digital tokens are "hybrids" between "money" and "security" as can be illustrated using the following equation:

$$x_i = \lambda_i M + (1 - \lambda_i) S$$

$$0 \leq \lambda_i \leq 1$$

x_i represents each digital token i. λ_i represents digital token i's parameter representing how close the digital token is to "Money." Therefore, $1 - \lambda_i$ represents how close the digital token is to "Security."

Figure 4 visualizes our theoretical framework on a diagram. We take a view that some digital tokens (e.g., security tokens) are closest to "Security" and some digital tokens (e.g., stablecoins) are closest to "Money." In addition, ICO tokens should in general be closer to "Security" compared to non-ICO tokens. This is due to the fact that for ICO tokens, there is an initial investment of money into a company/project when the ICO tokens are issued and initially distributed. On the other hand, for non-ICO tokens, people do not have to pay to acquire them during the initial distribution. Applying the Howey Test, the non-ICO tokens are not security. However, there is a possibility that the ICO tokens could be security (subsequent conditions for Howey Test need to be evaluated).

Although, in this paper, we proposed a two-dimensional framework (as shown in Figure 4), the framework can be extended into multiple dimensions. For example, Figure 5 illustrates a three-dimensional framework with the third axis being "commodity." In fact, the third dimension could also be other things. Moreover, the fourth, the fifth, etc. dimension could be added. Later

on, when the properties of the digital tokens are explicitly revealed and better understood, a multiple-dimensional framework can be applied. At the time of this writing, we believe that the two-dimensional framework should best reflect the properties of the digital tokens.

4. Data

In this paper, we obtained secondary market price data series of the digital tokens from coinmarketcap.com. Other information on the properties of the digital tokens such as native vs. non-native[25]; or mineable vs. non-mineable can also be retrieved from the same source. Moreover, we obtained relevant ICO information (whether each digital token had an ICO) from icorating.com/ico/all. We also collected the digital tokens' white papers from their websites and other reliable sources on the internet.

There are currently more than 2,000 digital tokens listed on coinmarketcap.com. Since we want to make sure that the digital tokens selected in our sample have adequate market cap and sufficient length of data period, we chose the tokens that have at least USD 100,000 market cap and have at least one year of price data (as of 28 February 2019). We ended up with 809 digital tokens. Out of the 809 digital tokens, about 512 of them have downloadable and readable white papers.

We can see that not all digital tokens have white papers but most of them do. Usually the white papers contain useful information about the tokens and the underlying technology. However, there is currently no standardized format on how the white papers should be written. Therefore, the white papers varied significantly in terms of the length and the information contained in them.

[25] Note that our "native digital tokens" can be referred to as "coin" under coinmarketcap.com's glossary (cryptocurrency that can operate independently) and our "non-native digital tokens" can be referred to as "token" under coinmarketcap.com's glossary (digital unit designed with utility in mind, providing access and use of a larger cryptoeconomic system; does not have store of value on its own, but is made so that software can be developed around it).

5. Methodology

In order to analyze whether the digital tokens should be classified under the same or different asset classes, we use the following criteria and methodology. We will examine the differences and similarities of these digital tokens by (i) how they were created and initially distributed (Creation and Initial Distribution); (ii) intentions of their creator(s) (Intended Properties); (iii) how they are actually used/treated by market participants (Actual Usage); and (iv) what can be implied from their secondary market price data series (Behaviors).

5.1 Creation and Initial Distribution

To evaluate whether the digital tokens are distinguishable by how were they created and initially distributed, we will use discussion/conceptual analysis.

5.2 Intended Properties

To evaluate whether the digital tokens are distinguishable by their intended properties, we will use (i) discussion/conceptual analysis, and (ii) white paper text mining analysis.

5.3 Actual Usage

To evaluate whether the digital tokens are distinguishable by how they are actually currently used/treat, we will use (i) discussion/conceptual analysis, and (ii) observation on how they are treated in the secondary markets by the participants.

5.4 Behaviors

To evaluate whether the digital tokens are distinguishable by their behaviors implied from their (secondary market) price data series, we will use (i) graphs and calculation of risk and return profiles; and (ii) t-SNE (t-Distributed Stochastic Neighbor Embedding) visualization of correlation distance.

6. Analyses and Results

This section provides the analyses on whether the digital tokens should be classified under the same or different asset classes (i.e., whether they are distinguishable under various aspects) and discusses the main results.

6.1 Creation and Initial Distribution

This sub-section evaluates whether the digital tokens are distinguishable by how were they created and initially distributed by using discussion/conceptual analysis.

There is an obvious distinction between the ICO tokens and the non-ICO Tokens regarding how they were created and initially distributed. The ICO tokens have a primary market. They have an initial price when they are first issued and distributed to the market. To obtain the tokens, people need to invest their money in exchange for the tokens. The information is available on how much fund the issuers have raised. On the other hand, non-ICO tokens have no initial price. People could obtain them via a mining process (creation of digital tokens during transaction verification process that usually involves solving mathematical problems) or from an airdrop process (given out for free to certain group of people – usually with existing wallets).

Recalling that the U.S. SEC uses the "Howey Test" to determine whether certain digital tokens are securities or not.[26] Basically, a digital token would constitute an investment contract (and thus is a security) under the Howey Test when all these conditions are met:

(iv) There is the investment of money;
(v) In a common enterprise;
(vi) With a reasonable expectation of profits to be derived from the efforts of others.

For non-ICO tokens, there is no initial investment of money in first place. Therefore, they would not pass condition (i) of the Howey test and thus are not securities under U.S. Securities Laws. On the other hand, for ICO tokens, there is an investment of money in a common enterprise when the tokens were issued and initially distributed. Therefore, the ICO tokens would pass

[26] https://www.sec.gov/corpfin/framework-investment-contract-analysis-digital-assets

conditions (i) and (ii) of the Howey test. Whether they are actually securities or not, condition (iii) will need to be evaluated.

Therefore, we conclude that ICO tokens and non-ICO tokens are distinguishable in the aspect of how they were created and initially distributed.

6.2 Intended Properties

This sub-section evaluates whether the digital tokens are distinguishable by their intended properties by using (i) discussion/conceptual analysis, and (ii) white paper text mining analysis.

The intended properties of the digital tokens are usually communicated to the participants via the white papers or other social media communities (like twitter, github or Reddit). For example, the Bitcoin white paper stated that Bitcoin was intended to be a "peer-to-peer electronic cash system." Thus, the creator(s) of Bitcoin wanted it to become a payment tool (or medium of exchange). Some digital tokens were intended to be utility tokens – tokens that can be exchanged for specific goods and services on a blockchain. Some other digital tokens were intended to be asset/security tokens – tokens that are debt or equity claims against the issuers.

We explore this concept further by using text-mining analysis on the digital tokens' white papers. Specifically, we utilize a type of Machine Learning (ML) called Natural Language Processing (NLP) to extract useful contents from the digital tokens' white papers. A topic-modeling algorithm called the Latent Dirichlet Allocation (LDA) Method is applied. Basically, LDA goes through the words in the documents and determines the topics and assigns selected group of words to belong to a topic. A white paper is assigned high probability of being associated with a topic if the words belong to that topic are used often in the document. In the end, we are supposed to get classification in which white papers of similar topics are assigned to be in the same group. However, after conducting the analysis, we were not able to draw any meaningful interpretations from the classifications retrieved from the ML method. Therefore, at this stage, we conclude that the text-mining analysis of the white papers cannot provide distinguishable results for the tokens.

However, we would like to note that, ML intelligence can be improved to the level called Deep Learning (which is currently beyond the scope of this paper). In the future, when Deep

Learning packages are made accessible and easy-to-use by non-computer-science researchers, this issue can be revisited. Note that a computer science paper by Bain et al. (2018) did use the Deep Learning techniques to analyze the white papers and to evaluate the credibility score of the ICO tokens (called ICORating).

Figure 6 shows the word clouds of (selected) payment tokens /cryptocurrencies, stablecoins (fiat-collateralized, crypto-collateralized, non-collateralized), utility tokens, and security token. The larger texts indicate that the words are used relatively often in the white papers. The text-mining analysis shows no clear pattern that can distinguish the digital tokens into meaningful groups. Figure 7 shows the word could of some well-known digital tokens.

Therefore, under this section, we conclude that although the digital tokens are distinguishable in terms of their intended properties, the text-mining analysis of the white papers show indistinguishable results.

6.3 Actual Usage

This sub-section evaluates whether the digital tokens are distinguishable by how they are actually currently used/treated by using (i) discussion /conceptual analysis, and (ii) observation on how they are treated in the secondary markets by the participants.

The ways the digital tokens are used/treated by the market participants could be the same or different from what their creator(s) had intended. For example, although Bitcoin was intended to be a payment tool, people use them as either payment tool or speculative investment vehicle. Ethereum was supposed to be a utility token that people use to pay for (code execution) services on Ethereum. However, people actually use Ethereum as (i) payment tool; (ii) speculative investment vehicle, and (iii) utility token to exchange for (code execution) services on Ethereum.

Observing how the digital tokens are treated in the secondary market, it appears that they are listed indistinguishable side by side. People usually buy and sell them to earn profits derived from fluctuation in prices (i.e., speculative investment). In fact, many people buy utility tokens for speculative investment and do not actually use them to exchange for the specific goods services as intended by the creator(s).

Under this section, we conclude that the digital tokens are distinguishable in some aspects in terms of their usage. However, in the secondary market (trading/listing), they are indistinguishable.

6.4 Behaviors

This sub-section evaluates whether the digital tokens are distinguishable by their behaviors implied from their (secondary market) price data series by using (i) graphs and calculation of risk and return profiles; and (ii) t-SNE visualization of correlation distance.

Figure 8 shows daily price series of selected digital tokens (cryptocurrencies vs. stablecoins vs. security token vs. utility tokens). We can observe that some tokens have volatile price series whereas some tokens have stable price series. Figure 9 illustrates the daily return series of the selected digital tokens. We can observe that the daily return series for Paragon Coin (Security token) is more volatile than others. Table 1 displays the risk and return profiles of the selected tokens. We can observe that Paragon coin (security token) has the highest volatility and highest average return whereas Tether (fiat-collateralized stablecoin) has the lowest volatility. Note that the market was in downturn since early 2018, therefore some of the tokens have negative returns. Noticing the stablecoins, we can see that Tether and bitUSD were able to hold their peg close to 1 USD.

Another method that we use to analyze the digital tokens is the t-SNE visualization of the correlation distance of the tokens' returns. t-SNE is a recent Machine Learning algorithm for visualization developed by Maaten and Hinton (2008). Specifically, the visualization can be generated by t-distributed Stochastic Neighbor Embedding (t-SNE) algorithm. The distance measure used is the return correlation of each asset pair. Like PCA (Principle Component Analysis), t-SNE is a dimensional reduction technique. While PCA tries to preserve maximum information content in given constrained dimensions, t-SNE tries to preserve high-dimensional distances between data points in low dimensions. t-SNE maps each high-dimensional point by low dimensional points such that points in the same neighborhood in the high dimension are likely to be mapped in the same neighborhood in the low dimensions. Since t-SNE collapses higher dimensions to lower ones, the meaning in dimensions themselves are lost but the meaning in distance is well preserved.

Figure 10 shows the visualization of correlation distance of various asset classes using the t-SNE method as explained above. Examining the visualization, we can observe the natural clustering of different asset classes. In accordance with the previous literature (Pele et al., 2019), the digital tokens set themselves apart from other traditional asset classes, confirming that they should constitute a new asset class.

We apply the same method to examine whether there is any natural clustering within the digital tokens. Figure 11 reveals the results for ICO tokens vs. non-ICO tokens. Figure 12 displays the results for (i) ICO/Native/Mineable vs. (ii) ICO/Native/Non-Mineable vs. (iii) ICO/Non-Native vs. (iv) Non-ICO/Native/Mineable vs. (v) Non-ICO/Native/Non-Mineable vs. (vi) Non-ICO/Non-Mineable. The left panel of the figures utilize 2-year data (therefore, only some digital tokens were displayed because many of them were not created yet back then). The right panel of the figures utilize 1-year data. It appears that within the digital tokens, we cannot observe any natural clustering.

We note here that, at the time of this writing, there are some obvious constraints that we cannot yet overcome to achieve better outcomes. First, the data period for the digital tokens are not very long. This is because most of the digital tokens were recently created since 2017 onwards. Second, there was a substantial systematic shock in the crypto/token market. Most of the digital tokens' prices went up significantly in late 2017 and fell sharply in early 2018. Therefore, the distinction among their prices and returns may not be easily recognized. In this paper, we conclude now that the current data do not reveal any natural clustering among the digital tokens. However, in the future, when the sufficient-length data are available and the crypto/token market is more matured, this issue should be revisited to either confirm or disprove our proposed argument.

Under this section, we conclude that the digital tokens are distinguishable for some obvious cases in terms of risk and return profiles. However, using the visualization of correlation distance, they are indistinguishable.

6.5 Summary of the Results

This sub-section summarizes the analyses on whether the digital tokens should be classified under the same or different asset classes. The results discussed in sub-sections 6.1 to 6.4 can be summarized as shown in Table 2.

7. Conclusion, Policy Implications, and Future Research

This section concludes the paper, discusses policy implications, and suggests future research directions.

7.1 Conclusion

Although the digital tokens are indistinguishable in some aspects, they differ in the way they are created and initially distributed. Moreover, some of them do have distinguishable risk and return profiles. Therefore, we take a view that the digital tokens take (or will take) different roles in the financial system; should be classified under different asset classes.

7.2 Policy Implications

With different roles in the financial system, the digital tokens should be subject to different sets of regulations (although some may overlap) and perhaps by different regulators. The digital tokens that have properties similar to "security" should be govern by security-related regulations/regulators. The digital tokens that have properties similar to "money" should be govern by money-related regulations/regulators. The digital tokens that have both "security" and "money" properties, should be regulated by both sets of regulators/regulations.

On the other hand, a new separate regulator could be set up to oversee all types of digital tokens. This regulator should acknowledge the differences among the digital tokens and govern each type of them appropriately.

7.3 Limitation and Future Research

At the time of this writing, there are some limitations regarding the availability of the data. First, since most of the digital tokens were recently created since 2017 onwards, the existing price data are not very long. Second, there was a substantial systematic shock in the crypto/token market. Most of the digital tokens' prices went up significantly in late 2017 and fell sharply in early 2018. Therefore, the distinction among their prices and returns may not be easily recognized. Third, STOs are currently in their early stage. We are not yet able to obtain secondary market price information for these newly issued security tokens to be used in our analyses.

In this paper, we filled the gap in the literature by attempting to answer the question whether the digital tokens should be classified under the same or different asset classes. Due to the limitations discussed above, many of our empirical results are still mixed. However, when the crypto/token market becomes more matured and longer-period data can be obtained, it would be interesting for future research to revisit the questions that we have raised and the issues that we have discussed here.

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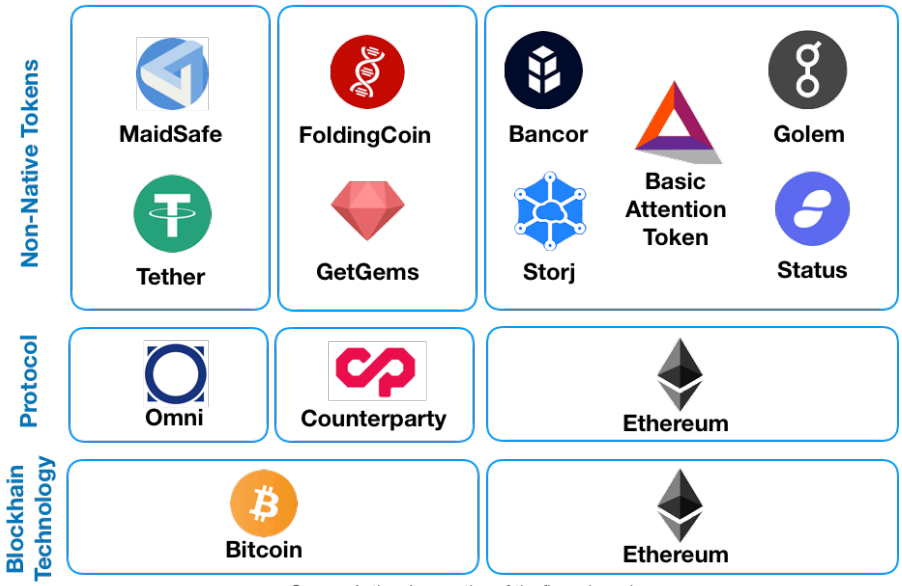
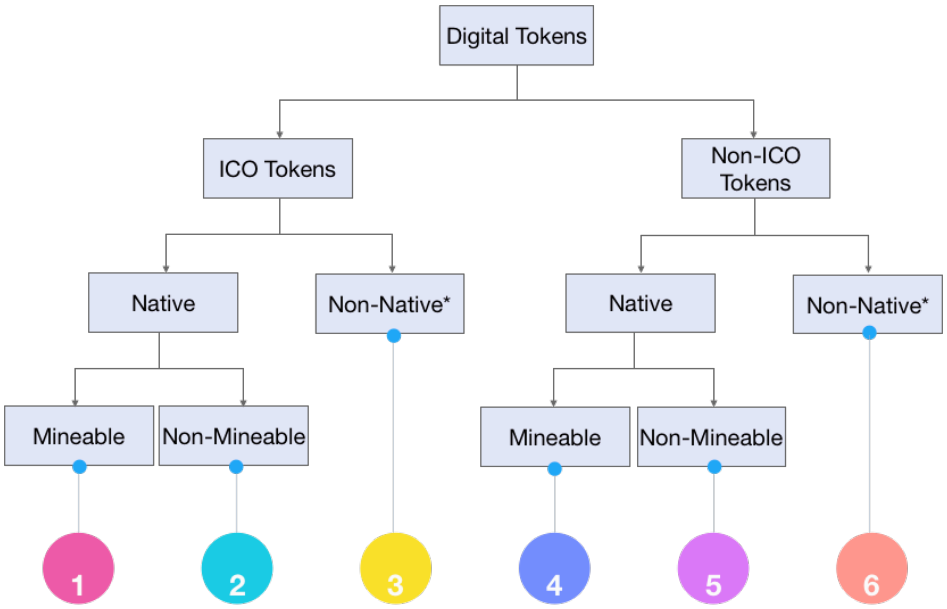
Figures and Tables

Figure 1: Native vs. Non-Native Digital Tokens



Source: Authors' recreation of the figure based on
Tokenomics (2018) by Sean Au and Thomas Power and https://tokenmarket.net/blockchain/ethereum/assets/

Figure 2: Classification of Digital Tokens
(by creation, initial distribution, and feature)



Source: Created by the authors based on our understanding

* Non-Native Tokens are Non-Mineable except for some very special cases.

Figure 3: Classification of Digital Tokens (by function)

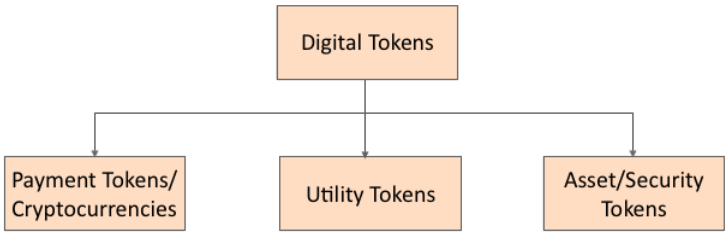


Figure 4: Visualization of Theoretical Framework

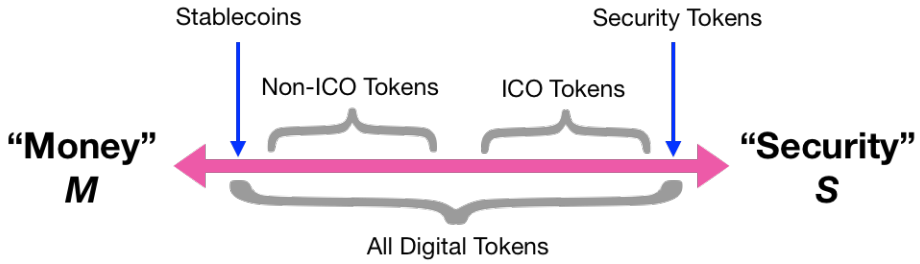


Figure 5: Visualization of Theoretical Framework (Broader Interpretation)

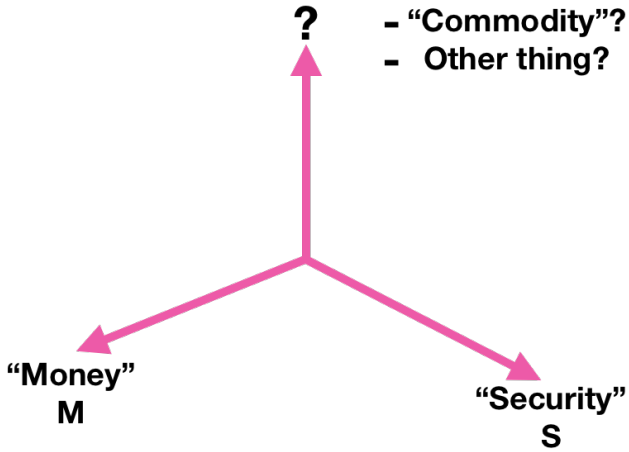


Figure 6: Text-Mining Analysis of White Papers (Selected Digital Tokens by Types)

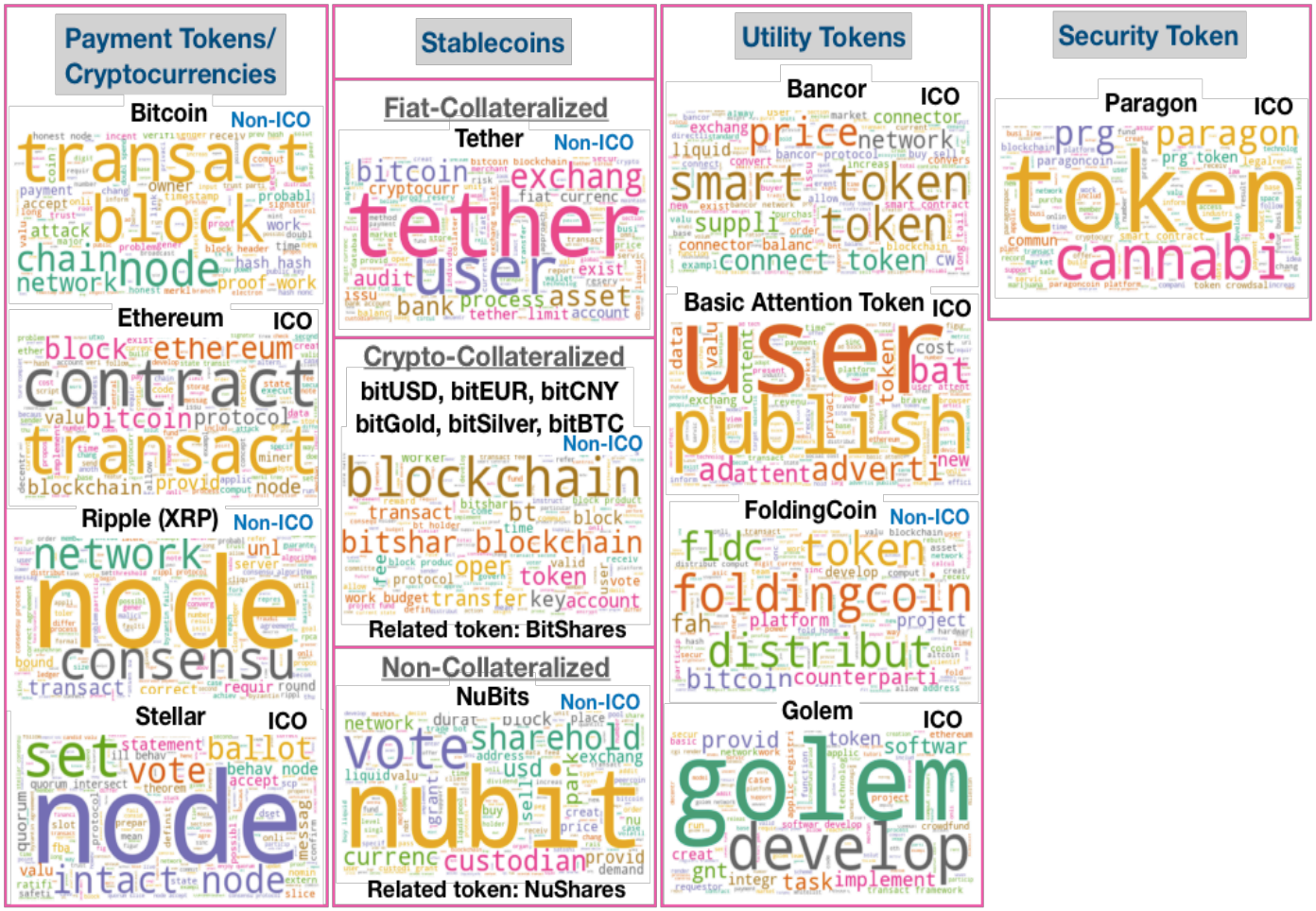


Figure 7: Text-Mining Analysis of White Papers
(Selected Well-Known Digital Tokens)

Figure 8: Daily Price Series of Selected Digital Tokens
(Cryptocurrencies vs. Stablecoins vs. Security Token vs. Utility Tokens)

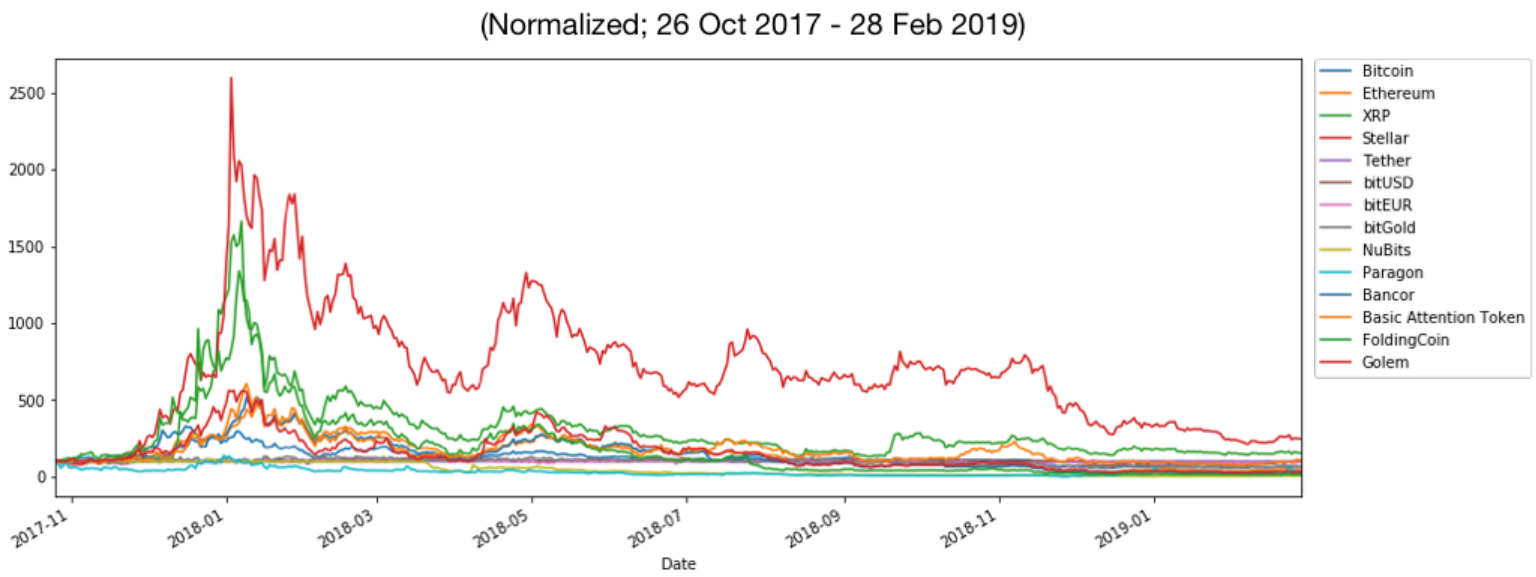


Figure 9: Daily Return Series of Selected Digital Tokens
(Cryptocurrencies vs. Stablecoins vs. Security Token vs. Utility Tokens)

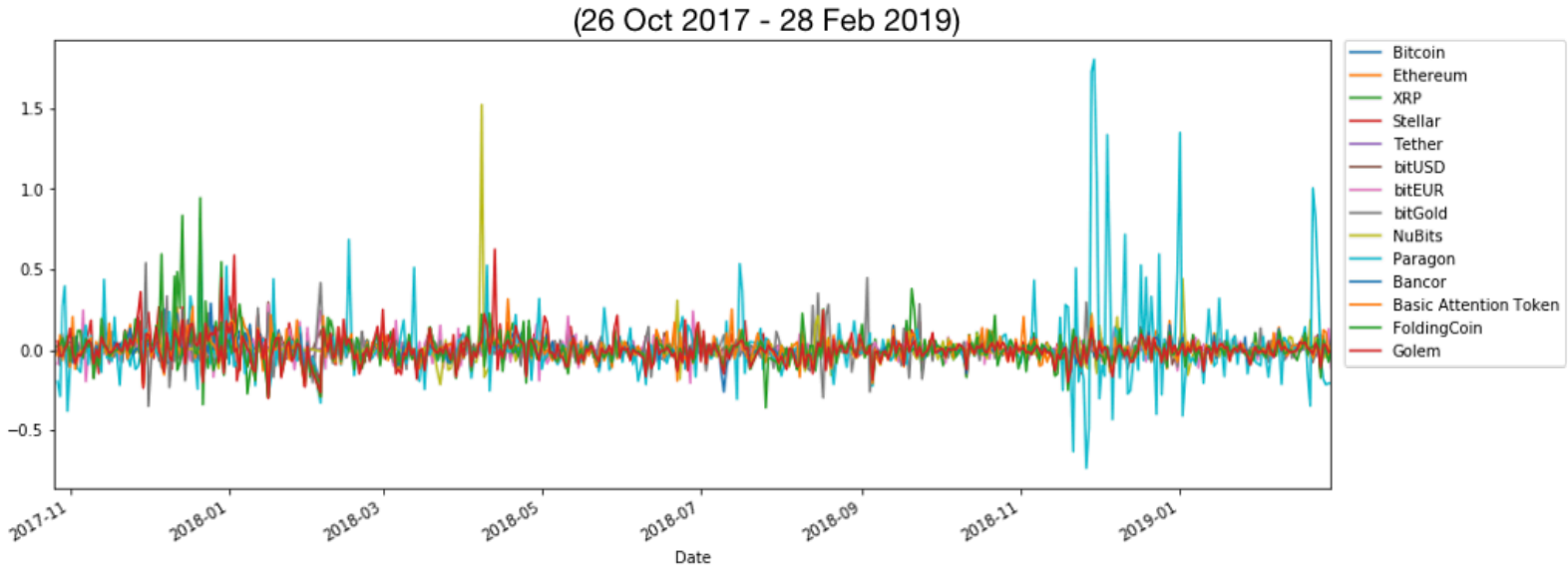


Figure 10: t-SNE Visualization of Pearson Correlation Distance of Return Series of Selected Assets (2016-2018)

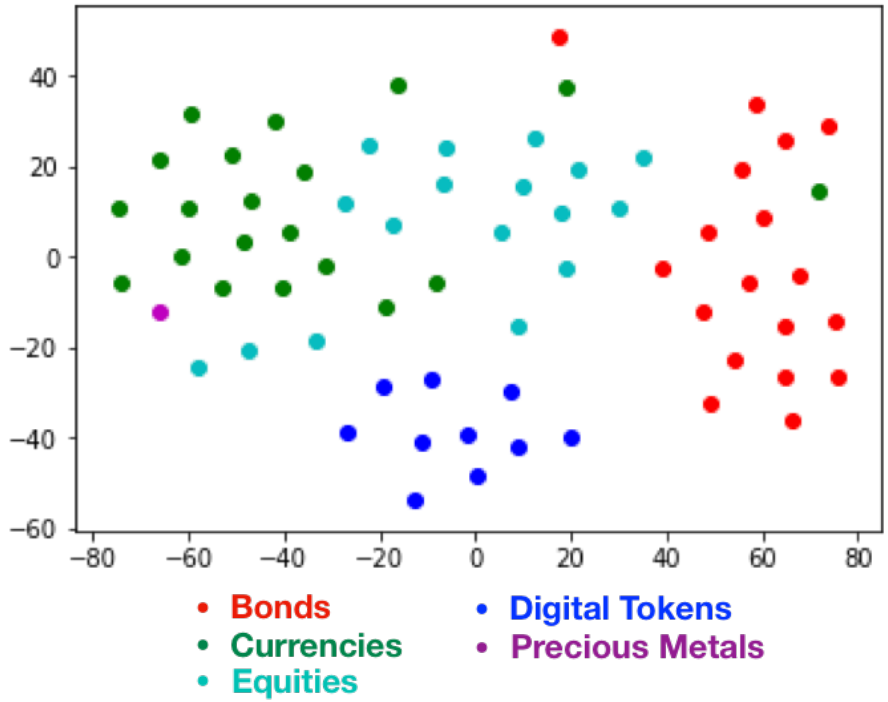


Figure 11: t-SNE Visualization of Pearson Correlation Distance of Return Series of Digital Tokens
(ICO Tokens vs. Non-ICO Tokens)

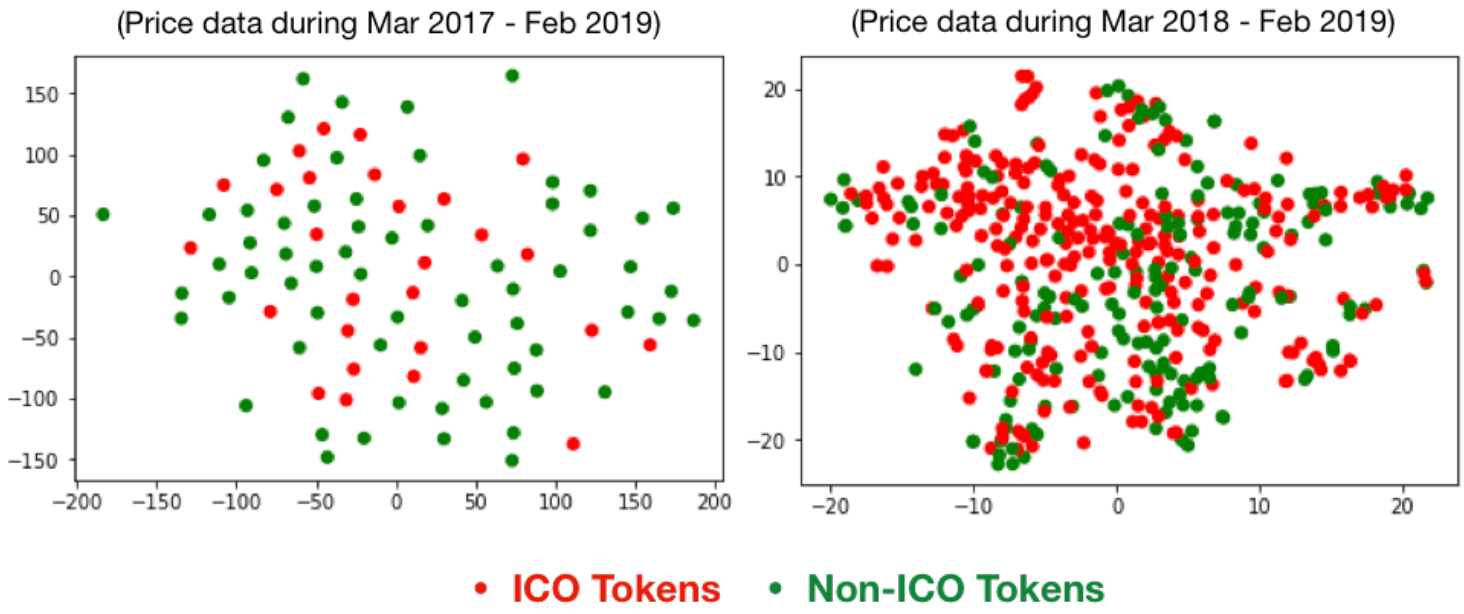


Figure 12: t-SNE Visualization of Pearson Correlation Distance of Return Series of Digital Tokens (6 Groups)

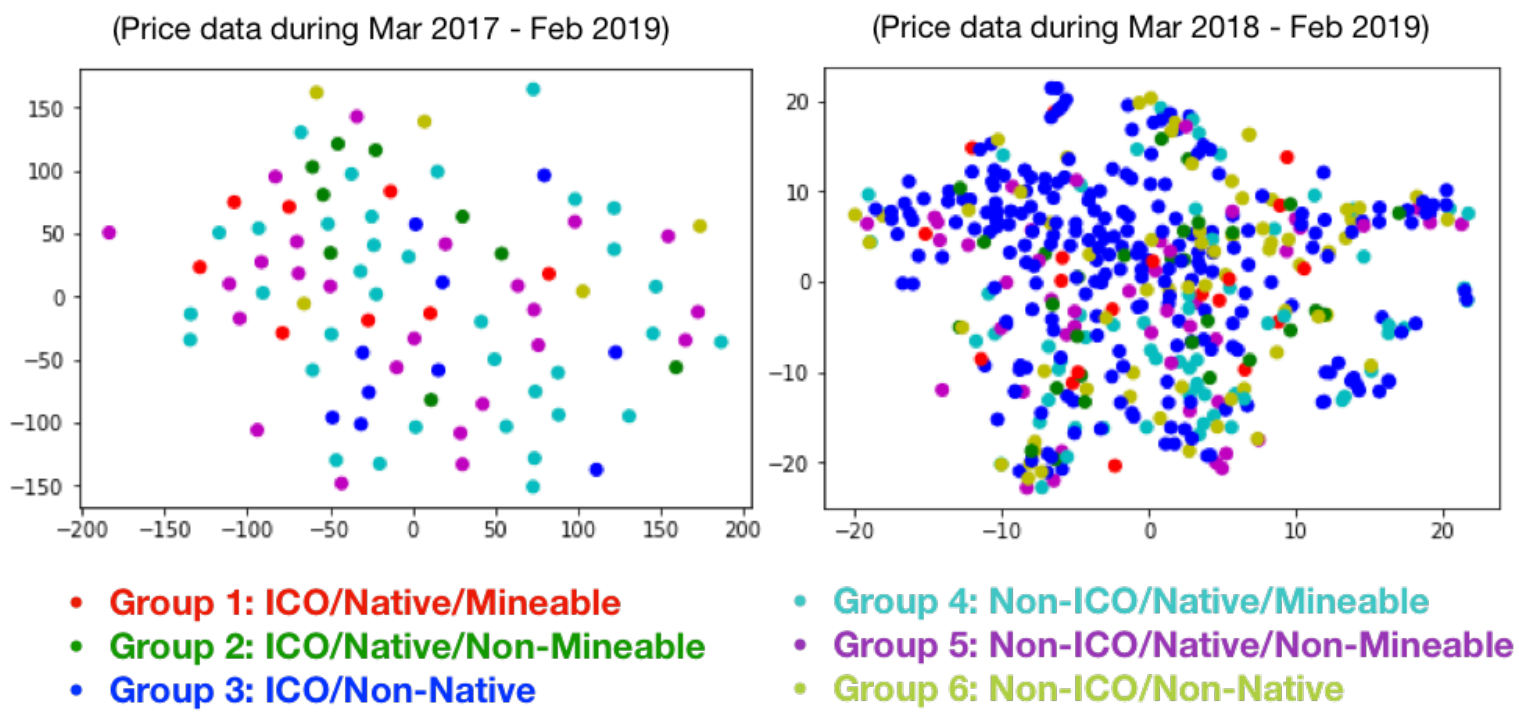


Table 1: Comparison of Risk and Return Profiles of Selected Digital Tokens
(Cryptocurrencies vs. Stablecoins vs. Security Token vs. Utility Tokens)

(Data Period: 26 Oct 2017 - 28 Feb 2019)

	Average Price (in USD)	Average Daily Returns	Volatility (Std of Daily Returns)	
Bitcoin	7576.901367	0.000188	0.046410	Payment Tokens = Cryptocurrencies
Ethereum	436.392731	0.000036	0.057198	
XRP (Ripple)	0.600213	0.004140	0.086168	
Stellar	0.235875	0.004990	0.081355	
Tether	1.002131	0.000046	0.007088	Fiat-Collateralized Stablecoin
bitUSD	0.991699	0.000693	0.040576	Crypto-Collateralized Stablecoins
bitEUR	1.255539	0.001530	0.059712	
bitGold	1314.078613	0.002556	0.084477	
NuBits*	0.437625	-0.003165	0.092081	Non-Collateralized Stablecoin
Paragon	0.193160	0.016350	0.226177	Security Token
Bancor	2.672426	-0.000862	0.060689	Utility Tokens
Basic Attention Token	0.257159	0.003389	0.079824	
FoldingCoin	0.013298	0.000178	0.096618	
Golem	0.294979	0.000911	0.080928	

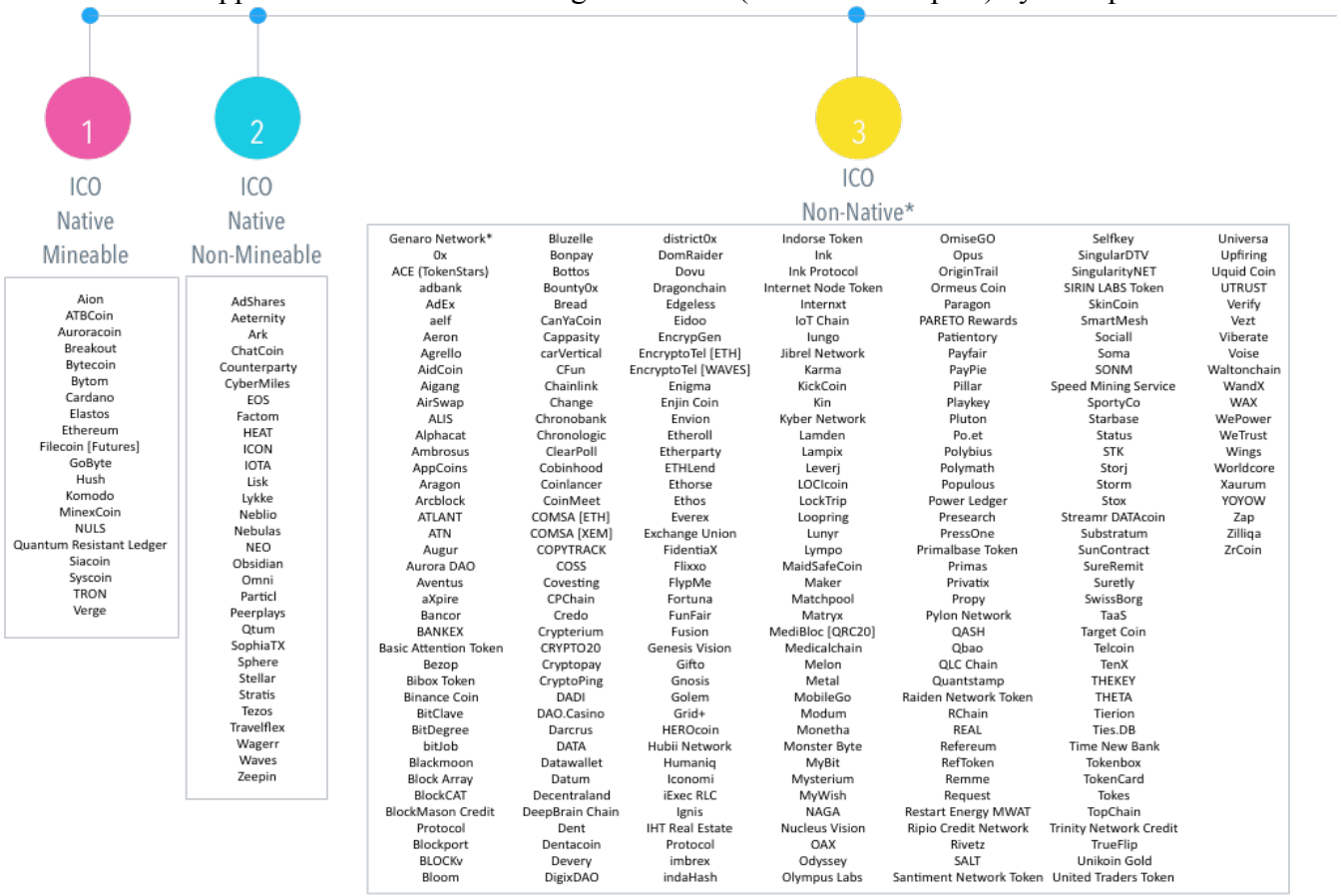
* NuBits was able to hold its value at 1 USD for quite some time but now the peg has already been broken.

Table 2: Summary of Results

Criteria	Methodology	Outcome
Creation and Initial Distribution	**Concept**	Distinguishable
Intended Properties	**Concept**	Distinguishable
	White Paper Text Mining	Indistinguishable
Actual Usage	**Usage**	Distinguishable in some aspects
	Secondary Market	Indistinguishable
Behaviors	**Graphs of Price & Return**	Distinguishable for some obvious cases
	Risk & Return Profiles	Distinguishable for some obvious cases
		• Tether (Fiat-Collateralized Stablecoin) has the lowest volatility • Paragon Coin (Security Token) has the highest avg. return and the highest volatility
	t-SNE Visualization of Correlation Distance	Indistinguishable

Appendix

Appendix 1: Detail of 512 Digital Tokens (with White Papers) by Groups



Source: Created by the authors based on the information from coinmarketcap.com and icorating.com/ico/all/

Source: Created by the authors based on the information from coinmarketcap.com and icorating.com/ico/all/