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REGULATING INITIAL COIN OFFERINGS? A TAXONOMY OF CRYPTO-ASSETS

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Research Paper

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Abstract

In 2017, the price of bitcoin skyrocketed and many investors wanted to participate in the crypto-hype. Hence, a lot of companies took the new opportunity to obtain financing by issuing crypto-assets in initial coin offerings instead of going the heavily regulated way through venture capital or initial public offerings. Besides valuable projects, many projects fail or turn out to be a scam. Retail investors are not aware of the potentially high risks of ICO investments. Regulators of most jurisdictions have not yet proposed new rules, but monitor the new phenomenon to gain insights. Many regulators stick to regulation in place and pursue case-by-case assessments in order to apply existing rules. This paper develops a taxonomy of crypto-assets based on academic literature and empirical data. The taxonomy covers embodied investor rights, security-like characteristics, and crypto-specific features being able to support regulators with their case-by-case assessment. The taxonomy helps regulators to classify crypto-assets allowing them to decide which characteristics are subject to regulation and whether new rules are necessary to ensure market integrity and investor protection. Further, the taxonomy is also designed to support issuers with the design of new crypto-assets helping them to understand which characteristics might be subject to regulation.

Keywords: Initial Coin Offering, Blockchain, Cryptocurrency, Crypto-Assets, Token Sales, Regulation, Investor Protection, Taxonomy.

1 Introduction

In the last two decades, the financial market landscape changed worldwide due to new products and technologies. First, through derivatives and their increasing complexity and second, through electronic and later algorithmic and high-frequency trading. Regulators were cautious regulating these new phenomenons in order not to harm innovation. For financial markets, jurisdictions implemented comprehensive regulations like the 'Markets in Financial Instruments Directive' (MiFID) in Europe in 2004 and the 'Regulation National Market System' (Reg NMS) in the United States in 2005. Both with the goal to achieve the main objectives of financial market regulation ensuring fairness and integrity, protecting investors and facilitating systemic stability (European Parliament and Council, 2004; Maume and Fromberger, 2018; SEC, 2005). Regulatory frameworks are updated and complemented on a regular basis and try to cover possible innovations and changes in the financial markets.

With blockchain and bitcoin gaining in popularity throughout the last decade, the price of bitcoin skyrocketed within the last years. Therefore, many investors wanted to participate in the crypto "gold-rush". A great number of companies took the new opportunity to obtain financing by issuing crypto-assets in so-called initial coin offerings (ICOs) instead of going the heavily regulated way through venture capital and initial public offerings (Hacker and Thomale, 2017; Rohr and Wright, 2017; Zetzsche et al.,

2017). Besides valuable projects, many ventures fail or turn out to be a scam (Maume and Fromberger, 2018). Since many retail investors are not aware of the potentially high risk of such investments, regulators around the world published warnings on ICOs (AFM, 2018; BaFin, 2017; ESMA, 2017; FCA, 2017; SEC, 2017b). Yet, regulators of most jurisdictions did not propose any new rules and are still monitoring this new phenomenon in order to gain more insights. Several regulators (e.g., the Securities and Exchange Commission (SEC) in the US, the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) in Germany, and the Financial Conduct Authority (FCA) in the UK) take the view that a case-by-case assessment, looking at every application for a new ICO separately, needs to be applied in order to decide whether existing regulation holds (BaFin, 2017; FCA, 2017; SEC, 2017a). Still, regulatory approaches differ among jurisdictions. This is because first, existing regulation and definitions of what constitutes a security deviate and second, countries vary in their regulatory strategy based on their perception whether ICOs represent a threat or an opportunity for a new way to capital access. Besides regulators, economic and legal scholars engage in discussing the applicability of existing financial market regulation showing that, depending on their design, many crypto-assets fall under existing securities market regulation (Hacker and Thomale, 2017; Langenbucher, 2018; Maume and Fromberger, 2018; Weitnauer, 2018).

In a recent speech in November, 2018, Verena Ross, Executive Director of the European Securities and Markets Authority (ESMA), stated that she suspects that *"[...] in the end we might well determine that some of these crypto assets are financial instruments under the current legislative framework, [...] and thus that their sale (for example through ICOs) should be subject to the applicable regulatory requirements"*. Further she mentioned that they *"[...] will need to discuss how to deal with the regulatory perimeter and how to react as regulators and supervisors to the crypto assets, and the services surrounding them, where they are not within the regulatory regime, but might be very close to traditional financial instruments"* (Ross, 2018). As a consequence, regulators and academics are still assessing this new phenomenon and discuss how existing regulation applies to the new types of assets and whether new rules are necessary. Until now, academic literature lacks a comprehensive framework to classify crypto-assets with a regulatory focus. In order to close this gap, we develop a taxonomy of crypto-assets based on academic literature and empirical data. The taxonomy covers embodied investor rights, security-like characteristics, and crypto-specific features being able to support regulators with their case-by-case assessment of crypto-assets. The taxonomy shall help regulators to classify crypto-assets based on their characteristics supporting their regulatory decisions and policy making on how certain features should be regulated and whether new rules are necessary. The taxonomy is also designed to support issuers with the design of new crypto-assets helping them to understand which characteristics might be subject to regulation.

The remainder of this paper is structured as follows: section two gives an overview of cryptocurrencies, initial coin offerings, the regulatory background, and related work and industry discussion. Further, the research goal is presented. Section three is dedicated to the taxonomy development process. In section four we evaluate our taxonomy and discuss our results with regards to the regulatory discussion. Section five concludes.

2 Background

2.1 Blockchain, cryptocurrencies, tokens, and initial coin offerings

Starting with Satoshi Nakamoto's white paper "Bitcoin: A peer-to-peer electronic cash system" in 2008 (Nakamoto, 2008) and the implementation of bitcoin in 2009, the first cryptocurrency using a public distributed blockchain, established the foundation for the use of blockchain technology. A blockchain represents a decentralized distributed database based on distributed ledger technology (DLT) which is maintained by a network of computers. Using cryptocraphic procedures and mathematical verifications, known as consensus mechanism, blockchains store tamper-resistant, resilient, and authenticated data and enable users to engage in pseudonymous transactions across a network of untrusted participants (Hacker and Thomale, 2017; Rohr and Wright, 2017). While the focus of the first generation of blockchains is

to create a basis for enabling cryptographically-signed financial transactions, the second generation of blockchains, such as Ethereum, enables programs to be deployed and run on the blockchain (Fridgen et al., 2018; Xu et al., 2017). These programs are also called "smart contracts" and enable more complex programmable transactions. Smart contracts can be used to control digital assets, to implement a trust-free trade of assets, and to issue so-called "tokens" (also called sub-currencies, app-coins, or crypto-assets[1]) on top of the blockchain (Beck et al., 2016; Buterin, 2014; Glaser, 2017; Xu et al., 2017). This new generation of blockchains allows a wide range of use cases for tokens associated with it. The original idea of cryptocurrencies was to establish an independent form of payment which is not under control of any governmental instance. But now, tokens may represent any promise made between two persons leading to an enormous variety of tokens and their design (Conley, 2017; Langenbucher, 2018).

With the rising interest for bitcoin and the hype for the blockchain technology, entrepreneurs made use of the momentum and the new possibilities offered through this new technology by selling tokens in so-called initial coin offerings. These tokens represent a claim for a future product, service or participation in their venture. Primarily, this seems attractive because entrepreneurs may collect funding without the need of overcoming the hurdles of heavily regulated traditional financing mechanisms like venture capital or initial public offerings (Hacker and Thomale, 2017; Rohr and Wright, 2017). ICOs represent a sort of financing source via crowdsales based on blockchain technology. During an ICO, tokens, which are usually generated on the Etherum blockchain, are sold to the public. The price is predefined by the issuer and paid in a cryptocurrency (e.g., bitcoin, ether) or in a fiat-currency, sometimes combined with pre-sales and rebates for early investors. The issuer of the ICO usually provides a so-called *white paper* in which the project is described and further information like business experience, early-stage investors, development status or a financial plan is presented. The level of detail varies strongly among white papers and although some offer a lot of information, the level of detail cannot be compared to a prospectus required under securities regulation. The legal framework can usually be found in some *terms and conditions* where the related rights and functions of the respective token are described[2] (Adhami et al., 2017; Fridgen et al., 2018; Langenbucher, 2018; Weitnauer, 2018; Zetzsche et al., 2017). For advertisement, issuers usually use social media channels given a younger and more tech-affine target investor than in traditional capital markets (Maume and Fromberger, 2018). Tokens regularly comprise different functions and rights based on their purpose and the business model of the project. Most tokens represent one of three basic categories: *currency tokens*, *utility tokens*, or *investment tokens*. Currency tokens, like bitcoin or ether, can be used like any fiat-currency in exchange for goods and services wherever a marketplace accepts them. Utility tokens usually offer access to products or services. Investment tokens represent an equity or debt like investment promising future returns similar to dividend payments or fixed annuities, sometimes combined with voting or participation rights (Hacker and Thomale, 2017; Langenbucher, 2018; Maume and Fromberger, 2018; Weitnauer, 2018). Nevertheless, these categories are not legal categories and the potential legal classification depends on the respective national or supranational regulation (Maume and Fromberger, 2018). Furthermore, tokens are extremely diverse and can represent any promise made between two persons offering a mixture of the above features dependent on the intention of the issuer. These tokens are called *hybrid tokens* (Conley, 2017; Hacker and Thomale, 2017; Langenbucher, 2018).

After the ICO, most tokens are traded on crypto-exchanges where the price is formed by supply and demand comparable to regular exchanges (Weitnauer, 2018). Different from crowdfunding, where participants expect rewards in form of a final product (reward-based crowdfunding) or nothing at all (donation-based crowdfunding) being satisfied having helped other people altruistically (Gerber et al., 2012; Koch, 2017), some investors in an ICO hope to receive a return on their investment by selling their token on a secondary market. This is the main difference compared to participants who take part in a crowdfunding project where no secondary market exists (Klöhn et al., 2018; Langenbucher, 2018).

[1] We use the terms token and crypto-asset interchangeably.

[2] A more detailed overview of the ICO process can be found in Kaal and Dell'Erba (2018).

2.2 Regulatory discussion and related literature

In the last two years, ICOs have become a serious source of finance having collected about $6.5 bn worldwide only in 2017 (Smith and Crown, 2018). Compared to traditional financing methods, ICOs come with a range of advantages for issuers. First, tokens are marketed directly to the client increasing the speed of the offering process and cutting cost of capital. Second, the required technology is simple and easily accessible lowering the barriers of market entry. Third, because of the crypto-hype, the amount of money that can be raised is relatively high compared to traditional financing methods and crowdfunding. And fourth, issuers believe that they are not in the scope of financial market regulation (Maume and Fromberger, 2018). In an ICO, investors usually invest in the future promise of a premature project or a future infrastructure product associated with the platform they invest in without having access to a tangible underlying product (Kaal, 2018). Besides valuable projects, many projects fail because of low competences of the issuers or because they turn out to be a scam, which is tempting due to the potential lack of regulation (Maume and Fromberger, 2018). Investors are mostly retail investors looking for profitable investments. Yet, investors are not aware of the potential risks they bear when purchasing tokens. Due to that and the vulnerability to money laundering and terror financing, many regulators published warnings on ICOs (e.g., AFM, 2018; BaFin, 2017; ESMA, 2017; FCA, 2017; SEC, 2017b). Further, regulators are paying close attention discussing which existing regulation has to be applied and whether new rules or amendments to existing regulation are necessary. Thereby, regulators need to decide, whether crypto-assets should be isolated, regulated or integrated in order to ensure market integrity and investor protection (Demertzis and Wolff, 2018).

National regulators consent that tokens need to be regulated in general. But for the assessment of ICOs and the corresponding tokens, regulators around the world have taken different directions: Some countries (e.g., China and South Korea) decided to ban ICOs viewing them as a threat. Other countries (e.g., France, Switzerland, Singapore) try to position themselves as an attractive place for ICOs remodeling their regulatory strategy (Langenbucher, 2018).[3] Most countries assess whether their existing regulation is applicable to the new form of financing. However, due to the fact that tokens are diverse in their characteristics and some of them are of completely new nature, a general assessment or a one-fits-them-all solution is not possible. For this reason, countries like the US, Germany, and the UK apply a case-by-case assessment in order to evaluate which regulation needs to be applied based on the characteristics and rights embodied in the respective tokens (BaFin, 2017; FCA, 2017; SEC, 2017a). Besides regulators, law and economic scholars are studying characteristics of crypto-assets in order to assess whether they fall under existing regulation. In the following, we give an overview with a focus on US and EU legislation.

Crypto-assets under US legislation

Whether a token falls under US securities regulation depends on its characteristics and whether those fall under the definition of a security. US law defines a security in Section 2(a)(1) of the Securities Act:

> *"The term 'security' means any note, stock, treasury stock, security future, security-based swap, bond, debenture, evidence of indebtedness, certificate of interest or participation in any profit-sharing agreement, collateral-trust certificate, preorganization certificate or subscription, transferable share, investment contract, voting-trust certificate, certificate of deposit for a security, fractional undivided interest in oil, gas, or other mineral rights, any put, call, straddle, option, or privilege on any security, certificate of deposit, or group or index of securities (including any interest therein or based on the value thereof), or any put, call, straddle, option, or privilege entered into on a national securities exchange relating to foreign currency, or, in general, any interest or instrument commonly known as a 'security', or any certificate of interest or participation in, temporary or interim certificate for, receipt for, guarantee of, or warrant or right to subscribe to or purchase, any of the foregoing."*
>
> (United States Congress, 1933)

[3] Detailed overviews of regulatory responses to ICOs can be found in Kaal (2018) and Dell'Erba (2018).

While this list offers a comprehensive set of instruments, the term 'investment contract' covers a "catch-all" definition for financial assets which do not fall under any of the other above listed categories (Hacker and Thomale, 2017; Langenbucher, 2018). To clarify which characteristics constitute an investment contract, the US Supreme Court established the *Howey test* in 1946 which involves four factors that need to be present for an asset to be classified as an investment contract: (1) the investment of money, (2) in a common venture, (3) a reasonable expectation of profit, and (4) the entrepreneurial or managerial efforts of others. This test is designed in order to check for essential components of investment activities and flexibly applies to all *"[...]schemes devised by those who seek the use of the money of others on the promise of profits"* (Murphy and Supreme Court Of The United States, 1946).
Whether a token qualifies as a security under US law is most likely decided based on the understanding of an investment contract. While buying a token always includes (1) an investment of money (including payments with cryptocurrencies[4]), the other factors are more complex. Langenbucher (2018) and Robinson (2017) discuss which characteristics of a token may represent the factors of the Howey test: (2) A common venture is understood to be given if there are no specific, individualized rights granted for certain investors and investors' funds are pooled while income and expenses are distributed proportionally to the investment. (3) An expectation of profit is fulfilled when a token offers some kind of dividend, return, or payment. And last, (4) a managerial effort of others is present where purchasers would *"[...] reasonably expect a person or group to carry out essential managerial or entrepreneurial efforts [...]"*, which is not the case if the network is sufficiently decentralized (Hinman, 2018; Langenbucher, 2018; Robinson, 2017). The SEC has applied the Howey test in two leading cases, i.e., the DAO and Munchee tokens. Hereby, the SEC has confirmed that investment tokens as well as hybrid investment/utility tokens are subject to US securities law arguing that the rights giving a practical use within the hybrid investment/utility token would not preclude the token from being a security (Hacker and Thomale, 2017; Maume and Fromberger, 2018). This is different for pure utility or currency tokens. While crypto-tokens such as bitcoin and ether do not qualify as a security, because they are traded in a decentralized manner, utility tokens do not qualify as such because they bear characteristics of a consumer consumption choice which would fall under consumer protection law (Langenbucher, 2018).

Crypto-assets under EU legislation

In European legislation, the term security is defined in Art. 4 para. 1 no. 44 MiFID II:

> *"'transferable securities' means those classes of securities which are negotiable on the capital market, with the exception of instruments of payment, such as:*
>
> *(a) shares in companies and other securities equivalent to shares in companies, partnerships or other entities, and depositary receipts in respect of shares;*
>
> *(b) bonds or other forms of securitised debt, including depositary receipts in respect of such securities;*
>
> *(c) any other securities giving the right to acquire or sell any such transferable securities or giving rise to a cash settlement determined by reference to transferable securities, currencies, interest rates or yields, commodities or other indices or measures;"*
>
> (European Parliament and Council, 2014)

Thereby, a financial instrument needs (1) to belong to a 'class' of securities, (2) to be negotiable on the capital markets, and (3) to be part of the listed instruments under (a)-(c) in order to qualify as a 'transferable security', with the exception of instruments of payment (Hacker and Thomale, 2017; Langenbucher, 2018). In contrast to US legislation, which focuses on the 'investment contract', the definition of 'transferable securities' in EU legislation is based on the transfer of units in the secondary

[4] The SEC confirmed in two leading cases that bitcoin and ether investments equally count as investment of money, since it is *"the type of contribution of value that can create an investment contract under Howey"* (Hacker and Thomale, 2017; Robinson, 2017; SEC vs. Shavers, 2014; SEC, 2017a).

market (Maume and Fromberger, 2018). In the literature, different scholars discuss the interpretation of the three different characteristics in the context of crypto-assets:
(1) A class is understood to be a set of identical objects which are fungible meaning that they can be traded and exchanged among themselves (Langenbucher, 2018). That does not mean that all units available need to share the exactly same characteristics, but the claims embodied in a token must not bear individualized features individually negotiated with investors. Standardized tokens which share comparable characteristics would satisfy this requirement, if they can be exchanged against each other without making a difference for the investor (Hacker and Thomale, 2017; Maume and Fromberger, 2018).
(2) In order for an instrument to be negotiable on the capital markets, it needs to be transferable. Since tokens can generally be sold on secondary markets, they are typically transferable (Hacker and Thomale, 2017). However, some issuers equip their token with technical limitations that make transfers impossible (so-called 'lockups'). For these tokens, ownership remains with the subscriber making them a non-transferable security. However, if the lockup is removed after the ICO, they are understood as being transferable (Hacker and Thomale, 2017; Maume and Fromberger, 2018). While transferability describes whether ownership can be passed on, negotiability refers to the ease of ownership transfer (Hacker and Thomale, 2017). A unit is considered negotiable if it can be bought or sold easily in a structured market setting. In this context, any transferable token, regardless of whether it is listed on a crypto-exchange, is considered negotiable unless it is stated that it will never be traded on an exchange (Maume and Fromberger, 2018). Further, the term capital market is to be understood broadly, encompassing any context where securities are offered (European Commission, 2008). If a capital market is understood as any venue where financial assets can be traded and the above criteria are met, negotiability on capital markets is fulfilled (Hacker and Thomale, 2017; Langenbucher, 2018). However, since the capital markets are defined by the relationship between issuer and investor, a token needs to provide some kind of membership rights or monetary streams in order to qualify as a transferable security. A return on investment based on an increased value of the token in the secondary market is not sufficient in the capital markets context (Hacker and Thomale, 2017; Maume and Fromberger, 2018).
(3) While shares and bonds constitute instruments which are typically traded on financial markets, it is not clear in which case new designed financial instruments are "equivalent to shares" or "other forms of securitised debt". In order to understand the common characteristics of the two aforementioned standard securities, we give a short definition: Shares (also called stocks) usually represent an ownership of corporate assets, net of corporate liabilities. Their value depends on corporate assets, liabilities, and income as well as on how traders expect managers to use corporate assets in the future. Dividend payments are common, while preferred stocks have priority to common stocks (Harris, 2003, p. 39f.). Bonds are debt securities issued by a debtor in order to borrow money. The value usually depends on interest rates, issuer creditworthiness, and collateral (Harris, 2003, p. 40). New instruments would need to be functionally equivalent or at least comparable to the listed examples (Hacker and Thomale, 2017). Still, it is unclear what level of comparability is necessary. At least, instruments would need to possess some minimum investment features like the participation in future cash flows in order to be capable of being traded in the capital markets as discussed under (2). This equivalence premise also depends on the implementation of the directive in the different member states. Hereby, the national authorities consider varying characteristics and features like different levels of voting rights (e.g., on investment proposals or on who gets to manage the company), predetermined share in profits or stake in partnership (Langenbucher, 2018). Nevertheless, some scholars argue that an equivalence test is irrelevant and the only criteria for securities under EU law are transferability, standardization, and negotiability (Hacker and Thomale, 2017). Looking at pure currency-tokens and hybrid tokens, Maume and Fromberger (2018) take the view that tokens can only be considered an instrument of payment if their main purpose is to be used for payments, they are defined as decentralized, and do not carry any inherent value. However, hybrid tokens do not fall under this definition. Moreover, the payment functionality of hybrid tokens is irrelevant when assessing if a token is qualified as a transferable security. Table 1 compares the most relevant criteria for security classification based on US and EU securities regulation, which are important for discussing the legal classification of crypto-assets.

US legislation *Main criterion*: investment contract (Howey test)	*EU legislation* *Main criterion:* transferability
Criteria that classify an investment contract:	*Criteria that classify a transferable security*:
• A common venture → No individualized rights → Investors' funds are pooled → Income and expenses are distributed proportionally	• A class of securities → No individualized rights → Set of identical, fungible objects
• Expectation of profit → Dividend, return, or payment	• Functional equivalence with ordinary securities → Profit participation → Stake in partnership → Voting rights
• Managerial effort of others → Expectation of a person or group to carry out managerial or entrepreneurial efforts	• Transferability & negotiability → Ownership transfer is possible → Security can be traded easily in a structured market setting → Relationship between issuer and investor is clearly defined through membership rights and monetary streams
• Investment of money (fiat or cryptocurrency)	

Table 1: Main characteristics relevant for the legal classification of securities under US and EU legislation

2.3 Research objective

Many studies engage in analyzing the phenomenon of ICOs. While some studies concentrate on the regulatory discussion and classification of tokens and ICOs (see section 2.2), other studies analyze common characteristics, design factors, and success factors. Adhami et al. (2017) analyze a sample of 253 ICO campaigns statistically regarding their success rates, objectives, embodied rights, and first day of secondary market trading. Blaseg (2018) analyzes the impact of voluntary disclosure on ICO success. He finds that quality disclosures, such as the preparedness or the availability and quality of the source codes, can predict the outcome of a project. Catalini and Gans (2018) show that the ICO mechanism allows entrepreneurs to generate buyer competition for the token. They find that venture returns are independent of any committed growth in the supply of tokens over time and that initial funds raised are maximized by setting that growth to zero. Kaal and Dell'Erba (2018) give an overview of the ICO process, the core risk factors, and ICO practices requiring regulatory improvements. Zetzsche et al. (2017) as well as Fridgen et al. (2018) analyze real-world cases of ICOs in order to provide taxonomies of their characteristics. Nevertheless, these taxonomies focus on the ICO process itself and not on the tokens issued and their regulatory classification based on their embodied rights. To our best knowledge, no study until now engaged in a comprehensive classification of crypto-assets with a regulatory focus based on related literature and empirical data. Therefore, the goal of this paper is to develop a taxonomy of crypto-assets covering embodied investor rights, security-like characteristics, and crypto-specific features being able to support regulators with their case-by-case assessment of crypto-assets. The aim of the taxonomy is to allow a categorization of crypto-assets by their characteristics and to compare them to traditional financial products which fall under existing regulation, so that the regulator can decide how to regulate the respective crypto-asset reasonably. Furthermore, unknown common characteristics among crypto-assets shall be revealed in order to give regulators a basis for the discussion of new rules. In addition, the taxonomy is also supposed to be designed for issuers who plan to finance their venture via an ICO. The taxonomy is intended to help them design the right token for their projects and understand which regulatory consequences different features may have.

3 A Taxonomy of crypto-assets

The primary goal of this paper is to develop a taxonomy of crypto-assets. In the literature, taxonomies are basically defined as *"[...] systems for grouping objects of interest in a domain based on common characteristics"* (Nickerson et al., 2013). Taxonomy development has been studied thoroughly in social science research. Bailey (1994), for instance, provides a detailed overview on classification techniques. We

apply the methodology developed by Nickerson et al. (2013), which has been used in many IS studies (e.g., Fridgen et al. (2018), Glaser and Bezzenberger (2015), and Siering et al. (2017)) providing an iterative approach where objects are discovered and grouped according to defined characteristics and dimensions with predefined steps in order to avoid intuitive development. In our view, this method perfectly fits our purpose. In the following sections, we briefly depict the methodology by Nickerson et al. (2013) and describe our taxonomy development process.

3.1 Taxonomy development methodology

Nickerson et al. (2013) define a taxonomy T as a set of n dimensions $D_i(i = 1,...,n)$ each consisting of $k_i(k_i \geq 2)$ mutually exclusive and collectively exhaustive characteristics $C_{ij}(j = 1,...,k_i)$ such that each object under consideration has one and only one C_{ij} for each D_i:

$$T = \{D_i, i = 1,...n | D_i = [C_{ij}, j = 1,...,k_i; k_i \geq 2]\} \quad (1)$$

Written prosaically, a taxonomy consists of multiple dimensions each containing different characteristics, while each object in the taxonomy has exactly one of the characteristics in each dimension. In order to develop a taxonomy as described in Equation 1, Nickerson et al. (2013) construct an iterative approach consisting of seven steps intended to provide a guideline for researchers during the taxonomy design process. The first two steps of their method predefine certain parameters of the taxonomy, while steps three to seven are performed iteratively. In step one, meta-characteristics need to be defined in order to avoid analyzing an arbitrary set of unrelated characteristics for the topic at hand. The meta-characteristic is the most comprehensive characteristic and constitutes the basis for each characteristic in the taxonomy being a logical consequence of it. Therefore, the choice of the meta-characteristic is crucial and thus should be based on the purpose, the expected use, and eventual users of the taxonomy. In step two, ending conditions need to be determined, which need to be satisfied in order to terminate the iterative part of the taxonomy development method. Nickerson et al. (2013) distinguish objective and subjective ending conditions presented in Tables 2 and 3. The method terminates when both objective and subjective ending conditions are satisfied as determined in step seven. Regarding steps three to six, the method provides two approaches: a conceptual approach and an empirical approach. The choice of the approach depends on the availability of data and the knowledge of the researcher about the topic at hand. Using the conceptual approach, the researcher conceptualizes dimensions and characteristics without using objects based on her understanding of how objects are similar or dissimilar trying to cover all objects that could conceptually fit in the taxonomy. In the empirical approach, dimensions and characteristics are identified statistically or unformally based on subsets of objects. If data and knowledge are available, both approaches can be used in the development process. A detailed figure depicting all steps of the method can be found in Nickerson et al. (2013). Regarding the conceptual approach, we adapt the methodology so it fits our purpose. Therefore, we follow Siering et al. (2017) and include different sources of input, i.e., existing financial regulation for US and EU legislation as well as literature in the fields of economics and law, which discuss the applicability of existing regulation to crypto-assets as presented in section 2.2. Further, we include empirical data collected from real-world ICOs.

3.2 Description of the taxonomy design process

Developing our taxonomy of crypto-assets, we rely on three types of resources, i.e., empirical data as well as regulatory documents and related economic and legal literature. For the empirical-to-conceptual iterations, we derive a data set of the 400 largest completed ICOs in 2017 regarding USD raised.[5] In each empirical iteration, we analyze subsets of our data set, each consisting of 20 randomly selected ICOs as proposed by Nickerson et al. (2013), to identify common characteristics of these objects. We

[5] We retrieved the data from `https://www.tokendata.io/` on 5 January 2018.

Objective ending condition	*Comments*
All objects or a representative sample of objects have been examined	If all objects have not been examined, then the additional objects need to be studied
No object was merged with a similar object or split into multiple objects in the last iteration	If objects were merged or split, then we need to examine the impact of these changes and determine if changes need to be made in the dimensions or characteristics
At least one object is classified under every characteristics of every dimension	If at least one object is not found under a characteristic, then the taxonomy has a 'null' characteristic. We must either identify an object with the characteristic or remove the characteristic from the taxonomy
No new dimensions or characteristics were added in the last iteration	If new dimensions were found, then more characteristics of the dimensions may be identified. If new characteristics were found, then more dimensions may be identified that include these characteristics
No dimensions or characteristics were merged or split in the last iteration	If dimensions or characteristics were merged or split, then we need to examine the impact of these changes and determine if other dimensions or characteristics need to be merged or split
Every dimension is unique and not repeated (i.e., there is no dimension duplication)	If dimensions are not unique, then there is redundancy/duplication among dimensions that needs to be eliminated
Every characteristic is unique within its dimension (i.e., there is no characteristic duplication within a dimension)	If characteristics within a dimension are not unique, then there is redundancy/duplication in characteristics that needs to be eliminated (This condition follows from mutual exclusivity of characteristics).
Each cell (combination of characteristics) is unique and is not repeated (i.e., there is no cell duplication)	If cells are not unique, then there is redundancy/duplication in cells that needs to be eliminated

Table 2: Objective ending conditions. Source: Nickerson et al. (2013)

Subjective ending condition	Questions
Concise	Does the number of dimensions allow the taxonomy to be meaningful without being unwieldy or overwhelming?
Robust	Do the dimensions and characteristics provide for differentiation among objects sufficient to be of interest? Given the characteristics of sample objects, what can we say about the objects?
Comprehensive	Can all objects or a (random) sample of objects within the domain of interest be classified? Are all dimensions of the objects of interest identified?
Extendible	Can a new dimension or a new characteristic of an existing dimension be easily added?
Explanatory	What do the dimensions and characteristic explain about an object?

Table 3: Subjective ending conditions. Source: Nickerson et al. (2013)

obtain relevant information for each issued crypto-asset from white papers, terms and conditions, websites, and press releases gathered from the internet. In conceptual-to-empirical iterations, we use regulatory documents as well as economic and legal academic literature in order to conceptualize the dimensions of the taxonomy based on the derived knowledge and discussions. Using these resources, we subsequently outline each iteration of our taxonomy development process. Due to page restrictions, we will only discuss relevant changes and their reasons in each iteration and present the complete taxonomy after terminating the iterative part of the approach.

The first step comprises the meta-characteristic. In order to understand the selection of our meta-characteristic, we shortly describe our target group and what benefit they have from the taxonomy. As discussed before, ICOs as well as the issued tokens are not yet subject to regulation in most jurisdictions. Based on case-by-case assessments, crypto-assets are classified in order to decide whether regulation applies. The aim of this taxonomy is to support regulators with their regulatory decisions and policy making by providing a tool that provides a comprehensive set of common characteristics of crypto-assets covering characteristics comparable to characteristics of traditional financial instruments as well as unknown unregulated characteristics of crypto-assets. Therefore, the primary target group for this taxonomy are regulators. As a secondary target group, issuers can use our taxonomy as a decision support tool to design their tokens. We define our meta-characteristics as follows: *Characteristics and properties of crypto-assets that represent specific rights or features for investors that are or may be subject to financial regulation due to their nature.* As ending conditions for the iterative part of the taxonomy development method, we rely on the objective and subjective ending conditions as proposed

by Nickerson et al. (2013). Since we gathered a broad knowledge about the basic types of crypto-assets, the characteristics of traditional financial instruments and their regulation, as well as the applicability of financial market regulation to crypto-assets in sections 2.1 and 2.2, we choose the conceptual-to-empirical approach in the first iterations and switch to the empirical-to-conceptual approach afterwards in order to test and adjust the derived dimensions and characteristics empirically.

Iteration 1 To start, we choose the conceptual-to-empirical approach in order to identify dimensions and characteristics based on the basic types of crypto-assets being currency, investment, and utility tokens as discussed in the literature. Given their key characteristics, we derive the following dimensions: First, currency tokens are meant to function as means of payment for goods and services outside of the platform. From this, we define the first dimension of the taxonomy covering this aspect: {Accepted in exchange for goods and services outside of platform [yes, no]}. Second, utility tokens usually embody the right to use a predefined product or service that issuers have developed or are developing. Therefore, the second dimension covers the characteristics whether a token embodies such rights or not: {Right to use predefined product or service [yes, no]}. And third, investment tokens usually give the owner the right to participate in the project's return comparable to dividends or fixed payments. Some investment tokens additionally include voting rights. Following these aspects, we add two dimensions to our taxonomy representing these features: {Promise for future returns [yes, no], Voting rights [yes, no]}. As discussed in the literature, many crypto-assets belong to one of the described basic types embodying the respective characteristics. Moreover, some tokens cover aspects of multiple basic types being called hybrid tokens. Since several dimensions and characteristics were added in this iteration and at least one objective ending condition is not satisfied, the method must be repeated.

Iteration 2 We continue with the conceptual-to-empirical approach, since the literature still offers valuable knowledge. We now focus on regulatory documents as well as academic literature discussing the applicability of existing regulation to crypto-assets. In this iteration, we concentrate on characteristics of crypto-assets that might classify them as an 'investment contract' according to the Howey test. Here, four factors need to be present. We start with the investment of money. Even though investments of cryptocurrencies count as investments of money in the US, we include a dimension covering how an investor has to pay for the respective crypto-asset in the initial offering (via cryptocurrency or fiat-currency) in order for the taxonomy to be applicable for other jurisdictions: {Investment of money [crypto only, crypto and fiat]}. Second, in order for a venture to be a common venture, commentators argue that there must not be individual negotiated rights for any investor. Therefore, we add another dimension addressing this aspect: {Individualized rights [yes, no]}. Third, investors have an expectation of profit. We already included a dimension covering this aspect in our taxonomy. Yet, since payments differ in their characteristics, comparable to equity or debt investments, we replace the characteristic 'yes' with two new characteristics being 'profit participation' for dividend like payments and 'fixed payments' for debt like paybacks. Fourth, we consider the entrepreneurial or managerial efforts of others. Commentators argue that this factor is present if one can expect a person or group to carry out essential entrepreneurial efforts which is not the case if the network is sufficiently decentralized. Therefore, we add a dimension covering the 'level of decentralization' being 'no', if no decentralization is present, 'low' if there is a central person or group managing the project, and 'full', if there is no central person or group managing the project: {Level of decentralization [no, low, full]}. The added dimensions can be found in several crypto-assets. During an ICO, most tokens can be bought with cryptocurrencies like bitcoin or ether. Investment tokens usually promise payments in form of profit participation or fixed periodic payments, while some also offer individualized rights. The level of decentralization in general depends on the business model and whether a venture wants to manage the network itself or wants it to be fully decentralized. Since several dimensions and characteristics were added in this iteration and at least one objective ending condition is not satisfied, the method must be repeated.

Iteration 3 Since the literature still offers valuable knowledge from regulatory documents and discussions of EU legislation, we again apply the conceptual-to-empirical approach. In this iteration, we focus on

characteristics that could classify crypto-assets as a 'transferable security' under EU legislation. In order to classify as a transferable security, crypto-assets need to be standardized, negotiable on the capital markets, and comparable to traditional financial instruments. First, in order to be standardized, tokens must not be individualized for single investors. We already included a dimension in our taxonomy covering this aspect. Second, in order for a token to satisfy the requirement of being negotiable on the capital markets, it needs to fulfill two criteria: it needs to be transferable and to be traded easily in a structured market setting. Thus, we extend our taxonomy by two new dimensions. The 'transferability' dimension includes characteristics representing whether a token can be transferred in general, after the ICO, or during the ICO: {Transferability [lockup, lockup during ICO, no lockup]}. In the 'exchange listed' dimension, characteristics indicate whether a token is listed, not listed, or whether an issuer states it will never be traded on an exchange: {Exchange listed [listed, not listed, listing ruled out]}. A dimension covering the comment that a 'transferable security' needs to offer membership rights or monetary streams is already included in the taxonomy. Third, in order to cover the 'comparable to financial instruments' aspect, we include key characteristics of such instruments. Regarding shares, we already included a dimension covering ownership rights by means of profit participation as well as voting rights. However, the dimension 'voting rights' needs to be specified in more detail. Shareholders usually have rights to vote on decisions in shareholder meetings, which affects the composition of the managerial board. Because some tokens only embody rights to vote on the design of products or services, these rights need to be differentiated. Therefore, we include different levels of voting rights as characteristics in this dimension being 'no', 'product specific', and 'managerial'. With respect to debt instruments such as bonds, we already included a dimension covering fixed payments. Further, we add a dimension representing ventures that use funds comparable to investment funds in order to invest in portfolios of securities or crypto-assets: {Investment fund [crypto-assets, financial instruments, financial instruments and crypto-assets, none]}. The newly chosen dimensions and characteristics are common for crypto-assets and chosen based on discussions of real-world ICOs. Since several dimensions and characteristics were added in this iteration and at least one objective ending condition is not satisfied, the method must be repeated.

Iteration 4 Since we have data on real-world ICOs, we now switch to the empirical-to-conceptual approach in order to test and extend our taxonomy. From our data set, we derive our first random subset of 20 crypto-assets. We are able to assign exactly one characteristic for each dimension to every object satisfying the respective objective ending conditions. However, analyzing the data, we can find three additional dimensions which are important for our taxonomy. First, we observe issuers who lock their own share in tokens for a given time period after the ICO to underline their trustworthiness comparable to a vesting period. We include a dimension covering this aspect: {Vesting issuer owned tokens [yes, no tokens for issuers, no]}. Second, we observe ventures offering investment advice meaning they perform research on the crypto or financial markets and make suggestions for investments. This service can be accessed using their issued tokens. Since investment research is subject to financial market regulation, we add another dimension: {Investment advice [yes, no]}. Third, while most issuers limit the total amount of tokens available, others allow the total amount of available tokens to grow (via mining) or decrease (via repurchases) affecting the market value of the respective tokens. Therefore, we include the dimension {Token supply [fixed, growing, decreasing]}. Since at least one dimension or characteristic was added in this iteration and at least one objective ending condition is not satisfied, the method must be repeated.

Iteration 5 We stick to the empirical-to-conceptual approach since we have more data available. Therefore, we derive another subset of 20 crypto-assets. Again, we are able to assign exactly one characteristic for each dimension to every object satisfying the respective objective ending conditions. Still, analyzing our data, we can find another dimension. Some tokens offer the possibility to participate in online gambling with a chance to win more tokens. These tokens can then be exchanged on crypto-exchanges to regular fiat-currencies. Because gambling is heavily regulated or prohibited in many jurisdictions, we add the dimension {Gambling [yes, no]}. Since at least one dimension or characteristic was added in this iteration and at least one objective ending condition is not satisfied, the method must be repeated.

Iteration 6 We again use the empirical-to-conceptual approach and derive another subset of 20 crypto-assets. For all objects in the subset, we are able to assign exactly one characteristic for each dimension to every object. We cannot find any new dimension or characteristic that needs to be added to the taxonomy and did not merge or split any existing dimension or characteristic. We did not find a crypto-asset in the empirical analysis embodying individualized rights. However, this dimension is based on regulatory discussions of real-world crypto-assets and therefore is valuable for the taxonomy. Thus, our taxonomy fulfills all objective ending conditions. We also argue that our taxonomy satisfies all subjective ending conditions, which we further address in the discussion. Figure 1 depicts the final taxonomy.

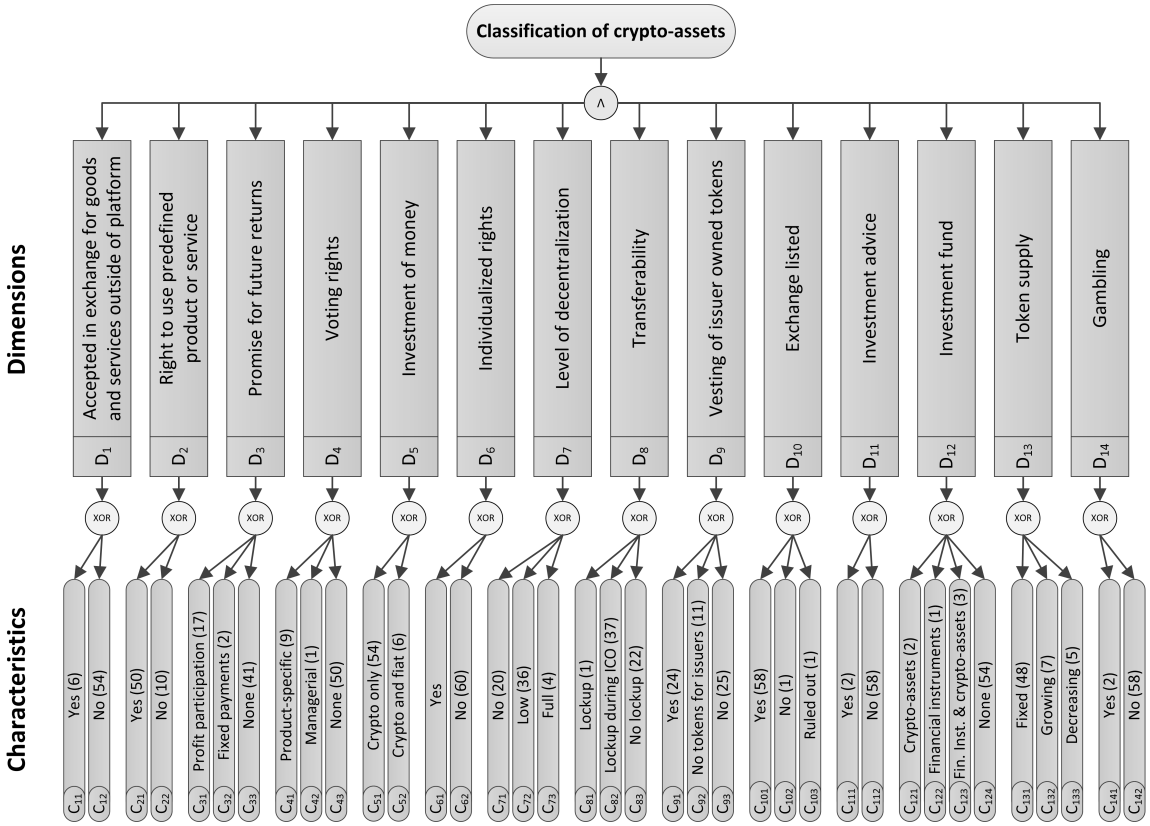

Figure 1: Final taxonomy of crypto-assets

4 Discussion

Looking at our final taxonomy depicted in Figure 1, we provide a comprehensive framework to classify crypto-assets with a regulatory focus. The taxonomy covers a comprehensive set of dimensions and characteristics derived from regulatory documents, industry discussions, and empirical data. Therefore, all objects can be classified clearly in order to assess whether a token embodies specific characteristics that are subject to regulation. Thus, the taxonomy is *explanatory* and *comprehensive*. Dimensions and characteristics can differentiate objects in a meaningful way and are *robust* for all observed objects. Also, the taxonomy is *concise* covering all dimensions and characteristics needed to clearly classify crypto-assets for the given purpose without being unwieldy or overwhelming. Finally, the taxonomy is *extendible*. Dimensions and characteristics can be extended easily in case new aspects of crypto-assets are observed or the purpose of the taxonomy is extended. Therefore, all subjective ending conditions are met. Regarding the empirical part of the taxonomy development process, we analyze a representative sample of 60 real-world crypto-assets. The numbers in brackets in Figure 1 show the number of observed tokens assigned to each characteristic in each dimension of the taxonomy. We find that most of the observed

tokens can be classified as basic utility tokens. Usually, their purpose is to be used to access a product or service on the issuing platform. They are not accepted in exchange for products and services outside the platform, do not promise future returns, and contain no voting or individualized rights. Most tokens can be bought in exchange for cryptocurrencies only, are locked up during the ICO, and are tradable afterwards, while issuer owned tokens remain locked in a vesting period and token supply is fixed. Furthermore, most platforms have a low level of decentralization meaning that the platform is managed by the developers and token holders can participate in a decentralized manner on the platform. Besides pure utility tokens, we also find tokens that are subject to US or EU regulation. Regarding the Howey test under US legislation, many crypto-assets fulfill the requirements: we did not find individualized rights in any observed token. Many tokens offer participation in profits and some fixed payments. Further, for most ventures issuing tokens, we find a person or group to carry out essential managerial efforts, given no or low decentralization. Regarding EU legislation, standardization, transferability, and negotiability are fulfilled for nearly all observed crypto-assets. Comparability needs to be assessed more in detail. Still, as mentioned earlier, many tokens embody profit participation or fixed payments and some also offer voting rights (mainly on products or services), while others represent a share in an investment fund. The majority of the above mentioned cases falls under the category of hybrid tokens, additionally offering access to products or services. We also find less common types of tokens offering gambling games or investment advice. Furthermore, we also include crypto-asset specific features in the taxonomy which may affect the value of the respective crypto-assets (token supply) and are valuable information for fraud detection (e.g., lockup for issuer owned tokens). All in all, we show that our taxonomy can be used to classify crypto-assets based on regulation-specific criteria such as embodied rights and features, and therefore is valuable to support regulators with their regulatory decisions and policy making. While gathering information regarding tokens, we experienced strong differences in information provision. Sometimes, high effort was needed to find relevant information. Since we can assume that retail investors not always act rationally but naively invest in any ICO with the hope to make easy profits in secondary markets, we argue that information provided for all ICOs, regardless of the classification of the token, needs to be standardized. Thus, in order to ensure market integrity and investor protection, it is crucial to make ICOs more transparent. This will help ICOs to become a real alternative to traditional financing methods in the long-run.

5 Conclusion

ICOs are on their way to becoming a serious alternative to traditional financing methods. Regulators and academics are assessing this new phenomenon to understand it and to decide whether regulation is needed to ensure market integrity and investor protection. Since there is no one-fits-them-all solutions because of the extreme diversity of crypto-assets, regulators apply case-by-case assessments in order to decide whether existing regulation is applicable or whether new rules are necessary. Our contribution to research on ICOs and the regulatory discussion is threefold: First, in order to support regulators with their regulatory decisions and policy making, we develop a taxonomy of crypto-assets covering embodied investor rights, security-like characteristics, and crypto-specific features. The taxonomy can be used by regulators to classify tokens as a basis for discussing which existing regulation has to be applied and which characteristics need to be regulated in the future in order to ensure investor protection and market integrity. Second, issuers who are planning an ICO benefit from this taxonomy. They can use it as a decision support tool designing their token in order to assess which characteristics are subject to regulation. And third, we gain insights in the nature and design of crypto-assets by analyzing their characteristics empirically and extract common combinations of their characteristics. Nevertheless, while the focus of our taxonomy is to classify crypto-assets based on their characteristics, some utility tokens can be used to access financial services on a platform. Therefore, we suggest future research to analyze platforms themselves to assess whether their services are subject to regulation.

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