Security Tokens, Ecosystems and Financial Inclusion: Islamic Perspectives

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Abstract

Purpose—Shariah-compliant security tokens can play an important role in developing innovative solutions to resolve voluntary and involuntary financial exclusion in Muslim societies. This paper aims to present features of Shariah-compliant security tokens and supporting ecosystems that can provide additional sources of financing for small and medium enterprises (SMEs) and create alternative investment opportunities for retail investors.

Design/methodology/approach—This conceptual paper presents the building blocks of security tokens, their ecosystem and key functions and activities and then examines these features from Islamic perspectives. This is done by reviewing the contemporary literature on cryptoassets and their ecosystems and analysing these in light of Islamic legal and ethical values and principles.

Findings—The paper provides a framework of how Shariah-compliant asset- and equity-based security tokens can be used by SMEs to raise funds quickly and efficiently on crypto exchanges. Given the novelty and complexity of the technology involved and the lack of understanding and skills to develop blockchain-based systems among SMEs, the paper suggests developing security tokens and exchanges in a controlled manner under the supervision of a nation's stock markets.

Originality—While several studies examine cryptocurrencies from Islamic perspectives, literature on other cryptoassets and their role in financial inclusion is scant. This paper identifies Shariah-compliant asset- and equity-based security tokens and supporting ecosystems that can contribute to the development of digital capital markets where SMEs can raise funds efficiently and retail investors can invest in alternative asset classes.

Key Words: Cryptoassets, crypto exchange, financial inclusion, security tokens, SMEs, Shariah compliance

1. Introduction

SMEs play an important role in job creation, poverty alleviation and economic growth in emerging economies as they constitute 90% of the businesses, provide 50% of employment and contribute to 40% of the national income.[1] A key factor determining the health and growth of SMEs is the availability of financial resources which enables them to invest in capital and buy the necessary inputs used in production. Access to finance, however, is identified as a key impediment to the growth of micro, small and medium enterprises (MSMEs). The annual finance gap for formal MSMEs in emerging and developing countries is estimated to be US$ 5.2 trillion (World Bank and IFC 2017). The corresponding equity gap for MSMEs in these countries is estimated to be US$ 3.92 trillion (World Bank 2020b: 73).

Financial exclusion of MSMEs preventing them from having access to credit that can positively impact their production and income levels can be due to involuntary and voluntary reasons. Most of the MSMEs are financially excluded involuntarily as financial institutions do not provide credit due to financial frictions such as acute asymmetric information problems and lack of acceptable collateral. Financial exclusion can also be voluntary due to cultural and religious reasons. For example, many Muslims do not engage with the financial sector voluntarily due to religious reasons (World Bank 2008). For example, even though there is a huge demand for Islamic financial products in the MENA regions, IFC finds that 32 per cent of small businesses are excluded from the formal banking sector due to a lack of Shariah-compliant products (IFC 2013). Thus, increasing financial inclusion in Muslim countries would require expanding the provision of Shariah-compliant financing.

Given that SMEs play a key role in economic development and poverty alleviation and traditional financial institutions have not been forthcoming to finance them, there are suggestions to come up with alternative solutions to facilitate SME financing. One option is to use capital markets as a source of funds for SMEs. In particular, capital markets can be used to raise funds in the form of both debt (minibonds, securitization and private debt placements) and equity (shares and private equity placements) (Nassr and Wehinger 2015). However, key constraints that SMEs face in using capital markets include the relatively higher costs of issuing and listing securities and onerous disclosure and reporting requirements. For example, the total average costs related to initial public offerings (IPOs) for 302 companies from different sectors

[1] https://www.worldbank.org/en/topic/smefinance

raising funds in the value range of $25 million to $99 million and having less than $100 million in revenue was between $2.1 million to $12.9 million.[2]

The Fourth Industrial Revolution (4IR) has opened opportunities to develop innovative solutions by using digital tools such as cloud, distributed ledger technology and blockchain, smart contracts, the internet of things, big data, machine learning and artificial intelligence. The new forms of connectivity and information technology (IT) integration in businesses have led to the introduction of cyber-physical systems (CPS), smart factories and customized and personalized smart products which are changing value chains, communication channels and business models (Nosalska et al. 2020). The use of digital technology in finance in the form of financial technology (or fintech) is changing the underlying foundations and architecture of financial services by moving from physical products and premises to their digital counterparts.

An important development in fintech is decentralised finance (DeFi) which uses distributed ledger technology (DLT) and blockchains. The use of DLT and blockchain in DeFI is changing traditional financial systems that depend on central authority to decentralised ones. DeFi can potentially transform the value chain by transferring value, recording transactions and sharing information in a decentralized manner (Hinman 2018). DeFi in the form of cryptoassets and its ecosystem has the potential to come up with innovative solutions that are efficient, safe and build trust. In particular, cryptoassets and exchanges can reduce the costs of listing, mitigate counterparty risks and shorten the settlement cycles (Deloitte 2020). Given these features, cryptoassets and exchanges can contribute to financial inclusion by providing opportunities for SMEs to raise funds on crypto exchanges quickly and at much lower costs. Other than creating opportunities for SMEs and entrepreneurial firms to raise funds, cryptoassets and crypto exchanges can help improve financial inclusion for retail investors by providing them with alternative investment opportunities.

Given the role that cryptoassets can play in coming up with innovative solutions in promoting financial inclusion, this paper presents the building blocks of cryptoassets and their ecosystem and identifies their key functions and activities. The paper then examines the features of security tokens from an Islamic perspective. The paper contributes to the literature in a few significant ways. First, most of the literature on cryptoassets from Islamic perspectives focuses on exchange tokens or cryptocurrencies. This paper examines the role of security tokens as alternative instruments to raise funds from the market. Second, while most of the existing

[2] See https://www.pwc.com/us/en/services/consulting/deals/library/cost-of-an-ipo.html#:~:text=Based%20on%20public%20filings%20of,7.0%25%20of%20gross%20IPO%20proceeds.

research concentrates on cryptoassets, they do not consider the supporting ecosystems or exchanges. This paper considers both the security tokens and the exchanges where these can be issued and traded. Finally, the focus of most of the current literature on cryptocurrencies is on Sharia-related issues. This paper presents a framework of how Islamic security tokens can help promote financial inclusion.

2. Cryptoassets: Architecture, Types and Ecosystem

The key functions of a capital market are to enable the issuance and listing of securities in the primary markets and facilitate their trading and redemption in secondary markets. The infrastructure entities managed centrally by capital market entities that enable these functions include exchanges, central counterparty clearing houses (CCPs), central securities depositories (CSDs) and automated clearing houses (ACHs) (ISSA 2018). Other intermediaries such as investment banks assist in the issuance of securities and brokers, dealers and investment firms help investors to trade in secondary markets. While the functions of cryptoassets and their ecosystem are similar to capital markets, their forms and structures differ. Different aspects of cryptoassets and their ecosystems are discussed below.

2.1. Cryptoassets architecture

Termed variously as digital assets, virtual assets, DLT assets, digital currency and cryptocurrency, the distinguishing feature of crypto assets is the underlying technology that is used to create them. Crypto assets are a part of 'Decentralised Finance' (DeFi) that includes 'financial products, services and activities that use distributed ledger technology ("DLT") to disintermediate and decentralize legacy ecosystems by eliminating the need for some traditional financial intermediaries and centralized institutions' (IOSCO 2022, 1). Crypto-asset is defined variously as 'codes that are stored and accessed electronically' (Narain and Moretti 2022:19), 'a type of private sector digital asset that depends primarily on cryptography and distributed ledger or similar technology' (FSB 2022a: 25) or "a cryptographically secured digital representation of value or contractual rights that uses some type of distributed ledger technology (DLT) and can be transferred, stored or traded electronically" (HMT, FCA and BOE 2018: 11). The crypto-asset ecosystem encompasses all crypto-asset activities, markets and participants (FSB 2022b: 71).

DeFi is based on a multi-layered architecture consisting of on-chain layers and external off-chain inputs (Schar 2021 and IOSCO 2022: 3). The on-chain architecture consists of four key elements. First is the 'settlement layer' where blockchain is used to record transactions and

hold cryptoassets securely under different addresses. The blockchain allows the secure storing of ownership information in a shared ledger. Cryptography is used to verify authorised participants and confirm transaction records on the blockchain through automatic computer-coded smart contracts which implement the terms of the agreement when specific conditions are fulfilled.

Second, the 'asset layer' represents crypto-assets (coins and tokens) that the participants create and transfer on a blockchain. The assets can be native to the protocol or other assets issued on the blockchain. While the native protocol asset can be tracked on the blockchain ledger, other assets can also be added to the ledgers through tokenization. A large number of the tokens are issued on Ethereum blockchain using the ERC20 token standard which is interoperable and used in many DeFi applications.

Third, 'protocol' or 'smart contract layer' embodies digital codes and auxiliary software that are executed on the blockchain and provide the functionality of crypto-assets for different activities such as exchange, lending, borrowing, derivatives, etc. Blockchains such as Ethereum support the storing and execution of smart contracts. Decentralised transactions are carried out through a reward mechanism whereby nodes are given incentives to verify and complete transactions. Nodes involved in mining verify the accuracy of the transactions, complete them and update the information in a decentralised manner. Each blockchain would have its native crypto-asset that is used to pay execution fees or 'gas' to nodes who act as miners to complete transactions. For example, Ether is a token issued and distributed by Ethereum to nodes for their activity of mining that validates and relays the transactions on the blockchain. The sender of a transaction pays Ether as 'gas' or fees to execute and complete the transactions on the Ethereum ledger.

The consensus mechanism that allows all computers or nodes in the blockchain to agree on the legitimacy of the transactions is of two types: proof-of-work (POW) and proof-of-stake (POS). In POW, decentralised agents compete to mine new cryptoassets by solving complex algorithmic problems and receive fees to verify and endorse new transactions on the blockchain. Bitcoin and Ethereum 1.0 used POW as a consensus mechanism. Miners use processing power to solve math puzzles and the first one to solve the puzzle gets to update the verified transaction on the blockchain and is paid a predetermined amount of crypto as a reward. However, since Ethereum's blockchain hosts a large number of tokens and DeFi transactions, POW was not very efficient in forming consensus and confirming transactions. The POS was introduced as an alternative to solve this problem whereby a network of validators contributes their cryptos

in exchange for getting a chance to validate the transaction and update the blockchain. The validators receive a reward in native tokens in proportion to each validator's stake. Ethereum 2.0 and other crypto assets such as Cardano and Atmos use POS consensus mechanisms.

The fourth layer is the 'application layer' constituting software, application programming interface (APIs) and front-end user interfaces that facilitate participants and users to interact with smart contracts through a website or mobile app. Some centralised service providers have developed APIs that help users to access the underlying blockchains. Although some apps allow users to transact in one protocol's smart contracts, other apps act as aggregators allowing users to deal with multiple protocols.

Many applications use off-chain technologies that use the traditional internet infrastructure and do not operate on a blockchain. The 'off-chain' inputs support the DeFi supply chain of crypto-assets and affect the layers of assets, smart contracts and applications. Off-chain systems include companies and ecosystems that provide essential services that support the DeFi activities (IOSCO 2022). Users typically access Defi products and services through off-chain interfaces. Centralised crypto-asset trading platforms and aggregators enable users to compare and connect to several applications and protocols and also provide other useful services that serve as input for on-chain protocols. For example, the prices of crypto-assets are determined on centralised platforms that are needed to make decisions for on-chain transactions. A feature of decentralised blockchain-based cryptoassets is that they can be accessed from anywhere and operate across borders.

2.2. Cryptoassets: Types and Activities

Cryptoassets are new forms of informational or digital commodities, with some having no intrinsic value and others representing some underlying valuable asset (Kirchner 2021). Cryptoassets are created and managed in a decentralised way by different participants and are not guaranteed by any public authority or central bank. As indicated, DLT enables the updating and sharing of records in a decentralised and distributed manner whereby many participants have access to and update the data on the ledger subject to some set controls and processes. However, in some cases cryptoassets and DeFi systems issue governance tokens that give token holders the right to vote and control decisions. There can be cases where the governance tokens are held by a few which concentrate control and voting rights (IOSCO 2022).

Originally cryptoassets were developed as currencies to democratise payments through decentralised systems but have since evolved into a variety of other functions and asset classes

that give certain rights. Collomb et al. (2019) identifies the rights associated with tokens into four types: rights of usage, rights of participation, rights to profit and rights of ownership. Crypto-assets can be broadly classified as exchange or payment tokens, utility tokens and security tokens (IOSCO 2020b). The features of these categories of cryptoassets are given below.

Exchange tokens: Also termed as cryptocurrencies, exchange tokens are unbacked crypto-assets and do not give any rights but can be used as a means of exchange or for investment (Bains et al. 2022, HMT, FCA and BOE 2018: 11). Cryptocurrencies are created as a new informational or digital commodity by decentralised agents through mining and can be exchanged between parties on digital exchanges. While cryptography assigns private keys to anonymous owners which makes ownership of cryptocurrencies secure, blockchain records all transactions and prevents duplication and fraud (Scharding 2019). Cryptocurrencies need to be distinguished from digital or electronic currencies. While the former is an alternative currency that is supported by cryptography and blockchain, the latter is an electronic representation of existing fiat currency.

The limitations of cryptocurrency in performing the functions of a unit of account and store of value due to their price volatility are resolved to some extent in stablecoins.[3] Stablecoins constitute one form of cryptocurrencies that 'purports to maintain a stable value by referencing to physical or financial assets or other crypto-assets' (FSB 2020). A key feature of stablecoins that is distinct from other unbacked coins is the stability of its value which makes it a better asset for use as collateral (FSB 2022b).

Utility tokens: These tokens provide consumptive rights and access to some specific service, product or platform. Utility tokens issued through Initial Coin Offerings (ICO) raise funds for new products and services by selling secured digital rights in new engineering or community development efforts or economy where token holders can spend their balance (Liebau and Krapels 2021). Utility tokens are usually linked to the network operated by the issuer and cannot be used on other networks (Bains et al. 2022).

Security tokens: Also termed as investment tokens, security tokens represent rights of ownership is some specific underlying assets such as bonds, stocks or other assets. Security tokens are created through Security Token Offering (STO) on a blockchain and bought, transferred, sold or destroyed according to the established rules of computer codes (Delloite

[3] For a discussion on stable coins see Arner et. al (2020).

2020: 3). A form of security token includes non-fungible tokens (NFTs) representing ownership of a specific non-fungible asset such as digital art. Depending on the regulatory regimes, the tokens must fulfil the security laws and regulations to be sold as securities. Accordingly, other relevant legal and regulatory requirements related to securities such as issuance and stamp duty, transferability, custody regulation, electronic transactions obligations, etc. may also apply to security tokens.

2.3. Cryptoassets Ecosystem

Ecosystems constitute different entities that support the essential functions and activities related to cryptoassets. The crypto ecosystem entities that support these activities include issuers or creators of cryptoassets, cryptoassets service providers such as centralised or decentralised exchanges, wallet providers, validators or miners and regulated financial institutions (Bains et al. 2022). Several essential activities such as customer onboarding, custody and storage in digital wallets, market surveillance, trading, etc. are provided by cryptoasset platforms and exchanges. A key issue in cryptoassets relates to wallets which can be custodial or non-custodial. While custodial wallets are operated by service providers who have private keys and are responsible for the safekeeping of cryptoassets on behalf of users, non-custodial wallets allow users to have self-custody of their crypto-assets and interact with the blockchain independently by using their private keys. A feature of non-custodial wallets is the anonymity of persons holding the crypto-assets which can raise money-laundering and terrorist financing concerns (FSB 2022b).

Some service providers and exchanges provide other services involving cryptoassets such as trading, lending, insurance, investment and derivative exposures and facilitate other functions such as providing liquidity and leverage (FSB (2022b, Narain and Moretti 2022:19). The exchanges also perform other important functions such as determining the prices of different crypto assets that facilitate their exchange using smart contracts (IOSCO 2022). The key functions and activities of the cryptoassets ecosystem identified by FSB (2022b) are shown in Table 1.

Table 1: Key Functions and Activities of Crypto-assets Ecosystem

Functions	Activities
1. Creation, issuance, distribution, redemption and underlying infrastructure	1. Creating, issuing, distribution and redeeming of crypto assets. 2. Operating infrastructure and validating transactions

2. Wallets and custody	3. Provision of custodial (hosted) wallet and custody services 4. Provision of non-custodial (un-hosted) wallets
3. Transfer and transactions	5. Payment for/of goods, services, gifts and remittances. 6. Exchange between crypto-assets or against fiat currencies, clearing and settlement
4. Investment, leverage and risk management	7. Use as collateral to borrow/purchase other cryptoassets 8. Trading/borrowing/lending of cryptoassets 9. Insurance 10. Direct/outright exposures to cryptoassets 11. Synthetic/derivative exposures to cryptoassets

Source: FSB (2022b:3)

3. Cryptoassets and Capital Markets: Benefits and Risks

The key frictions arising in financial intermediation relate to information, communication and coordination problems and implementing incomplete contracts and market-related problems (Aaron et al. 2017, Boot et al. 2021, Fenwick and Vermeulen 2020)). Resolving these frictions requires developing business models and operational structures that can minimise the risks and transaction costs. The information problems include adverse selection and moral hazard problems which if acute will prevent investors from participating in crowdfunding. Communication frictions arise in difficulties in establishing relationships and delivering services to customers through different distributional channels (Boot et al. 2021). A related problem of coordination arises in matching the parties (buyers and sellers) and can exist at the investment stage and also when the investors want to sell their assets. The market-related frictions relate to barriers to entry that can arise due to various factors. Other than competing with existing financial institutions providing similar services that have information advantages and enjoy economies of scale, onerous regulations can also hinder growth (Havrylchyk 2018).

As in the case of capital markets, cryptoassets and crypto exchanges facilitate connecting users of capital with the providers of capital in a disintermediated manner. The use of blockchain and smart contracts enables the development of tokenised crypto-assets and can resolve some of the frictions identified above. Developments in digital technologies enable huge amounts of data to be stored, processed and shared at low costs (Zetzsche et al. 2020). While information-related advantages of using blockchain technology include reliability and traceability of records, issues related to communication frictions include overall efficiency enhancement, reduction in cost and faster speed of settlement in a secured manner (IOSCO 2017b). Furthermore, the use of smart contracts reduces the human errors arising in implementing contracts physically.

While using technology has the potential to mitigate the frictions arising in financial transactions, it also introduces various risks. Blockchain-based cryptoassets have some

potential challenges when used in a capital markets framework. The risks can be broadly classified as technological, operational, trading and settlement-related, legal, and integrity risks (IOSCO 2017b). Technologically there are issues related to scalability, interoperability or communicating with the existing financial institutions and markets and cyber-risks. Since DeFi transforms intermediation from traditional legacy structures to one based on technology, operational risks related to technology are magnified. Specific risks related to technology include technological disruptions and cyber-security risks. Operational challenges relate to governance errors and legal risks in smart contracts. Trading and settlement-related challenges include lack of recourse to remedy erroneous transactions and anonymity of the persons transacting which can raise integrity issues. Furthermore, from an investor perspective cryptoassets also face market risk, liquidity risk, volatility risk, counterparty risk, risk of loss of investment, insufficient information risk, project risk, technical and operational risk, fraud risk and risk of lack of regulation (IOSCO 2020b).

An important aspect of the development of any new asset class relates to the market infrastructure that enables transactions in a secured, efficient and risk-free manner. Beyond some unique features of cryptoassets such as private keys and passwords, the key risks facing investors in transactions of these digital assets would be similar to other financial assets. While blockchain can deal with some of the risks related to ownership and fraud, other risks arise from weak market infrastructures. ISSA (2018) identifies the following risks related to the issuance and infrastructure of cryptoassets: truthful disclosure of the features of cryptoassets in the prospectus (whitepapers) before initial coin offerings (ICOs) to protect the investors; lack of liquidity which can be adversely affected by high price volatility; settlement of transactions and non-reversal of transactions carried out mistakenly; constraints of inter-operability with the mainstream financial sector limiting interaction with existing banks where most people keep their funds; risks related to safekeeping and securing the private keys that give access to crypto assets; and exposure to cyber risks.

A key risk of crypto exchanges relates to the governance of exchanges to protect investors. For example, the collapse of FTX in late 2022 revealed how an unregulated exchange could lead to the misuse of investors' funds and increase risks in the system (Reiff et al 2023). The total losses due to the FTX collapse are estimated at US$ 8 billion (Otte and Skopeloti 2022). Furthermore, since most cryptoassets are bought and sold through exchanges there are additional risks that need to be considered. The concerns related to exchanges include

accessibility and regulations, insecurity due to lack of deposit insurance, paying fees for transactions, illiquidity due to lack of volume, and storage on platforms (Little 2022).

4. Islamic Values and Principles for Economic Activities and Cryptoassets: Literature Overview

4.1. Islamic Values and Principles Governing Economic Transactions

The general principle guiding economic activities falls under jurisprudence related to *muamalat* (transactions) which is governed by the principle of permissibility (*ibahah*) (Kamali, 2000, p. 66) as affirmed by the maxim 'The permissibility is the original rule of all things' (Laldin et al., 2013, p. 117). The principle of permissibility would imply that new products can be introduced as long as they are free of the prohibitions. The prohibitions can be broadly categorised as forbidden goods and services and those relating to the contractual nature of transactions. Since Shariah texts explicitly prohibit certain specific products and activities such as wine, pork and gambling, these would be excluded in a *halal* (permissible) economy.

Two broad categories of prohibitions related to contracts in economic transactions are *riba* and *gharar. Riba* (literally meaning increase or growth) is prohibited by *Shariah*. Although it is common to associate *riba* with interest, it has much wider implications and can take different forms. The common premise is that *riba* arises from the unequal trade of values in exchange (Siddiqi, 2004). Other than interest-based loans, selling debt at a discount is also prohibited as it is considered *riba*. While *gharar* is usually referred to mean excessive uncertainty it also signifies deception, ignorance, gambling and fraud (Al-Zuhayli, 2003, p. 82, ElGamal, 2001, p. 32). *Gharar* relates to asymmetric information problems arising in the object or terms of the contract. While *gharar* in the object of sale exists when it is not identified, does not exist or is not deliverable, *gharar* in the terms of the contract relates to the ambiguity in the stipulations and conditions that can lead to disputes.

The ethical perspectives of Shariah are represented in the concepts of *maslahah* (welfare or benefit) and *maqasid al Shariah* (objectives of Shariah). Scholars identify the underlying guiding principle governing Shariah as "enhance welfare (*maslahah*) and minimize harm (*mafsadah*)" (Dien, 2004, p.3; Heinrichs 2002, p. 372; Kamali 2008, pp. 32, 35). *Maqasid al Shariah* are the essential elements that can achieve the best interests of humans and promote a good life (Ibn Ashur, 2006; Laldin, 2020). *Maqasid* is related to the consequences of acts and neglecting them can lead to rules that deviate from Shariah's intent of enjoining good. Scholars have identified five key *maqasid* to be the protection and enhancement of faith, self, intellect,

posterity, and wealth (Chapra, 2008; Hallaq, 2004; Kamali, 2003; Laldin, 2020). Ibn Ashur (2006: 285) identifies the *maqasid al* Shariah related to wealth and transactions as circulation or marketability (*rawaj*), transparency (*wuduh*), preservation (*hifz*); durability or persistence (*thabat*) and justice or equity (*adl*). Both notions of *maslahah* and *maqasid* relate to teleological or utilitarian ethics which views ethics in terms of welfare enhancements.

Key objectives (*maqasid*) of Shariah include the protection and enhancement of property or wealth (*mal*) and ensuring justice. Protection and enhancement of wealth for all segments of the population implies an Islamic financial system should be inclusive. In particular, given the key role played by SMEs in the overall employment and contribution to the national income in most countries, an inclusive Islamic financial industry should cater to their financial needs. Financing the SMEs would enhance production levels and fulfil the social goals of contributing to balanced equitable growth and prosperity.

4.2. Property and Markets

Ownership of property and property rights are fundamental elements of an Islamic economic system. Professor Al-Zarqa defines property as "any identifiable object with a material value for the people" (Al-Zuhayli, 2003, p. 6) and *Majallah* defines *mal* in line with the Hanafi School view as "a thing which naturally is desired by man and can be stored for times of necessity" (Majallah 2001, Article 126). *Mal* can take the forms of *ain* (corporeal properties), *manfaah* (usufructs), *dayn* (debt) and *haqq* (rights) (Islam, 1999; Vogel and Hayes, 1998; Zahraa and Mahmor, 2001). Whereas *ain* is a tangible property and has a physical existence, *manfaah* is the benefit derived from using an asset and is intangible. Since usufruct is the benefit that people get from property, the majority of scholars consider usufruct derived from the property as *mal* (Islam, 1999, p. 386, Al-Zuhayli, 2003, p.6). Debt (*dayn*) is considered as *mal* that is not in the possession of the owner. Although *dayn* is usually interpreted as debt, it is not the 'obligation' itself but the 'property' behind the obligation that is owned by the owner or creditor (Vogel and Hayes 1998: 94). *Haqq* is a right over a particular property such as the right over a passageway (Zahraa and Mahmor, 2001, p. 220). A ruling from the International Islamic Fiqh Academy has made intangible assets such as intellectual property, patents, and trademarks legitimate *mal* that can be traded in the market.[4]

[4] The Council of the International Islamic Fiqh Academy of the Organization of the Islamic Conference, holding its 5th session in Kuwait City, State of Kuwait, on 1–6 Jumādā al-Ūlā 1409h (10–15 December 1988), Resolution No, 43 (5/5), p. 78 states 'Business name, corporate name, trade mark, literary production, invention or discovery (copyrights and patents), are rights belonging to their holders and have, in contemporary times, financial value which can be traded'

While the exchange of goods and services takes place in markets, Shariah provides some guiding principles that govern markets. Reda (2013) identifies the distinct systems of ethics governing markets related to trade, usury, the merchant, contacts, compassion and prices. Obaidullah (2001) identifies ethics governing Islamic finance that affects stock markets as the freedom to contract, freedom from *riba, gharar*, gambling, detriment (*darar*), manipulation and price control and entitlement to transact at fair prices and access to equal, adequate and accurate information.

4.3. Cryptoassets from Islamic Perspectives

The Islamic perspectives on cryptoassets would depend on their type. Exchange tokens or cryptocurrencies are digital commodities with no underlying assets or intrinsic values. Berrahlia et al. (2024) provides a historical perspective on private currencies and then examines the Shariah related issues of virtual currencies during contemporary times. Three Shariah views on virtual currencies include prohibition, permitted and the need to do more research. While the majority of Shariah authorities and scholars have declared cryptocurrencies to be illegitimate, a few scholars consider them to be permissible. The Shariah bodies that have declared cryptocurrencies prohibited include the Indonesian Ulama Council, General Authority of Islamic Affairs and Endowments (UAE), Syrian Islamic Council, Turkish Government's Religious Authority, Fatwa Center of Palestine, Wifaqul Ulama Shaykh Shawki Allam (Dar al Ifta Egypt) and Mufti Taqi Usmani (Ahmed, 2022). The reasonings for prohibiting cryptocurrencies include not being issued by the state, risks and uncertainties, lack of intrinsic value and intangibility. A few entities and scholars such as the Shariyah Review Bureau and Mufti Muhammad Abu-Bakar allow cryptocurrencies by highlighting the principle of permissibility, custom (*urf*), economic benefit or *maslahah*, etc. (Ahmed, 2022).

Some studies present other issues related to cryptocurrencies. Hassan et al. (2021) examines the conventional and Islamic perspectives on cryptocurrencies and bitcoin by assessing various features including the trustworthiness of the issuing authority. Hassan et al. (2023) assesses the features of cryptocurrencies in terms of functions of money and conclude that they do not fully meet the characteristics of money from a Shariah perspective. Muneeza et al. (2023) discusses issues related to zakat payments on cryptocurrencies and crypto assets. While several studies discuss issues related to exchange tokens, there is meagre research examining other types of cryptoassets such as utility tokens and security tokens.

5. Cryptoassets and Ecosystem Functions and Activities: Islamic Perspectives

Technology itself is neutral and its Shariah views would depend on how it is used. Given the principle of permissibility and applying the maxim of *maslahah/mafsadah*, adopting new technology would be acceptable if the benefits are greater than the harms. As indicated, digital technology in general and cryptoassets, in particular, can lead to the benefits of reducing information and communication frictions and enhancing efficiency and financial inclusion. However, the use of digital technology also introduces various risks. As discussed, risks include those related to data ownership and protection, data privacy and digital identity, risks related to new business models and technologies that include cyber risks, biases in algorithms and smart contracts and robustness of different digital technologies. Furthermore, there are risks related to the ecosystem and infrastructure such as legal uncertainties, compliance and enforcement risks, vulnerabilities of the digital infrastructures, payments infrastructure and market infrastructures. Given the general *maqsid* of protection of wealth and specific *maqasid* of the protection and durability of property, there is a need to ensure that the harms caused to Shariah-compliant cryptoassets due to the risks are kept to a minimum.

Since crypto exchanges perform similar functions to capital markets whereby the former reflects the digital versions of the latter, the overall Islamic viewpoint on cryptoassets and their ecosystem will be similar to that of capital markets. The analyses of cryptoassets and their ecosystems from Islamic perspectives are discussed next in terms of their functions and activities identified in Table 1. In doing so, the similarities of the functions of capital markets and crypto exchanges are also highlighted.

5.1. Creation, Issuance, Distribution, Redemption and Underlying Infrastructure

This function is similar to the issuance and listing function of securities in primary capital markets. Whereas the issuance of securities in capital markets is a complex process involving different types of stakeholders (investment banks, lawyers, etc.), the issuance of cryptoassets is done on blockchains. As indicated, the settlement layer consists of a distributed ledger (DL) and blockchain that holds and stores the assets to facilitate settlements and the asset layers consist of the assets in terms of tokens that are issued on top of the settlement layer. A DL and blockchain framework similar to Ethereum blockchain can be used so that security tokens and be issued quickly and efficiently. Islamic perspectives on the features of cryptoassets and the infrastructure are discussed below.

5.1.1 Cryptoassets

While there is a difference of opinion on the legitimacy of exchange tokens or cryptocurrencies, utility and security tokens with underlying permissible activities and assets can be considered acceptable forms of property and constitute Shariah-compliant cryptoassets (Ahmed 2022). In particular, utility tokens are permissible if the underlying asset, business or project is permissible. For example, Ether which is used as a utility token of Ethereum is considered to be Shariah compliant as it can be used as gas (or fee) to carry out transactions on the blockchain (Amanie and Ethereum, 2021). Similarly, security tokens are considered digital representations of underlying acceptable tangible assets, usufruct and services (Adam, 2015).[5]

Shariah-compliant security tokens can be either asset- or equity-based. The asset-based security token would represent shares in ownership of durable assets such as machines and trucks and holders of these tokens would earn rental payments on these assets as returns. The equity-based security tokens would represent ownership of shares in the enterprise and get dividends as returns. While the equity-based security token can be used to raise capital by new start-ups and existing SMEs, asset-based security tokens can be used to finance specific durable assets needed in production.

5.1.2. Operating infrastructure and validating transactions

The blockchain framework enables the trading of cryptoassets and recording them transparently and efficiently. Under blockchain, the validation of transactions can take place in different ways including mining by validators. The validators are paid in cryptoassets for providing a service of validating the transactions and recording them on the blockchain. From a Shariah point of view, a key issue would be the nature of underlying transactions. If the transactions are permissible and the Shariah compliant cryptoassets are used to raise funds for some productive activity that is beneficial, operating the infrastructure and validating transactions would be permissible. Given that the protection of wealth is a key general *maqsid* and preservation and durability of property are specific *maqasid* related to economic transactions, a key role of the cryptoassets infrastructure would be to mitigate the technology-related risks to protect the users from losses arising from technological failures and hacking.

5.2. Wallets and Custody

[5] Conceptually, utility and security tokens would be similar to sukuk that are 'certificates of equal value representing undivided shares in ownership of tangible assets, usufruct and services or (in the ownership of) the assets of particular projects or special investment activity' (AAOIFI 2015: 468).

In traditional capital markets, the intermediaries hold records of investors' ownership of securities in their investment accounts and the securities are held by Central Securities Depositories (CSDs) managed by stock markets. A key role played by the intermediaries is to provide services of custody whereby they hold and administer securities on behalf of investors (Chan et al. 2007). Crypto exchanges provide the facility for investors to create accounts and hold cryptoassets in digital wallets on their behalf. There are no Shariah issues arising in providing digital wallets and custodial services for legitimate cryptoassets. As in the case of crypto infrastructure, a key concern for wallets from a *maqasid* perspective would be to ensure that the cryptoassets are kept safe from technological errors, cyber-attacks and theft.

5.3. Transfer and Transactions

This function of cryptoassets infrastructure relates to the trade and post-trade mechanisms in capital markets. In the traditional stock markets, banks and brokers act as intermediaries for investors to carry out trade and record the settlement in their books. In capital markets execution of a trade goes through a process of clearing, settlement and custody. These services are provided by the market infrastructure entities such as Central Counterparties (CCPs), Clearing Houses, CSDs and intermediaries such as banks and brokers (AFME, 2015). CCP ensures delivery versus payments (DvP) as it buys the security from the seller and then sells it to the buyer. Once the trade is settled in the clearing house which is usually done electronically, the buyer receives the security and the seller receives the payment. The securities are then registered in the buyer's name in CSDs.

The use of blockchain to settle payments for cryptoassets eliminates the role played by CCP, Clearing Houses and CSDs for ensuring the delivery of assets and payments in traditional capital markets. Cryptoassets use blockchain and smart contracts that enable transferring value and recording transactions in a decentralized digital environment thereby reducing costs and time. The transparency of technology and secure recording of transactions on blockchain comply with the Shariah requirements of avoiding *gharar* and fulfilling the *maqasid* of transparency, preservation and durability. Thus, there are no Shariah issues arising in cryptoassets exchange through blockchain as long as the assets and underlying transactions are permissible.

5.4. Investment, Leverage and Risk Management

In general, all activities that are permissible with physical assets are also allowed with cryptoassets. Since Shariah-compliant cryptoassets represent a valid form of wealth they can

be used as collateral, used for trading and purchase of other cryptoassets. Sharia-compliant cryptoassets can also be a part of an investment portfolio. However, they cannot be used for prohibited activities such as lending/borrowing on interest or used in derivative transactions.

6. Security Tokens and Crypto Exchanges for Financial Inclusion

As indicated, traditional financial institutions including Islamic banks are reluctant to finance SMEs due to various frictions. Similarly, SMEs cannot raise funds from traditional capital markets due to the high costs of issuances and disclosure requirements. The cryptoassets and ecosystem provide SMEs with opportunities to raise funds by issuing security tokens that can be listed on crypto exchanges. However, unregulated private crypto exchanges introduce various risks and challenges related to investor protection. Since novel digital cryptoassets are multi-layered and require sophisticated technological solutions, it is best to introduce cryptoassets in a controlled environment.

One option is to institute digital exchange for security tokens in the existing stock exchanges of the country. Given the infrastructure, resources and experience in managing traditional capital markets, the stock markets would be better positioned to introduce digital exchanges where security tokens can be issued and listed (Ahmed and Khan, 2024). Since most SMEs are likely to not have the technological skills to create and launch cryptoassets, Ahmed and Khan (2024) suggest that digital crypto exchange should provide the services of structuring security tokens for SMEs for a small fee. Other than building the DLT and blockchain-based infrastructure, the crypto exchange will be able to assist SMEs with the issuance and listing of Shariah-compliant security tokens.

The crypto exchanges can also provide services to investors including retail customers to create digital wallets where the security tokens will be held. Trading of specific security tokens can be carried out and recorded on the blockchain by the crypto exchange and the respective digital wallets of investors can be updated accordingly. Although the exchange of Shariah-compliant security tokens in crypto exchanges will fulfil the *maqasid* of transparency, preservation and durability, the *maqsad* of marketability will be realised only when the secondary market for security tokens develops and matures and numerous investors actively engage in trading.

7. Conclusion

While a large section of the population is financially excluded involuntarily due to economic reasons, in many Muslim societies a significant number of people do not engage with the conventional financial sector voluntarily due to religious reasons. Cryptoassets and exchanges

represent an innovative alternative to traditional capital markets where financially excluded SMEs and entrepreneurial firms can raise funds. After presenting the building blocks, functions and activities of cryptoassets and exchanges, the paper presented Islamic perspectives on these issues. Given the huge financing gaps that SMEs face in Muslim countries, the issuance of Shariah-compliant security tokens by SMEs would expand the role of capital markets in promoting financial inclusion and contributing to economic growth.

While SMEs can use Shariah-compliant asset- and equity-based security tokens to raise funds quickly and efficiently, they also give opportunities to retail investors to invest in alternative asset classes and diversify their portfolios. Given the novelty and complexity of the technology involved and the lack of understanding and skills to develop blockchain-based systems, the paper argues for the development of security tokens and exchanges in a controlled manner under the supervision of the nation's stock markets. Though there are challenges and risks in developing security tokens and their ecosystem, their development can be a useful tool to enhance financial inclusion and promote growth in the era of the Fourth Industrial Revolution.

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