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# DIGITAL (CRYPTO-BASED) CAPITAL MARKETS FOR FINANCIAL INCLUSION: SECURITY TOKENS AND INFRASTRUCTURE

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## Abstract

While small and medium enterprises (SMEs) play an important role in the economy, they face huge impediments to raising capital. Financial institutions are generally not eager to lend to SMEs for various reasons, and capital markets involve complex processes and infrastructure, which inhibit small firms from raising capital. While most research on cryptoassets focuses on cryptocurrencies, this paper examines how security tokens can enhance financial inclusion and presents a framework for enabling digital, crypto-based capital markets. The use of digital technology and the issuance of security tokens significantly reduce transaction costs, enabling SMEs to raise funds and providing opportunities to investors to invest in alternative asset classes. This study identifies the frameworks and features of cryptoassets and exchanges that SMEs can use to raise capital, as well as the issues that must be addressed in doing so. Specifically, the paper discusses issues related to the issuance, listing, trade, and post-trade mechanisms in digital exchanges. The use of Shariah-compliant equity- and asset-based security tokens to raise capital through digital capital markets can play an important role in enhancing financial inclusion and promoting development in Organisation of Islamic Cooperation member countries.

**Keywords:** *digital capital markets, financial inclusion, crypto assets, security tokens, crypto exchange.*

## I. INTRODUCTION

Small and medium enterprises (SMEs) play an important role in job creation, poverty alleviation, and economic growth in emerging economies, constituting 90% of the businesses, employing 50% of the workforce, and contributing 40% of the Gross Domestic Product.[1] A key factor determining the health and

[1] Ana Fiorella Carvajal and Tatiana Didier, *Boosting SME Finance for growth The Case for More Effective Supportive Policies*, (Washington DC: The World Bank, 2024). https://openknowledge.worldbank.org/server/api/core/bitstreams/6de94c67-e8a1-4cf0-871b-3ed4d5a8f046/content, p. 1..

growth of SMEs is the availability of capital, which enables them to purchase the necessary inputs for production. Access to finance, however, has been identified as a key impediment to SME growth. The annual financing gap for SMEs in emerging and developing economies is estimated at US$ 5.2 trillion.[2] The corresponding equity gap for SMEs in these countries is estimated at US$3.92 trillion.[3]

SMEs are financially excluded due to various factors that can be broadly classified as involuntary or voluntary. While involuntary exclusion is driven by economic and social factors (including insufficient income among SMEs, high risk, the informational framework, price/product features, and discrimination), voluntary exclusion can be driven by cultural and religious factors.[4] SMEs in Muslim countries are financially excluded due to both reasons, as there is a paucity of financing from formal financial institutions, and many firms may be reluctant to seek available interest-based financing for religious reasons. Thus, there is a need to provide Shariah-compliant financing to SMEs to reduce voluntary and involuntary financial exclusion, to promote growth, and to reduce inequalities.

The economic factors leading to financial exclusion can be understood by examining the key frictions that arise in financial intermediation. The frictions that financial institutions and markets face in financing include asymmetric information and transaction costs.[5] The asymmetric information problem is acute for poor households and small enterprises. Information asymmetry, along with a lack of acceptable collateral, increases credit risk, leading to credit rationing and/or higher interest rates. The relatively small volume of lending to SMEs implies higher per-unit costs of financial services, which also makes them unbankable. Furthermore, bank lending processes can be cumbersome, opaque, and expensive, discouraging smaller firms from seeking credit.[6]

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[2] World Bank and International Finance Corporation, *MSME Finance Gap: Assessment of the Shortfalls and Opportunities in Financing Micro, Small and Medium Enterprises in Emerging Markets*, (Washington DC: IFC, 2017) https://www.smefinanceforum.org/sites/default/files/Data%20Sites%20downloads/MSME%20Report.pdf.

[3] World Bank, *Capital Markets and SMEs in Emerging Markets and Developing Economies: Can They Go the Distance,* (Washington DC: The World Bank, 2020) https://openknowledge.worldbank.org/handle/10986/33373 73.

[4] World Bank, *Finance for All: Policies and Pitfalls in Expanding Access* (Washington DC: The World Bank, 2008).

[5] World Bank, "Finance;" Thorsten Beck, "Fintech and Financial Inclusion: Opportunities and Pitfalls," ADBI Working Paper 1165 (Tokyo: Asian Development Bank Institute 2020).

[6] Iota Kaosar Nassr and Gert Wehinger, "Opportunities and Limitations of Public Equity Markets for SMEs," *OECD Journal: Financial Market Trends* 2015, no. 1 (2015): 49-84, https://doi.org/10.1787/fmt-2015-5jrs051fvnjk.

Given that SMEs play a key role in economic development and poverty alleviation, and banks and financial institutions have generally been unwilling to finance them, there is a need for alternative solutions to facilitate SME financing. One option is to use capital markets to fund SMEs. Specifically, capital markets can be tapped to raise capital through debt financing (minibonds, securitisation, and private debt placements) and equity financing(shares and private equity placements).[7] There are suggestions for developing specific exchanges for SMEs.[8] However, key constraints that SMEs face in accessing capital markets include the higher costs of issuing and listing securities and onerous disclosure and reporting requirements. The introduction of digital technology, however, has the potential to reduce costs and improve transparency. This may be accomplished through crypto assets that use distributed ledger technology and blockchain to transfer value, record transactions, and share information in a decentralised manner, transforming the security value chain.[9]

Given the above, the study explores a digital capital market framework to mitigate some of the constraints SMEs face in raising funds from conventional capital markets. While there are suggestions for developing exchanges specifically for SMEs, the structure of these proposals is similar to that of traditional capital markets.[10] This paper develops a framework that leverages digital concepts and tools used by contemporary financial technology (fintech) firms (such as blockchain, crypto assets, and crypto-exchanges) to build a crypto-based digital capital market model for SMEs. The proposed framework has been developed by identifying the key challenges that SMEs face arising from the economic and structural features of contemporary capital markets, and then discussing how digital exchanges can address these issues. The proposed digital capital market identifies Shariah-compliant digital instruments to reduce both voluntary and involuntary financial exclusion among SMEs and potential investors.

On a broader level, tokenisation signifies the next logical progression in the evolution of the monetary and financial system. It can help overcome the

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[7] Nassr and Wehinger, "Opportunities and Limitations."

[8] World Federation of Exchanges WFE, "WFE Report on SME Exchanges," , (undated), https://www.world-exchanges.org/storage/app/media/research/Studies_Reports/WFE%20Report%20on%20SME%20Exchanges.pdf.

[9] Deloitte, "Are Token Assets the Securities of Tomorrow," Deloitte, 2020, https://www2.deloitte.com/content/dam/Deloitte/lu/Documents/technology/lu-are-token-assets-the-securities-tomorrow.pdf; William Hinman, "Digital Asset Transactions: When Howey Met Gary (Plastic)," Speech at Yahoo Finance All Markets Summit: Crypto, June 14, 2018, https://www.sec.gov/news/speech/speech-hinman-061418

[10] For example, see WFE, "WFE Report on SME Exchanges."

frictions and inefficiencies of the legacy systems.[11] Central banks, as stewards of the monetary and financial systems, can help transform these systems in several ways. Beyond providing a vision for a sound framework for a tokenised system, central banks can lay the foundation for a tokenised monetary system by fostering public-private partnerships.[12] Central bank funds play an important role in the payment system and the financial markets infrastructure.[13] However, the advent of private-sector exchange tokens and stablecoins may challenge this framework and the existing payment systems, hampering the implementation of monetary policy. In this regard, central banks should have a plan to tokenise financial and monetary infrastructure and provide services such as payments more efficiently. For example, a central bank can have tokenised reserves to settle interbank payments and implement monetary policy.[14] Furthermore, central banks should devise frameworks for implementing monetary policy in an increasingly tokenised financial system.[15]

This paper is organised as follows. While Section II provides an overview of the capital markets ecosystem and processes, Section III highlights the challenges SMEs face in raising funds on conventional capital markets. Section IV introduces crypto assets and features of different types of blockchain-based digital exchanges. Section V discusses a framework for digital exchanges that SMEs could use to raise funds, along with the issues arising therefrom, and Section VI highlights various regulatory issues. The last section concludes the paper.

## II. CAPITAL MARKETS: ECOSYSTEM AND PROCESSES

A legal and regulatory framework, a sound ecosystem, stakeholders supporting different functions, and intermediaries serving issuers and investors are all necessary for capital markets to function properly.[16] While laws and regulations

[11] Bank for International Settlements, "The Next-Generation Monetary and Financial System," in *BIS Annual Economic Report 2025*, BIS, 2025, 77, https://www.bis.org/publ/arpdf/ar2025e.htm.

[12] BIS, "The Next-Generation," 77.

[13] Bank for International Settlements, *Tokenisation in the Context of Money and Other Assets: Concepts and Implications for Central Banks* (BIS and CPMI, 2024), 21, https://www.bis.org/cpmi/publ/d225.pdf.

[14] BIS, "Tokenisation in the Context of Money;" Tansaya Kunaratskul et al., "Central Bank Exploration of Tokenized Reserves," IMF Fintech Note 2025/011, International Monetary Fund, 2025. https://www.imf.org/-/media/files/publications/ftn063/2025/english/ftnea2025011.pdf.

[15] Bank for International Settlements Innovation Hub and New York Innovation Center at the Federal Reserve Bank of New York, *Project Pine Central Bank Open Market Operations with Smart Contracts,* BISIH and NYIC, 2025, https://www.bis.org/publ/othp95.pdf.

[16] World Bank, "Capital Markets Development: A Primer for Policymakers," The World Bank Group, 2020. https://www.ifc.org/wps/wcm/connect/a1bcbfc3-a203-4d5b-b64a-b82a80df11a5/PrimerforPolicymakers-PublicRelease.pdf?MOD=AJPERES&CVID=no.kJ3u.

ensure the protection of investors' rights, the capital markets infrastructure, including exchanges, clearing and settlement systems, payment systems, and depositaries, supports entrepreneurial ventures. Governments and other entities issue securities (bonds and stocks) for purchase by different types of investors to raise capital.

The key functions of a capital market infrastructure are to enable issuance, trading, clearing and settlement, custody and safekeeping, while providing services related to the financial assets.[17] The infrastructure institutions that enable these functions include exchanges, central counterparty clearing houses (CCPs), central securities depositories (CSDs), automated clearing houses (ACHs), and real-time gross settlement systems (RTGSs).[18] A contemporary infrastructure is highly centralised, with RTGS functions conducted by central banks and the other infrastructure entities managed centrally by securities markets entities. Intermediaries, such as investment banks, assist in the issuance of securities, and brokers, dealers, and investment firms help investors to trade on secondary markets. The mechanisms and processes for raising funds from traditional capital markets are discussed below.

### II.A. Primary Markets: Issuance and Listing

Issuance of securities in capital markets is a complex process involving different types of procedures and stakeholders (investment banks, lawyers). Companies issuing securities are subject to disclosure and reporting requirements to mitigate asymmetric information problems and enable investors to accurately assess risks.[19] A company must prepare and publish a prospectus that provides essential information on the security to the investors. Usually, investment banks are engaged to conduct the necessary research and prepare the prospectus for the issuance of a security. The prospectus for new securities is prepared in line with applicable regulations and must be cleared by the regulators before distribution to prospective clients.[20] Regulations require a prospectus to disclose general information about the company, its organisational structure, operations, products and services, markets served, principal activities, sales and inventories, financial information, capital resources, and specific and material risks.[21]

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[17] International Securities Services Association, *Infrastructure for Cryptoassets: A Review by Infrastructure Providers, International Securities Services Association* (ISSA, 2018), 6, https://issanet.org/content/uploads/2016/02/2018-10_ISSA_report_Infrastructure_for_Cryptoassets.pdf.

[18] ISSA, *Infrastructure for Cryptoassets*.

[19] World Bank, "Capital Markets Development."

[20] Baker McKenzie, "Cross-Border Listings Guide: A Global Guide to Stock Exchanges and Raising Capital around the World," Baker McKenzie 2022), https://www.arthurcox.com/wp-content/uploads/2020/06/Cross-Border_Listings_Guide.pdf.

[21] Baker McKenzie, "Cross-Border Listings Guide."

Issuers incur various costs to list securities in capital markets. Direct costs include expenditures for preparing the listing documentation, underwriter and advisor fees, audit and ongoing compliance fees, and admission and ongoing fees paid to exchanges.[22] Listing charges include application, vetting, and admission or trading fees. Furthermore, other fees must be paid to advisers, accountants, and lawyers involved in the issuance and listing processes.[23]

PwC provides an overview of IPO costs, including underwriting, legal, accounting, printing, and SEC registration fees.[24] The smaller the issue, the larger the percentage cost incurred. For example, the average offering costs for IPOs of 302 companies across all sectors with deal values ranging from $25 million to $99 million and less than $100 million in revenue were between $2.1 million and $12.9 million.[25] While the average underwriting fee for deals ranging from $25 million to $99 million is 7% of the value, the corresponding average fee for deals with values over $1 billion is 4.1%.

### II.B. Secondary Markets: Trade and Post-Trade Mechanisms

A key feature of a properly functioning capital market is the smooth trading of securities. Execution of a trade in capital markets involves clearing, settlement, and custody. These services are provided by the market infrastructure entities, such as central counterparties (CCPs), clearing houses, central securities depositories (CSDs), and intermediaries such as banks and brokers.[26] While trade can take place directly between a seller and buyer, it can introduce counterparty risk. Using a CCP clearing house for settlement minimises this risk by ensuring delivery versus payment (DvP). In trades done through a clearing house, the CCP buys the security from the seller and then sells it to the buyer. Once the trade is settled, which is usually done electronically, the buyer receives the security, and the seller receives the payment.

Banks and brokers act as intermediaries for investors to trade securities and record the settlements in their books. A key role of intermediaries is to provide custody services, whereby they hold and administer securities

[22] WFE, "WFE Report on SME Exchanges," 20.

[23] London Stock Exchange, "A Practical Guide to Listing Debt in London: A World-Class Market for Listing and Trading Securities" (LSE, undated). https://docs.londonstockexchange.com/sites/default/files/documents/a-practical-guide-to-listing-debt-in-london.pdf.

[24] PwC, "Considering and IPO? First Understand the Cost," PwC, accessed March 4, 2025, 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.

[25] PwC, "Considering and IPO?"

[26] Association of Financial Markets in Europe, "Post Trade Explained: The Role of Post-Trade Services in the Financial Sector" (AFME, 2015).

on behalf of investors.[27] As custodians, the intermediaries hold investors' securities in their investment accounts and keep the assets in CSDs on behalf of investors. In addition to providing safekeeping and custody services, banks and brokers provide asset servicing, such as collecting income, handling taxes, and voting.[28] Other services in a capital market include securities lending and collateral management.[29] All of these services are fee-based, which adds to transaction costs.

Exchanges use a central limit order book (CLOB) to facilitate trading between buyers and sellers.[30] CLOBs are hubs where participants submit buy and sell orders, which are then matched and executed according to specific rules. The CLOB records all buy and sell orders and the associated bid and ask prices, then matches them according to specific rules set by the exchange, which may include price-time priorities. The prices at which assets are exchanged are determined through the matching process. After a trade is executed, the CLOB is updated, and the matched order is removed. In the process, the bid and ask prices are adjusted. This process continues in real time as new orders come in, are executed, and prices adjust.[31]

CLOBs perform useful functions. Since the CLOB is visible to all participants, they can make informed decisions. By matching buyers and sellers, CLOBs offer liquidity to assets, which can lead to more favourable prices. CLOBs also allow for different types of orders, such as market orders that are executed instantly, limit orders that specify prices at which assets are bought or sold and stop orders that halt sales at certain price levels.

## III. CAPITAL MARKETS FOR SMES: CONSTRAINTS AND ALTERNATIVES

The issuance of securities is challenging in many emerging economies due to underdeveloped capital markets and the onerous issuance processes.[32] As indicated, companies face large admission and maintenance costs, along with the need to fulfil the listing requirements of capital markets. Since these costs

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[27] Diana Chan et al., *The Securities Custody Industry*, Occasional Paper Series No. 68 (European Central Bank, 2007), https://www.ecb.europa.eu/pub/pdf/scpops/ecbocp68.pdf.

[28] AFME "Post Trade Explained."

[29] Deloitte, "Are Token Assets the Securities of Tomorrow."

[30] Anthony Clarke, "Demystifying the Central Limit Order Book (CLOB): Everything You Need To Know," Nasdaq, April 21, 2023, https://www.nasdaq.com/articles/demystifying-the-central-limit-order-book-clob-everything-you-need-to-know.

[31] Clarke, "Demystifying."

[32] International Organization of Securities Commissions, *Issues, Risks and Regulatory Considerations Relating to Crypto asset Trading Platforms* (IOSCO, 2020), https://www.iosco.org/library/pubdocs/pdf/IOSCOPD649.pdf.

must be paid regardless of company size, they are more burdensome for SMEs.[33] The disclosure requirements also increase the cost of raising capital, constraining SMEs' ability to raise small amounts.[34] The lack of transparency in smaller firms' securities issuance can increase risks and inhibit investment.

A long chain of custody arrangements can lead to an increase in costs at different levels of security structure.[35] A key issue in underdeveloped and small-capital markets in emerging economies is the lack of depth and small trading volumes, which adversely affect securities liquidity.[36] The illiquidity of securities issued by SMEs discourages investors as it creates uncertainties about investments. Furthermore, in some emerging markets, an efficient and safe settlement infrastructure, which is necessary for a well-functioning liquid capital market, may be lacking.

Since SMEs face various constraints in listing securities on existing capital markets, attempts have been made to create alternative avenues for smaller firms to raise capital. These include private offerings managed by investment firms. The definition of a private offering varies across countries and can be linked to the amount raised and the types and numbers of investors.[37] A related arrangement in which transactions take place is over the counter (OTC) facility, in which an investment firm facilitates the buying and selling of securities. Similarly, some countries have established SME bond platforms where minibonds issued through private placements can be traded. In some jurisdictions, such as the EU, multilateral trading facilities (MTFs) provide alternative venues for trading securities. MTFs are operated by investment banks or independent market operators and provide investors with the opportunity to trade securities with multiple buyers and sellers through computerised systems.[38] MTFs operate under the rules of the Markets in Financial Instruments Directive (MiFID) and are suitable for SMEs, as they have relatively lower listing costs and less stringent regulations than traditional exchanges.[39]

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[33] Nassr and Wehinger, "Opportunities and Limitations."

[34] World Bank, "Capital Markets and SMEs."

[35] Clifford Chance, "Digital Development in the Capital Markets-Summer 2021," September 2021, https://www.cliffordchance.com/content/dam/cliffordchance/briefings/2021/09/digital-developments-in-the-capital-markets-summer-2021.pdf.

[36] IOSCO, *Issues, Risks and Regulatory Considerations.*; World Bank "Capital Market Development."

[37] World Bank, "Capital Markets and SMEs."

[38] Corporate Finance Institute, "Multilateral Trading Facility (MTF)," CFI, 2022, https://corporatefinanceinstitute.com/resources/wealth-management/multilateral-trading-facility-mtf/

[39] Ioannis Zachariadis, "Enabling SMEs Access to Capital Markets" (European Parliamentary Research Service, 2018), https://www.europarl.europa.eu/RegData/etudes/BRIE/2018/630311/EPRS_BRI(2018)630311_EN.pdf.

## IV. DIGITAL CAPITAL MARKETS: ASSET TYPES AND OPERATIONAL ARCHITECTURE

Crypto assets are digital representations of value that exist as digital entries in a virtual, shared ledger.[40] Technically speaking, a Blockchain is 'a decentralised database hosted by a network of computers (called nodes) that communicate with each other via the internet'[41] and functionally as 'an open distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way'.[42] A feature of distributed ledger technology (DLT) and blockchain technologies for crypto assets is that they provide 'shared accounting tools that enable distributed recordkeeping without the need to rely on a single controlling party'.[43] The blockchain underlying crypto assets can be independent and unique to the crypto asset or built on an existing blockchain, such as Ethereum. Most crypto assets use the latter as it is relatively easy to develop using a standardised smart contract, ERC-20, which also facilitates interoperability among different tokens.[44] While the terms 'coin' and 'token' are used interchangeably, technically, a 'coin' is issued on an independent blockchain (such as Bitcoin) and a 'token' is built on an existing blockchain (such as the Ethereum blockchain).[45]

### IV.A. Types of Crypto Assets

Originally, crypto assets were developed as currencies to democratise payments through decentralised systems but have since taken on a variety of other functions and evolved into varied asset classes. Crypto assets can be broadly classified as exchange or payment tokens, utility tokens, and security tokens.[46] The features of these categories are described below.

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[40] Apoline Blandin et al., *Global Cryptoasset Regulatory Landscape Study* (Cambridge Centre for Alternative Finance, 2019) https://www.jbs.cam.ac.uk/wp-content/uploads/2020/08/2019-04-ccaf-global-cryptoasset-regulatory-landscape-study.pdf

[41] Moran Ofir and Ido Sadeh, "ICO vs. IPO: Empirical Findings, Information Asymmetry, and the Appropriate Regulatory Framework," *Vanderbilt Journal of Transnational Law* 53, no. 2 (2020): 532, https://doi.org/10.2139/ssrn.3338067.

[42] Marco Iansiti and Karim R. Lakhani, "The Truth about Blockchain: It Will Take Years to Transform Business, but the Journey Starts Now," *Harvard Business Review* 95, no 1 (2017): 118–127.

[43] Blandin et al., *Global Cryptoasset*, 15.

[44] Ofir and Sadeh, "ICO vs. IPO."

[45] Ofir and Sadeh, "ICO vs. IPO," 539.

[46] HM Treasury et al., *Cryptoassets Taskforce: Final Report*, HM Treasury, October 2018, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/752070/cryptoassets_taskforce_final_report_final_web.pdf; International Organization of Securities Commissions, *Investor Education on Cryptoassets* (IOSCO, 2020), https://www.iosco.org/library/pubdocs/pdf/IOSCOPD668.pdf; ISSA, "Infrastructure for Cryptoassets."

*Exchange tokens*

Also known as cryptocurrencies, unbacked crypto assets do not confer any rights but can be used as a means of exchange or for investment.[47] Cryptocurrencies are created as new digital commodities by decentralised agents through mining and can be exchanged on digital platforms. While cryptography assigns private keys to anonymous owners, which makes ownership of cryptocurrencies secure, blockchain records all transactions and prevents duplication and fraud.[48] Decentralised agents compete to mine new cryptocurrencies by solving complex algorithmic problems and receive fees for verifying and endorsing new transactions on the blockchain.

Stablecoins are one form of cryptocurrencies that purport to maintain a stable value by referencing physical or financial assets or other crypto assets.[49] A key feature of stablecoins, distinct from other unbacked coins, is their stable value, which makes them more suitable as collateral. [50]

*Utility tokens*

These tokens provide consumptive rights and access to specific services, products, or platforms. Utility tokens issued through initial coin offerings (ICOs) are used to raise funds to launch new products and services by selling secured digital rights in new engineering or community development efforts, or the economy, where token holders can spend their balance.[51] Utility tokens are usually linked to the issuer's network and cannot be used on other networks.[52]

*Security tokens*

Also called investment tokens, security tokens represent an ownership right in specific underlying assets, such as bonds, stocks, and other assets. Security

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[47] Parma Bains et al., "Regulating the Crypto Ecosystem: The Case of Unbacked Cryptoassets," IMF Fintech Note 2022/007 (International Monetary Fund, Washington, DC., 2022), https://www.imf.org/-/media/files/publications/ftn063/2022/english/ftnea2022007.pdf; Blandin et al., *Global Cryptoasset Regulatory Landscape Study.*; HM Treasury, FCA and BOE, *Cryptoassets Taskforce,* 11.

[48] Tobey Scharding, "National Currency, World Currency, Cryptocurrency: A Fichtean Approach to the Ethics of Bitcoin," *Business and Society Review* 124, 2 (2019): 219–238, https://doi.org/10.1111/basr.12169D.

[49] Financial Stability Board, *Regulation, Supervision and Oversight of "Global Stablecoin" Arrangements: Final Report and High Level Recommendations* (Financial Stability Board, 2020), https://www.fsb.org/wp-content/uploads/P131020-3.pdf.

[50] Financial Stability Board, *Regulation, Supervision and Oversight of Cryptoasset Activities and Markets*, Consultative document, (Financial Stability Board, 2022), https://www.fsb.org/wp-content/uploads/P111022-3.pdf.

[51] Daniel Liebau and Nicholas J. Krapels, "An Exploratory Essay on Minimum Disclosure Requirements for Cryptocurrency and Utility Token Issuers," *Cryptoeconomic Systems* 1, no. 2 (2021), https://doi.org/10.21428/58320208.668458d2.

[52] Bains et al., "Regulating the Crypto Ecosystem."

tokens are created through a security token offering (STO) on a blockchain and bought, transferred, sold, or destroyed according to the established rules of computer codes.[53] Security tokens include non-fungible tokens (NFTs) representing ownership of a specific non-fungible asset, such as digital art. Depending on the regulatory regime, tokens must comply with securities laws and regulations to be sold as securities.[54] Accordingly, other relevant legal and regulatory requirements related to securities, such as issuance and stamp duty, transferability, custody regulation, and obligations related to electronic transactions, may also apply to security tokens.[55]

### IV.B. Crypto Assets and Primary Markets: Issuance and Listing

Most ICOs are launched by blockchain-based ventures.[56] The stages involved in the issuance of coins and their listing on crypto exchanges are as follows.[57]

*Stage 1: Project Development and Marketing*

In this stage, the core team defines the project's vision and framework, builds a website, and sets up campaign details. A 'whitepaper' outlining the business plan and token features (rights, pricing, liquidity events) is prepared, and various marketing and social media tools are used to disseminate the information and attract prospective investors.[58] An important issue is to ascertain the token's status from a regulatory perspective and obtain the appropriate approval. [59]

*Stage 2: Pre-ICO or presale and ICO phase*

A small proportion of issued tokens is sold at a discount to a select group of investors using fiat currency to raise funds to cover the costs of the actual ICO and to test market demand for the token. The pre-ICO sale also provides the underwriters with information on the token's appropriate price and the total

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[53] Deloitte ,"Are Token Assets the Securities of Tomorrow," 3.

[54] Brian Elzweig and Lawrence J. Trautman, "When Does a Non-Fungible Token (NFT) Become a Security?," *Georgia State University Law Review* 39, no. 2 (2023): 295-336, https://readingroom.law.gsu.edu/gsulr/vol39/iss2/8.

[55] Dafan Zhang, "Security Tokens: Complying with Security Laws and Regulations Provides More than Token Rewards," *UMKC Law Review* 88, no. 2 (2019): 323-350, https://umkclawreview.org/wp-content/uploads/2019/03/zhang-2019-1.pdf.

[56] Ofir and Sadeh, "ICO vs. IPO," 592.

[57] Paul P. Momtaz, "Initial Coin Offerings," *PloS ONE* 15, no. 5 (2020): 1-30, https://doi.org/10.1371/journal.pone.0233018; Ofir and Sadeh "ICO vs. IPO;" Angelos Delivorias, "Understanding Initial Coin Offerings: A New Means of Raising Funds Based on Blockchain," (European Parliament, 2021) https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/696167/EPRS_BRI(2021)696167_EN.pdf.

[58] Ofir and Sadeh, "ICO vs. IPO," 557.

[59] Momtaz, "Initial Coin Offerings."

funding that can be raised.[60] After the pre-ICO phase, the ICO is launched, and contributions are sought from different investors. The campaign duration usually varies from 25 to 40 days.[61]

*Stage 3: Listing and Post ICO campaign*

Listing on a token exchange following the ICO is a critical objective to enable the public to trade the token. Trading provides a source of liquidity, which is important for investors.[62] Listing criteria for different crypto asset trading platforms (CTPs) and exchanges vary, with some requiring more information than others. CTPs are dependent upon the offering entity in terms of the conditions imposed to facilitate trading and may vary from one platform to another. Additionally, they must comply with regulations in a particular country, which might differ from one jurisdiction to another. Transactions on an exchange are done by using fiat currencies or other cryptocurrencies. Many ICOs with low demand end up being delisted. Momtaz indicates that 46% of the ICOs issued in 2017 were delisted by February 2018.[63]

## IV.C. Crypto Assets and Secondary Markets: Trade and Post-Trade Mechanisms

The operational architecture of CTPs consists of a settlement layer, an asset layer, and trading mechanisms.[64] While the settlement layer consists of a distributed ledger (DL) and blockchain that store assets to facilitate settlement, the asset layer consists of the assets, including coins and tokens, issued on top of the settlement layer. The trading mechanism layer can be on- or off-exchange, depending on the platform or exchange.

There are two main methods by which transactions are verified on a blockchain, and in the process, new coins/tokens can be mined and distributed.[65] The scope of verifications depends on whether the blockchain is public (permissionless or open) or private (permissioned or closed). In a public blockchain, the DL is open to all, and anyone can make changes, add new blocks, and view the recorded transactions. In a permissioned

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[60] *Ibid.*

[61] Ofir and Sadeh, "ICO vs. IPO."

[62] Momtaz, "Initial Coin Offerings."

[63] *Ibid.*

[64] Yuxi Chen et al., "A Review of Crypto-Trading Infrastructure: Exchanges' Engagement with Crypto Market Functioning & Development," WFE Research, August 2023, https://wfe-live.lon1.cdn.digitaloceanspaces.com/org_focus/storage/media/Crypto%20Infrastructure%20Review.pdf.

[65] Igor Makarov and Antoinette Schoar, "Cryptocurrencies and Decentralised Finance (DeFI)," BIS Working Papers No. 1061 (Bank of International Settlements, 2022), https://www.bis.org/publ/work1061.htm;

blockchain, the blockchain owner can limit access and determine who can validate transactions.[66] Proof-of-work (POW) and proof-of-stake (POS) are two key mechanisms to validate transactions.[67] Under POW, miners compete with each other to verify transactions by solving difficult computational tasks or puzzles, which, when solved, add blocks to the chain. The first miner to solve a puzzle that verifies transactions and add a new block is rewarded with additional tokens for their work. Since solving the puzzles requires significant computational capacity, POW consumes large amounts of electricity during the mining process. Under POS, prospective validators lock up some of the network's native coins/tokens, such as Ether, as a stake to create blocks and validate transactions. A block creator is chosen by an algorithm based on the user's stake and receives a transaction fee for adding blocks. If the validator fails to verify transactions or acts maliciously, the staked coins are forfeited.[68] Since the likelihood of being selected to validate transactions and receiving rewards depends on the number of cryptocurrencies staked, larger stakeholders have a higher chance of being selected and rewarded. POS, however, uses much less energy and is more scalable than POW.[69]

*IV.C.1 Decentralised Crypto Assets Exchanges (DEX) and Centralised Crypto Assets Exchanges (CEX)*

Crypto exchanges are broadly classified as centralised CTPs (or centralised platforms CEX) and decentralised CTPs (decentralised platforms DEX) with different operational architectures and rules. While trading in DEX takes place through smart contracts and automated market makers (AMMs), it is facilitated off-chain. The architectural features for CEX and DEX are discussed below.

In decentralised CTPs (DEX), there is no central entity that operates the platform, and both asset control and trading occur directly on the blockchain. DEX functions without an intermediary, managing assets and transactions facilitated by smart contracts and atomic swaps. They are truly decentralised, and investors manage their own keys, wallets, assets, and transactions. Since traders in this environment must be conversant with how blockchain works, not all investors are positioned to take advantage of a decentralised CTP due to the lack of requisite knowledge. A decentralised CTP is a peer-to-peer network in which service providers, buyers, sellers, and other network participants work together to maintain the network, rather than operating under a single

[66] Romi Kher et al., "Blockchain, Bitcoin and ICOs: A Review and Research Agenda," *Small Business Economics* 56, no. 2 (2021): 1699-1720, https://doi.org/10.1007/s11187-019-00286-y.

[67] Makarov and Schoar, "Cryptocurrencies and Decentralised Finance."

[68] *Ibid.*

[69] *Ibid.*

organisation. DEXs use constant-function market makers (CFMMs), which are AMMs that help price assets accurately and efficiently. Examples of decentralised CTPs include OKX, Uniswap, Sushiswap, and Kucoin.

Centralised CTPs (CEXs) are owned and operated by a central entity that acts as an intermediary for participants to access assets held on a blockchain. CEXs manage assets through a third party or intermediary, similar to how banks manage their clients' assets. When investors use a CEX, they delegate the exchange to guard their crypto tokens, which exposes them to exchange risk: if funds in the exchange are stolen or hacked, investors could face significant losses.[70] Utilisation of a CEX defies the decentralisation aspect of DLTs, as investors need to trust the CEX's stakeholders and forfeit custody of their keys. Investors in this scenario utilise the benefits of trading on a blockchain while remaining non-conversant with how it works. A CEX is often considered an entry point for most investors, given its ease of use by mimicking traditional exchanges. Investors trust the CEX to execute transactions on their behalf and manage trading between buyers and sellers.

CFMMs determine the validity of a trade, a process carried out by a centralised body within a CEX.[71] CEXs are usually regulated, depending on the jurisdiction, whereas DEXs may fall into a grey area for regulatory purposes. Examples of CEXs include Binance, Coinbase, and Kraken. Chen et al. report that 60% of a sample of 500 CTPs were centralised and 40% decentralised.[72] However, DEXs are sought after by the proponents of blockchain, and they have begun to surpass CEXs in transaction volume.[73]

### IV.D. Crypto Assets and Architecture: Islamic Perspectives

Islamic perspectives on economic activities in general are guided by two key doctrines. First, the legal perspective governing economic and financial transactions (*muamalat*) is the principle of permissibility (*ibahah*), which states, "permissibility is the original of all things".[74] The principle of permissibility implies that new products and systems can be introduced as long as they do not contain something prohibited by Shariah. Certain products and services, such

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[70] *Ibid.*

[71] Guillermo Angeris and Tarun Chitra, "Improved Price Oracles: Constant Function Market Makers," In Proceedings of the 2nd ACM Conference on Advances in Financial Technologies (AFT '20) (Association for Computing Machinery, 2020), 80–91, https://doi.org/10.1145/3419614.3423251.

[72] Chen et al., "A Review of Crypto-Trading Infrastructure."

[73] Christos A. Makridis et al., "The Rise of Decentralized Cryptocurrency Exchanges: Evaluating the Role of Airdrops and Governance Tokens," *Journal of Corporate Finance* 79 (2023) 102358, 1-13 https://doi.org/10.1016/j.jcorpfin.2023.102358.

[74] Mohammed Hashim Kamali, *Islamic Commercial Law: An Analysis of Futures and Options* (Islamic Texts Society, 2000), 66; Mohamad Akram Laldin et al., *Islamic Legal Maxims and Their Applications in Islamic Finance*, (International Shari'ah Research Academy for Islamic Finance, 2013), 117.

as pork and gambling, are prohibited by Shariah. In transactions, the broad categories of prohibitions are riba and gharar. While *riba* is usually translated as interest on loans and *gharar* as excessive uncertainty, they have much broader implications.[75] Second, Islamic ethical values are guided by the overarching goal of Shariah: enhancing general welfare (*maslahah*) and minimising harm (*mafsdah*).[76] The essential *maslahah* are represented by *maqasid al Shariah,* which identify the particular objectives of Shariah. While the general *maqasid* protect and enhance faith, life, intellect, posterity, and wealth.[77] The specific *maqasid* related to economic transactions include circulation, transparency, preservation, durability, and justice.[78]

Shariah perspectives on crypto assets vary and depend on the type of crypto asset.[79] Most discussions on crypto assets in Islamic circles have been focused on exchange tokens or cryptocurrencies. While several religious authorities have prohibited cryptocurrencies, a minority of scholars have found them permissible.[80] Utility and security tokens are considered permissible if the underlying activities and assets are permissible.[81] From an Islamic perspective, permissible security tokens can be either asset- or equity-based. While the former embodies ownership of shares in a permissible asset, such as a machine, the latter represents ownership rights in a business or enterprise.[82] The structural aspects of crypto assets and exchanges relate to technologies, which are Shariah-neutral in their essence. Technologies can be used as long as they enhance the general welfare (*maslahah*), minimise harm (*mafsadah*), and, in particular, help achieve the *maqasid*.

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[75] Ahmed Habib, *Product Development in Islamic Banks* (Edinburgh University Press, 2011).

[76] Mohammed Hashim Kamali, *Shari'ah Law: An Introduction* (Oneworld Publications, 2008).

[77] Wael B. Hallaq, *A History of Islamic Legal Theories: An Introduction to Sunni Usul al-Fiqh* (Cambridge University Press, 2004).

[78] Muhammad Al-Tahir Ibn Ashur. *Treatise on Maqasid al-Shariah* (International Institute of Islamic Thought, 2013)

[79] Habib Ahmed, "Security Tokens, Ecosystems and Financial Inclusion: Islamic Perspectives," *International Journal of Islamic and Middle Eastern Finance and Management* 17, no. 4 (2024), https://doi.org/10.1108/IMEFM-04-2024-0195.

[80] Habib Ahmed, "Crypto assets as Property (*Maal*): Islamic Legal and Ethical Foundations and Evaluative framework," presented at the International Conference on Islamic Finance, Hamad bin Khalifa University, Doha, Qatar (2022).

[81] Ahmed, "Crypto assets as Property."

[82] Ahmed, "Security Tokens."

## V. DIGITAL EXCHANGES FOR SMES

There are calls to develop innovative capital market frameworks that are responsive to the needs of SMEs.[83] One alternative for SMEs is to use crowdfunding platforms to raise capital in both debt and equity instruments.[84] However, a key issue with crowdfunding platforms is the lack of liquidity. One option to resolve the liquidity issue is to issue crypto assets as security tokens that can be traded on digital exchanges. While IPOs are used by large corporations to raise capital, SMEs can use ICOs on crypto exchanges to raise funds, as shown in Table 1. The table shows that ICOs and IPOs differ, illustrating that the former is more suitable for SMEs for various reasons, key among which are the amount raised and transaction costs.

**Table 1.**
**Differences between an ICO and an IPO**

| | ICO | IPO |
|---|---|---|
| Funding stage | Theoretically, all stages | After late stage |
| Issuance | Cryptocurrencies (CC), utility tokens (CC), security tokens (ST) | Equity shares |
| Investors | All types | Public |
| Investment size | >$100K | >$10m |
| Transaction costs | Low | High |
| Liquidity | High (if listed) | High |
| Voting rights | ST: Yes; UT and CC: No | Yes |
| Exit options | ICO, open market | Open market |

Source: Momtaz[85]

The ecosystem for crypto assets is complex, providing services to issuers, investors, and those related to trust services, infrastructure, and technologies.[86] The framework for the proposed digital capital markets for SMEs requires identifying key stakeholders, instruments, and institutional infrastructure, as shown in Figure 1. While issuers in the proposed digital capital markets are SMEs, investors could include both retail and institutional investors. While

[83] The Economic and Social Commission for Asia and the Pacific, *Financial Regulatory Issues for Financial Inclusion* (UNESCAP: 2017), https://www.unescap.org/sites/default/files/S6_Regulatory-Issues-for-FI.pdf.

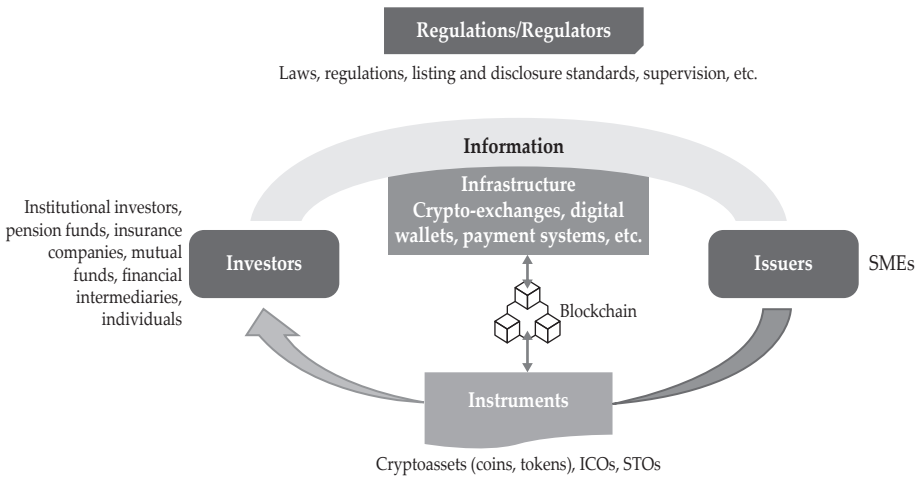
[84] Organisation of Economic Co-operation and Development, "Crowdfunding for SMEs," in *New Approaches to SME and Entrepreneurship Financing: Broadening the Range of Instruments* (OECD Publishing, 2015), 81-92; Alma Pekmezovic and Gordon Walker, "The Global Significance of Crowdfunding: Solving the SME Funding Problem and Democratizing Access to Capital," *William & Mary Business Law Review* 7, no. 2 (2016): 347-458, https://scholarship.law.wm.edu/wmblr/vol7/iss2/3/.

[85] Momtaz, "Initial Coin Offerings."

[86] ISSA, "Infrastructure for Crypto assets."

the issuer services include issuance, sales, and communications, the investor services include wallet/token providers and trust services such as know your customer (KYC) and token holder registration. The infrastructure services include smart contract verification, exchanges, and market-making.

**Figure 1. Digital (Crypto) Capital Markets Ecosystem for SMEs**




Source: World Bank (2020)[87] with modifications by the authors.

Blockchain-based exchanges will address some of the pain points that SMEs face on the traditional exchanges. Using blockchain technology to issue tokens or digital securities can eliminate the need for intermediaries and significantly reduce issuance costs. Once issued and listed, the tokens can be held in digital wallets, which serve as depositaries. While intermediaries can trade on the exchange, investors can also buy and sell directly on the digital exchange. Blockchain can make the settlement process easy, as it can be done directly on the ledger.[88] Blockchain technology will record transactions and resolve clearing and settlement issues without the CCP's involvement. Blockchain can also streamline the chain of custody and, hence, reduce costs. In addition to shortening settlement cycles, DLT and blockchain can also reduce counterparty risk.[89] The key features of tokens and key elements of the digital exchange for SMEs (abbreviated as CEX-SME) are discussed below.

[87] World Bank, "Capital Markets Development."
[88] Clifford Chance, "Digital Development in the Capital Markets."
[89] Deloitte, "Are Token Assets the Securities of Tomorrow."

## V.A. Crypto Assets: Types and Issues

### *V.A.1. Types of Crypto Assets*

The security token offerings (STOs) can be used by start-up and growth companies to raise equity capital. Investors in STOs will represent ownership of shares in the firms. To mitigate asymmetric information issues, SMEs seeking to raise funds using STOs must issue a 'whitepaper' providing information on the firms, their assets, and operations that can be used to rate them. While security tokens are usually used to raise equity capital, they can also be used by SMEs for asset financing. A key expenditure head for SMEs is fixed assets, which can be financed by digital securities in the form of security tokens (ST). For example, in 2018, 19.3% of SMEs in the EU invested in buildings, 28.6% invested in transport, and 42.6% invested in machinery, with average investment levels of €128,034, €63,271, and €54,701, respectively.[90] Asset-based financing mitigates asymmetric information problems in SME debt contracts and can also serve as collateral. Since financing is linked to assets, the need to assess the issuer's credit quality is reduced. Instead of debt-based bonds, it is proposed that SMEs issue crypto assets or digital securities.

Asset-based structures are not only Shariah-compliant but also an innovative alternative to debt-based bonds that raise some Shariah concerns. It should be noted that while some major national Shariah bodies have declared exchange or payment tokens (cryptocurrencies) forbidden from a Shariah perspective, security tokens that represent underlying economic activity or assets are permissible.[91] Note that while the goal is to facilitate fundraising for SMEs, larger firms can also use the digital exchange to raise capital by issuing asset-backed security tokens (STs). The STs will be issued on the blockchain and represent ownership of the underlying assets, on which investors will earn periodic rent. Furthermore, there would be a need for an entity that can hold legal ownership documents for the assets and also has a mechanism to provide insurance coverage for the assets underlying the security tokens. For investors, STs can be another Shariah-compliant asset class in the mezzanine category in their diversified portfolios.

### *V.A.2. Asset Eligibility for Listing*

Every exchange has its eligibility requirements for listing a token or coin. The disclosure requirements for SMEs to list a security token and related information would require a dedicated portal integrated with the CTP, which would digitalise the uploading of necessary documents for review. The review

[90] Martina Lawless et al., *SME Investment Report 2019 Developments between 2016 and 2018*, Economic and Social Research Institute, 2020, https://www.esri.ie/system/files/publications/SUSTAT86.pdf.

[91] Ahmed, "Cryptoassets as Property."

can be automated, but due to the variation among SMEs seeking funds, there would still need to be a dedicated community of experts who would validate the information provided and approve the relevant STO for listing by the requesting SME. Hence, asset eligibility is a corporate decision made by the stakeholders and their chosen expert panel regarding the selection of tokens to be listed. This might vary from one CTP to another, based on the governing body. In terms of integrating this SME review panel, centralised CTPs would be the ideal choice, as their governance is centralised. In a decentralised CTP, considerable development effort would be needed to ensure that the SME review process is also decentralised. Similar governance issues would be seen in any updates to blockchain platforms.[92] As with IPOs, regulators can provide guidelines on listing requirements to encourage financial inclusion. The guidelines should be proportional to the size of firms and the amount of funds sought.

*V.A.3. Security Token Issuances and STOs*

As indicated, most firms raising funds using coins or tokens are technology-based start-ups or firms with competencies in digital technologies.[93] However, this may not be the case for SMEs operating across diverse sectors. For these SMEs, issuing and accessing the crypto assets directly on decentralised exchanges can prove challenging, if not impossible. Thus, in these cases, the centralised exchanges (CEX-SME) can provide additional services of issuance of security tokens (STOs) for which they can charge a fee. This can be done by developing tokens on an existing blockchain, such as ERC20 on Ethereum. The process of creating a token on Ethereum is simple and can be completed in a few minutes.[94] Since the digital exchange is expected to be a technology-savvy enterprise, it will be easy for it to build a team capable of creating tokens on existing blockchains. The supporting code for tokens can be downloaded from Ethereum, and necessary adjustments can be made to suit each SME's features and needs. The centralised exchange can provide this additional service and help promote fundraising for SMEs. The cost of issuing a token will be scant compared to that incurred in IPOs.

[92] Nida Khan et al., "Blockchain Governance: An Overview and Prediction of Optimal Strategies Using Nash Equilibrium," *arXiv:2003.09241* (2020), https://doi.org/10.48550/arXiv.2003.09241.

[93] Ofir and Sadeh, "ICO vs. IPO," 592.

[94] Momtaz, "Initial Coin Offerings," 80.

## V.B. Digital Exchanges: Types and Operational Issues

### *V.B.1. Exchanges and Investor Services*

Customer engagement channels using digital assets can be through online interfaces, mobile, and assisted channels.[95] While customers can buy/sell crypto assets through online interfaces and mobile applications, they can also use other services provided by virtual asset service providers (VASP). There is a need for customer onboarding mechanisms, and once on-boarded, customer analytics can help provide better products and services to customers. However, in the case of decentralised exchanges, investors can trade directly on the blockchain, and the need for intermediaries such as investment firms and brokers would be minimised. Since a key issue in capital markets is liquidity, there may be a need for a mechanism to ensure liquidity for digital assets.

Assets are managed by exchange stakeholders in centralised CTPs, and participants can manage them themselves or delegate to other entities in decentralised CTPs. Centralised exchanges can therefore offer greater security while also creating a single point of failure for fraud and cybersecurity attacks. In contrast, decentralised exchanges rely on the security of participants' choice of wallet to keep their sensitive data confidential, as well as on the security of the underlying blockchain platform. Thus, in centralised CTPs, participants might not be aware of how their assets are used while they are in the exchange's custody. This can lead to the use of assets in markets not deemed Shariah-compliant without the participant being aware.

In the case of a centralised review panel in a decentralised CTP, the information can be made available to all peers, but the lack of an intermediary would pose the same challenges for SMEs to access the network as it would for investors. For SMEs issuing securities, the concerned centralised CTP can be required to disclose how assets are being used, and if multi-signature wallets are used, they can never be moved without the participant's signature. Access to the assets requires the usage of private keys, which are generally kept by the centralised CTP, which acts as the custodian. Crypto assets might be held in a hot or cold wallet, where in the former the wallet is 'connected to the internet and can be used for instant transactions of crypto assets. In a cold waller various controls and security, including disconnecting from the internet can be made to enhance the security of the crypto assets.[96] The custodians keep

[95] Laszlo Peter et al., "Investing in Virtual Assets: How Virtual Assets and Associated Service Providers Have Become Ready for Institutional Investment and Growth," KPMG, March 2021, https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2021/03/invetsing-in-virtual-assets.pdf.

[96] Axel Wieandt et al., "Thriving in the Era of Crypto and Blockchain: Distributed Ledger Technology and the Future of Digital Assets, Asset Management and Banking," KPMG (2022). https://assets.kpmg.com/content/dam/kpmg/be/pdf/Whitepaper-Digital-Assets.pdf.

the private keys to the assets, not the assets themselves, but they control the movement of the assets and safeguard their storage.

The discussions on both the supply and demand sides of security tokens indicate that a centralised exchange is more appropriate for developing a crypto-based capital market for SMEs.

*V.B.2. Clearing and Settlement*

Traditional clearance and settlement are supported by infrastructure that facilitates netting between counterparties, safely transfers ownership of assets, and then stores them. As mentioned, in digital exchanges, clearing and settlement are performed on the blockchain. The process by which tokens are exchanged and recorded depends on whether POW or POS is used to validate transactions. While POW is used in DEX, POS is usually used in CEX. In both cases, transaction validation results in the issuance of new tokens, either as a reward for successful mining in the former or as fees paid in the latter. Since the digital exchanges for SMEs will operate as CEX, it will follow the POS model. However, the staking process can have a simplified structure for validating transactions and will be similar to CLOB used in traditional capital markets.

Another issue in clearing and settlement in CTPs concerns the types of currencies or tokens that can be used for transactions. Transactions on CTPs can be executed by exchanging one crypto asset for another, or a crypto asset for fiat currency, and vice versa.[97] The framework used will partly depend on the regulatory regimes, since in some jurisdictions, cryptocurrencies are not allowed. Since SMEs raise funds to invest in their businesses, it is more appropriate for them to sell tokens for fiat currency, which they can use in their operations.

*V.B.4. Custody and Storage*

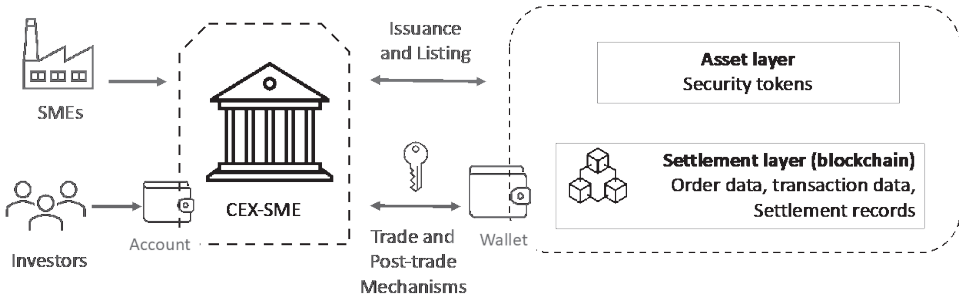
Unlike traditional capital markets, where the custody and storage of securities are done by Central Depositories, crypto assets are held and stored on blockchain.[98] The type of blockchain protocol will determine whether owners can maintain self-custody of their crypto assets and hold them in their wallets, or whether wallets are provided by VASPs that hold the crypto assets on behalf of the owners. The storage of investor account keys, payment data, and even login credentials need to be secured. Normally, centralised CTPs use hot wallets such as MetaMask, where the keys are directly connected to the internet, which poses risks. In contrast, users who control their own keys

[97] IOSCO, *Decentralized Finance Report*.

[98] IOSCO, *Decentralized Finance Report*.

in decentralised CTPs can use cold wallets such as the Trezor T, where the keys are stored offline, providing a higher degree of protection. The digital framework for a centralised CTP for SME-listed securities should employ all standard security measures adopted by any CTP and include two-factor authentication for investor logins, as well as multi-signature wallets to prevent incidents like Bitfinex's $65 million loss.[99]

**Figure 2. Architecture of Digital (Crypto) Capital Markets Ecosystem for SMEs**




Source: Chen et al.[100] with modifications by the authors

The architecture of the proposed digital (crypto) exchange for SMEs (CEX-SME) is depicted in Figure 2. As can be seen, CEX-SME carries out two broad functions: issuance and listing for SMEs, and trade and post-trade mechanisms for investors. On a digital, crypto-based exchange, these would be performed on a blockchain infrastructure. CEX-SME would not only assist SMEs in issuing security tokens on a blockchain, but it will also act as an intermediary for investors to carry out trade transactions on the blockchain. To avoid conflict of interest, these functions can be separated within the CEX-SME.

Not only are asset- and equity-based STs Shariah-compliant, but the proposed digital capital markets are also aligned with the ethical values inherent in the *maqasid al Shariah*. At the general *maqasid* level, a crypto-based digital capital market can promote the *maqasid* of enhancing wealth by increasing financial inclusion, and at the economic/financial-related *maqasid* level, the architecture of blockchain-based capital markets enhances the protection and efficacy of assets and the transparency of transactions.

[99] Rob Price, "Hackers Stole $60 Million from a Bitcoin Exchange in a Massive Heist," Business Insider, August 3, 2016, https://www.businessinsider.com/bitcoin-exchange-bitfinex-hacked-60-million-stolen-2016-8?r=US&IR=T.

[100] Chen et al., "A Review of Crypto-Trading Infrastructure."

## VI. DIGITAL TOKENISED EXCHANGES: LEGAL, REGULATORY, AND POLICY ISSUES

The proposed digital tokenised exchanges raise various legal, regulatory and policy-related issues.

Since financial products and services are legally constructed, developing a sound digital tokenised capital market would require providing a legal framework for security tokens. Thus, a key legal issue related to security tokens is ensuring the legal structure of tokenised assets.[101] While some countries, such as Malta, have enacted laws that establish a framework for issuing security tokens, in other jurisdictions, security tokens are considered digital versions of securities, and the regulations governing the latter are applied to the former.[102]

The key regulatory concerns for the financial system relate to market integrity, consumer protection, financial stability and competition. While stability issues will arise as crypto assets and exchanges grow, maintaining financial integrity, consumer protection, and enhancing competition remain ongoing concerns. Furthermore, the digital tokenised capital market can also raise issues within the ambit of the central bank's governance frameworks, including payment systems and the implementation of monetary policy. The regulatory and policy-related issues related to digital crypto-based capital markets are presented below.

### VI.A. Financial Integrity and AML/ KYC

Anti-Money Laundering (AML) and Know Your Client (KYC) are crucial, especially when transactions can be executed by using pseudonymous account addresses on blockchain platforms. The European Council has enacted a law to ensure that crypto transfers are traceable, requiring crypto asset providers to submit certain information about the sender and beneficiary.[103] This is because decentralised financial systems present opportunities for crimes and terror financing.[104] Centralised CTPs ensure KYC mechanisms are in place to prevent AML and counter-terrorist financing (CTF), as they are mostly regulated in the jurisdictions in which they operate. This is in opposition to

[101] Xavier Lavayssière, "Legal Structures of Tokenised Assets," *European Journal of Risk Regulation* (2025), 1–13, https://doi.org/10.1017/err.2024.88.

[102] "Walkthrough Overview of Security Token Offerings," Kira Belova, Pixelplex, July 13, 2021, https://pixelplex.io/blog/sto-regulations/.

[103] European Council, "Anti-Money Laundering: Council Adopts Rules Which Will Make Crypto-asset Transfers Traceable," May 16, 2023, https://www.consilium.europa.eu/en/press/press-releases/2023/05/16/anti-money-laundering-council-adopts-rules-which-will-make-cryptoasset-transfers-traceable/.

[104] Christoph Wronka, "Anti-Money Laundering Regimes: A Comparison between Germany, Switzerland and the UK with a Focus on the Crypto Business," *Journal of Money Laundering Control,* 25, no. 3 (2022): 656-670, https://doi.org/10.1108/JMLC-06-2021-0060.

the challenges posed by a decentralised CTP, where participating peers might be distributed globally, and adhering to laws across different jurisdictions would pose issues. KYC is generally not required to transact or trade through decentralised CTPs, and the anonymity of investors poses a threat to the perpetuation of crimes. Hence centralised CTPs would be more optimal for implementing SME funding initiatives. In the future, decentralised CTPs with e-KYC policies integrated into the network, together with machine-learning-based fraud detection, would become available at a cost-efficient price, and a switch might be considered. The business conduct regulations covering AML require some basic KYC procedures for investors.[105]

### VI.B. Consumer Protection and Security

There have been numerous ICOs that have been used to raise funds for new projects. A 'whitepaper' that provides basic information about an ICO is published before its launch.[106] However, due to a lack of regulations, the accuracy of the information in the whitepaper cannot be guaranteed, and many ICOs turned out to be scams, resulting in the loss of investors' funds.[107] For example, 80% of ICOs were scams, and half of the remaining 20% have failed.[108] Furthermore, many crypto exchanges have closed down due to scams, hacks, or simply disappeared along with depositors' funds. In 2020, 75 crypto exchanges closed due to scams, hacks, or simply disappeared.[109] Some other exchanges have unilaterally decided to close down trading, limiting owners' access to crypto assets.[110] A recent example is the scandal and bankruptcy of

[105] World Bank, *Regulation and Supervision of Fintech: Considerations for EMDE Policymakers* (World Bank, 2022). https://openknowledge.worldbank.org/server/api/core/bitstreams/ffa8d04d-d7f2-5cc1-833f-d79a366d0940/content, 16.

[106] Ofir and Sadeh, "ICO vs. IPO."

[107] Lars Hornuf et al., "Initial Coin Offerings, Information Disclosure, and Fraud," *Small Business Economics* 58 (2022):1741–1759, https://doi.org/10.1007/s11187-021-00471-y.

[108] Alexander Larsen, "Why 90% of Initial Coin Offerings (ICOs) & Security Token Offerings (STOs) Fail (and Much of the Rest May Follow)," *Enterprise Risk, Blog*, February 27, 2019, https://enterpriseriskmag.com/2019/02/why-90-of-initial-coin-offerings-icos-security-token-offerings-stos-fail-and-much-of-the-rest-may-follow/#:~:text=With%2080%25%20having%20been%20scams,why%20do%20so%20many%20fail%3F.

[109] Martin Young, "75 Crypto Exchanges Have Closed Down So Far in 2020," Cointelegraph, Oct. 7, 2020, https://cointelegraph.com/news/75-crypto-exchanges-have-closed-down-so-far-in-2020.

[110] Khristopher J. Brooks, "Cryptocurrency Prices Plunge as Major Exchanges Halt Trading," CBS News, June 13, 2022, https://www.cbsnews.com/news/celsius-binance-bitcoin-trading-pause-cryptocurrency-prices/; Ehrlich, Steven, "Bankman-Fried Warns: Some Crypto Exchanges Already 'Secretly Insolvent,'" Fobes, June 28, 2022, https://www.forbes.com/sites/stevenehrlich/2022/06/28/bankman-fried-some-crypto-exchanges-already-secretly-insolvent/?sh=53248a2b47f7.

FTX, one of the largest crypto exchanges, which left investors and creditors with huge losses.[111]

Blockchain-based trading platforms have been in the news for a multitude of wrong reasons, including the death of the owner of a centralised CTP, QuadrigaCX, which resulted in the loss of keys to $250 million in assets.[112] The recent FTX fraud has added to the misappropriation of investors' money and the complete lack of transparency for non-technical investors. There have been many security lapses as well, most recently when a hacker stole $10 million from wallets, leaving everyone clueless about the methodology he employed.[113] So, apart from inherent issues due to centralisation, there can also be issues caused by bugs in the underlying blockchain code used for the CTP, which can be exploited for malicious purposes. In the wake of all this, security provided by the CTP at its own interface must be significant.

The security measures need to be more stringent in decentralised CTPs, particularly for wallets, given user expertise and the need for security audits of the underlying blockchain code to prevent bugs that can lead to exploitation. An example of a hack is the famous DAO attack in Ethereum, which resulted in a $60 million loss.[114] The security of the decentralised exchange does not lie with a centralised entity, which makes it more vulnerable to the loss of funds by inexperienced investors, since blockchain technology is still at a stage where mass adoption is lacking.

In any implementation of a CTP, the focus needs to be on wallet security, platform security, the exchange, and the security of the underlying blockchain used for the service. Additionally, threats that are present/foreseen should be elaborated on to ensure that a robust remedial mechanism is in place to gain investors' trust and secure their investments. In centralised CTPs, the exchanges function as intermediaries that participants need to trust.

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[111] Morgan Chittum, "FTX Customers Are Reportedly Taking Huge Losses on Their Outstanding Investments so They Don't Have to Wait Months for Bankruptcy Claims," Markets Insider, December 29, 2022, https://markets.businessinsider.com/news/currencies/sam-bankman-fried-ftx-customers-take-losses-selling-bankruptcy-claims-2022-12.

[112] Cassie Williams, "Quadriga CEO's Widow Speaks out Over His Death and the Missing Crypto Millions," CBC News, Jan.8, 2022. https://www.cbc.ca/news/canada/nova-scotia/quadriga-widow-jennifer-roberston-gerald-cotten-1.6318955.

[113] Mat Di Salvo, "A Hacker Has Stolen $10 Million in Ethereum and No One Knows How," April 19, 2023, https://decrypt.co/137167/hacker-stolen-10-million-ethereum-no-one-knows-how.

[114] David Z. Morris, "CoinDesk Turns 10: 2016 - How the DAO Hack Changed Ethereum and Crypto," May 9, 2023, https://www.coindesk.com/consensus-magazine/2023/05/09/coindesk-turns-10-how-the-dao-hack-changed-ethereum-and-crypto/.

### VI.C. Transparency and Information Disclosure

Transparency and information disclosure are important features of capital markets that support their sound development, as they enable stakeholders to make informed decisions. From a regulatory perspective, transparency and information disclosure are related to consumer and investor protection objectives.[115] In a capital market setup, accurate and truthful information about the features of crypto assets must be disclosed at the time of issuance in the primary market and periodically thereafter to facilitate trading in secondary markets. Unlike regular exchanges, publishing a prospectus is not required, but some basic information about the company or the project raising funds must be included in a whitepaper.[116] As indicated, SMEs seeking to raise funds using STOs issue a 'whitepaper' to provide information on the firms, their assets, and operations that can be used to rate them. Thus, SMEs that list their securities on a centralised CTP might not be as transparent as their counterparts on traditional exchanges for large firms, which require extensive disclosures. However, a blockchain-based ecosystem provides greater visibility and transparency of trading and settlement activities.[117]

While crypto-based platforms raising funds for SMEs may have lighter disclosure and governance requirements that lower their reporting burdens, some regulatory guidelines would be required regarding what should be disclosed in a whitepaper and the ongoing and periodic disclosure requirements. The requirements for the whitepaper should be less stringent than those for IPO prospectuses to reduce the disclosure burden on SMEs. This can be done by using a proportional approach to regulations. The lower level of regulatory requirements can be countered by limiting the amounts that SMEs can raise or that investors can invest to protect them. [118]

### VI.D. Policy Implications for Central Banks

Most discussions of the implications of crypto assets for monetary systems focus on cryptocurrencies and stablecoins issued by private-sector entities. A concern is that the prevalence of decentralised cryptocurrencies and stablecoins could weaken central banks' authority to implement monetary policy. The suggested digital capital market for security tokens would not pose this problem. However, it will have a reciprocal influence on the development of the financial and monetary systems. On the one hand, since security

[115] IOSCO. *Issues, Risks and Regulatory Considerations.*

[116] World Bank, *Regulation and Supervision of Fintech*, 16.

[117] Teck Ming Tan and Saila Saraniemi, "Trust in Blockchain-Enabled Exchanges: Future Directions in Blockchain Marketing," *Journal of the Academy of Marketing Science* 51 (2023): 914–939, https://doi.org/10.1007/s11747-022-00889-0.

[118] World Bank, *Regulation and Supervision of Fintech*, 16.

tokens will be transacted in local currency, the central bank can facilitate their transactions through its payments system, which can be tokenised to further enhance efficiency. On the other hand, security tokens can be used in other financial transactions, potentially affecting other segments of the financial system. For example, security tokens can be used as collateral to get credit from banks. Security tokens would be similar to tokenised collateral, which enables fast movements of assets across different entities at much lower costs and enhances liquidity.[119] However, to perform this role, these tokenised assets must fulfil the central bank's collateral eligibility criteria.[120]

While this paper has outlined a framework of an inclusive and efficient digital crypto-asset-based capital market, it has implications for the development of a broader tokenised financial and monetary system. For example, from a central bank's perspective, a tokenised monetary system would entail tokenised central bank reserves, tokenised commercial bank money and tokenised government bonds.[121] Whereas tokenised central bank reserves can serve as a trusted settlement asset for wholesale transactions, tokenised commercial bank money can offer new functionalities, and tokenised government bonds could support various financial transactions and enhance liquidity.[122] Thus, central banks can play an important role in shaping the future of digital financial include digital capital markets and monetary systems, by considering the implications of these developments for payments systems, financial stability and other policy objectives.

## VII. CONCLUDING REMARKS

While SMEs contribute significantly to GDP and employment in most economies, they face huge gaps in their ability to raise capital. Financial institutions are reluctant to finance SMEs due to asymmetric information and high transaction costs, and capital markets entail complex processes and infrastructure that enable only large firms to raise capital. Given the key role that SMEs play in job creation and economic growth, and the funding gaps they face due to financial exclusion, the paper presents an innovative framework for a CEX-SME to enhance financial inclusion. On the one hand, SMEs can issue

[119] Sasha Mills, "The Sky's the Limit: Shaping the UK's Digital Financial Future," Speech given at the Tokenisation Summit, 2026, https://www.bankofengland.co.uk/speech/2025/january/sasha-mills-speech-at-the-tokenisation-summit.

[120] Association for Financial Markets in Europe, "Use of DLT and Tokenisation in Financial Markets: A Proposed Vision and Policy Recommendations," AFME November 2024. https://www.afme.eu/media/xerflxs1/afmesubmissiontoecfinalupdate.pdf.

[121] BIS, "The Next-Generation Monetary and Financial System," 79.

[122] *Ibid.*

equity- or asset-based security tokens to raise funds; on the other hand, retail investors with limited investment opportunities would have alternative asset classes to invest in.

The paper also outlines the supporting infrastructure and mechanisms that enable the efficient functioning of digital exchanges and identifies operational issues in primary and secondary markets, such as the issuance, listing, and trading of crypto assets. It argues that a CEX-SME can best serve the objectives of the SME capital market. The paper suggests that the CEX-SME should provide services for creating tokens. This can be done by having a team that can issue tokens on existing blockchains such as Ethereum. Since most SMEs lack technological sophistication, this service is essential to promoting digital capital markets for SMEs. On the investors' side, CEX-SME can use various customer engagement channels to hold and transact in digital assets. This would require CEX-SME to provide additional services, such as digital wallets, where security tokens can be securely stored.

The proposed CEX-SME can transform the financial sector in the era of the Fourth Industrial Revolution (4IR) and play an important role in reducing both voluntary and involuntary financial exclusions. Specifically, CEX-SME can mitigate involuntary financial exclusion by providing SMEs with efficient access to digital capital markets and offering alternative investment opportunities to retail investors. Since equity- and asset-based security tokens are deemed Shariah-compliant, they will also help reduce the voluntary financial exclusion likely to occur in Muslim-majority countries. The basic framework for digital capital exchange presented in this paper can serve as a blueprint for developing Shariah-compliant digital exchanges in OIC member countries.

On a broader level, tokenisation can transform the financial markets infrastructures underlying both securities and payments systems.[123] In most jurisdictions, the securities regulators oversee the securities market infrastructure, and central banks manage the payments infrastructure. While this paper focuses on the tokenisation of securities, the future development of the financial system toward greater inclusivity and efficiency would also include the tokenisation of payment systems. A tokenised financial system would integrate the crypto-based securities infrastructure with a tokenised payment system. In this regard, along with the capital markets authorities, the central banks will play an important role in contributing to an inclusive and efficient digital tokenised capital market by facilitating a fast and efficient tokenised payment system.

[123] BISIH and NYIC, *Project Pine*.

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