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Islamic Sale & Purchase Principles in Decentralized Exchanges: An Evaluation of Sharia Compliance

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Mila Dwi Rahmatya[1], Mohd Syahiran Abdul Latif [2], Mohd Hapiz Mahaiyadin[3], and Mohd Sirajuddin Siswadi Putera Mohamed Shith [4]*
[1]University of Technology(UiTM) Sarawak Malaysia, [2,3,4] MARA University of Technology (UiTM) Syah Alam Malaysia
milarahmatya76@gmail.com[*]

Abstract

Decentralized Exchanges (DEX) powered by immutable and automated smart contracts have revolutionized cryptocurrency trading by eliminating intermediaries. However, the alignment of their mechanisms with Islamic principles of sale and purchase remains unclear. This study conducted a qualitative analysis to assess the sharia compliance of DEXs. This research examines the conformity of DEX trading mechanisms with sharia principles by utilizing content and normative analysis of classical and contemporary Islamic finance literature alongside DEX-related articles, white papers, and industry reports. The findings reveal critical areas of non-compliance, particularly concerning contracting parties (*'aqīd*) and subject matter (*mabī'*). DEXs lack mechanisms to verify the legal capacity of transacting parties, potentially enabling involvement from individuals deemed incompetent under sharia. Cryptocurrencies as a medium of exchange also raise concerns because of their ambiguous nature as commodities or currencies, potentially leading to *gharar* (uncertainty) and *ḍarar* (harm). While certain aspects, such as the clarity of offer and acceptance (*ijāb wa qabūl*) through smart contracts and specific traded assets, such as certain tokens and NFTs, might align with sharia, the overall risks associated with speculation and inherent uncertainties necessitate caution. This study recommends that Muslims approach DEXs with caution until clear guidelines and sharia-compliant platforms are established. Furthermore, increased scrutiny from Islamic scholars and regulatory bodies is crucial for ensuring this rapidly evolving technology's ethical and compliant development.

Abstrak

Decentralized Exchanges (DEX) yang didukung oleh *smart contracts* telah mengubah perdagangan mata uang kripto dengan menghilangkan peran perantara. Namun, kesesuaian mekanisme DEX dengan prinsip jual beli dalam Islam masih menjadi perdebatan. Studi ini melakukan analisis kualitatif untuk menilai kepatuhan DEX terhadap syariah. Metode analisis konten dan normatif digunakan berdasarkan literatur keuangan Islam klasik dan kontemporer, serta artikel, white papers, dan laporan industri terkait DEX. Hasil penelitian menunjukkan beberapa aspek kritis yang tidak sesuai dengan syariah, terutama terkait pihak yang berkontrak (*'aqīd*) dan objek akad (*mabī'*). DEX tidak memiliki mekanisme untuk memverifikasi kapasitas hukum pihak yang bertransaksi, sehingga berpotensi melibatkan individu yang tidak kompeten menurut syariah. Selain itu, status mata uang kripto sebagai alat tukar menimbulkan ketidakpastian terkait posisinya sebagai komoditas atau mata uang, yang dapat mengakibatkan *gharar* (ketidakpastian) dan *ḍarar* (kerugian). Meski beberapa aspek seperti penawaran dan penerimaan (*ijāb wa qabūl*) melalui *smart contracts* sesuai syariah, risiko spekulasi tetap tinggi. Oleh karena itu, studi ini merekomendasikan kehati-hatian bagi umat Muslim dalam menggunakan DEX hingga panduan syariah yang lebih jelas tersedia, serta pengawasan ulama dan regulator yang lebih ketat diperlukan.

Keywords:
Decentralized exchange; Islamic finance; Sharia compliance; Cryptocurrency; Smart contract

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Introduction

The burgeoning field of Decentralized Finance promises to revolutionize traditional financial systems by leveraging blockchain technology to facilitate permissionless, transparent, and efficient financial transactions (Auer et al., 2023). At the forefront of this revolution are Decentralized Exchanges (DEX), platforms that empower users with direct control over their assets, eliminating the need for intermediaries in cryptocurrency trading (Schueffel, 2021). This paradigm shift is evidenced by DEX's impressive on-chain transaction volume, reaching $224 billion, surpassing the $175 billion recorded by centralized exchanges between April 2021 and April 2022. The following graph illustrates this significant growth (Team, 2022).

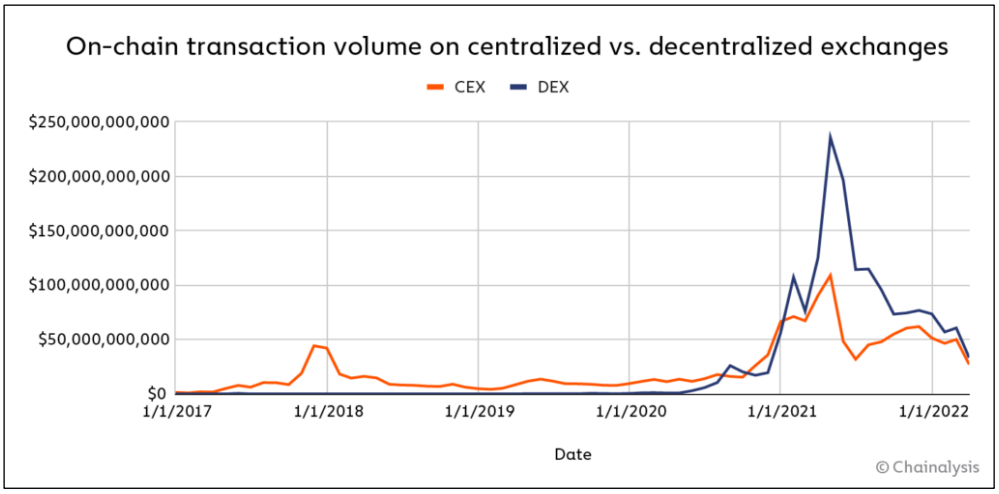

Figure 1.
Chainalysis 2022 report

This surge in popularity, with daily trading volumes exceeding $1.3 million and over 209 million users engaging in 2023 (Howell, 2024), underscores a significant migration towards decentralized financial ecosystems. However, despite the numerous advantages of DEX, their emergence raises critical concerns regarding their alignment with Islamic economic principles, particularly within *Fiqh al-Mu'āmalāt*. The autonomous and immutable nature of smart contracts (Mohd Noh et al., 2024), which automatically execute sales contracts on DEX, starkly contrasts the inherent flexibility of Islamic contracts designed to prevent potential harm and ensure fairness for all parties involved. This inherent tension necessitates a comprehensive analysis of DEX Sharia compliance, particularly regarding sales transaction principles.

Furthermore, the DeFi landscape is fraught with challenges, including the prevalence of rug pulls and fraudulent schemes that result in significant financial losses for unsuspecting users (Pamela, 2022). This underscores the urgent need for rigorous scrutiny of transaction compliance within DEX to ensure its ethical and legal conduct. This study investigates compliance with Decentralized Finance with the principles of Sale and Purchase in *Fiqh al-Mu'āmalāt*. By meticulously examining the intricacies of buying and selling transactions within this framework, this study seeks to contribute to a deeper understanding of how DEXs can effectively align with sharia principles, ultimately fostering a more ethically grounded and robust approach to decentralized financial systems.

This research contributes to the burgeoning field of Islamic Fintech by providing a timely and critical analysis of DEX compliance with sharia law. Continuous research and education regarding blockchain technology, especially from an Islamic perspective, are essential to support the rapid growth of this technology (Effendi & Latif, 2023). The findings will be instrumental in guiding stakeholders, including developers, investors, and regulators, to foster a more inclusive and ethical DeFi ecosystem that aligns with Islamic finance principles.

Blockchain technology has triggered a wave of innovation in the global financial system, giving rise to a new era of decentralized finance. Its advantages in creating transparency in transactions and opening up new business opportunities in Islamic finance have been widely recognized, as expressed by Rabbani et al. (2020) through 113 systematic literature reviews. Despite its promise, the issue of sharia compliance in applying cryptocurrencies and blockchain is still a matter of debate among scholars. Choudhary et al. (2024) emphasized the urgent need to develop Islamic cryptocurrencies to realize digital currencies that align with sharia principles. To further solidify the potential synergy between blockchain technology and Islamic finance, Aljamos et al. (2022) examined blockchain technology through the lens of *maqāṣid al-sharī'ah* (the objectives of Islamic law) and concluded its compatibility. The inherent characteristics of blockchain, such as its facilitation of transactions, security, and anti-monopoly features, were deemed *ḥājiyāt* (needs) and *ḍarūriyyāt* (necessities), as they protect the fundamental Islamic principles related to faith, life, progeny, and wealth. Furthermore, the transparency offered by blockchain technology aligns with the *maqāṣid al-taḥsīniyyāt* (embellishments), promoting ethical and responsible conduct.

On the other hand, Majumdar and Gotchait (2022) highlighted the risks and opportunities presented by Islamic Decentralized Finance. The decentralized nature and lack of central regulatory authority in DeFi pose unique challenges. Therefore, adopting DeFi within Islamic finance necessitates comprehensive risk management strategies to ensure seamless and sharia-compliant processes. Unal et al. (2022) emphasized the alignment between fintech, blockchain, and digitalization principles in Islamic finance with core Islamic values such as transparency, social investment, wealth protection, and minimizing financial friction. Septianda et al. (2022), further suggested the adoption of blockchain technology within Islamic fintech through the implementation of smart contracts in banking, optimization of zakat (alms-giving) and *waqf* (endowment) systems, and its application in *sukuk* and *ḥalāl* value chains.

However, Hassan et al., (2023) argued that cryptocurrencies, as the foundation of blockchain systems, do not fully comply with the Islamic concept of *māl* (wealth). The volatility, intrinsic value, and governance of cryptocurrencies remain major concerns, although the decentralized nature of blockchain in preventing monopolies is acknowledged as a positive aspect. Furthermore, Ahmad et al. (2024), identified potential sharia non-compliance issues within smart contracts used in blockchain technology. The lack of clarity regarding contracting parties, the autonomy of contracts that makes them susceptible to manipulation, the presence of *gharar* (uncertainty), and the potential for illegal transactions all contribute to sharia non-compliance risk.

Although research has been conducted on blockchain, cryptocurrency, and DeFi within Islamic finance, the focus on decentralized exchanges and their compliance with sharia remains limited. This is even though DEX is an integral part of the rapidly growing blockchain

ecosystem based on DeFi principles. This study aims to address this gap by thoroughly examining the compliance of DEX with the principles of *Fiqh al-Mu'āmalāt* in the context of buying and selling, thereby providing a foundation for the development and implementation of DEX that aligns with sharia values.

Method

This study adopts a qualitative approach, employing a descriptive-analytical method to investigate the compatibility of Decentralized Exchanges with the principles of Islamic sales and purchases, particularly within the realm of cryptocurrency asset transactions. This research draws upon two primary sources of data: classical and contemporary Islamic jurisprudence texts (*fiqh*) and fatwas (religious rulings) about cryptocurrencies and blockchain technology, as well as secondary data encompassing reputable scholarly journal articles in Islamic finance, fintech, and Islamic law published within the last five years, newspaper articles from various crypto platforms, and white papers related to DEX.

Data analysis was performed in two primary stages. First, content analysis was employed to identify the elements within the DEX mechanics relevant to the principles of Islamic sale and purchase. Second, a normative analysis is conducted to evaluate the compliance of DEX mechanisms with Islamic principles of sale and purchase. This evaluation will involve scrutinizing the elements identified through content analysis against the established pillars (*arkān*) and conditions (*shurūṭ*) of a valid sale according to Islamic law, alongside an examination of potential violations of prohibitions against *ribā* (interest) and *gharars* (excessive uncertainty). The central focus of this research is on the pillars and conditions of a valid sale, coupled with identifying potential *ribā* and *gharar* within the context of cryptocurrency transactions conducted through DEX.

Overview of Decentralized Exchange

Decentralized Exchange (DEX) is a cryptocurrency asset trading service that operates within a decentralized finance ecosystem, enabling users to engage in free and unrestricted trading. In a DEX, digital assets can be traded without a central authority, thereby promoting the creation of a comprehensive financial system that fosters an open and free trading environment (Bondarenko et al., 2024). According to Zeyu (2020), decentralized systems are well-suited for application in various ecosystems, including finance, as they guarantee system security and reliability, do not depend on a single server, and can easily integrate advanced networks, such as blockchain and cryptocurrency. DEX services built on blockchain technology enable investors to exchange digital assets based on predetermined exchange rate formulas (Harvey et al., 2024).

DEX has unique features such as accessibility, transparent price setting, easy simulation, and transaction settlement. DEX operates without a single corporate entity or intermediary, primarily based on the Ethereum network (Chen et al., 2024). Decentralized exchanges (DEX) are primarily supported by innovative contract technology that enables direct asset trading. Smart contracts are designed to facilitate pre-order trading. Once all conditions are met, the transaction is executed on the chain, requiring users to pay a certain amount to replace the fuel chain fee, which depends on the network and current demand (Choudhary et

al., 2024). Smart contracts allow DEX users to trade any asset supported by blockchain technology, whether tokens or cryptocurrencies (Makarov & Schoar, 2022). These contracts play a crucial role in DEXs, enabling trustless, transparent, and seamless transactions without intermediaries. They act as automated self-executing contracts, with the terms of the agreement directly written into code, which enhances transparency and trust among participants while reducing infrastructure, transactions, and administrative costs (De Collibus et al., 2022).

In contrast to centralized finance, where only cryptocurrencies, tokens, or stablecoins representing fiat currencies can be traded, decentralized exchanges can trade any asset, including those that can be traded in centralized finance systems (Qin et al., 2021). Decentralized exchanges offer users the advantage of remaining in control of their private keys and regulated trading by smart contracts that eliminate the risk of partnership for users, as transactions are performed instantly after confirmation. Unlike centralized exchanges, where users lose ownership after depositing cryptocurrencies, decentralized exchanges retain user ownership, which increases the risk of trading if the centralized exchange is hacked. Funds are stolen (Makarov & Schoar, 2022).

Diverse types of Decentralized Exchanges (DEX) exist in cryptocurrencies, catering to various trading preferences and strategies. These can be broadly classified into three primary categories: order book DEX, automated market maker (AMM) DEX, and Hybrid DEX. Orderbook DEX functions similarly to conventional exchanges, maintaining order books and matching buy and sell orders. Examples of such DEX include WOOFI DEX, REF Finance, and JUMP DEFI. These DEX share similarities with traditional centralized exchanges and facilitate buyer-seller interaction, with cryptocurrency trading pair prices and quantities displayed on their interfaces. The transactions were recorded on a public ledger to enhance transparency. However, Orderbook DEX may vary in efficiency, particularly in illiquid markets or low trading volumes, potentially leading to increased slippage. They can be further categorized into on-chain and off-chain variations, each presenting distinct characteristics and trade-offs. On-chain order book DEX directly records every order and transaction on the blockchain, ensuring transparency and decentralization. However, this approach may result in higher transaction fees and slower speeds due to on-chain validation. Off-chain order book DEXs move a significant portion of trading activity off-chain, settling final trades on the blockchain. This approach accelerates transactions and reduces gas fees but may introduce the risk of centralization (Network, 2023).

Automated Market Makers (AMMs) are a crucial component of the decentralized finance (DeFi) ecosystem, enabling permissionless and automated trading of digital assets through liquidity pools rather than a traditional market structure. Participants in AMM contribute crypto tokens to these pools, and prices are determined using a consistent mathematical formula. These liquidity pools can be tailored for various purposes and are increasingly recognized as a significant tool within the DeFi ecosystem (Staff, 2023). Hybrid DEX combines Orderbook and AMM Decentralized Exchange (DEXs) elements to offer users various trading options, including different order-matching mechanisms (Network, 2023).

No registration is required on the platform to begin trading on a DEX. Users only need a cryptocurrency wallet supported by smart contracts within the chosen DEX network and have sufficient funds with the native tokens of the network. Native tokens are used for transactions within a specific network and can be purchased through centralized exchanges. After selecting

a digital cryptocurrency wallet, it must be extended to the DEX application and imported using a seed phrase or a private key. Once the wallet is filled with native tokens, it funds transactions in the chosen DEX network (Cornèr, 2023).

Analysis of Key Elements in Decentralized Exchange Mechanism Smart Contract in DEX

Decentralized Finance (DeFi) is built on blockchain technology, with smart contracts as the foundation for user interaction. Smart contracts in blockchains execute transactions more quickly and efficiently than traditional contracts (Ahmad et al., 2024). In decentralized exchanges (DEX), smart contracts can operate automatically and execute trades according to the code written in the blockchain network, such as Ethereum, which can produce a variety of outputs (George, 2022). When a user wants to exchange cryptocurrency, they input the asset into the smart contract, and the smart contract matches buy and sell orders automatically, executing the sale transaction if all conditions and requirements are met. This transaction is performed while maintaining the user's digital wallet. As long as users have Internet access and a cryptocurrency wallet, anyone can conduct transactions using DEX through various DEX platforms, such as SushiSwap and UniSwap, each with unique features (Staff, 2023b).

In its transactions, the DEX user is charged two types of fees: network fees originating from on-chain gas transaction costs and trading fees collected by the protocol, whether by token holders or liquidity providers. Each contract will be stored in a blockchain infrastructure such as Ethereum, ensuring the security and resilience of the transactions conducted (Lehar & Parlour, 2021).

Parties involved in DEX Transaction

Decentralized Exchanges are platforms designed for direct cryptocurrency trading to eliminate the need for intermediaries. DEX facilitates peer-to-peer transactions between buyers and sellers without the involvement of a central authority that typically oversees and regulates traditional exchanges. This means trading occurs directly between users' crypto wallets through smart contracts, ensuring transparency and asset control (Cornèr, 2023).

Users or traders buy and sell digital assets on the DEX, benefiting from its key advantages of transparency, accessibility, and the simultaneous execution and settlement of trades, all made possible by smart contracts operating on the blockchain (Harvey et al., 2024). It is crucial to note that this direct trading model also places users responsible for safeguarding their assets. For instance, losing access to one's private key could result in an irreversible loss of funds. This key obtained during the crypto wallet setup is crucial for accessing and managing funds.

Users who deposit assets on a DEX platform receive "I owe you" tokens. These tokens, representing deposited assets, are freely tradable on the blockchain and hold a value equivalent to the underlying assets they represent (Cornèr, 2023). In addition to buyers and sellers, Decentralized Exchanges rely on Liquidity Providers. These individuals or entities play a crucial role by supplying assets to liquidity pools, which are collections of funds locked within smart contracts. These pools are the engine behind the automated market-making process that powers DEXs, such as Uniswap. These providers earn a share of the pool's trading fees by providing liquidity.

Two primary models govern the operation of DEX: Automated Market Makers and Order Books. AMM, such as those used by Uniswap, algorithmically determines the price of assets based on the ratio of assets within the liquidity pool. This means that the pool size and order directly influence the price you pay for a trade. Think of it like a sliding scale: larger pools and smaller trades mean less price impact. On the other hand, Order Book DEXs function more like traditional exchanges, where buyers and sellers submit specific buy and sell orders, and trade occurs when these orders match (Lehar & Parlour, 2021). These liquidity pools, created by pooling funds from multiple users, are essential for trade facilitation. Users who contribute to these pools earn a portion of their trading fees as a reward for providing liquidity. Liquidity providers deposit equal values for both assets in a trading pair into the pool. For example, in an ETH/USDT pool, a provider deposits equivalent values of both Ethereum and Tether. This ensures a balanced pool and prevents automatic transaction cancellations by the smart contract. The size and activity of these liquidity pools are often measured by the total locked value, which represents the overall value of assets locked within the smart contracts governing the pools. A higher TVL generally indicates greater liquidity and potentially more trading activity on DEX (Cornèr, 2023).

In contrast to AMMs, Order Book DEX functions similarly to traditional centralized exchanges. They maintain an order book that lists buy and sell orders at various price points, prioritized by price and then by the time the order was placed. Trades occur when these orders match each other. However, this method of execution on a blockchain introduces certain risks, as profit-seeking entities, or "miners," can potentially manipulate the order of transactions within a block to their advantage (Harvey et al., 2024). Order Book DEXs, as previously mentioned, utilize an order book system to match buyers and sellers. The order book acts as a public ledger, displaying all open buy and sell orders for a specific asset pair at various price levels. The difference between the highest buy order (bid) and the lowest sell order (ask) represents the spread, which provides insights into the asset's liquidity and the current market price on the exchange.

There are two primary types of Order Book DEX: on-chain and off-chain. On-chain order books store all the order information directly on the blockchain. User funds remain in their wallets until the trade is executed, offering higher security. Some On-chain DEXs also allow leveraged trading, enabling traders to amplify their positions using borrowed funds. Although this can magnify profits, it carries liquidation risk if the market moves against the trader's position.

On the other hand, off-chain order books store order information of the blockchain, recording only the final settled on-chain trades. This approach results in lower transaction fees and faster execution speeds, similar to centralized exchanges. Off-chain order book DEX may also offer leveraged trading and lending features, allowing users to earn interest on their deposited funds. To mitigate risk, these platforms often employ liquidation mechanisms to protect lenders when borrowers default on their loans.

However, it is important to acknowledge that order-book DEXs, particularly those operating on-chain, often face challenges related to liquidity. They compete with well-established centralized exchanges that boast significantly higher trading volumes. While off-chain order book DEX aims to address concerns regarding transaction costs and speed, it

introduces potential risks associated with smart contracts because users must deposit funds into these contracts to participate in trading (Cornèr, 2023).

Assessing the Sharia Compliance of Decentralized Exchanges

In Islamic jurisprudence, a sale is considered valid only when it fulfills specific pillars (*arkān*) and conditions (*shurūṭ*). Islamic sales, as defined by Ibn Qasim (1985), encompass any exchange of ownership involving goods, services, or items of equivalent value. The pillars of Islamic sales, as outlined by al-Tuwayjirī (2009), are threefold: 1) contracting parties (*al-'aqīdān*) refer to the buyer (*al-mushtarī*) and the seller (*al-bā'i*); 2) subject matter (*al-ma'qūd' alayh*) pertains to exchanging goods or services; 3) offer and acceptance (*al-sīghah*): This involves a clear offer (*ijāb*) from one party and unconditional acceptance (*qabūl*) from the other, adhering to established customary practices (*'urf*).

Furthermore, the contracting parties must meet specific conditions for a sale to be deemed valid. Both parties must be of sound mind (*rashīd*), have reached the age of legal maturity (*balīgh*), and enter the transaction willingly and without coercion (*qasd* and *riḍā*) (Zuhaylī, 2002). In cryptocurrency asset exchanges on Decentralized Exchanges, the transacting parties are called "traders." These traders can assume the role of either a buyer or seller, depending on their specific actions within the DEX ecosystem. A trader acts as a buyer when acquiring cryptocurrency assets through an order book model or an Automated Market Maker. Conversely, a trader assumes the role of a seller when placing a sell order on an order book or acting as a liquidity provider within an AMM framework.

This aligns with the definition of a trader as an individual or entity engaged in the buying and selling of crypto assets (Harvey et al., 2024), with their designation as a buyer or seller contingent upon their specific activity within the DEX. The lack of age verification mechanisms on DEXs and the platforms' open-access policy raises significant concerns regarding their compliance with the Islamic legal requirement of legal capacity for contracting parties. While this open access, facilitated by the absence of KYC procedures and registration requirements (Staff, 2023b), promotes financial inclusivity, it simultaneously conflicts with sharia principles.

According to sharia, the potential for minors who lack the legal capacity to enter into contracts directly contradicts the Islamic stipulation that contracting parties must possess legal capacity, encompassing *balīgh* (age of maturity), *rushd* (sound mind), and *ikhtiyār* (freedom from coercion) (Zuhaylī, 2002). This non-compliance is further compounded by the pseudonymous nature of DEX transactions, where users often operate without revealing their true identities (Ahmad et al., 2024a), making it practically impossible to ascertain their legal capacity to engage in such transactions according to Islamic law.

The second pillar of a valid Islamic sale and purchase transaction pertains to the object of that transaction. Islamic jurisprudence mandates that the object must be tangible and transferable to the buyer, possess utility permissible under sharia law, be clearly defined and mutually agreed upon by both parties, and be free from elements of *ribā* (interest), *gharar* (excessive uncertainty), and deception (al-Tuwayjirī, 20 09). While DEXs facilitate the trade of various assets, including cryptocurrencies, stablecoins pegged to fiat currencies (Qin et al., 2021), and other digital assets compatible with blockchain technology (Miller, 2024), the sharia

compliance of each asset type requires a closer examination of their inherent nature and characteristics.

Cryptocurrencies

Cryptocurrencies, a specific asset class traded on DEXs, present significant challenges in meeting these sharia requirements. Despite their digital tangibility and transferability via cryptocurrency wallets, the lack of intrinsic value, price volatility, and potential for speculation raises concerns regarding *gharar* (excessive uncertainty) and *maysir* (gambling). Furthermore, prominent Islamic scholars and institutions, including the Indonesian Ulama Council, Grand Mufti of Egypt Shawqi 'Allam, and the Secretary General of the International Union of Muslim Scholars, Sheikh Ali Qaradaghi, have issued fatwas declaring specific cryptocurrencies, particularly Bitcoin, as *ḥarām* (forbidden) due to their speculative nature, potential for financial harm (*ḍarar*), and lack of backing by a tangible asset (Batubara & Tho'in, 2024). These pronouncements stem from the understanding that cryptocurrencies, in their current form, do not fulfill the criteria of a permissible commodity (*sil'ah*) under Islamic law and contradict the principles of certainty and transparency required in Islamic financial transactions.

Token & Stablecoins

Tokens constitute a distinct category within the broader classification of crypto assets, which are digital representations of value recorded on open distributed ledgers secured by cryptographic techniques. Unlike some cryptocurrencies, specific tokens are valued from underlying assets, mirroring real-world assets, such as gold, natural resources, or company shares within the blockchain ecosystem (Abadi et al., 2023). This linkage to tangible assets forms the basis of their potential permissibility under Islamic finance principles.

Categorizing tokens based on their functionality and underlying structure is crucial for determining their sharia compliance (Advisor, 2018). 1) Work Tokens grant holders have the right to participate in, manage, or contribute work to a blockchain network. Analogous to licenses for specific activities within the blockchain, they resemble the concept of a*l-ḥuqūq al-'urfiyyah* (customary rights) in Islamic jurisprudence. Like *ḥaqq al-murūr* (right of passage), these rights are generally deemed permissible for trading. 2) Utility Tokens provide access to services or functionalities within a platform; these tokens function like API keys. As representations of specific rights, they also fall under the purview of *al-huqūq al-'urfiyyah* and are generally permissible for trading, provided the underlying services comply with sharia principles. 3) Asset-Backed Tokens represent claims on underlying assets; these tokens operate similarly to Sukuk *al-ijārah* (leasing certificates) or Sukuk *al-murābaḥah* (cost-plus financing certificates). The transfer of ownership *(qabd*) occurs through the possession of tokens in digital wallets, aligning with sharia principles governing asset-backed securities. 4) Revenue Tokens promise future income participation to holders, often lacking legally binding obligations from the issuing entity. This characteristic mirrors conventional bonds with interest-bearing features, rendering them non-compliant with the prohibition of *ribā* (interest) in Islamic finance. 6) Equity Tokens represent ownership stakes in the issuing company; these tokens grant holders voting rights and potential dividend participation and resemble conventional stocks. Their permissibility depends on the sharia compliance of the issuing

company and its operations. 7) Buy-Back Tokens promise value appreciation based on the issuer's commitment to repurchase and destroy tokens after achieving specific milestones. However, the contractual structure often involves *ta'līq al-'aqd* (conditional contracts), where the second sale (buy-back) is contingent on the first, potentially leading to *gharar* (excessive uncertainty) and rendering them non-compliant.

Therefore, while the digital nature of tokens presents novel challenges, their sharia compliance ultimately depends on specific features, underlying assets, and adherence to Islamic financial principles. In addition to tokens, crypto assets encompass stablecoins, which distinguish themselves through their peg to an underlying asset, typically a fiat currency such as the US dollar or a commodity such as gold (Abadi et al., 2023). This inherent design aims to mitigate the notorious volatility of the broader cryptocurrency market by anchoring its value to more stable assets (Nugroho, 2023). Given their characteristics as both a store of value and a medium of exchange, stablecoin transactions resemble *sarf* (currency exchange) in Islamic finance. Contemporary scholars generally view sharia-compliant stablecoins as permissible, provided they fulfill the functions of a legitimate medium of exchange and a store of value (Hassan et al., 2023).

The nature of the underlying asset is a crucial factor in determining the permissibility. For a stablecoin to be deemed sharia-compliant, its value must be underpinned by an asset with intrinsic value, such as a fully backed reserve of fiat currency or a tangible commodity like gold (Yunita & Cheumar, 2022). This backing mitigates excessive uncertainty (*gharar*) and ensures the stability and legitimacy of the stablecoin within the framework of Islamic finance.

NFT

NFT is a cryptographic token within a blockchain system that represents a digital or real-world asset such as a property or artwork. Its uniqueness and non-replicable nature, stemming from the tokenization process, contribute to more efficient buying and selling processes (Sharma, 2024). Pinto-Gutierrez et al. (2022) defined NFTs as cryptographic assets based on blockchain technology that prove ownership of legitimate digital assets or objects. From an Islamic perspective, non-fungible assets are categorized as *Qimiy* assets, which are unique and lack resemblance to other assets in their form, such as custom-designed clothing or items made for a specific individual (Adam, 2021). In the case of damage or loss caused by a third party, compensation for *Qimiy* assets is determined by market value because replacing them with identical items is impossible. According to Islamic jurisprudence, NFTs can be classified as wealth and property because they possess value, utility, and ownership attributes. Most Islamic legal schools, including Shāfi'ī, Mālikī, and Ḥanbalī, hold this view, which considers NFTs valuable assets (*al-māl al-mutaqawwim*) as long as they do not violate Islamic principles. Therefore, buying and selling NFTs are permissible, provided they fulfill the necessary conditions and pillars of Islamic trade and exchange (Robbani & Ningrum, 2022).

Based on the analysis of various crypto assets through the lens of *mabī'* (commodity) requirements in Islamic jurisprudence, it is concluded that only tokens possessing an underlying asset and representing legitimate property according to Islamic law qualify as tradable commodities. Tokens falling under this category include Work Tokens, which grant participation and governance rights within a blockchain network; Utility Tokens, providing

access to specific services or utilities; Asset-backed Tokens, reflecting ownership of tangible underlying assets; and Equity Tokens, representing shares in the issuing company. NFTs can also be considered permissible for trading, provided underlying assets such as artwork or digital property do not violate Islamic principles.

Conversely, cryptocurrencies lacking an underlying asset and susceptible to extreme price fluctuations are deemed non-compliant with Islamic principles because of the high degree of speculation and *gharar* (uncertainty) involved. Revenue Tokens also fall into the category of prohibited assets for trading as they contain elements of *ribā* (interest), where investors are promised uncertain future returns. In digital currencies, only Stablecoins are acceptable as a medium of exchange according to Islamic principles because of their stable value pegged to underlying assets, such as fiat currency.

The third crucial aspect of analyzing crypto assets through the lens of Islamic jurisprudence is the fulfillment of *ṣīghah*, offers, and acceptance (*ijāb wa qabūl*). In Islamic transactions, *ijāb wa qabūl* necessitates a clear expression of consent between the transacting parties, either verbally, in writing, or through actions that signify an agreement to the terms of trade. In DEX, a contractual agreement is executed automatically via smart contracts. Both buyer and seller input specific codes that trigger the execution of the transaction upon fulfillment of predefined conditions embedded within the smart contract (George, 2022). These smart contracts, typically written in programming languages such as Solidity, JavaScript, or C++, act as self-executing digital agreements. While the process is automated, the act of *ijāb wa qabūl* remains upheld. When parties consent to a specific smart contract, they confirm their agreement using their private keys, signifying acceptance of the terms and conditions stipulated within the contract (Ahmad et al., 2024).

This signifies informed consent and fulfills the requirements of *ijāb wa qabūl* in the digital realm. Analyzing transactions facilitated by smart contracts through Islamic contract law reveals that they meet the fundamental requirements of a valid contract (‘*aqd*). Using smart contracts with predefined terms and conditions written in code satisfies the *ṣīghah* requirement and establishes a clear intention to transact. This written form of agreement, akin to a traditional contract, renders transactions permissible from an Islamic perspective. Furthermore, the confirmation mechanism involving private keys reinforces the voluntary nature of the agreement, aligning it with *ijāb wa qabūl's* principles.

The ability to review and consent to terms before executing the smart contract ensures that the transaction is free from coercion and aligns with the principles of free will and informed consent in Islamic jurisprudence. This confirmation step, which utilizes private keys, can also be interpreted as embodying *khiyār* (option or right to cancel) within the innovative contract framework. Parties retain the right to withdraw from the transaction before the smart contract is executed and immutably recorded on the blockchain (Ahmad et al., 2024). This feature provides flexibility and control that aligns with the principles of fairness and mutual consent emphasized in Islamic contract law.

In order book DEXs, *ijāb* (offer) is established when a trader places a buy or sell order specifying the desired price and quantity. When a matching order is found, the smart contract executes the trade upon confirmation from both parties using their private keys, signifying *qabūl* (acceptance). It is important to note that in a DEX environment, the roles of the offeror and acceptor are not strictly confined to the buyer and seller, respectively. Imām Abū Ḥanīfah's

interpretation affirmed that both parties could initiate *ijāb wa qabūl*. He posits that *ijāb* constitutes any statement of intent from the first party, be it a buyer or seller, and *qabūl* represents the corresponding acceptance from the second party, regardless of their role in the transaction (al-Islāmiyyah, 2006).

Decentralized Exchanges operating on Automated Market Maker models present a different scenario. Here, the smart contract governing the liquidity pool determines the asset price algorithmically, factoring in the available token supply and real-time market demand (Team, 2023). The smart contract automatically processes the transaction when a buyer agrees to the offered price. In this context, the smart contract represents liquidity providers who have deposited their assets into the pool. Therefore, *ijāb* originates from the smart contract, whereas *qabūl* is executed by the trader purchasing the asset from the liquidity pool. However, the AMM model presents potential concerns regarding fairness and *gharar* (uncertainty). The fluctuating nature of asset prices driven by algorithms and unpredictable market dynamics could disadvantage liquidity providers. High price volatility may lead to impermanent losses, forcing liquidity providers to sell assets below their purchase price. Although AMM algorithms strive for objective price determination, they cannot eliminate the possibility of price manipulation that could harm liquidity providers.

Based on the analysis of contractual validity within the framework of Islamic jurisprudence, the *ijāb wa qabūl* mechanisms employed in order book DEXs, facilitated by smart contracts, align with sharia principles. As long as the traded assets are permissible (*ḥalāl*), the transactions conducted on these platforms can be deemed valid.

Assessing the Sharia Compliance of DEX within the Framework of Islamic Sale Principles

Sharia compliance is the cornerstone of all financial transactions within Islam, serving as the decisive factor in determining the permissibility of any given transaction (Wulandari & Nasik, 2023). DEX, representing a relatively recent innovation in fintech, has garnered significant attention from users of digital financial instruments (Reku, 2023). This study aimed to evaluate the adherence of DEX to the principles of Islamic sale contracts. A comprehensive analysis of the fundamental pillars (*arkān*) and conditions (*shurūt*) governing sale contracts within the context of DEX reveals several points of divergence from established sharia principles.

An analysis of the pillars and conditions of trading within DEX reveals several inconsistencies with sharia principles. One such inconsistency lies in fulfilling the conditions related to transacting parties. In practice, DEX allows anyone to transact, even if they do not possess legal capacity. This stems from the absence of specific criteria for transacting parties, the lack of identity verification processes, and the prevalent use of pseudonymous accounts. Consequently, minors, individuals with unsound minds, or *maḥjūr* officials can engage in transactions. However, Islamic principles stipulate that transacting parties must possess legal capacity, meaning they must be of age, sound mind, and free from coercion.

Beyond the unfulfilled conditions of trading, this study identifies several elements prohibited in Islam, such as *gharar* (excessive uncertainty), *ḍarar* (harm), and *maysir* (gambling), within the primary transaction object of DEX: cryptocurrencies. The lack of clarity

regarding the quality and quantity of cryptocurrencies prevents their categorization as either goods or currencies under sharia law. Furthermore, *gharar* and speculation are also identified in the price determination process of DEX employing the AMM model. Determining asset prices by smart contracts using algorithms based on fluctuating market dynamics can be detrimental to liquidity providers. Moreover, these algorithms do not guarantee the absence of price speculation, which could lead liquidity providers to sell their assets at lower prices.

Furthermore, the potential for *ribā* (interest) arises in the context of trading objects on DEX, particularly revenue tokens. These instruments promise future profits to their holders, resembling the principle of bonds, which is considered to contain *ribā* in Islam. However, several other transaction objects within DEX, such as work tokens, utility tokens, equity tokens, asset-backed tokens, and NFT, can be categorized as permissible assets for trading. These assets possess clear characteristics, can be utilized following sharia, hold intrinsic value, are transferable, and are free from *gharar*, *ribā*, and speculation. Meanwhile, in digital currency trading, stablecoins are permissible because their underlying assets are fiat currencies or gold, aligning applied trading principles with the concept of *bay' al-sharf*.

Although DEX fulfills the pillars of trading in Islam, they cannot be readily categorized as sharia-compliant. Inconsistencies were found when the conditions were met within specific pillars. For instance, this study finds that the process of *ijāb wa qūbul* (offer and acceptance) in DEX utilizing smart contracts fulfills the requirements of *ijāb wa qabūl*, reflecting mutual consent between the transacting parties. *Ṣīghah* (formulation of the contract) is executed through written computer code and clearly states all agreed-upon terms and conditions of the transaction. The principle of *khiyār al-majlis* (option of revocation) is also fulfilled because, before the smart contract is executed, a private key is sent as a final confirmation of consent to the transaction. This mechanism grants any party the right to cancel the transaction before the contract is executed.

While promising, DEX, such as blockchain-based digital platforms, are still in their developmental stage and carry inherent risks, particularly concerning sharia compliance. The decentralized nature of DEX, while promoting transparency, poses challenges for regulatory oversight and law enforcement. This characteristic potentially increases the risk of hacking, market manipulation, and money laundering. The absence of comprehensive regulations governing crypto assets and DeFi further contributes to legal uncertainty and potentially creates loopholes for practices that contradict sharia principles.

This high degree of freedom within the system also raises concerns regarding implementing ethics and compliance with sharia. The open nature of DeFi enables anyone to create financial products, including those potentially violating sharia principles, such as speculation, *ribā*, and *gharar*. Furthermore, several hacking incidents in cryptocurrency exchanges highlight vulnerabilities in security systems and opportunities for platform developers to engage in malpractice. Given these risks and challenges, Muslims must exercise caution and ensure that the chosen DEX platform comprehensively implements sharia principles and guarantees the permissibility of all transactions.

Conclusion

This study investigates the compliance of DEX with Islamic principles of trade. The analysis revealed inconsistencies concerning the transacting parties (*'aqīd*) and the object of trade (*mabī*). DEXs, which lack specific criteria for legal capacity, allow anyone to transact, potentially enabling participation from individuals lacking legal competence. Furthermore, using cryptocurrencies as trading objects presents *gharar* and *ḍarar* elements because of the ambiguity surrounding their quality, quantity, and value. The potential for *ribā* is also identified in trading schemes involving revenue tokens that promise future profit. While certain aspects of DEXs align with sharia, such as the *ijāb wa qabūl* process and permissibility of specific trading objects, the inherent risks within the decentralized financial system, including vulnerability to manipulation and data breaches, raise serious concerns. Consequently, this study recommends that Muslims exercise caution and refrain from transacting through DEXs until clear fatwas, government regulations, and platforms guaranteeing their permissibility are established.

This study makes a significant contribution to the development of a sharia-compliant DeFi ecosystem by providing a theoretical framework for understanding the sharia implications of DEXs and DeFi, offering practical guidance to regulators, Islamic financial institutions, and platform developers in designing and implementing sharia-compliant solutions, and fostering trust through the promotion of reliable and ethically aligned DEX platforms for Muslim users.

This study acknowledges the limitations in its scope, primarily focusing on the general characteristics of DEXs rather than examining specific platforms. Future research should investigate the compliance mechanisms of individual DEX platforms, such as SushiSwap and UniSwap, to identify their unique characteristics and implications for sharia. This granular approach provides a more comprehensive understanding of sharia compliance within the evolving landscape of decentralized finance.

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