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Smart Contract's Contributions to Mudaraba

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Abstract. *A Smart contract is a technology initiated in 1994 by Szabo and was taken over and became potentially highly applicable since the emergence of Blockchain technology. The idea that was developed by Szabo is to adopt digital self-executing contracts between parties without human intervention by using distributed ledgers to store contracts. This new technological era is intended to be used on a large scale in the financial sector. Insofar as the financial sector seeks to benefit as much as possible from these new technologies, Islamic finance also aims to position itself and integrate these innovations into its core. In the context of Islamic finance, the mudaraba contract (equity-based investment contract) despite its great economic benefits remains under-applied because of technical risks, investment obstructions, and Sharia restrictions. This work aims to study to what extent Smart contracts can contribute to the resolution of these drawbacks and the improvement of the mudaraba contract to be applied potentially by Islamic finance institutions. It is concluded that by the mudaraba contract can be enormously developed technologically, operationally, and from Sharia compliance perspective by applying smart contracts.*

Keywords: *Smart contract, Blockchain, Islamic finance, Mudaraba.*

Abstrak *Kontrak Cerdas adalah teknologi yang diprakarsai pada tahun 1994 oleh Szabo dan diambil alih dan menjadi berpotensi sangat berlaku sejak munculnya teknologi Blockchain. Ide yang dikembangkan oleh Szabo adalah untuk mengadopsi kontrak self-executing digital antara pihak-pihak tanpa campur tangan manusia dengan menggunakan buku besar yang didistribusikan untuk menyimpan kontrak. Era teknologi baru ini dimaksudkan untuk digunakan secara besar-besaran di sektor keuangan. Sejauh sektor keuangan berusaha untuk mendapatkan keuntungan sebanyak mungkin dari teknologi baru ini, keuangan Islam juga bertujuan untuk memposisikan diri dan mengintegrasikan inovasi ini ke dalam intinya. Dalam konteks keuangan Islam, kontrak mudharabah (kontrak investasi berbasis ekuitas) meskipun memiliki manfaat ekonomi yang besar tetap kurang diterapkan karena risiko teknis, hambatan investasi, dan pembatasan Syariah. Karya ini bertujuan untuk mempelajari sejauh mana kontrak Cerdas dapat berkontribusi pada penyelesaian kelemahan ini dan peningkatan kontrak mudharabah untuk diterapkan secara potensial oleh lembaga keuangan Islam. Disimpulkan bahwa kontrak mudharabah dapat dikembangkan secara besar-besaran secara teknologi, operasional, dan dari perspektif kepatuhan Syariah dengan menerapkan kontrak pintar.*

Kata kunci: *Kontrak pintar, Blockchain, keuangan Islam, Mudharabah*

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Introduction

As the Internet of Things (IoT) and Artificial Intelligence (AI), blockchain sees itself as a technological revolution that will spark a new world order. It represents a decentralized system offering the possibility of settling transactions at a low cost with absolute transparency and security in an immutable distributed ledger. A distributed ledger constitutes a database recorded and put to the reach of several nodes in a decentralized structure where no entity has control over it, and therefore it cannot be modified or changed (Muneeza & Mustapha, 2020). Blockchain has grown and become famous thanks to the development of cryptocurrencies, among the most important in particular Bitcoin. However, this only represents one Blockchain category which can be called: Blockchain 1.0. The second category (Blockchain 2.0) is based on the smart contracts concept (Kamdzhalov, 2020).

Szabo developed the concept of smart contracts in 1994. It's about tiny computer programs stored in a blockchain that takes the form of digital self-executing contracts between parties without human intervention and which are created by using a distributed ledger to store contracts. Their ultimate aim is to automate the settlement, the execution, and the entry into force of contractual agreements between parties. Smart contracts are becoming a vital element in many industries such as healthcare, real estate, and securities. (Rahim et al., 2018). It is expected that their implementation will offer the opportunity to save billions of dollars in the trillion-dollar size of the global Islamic finance markets (Mohamed, 2017).

Islamic finance (financial system based on Islamic jurisprudence) should not be left behind this vague technological revolution. It is prompted to follow all the technological innovations and benefit from any form of structural development to keep its known expansion during these last decades, especially when we consider that Islamic law (Sharia) has flexibility and inclusiveness. It is thus imperative to keep abreast of these developments and find solutions to them. Among the most important factors that encourage

Islamic financial institutions to exploit these new developments and to benefit as soon as possible and as much as possible from its advantages in a world that coexists with a technological boom of accelerated digitalization, is the compliance of many of the technical principles of these new technologies with the fundamental moral principles of Islamic finance and smart contracts are among the most important within this specific framework.

In this context, the study is devoted to identifying Smart contract's contribution to a product among the very important of the Islamic financial industry, namely: the mudaraba contract an Islamic equity-based partnership contract, commonly known as a profit-sharing contract. Perceived as an effective alternative of banking investment under the rules of Islamic jurisprudence (Fiqh), it is very incentive to find the horizons which can be opened within the framework of the applicability of the mudaraba contract in Islamic banks to improve its efficiency. In this way, the remainder of this paper is structured as follows: Section 2 includes a description of work related to the Smart contract and its contribution to Islamic finance. Section 3 the characteristics and technical sides of smart contracts whereas section 4 gives the research methodology and paper exploration process. Section 5 presents the results and discussion related to the research purposes. Finally, section 6 serves as the conclusion.

Literature Review

First set of studies tried to analyze globally how fintech, blockchain, and smart contract technologies can contribute to the modernization and digitalization of Islamic finance. Rahim et al. (2018) assessed artificial intelligence (AI) and smart contract operations in Islamic finance and by explaining the smart contract process and identifying in which way they can contribute to the flourish of Islamic finance areas such as S*ukuk* (Islamic bonds), takaful (Islamic insurance), trade finance and crowdfunding they concluded that Islamic finance tended to find future in each of AI and Smart contracts. (Kasujja, 2018), discussing financial disintermediation and

Distributed Ledger Technology (DLT), concluded that Islamic banks and Islamic financial institutions generally can benefit from the transparency, immutability, and efficiency provided by blockchain, and smart contract technologies. (Lacasse, Lambert, & Khan, 2018), analyzing the monitoring process between Islamic bank stakeholders (contributors, beneficiaries, Sharia Supervisory Boards, and governmental regulators) affirmed that blockchain technology and smart contracts contribute to transparency in Islamic banking which is the main asset in its fundamental principles. In a global context, many works have taken place to assess the future visions of Fintech in Islamic finance. Kamdzhalov (2020) found an interconnection relationship between financialization, Blockchain, and Islamic finance and that Blockchain could contribute to business prosperity.

There studies have attempted to identify these contributions technically on the operational side, and models have been developed in this context. By studying the horizons of blockchain technology and fintech within the framework of Islamic finance, Peredaryenko (2019) has identified that smart contracts help ensure funds transfer operations in banking systems that comply with *sharia* rules. Kapsoulis et al. (2020) discussed the implementation of smart contracts in the Know Your Customer (KYC) process within a decentralized framework. This is among the indirect operational contributions of smart contracts to general Islamic finance and the *mudaraba* contract in particular. An e-mudaraba system was proposed by (Hamid & Allaymoun, 2019) in which they discussed the different advantages that the digitalization of banking services can provide to the different operational functionalities in the *mudaraba* contract within Islamic banks. Feng et al. (2019) have tried to develop new models of smart contracts that go against the vulnerabilities of current smart contracts. They suggested a new operating model based on the division of smart contracts into subcontracts and then discussed the applicability of this model. (Sa'ad et al., 2019) proposed a *musharakah* (partnership-based investment contract) smart contract model in which a P2P company liaises between the investor and the business owner.

Smart Contract

Background

Perceived as an innovation that will make a technological and organizational disruption over a wide area, smart contracts are expected to be the future of a whole automated, immutable, and transparent institutional ecosystem. That said, traditional contracts, taking the form of physical paper, are exposed to non-transparency, fraud risks, and slowness. Although this could be resolved relatively by delegating a financial intermediary, high costs will be recommended above (Cant et al., 2016). However, smart contracts, transactions will be independent, transparent, without a financial intermediary, and therefore at low cost and reliability since they result from a programming process.

At the beginning of their invention in the 90s, smart contracts could not be spread on a large scale given the lack of a technology sufficiently capable of supporting such fields of programming, until the emergence of blockchain technology. This last form is data chain of transactions between users stored in blocks where each block records a specific amount of data encrypted thanks to cryptographic hashing. If a user wishes to carry out a transaction, he must communicate it to all other network users to verify the authenticity of the operation. Each user will have a copy of the data ledger. Thus, all transactions are visible and transparent to all of them, making any false transaction, fraud act, or hacking operation impossible. Fig 1 shows us how transactions are being promoted in a blockchain. The first step is about creating a digital security code by making encryption. The second step is where users attempt to authenticate the transaction while preserving private information. Finally, the transaction is thus recorded imminently and will be automatically distributed to all users (Changa et al., 2020).

Figure 1. How Blockchain promotes transactions
Source: Changa et al (2020)

Blockchain and smart contract are strongly stood out, and more specifically, it was thanks to Ethereum decentralized exchange protocol which allows users to create smart contracts for exchanges while using a cryptographic currency called Ether as an accounting unit. Thus, most smart contracts today are being applied on blockchain platforms (Feng et al., 2019). There are different types of Blockchain, and smart contracts do not always operate in the same blockchain type. For example, while Hyperledger Fabric applies the alliance chain, Ethereum smart contract model mainly uses the public chain platforms (Feng et al., 2019). Blockchain and distributed ledger technology a smart contract will be impossible to hack and, therefore, be protected from any falsification.

Although smart contracts are promising to be used in multiple activity sectors, they remain the most sought in the financial sector, where transactions generally suffer from heaviness, slowness, lack of transparency, and high costs. The fields in which smart contracts can help develop the financial industry can be divided into four categories: Capital markets Investment banking and stock exchange infrastructure / Commercial and retail banking / Insurance / RegTech and compliance functions (Oseni & Ali, 2019).

Process

The process is based on creating a contract in the form of algorithmic

codes stored in a blockchain so that once it is created, it can never be modified or changed again (Immutability) and should be validated by all the users in the network (Distribution).

Like any traditional contract, the process takes birth by an agreement between specific parties on a set of items. These items take the form of computer algorithms that translate a flow of instructive steps executed one after the other until the transaction takes end (Rahim et al., 2018). Once the parties agree on the contract's content, they proceed to cryptographically sign a smart contract and deploy it into a distributed ledger. Contract data are therefore accessible by any computer on the network and integrated into the Blockchain in the form of codes and when a specific code is met the smart contract will automatically trigger a corresponding action (Levi & Lipton, 2020).

Several blockchain platforms use smart contracts. Among those, Bitcoin, the cryptocurrency which was the main cause of blockchain's notoriety. However, the main blockchain, which is considered as a benchmark in this field, is Ethereum. This last was created specifically for the implementation and the execution of smart contracts through a contract-oriented, high-level, and Turing-complete programming language (Kapsoulis et al., 2020).

The settlements in the smart contracts are realized through cryptocurrencies for the digital assets, while for physical assets, it is through fiat money and actions. (Rahim et al., 2018).

Sharia Perspective

Sharia is flexible and open to any innovation likely to enable it to achieve its objectives (Maqasid al-Sharia) since it follows a fundamental rule in the organization of transactions which stipulates that anything is allowed as long as there is not a text which prohibits it (Alam et al., 2019). The correct Islamic transaction dealing must be based on honesty, truthfulness, and clarification of conditions in a way that removes confusion and matches reality within harmony with the Islamic jurisprudence perspective (International

Islamic Fiqh Academy, 1995). Therefore any technology capable of giving advantages to stimulate such values will be welcome.

When we talk about the smart contract, we can easily conclude that they are placed relatively within this framework since it meets the Sharia values in the transparency that it establishes as well as it helps to avoid practices that distort morality such as maysir (gambling), dharar (harms), tadlis (cheating) and gharar (uncertainty) thanks to the distributed ledger technology (Peredaryenko, 2019). In addition to that, the transactions are secure and risk-free since the terms are in the form of algorithmic codes. Thus, not only will parties' interests be protected, but it will also lead to an environment of trust and sincerity, which are the primary purposes of Sharia (Alam et al., 2019).

However, some challenges related to smart contracts need to be resolved for this product to be fully Sharia-compliant. Among these challenges, the inevitability of an offer and acceptance (sighah) that expresses the esoteric will of both parties, adapting of the contract session (majlis), the way the settlement is realized, warranty and liability for loss and defects, and finally the contract evidence, that is, how to prove a contract without a physical paper so as not to lead to disputes. There is also another challenge related to cryptocurrency and how it can be a Sharia-compliant means of payment under any conditions. In light of this, the International Islamic Fiqh Academy held at its twenty-fourth session in Dubai, during the period 04 - 06 November 2019, decided to postpone the decision on the subject.

Within Islamic Finance

The application of smart contracts programmed on blockchain platforms in Islamic finance is still in its early stages. However, it promises to be applied in a very broad field in Islamic banking, takaful, Sukuk market, microfinance, and crowdfunding. Islamic finance is struggling to operationally impose its values in a traditional financial ecosystem that is not the most favorable on the regulatory side to achieve its purposes. These new features will facilitate this, especially when we know that blockchain and smart contracts operate in a decentralized system, thus offering independence to IFIs

from the pressures of the regulation dominance of traditional finance.

Over time, it is expected that Blockchain and smarts contracts will be dominant technologies in the banking and financial sector, this is why even if it currently seems an optional choice for IFIs to take them into the application, they will face a huge lack of competitiveness compared to conventional financial institutions if they do not apply them in the future (Baniamer & Tahsin, 2019). The framework even touches the macroeconomic aspect because the context does not only present a simple integration of technology in Islamic finance but touches a whole new structure of a new Islamic digital economy which going to be a channel for economic prosperity such as growth, job creation and solving the problems that Islamic countries are facing (Peredaryenko, 2019).

Several traditional and Islamic financial institutions have started introducing smart contracts into their organizational systems, as in Malaysia, where nine banks have integrated blockchain technology into their trade financing application (Hilal & Jamaludin, 2019). Smarts contracts have broad opportunities to be applied in all Islamic finance contracts, whether investment or financing contracts based on profit and loss sharing such as musharaka (partnership) and mudaraba (equity-based).

Method

Mudaraba is an Islamic finance contract based on profit and loss sharing in which the bank takes the role of an entrepreneurial partner (*mudarib*) by ensuring the investment of its client's funds (*Rab'ul mal*) in sharia-compliant projects. This form applied today in Islamic banks is a developed one of the traditional mudaraba, where the IFI enters as a capital partner and an entrepreneurial partner at the same time and forms a unified investment pool in which capital is raised from many clients.

The mudaraba system in Islamic banks is based on the successive mixing of client funds. Thus, even if new clients want to enter, their new contributions will be allocated to the old ones. Once the funds have been collected and

invested, a certain percentage will be taken from the profit for the reserve requirements, and the rest will be shared between the bank and the investment pool according to percentages determined in advance where each client will earn a profit according to his contribution rate, and this is done within accurate calculations. Thus, investing by mudaraba in Islamic banks is a process that never turns off, and we never talk about a final profit payout only if the client closes his investment account and withdraws his funds (Dardour, 2017).

Given the complexity of the operational side of the mudaraba contract in IFIs, the technology of smart contracts applied on blockchain platforms will significantly help simplify the procedures, whether relating to the technical sides, from a sharia compliance perspective or again within the investment framework.

The study will adopt the analytical methodology based on the collection of information and link it with the body of our subject and the inductive methodology through the examination of pieces of information and opinions mentioned to identify the potential contributions of smart contracts mudaraba.

Results and Discussion

Technical contributions of smart contracts to mudaraba

Matching Financer to the financed

The smart contracts applied on blockchain platforms pave the way towards a decentralized financing system, where the one in need of financing can easily collect the required funds by only connecting to his blockchain account (on Ethereum for example) while establishing a set of demand and also showing his project proposal (Kasujja, 2018). This can also potentially be applied in matching the financer (*Rab'ul mal*) to the financee (*mudarib*) so that the customer does not have to go to the bank himself to put his money under mudaraba investment, as smart contracts allow a direct link between the two parties without mediation simply by entering in an account that the client has on a blockchain platform and communicates with the funder directly who offers the project that suits him.

Accounting Process Facilitation

The operational side within the framework of the mudaraba applied in Islamic banks is based on a relatively complicated calculation system especially in the profits accumulation rules. The mudaraba contract is made on an investment account, allowing the client to withdraw his funds over time. That said, profits accumulation is ascending between the bank and the customer (every three months for some banks: 50-50 / 40-60 / 30-70 / 20-80). Besides, the client is entitled to profit only on the part of the funds that have not withdrawn throughout a specified investment period (at least three months). Adding to this, the calculation relating to the investment pool, roughly speaking, is a fairly rigorous and strict calculation process that consumes time, effort, and material costs (Dardour, 2017).

All these accounting rules can be included in a smart contract in the form of algorithmic conditions, and a smart contract will self-execute a corresponding action if one of the conditions is met. This will reduce banks 'trouble in manual verification (i.e., non-automated) from the rates of an immovable fund in the light of which profits will fall, as well as in investment pool calculations and the process of deduction of capital if a loss occurs. All of this becomes an automated process that smart contracts undertake, facilitating the audit and protection process, reducing costs and gain time, and stimulating the efficiency of financial services for Islamic banks within this framework (Kasujja, 2018).

Efficiency in transferring funds

Transferring funds is time-consuming for banks, especially in their third-party relationships with suppliers, companies, and customers. Smart contracts contribute enormously to the acceleration of this operation while preserving transparency and accuracy given that algorithmic codes are immutable and distributed within the network. A smart contract will also contribute to the post-negotiation phase, where the verification of the transaction and the settlement will no longer be a manual operation (Lambert, 2019).

Improving KYC process

Know Your Customer (KYC) technique is a set of data relating to the customer's identity collected by the bank to offer services more effectively. It prevents impersonation, financial fraud, money laundering, and terrorism finance (Moiseev, 2019). The need for a KYC procedure arises mainly in the opening of bank accounts, the granting of loans or credit cards, and investments in mutual funds such as mudaraba. Any client who wants to join a mudaraba investment pool needs to be identified by the bank through the KYC procedure.

How Blockchain and smart contracts can contribute to the development of KYC should be considered in this field. An example process should be : a certification node (usually owned by the state or an authorized agent) is first integrated into the blockchain network. Once company A requests a certain number of documents on company B, it sends its request to this certification node. The latter thus ensure the verification of the validity of the documents after having taken consent for this from company B. All this process can be programmed in a smart contract, and the ultimate advantage in this context will be to reduce the time necessary for data collection and authenticity control (Moiseev, 2019). The same example can be seen in a bank and its customer.

The more efficient Crowdfunding process

Crowdfunding, a method of raising funds through online platforms, is among the fields where smart contracts can be applied. Crowdfunding was also approved and adapted for application within the framework of Islamic finance principles under a new analog concept known as Islamic crowdfunding. It thus relies on partnership contracts of Islamic finance such as musharaka and mudaraba to finance projects, start-ups, small and medium enterprises, or capital increase (Kamdzhalov, 2020).

In this sense, concluding a mudaraba contract in the form of a smart contract within a crowdfunding operation will be a very sophisticated digital combination. All the conditions relating to the operation can be coded in a smart contract which will automatically ensure the corresponding actions if

one or the other condition is satisfied. Supporters of a project by mudaraba transfer their funds to the smart contract automatically allocating these funds to the project if the latter has been fully funded and returning the funds to its owners if the project ran out of funds. This will make the fundraising operation through mudaraba more transparent and faster in an environment of total trust between parties.

Smart contract benefits to Mudaraba investment mechanisms and prospects

Mitigate investment risks

In a partnership contract like mudaraba, the bank tends to participate in the investment pool with the funds of its depositors, which exposes it to a risk familiar in all banking systems that of the loss of these funds and the lack of liquidity, especially in the case of risky investments that can upset the stability of the financial sector. Indeed we talk about counterparty risk in the bank balance sheet, which can be mitigated through sufficient monitoring of the funds available and how they are used as well as making the share of profits or losses clear and all this is thanks to the transparency provided by smart contracts within distributed ledger technology (Kasujja, 2018).

Mudaraba Smart Sukuk

Islamic investment certificates named Sukuk present a modern investment method in the context of Islamic finance. There is a golden opportunity to integrate the smart contract into the negotiation of transactions based on Sukuk and thus conclude a new model called Smart Sukuk. This is already implemented, and the first Smart Sukuks in the world were from Blossom finance which uses Ethereum smart contracts. As a result, investment in Sukuk will be more efficient, transparent, less costly, potentially minimize financialization effects, and open the way for SMEs, projects with social impact, groups, and associations to issue their Sukuk thanks to blockchain technology (Kamdzhalov, 2020).

Integrating mudaraba in a smart Sukuk opts for a Mudaraba Smart Sukuk model, which will benefit significantly from these benefits. Blossom is already using this form of investment through investors and fund providers who are

mainly American and rewarded based on a mudaraba agreement (Kasujja, 2018).

Financial Inclusion Improvement

It is possible and potentially promising to deploy smart contracts in Islamic microfinance activities in to automate the chain of intermediation or facilitate disintermediation and transformation into other intermediaries. Thanks to this automation, the resource planning tools of companies can be integrated into a blockchain which allows supporting young companies and start-ups with transparency and visibility on the operational side as well as in the advice in terms of their commercial operations (Kasujja, 2018). Mudaraba contracts used Islamic microfinance can greatly benefit from these advantages and contribute to a digitalized and more efficient financial inclusion system. An investor in a mudaraba contract in a microfinance operation can take the form of a venture capitalist or a business angel

The more flexible Investment system

Technically speaking, smart contracts allow simultaneous transactions to be carried out (Prause, 2019). By adopting a system in which smart contract links each client, it is possible to operate in a flexible investment system where entry and exit operations in the investment pool are also carried out simultaneously, which is very attractive as a flexible investment mechanism for investors as it is less costly and less time-consuming.

Smart Contracts for a more Sharia-Compliant Mudaraba

Ensuring a halal investment

Some Islamic banks are suspected of investing the funds of the investment pool in the context of the mudaraba outside the framework mentioned in the contract, i.e., in projects which may not be confused with the principles of Sharia. Through blockchain technology, invested funds in the mudaraba investment pool will be accurately tracked to know where and for what purposes have been used. This verification can be done by encrypting and including halal certification in the blockchain in PDF form. As a result, it cannot be manipulated or modified as the transparency of blockchain

technology ensures (Peredaryenko, 2019). It is thus always checked whether the mudaraba investment is sharia-compliant or not.

Contract Binding

It is well known that Islamic contracts are of two types: binding contracts and not binding contracts. A binding contract is a contract in which neither party can terminate the contract without the consent of both parties, while either party can terminate a not binding contract. Mudaraba in the general principle is not binding except if the business was already started, so in this case, it becomes binding up to the date of actual or constructive liquidation, or if a period during which the contract will remain in force has been determined (AAOIFI-Accounting and Auditing Organization of Islamic Financial Institutions (2005), Shariah Standards. (n.d.).).

Technically speaking, smart contracts can be used to function as escrow account. Thus, in a sale contract, a smart contract will not release the funds to the seller only if the buyer transfers the agreed amount to this account and take ownership of the asset, for example (Hilal & Jamaludin, 2019). The same thing can be applied to the mudaraba framework. Both conditions for binding of a mudaraba contract can be implemented in a smart contract and assisted by an escrow account. The automatic implementation of the mudaraba contract will not begin unless the mudarib has handed over his fund to the IFI and this last start investing, and there is no review in this case because the contract became binding. Thereby, the smart contract guarantees and organizes binding mudaraba issues with full transparency.

Fund Guarantee

In mudaraba, the mudarib is trustworthy, which means that the fund he gets from Rab'ul mal is not guaranteed unless it is proven that he abused, intentionally failed to perform his tasks, or violated a contract agreement. These counterparty risks are difficult to identify with traditional methods. However, with smart contracts applied on blockchains, by the possibility of tracking transactions one by one in a completely transparent system, it is easy to know if such violations or other negligence have been committed, which

minimizes disputes between parties and makes Rab'ul mal keener.

Conclusion

Our work focused on identifying the different contributions of smart contracts to one of the most important contracts in Islamic finance, the *mudaraba* which suffers from some obstacles preventing it from being applied on a large scale. We concluded that the *mudaraba* contract could largely be developed from the technical and operational sides and Sharia-compliance perspective. If smart contracts are applied correctly in IFIs, *mudaraba* will present an efficient, secure, and innovative investment model and will be able to overcome the downsides faced by the traditional system. It is important in future works to study what smart contracts can improve in the rest of Islamic finance contracts.

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