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# IMPROVING ATTRACTIVENESS OF FRONTIER MARKETS USING BLOCKCHAIN TECHNOLOGY

# Dino Arnaut[1], Damir Bećirović[1], Janez Kolar[2]

[1]International Business-Information Academy Tuzla, Tuzla, Bosnia and Herzegovina
[2]The Public Research Institute RUDOLFOVO, Novo Mesto, Slovenia

| ORCID iDs: | Dino Arnaut | https://orcid.org/0000-0003-4262-5757 |
| | Damir Bećirović | https://orcid.org/0000-0002-6589-7213 |
| | Janez Kolar | https://orcid.org/0000-0001-5237-3202 |

**Abstract**. *Frontier capital markets are a specific category within emerging markets, characterized by lower market capitalization, liquidity, and fewer investment constraints. These markets do not offer opportunities for investment and their functionality for companies to finance their future endeavors is not efficient. This paper offers a comprehensive examination of smart contracts, including their functioning principles, prevalent platforms, and uses. Consequently, it suggests a model for a junior stock market that utilizes blockchain-supported smart contracts. The model gives a framework for organizing the Junior stock exchange segment in frontier capital markets by offering a new fundraising method for SMEs. Application of this model simplifies the entry of smaller companies, allowing them to enter the market without regular trading requirements. Therefore, shift in financial instrument supply and alternative financing for young companies can boost market liquidity and capital mobilization. Blockchain technology ensures transparency and strengthens market confidence.*

**Key words:** *Frontier Markets, Blockchain, Smart Contract, Junior Stock Exchange Financial Management*

## 1. INTRODUCTION

Nowadays, economic growth represents the basic economic and political goal of every country. In this process, the development of the financial system, especially the capital market, has an important role. The role of the financial system is based on the transfer of funds from surplus to deficit entities (individuals, companies, and the state). Countries differ according to the characteristics of the financial system. The financial system can be bank-centered or market-centered. The level of development of both systems is important to support the development of the economy. Shen and Lee [1] state that in the context of economic growth, the development of the stock market has a more positive effect on economic growth

than the development of the banking system. Most of the countries in transition, especially the Western Balkans countries, are still at a low level of capital market development. These markets are classified into the so-called *frontier capital markets*. This term was introduced by Farida Khambat at the International Finance Corporation-IFC in 1992, with the emergence of a capital market that could not be classified as an emerging capital market. For any market to exist there must be demand and supply. In the context of the capital market, the product is the external manner of financing of the capital of a company. It is sought by companies that do not have enough capital and want to use the capital market for financing. The offer for financing comes from investors, usually institutional investors such as pension and investment funds, insurance companies, etc. [2]. Stock market liquidity is a positive predictor of economic growth, capital accumulation and productivity improvements [3]. The main disadvantage of frontier capital markets is the absence of both supply and demand of financial instruments, i.e., a low level of liquidity. The illiquidity of frontier capital markets is a key obstacle to investing in these markets and their more significant inclusion in global capital flows [4]. Liquidity on the capital market can be viewed simply as the ease of selling securities i.e., as the ease of trading securities. The basic prerequisite of any liquid capital market is that at any moment there is a significant number of buyers and sellers, the possibility that the next transaction can be carried out at the same price as the previous one, and that the market, without significant influence on the price, can accept the purchase and sale of large quantities of financial instruments [5]. This indicates that frontier capital markets do not have sufficient influence on economic growth, nor are they able to perform their basic function. When it comes to Western Balkans countries in transition, the process of the emergence of the capital market is related to the process of privatization of state-owned property into private property, which was accompanied by many controversies, and as a result, there are shares of companies that are not attractive to potential investors. New issues of equity and debt securities of private companies are very rare, and the stock exchange mainly serves as a platform for issuing government bonds or treasury bills.

The aim of this paper is to offer a model for organizing the junior stock exchange segment on the frontier capital markets based on blockchain technology. In this way, the entry of smaller companies as issuers into the capital market, which do not meet the strict requirements for listing on regular trading, would be easier. Thus, positive shifts can be made on the supply side of financial instruments, and young potent companies can get an alternative source of financing. The offer of securities of promising companies will have a positive effect on demand on the part of potential investors. In this way, there is a positive effect on increasing market liquidity, capital mobilization, and moreover, due to blockchain technology transparency is ensured and confidence in the market is strengthened.

## 2. FRONTIER CAPITAL MARKETS

Capital markets were traditionally divided into developed capital markets and emerging capital markets. In the 1990s, a category of marginal capital markets was introduced. Precisely defining these markets is not easy because the rating agencies do not use unique indicators [4]. Frontier capital markets share many common characteristics with emerging markets. However, in comparison to them, marginal markets have lower market capitalisation, lower liquidity and higher restrictions for investors [6]. Due to the absence of foreign investors, marginal capital markets show a low level of correlation with the global market [4]. On the

frontier capital markets, investors face difficulties related to an insufficiently developed secondary market, difficult identification of the appropriate market indices, asynchronous trading and the impossibility of forming a real share price. Unbalanced supply and demand of securities and illiquidity of the market often lead to the formation of absurd prices of financial instruments. Potential and real investors cannot rely on the fact that the positive financial results of the company in the last few years will be reflected in the increase in market prices, and vice versa [7].

In addition to illiquidity, the inefficiency of frontier capital markets is their basic characteristic. According to the efficiency market hypothesis (Efficiency Market Hypothesis EMH), the capital market is considered efficient where the prices fully reflect all available information [8]. This means that the prices of securities in an efficient market are the result of supply and demand, assuming rational participants who take all relevant information into account at the moment. In an efficient market, it is not possible to identify the so-called underestimated or overestimated securities because there is always a sufficiently large number of market participants who are looking for such investment opportunities, that is, for the possibility of achieving above-average returns, which eliminate all unused opportunities for profit [9].

The availability of all relevant information and transparency is an important precondition for the development and efficient functioning of the capital market. The transparency of the capital market ensures equal treatment of investors in terms of conducting transactions and legal protection. In addition, increasing the transparency of the capital market contributes to increasing public confidence in the market, increasing the credibility of the market and financial instruments traded, encourages investors to invest in financial instruments in the market and reduces the frequency of illegal actions [10]. Transparency and availability of information is one of the main obstacles for investors to invest more significantly in frontier capital markets.

On the other hand, the absence of correlation with developed capital markets and its inefficiency opens the possibility of realizing the effects of international diversification through investments in frontier capital markets for investors coming from developed markets [11], as well as the adoption of active investment strategies in these markets.

## 3. BLOCKCHAIN

Bitcoin, a well-known and well-liked cryptocurrency created in 2008, by an unidentified individual or group of persons using the pseudonym Nakamoto [12], is where the notion of blockchain first appeared. Blockchain is an ever-expanding database of records kept in so-called blocks that are connected and secured using cryptographic principles [13]. Blockchain utilized P2P protocol to accept a single point of failure. This protocol ensured that all transactions were ordered consistently and unambiguously in blocks, guaranteeing the consistency and integrity of the blockchain across all of its visually distributed nodes. Blockchain hence has attributes like decentralization, integrity, and auditability by design [14].

Xu et al. [15] suggest that blockchain can serve as a new type of software connector, acting as a decentralized alternative to the currently utilized centralized shared data storage. Blockchains can be classified into three types based on varying access permissions:
- Public - *Bitcoin* and *Ethereum*,
- Private, and
- Consortium blockchain - *Hyperledger* and *Ripple*.

The blockchain network is used to run smart contracts, a computer programs that may define triggers as well as conditions [13], and business logic to enable complexly programmable transactions [15]. An overview of the development of smart contracts is shown in Fig. 1.
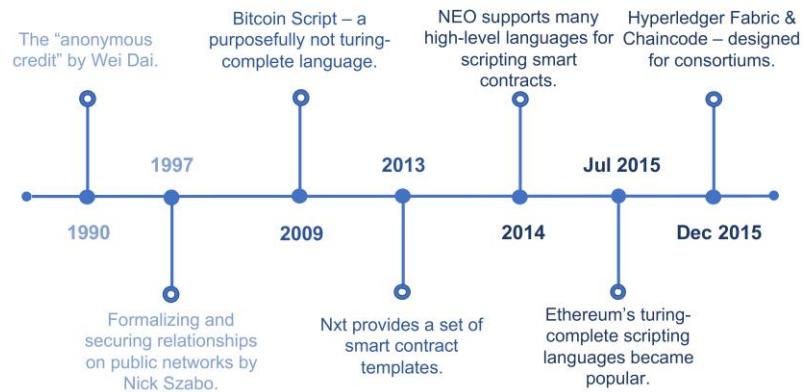


**Fig. 1** Development of smart contracts [16]

Blocks, chains, nodes, and master nodes make up a blockchain. The blocks of the network are managed by nodes. The process of adding blocks to the blockchain is difficult and demands mathematical problem-solving. The difficulty of solving difficult mathematical riddles prevents the blockchain network's ability to grow indefinitely. Because each hash code is distinct, it is extremely hard to hack, cheat, or otherwise change the blockchain network. A copy of the ledger is stored on each connected computer in a distributed ledger called a blockchain. Because it consists of interconnected blocks that serve as transaction records, the network is known as the blockchain [17-19].

A blockchain is a digital ledger for transactions and the term is derived from its structure, which consists of connecting distinct pieces of data, known as blocks, in a single list called a chain. Beyond recording financial transactions like those involving Bitcoin, blockchains can be used for a variety of purposes. By managing and storing data, a blockchain makes it difficult or impossible to change thus preventing possibility of hacking or defrauding the network [20, 21]. A blockchain is a network of computers that makes copies of digital transaction records and distributes them. The financial sector has long used contemporary technology to ensure the security of data and processes. In the banking industry, blockchain has already become more and more popular. The rise of cryptocurrencies is evidence that blockchains enable the safe, trustworthy, and verifiable conduct of financial transactions [22, 23].

A digital database known as blockchain allows for the parallel recording of certain operation records across several devices. Using this technique, all digital data of transactions, created contracts, as well as contact databases is kept as a collection of interconnected blocks. Lack of clear and transparent financial system regulations leaves the company open to frequent errors and incorrect information interpretation [24, 25]. Most of these issues are resolved by blockchain technology, which also significantly reduces financial risk. The major reason for creating banks was to bring people together

and enable them to conduct trade and business in a secure and effective manner. The blockchain platform is an invention that makes it simpler to carry out numerous tasks on a worldwide scale [26-28].

The worldwide financial system, handling trillions and serving billions daily, struggles with issues such as costs, delays, paperwork, and data breaches, leading to substantial yearly losses. Blockchain technology could potentially solve these problems [29-31]. The existence of organizations like regulators, brokers, and the stock exchange increases the cost of the existing stock market. A decentralized management style for stock exchanges can enhance system efficiency. A blockchain can generate smart contracts, eliminating the need for external regulators. As a result, equity markets are moving towards decentralization. Blockchain technology enables every investor-company interaction to be conducted safely and without intermediaries, reducing costs [32-34].

The financial industry has grappled with numerous challenges. While technological advancements have addressed some, they have also introduced new ones. Financial service businesses encounter difficulties in selecting the appropriate fintech solution to tackle all pressing issues. The application of Blockchain technology in financial services is compelling and has the potential to resolve significant business problems [35-37]. Centralization in the financial sector leads to substantial money distribution among enterprises, necessitating investments in accounting, database maintenance, value transfer systems, security, labor costs, and intermediary commissions by financial service providers. These recurring expenses necessitate regular budgeting, which could potentially escalate costs in a financial service system [38, 39].

Over the past decade, the financial services sector has been exploring the potential of Blockchain, an online database of completed financial transactions, which is distributed, published, and maintained in multiple locations, ensuring accurate transaction recording [40, 41]. Because there are many copies of the ledger, blockchain is virtually immutable and extremely secure; to edit or falsify any part, a hacker would need to simultaneously update every copy of the ledger, a task that is extremely challenging. Blockchain fosters trust, enables secure transactions, and automates business logic through deterministic smart contracts, increasing efficiency and trust among business partners. It offers industry-leading technology for data privacy enabling selective data sharing in business networks [42-44].

Digital securities offer faster, more efficient issuers with specialized financial products like tokenized microeconomies, safe asset transfers, and fractionalized ownership of physical assets. These advantages lead to improved stakeholder incentives, more efficient corporate operations, and transparent and accountable governance structures [45-47]. Venture capital, private equity, real estate funds, and specialty markets are under pressure to improve liability risk management, implement dynamic decision-making frameworks, and effectively manage evolving legislation [13]. Because digital currencies were the first thing to be kept on blockchains, financial applications are among the most promising [48, 49].

### 3.1. Smart contracts

Smart contracts can potentially lower costs associated with data collection, negotiation, agreement supervision, and relationship management, thereby fostering market-based governance structures. They also bolster data trust by securely storing data and automating payment processes, thereby eliminating human errors or intermediaries [50-52]. Smart contracts can enhance trust among open account trading participants, improve transparency of trade transactions, ensure data accuracy, decrease the chances of errors or fraud, and

streamline the payment exchange process. Blockchain technology facilitates tracking of transactions and ownership of both tangible and intangible assets, automates contract creation and execution, and aids in recording and tracking transaction data [53, 54].

   Smart contracts typically possess two characteristics: value and state. The operational mechanism of smart contracts is illustrated in Fig. 2. The conditions that trigger and the corresponding actions of the contract terms are predetermined using statements like If-Then [13]. All parties must consent to and sign a smart contract before it can be transmitted to the blockchain network as a transaction. These transactions are then broadcasted via a peer-to-peer (P2P) network, validated by miners, and placed in a specific block of the blockchain. Miners utilize their local Sandboxed Execution Environment to create contracts or execute contract code upon receiving a contract creation request. The system's built-in incentive mechanism encourages miners to participate by contributing their computational power to validate the transaction. The contract determines if the current scenario meets the triggering requirements based on information from Oracles (trusted data feeds) and the system state. If the criteria are met, the response actions are strictly executed, and the transaction is validated and bundled into a new block. Once the entire network reaches a consensus, this newly created block is chained into the blockchain [55, 13].
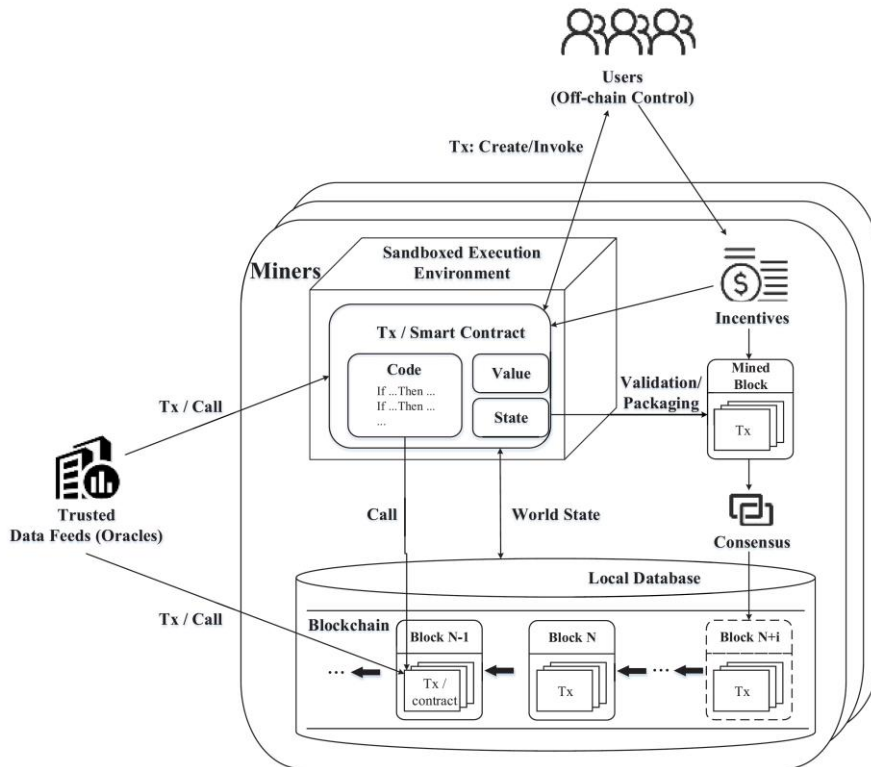


**Fig. 2** Smart contract's operational mechanism [55]

   Wang et al. [55] divided the life cycle of a smart contract into five stages based on the operational mechanism of smart contracts:

1. negotiation,
2. development,
3. deployment,
4. maintenance, and
5. learning and self-destruction.

They utilized this life cycle to provide a fundamental research framework for smart contracts. This framework was not their original idea. Xu et al. [56] proposed a taxonomy to categorize and compare blockchains and blockchain-based systems. Risius and Spohrer [57] presented a research framework to organize the insights of the current body of research on blockchain technology. Glaser [58] developed a comprehensive conceptual framework of blockchain systems and further divided blockchain systems into two code layers, the fabric layer, and the application layer [13].

Wang et al. [55] proposed a research framework for smart contracts based on six layers [13, 59]:

1. *Infrastructures*: Supports smart contracts with necessary environments and data feeds.
2. *Contracts*: Stores contract data and rules for execution and communication.
3. *Operations*: Manages actions on contracts like design, verification, updates, and self-destruction.
4. *Intelligence*: Adds smart features to contracts using algorithms.
5. *Manifestations*: Contains different forms of smart contracts for applications.
6. *Applications*: Includes all domains that use the smart contracts.

This research framework is highly beneficial for both academics and practitioners due to its theoretical and practical relevance.

## 4. Transformation of Frontier Market using Blockchain

This paper proposes a fundamental framework for enhancing frontier markets using blockchain-enabled smart contracts. It provides a comprehensive overview of smart contracts, their operational mechanisms, and their applications in frontier markets. Arnaut and Bećirović [13] suggested a blockchain-based equity platform for a Junior stock market, utilizing smart contracts on the Ethereum blockchain. This platform merges the benefits of traditional markets, such as IPOs and VCs, with the advantages of blockchain technology through ICOs.

Equity tokens, which represent asset ownership like SME company stock, are unique due to their digital value. They can be issued as non-voting shares, allowing company owners to maintain control. The operation of this Junior stock market involves six steps: company registration on a blockchain-based platform, term specification for potential investors, investor selection of a suitable company, equity token purchase, smart contract generation, equity token transfer to investors, and a success fee deduction to ensure the platform's long-term functionality. Equity tokens introduce a novel fundraising method for SMEs, enabling them to issue tokens on the blockchain in public or private placements. A successful equity token offering on a hybrid Junior stock market platform should embody a true token economy, linking investors with SMEs through transparency and legal compliance [13].

Incorporating the concept that the stock market is a collection of offers for buying and selling assets, such as bonds or shares [60], blockchain technology is particularly beneficial for underdeveloped capital markets. By facilitating the creation and offering of

new financial instruments, it enhances transparency, trust, and attractiveness for foreign investors.

Pop et al. [61] examine the limitations of the traditional stock market and propose a blockchain-based trading platform as a solution. Their research contrasts the conventional stock exchange platform used by the Bucharest stock market, aiming to illustrate how blockchain technology can reduce transaction fees.

Jaoude and Saade [62] underscore the adoption of blockchain in the financial sector, focusing on four main areas: accelerating transaction processing, ensuring sustainability, improving data privacy and security, and contract automation. Blockchain streamlines financial transaction resolution by creating a unified account structure for financial institutions, thereby speeding up global capital transfers [63]. The banking sector grapples with sustainability issues due to the industry-wide impact of failures. Blockchain technology can contribute to the stability of the financial industry by eliminating regional and national regulations [64]. Centralized data storage in banking and financial institutions presents data security and privacy challenges, potentially leading to breaches that compromise customer privacy and confidentiality [65].

Blockchain addresses data decentralization and unauthorized access by securely storing data in nodes, allowing participants to adjust roles while maintaining anonymity [66]. Jaoude and Saade [62] highlight that blockchain automates financial contracts by eliminating a third party, enabling quick and efficient transactions, particularly in poorer nations with regulatory validation requirements. Blockchain transactions can be executed swiftly and securely, eliminating the need for an intermediary, provided that all contractual obligations are met by both parties [64].
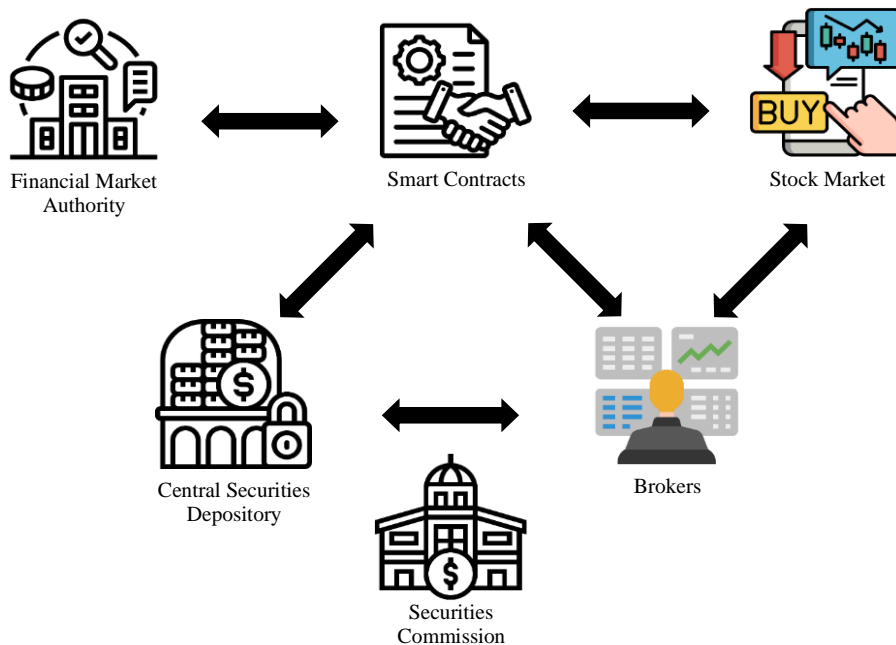


**Fig. 3** Decentralized frontier markets blockchain-based stock exchange platform

We propose a decentralized stock exchange platform for frontier markets (Fig. 3). This platform uses blockchain technology and includes existing financial and corporate members of the traditional stock market. The blockchain oversees smart contracts for stock trading and simplifies transactions among various participants [67].

The proposed framework is composed of a group of approved validators that are participating entities of stock exchange including the Financial Market Authority, Central Securities Depository, Securities Commission, Brokers, and Stock Exchange. Each of them has specific functions and duties based on a conventional stock exchange platform. The stock exchange smart contract defines the trading rules and various operations that participants can perform, such as setting up brokers, onboarding new investors, and allocating shares [67].

Each entity has a private and public key, and an address that all together serve as authentication. As a result, the smart contract ensures that each entity can only trigger functions that align with their privileges.

The Financial Market Authority oversees developing the smart contract, keeping it up to date, and specifying all the trading logic and functions. Additionally, it keeps an eye on the trading process to make sure all established guidelines are followed. To build and manage corporations with shares as well as to create and maintain brokers, it communicates with the smart contract. The Central Securities Depository oversees creating and maintaining investor accounts. It interacts with smart contracts to establish investor accounts and distribute shares to them [67].

Brokers act as the investors' agents when they trade. Brokers connect investors to the smart contract and place buy and sell orders on their behalf. They are also allowed to move shares from investor accounts, held at the Central Securities Depository, to the investor's trading account managed by the broker [67]. The Securities Commission oversees financial settlements, and the Stock Exchange oversees creating trade by matching orders that are waiting in the order book.
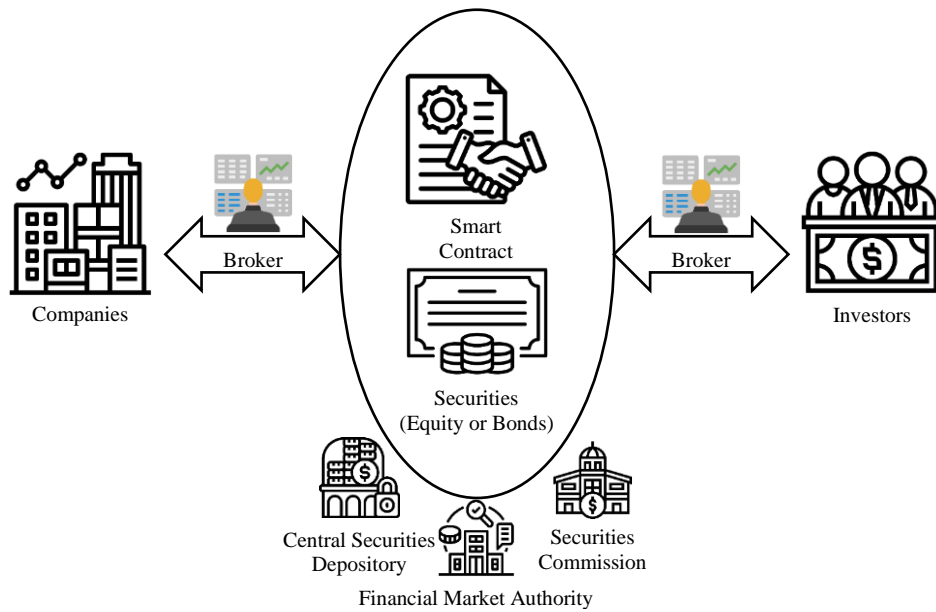


**Fig. 4** Junior stock exchange platform logic

Fig. 4 shows the functioning of a junior stock exchange platform based on blockchain technology. The logic of this platform enables all participants to conduct a successful trade based on blockchain technology. Companies offer securities as equity or bonds that are listed via brokers and offered to investors. Investors enter buy orders via brokers and if a successful match is generated and a smart contract is created. Financial Market Authority, Central Securities Depository and Securities Commission act as a regulator that define and regulate list of brokers, define details of listed companies on platform and their equity shares and bonds on offer side as well as validate investors integrity for bid side of blockchain-based stock exchange platform.

This proposed frontier markets blockchain-based junior stock exchange platform enables additional security and system efficiency compared to traditional stock exchanges that are usually underdeveloped in frontier markets. This model represents the framework for the creation of junior stock exchange that can overcome imperfections of traditional stock markets in frontier capital markets.

Growth-oriented business owners can list their company on a junior stock market to obtain public ownership earlier and gradually advance to the senior exchange. Junior stock exchanges ease listing rules for SMEs that couldn't access the main list. Entrepreneurs can quickly reach the senior exchange if the junior stock market succeeds, with graduation numbers and graduation rates being indicators of its success. Therefore, SMEs competitiveness can be improved via better capital availability based on security and transparency principles of blockchain technology.

In contrast to a traditional stock exchange, our proposed framework advocates for the use of a unified smart contract-based platform and shared software by all participants. This approach simplifies the system, reduces maintenance and technical support costs, and makes it more cost-effective and accessible without the need for a separate disaster recovery environment.

When it comes to altering the functions and bringing fresh changes to the trading logic, the proposed framework offers greater flexibility and scalability than the conventional stock exchange platform. All participants share a common ledger, ensuring everyone has the same data. Any changes in one node are immediately mirrored in others, resolving any data conflicts like those in traditional stock exchanges through smart contracts. The transparency of blockchain technology guarantees that all transactions and data are accessible to authorized entities and remain unchangeable [31].

To be valid, a modification must first receive the support and agreement of all network members. The traditional stock exchange, in comparison, struggles with an inadequate amount of transparency because each party has their own system and is able to conceal or manipulate the data before sharing it with other participants. This greatly improves trust in the stock market.

## 5. CONCLUSION

The problem of illiquidity and unattractiveness of the frontier capital market is a key obstacle in the functioning of these markets. Such frontier capital markets are unable to perform their function within the overall financial system. At the same time, it is a limiting factor of the economic growth of the overall economy. In this paper, we propose a model that offers a decentralized platform for trading in frontier capital markets that is

based on blockchain technology. The blockchain oversees the operational rules of stock trading through a smart contract implemented in the stock exchange. Additionally, the blockchain facilitates transactions among numerous participating entities. The model includes financial and corporate institutions that are already part of the traditional capital market, but also opens the possibility of including issuers that were not included in the traditional stock market until now. Through the Junior stock exchange segment on the frontier capital markets, companies that do not meet the conditions for inclusion in the traditional market can easily be listed on the stock exchange. In this way, the liquidity of the market is positively affected on the supply side, and on the other hand, a greater interest of individual and institutional investors can be expected on the demand side. Thanks to blockchain technology, transaction security and transparency are positively affected as key stock market principles. In addition, the existence of a broad community that supports blockchain technology has a positive effect on the international attractiveness of the market.

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