Futures Trading Security Based on Smart Contract Technology

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Abstract. With the development of blockchain technology and the increasing vitality of the world economy, the use of blockchain technology is expanding in the financial field gradually. Among all the financial derivatives, futures with their high-risk, high-return investment pattern have been popular to global investors, but their risks from leverage always lead to a disaster. Currently, there is no reasonable or appropriate safety net measure available to protect investors' losses within acceptable limits. However, smart contracts at the blockchain contract layer with their properties of security, automation and strict adherence to contract terms, naturally align with the nature of futures trading. Therefore, this paper designs three types of smart contracts in trading access, risk aversion assessment and safety net protection respectively, to provide tailored safeguards for investors while promoting futures trading developing healthily and maintaining investor enthusiasm at the same time.

Keywords: Futures; Transactions; Smart Contracts; Future Risk; Financial Derivatives.

1. Introduction

Blockchain technology was initially used in the financial sector for the generation, storage and trading of digital currencies such as Bitcoin, and its applications are currently expanding to banking, payment settlement, accounting, auditing, risk management and securities and futures. For instance, by the end of 2015, the NASDAQ market launched a new trading platform based on blockchain technology for the trading and settlement of some stocks which wouldn't be traded publicly [1]. UBS established a blockchain research and development lab in London to explore the use of blockchain in payment and settlement. China UnionPay, in collaboration with IBM, attempted to launch a cross-bank points redemption system based on blockchain technology in 2016. The SEC approved online retailer Overstock to offer shares and trade cryptographic tokens via blockchain. NASDAQ established a private blockchain-based equity trading platform called Linq, which primarily serves the transfer of equity of unlisted companies and the settlement of private equity transactions [2]. On 23 August 2018, the World Bank issued the world's first blockchain-created and managed bond named "Bondi'' [3].

Exchange blockchain research in China mainly focuses on infrastructure. The Shanghai Insurance Exchange released a blockchain underlying technology platform in September 2017, depending on Golang encryption algorithms to support the digital policy deposit certificate 50,000 policy fingerprints per second and other data uploading and high-concurrency processing. The Shanghai Bill Exchange set up a digital bill trading platform in January 2018, where four banks, such as the Industrial and Commercial Bank of China, completed digital bill issuing, accepting, discounting and rediscounting digital notes based on blockchain technology on their platforms.

The contract layer in the blockchain employs smart contracts. A smart contract is a computer interaction protocol executed according to the terms of a specific contract, referring to an automated programme stored in a blockchain system. It is a kind of coded business logic that can be run automatically, being widely used in distributed systems. There are various similarities between the essence of smart contracts and that of the futures.

Since 1980s, the creation and trading of financial derivatives has become primary in international financial innovation. Among all the derivatives, financial futures have gained popularity among investors for their price discovery, asset allocation and risk hedging functions. Financial futures are futures contracts that have financial instruments as their underlying assets. Financial futures trading refers to a transaction carried on a specific exchange, in which a trader commits to buy or sell a specified quantity of certain financial instruments at a pre-agreed price through open bidding on a particular date or within a chosen period. When the futures firstly emerged, they were to satisfy the demand of hedging and risk avoidance of investors.

However, the futures weren't meant to eliminate the risks, but to transfer them between different market participants. Therefore, if the futures are misused, they will bring severe harm to the market. Basically, there are three types of participants: arbitrageurs, hedgers, and speculators. While hedgers engage in futures trading in order to transfer the risk of price fluctuations of other investments, speculators are those who take on the risks from hedgers, aiming at achieving huge returns at relatively small costs. This high-risk, high-return investment strategy depends on the leverage effect of futures trading, which has attracted enormous investors who aren't sober enough, only focusing on the probability of getting rich overnight, ignoring the risk itself.

When this kind of excessive speculative behaviour dominates the futures market, it will be exposed to significant price risks, furtherly resulting in huge fluctuations. Moreover, such behaviour will also trigger liquidity risk, that is, the counterparty may not be capable to meet margin call requirements on the settlement date, being forced to close the position, or fail to fulfill delivery obligation when the contract expires due to insufficient funds, eventually leading to losses. This contradicts the original intention of investors to hedge the risk.

Though risks themselves are the uncertainty of investing results in the future, referring to losses or the probability of losses, it is unreasonable to completely cut off the risks. This is because returns and risks are tightly connected, therefore people not always try to avoid them, but sometimes face them out of diversified risk aversion. This article targets at providing tailored protection for participants with different risk tolerance levels by smart contracts in block chains, enabling individuals to engage in futures trading optimistically. This paper will provide a detailed analysis of the design of smart contracts in three aspects: market access, investor risk aversion assessment and safety net protection aiming at enhancing market security and reliability.

2. Literature Review

In academia, there have been explorations and attempts on the use of smart contracts in OTC derivatives business. Li et al. [4] discussed the feasibility of using blockchain technology into application in the futures market by its properties in terms of decentralisation, de-trust and tamperability of blockchain. Wang et al. [2] analysed the scenario and advantages of blockchain put into operation in the financial market, and explored the innovation in the business of exchanges based on digital futures contracts. Liu [5] proposed intelligent transformation and automatic execution of business processes could be carried by the construction of smart derivatives contracts. The Donghai Securities Research Group [6] provided a B-OTC framework that was Blockchain based OTC Derivatives Trading Platform Framework, which attempted to realise standardised distributed trading. Yao [7] carried out a blueprint of smart contract based securities trading and central counterparty clearing, and gave the process flow of securities trading, clearing, settlement instructions, and the invocation flow of relevant smart contracts based on distributed ledgers. Schär [8] highlights opportunities and potential risks of the DeFi ecosystem, short for decentralised finance which is an alternative financial infrastructure built on top of the Ethereum blockchain, and proposes a multi-layered framework to analyse this architecture, concluding that despite certain risks, DeFi may still contribute to a more robust, transparent financial market. Rius et al. [9] presented a framework for the development of on-chain forwards and futures, utilising smart contracts to automate the custody of collateral and settlement of payouts on expiry, and this enabling forwards to be traded without risk of counterparty or reliance on off-chain assets. Reconsidering shared futures, Fazeldehkordi and Owe [10] suggested a more general and expressive notion taking place of futures, satisfying the need of garbage collection and privacy protection, including support of functionalities found in smart contracts. Karantias et al. [11] devised a mechanism where a derivative smart contract could be deployed in practice on the Ethereum blockchain to help derivatives derive their value, and described applications of smart contract derivatives which insured an underlying on-chain security. With the aim to construct a new digital representation of a financial derivative contract, Fries et al. [12] described the application of existing smart contract technologies, comparing several distributed ledger technologies.

On the basis of the previous literature, this paper aims at smart contracts from the perspective of protecting investors from excessive risks and will play a role in enriching and expanding the existing literature in this field.

3. The Application of Smart Contract On future

3.1. Futures Trading Access Contract

The requirements for obtaining membership in futures exchanges are too stringent for general individual investors. Therefore, this paper focuses on investors who will obtain trading qualifications through the intermediary services of futures companies that is to get involved in futures trading in an indirect way.

The traditional account opening process contains requiring investors to provide their personal information by submitting relevant documents in the first phase. Then the futures company will issue “Risk Disclosure Statement” and “Futures Trading Rules”, which are to be signed by both the company and the investor in “Customer Brokerage Agreement”. In the second phase, the futures company will conduct assessments towards clients applying for account, including evaluation of their cognitive ability, performance capability, and market risk tolerance. Moreover, the futures company will examine the financial strength and sources of funds of investors, whether they have any adverse credit records, and whether they are prohibited to participate in futures trading or whether they have provided adequate application documents. Additionally, taking Chinese futures companies as an example, there are certain rigid indicators for investors to meet: the available balance of the margin account after settlement for five consecutive trading days prior to applying must not be less than RMB 500,000. Furthermore, they must have ten or more derivative trading records on domestic trading platforms in the past three years.

When designing smart contracts to smarten up user access standards in the futures market, considering the existing user-input-based audit method, this paper aims will use smart contracts to provide a more reliable and automated access mechanism.

Smart contracts will programmatically execute the user access audit process. The financial requirements towards investors, such as the margin in the account greater than or equal to five hundred thousand, the absence of adverse credit records, or prohibitions from participating in futures trading, can all be formulated into smart contract code using "if-then" statements, which will describe these access conditions formally using programming languages. Smart contracts can interact with trusted data sources, such as government identity authentication databases, financial institutions' credit rating systems, or other authoritative futures trading applications, to obtain users' personal information as well as data records of their fund sources and trading history, then organise them into protocols and parameters in smart contract, packaging them into blocks, and providing them to application programming interfaces. When a user is willing to apply for an account, after entering the information, the smart contract is invoked. Users who meet the account opening conditions do not need to wait for manual review time and are automatically assigned accounts by the system.

3.2. Risk Aversion Contract

According to the regulations of the Futures Industry Association, most futures companies require users to pass the "Futures Trading Basic Knowledge Test" provided by the China Futures Association during the account opening process. To proceed to the next step, investors need to score above 80 out of 100 in this test, which involves an assessment of their risk aversion level for futures companies to understand their investment personality. All futures companies and investment platforms will provide users with risk assessment questionnaires in order to understand their risk tolerance, assisting them to select proper financial products appropriate to their risk preferences. However, such questionnaires often suffer from issues such as redundant information collection, lack of specificity, and limited usefulness. For example, the first part of the questionnaire repeatedly collects users' income and debt information, which has already been collected during the account opening process. The second part assesses investors' risk preferences and investment experience. However, using such questionnaires is not an efficient or effective measure to obtain genuine information. The actual utility often falls short of expectations. For instance, risk-averse users will still engage in futures trading, despite futures being inherently high-risk financial derivatives. The conservative users at futures companies or platforms serve little purpose other than providing a dismissible prompt during trading, thereby somewhat diminishing users' autonomy and failing to effectively help them mitigate risks. Moreover, this approach sacrifices the personalized and customized features of derivatives to some extent.

This paper digitizes and automates the process of assessing investors' risk aversion levels. With the aid of blockchain technology, information including users' investment patterns, trading information, and financial characteristics can be obtained in an accurate and genuine way, without any redundant input, showing more practical reference value. Based on this, a smart contract evaluating investors’ risk aversion can be established. Unlike traditional and rigid classifications into low, medium, and high-risk investment tendencies, this smart contract gives more flexible and customized analysis of users' investment characteristics, aligning with the personalized nature of futures trading. Moreover, this smart contract, after analyzing users' investment patterns, serves as an important reference indicator for subsequent smart contracts designed to provide safety nets for users, feasibly considering users' diversified risk preferences, thus holding deeper practical significance.

3.3. Close Out Contract

In present futures trading environment, currently there is no effective or appropriate safety net system specifically made to safeguard users' investment risks. Due to the risks objectively associated with futures trading, countless investors suffer from the potential significant market fluctuations. This section will establish a contract to provide investors with a safety net, tailored to calculate a loss limit for each client. If losses are within tolerance limits, users can choose not to close their positions before the maturity date. However, if users wish to cut losses in a timely manner, the loss limit calculated by this capital contract can serve as a reference for users to close their positions.

The loss limit is essentially a percentage, which means if users rely on this smart contract to make decisions, their positions will be automatically closed once losses in futures trading reach this threshold. The loss limit is not rigid but tailored based on users' personal data. The capital contract in this section focuses on this calculation. Three smart contracts work in a chain. Therefore, as an extension of the Futures Trading Access Contract (section 3.1) and the Risk Aversion Contract (section 3.2), the capital contract primarily considers two key indicators: the user's personal information which has already been collected, including occupation, income, and investment patterns, as well as their personal risk aversion level.

The operation of the three contracts is sequential, allowing for the direct transfer of users' personal information from the Futures Trading Access Contract (section 3.1). The first attribute is occupation. If investors work in the economic or financial sectors, their loss limit may be raised appropriately. These investors can leverage their professional knowledge to conduct rational analysis of market trends, possess a clearer understanding of market risks, and have psychological expectations regarding market fluctuations. By contrast, users in other professions may have a weaker understanding of the market and may not be mentally prepared for price fluctuations, and thus lower loss limits are more suitable for them. Moreover, investors with different income levels have varying risk tolerance levels. For users in different income brackets, the tolerance for losses increases in descending order. As higher-income individuals have greater ability to absorb market losses, wealthier individuals may tolerate a loss limit of 30%, while those with moderate incomes may accept 15%, and those with lower incomes may only be able to tackle 10% loss limit.

From the perspective of investment patterns, the capital contract integrates and analyzes investors' investment behaviors collected from the Futures Trading Access Contract (section 3.1). Users who trade infrequently and tend to hold financial derivatives for longer periods are less sensitive to market fluctuations and more patient. However, investors who engage in frequent short-term trading are more sensitive to market trends and they typically set shorter profit cycles. Therefore, the former's loss limit should naturally be lower than the latter's. Additionally, personal risk aversion levels assessed in the Risk Aversion Contract (section 3.2) also provide important information. When other conditions are roughly similar, investors' attitudes towards market fluctuations, namely risk aversion, are taken into consideration. For example, among investors with similar income levels and professions who tend to hold financial derivatives for longer periods, risk-takers assessed as aggressive investors in the risk aversion contract (section 3.2) may have a lower position closing threshold (for example, 40%) compared to risk-averse conservative investors (10%), as risk-takers have a higher tolerance for risk, while balanced investors are in the middle.

An additional factor to consider is the user's trading tenure. The longer the users trading tenure, the greater their understanding of the market and acceptance of risks associated with high-risk, high-reward trading patterns and price fluctuations. Therefore, for users with different trading tenures, the position closing threshold is staggered. Investors with trading period of less than 3 years have the highest threshold, followed by a decrease for those with trading tenures of 3 to 5 years, a moderate threshold for those with trading tenures of 5 to 10 years, and the lowest threshold for those with trading tenures of over 10 years.

This paper focuses on futures trading with a delivery period of one year. Although there are futures with longer delivery periods in the market, due to the broader time span and more complex factors involved, such as fluctuations in currency purchasing power and policy changes, these futures contracts have not been considered in this paper.

However, the aforementioned position closing thresholds are merely illustrative examples and not rigid standards. When constructing smart contracts, certain algorithms should be adopted to comprehensively consider factors such as those mentioned above, tailoring a position closing threshold based on users' personal data and preferences, to be used as a reference for decision-making.

The safety net contract, by customizing the maximum tolerable loss limit for individuals, can maintain market vitality while cushioning the losses of investors with low risk tolerance within a reasonable range. It also allows aggressive investors who can bear their own losses to trade in futures markets without worry, furtherly promoting the healthy and orderly development of futures markets, and avoiding more complex situations such as investor bankruptcy or default, thereby reducing trading disputes.

4. Conclusion

Through futures trading access, risk aversion assessment and safety net protection that is close out contract, this paper provides a detailed analysis of the design of smart contracts in these three aspects. Aiming at enhancing market security and reliability, this article provides tailored protection for participants, from collecting detailed personal information, calculating different risk tolerance levels, finally obtaining a loss limit as safety net, by adopting smart contracts to automatically close positions when investors are suffering from huge loss, and enables individuals to engage in futures trading optimistically.

With the development of blockchain technology, the use of it should be furtherly expanded in the financial field. Facilitated by smart contracts, proactive approaches to enhance market stability and to reduce trading risks can be conducted. By making use of blockchain technology’s properties of transparency and automation, more contracts can be established to promote trust for individualised risk assesssment and other automatic execution of management measures. This will definitely contributes to a more robust and stable futures trading ecosystem, enabling regulators and market participants to help to uphold market integrity, fostering a healthy trading environment.

This paper concentrates on those futures with a delivery period of only one year, and futures with longer delivery periods (such as three years, five years or more) in the market has been cut off from consideration. This is because the existence of complex factors including broader time span, fluctuations in currency purchasing power and policy changes will bring much more complicated results which are hard to tackle. However, it is necessary and significant to carry analysis about futures trading under compound situations with those factors, for this kind of analysis will provide profound practical use engaged in real life trading. Therefore, a more comprehensive study taking into account those factors mentioned above might overcome the shortcomings of the study in this paper.

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