

1. Когда в исследуемую экономическую модель входят внешние участники, не преследующие тех же интересов, что и исследователь. Например, при планировании торговли с зарубежными странами важно учитывать действия зарубежных стран; во многих случаях невозможно предсказать, какими будут такие действия.

2. Неуказанные факторы также могут возникать из-за того, что явление или некоторые переменные недостаточно изучены. Пример - погода. Такую неопределенность также называют естественной неопределенностью.

3. Когда параметры недостаточно известны, мера дохода также может быть связана с параметрами функции $C(x,y)$.

В задачах, рассматриваемых в данной работе, факторы, характеризующие систему, предполагаются случайными. Такие задачи также называют задачами со стохастическими параметрами.

Во многих реальных задачах со стохастическими параметрами интересующие параметры не могут быть рассчитаны аналитически. В таких случаях интересующие характеристики оцениваются с использованием метода Монте-Карло путем проведения независимых испытаний и усреднения результатов этих испытаний.

Как упоминалось выше, стохастические задачи параметров обычно используются для анализа повторяющихся явлений. Поэтому при анализе и заключении таких проблем обычно предлагается решение, оптимальное в среднем по многим итерациям.

В стохастической задаче с параметрами предполагается, что функция распределения факторов y является известной случайной величиной. В то же время мера возврата $C(x,y)$ также является случайной величиной и закон ее распределения зависит от управляющей переменной x . Таким образом, задачу оптимизации стохастической системы можно сформулировать в следующем виде (для простоты пусть X — независимый параметр y):

$$\max_{x \in X} E[C(x, y)]$$

нам нужно найти точку x^* , которая дает значение, т.е.

Здесь E обозначает математическое ожидание. Полученные рабочие коэффициенты посвящены методам анализа случайных задач. Работа состоит из трех частей, первая часть посвящена системам государственных услуг, которые более актуальны в реальных задачах случайных факторов, а вторая часть посвящена моделям управления резервами. В третьей части представлены основы моделирования методом Монте-Карло системы обслуживания автомобилей, которая является одной из систем обслуживания населения, и примеры, решаемые компьютером. В данном примере мы рассмотрели простейший случай: поступающие запросы формируют пуассоновскую последовательность, время обслуживания распределено по экспоненциальному закону, имеется только одно обслуживающее устройство. В реальных системах КТО ситуация усложняется, и во многих случаях интересующие характеристики, как указано выше, не могут быть рассчитаны аналитически. В таких случаях интересующие характеристики оцениваются с использованием метода Монте-Карло путем проведения независимых испытаний и усреднения результатов этих испытаний.

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FEATURES OF THE APPLICATION OF BLOCKCHAIN TECHNOLOGY IN THE FUNCTIONING OF THE BANKING SECTOR

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Abstract: *Since the advent of blockchain in 2008, this technology has become one of the hottest topics in FinTech research and has gradually made its way into the global banking industry. Commercial banks in many countries have already begun to use blockchain in three main aspects of the payment and settlement business, the asset business and the intermediary business. The current application of blockchain in banks is mainly aimed at creating platforms and systems to improve the efficiency of transactions and information processing. Although blockchain faces risks when applied by commercial banks, in the future, commercial banks may apply blockchain technology in many aspects, such as inter-bank blockchain alliances, internal and external cooperation, multi-service blockchains, and digital currencies.*

Key words: *Blockchain, bank, application, characteristics.*

Introduction. In recent years, blockchain has sparked a wave of technology development around the world. The application of blockchain technology has been extended to many areas such as digital finance, the Internet of Things, smart manufacturing, supply chain management, and digital asset transactions. Blockchain contains two concepts of technology and finance. The blockchain economy, a new type of financial cooperation, refers to the integration of traditional financial

institutions and Internet companies, between banks and third-party payment platforms, and between consumers and businesses through information sharing and trust building. From a technical point of view, it is a distributed database that sacrifices consistency efficiency and guarantees eventual consistency; From an economic point of view, since blockchains are distributed, decentralized and invariant, this means that the nodes are distributed over several computers, creating a network where everyone has access to the same information, while the system cannot be hacked by anyone. Such characteristics and properties of the network help to prevent foreign financial fraud, cross-border illegal transfinancing and the high cost of non-instant cross-border transactions. In addition, the system is secure, eliminating the possibility of tampering, and ensures that any changes to records or data can be immediately disclosed - Cheap and reliable business and financial environment .

The subject of the consideration undertaken by the author of the article is the possibility of using blockchain in the banking sector, related researchers have made some suggestions, but there is still room for discussion of these results. This article will analyze the development of blockchain and discuss the application of blockchain business in commercial banks in different countries, as well as consider the future prospects for the development of commercial banks in the field of blockchain.

Analysis of the ways of development of blockchain technology, expanding the capabilities of commercial banks

New credit mechanism. The characteristics are: First, the reliability of the information is high, and the anti-tamper function can ensure that the reliability of transaction information is higher than that of the big data risk management model. Secondly, the cost of providing credit is low, and decentralization forces banks to no longer rely on intermediaries such as credit reporting companies, but simply transfer the relevant data on the blockchain. Thirdly, information is open and transparent, blockchain technology, relying on software algorithms for recording and storing huge amounts of data, can be open and transparent in the process of information transfer.[1]

New supply chain financing. Supply chain financing refers to the fact that banks focus on the main enterprises in the supply chain, obtain information about the capital and goods flows of upstream and downstream enterprises in the supply chain, and transform the uncontrolled risk of an individual enterprise into a controlled risk of the entire supply chain system through chain integration . In addition, banks can provide low-cost and low-risk financial services by obtaining various information in the supply chain, and make information between banks and enterprises symmetrical along the supply chain, reduce the cost of mutual trust between banks and enterprises, and reduce credit risk. banks. From a traditional perspective, where banks, factoring institutions, and regulators provide financial services to businesses, data is difficult to obtain. To assess the creditworthiness of an enterprise, it is necessary to collect relevant data from an enterprise that conducts transactions with other business entities. This cost of data validation and consistency by the financial institution is extremely high, which increases the cost of providing credit to the financial institution and increases the difficulty of financing the enterprise. Blockchain technology has a flexible architecture that can create a relatively independent chain with a short path according to different application scenarios, user needs, customer structure and capital transaction process, and promote the integration of finance and the real economy into the scenario.

New payment method. Payment, clearing and settlement are relatively mature areas of blockchain technology in banks at this stage, especially cross-border payment settlement and interbank liquidation. Blockchain technology allows connected businesses to significantly improve the efficiency of business processes and reduce communication between financial institutions. Secondly, after the use of blockchain technology, the third party is not required to participate in the process of payment, clearing and settlement, and point-to-point settlement of value can be realized, thereby reducing the value transfer cost (P2P , credit model) and shortening the liquidation and settlement time.[4]

New operating logic. Blockchain technology can anchor transaction rules and underlying systems in the underlying protocol, realize the standardization and automation of financial infrastructure, and better solve the problem of trust between banks, customers and third-party partners by optimizing the entire business chain as needed, as well as pain points in transactions in the past .

The advantages of blockchain are multilateral cooperation, transaction traceability, high degree of information sharing, so in public services such as trade finance and other places where it is difficult to form a multilateral trust mechanism, the multilateral joint construction system can break down the information barrier and solve the problem of multilateral trust and cooperation. on a larger scale.[2]

In general, the foreign banking industry has a positive attitude towards blockchain technology. Whether there is a “coin” application or not, banks are also focusing on using blockchain technology to streamline the traditional banking business and eliminate current existing problems.

Problems, challenges and countermeasures

Blockchain banking challenges:

High implementation cost. Blockchain is more expensive compared to a traditional bank. In addition, banks need proper planning and execution to integrate blockchain into the process, especially for large banks, the costs are mainly related to staff training, purchase of new equipment and staff development, which will lead to instability of banks towards customers for a certain period of time .

Current transaction speed and performance. Blockchain-based banks are significantly slower than traditional banks because blockchain technology executes more transactions. First, it performs signature verification, including the cryptographic signature of transactions. Blockchain also relies on a consensus mechanism to validate transactions such as proof of funds or proof of work, resulting in low transaction throughput. Finally, there is redundancy where the network requires each node to play a critical role in verifying and storing each transaction, but as technology advances, this shortcoming will be gradually overcome.[5]

irreversibility of transactions. Blockchain technology does not allow data to be easily changed after it has been written, which means that for banks, if a transaction error occurs during a transaction due to an incorrect recipient, it will be very difficult to recover this amount, and the associated costs during the recovery process will also be very high.

The development of blockchain technology and its application in the financial industry is in its infancy. Although blockchain technology has received a lot of attention, its development is still immature. First, blockchain technology itself is still in its early stages of development, and there is still room for improvement in terms of computational performance, resource usage, algorithm flexibility, and position calculation. Second, as the legislature establishes and clarifies the relevant legal regulations (such as the amount of transactions, the movement of declared funds, the authority that issued the tax return, etc.), the government will take the lead in creating an appropriate system of banking supervision. For the bank's new blockchain transaction system, to some extent, when the relevant legal regulation has been clarified and an appropriate banking supervision system will be established, which will alleviate inconveniences such as overseas financial fraud, cross-border illegal transfinancing and the high cost of non-instant cross-border transactions (fee costs, service costs, time costs). Thirdly, the application of blockchain by financial institutions themselves is also uneven. Most of them have low subjective readiness. At the same time, they need to invest a lot of money and personnel to change the existing IT system architecture and change business processes.

Building a blockchain ecosystem in the banking sector. Small and medium-sized banks are having difficulty extending loans, investing debt, and replenishing capital. This is the best of both sides of banks in building a blockchain ecosystem led by large banks, because large banks have "business gaps" that can be filled by small and medium banks, and large banks can invest in small and medium banks. Easier to finance small and medium banks. Lending and debt investments by small and medium-sized banks often fail or even incur losses due to investment defaults, bond investment defaults, and low investment interest rates. The blockchain ecosystem can avoid defaults the most thanks to the existence of shared registries. On the other hand, large banks, which have a strong capital chain and better ability to withstand risks, as well as small and medium-sized banks, which are easier to implement reforms and use reliable financial data and experience of large banks, such as interest rate adjustments on loans, monetary policy and financial risk assessment of large banks will complement each other and voluntarily participate in the joint promotion of ecosystem development.

Banks need to consider whether the new technology complies with regulatory policy, invest a large amount of funds and personnel, and transform the bank's infrastructure, whether it can bring obvious economic benefits to the bank. In addition, it is also necessary for banks to consider how the blockchain can be integrated with the source systems and business of the bank, as well as how to migrate and adjust the source business.[5]

Entrepreneurs looking to raise capital have traditionally turned to outside financiers such as angel investors, venture capitalists, or bankers. This can be a very complex and painstaking process, requiring lengthy negotiations about valuations, spinoffs, corporate strategies and more. Initial Coin Offerings (ICOs) and Initial Exchange Offerings (IEOs) offer new projects the opportunity to raise capital without the need for banks and other financial institutions. With the support of the blockchain, companies can sell tokens through ICO in exchange for funds, and the tokens will bring profit to investors. In the traditional model, banks typically charge hefty fees to secure business securitizations and initial public offerings (IPOs), but blockchain technology can eliminate these fees.

Buying and selling securities and other assets such as stocks, bonds, commodities, currencies and derivatives requires complex coordination between bank brokers, clearing houses and stock exchanges. The process must be not only efficient, but also accurate. As the complexity continues to grow, so does the associated time and cost. Blockchain technology simplifies this process by providing a technological base layer that makes it easy to tokenize all types of assets. Most financial assets are bought and sold digitally online by traders, so tokenizing them on the blockchain seems to be a more convenient solution for all participants.

Summing up, it can be said that there is a general tendency for banks to integrate the application of blockchain technology into various types of banking activities. Commercial banks should prepare technical reserves and responses in advance, formulate active development strategies, conduct good technical practice and business planning, and look for opportunities in future competition.

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