

## Research Article

# Analysis of Computer-Based Blockchain Technology in Cross-Border E-commerce Platforms

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Under the background of economic globalization and the rapid development of computer technology in the global coverage of the Internet, the integration of the world economy has been strengthened, and the continuous innovation of technology and foreign trade formats has promoted the rapid development of e-commerce, but there are also small e-commerce entities, weak high trade trust cost, high logistics payment cost, long cycle time, and adjustments caused by data flow. The decentralization, information sharing, irreversibility, and smart contract technology of computer blockchain can change the business model of traditional industries and promote business and social change. Based on the current trend of e-commerce development, this thesis analyzes the problems in the development of e-commerce, discusses the innovation of e-commerce business models, constructs the framework of e-commerce, and gives the issues of trust, customs supervision, payment and other issues. *Solution.* The logistics and data flow encountered in e-commerce using computer blockchain technology has low emissivity of information, high cost of data format conversion, and it is not easy to form a consensus.

## 1. Introduction

Against background of economic globalization and gradual spread of Internet coverage worldwide, foreign trade is changing from “trade diversification” to “global buying, global selling, global payment, and global transportation,” and main body of trade is changing from traditional trade enterprises to small and medium-sized enterprises and individuals. The trade form is changing from traditional offline trade to e-commerce; transaction characteristics are changing from “large in and large out, low frequency” to “small volume, high frequency”; trade supply chain is changing from nonpersonalized, large volume to personalized, fragmented, flexible supply chain to meet customer needs [1–3].

In recent years, the e-commerce transaction scale has maintained a high growth rate of more than 20% per year, and growth rate has far exceeded that of traditional trade (traditional foreign trade growth rate of 7.8%); according to latest statistics released by customs in 2021, total import and export of e-commerce in China increased by 31.1% in case of

epidemic in 2020 [4–7]. China’s e-commerce industry has shown vigorous development of vitality but also exposed some problems encountered in development: (1) e-commerce relies on third-party platforms and lack of information sharing between platforms, resulting in information silos; (2) the e-commerce supply chain is long and complex, authenticity of origin of goods and its own quality is difficult to ensure, credit information of merchants is difficult to pass e-commerce financing difficulties; (3) e-commerce logistics are complicated, including domestic transportation, customs clearance, international transportation, and overseas transportation, resulting in difficulties in logistics management and long logistics time, and in addition, tracking of goods is not timely and poor consumer experience; (4) payment costs are high and faces risk of security and exchange rate changes, which damage interests of e-commerce; and (5) e-commerce countries have different customs trade legal norms and data, and the legal norms of flow regulation bring great challenges to compliance of trade.

In addition, e-commerce transactions involve a large number of documentary information, and such information

needs to be shared between multilateral trade and also needs to be submitted to regulatory authorities, and current trade information is scattered in their own independent system and lack of transparency of information although countries have designated their own EDI data exchange format standards, but speed of transmission of information is low, and data format conversion costs and are not easy to form a consensus.

## 2. Related Work

In recent years, domestic and foreign journals and papers published in last two years have gradually increased number of blockchain-based e-commerce, and their research areas mostly focused on e-commerce logistics, solving trust issues in e-commerce, payment, and legal and regulatory proposals.

Malby studied [8] the business model based on blockchain and its regulation and concluded that blockchain can bring continuous innovation to business models under regulation; Olatunji [9] explored revolutionary changes brought by blockchain to traditional industries; Reddy [10] studied logistics and distance effects of e-commerce in EU market, and logistics affects development; Ezuwore-Oboedokwe [11] studied problem of logistics path optimization in context of epidemic; Yao et al. [12] studied the prospect of blockchain application in supply chain and its commercial value are studied. Allen et al. [13] discussed in detail problems encountered in payment and proposed solution of settlement by DECP, LIBRA, etc.; Balamurugan et al. [14] discussed application of blockchain in supply chain in field of customs compliance and analyzed advantages of using blockchain with projects that have been carried out at home and abroad and gave suggestions on information collaboration and cooperation between government and enterprises; Brynjolfsson et al. [15] took e-commerce between China and Europe as a object of research and proposed application of blockchain in supply chain. Hart et al. [16] proposed the use of blockchain as underlying technology to build a business ecosystem for goods supervision and trade tracking; Mishra et al. [17] studied the use of blockchain to solve crisis of e-commerce and proposed the solution of using blockchain; Bergamaschi et al. [18] conducted an in-depth study on blockchain in the whole monitoring of logistics storage and transportation and proposed the concept of commodity tide source.

The above studies by scholars at home and abroad on blockchain-based e-commerce focus on business impact, policy and regulation, or on an individual business of e-commerce, but research on the business model and overall framework of blockchain-based e-commerce is scarce and insufficient. Based on the previous research results, this thesis investigates the use of computer blockchain technology to build a e-commerce system, change business model of e-commerce, and solve problems in e-commerce.

## 3. E-commerce Architecture

Government enterprises use face-to-face “e-commerce public service platform”; the platform is on the one hand for

government departments to build information sharing platform, and on the other hand, it is to serve e-commerce enterprises [19]. The platform is currently built by local governments, and the country has not yet formed a unified standard for the platform inspection and quarantine, tax refunds, payment and settlement, enterprise records, and data statistics, which involves national quarantine, Bureau of Taxation, Foreign Trade Administration, foreign trade and banking and other departments and institutions, and need for cooperation and docking services. At present, Hangzhou’s “single window” has service for platform’s representative model, “single window” has two functions of government services and comprehensive services, including B2B import and export filing and declaration, B2C import and export business declaration, and tax rebate declaration management [20]. The platform has six major system layouts, namely, information sharing, financial services, intelligent logistics, e-commerce credit, statistical testing and risk prevention and control system; the main task is to establish a new regulatory service model for e-commerce based on information, with trust as core, supported by technology, to achieve convenient, free, and standardized development of e-commerce. Its system structure is shown in Figure 1.

Compared with domestic e-commerce logistics, business of e-commerce logistics is more complicated, and e-commerce logistics involves customs, inspection and quarantine, taxation, foreign exchange and cargo transportation, etc. There are also differences in logistics between B2B and B2C modes of e-commerce, and timeliness and cost of different logistics methods vary greatly. This section examines characteristics of different logistics methods under different e-commerce models and aims to find suitable point for using blockchain technology to solve logistics business. Figure 2 shows basic process of e-commerce logistics.

According to the current customs regulations, eligible e-commerce companies or platforms need to be connected to customs network; after purchases by overseas individual consumers, platform needs to transmit electronic orders, payment vouchers, and waybills to customs through customs public standard interface and then submit a declaration list to customs, and finally, goods are shipped out of country in form of postal parcels or express mail, and customs clearance list is then periodically put together to form an export declaration list, with which the e-commerce company will go through clearance and tax refund procedures. The customs clearance list is then periodically aggregated to form export declarations, and e-commerce companies rely on documents for clearance and tax refund procedures. E-commerce pilot area adopts the “simplified declaration, checklist release, summary statistics” approach to customs clearance, while others still use the “checklist release, summary declaration” approach to customs clearance. Figure 3 depicts “general export” customs clearance methods.

“Special area exports (bonded exports)” customs clearance, according to current customs regulations, eligible for e-commerce platform needs to be networked with customs, and e-commerce enterprises need to declare whole batch of

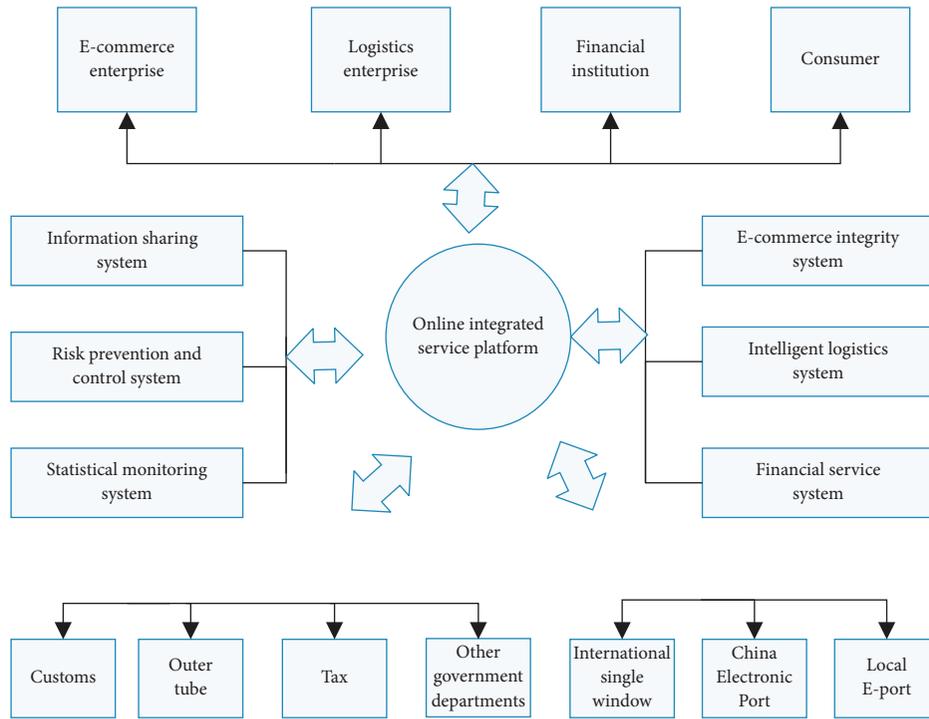


FIGURE 1: Architecture of cross border e-commerce comprehensive test area.

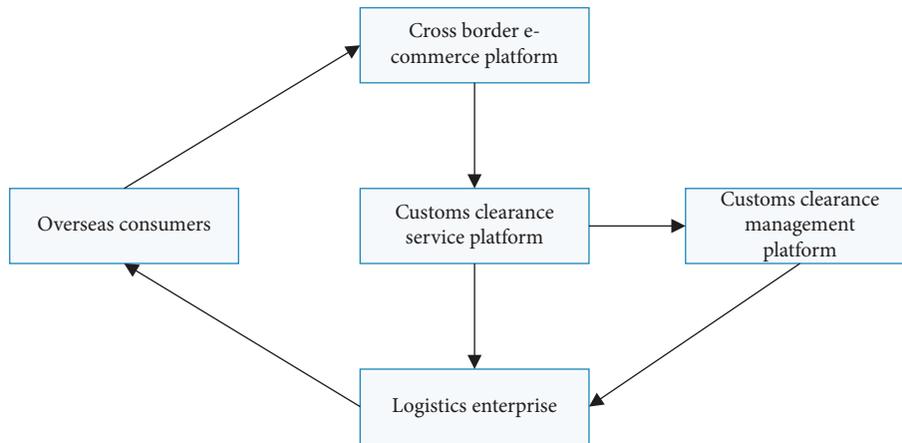


FIGURE 2: The basic process of e-commerce business (sorted through Alibaba International Station of E-commerce).

goods according to general trade and then transported to special customs supervision area enterprise to achieve tax rebates; for goods entering special customs supervision area, after overseas online purchase, customs will check and release goods with list, and after goods leave customs supervision zone, customs will regularly combine released lists to form export declarations and e-commerce enterprises will apply for clearance procedures with this certificate. Figure 4 describes the customs clearance process in bonded area.

There are two types of third-party payment platforms, one is the independent gateway model, such as CaiPay and Fast Money, and the other is third-party payment gateway supported by e-commerce platforms, such as Amazon Pay, Alibaba’s International Alipay and PayPal. Its structure is shown in Figure 5.

The blockchain-based e-commerce model, using decentralization, distributed storage, and antirevision characteristics of blockchain, can be built into a multicollaborative platform, and parties located on the blockchain platform form a community of interest alliance according to their roles and functions and participate in consensus of data on the e-commerce platform and can realize sharing of underlying data so that functional positioning of each participant can be changed, which is conducive to collaboration of multiple parties to maintain and promote orderly development of e-commerce. Figure 6 shows the collaboration mode of e-commerce alliance participants based on blockchain.

After using blockchain, qualification information, user data, supply chain information, and operation data of e-commerce are stored on blockchain, and under the

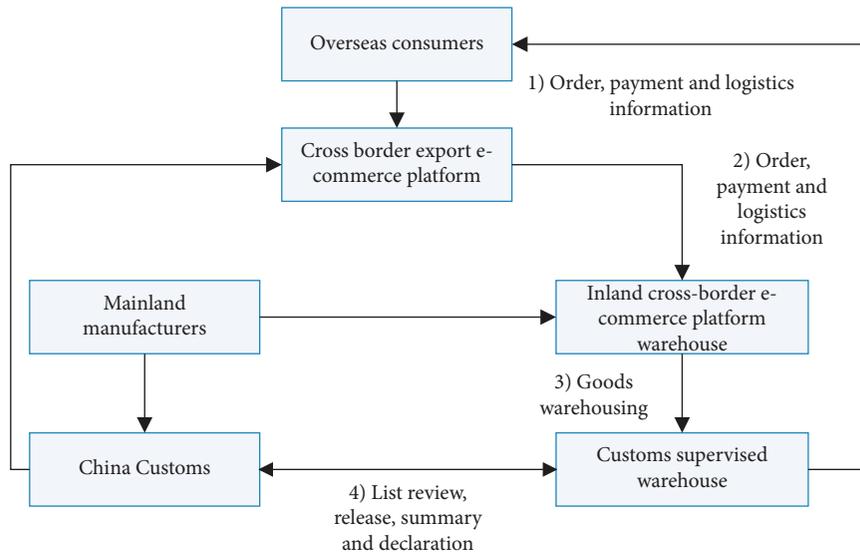


FIGURE 3: “General export” customs clearance mode (sorted out according to customs data).

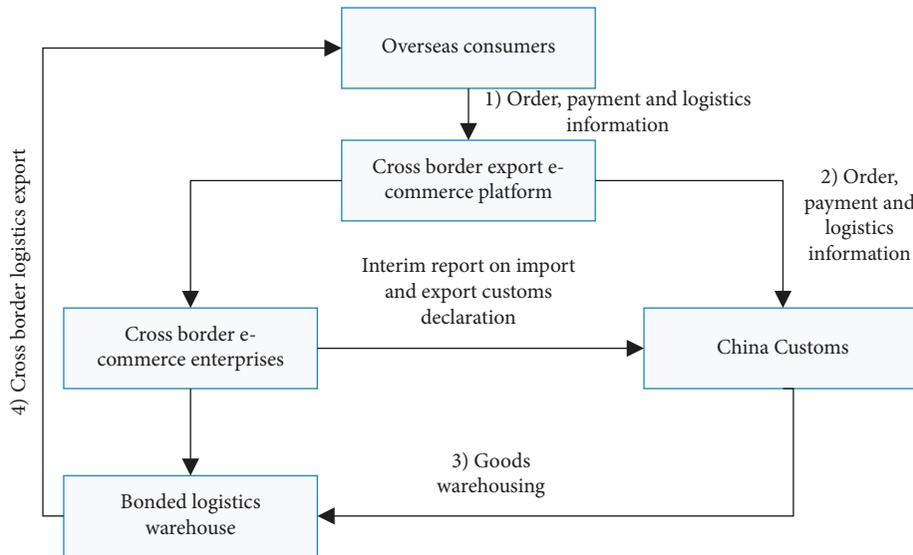


FIGURE 4: Customs clearance mode of “bonded area” (sorted out according to customs documents).

condition of privacy protection, real and effective data can be used to give credit rating to each participant of e-commerce, and rating can be easily queried to outside world, which can protect enterprises operating in good faith and law-abiding consumers, which enhance consumers’ trust in e-commerce, and also combat nonhonest enterprises, ensure interests of honest enterprises and reduce cost of credit acquisition, as shown in Figure 7.

The use of blockchain as underlying logistics database is not only to ensure transparency of logistics data in e-commerce transactions between entities but also to ensure correctness and security of storage data; second, the blockchain database and integrated services platform and customs real-time connection is to achieve real-time customs supervision; third, the use of big data technology and artificial intelligence technology, establishment of intelligent

storage management platform, through smart contracts is to achieve dynamic management of goods; fourth, based on blockchain to create a safe distribution platform and intelligent scheduling procedures to ensure safe and timely delivery of goods, we can monitor the entire process of delivery in real time; fifth, based on blockchain information sharing and passwords to construct intelligent customer service system and evaluation system, consumers can evaluate e-commerce; on the one hand, this is to improve consumer satisfaction, and on the other hand, to improve credit evaluation system of entire e-commerce alliance and use passwords as credit guarantee. The details are shown in Figure 8.

E-commerce can use several models in combination to solve problems of payment security, low efficiency, and high cost, on top of which information flow and capital flow will

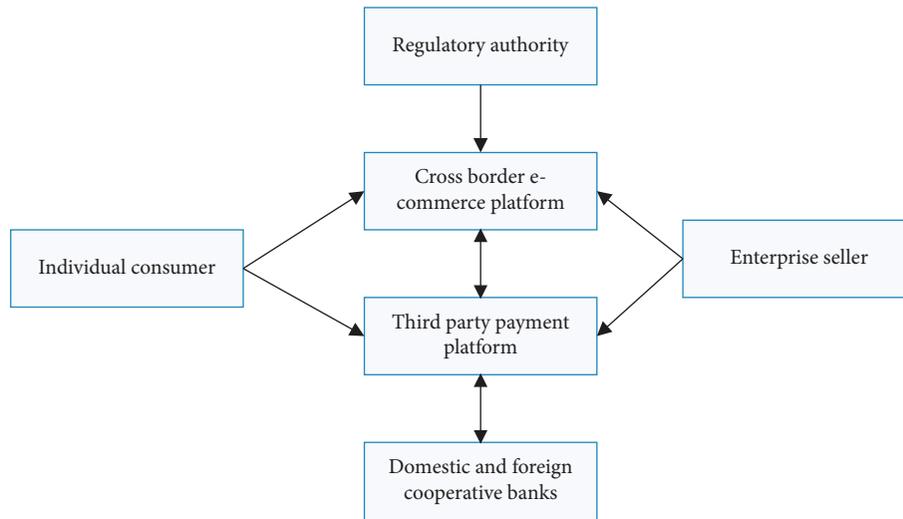


FIGURE 5: Cross border e-commerce B2C payment system.

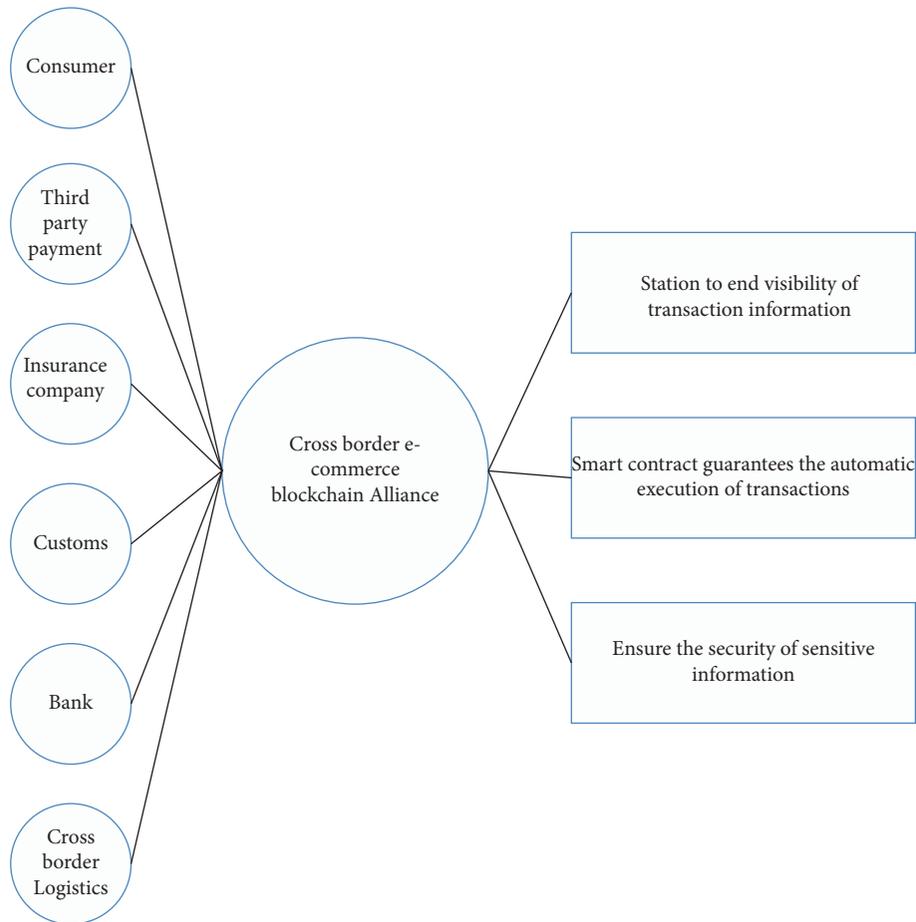


FIGURE 6: The collaboration mode of cross border e-commerce alliance participants based on blockchain.

be unified on top of blockchain, which also solves the problem of nonuniform transaction data format, as shown in Figure 9.

From the technical dimension of blockchain, it is an integrated innovation of various technologies to achieve a trustworthy technology platform for information and value

transfer, and its core technologies include asymmetric encryption, peer-to-peer communication network, and consensus algorithm. From the viewpoint of business that can be achieved by blockchain, blockchain realizes multiparty participation and joint maintenance and uses cryptography to ensure security of data transmission and access, A typical

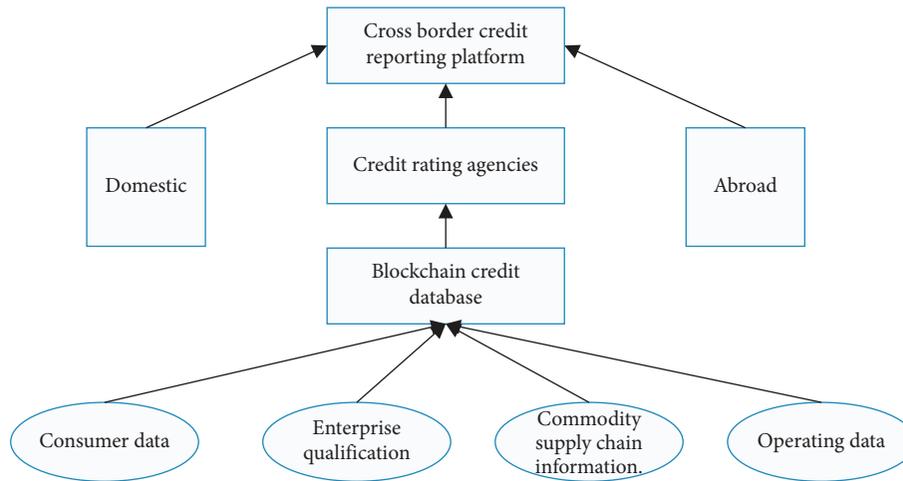


FIGURE 7: Blockchain-based credit reporting platform.

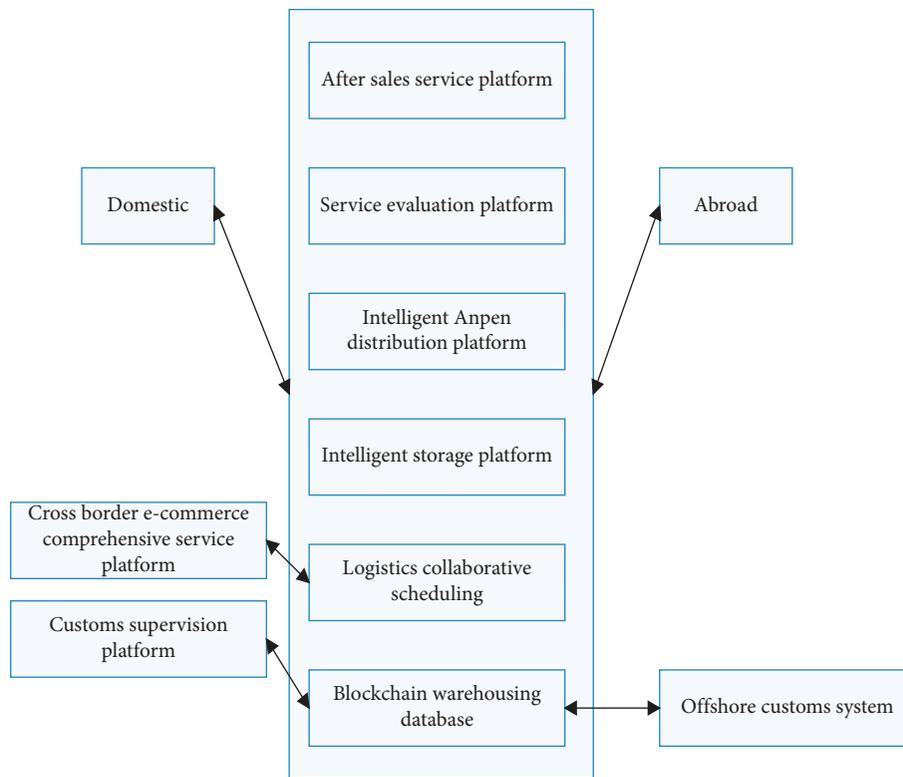


FIGURE 8: Blockchain-based logistics solutions.

blockchain data storage structure is in the form of a blockchain. Figure 10 and 11 show the blockchain structure and collection of technologies used according to Satoshi Nakamoto’s paper “Bitcoin: A Peer-to-Peer Electronic Currency System.”

**4. BP Neural Network Algorithm**

The BP neural network algorithm is combined with the genetic algorithm, and the genetic algorithm is used as an auxiliary and then connection weights between layers of neural network are optimized. Establish the mathematical

model of e-commerce logistics risk evaluation based on genetic neural network.

- (1) Clarify objective function:

According to the definite structure of neural network, the number of hidden layer neurons and input layer neurons is  $s$  and  $m$ ,  $n$  is number of output layer neurons, and  $w_i$  is connection weight between the input layer and the hidden layer.  $\theta_i$  is fitness function of each sample individual, and  $N_g$  represents dimension of weight threshold vector. The connection threshold and weight of neurons between layers are

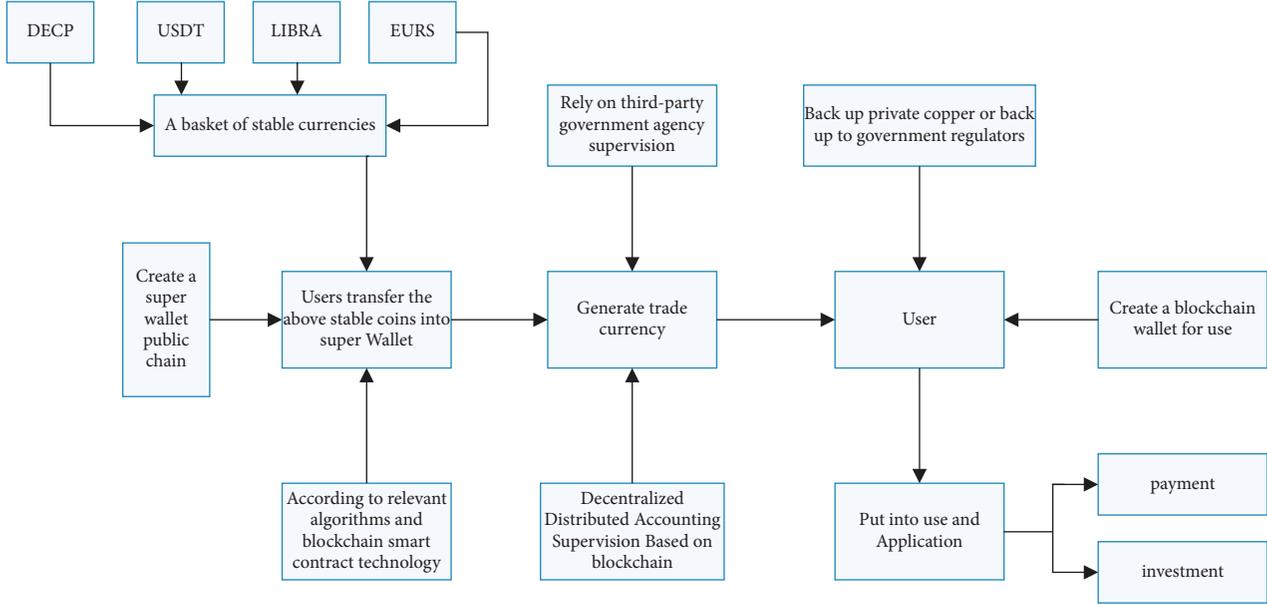


FIGURE 9: Modes supporting multiple stable digital currencies.

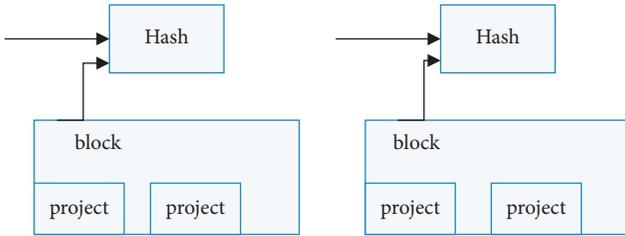


FIGURE 10: Blockchain data structure.

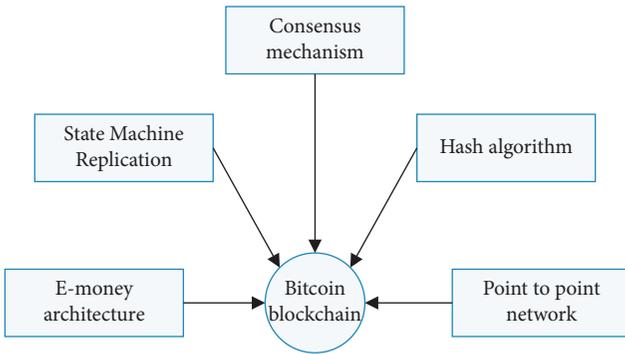


FIGURE 11: Technologies used in bitcoin and blockchain.

represented by vector  $x$ , then  $x$  is called the weight threshold vector, which is expressed as

$$X = \{x_1, x_1, \dots, x_{N_1}\}^T = \{w_1, w_2, \dots, w_{N_2}, \theta_1, \theta_2, \dots, \theta_{N_3}\},$$

$$\{N_1 = M^*S + S^*M,$$

$$\{N_2 = M + S,$$

$$\{N_3 = N_1 + N_2 = M^*S + S^*M + M + S.$$

(1)

- (2) The samples are preoptimized by the genetic algorithm.  $C$  is the coding method for individual selection of samples,  $e$  is the evaluation function of individual fitness of samples,  $P$  is the initial population selected in the sample group, and  $M$  is the population number (including number of individuals,  $\Phi$ ). The genetic algorithm submodel (GAM) is composed of selection operator,  $R$  crossover operator, and horizontal mutation operator:

$$GAM = (C, E, P, M, \Phi, \Gamma, \Psi, T). \quad (2)$$

- (3) The fitness function first calculates the error function in the BP neural network:

$$E = \frac{1}{2} \sum_{k=1}^p (d_k^p - o_k^p)^2, \quad (3)$$

where  $p$  is number of samples,  $o_k$  is output vector of output layer, and  $d_k$  is desired output vector.

The genetic algorithm only plays an auxiliary optimization role in the whole model, that is, finding a set of threshold vectors that minimize error value, so the objective function of genetic algorithm is

$$E_{\min} = \frac{1}{2} \sum_{x=1}^p (d_k^p - o_k^p)^2. \quad (4)$$

Fitness function  $f$  is given as

$$F = \frac{1}{E}. \quad (5)$$

Based on above calculation formulas and meanings, the risk assessment model of e-commerce logistics based on genetic neural network is as follows:

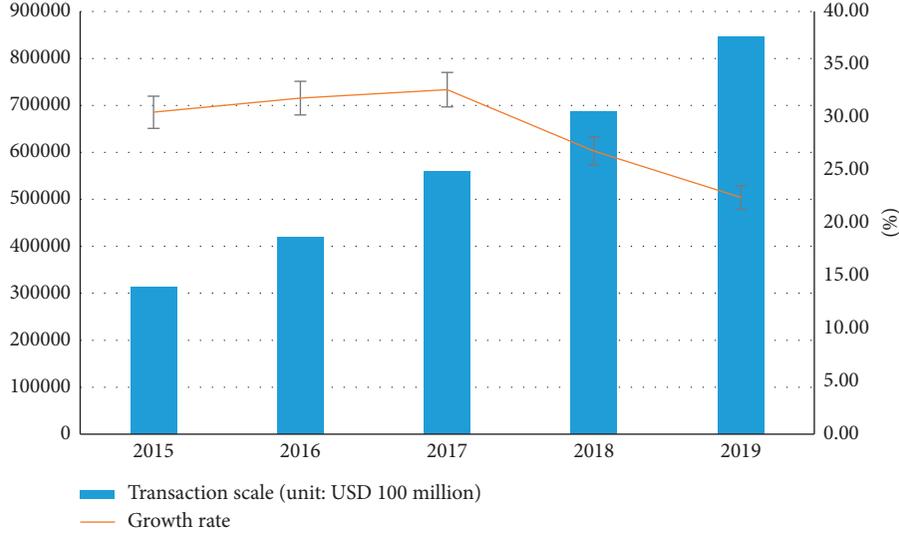


FIGURE 12: Global B2C transaction scale in 2015–2019.

$$\text{GAM} = (C, E, P, M, \Phi, \Gamma, \Psi, T),$$

$$\begin{aligned} X &= \{x_1, x_1, \dots, x_{N_1}\}^T \\ &= \{w_1, w_2, \dots, w_{N_2}, \theta_1, \theta_2, \dots, \theta_{N_3}\}, \end{aligned}$$

$$E = \frac{1}{2} \sum_{k=1}^P (d_k^p - o_k^p)^2, \quad (6)$$

$$F = \frac{1}{E},$$

$$N_1 = M * S + S * M,$$

$$N_2 = M + S,$$

$$N_3 = N_1 + N_2 = M * S + S * M + M + S.$$

The total sample set collected is aggregated, and size population with  $M$  sample individuals is randomly generated in the total sample. The principle of the parameter selection algorithm is specified as a random value between 0 and 1 to ensure sensitivity of the BP neural network implementation process. The initial coefficient value selection optimization consists of four parts: broad values of implicit and output layers, connection weights of input and implicit layers, and connection weights of implicit and output layers.

## 5. Results

The global e-commerce industry continues to grow in transaction size. Accenture and Ali Research Institute report released in January 2021 pointed out that in 2020, despite the

impact of epidemic, global e-commerce B2C transaction size can reach 3.4 trillion U.S. dollars. The number of e-commerce participants will grow from 309 million in 2014 to 900 million in 2020, and although logistics will be restricted due to global epidemic in 2020, number of e-commerce participants will grow from 309 million in 2014 to 900 million in 2020 according to “Blue Book on Enterprise Overseas Development: Chinese Enterprises Overseas Development Report (2020).” From the “Development Report (2020),” it is expected that the global e-commerce transaction scale will exceed USD 10,000 billion in 2020, with an average annual growth rate of up to 30% to achieve high growth (see Figure 12).

With development of 5G in 2019, Internet infrastructure is increasingly improved, construction of global logistics network gradually mature, and e-commerce has been in a high growth trend. From the current development situation, according to research results of Foresight Industry Research Institute, it is expected that in the next few years, global e-commerce under the influence of new crown epidemic, in B2C transaction scale, will remain at 10%–20% growth (see Figure 13).

According to Foresight Industry Research Institute, when choosing e-commerce transactions, 24% of consumers use Amazon’s platform, 16% use Global Express (Alibaba’s e-commerce platform), and 14% choose eBay; Amazon is still in the leading position in e-commerce platforms (see Figure 14).

According to data of Aimedia Consulting, consumers in the Middle East region use e-commerce for sea-tao which accounted for 70% of online shopping compared to other regions, and less than 50% of e-commerce consumers is seen in Asia Pacific and North America (see Figure 15).

According to data released by McKinsey and China Electronic Commerce Research Center, China’s e-commerce has grown rapidly in the past few years from 2014 to 2020. With the impact of new crown pneumonia epidemic,

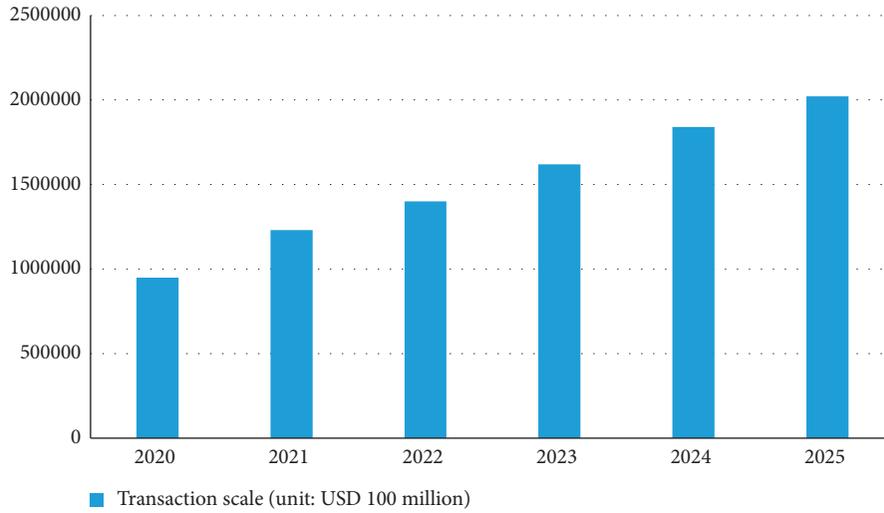


FIGURE 13: Global B2C e-commerce transaction scale forecast from 2020 to 2025.

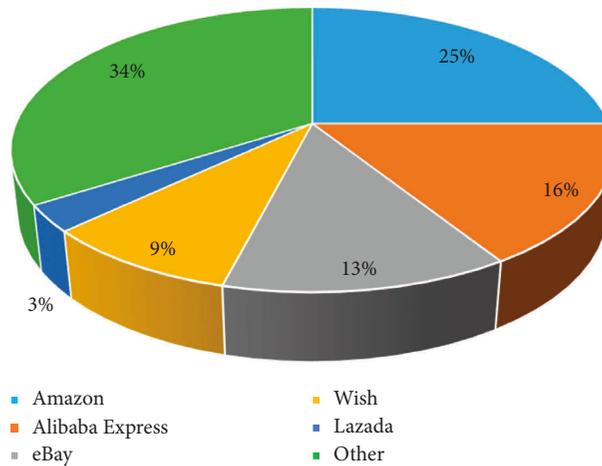


FIGURE 14: Market share of e-commerce platforms.

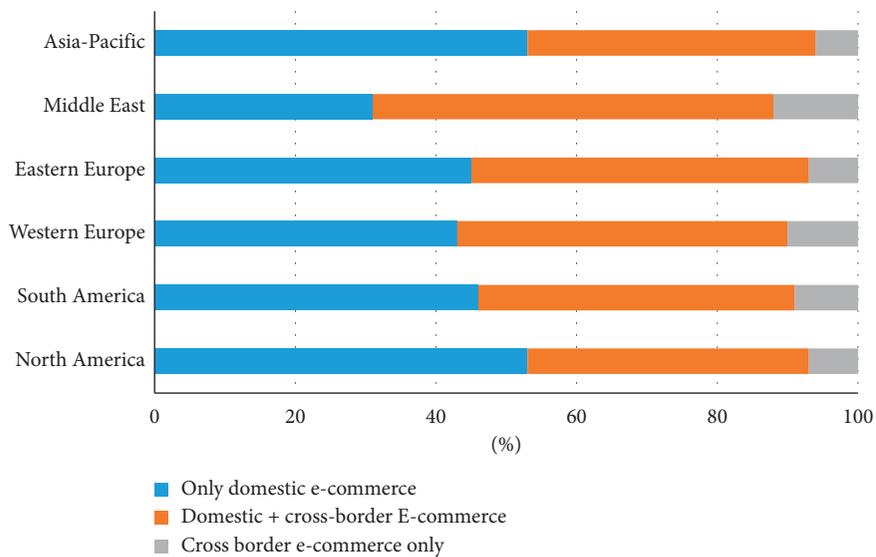


FIGURE 15: Global consumer online shopping platform categories.

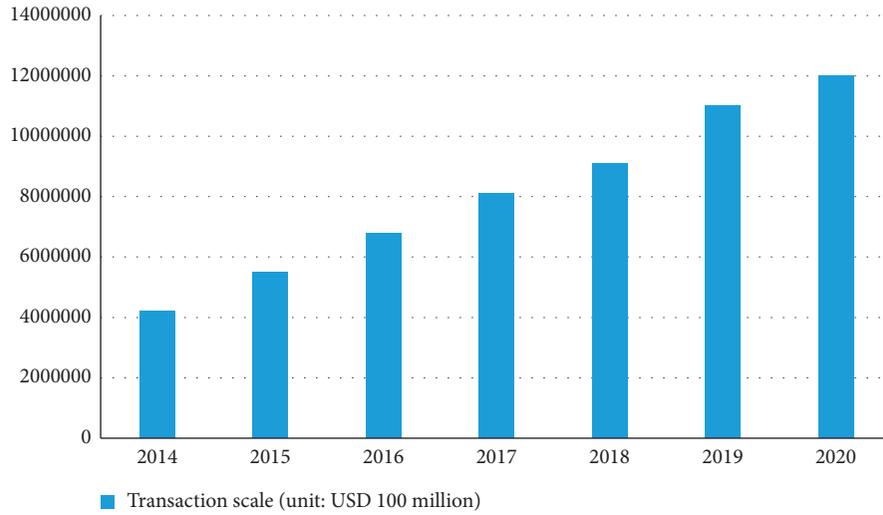


FIGURE 16: Scale of e-commerce transactions in China from 2014 to 2020.

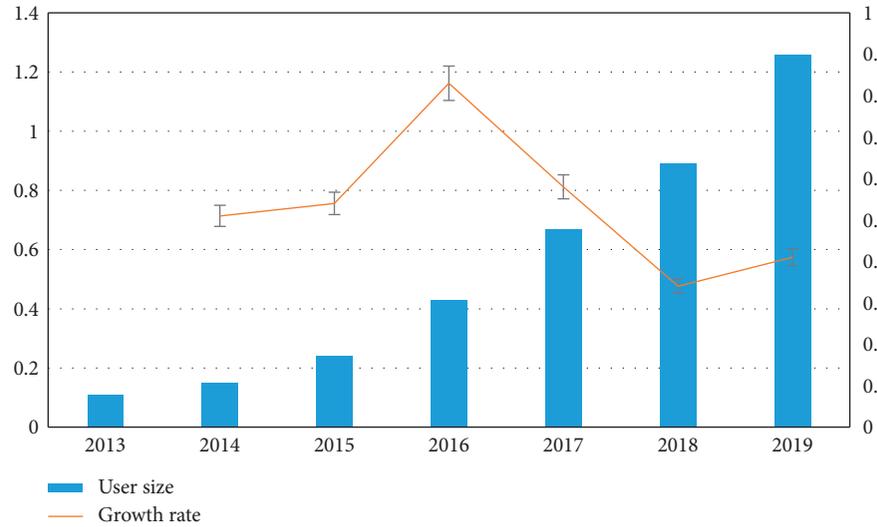


FIGURE 17: Scale and growth rate of China's imported e-commerce users from 2013 to 2019.

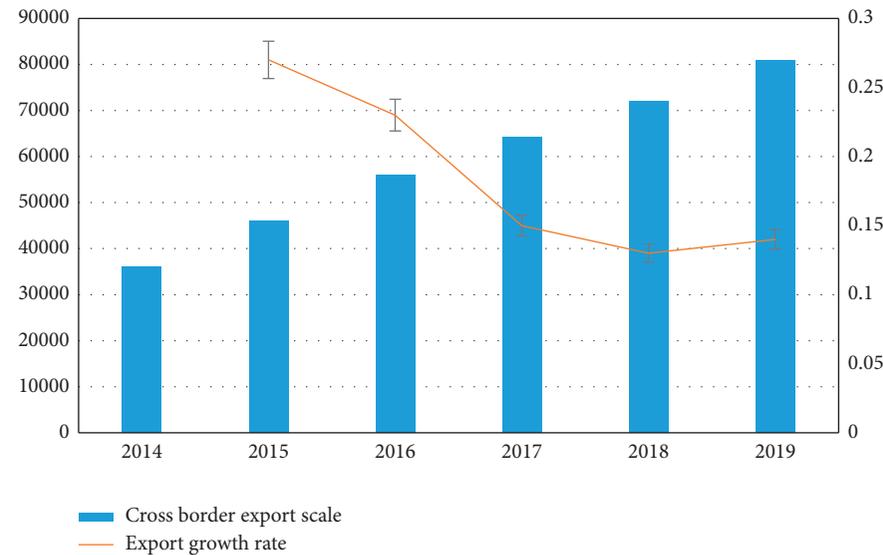


FIGURE 18: Scale and growth rate of China's e-commerce export transactions from 2014 to 2019.

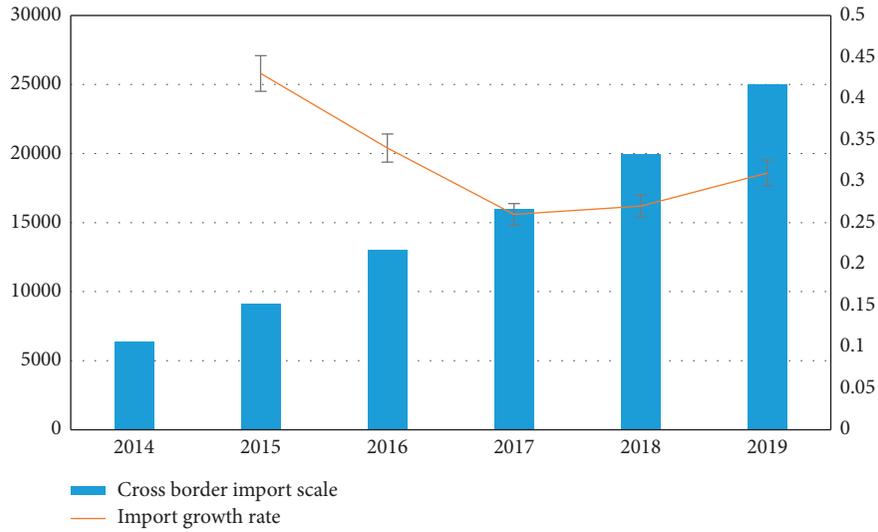


FIGURE 19: Scale and growth rate of China's e-commerce import transactions from 2014 to 2019.

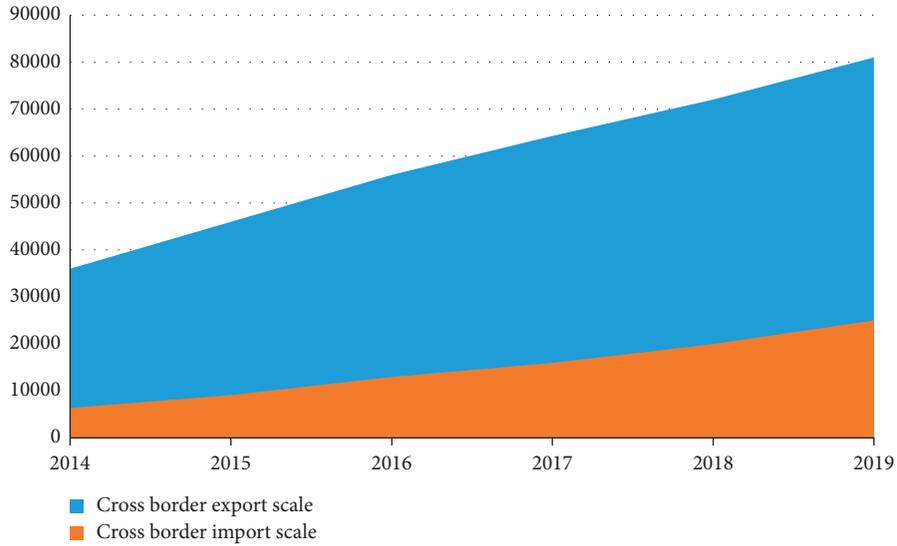


FIGURE 20: Comparison of China's e-commerce export and import scale from 2014 to 2019.

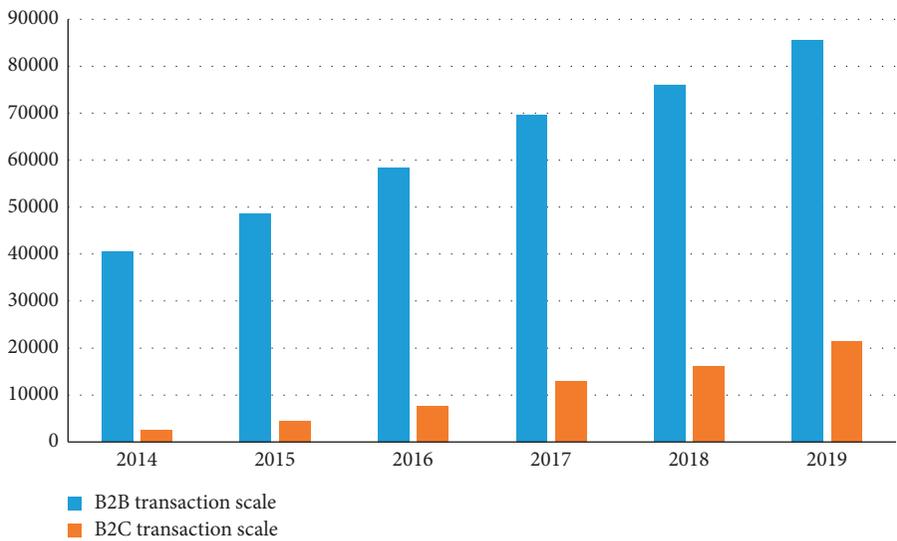


FIGURE 21: Export of China's e-commerce B2B and B2C transaction scale from 2014 to 2019.

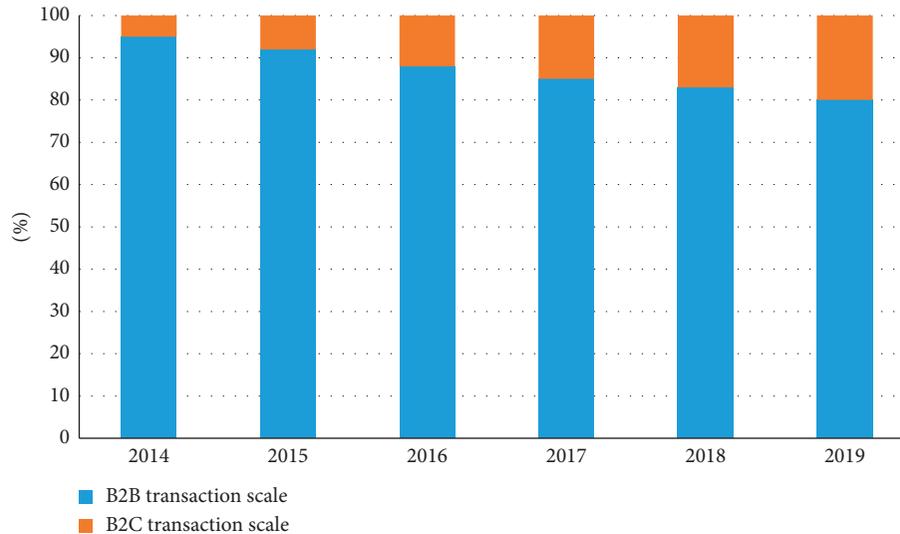


FIGURE 22: Proportion of China's e-commerce B2B and B2C transactions in 2014–2019.

according to China's customs data, China's e-commerce exports were 7.29 trillion, up to 40.1%, and imports were 3.76 trillion, up to 16.5% (see Figure 16).

The total size of imported e-commerce users in China was 125 million in 2019, up to 41.24% in 2018 (88.5 million e-commerce users in 2018), and the following chart shows size and growth rate of number of imported e-commerce users from 2013 to 2019 (see Figure 17).

This paper analyzes data of China's e-commerce imports and exports from 2014 to 2019, and Figure 18 shows scale and growth rate of China's e-commerce exports.

According to data in "2019 China e-commerce Market Data Monitoring Report," scale and growth rate of China's e-commerce imports from 2014 to 2019 are plotted, as shown in Figure 19:

By analyzing and comparing the above two groups of data, results are shown in Figure 20:

From the above chart, it can be seen that the structure of China's e-commerce or export-oriented year-on-year accounts for about 76.5%, and the structure is relatively stable, but the growth rate of imports in proportion is gradually expanding.

According to "2019 China's e-commerce market data monitoring report," (Figure 21) and 2014–2019 China's e-commerce transaction scale (Figure 22), the proportion of B2B transactions is declining year by year, and the proportion of B2C increased year by year.

## 6. Conclusions

With the recognition of the value of blockchain technology, the business model of traditional industries will become heavy, and the needs of the e-commerce industry will match the value provided by the blockchain, which will surely promote the development of the e-commerce industry and realize e-commerce logistics. The unification of information flow and capital flow promotes the transformation of corporate behavior and ultimately realizes the transformation of

the e-commerce industry driven by blockchain technology. In 2020, affected by the new crown pneumonia epidemic, according to China customs data, China's e-commerce exports will be 7.29 trillion yuan, a year-on-year increase of 40.1%, and imports will be 3.76 trillion yuan, which is an increase of 16.5%. The major e-commerce platforms have found the shortcomings of the current e-commerce business model as well as problems in logistics, payment, data flow, and customs supervision. The innovation of e-commerce model based on blockchain is expounded, and solutions for e-commerce logistics, payment, data flow, and customs supervision based on blockchain technology are given.

## Data Availability

The experimental data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare that they have no conflicts of interest regarding this work.

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