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Blockchain-Based E-Commerce: An Evaluation

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Abstract

The e-commerce sector has grown beyond predictions with the help of the most recent technological developments, changes in consumer preferences, and the COVID-19 pandemic. E-commerce activities assume a subsidiary role of brick-and-mortar shops with the benefits it offers to all parties, which have also resulted in new problems such as privacy, security, transparency, and costs, unlike traditional businesses. Blockchain technology is among the promising technologies in solving the problems of the e-commerce sector with its decentralized structure that does not require third-party intermediaries, and its features (such as privacy, immutability, security, transparency, and auditability). In this study—which examines, under five titles, the benefits that blockchain can offer to e-commerce—it is concluded that blockchain can reshape e-commerce activities by enabling integrated e-commerce systems that include all parties and offering low transaction costs, high transaction speed, traceability of transactions, strong security standards, and low risks. In this direction, blockchain-based e-commerce platforms can push existing e-commerce platforms into the background.

Keywords: Blockchain, e-commerce, distributed systems, cross border e-commerce

Jel Codes: L8, M1, O3

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Blokzincir Tabanlı E-Ticaret: Bir Değerlendirme

Öz

Elektronik ticaret, son yıllarda yaşanan teknolojik gelişmeler, tüketici tercihlerindeki değişimler ve COVID 19 salgınının etkisi nedeniyle öngörülerin çok daha ötesinde büyüme yaşayan bir sektör haline gelmiştir. E-ticaret, taraflara sunduğu faydalar ile fiziki mağazaları ikinci plana atarken, geleneksel işletmelerden farklı olarak kendine özgü yeni problemlerin ortaya çıkmasına neden olmuştur. Blok zincir teknolojisi, adem-i merkezi ve üçüncü taraf aracılara ihtiyaç duymayan yapısı ve gizlilik, değişmezlik, güvenlik, şeffaflık, denetlenebilirlik gibi özellikleri ile e-ticaret sektöründe karşılaşılan sorunların çözümünde umut vaat eden önemli bir alan olarak karşımıza çıkmaktadır. Blokzincirin e-ticarete sunabileceği faydalar, daha düşük maliyetler, daha şeffaf ve güvenilir ödeme süreçleri, daha yüksek veri gizliliği ve güvenliği, daha etkin tedarik zinciri ve itibar sistemleri olmak üzere beş başlık altında incelenmiştir. Yapılan çalışma ile blokzincirin sahip olduğu bu özellikleri sayesinde e-ticaret faaliyetlerini yeniden şekillendirebileceği ve e-ticaret sektörünün gelişimini hızlandırarak kârlılığını arttırabileceği sonucuna ulaşılmıştır. Bu doğrultuda blokzincir tabanlı e-ticaret platformlarının mevcut e-ticaret platformlarını arka plana itebileceği düşünülmektedir.

Anahtar Kelimeler: Blokzincir, e-ticaret, dağıtılmış sistemler, sınır ötesi e-ticaret

Jel Kodları: L8, M1, O3

1. Introduction

Since its invention in 1962 (Leiner et al., 1997), the internet has changed social life, communication, access to information, payment systems, and commercial activities. Web applications, which emerged as an internet service in the mid-1990s, led to the widespread use of the internet and to the emergence of e-commerce activities (Xu & Gao, 2021). E-commerce[1], which can be briefly defined as online shopping of products and services, has become an important supporter for companies in realizing financial growth and meeting the needs of consumers (Kumar et al., 2020). Initially developed to facilitate transactions between large enterprises, e-commerce is now frequently used for transactions between businesses and consumers (OECD, 2019). Developments in network communication technologies and big data, global trends in trade and unpredictable external shocks (such as COVID-19 pandemic) have caused e-commerce to become one of the most important retail channels (M. Li et al., 2020; Zhou et al., 2021). The Organisation for Economic Co-operation and Development [OECD] (2019) states that digital transformation will increase economic efficiency and that businesses that do not operate in the field of e-commerce will have less or even no chance to compete.

Retail e-commerce differs from traditional retail stores, with the former offering benefits such as providing competitive advantage, reducing costs, offering product variety, expanding the customer portfolio, and eliminating physical restrictions. With e-commerce, companies can promote, market, and sell their products or services to more consumers without interruption, while consumers can reach more types of products faster. For example, Walmart's physical stores offers a range of approximately 120,000 products, while its online store offers a range of approximately 35 million products (OECD, 2019). Moreover, marketing all products via an electronic platform with detailed information, receiving feedback, measuring consumer satisfaction (Shorman et al., 2019), and offering personalized services (Frey et al., 2016) make e-commerce platforms much more useful for both consumers and businesses. Online platforms

[1] In this study, e-commerce is discussed as retail e-commerce that is within the scope of the sale of physical products from the business to the final consumer (B2C) through a digital channel. Business-to-business e-commerce (B2B), consumer-to-consumer e-commerce (C2C), and second-hand sales over the internet are not included.

improve the benefits for all parties by reducing transaction and search costs, as well as market disputes, for both buyers and sellers (OECD, 2019).

The developments in internet technology, the mobile internet industry, and electronic payment systems have encouraged the main consumer groups to change their shopping routines (Deng et al., 2021). Particularly as a result of the restrictive measures taken by the governments worldwide due to the COVID-19 pandemic that emerged at the end of 2019, the increase in the demand of consumers for online applications and the fact that businesses outside the food sector were able to continue their activities only through e-commerce have caused e-commerce retail sales to increase beyond expectations. According to Statista (2022), the world retail e-commerce volume, which was $1.3 trillion in 2014, reached approximately $4.9 trillion in 2021 because of the pandemic. By 2025, it is predicted that this figure will increase by more than 50% compared to 2021 and reach approximately $7.4 trillion. It is estimated that the highest compound annual growth rate in retail e-commerce volume for each year from 2021 to 2025 among selected countries (e.g., China [6.73%] and the US [4.68%] will be seen in Türkiye [14.29%]) (Statista, 2021). Moreover, Türkiye's retail e-commerce volume, which was $16 billion in 2021, is expected to increase by 50% in 2024, reaching approximately $23.6 billion (Statista, 2021). Easier access to the internet, increase in digital literacy, and higher young population density are important factors that make Türkiye stand out in the e-commerce sector (Göl et al., 2019). As can be seen from the estimations, e-commerce is a business area with increasing importance and a high growth potential. However, various problems, such as privacy, data security, costs, and transparency, create obstacles to the development of e-commerce, and the solutions for these problems often fall short. Blockchain is considered as one of the promising technologies for solving these problems (Bulsara & Vaghela, 2020; Deng et al., 2021; Treiblmaier & Sillaber, 2021).

Designed by Haber and Stornetta (1997), blockchain reached its current recognition when Satoshi Nakamoto introduced it as the public ledger where Bitcoins were created, recorded and transferred (Nakamoto, 2008). Blockchain technology has found areas of application other than cryptocurrencies with its decentralized and secure data sharing structure. This shared data can be used as currency, intellectual property, financial assets and even digital representations of real-world assets. This has made blockchain a general-purpose technology that can be used to create new types of digital platforms (Catalini & Gans, 2020). While this situation has led to an increase in studies on the effects of blockchain on different fields such as library science and medicine (Hoy, 2017), corporate governance (Lafarre & Van der Elst, 2018), administrative processes (Ølnes et al., 2017), and banking (Guo & Liang, 2016), studies on its effects on the e-commerce sector are limited (Bulsara & Vaghela, 2020; Treiblmaier & Sillaber, 2021). It is considered that this study, which examines the solutions that blockchain can offer to e-commerce, will contribute to the literature.

In the second part of the study, the general structure of blockchain technology is discussed. In the third part, the problems encountered in e-commerce, under five titles, and the solutions that blockchain may offer are examined in detail. The last section consists of the conclusion and evaluation.

2. Blockchain

Briefly, blockchain is a decentralized database system. In other words, blockchain is a distributed peer-to-peer network secured by cryptography; it is not based on a single central authority (Cocco et al., 2017). Blockchain, originally designed by Haber and Stornetta (1997), was used by Nakamoto (2008) as a public ledger where cryptocurrencies are recorded and the value they represent is transferred. Therefore, as a first-generation blockchain, Bitcoin provides a suitable basis for explaining the working principles of the technology (Hughes et al., 2019).

Blockchain refers to a chain of blocks, each containing a certain number of Bitcoin transactions and linked by the cryptographic hash of the previous block. The system performs the transfer, verification and storage of data through a network of volunteers called nodes, rather than trusted third parties. Each of the nodes, with the same rights and obligations, maintains an up-to-date copy of the blockchain, and they must always be consistent with each other to ensure the reliability of the transaction records. Since no node knows which blockchain version is valid, the hash-based proof-of-work (PoW) algorithm Hashcash (Back, 2002) is used to achieve consensus on a single ledger format and to secure and verify transactions (Ciaian et al., 2018; Cocco et al., 2017; Decker & Wattenhofer, 2013).

Originally developed to prevent spam (Dwork & Naor, 1992), PoW is an easy-to-check cryptographic proof of computational effort (Delgado-Mohatar et al., 2019). PoW is the process of solving a hash key determination problem that starts with a certain number of zeros, which is difficult to solve by users called miners and requires a significant amount of time and computing power (Pinna et al., 2018). The Bitcoin protocol is based on an algorithm that adjusts the computational difficulty so that when new miners join the network or miners invest in computing power, the new block-generation time is 10 minutes (Ciaian et al., 2018; Vranken, 2017). The requirement for a block to have a certain amount of hash value to be considered valid ensures the data integrity and security of the blockchain (X. Li & Wang, 2017). The first miner to complete the PoW publishes the solution to the network for verification. If most of the nodes in the network agree on the validity of the transactions and the block, the new transaction block is added to the blockchain (Abduljabbar et al., 2021), and the new Bitcoins issued are given to the first miner who finds the solution. Once the transactions are confirmed, they cannot be reversed, and they become permanently secure on the blockchain (Chen, 2018). The new block publishes a hash using the public key, private key, cryptographic hash of the previous block, and timestamp, as well as with transactions (Lim et al., 2019). Transaction data is secured with a cryptographic hash function, and fake and duplicate transactions are prevented with timestamp-based verification (Subramanian, 2018). Successive and unique hashes and timestamps ensure that the contents of a previous block cannot be changed by anyone, including nodes, without leaving any traces and that transactions are tamper-proof (Hughes et al., 2019; Liao & Shao, 2021; Nærland et al., 2018; Yoo, 2017). This makes the blockchain more immutable than an equivalent traditional database (Alabi, 2020).

Bitcoin users use digital wallet software that allows the creation of Bitcoin addresses and stores the necessary digital data (Polasik et al., 2015). Users can have more than one address since no identity information and payment is required during the address creation process (Pinna et al., 2018). Bitcoins are sent and received through these anonymous addresses, and for the transaction to take place, the private key of one of the parties must match the public key of the other party (Bação et al., 2018). The public key is similar to the account number in the current financial system, and the private key is similar to the password used to access the account. The public key, private key, and digital signature ensure the integrity and

nonrepudiation of transactions without the need to apply any external security measures (Kim & Kim, 2020). Furthermore, unlike the current system, the identity of the account holder is not known by other users, while the amount in the account is known (Polasik et al., 2015); thus, user privacy is protected.

3. Potential Benefits of Blockchain to the Challenges Faced by Retail E-Commerce

Despite the growth potential and benefits it brings to all parties, the solutions developed to address e-commerce problems (Anbar, 2001; Deng et al., 2021; Khan et al., 2019) such as privacy, security, transparency, logistics, and costs remain insufficient. In this context, blockchain is considered one of the promising technologies for solving these problems (Bulsara & Vaghela, 2020; Deng et al., 2021; Treiblmaier & Sillaber, 2021).

Blockchain has enabled the integration of the real economy and the digital economy (Su et al., 2020), creating new market areas where competition has increased, barriers to entry have been reduced, and the risk of privacy and censorship has decreased (Catalini & Gans, 2020). In this respect, blockchain has great potential in the development of the e-commerce sector, where transaction reliability and privacy are important, transaction efficiency can be increased by reducing intermediary costs, and competition and barriers to entry are high (Voshmgir, 2020). Deng et al. (2021) stated that the benefits of blockchain applications (such as alternative payment methods, fast authentication, and safer payments) produce unlimited possibilities for e-commerce and that blockchain is a natural fit for e-commerce activities. Similarly, Treiblmaier and Sillaber (2021) stated that blockchain will affect e-commerce by solving technological, legal, organizational and quality problems, as well as consumer problems.

3.1 Reducing Costs

It is thought that blockchain technology affects two important costs related to digital marketplaces—namely, the verification of transactions and the operation of a platform. With its decentralized distributed structure, blockchain, on the one hand, ensures the transfer of data without the need for a trusted third-party intermediary and without considering distance. On the other hand, it prevents centralization and monopolistic market power in digital platforms (Catalini & Gans, 2020).

In online shopping situations where there is not enough trust between the parties (J. Y. Lee, 2019) that the transactions will be carried out smoothly, problems such as information asymmetry, moral hazard risk, or failure of the parties to fulfill their contractual responsibilities may arise, requiring third-party intermediaries. Through third-party verification, intermediaries enable tracking participants, maintaining reliable reputation systems, fulfilling responsibilities such as payment and delivery based on contractual clauses, managing confidentiality and censorship risk, and making additional disclosures, thus allowing transactions to be carried out reliably for all parties (Catalini & Gans, 2020). While these guarantees provided to the parties and the fees paid to the intermediaries involved in the transaction increase the costs, it forces the retailers to submit to the wishes and the monopoly of third parties. In particular, making transactions through cross-border e-commerce increases the number of intermediaries and, indirectly, costs. According to research done by Monetha company (2017), traditional payment

systems consist of 16 stages, and transaction fees range from 2% to 6%. The commissions paid by retailers to e-commerce platforms increase costs even further.

Blockchain technology, which is based on a decentralized peer-to-peer distributed network system in the verification, storage, and transfer of data, ensures that verification costs are reduced in transactions and data is transferred faster, as the blockchain structure does not require third-party intermediaries. Deloitte (2016) stated that with blockchain, there will be a 40%–80% reduction in cross-border payment costs and transfers will take between 4 and 6 seconds on average. It is expected that blockchain technology will be able to automate cross-border payments in real time, seamlessly, and automatically (Zhu & Wang, 2019), significantly reducing financial services infrastructure costs (Belinky et al., 2015). In addition, the fact that blockchain is not affected by restrictions such as fees and foreign exchange, which hinder international payments in cross-border e-commerce makes it possible to use cryptocurrencies and blockchain-based payment cards that allow direct money transfer between the seller and the consumer. Jaag and Bach (2015) stated that the earliest effect of cryptocurrencies such as Bitcoin on e-commerce will be related to the irreversibility of payment, and in this way, e-commerce should gain strength via reduced overall risk. One of the first examples of the use of cryptocurrencies in e-commerce is when the Chinese search engine Baidu accepted Bitcoin in 2013 (Halaburda et al., 2022). Today, the leading e-commerce company in Switzerland, Galaxus, accepts several cryptocurrencies, which can be instantly converted into Swiss francs. In addition, pegged exchange rates ensure that customers are not affected by market fluctuations (Shome, 2019). While blockchain is becoming a strong competitor to e-commerce platforms with all these possibilities, it also has the potential to offer lower transaction costs, strong security standards, and a smooth customer experience for e-commerce businesses (Bulsara & Vaghela, 2020; Shorman et al., 2019).

3.2 Trust and Transparency in Payments

Many payment alternatives in e-commerce systems are based on centralized systems where all services are carried out through third parties. While this increases the costs, considering the fees paid to all intermediaries involved in the transaction, it also leads to damages to personal privacy because the information is shared. For example, eight different institutions are involved in purchases made with a credit card and five of these institutions have access to the identity information on the card. The lack of transparency and trust in existing platforms is one of the biggest challenges in e-commerce for both consumers and online retailers (Bulsara & Vaghela, 2020; Vigna & Casey, 2015/2017).

The decentralized and distributed network structure of blockchain eliminates the need for third parties, such as any bank or credit institution, to process and approve transfers and transactions. Features of a blockchain such as the blocks being linked to each other with hash values, each node keeping an up-to-date copy of the ledger, and the consensus on transactions, make it possible for transactions made through the blockchain to be more transparent, safer, less costly, and more resistant to external attacks (Guadamuz & Marsden, 2015). In addition, the completion of a transfer in traditional international banking networks such as SWIFT and SEPA, may take one to four business days, depending on the relevant currencies, payment method, public holidays, and weekends. However, transfers are made in a much shorter time (10 minutes for Bitcoin) with the blockchain system (Cocco et al., 2017). Moreover, while intermediaries gain market power by accessing all transaction data in existing payment platforms, blockchain prevents third-party organizations from monopolizing

information, making it difficult to tamper with and falsify information, and increasing transparency within the system (Catalini & Gans, 2020; J. Y. Lee, 2019). In this way, blockchain increases the efficiency and transparency of e-commerce transactions and enables real-time payments and transactions (Zhu & Wang, 2019). Blockchain facilitates the transmission of sensitive and confidential information and increases the transparency of transactions without compromising security and privacy (Ismanto et al., 2019). Blockchain technology facilitates online shopping for both consumers and online retailers with the high security it offers to e-commerce payment systems, increased transparency, high transaction speed, and traceability of transactions.

3.3 Ensuring Data Security

The development of e-commerce platforms in recent years is gradually increasing the amount of data[2] stored by third parties (such as in clouds) about consumers, products, and suppliers. The collection, analysis, and visualization of data (Deepa et al., 2022), which has become a valuable asset for businesses, offers opportunities to grow commercially and gain market share. Conversely, the increase in digital data causes new problems—such as energy management, data management, scalability of computing infrastructure, and real-time data processing (Abduljabbar et al., 2021) and (Deepa et al., 2022) data sharing among enterprises at the international level at very low costs (Sovbetov, 2018), which threatens data security and privacy. In addition, sending data copies to the server of the service provider during transactions made over the internet causes users to lose control of their data (Voshmgir, 2020). Data security is particularly important in markets where consumers have to disclose their personal information to third parties in exchange for services. Transacting through third-party intermediaries may lead to security breaches and misuse of user data without the knowledge of the consumer (Catalini & Gans, 2020; Deepa et al., 2022). Data leaks, which have increased in recent years (Zhu & Wang, 2019), jeopardize the security and privacy of customers, businesses, and employees. While this situation negatively affects customer loyalty and social trust, it causes great losses for businesses as in loss of productivity, loss of data and intellectual property, loss of reputation, decrease in stock price, and damage to brand reputation (Xu & Gao, 2021; Xuan et al., 2020). While there were 1,001 data breaches in the US alone in 2020, sensitive information of more than 155.8 million people leaked due to insufficient information security (Johnson, 2020).

Large and reputable platforms that provide better data protection create a strong centralized structure with large amounts of personal information about users that can be processed and sold, which also creates barriers for novice investors (Shorman et al., 2019). Kabi and Franqueira (2019) stated that large marketplaces pose a greater security threat, as they require consumers to report their personal and banking information. In fact, the personal and banking data of millions of eBay and Amazon customers were leaked in 2020 (Dunn, 2020). Measures such as privacy seals, which act as assurances for consumers, and cloud computing, which is widely used for big data services, can partially solve privacy problems, but hackers continue to pose a potential threat to data (Bulsara & Vaghela, 2020; Treiblmaier & Sillaber, 2021).

[2] According to a research report published by MarketsandMarkets, the global big data market is expected to increase from $138.9 billion in 2020 to $229.4 billion by 2025 (MarketsandMarkets, 2022).

Features such as the consensus algorithm, hash function, chained block structure, and timestamp of a blockchain ensure data integrity and make consumer data safe from tampering and manipulation. The immutable, programmable, and decentralized structure of blockchain technology completely eliminates security vulnerabilities in terms of personal data protection. It also ensures that the data are always available to the public and prevents data loss by making it difficult for malicious attackers to use them without authorization. In addition, the cryptography used in a blockchain provides a high level of security to users with the application of algorithms that act as a firewall against unauthorized actions (Deepa et al., 2022; Kumar et al., 2020; Xuan et al., 2020). These new platforms, where trust in third-party intermediaries is replaced by trust in algorithms, enable personal data management systems that allow consumers to manage their own data (Deepa et al., 2022). While new mass media and social media platforms generate large amounts of advertising revenue by using consumers as advertising tools, the implementation of decentralized search engines in blockchain-based platforms allows consumers to earn their own advertising revenue by adding their personal information to the blockchain (Ghanbary et al., 2020). Furthermore, in the current e-commerce system, it is possible to store cryptographically in a data block documents, such as invoices and after-sales services, that businesses generate by e-mail or hard copy (Bulsara & Vaghela, 2020). Blockchain technology contributes to the data privacy and data security areas of e-commerce platforms (Xuan et al., 2020) both by reducing the security concerns of consumers and increasing positive user experience and by facilitating for e-commerce businesses the process of providing the service demanded by the consumer.

3.4 Optimized Supply Chain Management

Supply chain management, which has gained importance with the progress of globalization and international trade, is a 17.42 billion-dollar market[3] that covers every stage from the production to the delivery of the product to the customer, and is of vital importance for e-commerce retailers. Fast and safe delivery of products to consumers is a major concern for both e-commerce staff and consumers (Deng et al., 2021). Nærland et al. (2018) noted that decentralized interorganizational environments such as supply chains are characterized by high transaction uncertainty and risk. Traceability of products, management of stocks and key documents, and correct use of databases are the requirements of effective supply chain management. However, the fact that the supply chain contains valuable goods that need to be verified and the involvement of many parties and documents in the process cause the risk of failure and increased costs. The fact that business management applications, customs, insurance, tax, and banking structures differ by region or country and the connections between them increase the security risk (Deng et al., 2021), and cause a slowdown of payment processes (Chang et al., 2019), an increase in intermediate costs, a decrease in payment efficiency (Zhu & Wang, 2019), and the inability to establish a common legal framework and policies regarding payment systems (Xu & Gao, 2021). Maersk, the world's largest container-shipping line, has been participating in a proof-of-concept initiative, as managing trade documents can cost more than the actual shipping of the container (Lehmacher & Mcwaters, 2017; Nærland et al., 2018). In particular, underperforming supply chains, where the risk of fraud, loss and theft is high, increases distrust and raises the need for better information sharing and verifiability (Saberi et al., 2019). About 42% of all global supply chain and product chain management

[3] The Global Supply Chain Management Market size was estimated to be $15.58 billion in 2020 and is expected to reach $34.70 billion in 2027 (Research and Markets, 2022).

companies have faced incidents of fraud (such as falsified comments of goods or services, bribery, and kickbacks) in the last 10–15 years (Kumar et al., 2020). Therefore, it is important that operational procedures are more efficient and less costly for parties involved in the supply chain process, such as businesses, banks, and shipping companies (C. S. Yang, 2019; Lehmacher & Mcwaters, 2017).

Blockchain's innovative features are aimed at eliminating or improving many of the existing problems or deficiencies in traditional supply chain management and restructuring the sector (Hughes et al., 2019). The tamper-proof and transparent nature of blockchain lays the foundation for collaborative commerce, providing simultaneous control among partners, simplifying decision-making at every stage, and increasing confidence throughout the supply chain (C. S. Yang, 2019). Moreover, in e-commerce transactions, both the originality and the origin of products have become a subject that consumers take into consideration more often regarding both daily consumption goods and luxury products. Blockchain is expected to reduce the risk of counterfeit products, protect consumers, and speed up the customs clearance process by providing customs officials with access to all information, such as ownership, source, authenticity, and price. Businesses such as Everledger and Provenance, which continue their activities in the field of blockchain-based supply chain, aim to increase supply chain transparency with services such as the origin and traceability of products (Bălan, 2018; C. S. Yang, 2019; Hughes et al., 2019). Currently, cargo tracking information is obtained through the systems of transportation service providers; blockchain overcomes the problem of not being able to track the order item to the source in traditional e-commerce platforms by enabling the auditing of transactions. A decentralized environment is created, in which even small changes in transactions can be noticed and customers can follow transactions at any time through auditing. Crosby et al. (2016) stated that in a scenario where brands, sellers, and marketplaces are part of the blockchain with nodes, there would be no need to rely on a third-party organization for the authenticity of products. As blockchain technology enables the tracking capability of more logistics partners (such as shippers, terminal operators, and customs offices), it makes it possible to track and trace products more effectively and provides open access to information about delivery times (Bulsara & Vaghela, 2020; C. S. Yang, 2019; Lim et al., 2019; Liu & Li, 2020).

Kumar et al. (2020) proposed a blockchain-based solution called ProdChain that integrates the product and the supply chain for e-commerce problems such as data manipulation, monopoly effect, unbalanced product prices, and product quality uncertainty, and they stated that this solution is beneficial for the traceability of products. Similarly, Liu and Li (2020) stated that the blockchain-based product traceability tag they proposed to effectively obtain traceable products and transactions in supply chain management ensures the verification of tag source, tag information, and tag ownership. In addition to academic studies, businesses have started to adopt blockchain-based supply chain management. Nestle, one of the world's food giants, benefits from the blockchain-based supply chain service offered by Amazon, one of the leading companies in this field. Nestle Oceania Digital Technology Manager Armin Nehzat emphasized that blockchain has an important place in satisfying consumers who are especially curious about the content and the origin of food products (AWS, 2022). ReportLinker (2022) stated that the blockchain market in the global supply chain industry is predicted to grow by 50% each year, reaching $3.32 billion by 2026. Cross-border and local e-commerce transactions have an important place in this growth trend. Blockchain is expected to increase

the transparency and efficiency of supply chain management, reduce costs, reduce paperwork and risks, and create an integrated system involving all parties.

3.5 Reputation Systems

One of the most important expectations for consumers in e-commerce is to be able to buy high-quality products at reasonable prices (C. N. Yang et al., 2019). Concerns about the quality of the product (Alam & Elaasi, 2016) and the risk of counterfeit or altered products (Jun & Jaafar, 2011) are the most important trust issues for consumers. As a direct determinant of consumer attitude, trust is the expectation that the parties will not be opportunistic in the shopping process and that the seller will deliver what is promised (Akroush & Al-Debei, 2015). However, the fact that consumers and suppliers have different perceptions of product quality causes commercial disputes (Zhou et al., 2021). Furthermore, malicious behaviors that occur in the form of hiding negative information about the product, unclear information about the product, selling nonexistent products (Treiblmaier & Sillaber, 2021), or deliberately misleading users by competitors or other users, create lack of trust in the seller and obstacles to e-commerce transactions (M. K. O. Lee & Turban, 2001). Reputation systems are used to address such problems, which cause unfair commercial competition in e-commerce and damage consumers' trust in businesses and e-commerce platforms. The reputation gained by businesses and consumers in e-commerce platforms is based on the feedback provided by the parties about each other after the completion of the transaction (Ryan, 2017). Consumers take into account the feedback of other users about the product, as well as the information provided by businesses about the product. Smith and Anderson (2016) reported that 82% of American adults at least sometimes review online ratings before purchasing products for the first time. In this respect, feedback plays a crucial role in consumers' shopping activities. Managing the accuracy of feedback, obtaining feedback from real users, and preventing modification by unauthorized persons are the most important components of reputation systems. However, in existing e-commerce systems, storing the reputation ratings of users on cloud servers can cause errors and fraud, and reputation systems are ineffective against fake comments and ratings. A platform's ability to determine which reviews to highlight, as well as the uncertainty of the validity of reviews and the filtering processes, make consumers unable to distinguish fake reviews, and thus, competition among businesses is damaged. In addition, reliable solutions to prevent the abuse of feedback are centralized under the control of several large internet companies (Ramachandiran, 2018; Ryan, 2017; Zhou et al., 2021).

Blockchain-based decentralized reputation systems offer significant opportunities to change online reputation management (S. Lee, 2018). In addition to the verification, storage, and transfer of transactions thanks to blockchain's distributed network structure, the fact that verified transactions are tamper-proof ensures that reputation scores are protected against manipulations and fraud. Blockchain prevents the manipulation of reputation scores and the creation of fake identities through methods such as the integration of the proof-of-individuality protocol developed against sybil attacks and the tokenization of reviews and links (Scheer, 2018). Through a decentralized process that prevents information monopolization, blockchain enables users to share their feedback more openly, securely, and fairly (J. Y. Lee, 2019). The DREP project is an example of decentralized reputation systems (S. Lee, 2018). In addition to practice, studies on blockchain-based reputation systems continue in theory (Dennis & Owen, 2016; Schaub et al., 2016; Zhou et al., 2021). It is thought that the blockchain-

based reputation systems developed to protect both consumers and businesses will contribute significantly to the creation of e-commerce environments that are based on trust.

4. Conclusion

The Web1 era, which increased the use of the internet in the 1990s, also increased e-commerce activities. In the Web2 era, where social interaction increased through reliable intermediaries by bringing producers and consumers closer together, e-commerce turned into a rapidly growing field of commercial activity. The number of academic articles published on e-commerce have also increased in this process. Compiling research on e-commerce, Wang and Chen (2010) stated that a total of 7,823 articles were published in the SCIE and SSCI databases. The concept of Web3 (Wood, 2022), put forward by Gavin Wood (the cofounder of Ethereum), is used as a new-generation internet based on blockchain technology.

Blockchain technology changed the way data is stored and managed on the internet, enabling intermediary peer-to-peer transactions for the first time (Voshmgir, 2020). The fact that applications, which are performed centrally through third-party intermediaries, can also be executed with the same precision, without intermediaries and decentralized with blockchain technology, has triggered changes in traditional business processes (Casino et al., 2019). This has led to an increase in the work of academics in this field, even though the technology is still in its maturation stage (Abduljabbar et al., 2021; Hughes et al., 2019; J. Y. Lee, 2019). An average of 33% of organizations across all industries and regions are already or actively engaged in blockchains, according to a survey of nearly 3,000 global senior executives by IBM (2017). Gorkhali et al. (2020) stated that the number of blockchain-related articles published in different journals in the SCI/SSCI database increased from 1 in 2016 to 18 in 2017 and 68 in 2019.

Today, e-commerce has turned into an industry of $5 trillion worldwide and $16 billion in Türkiye (Statista, 2021). The retail e-commerce volume is still very low in Türkiye when compared to $1.5 trillion in China and $900 billion in the US. The developments in internet technology, the changes in the shopping routines of consumers during the COVID-19 pandemic, the global trends in trade, and the technology-oriented growth of new generations have made e-commerce widespread worldwide. The retail e-commerce sector volume in Türkiye grew below the world average before the pandemic; however, the pandemic changed the direction of this trend. Türkiye's retail e-commerce sector is expected to show the highest annual growth until 2024. Despite the e-commerce sector's global reach and high growth potential, various problems (such as privacy, data security, high costs, and transparency) create obstacles to the development of e-commerce, and the solutions developed for these problems often fall short.

Blockchain technology has great potential in eliminating the deficiencies and inadequacies of the e-commerce sector with its features, such as privacy, immutability, security, transparency, auditability, and decentralization. The results of this study, in which the solutions that blockchain can offer to the e-commerce sector are examined under five titles, are summarized in Table 1. According to the results, blockchain has the potential to accelerate the development of the e-commerce sector and increase its profitability by offering lower costs, more transparent and reliable payment processes, higher data privacy and security, and more effective supply chain and reputation systems. The opportunities provided by blockchain enable integrated e-commerce activities involving all parties, with low transaction costs, high

transaction speed, traceability of transactions, strong security standards, and low risks. Blockchain-based e-commerce activities are expected to overtake existing e-commerce platforms.

Table 1

Traditional vs. Blockchain-Based E-Commerce (Domestic and Cross-Border)

	Traditional E-Commerce	Blockchain-Based E-Commerce
Costs	• Fees paid to third-party intermediaries due to information asymmetry, moral hazard risk, privacy, and censorship risk • Fees paid to verify transactions	• Decentralized peer-to-peer distributed network system eliminates the need for third-party intermediaries in the verification, storage and transfer of transactions • Peer-to-peer payment with cryptocurrencies • No currency restrictions in international trade • Small-scale payments are possible • Payments are non-refundable
Trust and Transparency in Payments	• Personal information provided to payment platforms • Transfer times are between 1 and 4 days • Third-party agents monopolizing personal information • Low payout efficiency • Non-transparent payment processes	• Transactions are public • Elimination of the need for personal information with features such as anonymity and semi-anonymity • Transfer between consumers and sellers with cryptocurrencies and without intermediaries • Real-time transfers
Data Security	• Data management • Energy management • Scalability of computing infrastructure data-sharing among international businesses • Violation of the privacy of customers, businesses, and employees due to data leaks • Damage to customer loyalty • Loss of reputation for businesses • Strong centralized structure of large platforms in data management	• Data immutability • Decentralized structure • Prevention of unauthorized use of data • Consumers are able to manage their own data • Tamper-proof data • High level of security with cryptography • High customer loyalty
Supply Chain Management	• Different practices of customs, insurance and tax in different regions • High risk of security • High intermediary costs • Lack of a common legal framework, falsified image of goods and services, and ineffective inventory management due to incorrect supply and demand data • Product origin and originality are unknown • The risk of bribery and kickbacks • Quality control performed by third parties	• Cooperative trade between parties • Product origin and originality are known • Faster customs clearance process • Traceability of the order item to its source • Real-time stock management
Reputation Systems	• Different perception of quality between the business and the customer • Unfair competition • Uncertain and untrustworthy review and filtering processes	• Reputation points are protected against fraud and manipulation

Note. Created by the authors based on the text.

In addition to all the innovations and potentials, blockchain technology is still immature and has some problems to overcome, including scalability, long transfer times, high computational costs, and social adoption of the technology. In addition, the electricity consumption that blockchain consumes during the mining process is very high. For example, O'Dwyer and Malone (2014) suggested that the power used for Bitcoin mining was comparable to Ireland's electricity consumption in 2014. Again, according to a comparison made by University of Cambridge based on the U.S. Energy Information Administration in 2019 country data; while the energy consumption of Bitcoin is higher than Finland and Belgium, it is very close to the Philippines and Kazakhstan (University of Cambridge, 2020). Furthermore, the lack of legal and political grounds for technology increases the uncertainty and makes it difficult to predict the future of blockchain.

In this study, the benefits of blockchain-based e-commerce systems are studied under five titles. However, each title is crucial individually and should be considered in detail. Therefore, it will be useful to consider each topic separately in future studies. Empirical studies are necessary in order to reach precise conclusion about the superiority of blockchain-based e-commerce.

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The authors declare that this article complies with the ethical standards and rules.

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Ebru Aydoğan I Literature review; Design; Data Collection/Analysis; Interpretation of data/findings; Supervising; Drafting; Critical review; Final approval and accountability. Contribution rate %60

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CONFLICT OF INTEREST
The authors declare no conflict of interest.

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Genişletilmiş Özet

Başlangıçta büyük işletmeler arasındaki işlemleri kolaylaştırmak amacıyla geliştirilen e-ticaret, günümüzde işletme ile tüketici arasındaki işlemler için de önemli bir potansiyele dönüşmüştür. Özellikle ağ iletişim teknolojilerinde, büyük veri alanında yaşanan gelişmeler, ticarette yaşanan küresel eğilimler ve COVID-19 gibi öngörülemez dışsal şoklar e-ticaretin en önemli perakende kanallarından biri haline gelmesine neden olmuştur. Perakende e-ticaret rekabet avantajı sağlaması, maliyetleri düşürmesi, ürün çeşitliliği sunması, müşteri portföyünü genişletmesi ve fiziksel kısıtları ortadan kaldırması gibi faydaları ile fiziksel perakende mağazalarından ayrışmaktadır. E-ticaret ile firmalar daha çok tüketiciye kesintisiz olarak tanıtım, pazarlama ve satış yapma imkanı bulurken, tüketiciler daha fazla ürün çeşidine daha hızlı ve düşük maliyetle ulaşabilmektedir. Ayrıca, tüm ürünlerin detaylı bilgilendirme ile elektronik platformda sunulabilmesi, alınan geri bildirimler ile tüketici memnuniyetinin ölçülebilmesi ve kişiselleştirilmiş hizmetler e-ticaret platformlarını hem tüketiciler hem de işletmeler için daha kullanışlı hale getirmektedir. Çevrimiçi platformlar, hem alıcılar hem de satıcılar için işlem ve arama maliyetlerinin yanı sıra piyasa uyuşmazlıklarını da azaltarak, her iki tarafın faydalarını daha üst noktalara taşımaktadır.

2019 yılı sonunda ortaya çıkan COVID-19 nedeniyle hükümetlerin toplumsal hayatı kısıtlayıcı önlemleri sonucunda tüketicilerin çevrimiçi uygulamalara talebinin artması ve gıda sektörü dışında işletmelerin sadece e-ticaret üzerinden faaliyetlerini sürdürebilmesi e-ticaret perakende satışlarının öngörülerin ötesinde artmasına neden olmuştur. 2014 yılında 1,3 trilyon ABD doları olan dünya perakende e-ticaret hacmi pandeminin etkisiyle 2021 yılında yaklaşık 4,9 trilyon ABD dolarına ulaşmıştır. 2025 yılında ise bu rakamın 2021 yılına göre %50'den fazla artarak yaklaşık olarak 7,4 trilyon dolara ulaşacağı öngörülmektedir. Dünyanın en büyük perakende e-ticaret pazarları olan Çin (1,5 trilyon ABD Doları) ve ABD (900 milyar ABD doları) ile karşılaştırıldığında, Türkiye'nin perakende e-ticaret hacmi 16 milyar ABD doları ile hala oldukça düşüktür. Türkiye'de perakende e-ticaret sektörü hacmi pandemi öncesi dünya ortalamasının altında büyümüş ancak pandemi bu trendin yönünü değiştirmiştir. 2021 yılından 2025 yılına kadar perakende e-ticaret hacminde seçili ülkeler arasında Çin'de %6.73 ve ABD'de %4.68 büyüme beklenirken, en fazla büyümenin %14,29 ile Türkiye'de olacağı tahmin edilmektedir. Diğer yandan 2021 yılında 16 milyar dolar olarak gerçekleşen Türkiye perakende e-ticaret hacminin 2024 yılında %50 artarak yaklaşık 23,6 milyar dolara ulaşacağı öngörülmektedir. İnternet erişiminin kolaylaşması, dijital okur-yazarlığın artması ve genç nüfus yoğunluğu, Türkiye'yi e-ticaret sektöründe öne çıkaran önemli değişkenlerdir. Görüldüğü gibi e-ticaret sektörü hem Türkiye'de hem de tüm dünyada yaygınlaşmasına ve yüksek büyüme potansiyeline sahip olmasına rağmen gizlilik, veri güvenliği, yüksek

maliyetler ve şeffaflık gibi çeşitli sorunlar yaratmaktadır. Bu sorunlar e-ticaretin gelişmesinin önünde engel oluşturmakta, buna yönelik geliştirilen çözümler ise çoğunlukla yetersiz kalmaktadır. Blokzincir e-ticaret sektörünün karşılaştığı sorunların çözümü konusunda umut vadeden teknolojilerden biri olarak kabul edilmektedir.

Haber ve Stornetta (1997) tarafından tasarlanan blokzincir, Satoshi Nakamoto (2008) tarafından Bitcoin'in yaratıldığı, kaydedildiği ve transfer edildiği halka açık defter olarak tanıtılması ile bugünkü bilinirliğine ulaşmıştır. Blok zincir teknolojisi, merkezi olmayan ve güvenli veri paylaşımına izin veren yapısı ile kripto para birimlerinin ötesinde uygulama alanı bulmuştur. Paylaşılan bu verilerin para birimi, fikri mülkiyet, finansal varlık ve hatta gerçek dünya varlıklarının dijital temsilleri vb. olabilmesi, blok zinciri yeni dijital platform türleri oluşturmak için kullanılabilecek genel amaçlı bir teknoloji haline getirmiştir. Bu durum blokzincirin kütüphane ve tıp, iş ve bilgi sistemleri idari süreçler gibi farklı alanlara etkileri üzerine yapılan çalışmaların artmasına neden olurken, e-ticaret sektörüne etkileri üzerine yapılan sınırlı sayıda çalışma bulunmaktadır. Bu amaçla çalışmada blokzincirin e-ticarete getireceği yenilikler incelenmiştir.

Blokzincir teknolojisi, gizlilik, değişmezlik, güvenlik, şeffaflık, denetlenebilirlik, yerinden yönetim gibi özellikleri ile e-ticaret sektörünün eksikliklerini ve yetersizliklerini gidermede büyük bir potansiyele sahiptir. Blokzincir'in e-ticaret sektörüne sunabileceği çözümler bakımından daha düşük maliyetler, daha şeffaf ve güvenilir ödeme süreçleri, daha yüksek veri gizliliği ve güvenliği, daha etkin tedarik zinciri ve itibar sistemleri öne çıkmaktadır. Blokzincirin bu çözümleri sayesinde e-ticaret faaliyetlerini yeniden şekillendirebileceği ve böylelikle hem e-ticaret sektörünün gelişimini daha da hızlandıracağı hem de e-ticaretten elde edilen kârlılığı arttırma potansiyeline sahip olduğu sonucuna ulaşılmıştır. Bu doğrultuda blokzincir tabanlı e-ticaret faaliyetlerinin mevcut e-ticaret platformlarını geride bırakması beklenmektedir. Bu çalışmada blokzincir tabanlı e-ticaret sistemlerinin faydaları beş başlık altında incelenmiştir. Ancak her başlığın ayrı ayrı önemli olduğu ve ayrıntılı olarak ele alınması gerektiği düşünülmektedir. Bu nedenle bundan sonraki çalışmalarda her konunun ayrı ayrı ele alınması faydalı olacaktır. Ayrıca blokzincir tabanlı e-ticaretin üstünlüğü konusunda kesin sonuca varmak için ampirik çalışmalara ihtiyaç olduğu düşünülmektedir.