Blockchain-based E-commerce for the COVID-19 economic crisis

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ABSTRACT

The beginning of 2020 is associated with the emergence and spread of the COVID-19 disease. The characteristics of this virus, such as high transmission power and lack of definitive treatment have caused problems in all aspects of organizational economics. Restrictions that were imposed to deal with the virus affected the global economy. Fear of being exposed to the virus, quarantine and lockdown led to a massive increase in online shopping. However, people's concern about the health and authenticity of the products offered online and their incompatibility with consumer standards raised concerns about the reliability of the existing e-commerce models. Fraud, counterfeit products, ethical sourcing and product safety are some of the concerns that affected online business acceptance. To address these challenges, we examine the use of a blockchain-based e-commerce approach to guarantee authenticity through blockchains trace and trace capabilities. In this approach, we evaluate the profit gains achieved through addressing consumer concerns on safety and authenticity. To examine these benefits, we use a game theory leader-follower approach. We evaluate the profitability of e-commerce in three scenarios, including when non of seller and e-commerce website use blockchain, only when the seller uses the blockchain and when both the seller and the e-commerce websites use blockchain. The evaluation results show that the situation in which both the seller and the website use blockchain has the highest profitability for the seller due to the maximum reduction of customer concerns.

CCS CONCEPTS

• **Security and privacy** → **Domain-specific security and privacy architectures**.

KEYWORDS

Blockchain, E-commerce, Covid-19

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1 INTRODUCTION

Due to the high transmission rate of COVID-19, it has been declared a pandemic by the World Health Organization (WHO) on 11 March 2020 [5, 34]. To combat this virus outbreak, different countries have put in place restrictions including social distancing, quarantining infected people, closing public places and shops, cancelling meetings and events, and restrictions on travel. These policies caused social, financial, political, and economic impacts in societies and the global economy. Direct impacts include significant population losses due to the disease, and indirect impacts include severe social and economic crises.

The COVID-19 pandemics have inadvertently affected businesses and organizations worldwide and disrupted the classical supply and demand market models. COVID-19 has disrupted all the operational assumptions of economic models and has shown that these models are not resistant to such crises [9, 18, 35]. This disorder is caused by the over-concentration of global supply and production chain networks and the fragility of the global economy [14]. A high percentage of people lost their jobs due to the closure of public places such as restaurants and shops, tourist centers and reduced industrial production [6, 22]. Due to quarantine and self-isolation, people's consumption, demand, and utilization of products declined. As a result of this decrease, companies' revenue declined resulting in the dismissal of some of their workers to make up for lost revenue. The high number of unemployed increased poverty for the first time since 1998 [2]. Another critical factor that has reduced the performance of companies during the pandemic is the problems caused by the supply chain [19, 33]. More than 75% of companies in the United States say that pandemics have disrupted their supply chains [36]. These disruptions particularly affected exporting countries, due to the lack of output for their local firms, and importing countries, due to the unavailability of raw materials. To respond to the challenges created by COVID-19, company managers must consider new strategies for their business.

According to a survey of 3,450 executives in 20 countries, businesses' priorities, and running policies in the post-pandemic era will be different and will require an intelligent combination of information technology, cost management, cybersecurity, and organizational agility [3]. The majority of these issues can be resolved through the use of decentralized E-commerce [13, 20]. Decentralized E-commerce solves not only the problem of supply but also the problem of demand in enterprises [15, 32]. Using this technology, companies can procure the raw materials they need online and compare products online without being exposed to viruses. Additionally, businesses can offer their products through online stores, which according to research, can restore 94% of the damage caused by pandemics [3]. This approach has proven to be a robust business model in the face of crisis, and organizations are increasingly using this method to recover their business after a pandemic [36]. On the other hand, because people's behavior patterns have changed, they will turn to e-commerce more than high street shopping in the coming years.

Emerging technologies such as blockchain [26, 41] can improve E-commerce services by creating a secure, transparent, and decentralized platform. Blockchain shows great potential to increase trust and improve the user experience over time[31]. Although various companies are looking for ways to recover from financial damage caused by COVID-19, the role of blockchain-enabled E-commerce has been properly investigated in the literature. In this article, we propose a model of decentralized E-commerce business in which all participants connect using a public peer-to-peer (P2P) blockchain. Using blockchain, sellers and buyers can come together securely without third parties and intermediaries to control and extract value from a decentralized marketplace. We assess this blockchain-enabled E-commerce approach with the aim of reducing the impact of the economic crisis caused by the pandemic. Evaluation results show that this approach can reduce the financial shocks caused by the demands and supply fluctuations. This is achieved by allowing businesses to select the products they need by directly checking suppliers and comparing prices. Using smart contracts reduces the risk of delays and low side costs. Blockchain properties speed up business transactions and enhance their overall efficiency by eliminating the need for institutions to refer to centralized institutions.

The rest of this article is structured as follows. Section 2, presents background information and related works about the economic crisis during the pandemic, blockchain, and E-commerce roles in tackling these problems. Section 3 provides our methodology. Section 4 discusses the results of the study. Section 5, concludes the work and provide future research directions.

2 BACKGROUND & RELATED WORK

Pandemics have devastating effects on the economy. Federal Reserve data show that the pandemic has caused the worst drop in production since 1940 [4]. For this reason, much research has been done on various aspects of the pandemic effects on the economy [9, 12, 38], and also in Artificial intelligence, Machine learning, blockchain, and the Internet of things[27, 44, 46]. This section, provides a brief overview of the existing research on the economic issues caused by pandemics and e-commerce and blockchain applications in this context.

2.1 Negative economic impact of COVID-19

The Pandemic has had many effects on the economy, specifically small and medium size companies [14, 36]. These effects are in the form of changing production rates [6], demand rates [29], and product distribution [16]. This pandemic, especially in the early days of the outbreak, has set records in the agriculture sector. In [11], the authors argue that various factors such as declining demand and labor shortages are causing a recession in this sector. Many European countries depend on the fruit and vegetable industry, which requires a very high labor force. Labor shortages led to declining production and financial losses. Quarantine and the closure of public places have drastically reduced the demand for food consumed in cafes, restaurants, and even parties.

Another important area that affects economic conditions is the supply chain. The supply chain is more complex and interdependent today because of globalization, making them vulnerable to the pandemic [11, 16]. Around 75% of companies in the USA reported disruptions in their supply chain. These disruptions impact both exporting and importing countries [14]. Guan and colleagues [16], examined the impact of different lockdown scenarios on the supply chain. Their goal was to identify the most critical aspects of lockdown, including strictness, duration, and recurrence of lockdowns and their influence on supply chains. Their research results show that supply chain losses largely depend on the number of countries imposing lockdown restrictions and these restrictions duration.

Although all companies are at risk, SMEs are more vulnerabilities to risks [22]. In [8], the authors assert that to respond to the COVID-19 crisis, corporate executives must change their business model and look for new ways to sell. Accordingly, the authors proposed a framework for SEM in post-pandemic. In their proposed model, they insist on the role of digital transformation in meeting productivity challenges.

In [23], the authors examine the impact of the economic recession caused by the pandemic on older people (over 65). This group of citizens often have financial constraints. Retirees have lower incomes and pandemic inflation may cause them economic hardship. Also, the pandemic may have devastating impacts on older workers who have fewer working years left to pay off debt and rebuild savings. These people may be less able to use technology to work remotely than young ones, making them more unemployed. Given the problems mentioned, the authors consider the role of the government and authorities to be vital for economic recovery.

2.2 E-commerce and COVID-19

E-commerce refers to a business model that allows companies and individuals to buy and sell goods and services over the Internet. Today, all the goods and services are available through e-commerce transactions, including houses, books, music, tickets, financial services, etc. The e-commerce process includes more than one party for data exchange or financial transfers for processing transactions. It helps businesses gain access to a broader market by providing cheaper and more efficient distribution channels for their products and services [30].

COVID-19 significantly impacted e-commerce increasing its overall value [1]. This pandemic has changed people's behavior patterns and made them rely on e-commerce as part of their daily habits. For instance, Walmart grocery e-commerce increased to 74% [10]. Following this pandemic, it is estimated that its e-commerce sales will reach $6.5 trillion by 2023 [10].

In the following, we give a brief overview of the research done on e-commerce during the pandemic. In [40], researchers found that executives are looking to run an online sale offer a unique platform to improve customer satisfaction consistently and over time. The authors of this paper examine a model of the perceived effectiveness of an e-commerce platform (PEEP) for economic benefits and sustainable consumption under conditions of pandemic fear. Findings show that companies need to create a PEEP with an effective mechanism for protecting personal data, online transactions, and economic proposals to increase customer consumption in times of pandemic fear. The authors in [30] examine e-commerce readiness in Indonesian organizations during pandemics. A company's readiness is measured in an unstable environment, and the pandemic period is a good time for that. E-commerce readiness is evaluated based on technological readiness, organizational readiness, and environmental readiness. According to their assessments, technology readiness has the most critical impact on the ability of companies to cope with fluctuations and environmental readiness encourage businesses to adopt e-commerce. On the other hand, the organization's readiness does not affect the readiness of E-commerce.

In related research [7], a case study was conducted on a food distribution company called Grub Hub. Launched in 2004, the company has grown by 53% in e-commerce. Pandemic has affected all aspects of the company, including restaurants, customers, and delivery personnel. In a pandemic, managers must meet the needs of their customers and have a better relationship with the stakeholders. The company's success in pandemic management depends on three factors: timely innovative solutions to meet the community's needs in times of crisis, addressing stakeholders' concerns by implementing various policies and supporting employees.

2.3 Blockchain and COVID-19

A blockchain is a general ledger distributed between nodes in a computer network[43]. All transactions between these nodes are stored in the general ledger and are available to all nodes with the aim to verify transactions[21, 43]. Blockchain allows individuals or organizations to trade in a completely secure way without a third party. A blockchain collects transactions and data into groups called blocks. Blocks hold a collection of information. The header block contains block hash, previous block hash, block version, nonce, Merkle tree root hash, timestamp, and difficulty target [28]. All blocks have a previous hash block and are thus connected.

To process transactions in the blockchain, transactions are first published on a P2P network. Network members check transactions validity, and if they are valid, they are placed in blocks and published in the network[45]. Once the block is authenticated, the transaction is completed, and a new block is added to the general ledger [39].

In recent years, much research has been done on blockchain as a tool to improve digitalization [37]. Many researchers have also considered blockchain during the pandemic period, and in the following, we will give a brief overview of these efforts. In [28], the authors present a blockchain and AI-based model for combating COVID-19. This model consists of 4 layers. In its initial step, the relevant data is collected from laboratories, clinics and hospitals. Then, this data is securely transferred to the next layer by blockchain and analyzed by tools offered by the blockchain, such as an outbreak monitoring, safe day-to-day operations, medical supply chain, and donation tracking. AI tools can process these data for outbreak estimation, coronavirus detection, coronavirus analytics, vaccine/drug development [17]. Finally, Stakeholders can use the result. The authors advocate that unreliable medical data, low accuracy, and time-consuming system to detect the COVID-19 virus lead to more epidemics. Hence, their proposed model improves the problem.

Torki et. al [39] proposed a P2P-mobile application for detecting positive COVID-19 cases. This application uses blockchain-based platform with blockchain's inherent features, such as a time-stamping and decentralization to verify and detect positive cases. The platform uses four components, including Infection Verifier Subsystem (IVS), a Blockchain platform, P2P-Mobile Application, and Mass-Surveillance System, to work. IVS stores the data of infected people and the places where they are infected in the blockchain. For protecting the privacy of infected people, regular expressions are used to find the pattern of infected places by the patient. The surveillance system is adopted to trace the users in these places. Another feature that blockchain provides is the ability to share information securely. This information can be medical records, files, and data of researchers or companies. Medical information is susceptible and should be securely distributed among insurance companies, pharmacies, and hospitals.

The authors of [24] propose a model based on artificial intelligence (AI) and blockchain to share COVID-19 data securely. The authors suggest an application based on AI and blockchain, designed for self-testing at a low cost. AI is used to diagnose the disease, and blockchain is used to collect and share it safely. Another important application of blockchain in a pandemic is vaccine supply chains. In [25], the authors propose an IoT and blockchain-based vaccine supply chain model. This model, named Go-Win, uses an IoT monitoring system, such as temperature sensors, to manage the condition of the vaccine doses during transportation or when they are stored. Also, blockchain is adopted for supply chain management, for instance, sharing data, authentication, and security. The above research is a short part of the applications of blockchain in combating this pandemic. Still, it also provides its vast potential to solve this problem and overcome the challenges resulting from COVID19.

3 MATERIALS AND METHODS

Figure 1, describes a blockchain-based e-commerce. In this design, companies offer their products online in the form of websites for the convenience of people under pandemic conditions. We consider a situation where these companies use a reputable site (such as Amazon) to launch their products. One of the advantages of using reputable e-commerce sites is that people trust them more [7]. In addition, these sites usually sell various products that give customers more choice [3]. When a sales company intends to use an e-commerce site, a contract must be reached between them. We consider a profit-sharing agreement [42] . In this type of contract, the profit is divided between the seller and the website, but the method

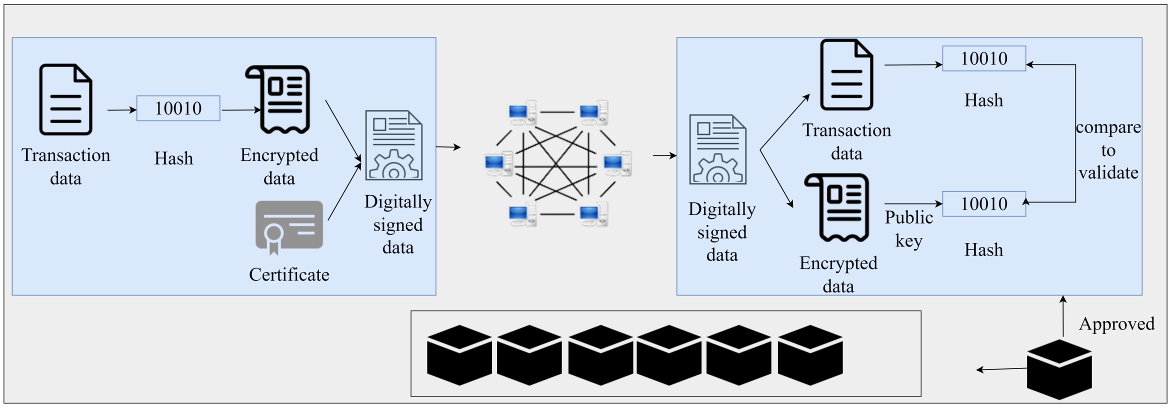

Figure 1: A typical blockchain architecture.

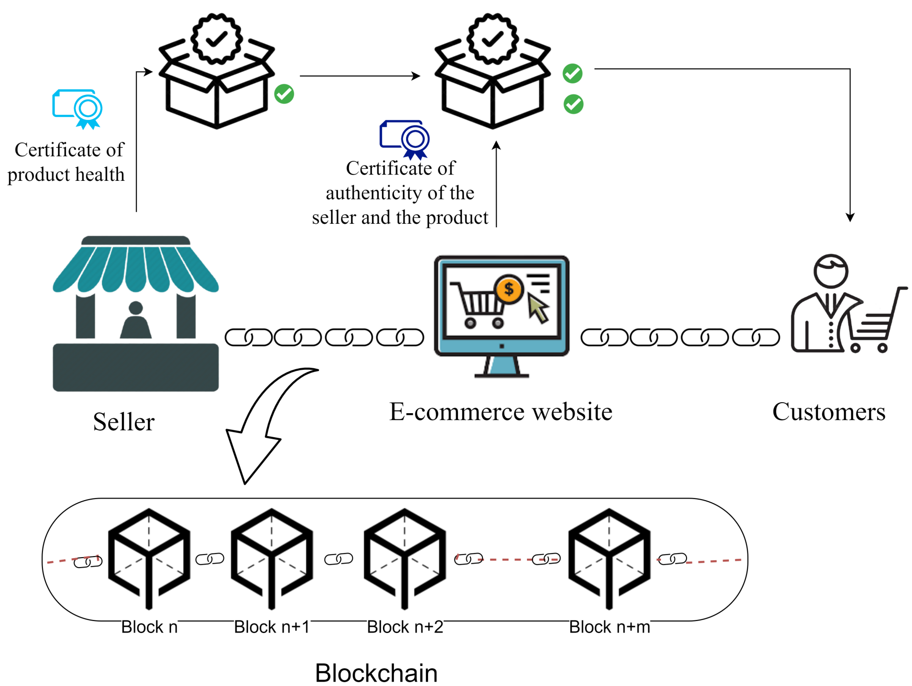

Figure 2: Blockchain based e-commerce.

of distribution and allocation of this profit must be determined. Therefore, a smart contract is created between them, and all the details of the agreement, including the ID of the parties, the type of product, the type of contract, and how to allocate percentages are specified.

According to our model, the e-commerce system is based on blockchain, and all information is recorded in all stages of preparation, maintenance, and distribution of products in the blockchain. When the seller company presents the products to the site, all information, including product preparation steps, storage conditions, transfer, which are recorded in the blockchain. The e-commerce website then issues a valid certificate for the product after verifying the product information and registering it in the blockchain. In this way, customers can be informed by examining how products are prepared, maintained, and distributed.

It is important to note that implementing blockchain is costly for the e-commerce website vendor. Using game theory, we examine under what conditions the profit and satisfaction of the seller, e-commerce website and customers are maximized. This model represents the seller with S, the e-commerce site with E, and the customers with C. The preparation price of each product in this model is equal to u. Sellers sell each product directly (without interfaces) at the cost of W, but if the site is used because the profit must be divided between them, we consider the price of each unit of product P, where $P > W > U$. We show the customer's desire to buy a product in binary 0 and 1. Since the customer's willingness to buy a product is variable, we denote it by the $f(x)$ function.

We consider two factors that cause people to worry in times of pandemic that affect their willingness to buy. One of these cases is the contamination of products during production, maintenance, and distribution, which we represent as $c1$. The second factor is people's concern about the authenticity of these products on the Internet, which we represented as $c2$. The value of each of these worries can be between 0 and 1. To alleviate these concerns, we considered a situation where blockchain records complete product information. Customers can ensure products' safety by reviewing this information in this situation. We represent this characteristic as $V1$. In addition, the e-commerce site issues a certificate to the seller after receiving the seller's data and authentication and registers it in the blockchain. In this case, customers make sure that product information is not fake, which is represented as $V2$. The blockchain implementation is costly for the vendor company and the e-commerce site. Therefore, we examine in which case the sales parties receive the highest profit simultaneously as customer satisfaction.

We define the expected performance for product sales as follows. If customers have fewer concerns, they will buy more and be more satisfied, increasing the efficiency of better and more involved factors.

$$E = \int_{((c1+c2)-v1-v2)-p}^{1} f(x)dx = 1 - ((c1 + c2) - v1 - v2) - p \quad (1)$$

If customers have fewer concerns, they will buy more and be more satisfied, increasing the efficiency of better and more involved factors. The total cost of applying the blockchain is $2b(v1 + v2)$, equal to $bv1$ for the seller and $bv2$ for the e-commerce site. This cost is for blockchain hashing, mining, and so on.

In this model, we use the full underlay Nash equilibrium method. This is a dynamic method for analyzing the multilateral competition of companies, where inverse inference is used. In this way, first, the leader company makes the best decision, and then the follower makes the best decision based on the follower's decision. In this model, the seller company is the leader, and based on his decision to use or not to use blockchain, the e-commerce website decides whether or not to adopt blockchain. We consider the following three scenarios to evaluate the profit.

$S1$ = None of the parties to the seller company and the e-commerce site should use blockchain. Obviously, the profit for the seller and the site is calculated as follows.

$$U_S = (w - u)(1 - (c1 + c2) - p) \quad (2)$$

$$U_w = (p - w)(1 - (c1 + c2) - p) \quad (3)$$

$S2$ = In this case, only the seller registers the product information in the blockchain, including preparation, maintenance, and distribution. Still, the e-commerce site does not certify the information and does not issue a certificate. The status of this certificate is unknown. The profit from the sale is as follows:

$$U_S = (w - u)(1 - ((c1 + c2) - v1) - p) - bv1 \quad (4)$$

$$U_W = (p - w)(1 - ((c1 + c2) - v1) - p) \quad (5)$$

In this case, only the seller has used blockchain and pays for the implementation. Still, because the blockchain-based e-commerce approach has been used, both the seller and the site benefit from reducing people's anxiety and increasing their willingness to buy. This means that it is not feasible for the seller not to use the blockchain to record information but for the website to issue a confirmation certificate. This information is a prerequisite for certification.

$S3$ = The last scenario is where both the vendor company and the e-commerce website use blockchain. And their profit will be as follows.

$$U_S = (w - u)(1 - ((c1 + c2) - v1 - v2) - p) - bv1 \quad (6)$$

$$U_W = (p - w)(1 - ((c1 + c2) - v1 - v2) - p) - bv2 \quad (7)$$

4 RESULTS AND DISCUSSION

In this model, we define $O \in \{w, p, v1, v2\}$, $M \in \{S1, S2, S3\}.R = argmaxU(X, M)$, when R is the best response. The $w, p, v1$ and $v2$ arguments are first calculated to maximize Us and Uw in each scenario. Then, the values of U_S, U_W are calculated using the obtained values. The seller is the leader, and the e-commerce website is the follower.

For solving problems under different scenarios, we use the backward decision approach. In this method, the e-commerce website assumes that the seller has made his decision before, and therefore, the value of w is considered a constant number as a predetermined value. Firstly, we calculate the derivative from the website's profit to obtain p based on w. We place the value of p obtained in terms of w in the seller's profit equation. In this case, the exact value of w is obtained. We place the value of w obtained in Uw to calculate the actual value of p. Then, the exact amount of profits is obtained by placing the values obtained in the seller's profit equations and the e-commerce site. We illustrate this process for finding optimized value in each scenario is the following.

Scenario $S1$: We use the backward decision method to calculate the values. In this method, we first, assume that the seller considers the value of w. Therefore, assuming the value of w, we use the local derivative of the e-commerce website profit equation to calculate p.

$$\frac{Uw}{Dp} = \frac{(p - w)(1 - (c1 + c2) - p))}{DP} = \frac{1 - (c1 + c2) + w}{2} \quad (8)$$

In the next step, we place the obtained value of p in Equation 2 to get the value of w.

$$\frac{Us}{Dw} = (w - u)(1 - (c1 + c2) - (\frac{1 - (c1 + c2) + w}{2})) * \frac{1}{Dw} = \frac{1 - (c1 + c2) - u}{2} + u \quad (9)$$

By replacing the w value obtained from Equation 9 with Equation 8 the value of p is obtained.

$$p = \frac{1-(c1+c2)+(\frac{1-(c1+c2)-u}{2}+u)}{2} = \frac{3(1-(c1+c2)-u)}{4}+u \tag{10}$$

Using the p and w values obtained from Equations 9 and 10 and placing them in Equations 2 and 3, the seller's profit values and the e-commerce website one will be as follows.

$$Uw = ((\frac{3(1-(c1+c2)-u)}{4}+u)-(1-\frac{(c1+c2)-u}{2}+u)) \\ (1-(c1+c2)- \\ \frac{(3(1-(c1+c2)-u)+u)}{4}) = \\ = \frac{(1-(c1+c2)-u)^2}{16} \tag{11}$$

$$Us = \left(\frac{(1-(c1+c2)-u)}{2}-u\right) \\ (1-(c1+c2)-\left(\frac{3(1-(c1+c2)-u)+u}{4}\right)) = \\ \frac{(1-(c1+c2)-u)^2}{8} \tag{12}$$

Scenario $S2$: In the second scenario, the values of p and w are obtained as in the first scenario. Based on Equations 8 and 9 and their placement in equation 4, we calculate $v1$. Since the seller reduces people's health concerns about products by adopting a blockchain, we must calculate the derivative of Us to find the $v1$ value.

$$\frac{Us}{Dv1} = (w-u)(1-((c1+c2)-v1)-p)-bv1*\frac{1}{Dv1} = \frac{1-(c1+c2)-u}{2b-1} \tag{13}$$

By putting the value of p (Equation 8) and $v1$ in Equation 4, the exact value of w is obtained.

$$\frac{Us}{Dw} = (w-u)(1-(c1+c2)-\frac{1-(c1+c2)-u}{2b-1})- \\ (\frac{1-(c1+c2)+w}{2})\frac{1}{Dw} = \\ \frac{b(1-(c1+c2)-u)}{2b-1} \tag{14}$$

By placing the value of w and $v1$ in Equation 5, the value of p is calculated as follows.

$$\frac{Uw}{Dp} = \frac{1-(c1+c2)+w}{2} - \frac{b(1-(c1+c2)-u)}{2b-1} \\ = \frac{2b(1-(c1+c2)-u)}{2b-1} \tag{15}$$

By using calculated values of p, w ,and $v1$ based on Equations 13, 14 and 15 the Us and Uw for scenario $S2$ are calculated in Equations 16 and 17.

$$Us = \frac{b^2(1-(c1+c2)-u)^2}{2(2b-1)} \tag{16}$$

$$Uw = \frac{b(1-(c1+c2)-u)^2}{2b-1} \tag{17}$$

Scenario $S3$: In scenario $S3$, we adopt the backward decision method just like former scenarios. For this purpose, at first, we calculate the derivative of Equation 7 for p. According to Equation 19, we reposition the value of p in Equation 7 and calculate the derivative to obtain the value of $v2$.

$$\frac{Uw}{Dp} = (p-w)((1-(c1+c2)-v1-v2)-p)-bv2*\frac{1}{Dp} = \\ \frac{1-(c1+c2)-(v1+v2)+w}{2} \tag{18}$$

$$\frac{Uw}{Dv2} = (\frac{1-(c1+c2)-(v1+v2)+w}{2}-w) \\ (1-(c1+c2)-(v1+v2)-p)-bv2 \\ = \frac{(c1+c2)-2(1+b-w)-v1}{2b-1} \tag{19}$$

$$\frac{Uw}{Dv1} = (w-u)(1-((c1+c2) \\ -v1-\frac{-2-2b+(c1+c2)+2w-v1}{1-2b}) \\ (\frac{1-(c1+c2)-(v1+\frac{(c1+c2)-2(1+b-w)-v1}{2b-1})+w}{2}) \\ -b(\frac{-2-2b+(c1+c2)+2w-v1}{1-2b} \\ +\frac{1}{Dv1} = \frac{4(1-(c1+c2)-u)}{16b-2} \tag{20}$$

Then, we obtain the value of w by placing the value of $v1$ in Equation 6 and derivative from this equations.

$$\frac{Uw}{Dw} = (w-u)(1-((c1+c2)-\frac{4(1-(c1+c2)-u)}{16b-2} \\ -\frac{-2-2b+(c1+c2)+2w-\frac{4(1-(c1+c2)-u)}{16b-2}}{1-2b})- \\ \left(\frac{1-(c1+c2)-\left(\frac{4(1-(c1+c2)-u)}{16b-2}+\frac{(c1+c2)-2(1+b-w)-\frac{4(1-(c1+c2)-u)}{16b-2}}{2b-1}\right)+w}{2}\right) \\ -b(\frac{-2-2b+(c1+c2)+2w-\frac{4(1-(c1+c2)-u)}{16b-2}}{1-2b}+\frac{1}{Dw} = \\ \frac{2(1-(c1+c2)-u}{16b-2} \tag{21}$$

By placing the calculated values from Equations 18 and 19 in Equation 6 the values of $v1$ and w can be obtained, that is shown in Equation 20.

In the last step according to Equations 22 and 23 using this values we can calculate the Us and Uw for scenario $S3$.

$$Us = \frac{2(8b-1)(1-(c1+c2)-w)^2}{16b-2} \tag{22}$$

$$Uw = \frac{(16b-1)(1-(c1+c2)-w)^2}{2(16b-2)^2} \tag{23}$$

According to the obtained values, more profit will be received if both the seller and the website have used blockchain. On the other hand, the use of blockchain on both sides reduces customers' concerns about the authenticity and health of the product, making customers more satisfied. It should be noted that the use of blockchain only on the seller side reduces some of the customer concerns. It is observed that it is in the second degree of profitability, while scenario S1 is in the lowest stage of profitability.

5 CONCLUSION

In the last two years, COVID-19 caused unprecedented global economic crisis. Unlike previous economic problems, this crisis is caused by pandemic. Although e-commerce can alleviate this economic crisis, it should be borne in mind that people's concerns about the safety and authenticity of products will reduce their purchases. We, therefore, examined the blockchain-based e-commerce approach to address these two concerns. Using the complete underplay Nash equilibrium game theory method, we examine the profit and satisfaction of customers, the seller company, and the website. For evaluating our proposal, we considered three scenarios where none of them use blockchain, only the vendor company uses it, and when both vendors and the website use it. The results analysis show that the situation in which both parties use the blockchain, due to the further reduction of public concern, will bring more profit to both parties. In future research, we will examine the role of circular economy in improving the economic challenges posed by the pandemic for sustainable economic growth.

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