Effect of Blockchain Technology Investment on the Stock Market Reaction, Firm Value, and Financial Performance.

تأثير الاستثمار في تقنية سلسلة الكتل على رد فعل سوق الأوراق المالية وقيمة الشركة والأداء المالي.

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Abstract:

Blockchain technology is the most successful emerging technology. It made a massive change in traditional online transactions by eliminating the intermediaries or verifying authorities, and it attracted the attention of firms and investors. In addition, most previous studies agreed that blockchain technology improves transparency, reduces information asymmetry, and increases investors interactions. However, those studies have been conducted in the developed countries, and till now according to the researcher's knowledge there is a shortage in the studies that investigate the market and financial value of blockchain technology in the developing countries. Therefore, this study investigates the relationship between blockchain technology investment, stock market reaction, firm value, and financial performance in one of the developing countries. Based on 182 observations of 26 financial firms between 2014 and 2020, an empirical study was conducted to examine the relationship between blockchain technology investment and financial performance, and the results revealed a significant positive effect of blockchain technology investment on both return on assets and return on equity. Further, the publicly unlisted firms have been removed to examine the relationship between blockchain technology investment, stock market reaction, and firm value, so the number of observations has been decreased to be 112 of 16 financial firms and the results indicated a significant positive effect of blockchain technology investment on the abnormal return of stocks and Tobin's q as a measurement of firm value.

Keywords: Blockchain technology investment, Stock Market reaction, Firm Value, and Financial Performance.

الملخص:
تعد تقنية سلسلة الكتل أنجح التقنيات الناشئة، والتى أحدثت تغييرًا هائلاً في المعاملات التقليدية عبر الإنترنت من خلال القضاء على الوسطاء أو التحقق من السلطات، كما جذبت انتباه العديد من الشركات والمستثمرين. بالإضافة إلى ذلك، اتفقت معظم الدراسات السابقة على أن تقنية سلسلة الكتل تحسن الشفافية، وتقلل من عدم تماثل المعلومات، وتزيد من تفاعل المستثمرين، ولكن معظم هذه الدراسات تم أجرائها في الدول المتقدمة. لذلك ووفقًا لمعرفة الباحثه، فأن هناك نقص في الدراسات التي العلاقة بين رد فعل سوق الأوراق المالية والاستثمار فى تقنية سلسلة الكتل في الدول النامية. لذلك، هدفت هذه الدراسة إلى إختبار العلاقة بين الاستثمار في تقنية سلسلة الكتل وكلاً من رد فعل سوق الأوراق المالية، وقيمة الشركة، والأداء المالي في أحد البلدان النامية. واعتمدت الدراسة على ١٨٢ ملاحظة لـعدد ٢٦ شركة مالية خلال الفترة من ٢٠١٤ إلى ٢٠٢٠. وتوصلت الدراسة إلى وجود تأثير إيجابي كبير للاستثمار في تقنية سلسلة الكتل على كلاً من العائد على الأصول، والعائد على حقوق الملكية. علاوة على ذلك، فقد تم استبعاد الشركات الغير مدرجة في سوق الأوراق المالية لفحص العلاقة بين الاستثمار في تقنية سلسلة الكتل وكلاً من رد فعل سوق الأوراق المالية، وقيمة الشركة، لذلك انخفضت عدد الملاحظات إلى ١١٢ لعدد ١٦ شركة. وأشارت النتائج إلى وجود تأثير إيجابي كبير للأستثمار في تقنية سلسلة الكتل على العائد غير العادى للأسهم و Tobin q كمقياس لقيمة الشركة.

الكلمات المفتاحية: الاستثمار فى تقنية سلسلة الكتل، رد فعل سوق الأوراق المالية، قيمة الشركة، الأداء المالي.

I. Introduction.

Digital technology (DT) has changed the way people do their things, everything is going online, like e-commerce, electronic data interchange, cloud computing, the internet of things, and blockchain (Chin et al. 2021). Thus, through the internet you can buy and sell anything, such as houses, smartphones, products and more. However, the traditional online transactions between buyers and sellers depend on a centralized database system and the third parties such as Amazon and PayPal (Kim et al. 2020; Li and Wan 2021). Therefore, the emergency of blockchain technologies has become the main driver of firms' innovation and competitiveness (Allam 2018). It has been considered the main technology for the information revolution that has made a significant change in the payment methods and increased firms' attention toward improving productivity and performance to increase their competitive advantages (Allam 2018; Chin et al. 2021). It is a decentralized distributed ledger database that contains all digital transactions that have been done and shared among all participants on a peer-to-peer network, which can be joined by anyone (Noble and Patil 2021; Paul et al. 2021).

In addition, blockchain technology stores transactional data in blocks, whereas each block is linked with the previous and the following block in a sequential manner, and it contains a hash of the previous block, timestamp, and data transactions (Allam 2018; Sheel and Nath 2019), which prevents the adding, removing, or modifying of any block of the chain without modifying the previous and subsequent block (Zhou 2018; Sheel and Nath. 2019). Thus, this technique makes the blockchain very precise and innovative, and perfect for keeping transactions (Paul et al. 2021). Moreover, it has been introduced by Satoshi Nakamoto to allow online transactions between two parties without the need for intermediaries (Noble and Patil 2021), and it has emerged in different digital assets such as bitcoin, Ethereum, and hyper ledger, which increased its use in different applications such as financial service, e-commerce, insurance, fraud detection, copyright protection, and healthcare (Yen and Wang 2021; Noble and Patil 2021). Therefore, it overcomes the information sharing and resource integration problems, and generates new models of business operation and management (Pan

et al. 2020). The smart contract, supply chain management, digitalization, information sharing, and intelligent transportation systems are the main applications of blockchain technology (Li and Wan 2021).

Blockchain technology can reduce the time and costs spent by third parties such as banks or governmental organizations (Chin et al. 2021). It also can provide a safe payment method without the need for authorization from any authority (Noble and Patil 2021). It has some characteristics such as cryptography, decentralized technique, distributed ledger, transparency, and immutability of information, which support reliability, avoid error, failure, detect fraud and confirm customers' validity (Kim and Shin 2019; Noble and Patil 2021). In addition, it can improve the efficiency, traceability, accountability, and transparency of the business processes during the different stages of the product life cycle (Yang et al. 2020), Therefore, firms can depend on blockchain technology to develop their products (Chin et al. 2021). In addition, firms can use blockchain technology to establish relative superiority in technology from their competitors to improve their competitive advantages (Chin et al. 2021). Moreover, blockchain technology can help managers effectively evaluate firm performance and make decisions about innovation strategies and update them continuously (Chin et al. 2021) because it improves the accuracy and efficiency of accounting prediction, which improves the firm's stock price, performance, and its value creation (Li and Wan 2021).

Based on the above discussion, there are few studies on blockchain technology investment, and most of them have focused on the use of blockchain in different areas such as supply chain management, finance, auditing, accounting, and healthcare, but it can be used to achieve a remarkable development in those areas. Therefore, there is an available research gap for the impact of blockchain technology on the stock market reaction, value creation, and financial performance. Thus, the research questions are as follows: Do blockchain technology investment announcements increase the stock market reaction? Does blockchain technology investment improve the firm value of Egyptian firms? Does blockchain technology investment improve the financial performance of

Egyptian firms? The objectives of this study are: First, examining the stock market reaction during an event announcement period depending on the event study. Second, investigate whether the investment in blockchain technology improves the firm value. Third, investigate whether the investment in blockchain technology improves the firm's financial performance. In order to achieve those objectives, the study first, depends on an analysis of the literature review that related to blockchain technology, market reaction, firm value, and financial performance. Second, it depends on data of Egyptian banks that adopted blockchain technology during the period of 2015 through 2019. Third, it empirically tested the research hypotheses to find whether there is evidence on the relationship between blockchain technology investment, market reaction, firm value, and financial performance.

This study contributes to the literature as follows. First, it provides evidence on the relationship between blockchain technology investment disclosure and the stock market reaction. Blockchain technology has been recognized as the main digital technology for creating and acquiring value creation because it can change many aspects of the business (Chin et al. 2021). Therefore, the announcements of blockchain technology investment can increase stock prices and investors' reactions. While prior studies have reached mixed results regarding the relationship between blockchain technology announcements and the stock market reaction and most of them have been done in the United States and China, this research is trying to find any evidence on the relationship between blockchain technology investment announcements and stock market reaction in a different country such as Egypt, to be able to compare the results of this study with those of the previous literature. Second, this research contributes to the literature on the long-term stock market reaction to blockchain technology investment by examining the impact of blockchain technology investments on firm value. Third, the study contributes to the literature on the relationship between financial performance and blockchain technology investments because according to the researcher's knowledge there is a shortage in the previous studies that have examined that relationship. Finally, some Egyptian firms have started to consider or adopt blockchain technology, therefore, this research will help them

recognize the benefits that can be generated from adopting that advanced technology.

The rest of this paper is organized as follows: first, the theoretical background of blockchain technology is presented in section II. The literature review and hypothesis development are presented in section III. The research methodology is presented in section IV. The research results are presented in section V. Finally, the research conclusion, limitations, and areas for future research are presented in section VI.

II. Theoretical Background

The blockchain originated from the concept introduced by two researchers in 1991 named Stuart Haber and W. Scott Stornetta. They developed a system cryptographically using a secured chain of blocks to protect the digital time-stamped documents from tampering (Alsaqa et al. 2019). In October 2008, blockchain technology was developed as a public ledger for recording the trading of the cryptocurrency bitcoin without any outsider by Satoshi Nakamoto (Dai et al. 2017; Alsaqa et al. 2019), who wrote a paper about exchanging money between two participants without a financial institution (Gomathi et al. 2021). This development made the bitcoin the first digital currency for solving the problem of duplicate spending and for allowing the exchanges in a trusted environment without the need for third-party intermediates or certifying authorities to record and verify the digital ledger and double-dealing transactions (Appelbaum and Smith 2018; Wang and Kogan. 2018). In addition, that development allows users to access all transactions' details, such as sender and recipient name and the amount, and it also allows them to update and maintain the shared database (Wang and Kogan. 2018). Under blockchain technology, each user on the network is a node, and it must verify the validity of each new transaction, which is published to all nodes and packed as a block (Yen and Wang 2021).

Blockchain is a decentralized distributed ledger technology for recording and maintaining all encrypted digital transactions that have been shared among participants on a peer-to-peer network (Osmani et al. 2020; Ji and Tia 2021; Aketch et al. 2021). The network nodes confirm each transaction before adding it to the blockchain, and once the information

is entered it cannot be deleted or changed, but it can be retrieved at any time (Osmani et al. 2020; Ji and Tia 2021). In addition, it is a list of records called blocks that are linked together using cryptography and each block follows the other in a specified sequence of chains, and it is linked with the previous and next block, so the data in the blockchain cannot be modified in any block (Zhou 2018; Autore et al. 2021). Each block contains several transactions that are protected by cryptographic and digital signatures (Meidute-Kavaliauskiene et al. 2021). In addition, each block has a limited capacity, so once the block is completed it becomes a permanent record of transactions, and then the new one is published (Osmani et al. 2020; Aketch et al. 2021). Security is considered one of the most important advantages of the blockchain. The information in the blockchain is validated by millions computer, thus, it is impossible to destroy the blockchain (Ji and Tia 2021).

Moreover, each block includes three elements, which they are transaction data, timestamp, and a cryptographic hash of the current and the previous block, to prevent any block from being altered or a new block to be added between two blocks (Kawaguchi 2019). The timestamp proves the time of publishing the block and getting its hash (Kawaguchi 2019; Aketch et al. 2021). The cryptographic hash looks like a fingerprint, and it is a function that converts the transaction data, and the previous block's hash to a unique value (Kawaguchi 2019). Therefore, the computers in the network must verify the transactions by solving the hash and then the block is added to the blockchain (Aketch et al. 2021). Each subsequent block in the previous ledger uses the previous block's hash to calculate its own hash (Ji and Tia 2021). The first block in the blockchain is called the genesis block and its previous hash is zero (Dai et al. 2017; Kawaguchi 2019). Figure 1 shows the elements of blockchain.

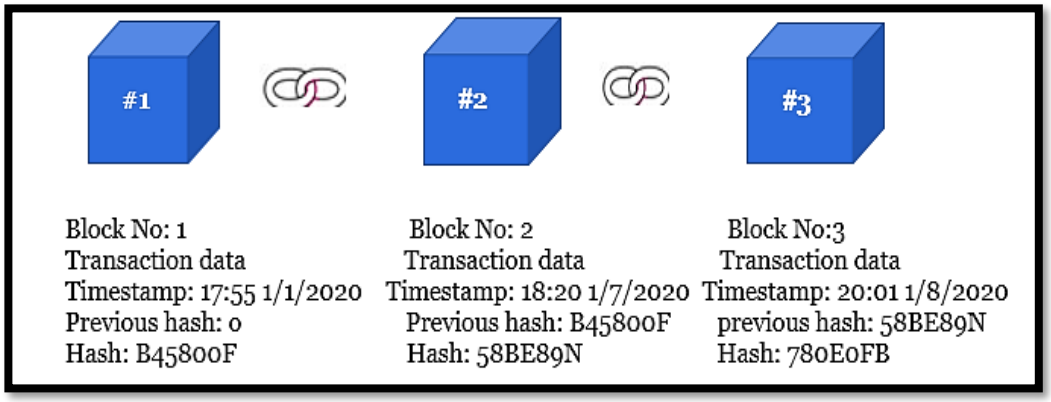

Figure 1: Blockchain elements (Source: The researcher)

Blockchain has many Features that make it very useful to users. As shown in figure 2, the characteristics include:

1- Decentralization: it refers to the process of storing, maintaining, verifying, and transmitting of data on blockchain (Chen et al. 2018). In blockchain technology, all information is available to all participants (nodes) and each participant has the right to access all transactions without any need for a third-party or trusted authority (Lu 2018; Zheng and Lu 2021). Therefore, the rights of all nodes in the blockchain are the same, and because each node has a complete record of the transaction, the damage to any node will not affect the other nodes or blockchain technology (Lu 2018). In addition, all participants can work together and control the system (Dai et al. 2017).

2- Distributed ledger: each node of the blockchain has a distributed ledger and after each block is completed a new one is created and recorded through encryption and each node will be notified (Wang and Wu 2021). In addition, to maintain the consistency of all node ledgers, all ledgers of all nodes are updated at once (Wang and Wu 2021).

3- Anonymity: blockchain technology provides an encrypted record of all transactions (Zheng and Lu 2021), so there is no need for disclosing the related information or verifying the identity of each node (Lu 2018), and there is no need to keep any private information because this information may be required in the

private blockchain, which operates by limited number of participants (Viriyasitavat and Hoonsopon 2019).

4- Persistency: once the transaction is recorded in the blockchain ledger it becomes persistent, so it cannot be changed or reversible (Dai et al. 2017; Zhou 2018). This is because each transaction is spread across the different nodes on the network and each node keeps and controls its records (Viriyasitavat and Hoonsopon 2019).

5- Immutability: it refers to the ability of the blockchain ledger to remain the same because all transactions are stored in the block with an encrypted hash (Zheng and Lu 2021) and that block is linked with the previous and following blocks (Chen et al. 2018). Therefore, interfering with any transaction will result in a different hash value and it can be discovered by all nodes. Thus, the information in the blockchain cannot be changed or altered (Zheng and Lu 2021). This is because the successful interfering needs to change more than 50% of the ledgers on the network (Chen et al. 2018).

6- Traceability: it refers to the sequential order of all the transactions on the blockchain and each block is connected to the previous and following block by the cryptographic hash and time stamp. Therefore, double recording is avoided, and each transaction is traceable by identifying the block hash and its time stamp (Wang and Wu 2021).

7- Transparency: the public blockchain is an open source, so all participants in blockchain technology can access all transactions at any time, and they can develop applications, trace and verify the blockchain data (Lu 2018; Viriyasitavat and Hoonsopon 2019; Zheng and Lu 2021).

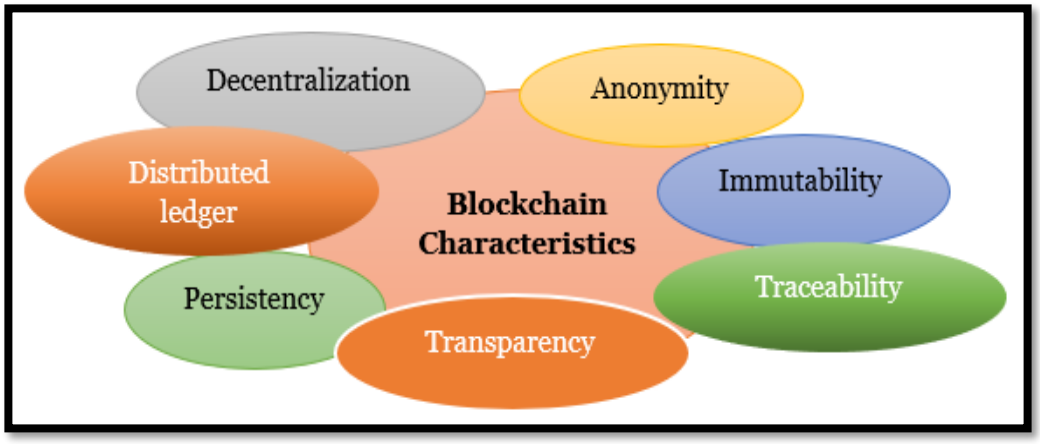

Figure 2: Blockchain characteristics (Source: The researcher)

The implementation of blockchain technology can be classified into four models, as shown in figure 3, based on permission as public, private, consortium and Hybrid (Ølnes et al. 2017; Cao et al. 2020; Yang et al. 2020).

A public blockchain is permissionless and open for participation by any node, so anyone can join and be a part of the network without the need for permission (Yang et al. 2020). All participants have equal rights of reading, writing, sending, verifying transactions, and creating new blocks (Natarajan et al. 2017; Gomathi et al. 2021). It is also a decentralized platform, so no one can control the recording and processing of transactions, and the validation of transactions can be done without any trusted authority (Ølnes et al. 2017; Yang et al. 2020). In addition, it is immutable once the data has been validated on the blockchain, and it cannot be modified or altered (Natarajan et al. 2017). It depends on some mechanisms such as bitcoin, which is a proof of work, and Ethereum, which is a proof of stake, so it is mainly used for exchanging cryptocurrency (Yang et al. 2020). Moreover, it has an unlimited number of nodes, and all blocks should be linked with the genesis block (Ølnes et al. 2017; Yang et al. 2020). It can be used in public sectors such as healthcare and education (Yang et al. 2020).

A private blockchain is permissioned because it works on the basis of access control, which restricts anyone from participating in the network,

and that its access can be varied from reading and writing to making changes on the blockchain (Natarajan et al 2017; Ølnes et al. 2017). It is also centralized whereas a single entity controls the network and determines who can read, write, send, and verify the transactions (Ølnes et al. 2017; Yang et al. 2020). Unlike a public blockchain, a private blockchain is restricted if someone wants to join the network, he/she should obtain permission (Natarajan et al 2017; Yang et al. 2020; Gomathi et al. 2021). Therefore, it has different levels of access rights, and the information of any transaction is available only to participants (Ølnes et al. 2017; Yang et al. 2020). Therefore, it has data privacy because any change can be made by the agreement of all nodes (Lu 2018). It also has fewer nodes, so it is easy to control it and get permission from the owners (Natarajan et al 2017; Yang et al. 2020). Hyperledger virtual currency exchange network is an example of a private blockchain (Lu 2018). That blockchain can be adopted by specific sectors, such as finance and government (Yang et al. 2020).

A consortium blockchain is permissioned and partially private, where it is controlled by a group of enterprises that determine who can access data and verify transactions, and each entity controls one or more nodes (Dib et al. 2018; Elisa et al. 2020; Gomathi et al. 2021). It is more decentralized than a private blockchain and allows limited access to data, so only participants can read, write, and verify the transactions (Elisa et al. 2020; Zhong et al. 2020; Gomathi et al. 2021). In addition, it combines the benefits of the public blockchain and private blockchain, such as efficiency, extension, permission, and privacy (Dib et al. 2018; Zhong et al. 2020). Moreover, it can be used by the financial service industry (Dib et al. 2018; Elisa et al. 2020).

Hybrid blockchain is also called a semi-private blockchain and is controlled by a single entity that identifies the information that should be kept private, and which can be accessed by all users (Chen 2018). Therefore, it combines the features of the public and private blockchain by identifying private and public (Chen 2018; Cao et al. 2020). It can be centralized or decentralized, whereas the transaction process is controlled by some authorized parties who perform their operations according to their permission (Cao et al. 2020). It is also flexible, where it allows users

to join the public blockchain and access the data, but it controls who can store the data and create blocks (Chen 2018). However, it has a degree of security related to the public blockchain (Natarajan et al 2017; Cao et al. 2020).

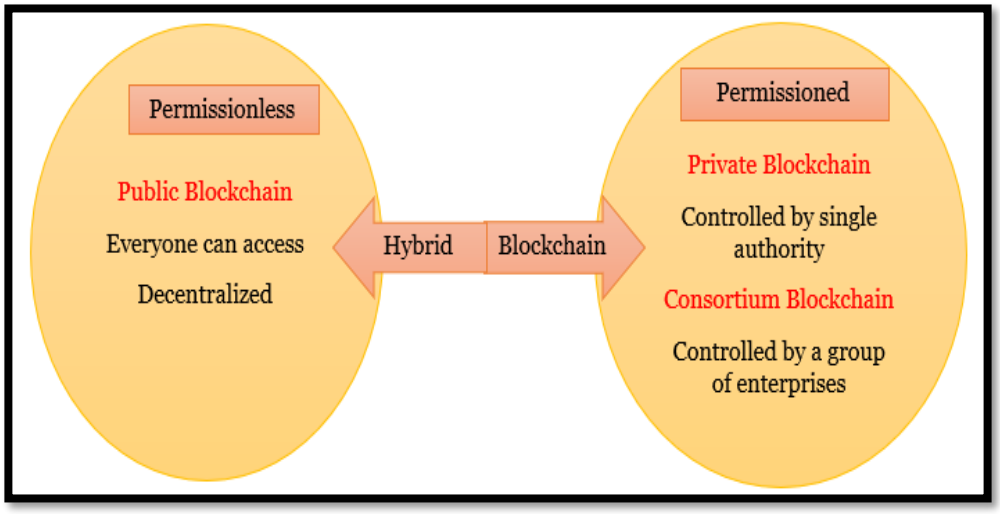

Figure 3: Blockchain types (Source: The researcher)

There are many applications of blockchain technology in enterprises, as shown in figure 4. The first application of blockchain technology is a smart contract, which was introduced by Ethereum and Nick Szabo in 1994 (Dib et al. 2018) and it has combined users' interfaces with computer protocols (Zhou 2018). It is a self-execution that depends on programmed computer code, so it can be implemented without human interaction (Balaji 2019). Therefore, the payment of each contract can be made automatically, whereas the participating enterprises are involved, and all pre-configured conditions are met (Zhou 2018; Varfolomeev et al. 2021). The smart contract has replaced the intermediaries such as banks and lawyers to sign a contract because it can be done by the system (Zhou 2018). In addition, there is a local virtual machine such as an electronic voting machine for each node connected to the blockchain (Dib et al. 2018; Varfolomeev et al. 2021). On the other hand, the smart contract can also be used for exchanging property ownership (Dieterich et al. 2017; Zhou 2018). Smart property can be used with physical and non-physical assets such as cars, houses, smartphones, shares, and patents (Zhou 2018).

Thus, in a smart contract, anyone can exchange money or any asset without any need for a middle party's services (Balaji 2019).

Another blockchain application is supply chain management. Blockchain can improve supply chain flexibility and transparency (Meidute-Kavaliauskiene et al. 2021). Flexibility refers to the ability to gain a competitive advantage through moving and responding quickly to any change in customer needs (Meidute-Kavaliauskiene et al. 2021). A flexible supply chain can improve the delivery of products to the market in required quality, features, and quantities (Meidute-Kavaliauskiene et al. 2021). In addition, it can be achieved by sensing and responding quickly to any changes in the dynamic environment (Meidute-Kavaliauskiene et al. 2021). Blockchain technology can improve supply chain flexibility by assisting in tracing and tracking the customers' orders to deliver them in real-time (Meidute-Kavaliauskiene et al. 2021). Moreover, blockchain technology can also improve the management of supply and inventory by enhancing predictions and managing demand (Meidute-Kavaliauskiene et al. 2021).

Transparency refers to providing timely and complete information about the moving process of requested products to all stakeholders (Meidute-Kavaliauskiene et al. 2021). Supply chain transparency can improve customers' trust and satisfaction by providing information about the place of manufacturing and processing products and their routing of delivery (Meidute-Kavaliauskiene et al. 2021). Blockchain technology can improve supply chain transparency by sharing real-time data, and developing a strategic tool for planning, outsourcing, and improving the relationship between suppliers and customers (Meidute-Kavaliauskiene et al. 2021).

The third application of blockchain is information management, whereas blockchain technology enables storing a wide range of data or information in the leasing domain, such as property leasing information (Yang et al. 2020). Therefore, the ownership of smart property such as cars, phones, and houses can be controlled by blockchain (Zhou 2018). In addition, the smart leasing process and components can be registered, updated, and programmed by blockchain technology (Yang et al. 2020). One more

application of blockchain technology is the internet of things (IoT), which enables the interaction between humans and machines by the sensor network (Dai et al. 2019). The valuable information transferred and employed by sensor networks should be accurate and safe (Duan and Guo 2021). Therefore, the blockchain provides a protected environment for storing, managing, and transferring that information (Dai et al. 2019). In addition, blockchain technology can also enable IoT applications to keep the transaction records permanently and verifiably (Duan and Guo 2021).

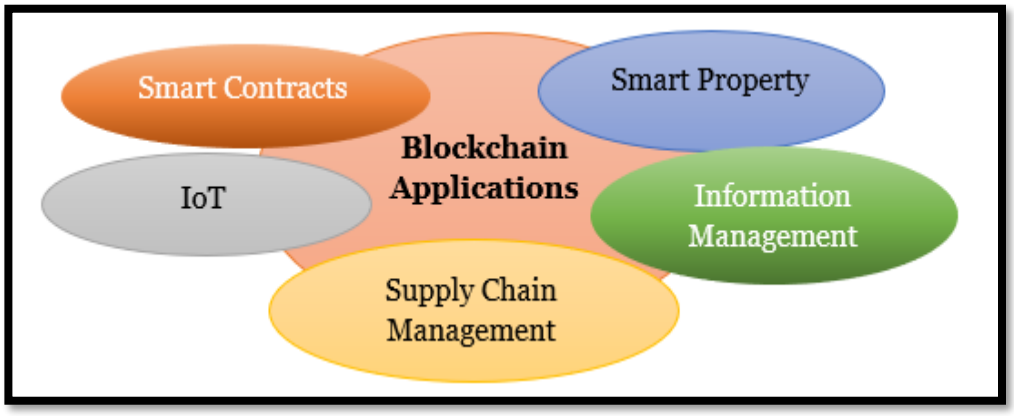

Figure 4: Blockchain applications (Source: The researcher)

II. Literature Review and Hypotheses Development.

According to the efficient market theory, the stock price reflects all negative and positive information, therefore the announcements of blockchain technology investment will cause a change in the abnormal returns. In addition, the investment in blockchain technology will improve the firms' performance and their values through improving real-time transparency and data sharing, reducing costs, improving the reliability and validity of data, which improve firms' sales, revenue growth, return on assets, and their competitive advantages. Therefore, the research hypotheses will be developed based on the analysis of the previous studies on blockchain technology and its relationship with the stock price, firm value, and financial performance.

The effects of blockchain technology investment on stock market reaction.

The application of blockchain technology in the financial industry can increase operational efficiency, security, and accuracy and reduce costs. According to the market efficiency theory, the more information about companies, the more efficient the stock market price, which is expected to react to the event announcements in the following period. Therefore, prior studies have found a positive relationship between blockchain technology application announcements and stock market reaction. For example, Zhou (2018) investigated the relationship between blockchain investment announcements and stock prices. Zhou observed the abnormal return, average abnormal return, and cumulative average abnormal return of 80 announcements. The results indicated that the blockchain investment announcements positively affected the stock price of financial companies, and that effect is different at different stages of the R&D process, whereas the initiation and continuation project stages had a positive effect on the stock price than the last stage. Moreover, the positive effect of blockchain investment announcements on stock prices was higher for small firms than large firms.

Focusing on blockchain investment disclosure and investor reactions, Cheng et al. (2019) examined the short-term investors' reactions to 8-k disclosure that contained blockchain through abnormal stock returns within 30 trading days. They depend on 82 firms that use blockchain technology in their 8-k disclosure. The results revealed a significant positive relationship between investors' reactions and speculative 8-ks blockchain disclosure. Investors had reacted positively to the blockchain announcements by speculative firms, and that reaction was reversed after 30 days of blockchain disclosure. Therefore, the authors concluded that investors had overreacted to blockchain disclosure when bitcoin returns were positive. In addition, Corbet et al. (2020) analyzed the stock market index returns to the announcements of kodak and cryptocurrency announcements and collected data on a 5 m frequency basis from 4820 observations during the period of 22 November 2017 through 21 February 2018. They found a significant and sustained increase in share value and returns volatility after the announcements of any investments in

blockchain technology such as cryptocurrency and Kodak coin, with a positive correlation between kodak returns and the high-risk asset class of cryptocurrency.

The recent studies on bitcoin and cryptocurrency have focused on the mediating effect of bitcoin performance on the relationship between blockchain investment announcements and markets' responses. Cahill et al. (2020) investigated the market reaction to firms' intention to adopt blockchain technology and its relationship with bitcoin performance. Based on a sample of 713 firms that have made announcements about the adoption of blockchain between 2016 and 2018, they found that the cumulative abnormal returns were higher, the average abnormal returns were 5.3% on the announcement day and linked to the bitcoin performance, for those firms that made a blockchain announcement in 2017 than those that made blockchain announcements in 2018. They also found that the abnormal returns were higher for speculative firms and those that have mentioned blockchain in their 8-k filings than non-speculative firms and the other firms that have not mentioned blockchain in the 8-k filings.

In a similar line, Hashemi Joo et al. (2020) examined the market reactions to the announcements of three types of cryptocurrencies: Bitcoin, Ethereum, and Ripple. They depended on 10 positive and negative announcements of those three currencies and found high abnormal returns on the event day (day 0) and high cumulative abnormal returns during the event window of (-3,6) and (0,6) and larger for negative events than the positive events. Thus, the authors concluded that the investors had reacted slowly to the cryptocurrencies' announcements and their reactions to the positive announcements were stronger than the negative events.

Based on the efficient market hypothesis, the stock market and stock prices will be affected by the available information, and they will be changed according to any change in that information. In addition, the interactive information of blockchain provides a useful channel of communication between users and firms. Therefore, Zhang et al. (2020) examined the short-term stock price movements and predictions due to

the intervention of blockchain information. Based on a stock price prediction model and a convolutional neural network to extract the features of blockchain interactive information, the results revealed a significant positive effect of the interactive information of blockchain technology on the stock market prices and forecasts.

Additionally, Autore et al. (2021) examined 249 news announcements that had mentioned an investment in blockchain technology or potential use of blockchain technology, depending on Dows Jones Factiva global news database and during the period from 2008 through June 2019. For the first public announcement of blockchain investment, they found the average stock price reaction was +13%, followed by the return reversal over the next three months. In addition, the announcement of credible blockchain technology strategies was associated with higher significant reactions and with no following reversal. Therefore, the blockchain investments were viewed appreciatively by investors. In a similar line, but specifically focusing on the market reaction to applying blockchain technology for Chinese companies, a recent study by Xu (2021) depended on a short-term event analysis method to investigate the market reaction of 73 listed companies that published blockchain technology application announcements during the period from 2016 through 2019. The results showed that the Chinese capital market has responded positively to the application of blockchain, and the abnormal income of the listed companies has been increased after the announcements of blockchain technology applications.

On the other hand, and by focusing on long-term stock-market reaction to the blockchain announcement, Eshghi et al. (2021) investigated the stock market reaction to the announcements of bitcoin, blockchain, and cryptocurrency in the 10-k filing. They used a sample of 110 firms that have mentioned blockchain, bitcoin, or cryptocurrency in their 10-k filing from 2013 through 2018 and returns from 2014 through 2019. The authors found that the average stock returns were higher when the bitcoin return was higher than the low. They also found that the average stock returns of bitcoin, cryptocurrency, and blockchain were higher on the days with similar news stories and high bitcoin returns than the less similar news stories and low bitcoin return days. The trading volume of

bitcoin, cryptocurrency, and blockchain was higher on days with negative news stories and similar content to the 10-k filing. Thus, they concluded that investors had paid attention to both 10-k content and news stories. Moreover, Austin and Williams (2021) investigated the relationship between the adoption of advanced technology such as blockchain and the judgments of nonprofessional investors. They found no relationship between blockchain technology investments and investors' judgments. They also found negative investors' interactions when the blockchain technology was combined with the critical audit matter, and their negative interactions were due to their less familiarity with the advanced technology.

Based on the above discussion, the announcement of blockchain technology investment affects the stock price through abnormal returns because the stock price reflects the available information, and it changes according to the content of the available information. Thus, the more information the firms provide, the more efficient the stock market will be. In addition, blockchain technology investment announcements improve transparency, reduce the information asymmetry between investors and managers, adverse selection risk, and variation in stock prices. Moreover, the announcements of blockchain technology help investors revise their expectations, they also attract new investors, increase the abnormal returns and stock turnover rate. Therefore, the blockchain technology investment announcements improve the efficiency of the stock market and stock market reactions, and this leads to the development of first research hypothesis:

H1: Blockchain technology investment has a significant positive effect on stock market reaction.

The effects of blockchain technology investment on firm value.

The financial markets are the main users of blockchain technology. Most banks, insurance firms, and other financial institutions are using the blockchain in their business operations such as payments, stock trading, security, and other transactions. Therefore, Evans (2019) used case studies of the US and China for the period of 2008 through 2016 to investigate the relationship between blockchain technology and the

financial market. He found that the innovation of blockchain technology had improved the financial market in the two countries. Thus, the higher level of blockchain technology, the more advanced the financial market.

Additionally, Wadhawan (2019) investigated the relationship between blockchain investment announcements and the market value of the firms that have adopted blockchain technology. Based on an event study for 53 publicly traded firms in the US exchange, the author collected the data related to firms' stock price and trading volume for twenty days prior to and after the announcement of blockchain investment. The results indicated that the stock market reaction and abnormal returns were higher for smaller firms than larger firms such as Microsoft and IBM during the twenty days after their announcements of blockchain investments. Therefore, the author concluded that blockchain investments were associated with the positive and significant market value of small firms. Focusing on blockchain patents sustainability and firm value, Kim et al. (2020) examined the relationship between firms' patents of blockchain and firm value using a 153-panel observation from the United States patents and trademark office during the period from 2014 through 2018. The results revealed that firms can sustainably increase their value by getting a blockchain patent.

Depending on different digital technologies, Chan and Srinivasan (2020) investigated the firm value and performance of non-technology firms that have adopted digital technologies such as automation, artificial intelligence, big data, cloud computing, and machine learning. They collected the data of non-technology firms from the COMPUSTAT-CRSP universe from 2010 through 2019 using earnings/sales forecasts from IBES and 10-K filings. The authors found that firms that have adopted digital technologies had a higher market-to-book ratio than their industry peers. They also found that digital activities had increased earnings valuations, sales, and asset turnover. In addition, the return on assets, profit margins, and sales growth had a positive and significant correlation with digital activities, and that had improved firms' productivity and efficiency.

The value relevance of financial and non-financial disclosure is one of the main factors of useful information because it measures the ability of information to influence the stock price (Francis et al. 2004). Several studies have investigated the value relevance of non-financial disclosure. For example, Yen and Wang (2021) examined the value relevance of blockchain and cryptocurrency disclosure using 10-k filings as proxies for the firms' involvement in blockchain technology and its applications. They found that blockchain disclosure had a positive and significant impact on the stock price relevance for both financial and non-financial industries. They also found that cryptocurrency disclosure had a negative and significant effect on the value relevance in some industries rather than non-financial industries.

On the other hand, the new technology may have a negative effect on firm value, so according to the technology acceptance model, the acceptance of the new technology depends on the user's perceived ease of use and usefulness of use. Therefore, several studies have focused on the relationship between blockchain investment and corporate performance. For example, Aketch et al. (2021) examined the effects of blockchain technology on the performance of Kenya's financial market. Based on the structured questionnaire of 84 bank managers, they found that the government policy in Kenya and the internet infrastructure had encouraged firms to use blockchain technology. They also found that the high level of transaction costs and risk analysis increased the adoption of blockchain technology.

Based on the stock market reaction to blockchain announcements according to the operations and supply chain management, Klöckner et al. (2021) investigated the impact of blockchain initiatives on the market value of the firms. They depended on 175 blockchain announcements by 11 industries and 15 different countries from 2015 to 2019. The results revealed a significant abnormal return of 30% on average on the announcement day and an increase in the shareholder value of $159 million. In addition, the results showed less positive stock market reaction to the blockchain announcements when they used to share sensitive data or trace physical objects and when they involved external information such as IT service provider and firm innovativeness. On the

other hand, the stock market reaction was found to be higher for firms with higher productivity. Furthermore, the authors found a significant and positive relationship between firms' competition such as industry R&D intensity and stock market reaction, and the macro environment was found to have a positive impact on shareholder value.

Based on the previous discussion, blockchain technology investment can improve the market-to-book ratio, earnings valuations, sales growth, profit margin, productivity, and efficiency of firms, which in turn improve their value. In addition, it helps firms make innovation strategies, by reducing innovation risks and transaction costs. It also reduces the number of staff needed for processing operations, and the average time of processing orders because it uses distributed bookkeeping techniques. Moreover, it improves the agility of firms, which allows them to react faster to any changes in the dynamic environment than their competitors, which improves the firms' sustainability and efficiency, and its value. Therefore, the blockchain technology investment improves the value creation of firms, and this leads to the development of second research hypothesis:

H2: Blockchain technology investment has a significant positive effect on firm value.

The effects of blockchain technology investment on firms' financial performance.

Several previous studies have identified a positive and significant relationship between blockchain technology investments and firms' financial performance. For example, Chuen et al. (2018) investigated the performance of investing in cryptocurrency, which is the most use of blockchain technology, whereas they analyzed 100 different cryptocurrencies. They found that cryptocurrencies were a good diversifier in a traditional portfolio, and they had provided an additional utility to investors who overpriced the investments of blockchain and cryptocurrency. Focusing on the sustainability of the manufacturing industry through the adoption of blockchain, Ko et al. (2018) used three benefits of blockchain technology: real-time, transparency, and cost savings. They investigated the implications of blockchain technology on the sustainability of manufacturing firms. First, they examined the

employing of distributed ledger technology based on blockchain, then they reviewed the applications of blockchain technology in the financial industry, and finally, they compared the profits of the manufacturing firms that have adopted blockchain technology. The results revealed that blockchain technology was found to protect the distributed ledger integrity, improve real-time transparency, and cost savings. In addition, the blockchain features were found to increase the profitability of manufacturing firms.

Moreover, blockchain technology can improve firms' ability to develop new products, reduce manufacturing and delivery time. In addition, it can help them improve the integration process and control the product mix according to the market requirements, which increases customer satisfaction and firm performance. Thus, Sheel and Nath (2019) investigated the relationship between the adoption of blockchain technology, supply chain performance, and firm performance. They collected the data from 600 supply chain professionals with the URL through an email survey during the period of October 2018 through December 2018. The results revealed that the three parameters of the supply chain, which are agility, alignment, and adaptability had been improved due to the adoption of blockchain technology and the improvements in the three parameters of the supply chain had improved the competitive advantages of the firms and their performance.

In addition, blockchain technology investments can improve the organizational capabilities of firms through improving their internal operations, internal trust relationships, and external collaborations between supply chain members. Therefore, Pan et al. (2020) examined the impact of blockchain technology on operational capabilities and they collected data from 50 Chinese listed firms that have implemented blockchain technology. The results indicated that the expansion of firms' asset scale was found to increase the implementation of blockchain technology, and that implementation was found to improve asset turnover rate and reduce sales expense rate, which had a positive and significant impact on firms' organizational capabilities. Rehman Khan et al. (2021) applied a close-ended questionnaire to Chinese and Pakistanis manufacturing firms and collected cross-sectional data from 290

respondents in order to examine the relationship between blockchain technology investments and organizational performance. They found that the features of blockchain, such as visibility, transparency, relationship management, and smart contracts had a positive and significant effect on firm performance. They also found that blockchain technology had a positive effect on the circular economy and environmental performance through its effect on green practices such as recycling, manufacturing, and green design, and remanufacturing.

In contrast, Li and Wan (2021) investigated the negative relationship between blockchain technology applications and financial performance. They used a sample of Chinese listed companies during the period from 2012 through 2019 to test whether blockchain investment was associated with higher firm performance. The results indicated that firms with low performance have adopted blockchain technology to attract investors' attention, improve the abnormal stock returns and increase the stock turnover rate, but the benefits of adverse selections were only temporary because the investment in blockchain technology was not accompanied by the increase in R&D expenditure to develop blockchain applications, therefore, in the long term, those firms' financial performance will be declined.

Based on the above discussion, blockchain technology features such as visibility, transparency, relationship management, and smart contracts improve the firms' organization capabilities through reducing the sales expense rate, and increasing asset turnover rate, improving agility, alignment, and adaptability of the supply chain. In addition, blockchain technology improves the sharing of information between firms and real-time reporting, which increases the trust between firms. Moreover, it reduces uncertainty by reducing the manual input of data, human error, and manipulation. Blockchain technology can improve firms' ability to develop new products, reduce manufacturing and delivery time. In addition, it helps firms to improve the integration process and develop new products according to the customers' requirements, which increases customer satisfaction, firms' sales, revenues, competitive advantages, and performance. This leads to the development of third research hypotheses:

H3: Blockchain technology investment has a significant positive effect on financial performance.
H3a: Blockchain technology investment has a significant positive effect on return on assets.
H3b: Blockchain technology investment has a significant positive effect on return on equity.
Based on the previous discussion, the researcher derived the following model:

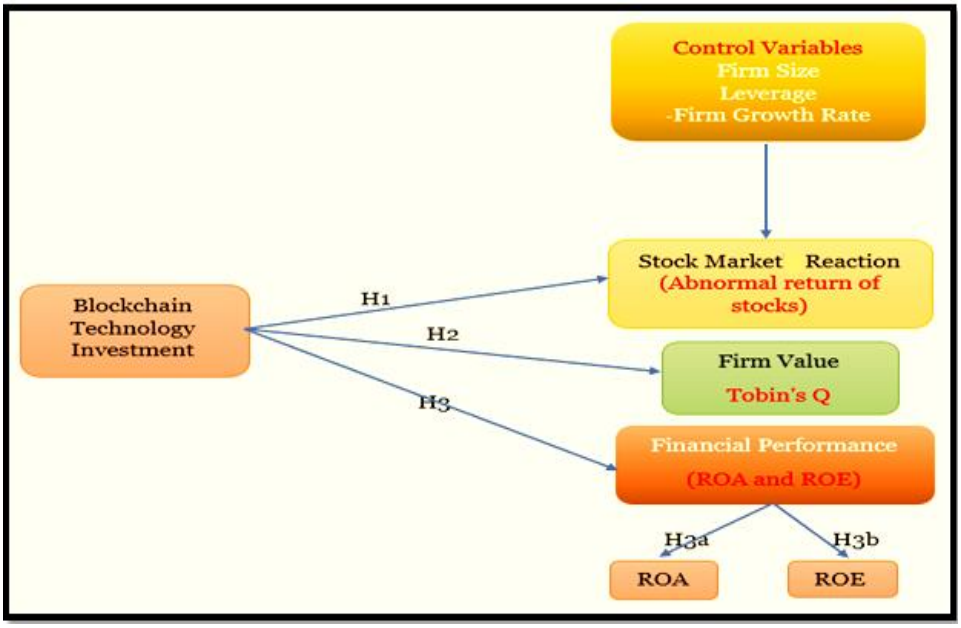

Figure 5: Research model

III. Research Methodology.

Data Collection.

The empirical study is used to examine and analyze the effect of blockchain technology investments on the stock market reaction, firm value, and financial performance. Therefore, the secondary data about blockchain technology were collected from the board of director report for the Egyptian banks. Announcement of blockchain technology investment was collected by searching for keywords such as blockchain, blockchain technology, blockchain investments, distributed ledger technology,

bitcoin, and cryptocurrency during the period of 2014 and 2020. The announcements of blockchain technology started in 2017, therefore, the study focused on three years before the adoption of blockchain technology and four years after the adoption. Consequently, the study depended on two samples, the first sample was the Egyptian banks that have invested in blockchain technology whether they are listed or not listed in the Egyptian stock exchange. Therefore, the final sample consisted of (182) blockchain technology investment announcements from 26 banks such as (CIB- Crédit Agricole Egypt-Qatar National Bank Alahly- National Bank of Kuwait - HSBC Bank Egypt -Attijariwafa bank-Mashreq Bank.....), and that sample was used only to test the third research hypothesis. The second sample consisted of (112) blockchain technology investment announcements from 16 listed banks in the Egyptian stock exchange and it was used for testing the first and second research hypotheses. In addition, the data about ROA, ROE, the book value of assets, and debt were collected from the annual reports and press releases. The opening and closing prices of shares were collected from the market screener, Mubasher information, and investing websites.

Variables.

The independent variable is the blockchain technology investment, and it is based on the previous studies, whereas it is measured as a dummy variable by giving value one if the firm has adopted the blockchain technology during the sample period, otherwise, it takes zero (Li and Wan 2021). The dependent variables are the stock market reaction, firm value, and financial performance. The stock market reaction is measured by the abnormal return of stocks, which is the difference between the actual return rate and the expected return rate (Xu 2021), so it can be calculated by using the following equation

ARit=Rit-E(Rit).

Whereas AR is the abnormal return, R is the actual return, which is measured by the daily closing price, and E(Rit) is the expected return of stock i at the time t, and it can be estimated by using the following equation (Zhou 2018).

E(Rit)=ά$_i$ +ß$_i$ E(Rmt).

The firm value includes the current firm's assets and its growth opportunities, so it refers to the current value of the cash flows generated by current assets and their growth (Habib and Ljungqvist 2005). It is measured by Tobin's q, which captures the market value of the firm divided by the replacement cost of its assets. It can be calculated by using the following equation (Kim et al. 2020).

Tobin's q=(MVE+BVDE)/BVTA

Whereas MVE refers to the market value of equity, which can be calculated by the closing price of shares at the end of the year multiplied by the number of common shares outstanding (Kim et al. 2020). The BVDE is the book value of debt, and the BVTA refers to the book value of total assets (Kim et al. 2020).

Financial performance refers to the firm's ability to improve its profitability and return on investments (Li and Wan 2021). It is measured by return on assets (ROA), which is the net income divided by average total assets, and return on equity (ROE), which is the net income divided by average shareholders' equity. Consistent with previous studies, the control variables that can affect the stock market reaction, firm value and financial performance are firm size, firm growth, and leverage. The firm size is measured by the logarithm of total assets at the end of the year, firm growth is measured by the change in the total sales at the end of the year, and the leverage is measured by the total debt to total equity at the end of the year.

IV. Research Results.

Descriptive statistics.

A test for normality was conducted to determine whether the data follow the normal distribution or not and indicate the appropriate statistical techniques. Therefore, the Kolmogorov-Smirnov test and Shapiro-Wilk test were used to test the normality of data. The results showed that all the data were normally distributed (p-value = 0.132 and .334), which is greater than 5%, as shown in table 1, which indicated that the observations were drawn from normally distributed populations. Therefore, parametric statistical techniques were used to test the research hypotheses.

Table 1. Normality Test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Total	.050	182	.200*	.990	182	.245
*. This is a lower bound of the true significance.						
a. Lilliefors Significance Correction						

The descriptive statistics were presented in table 2. The summary statistics of the full sample were presented in panel A, with 182 observations during the period of 2014 and 2020 and for 26 banks. The description of the sample was presented in panel B, with an average return on assets of 1.65%, average return on equity of 15.29%, an average leverage ratio of 9.6%, average abnormal return of stocks 6%, an average firm growth rate of 8.59%, and average firm size £511,881,635. The description of the blockchain technology investment was presented in panel C, with 92 observations before the adoption of blockchain technology during the period of 2014 and 2016 and 90 observations after the adoption of blockchain technology during the period of 2017 and 2020.

Table 2. Descriptive statistics.

Panel A: Full sample

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Total	182	100.0%	0	0.0%	182	100.0%

Panel B: Description of the sample.

	N	Minimum	Maximum	Mean	Std. Deviation
ROA	182	-1.570	4.700	1.65181	1.014853
ROE	182	-13.890	58.400	15.29503	11.200497
Leverage	182	-18.440	81.000	9.60725	8.865794
Growth	182	-25.580	38.600	8.59011	9.708456
Abnormal return of stocks	112	-.247	6.974	.06073	.661579
Firm-size	182	535,600	192,593,900	511,881,635	184,671,429

Panel C: description of the blockchain technology investment.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	before adoption	92	50.5	50.5	50.5
	after adoption	90	49.5	49.5	100.0
	Total	182	100.0	100.0	

The Pearson correlation coefficient was used to show the relationship among variables. Table 3 shows the correlation matrix and indicates a high positive and significant correlation of .769 between blockchain technology investment and return on assets and .714 between blockchain technology investment and return on equity. The results also indicate a positive and significant correlation of .405 between blockchain technology investment and firm value (Tobin's q) and .240 a positive and significant correlation between blockchain technology investment and stock market reaction (Abnormal return of stocks). In addition, table 3 shows a highly positive and significant correlation of .972 between return on assets and return on equity and a positive and significant correlation between both return on assets, return on equity and firm value, whereas the correlation was .308 and .320 respectively. Furthermore, the results indicate a weak positive and significant correlation of .211 and .213 between financial performance (ROA and ROE) and stock market reaction (abnormal return of stocks) and a positive and significant correlation of .635 between stock market reaction (Abnormal return of stocks) and firm value (Tobin's q).

Table 3. Correlation Matrix

Correlations						
		Blockchain technology	ROA	ROE	Tobin's Q	Abnormal Return
Blockchain technology	Pearson Correlation	1	.769**	.714**	.405**	.240*
	Sig. (2-tailed)		<.001	<.001	<.001	.011
ROA	Pearson Correlation	.769**	1	.972**	.308**	.211*
	Sig. (2-tailed)	<.001		<.001	<.001	.026

Correlations						
		Blockchain technology	ROA	ROE	Tobin's Q	Abnormal Return
ROE	Pearson Correlation	.714**	.972**	1	.320**	.213*
	Sig. (2-tailed)	<.001	<.001		<.001	.024
Tobin's Q	Pearson Correlation	.405**	.308**	.320**	1	.635**
	Sig. (2-tailed)	<.001	<.001	<.001		<.001
Abnormal Return	Pearson Correlation	.240*	.211*	.213*	.635**	1
	Sig. (2-tailed)	.011	.026	.024	<.001	
**. Correlation is significant at the 0.01 level (2-tailed).						
*. Correlation is significant at the 0.05 level (2-tailed).						

Regression Analysis Results.

To test the research hypotheses, multiple regression analysis was used to test and identify the relationship between blockchain technology investment and stock market reaction, firm value, and financial performance with three control variables, firm size, firm growth, and leverage. Therefore, the following regression models were established to test H1, H2, H3, H3a and H3b.

Abnormal return of stock $_{(i,t)}$ = β 0 + β 1 Blockchain technology investment $_{I,t}$
+ β 2 Firm size $_{I,t}$ + β 3 Leverage $_{I,t}$
+ β 4 Firm growth $_{it}$ + ε $_{i,t}$ Model (1)

Tobin's q $_{(i,t)}$ = β 0 + β 1 Blockchain technology investment $_{I,t}$
+ β 2 Firm size $_{I,t}$ + β 3 Leverage $_{I,t}$
+ β 4 Firm growth $_{it}$ + ε $_{i,t}$ Model (2)

ROA & ROE $_{(i,t)}$ = β 0 + β 1 Blockchain technology investment $_{I,t}$
+ β 2 Firm size $_{I,t}$ + β 3 Leverage $_{I,t}$

$$+ \beta 4 \text{ Firm growth}_{it} + \varepsilon_{i,t} \quad \text{Model (3)}$$

$$ROA_{(i,t)} = \beta 0 + \beta 1 \text{ Blockchain technology investment}_{I,t} + \beta 2 \text{ Firm size}_{I,t} + \beta 3 \text{ Leverage}_{I,t} + \beta 4 \text{ Firm growth}_{it} + \varepsilon_{i,t} \quad \text{Model (4)}$$

$$ROE_{(i,t)} = \beta 0 + \beta 1 \text{ Blockchain technology investment}_{I,t} + \beta 2 \text{ Firm size}_{I,t} + \beta 3 \text{ Leverage}_{I,t} + \beta 4 \text{ Firm growth}_{it} + \varepsilon_{i,t} \quad \text{Model (5)}$$

where firm i is in year t. The five regression models are presented in table 4, model one was used to test the first research hypothesis and the results of that hypothesis are presented in column 2, the model has supported H1 and has produced an adjusted R-squared of .186, so 18.6% of the variance in the stock market reaction (abnormal return of stocks) is explained by blockchain technology investment. The model also showed the F-value = 7.340 with p-value <.001, which referred to a significant positive effect of blockchain technology investment on the stock market reaction.

The results of the second research hypothesis are presented in column 3 of table 4. Model 2 indicated that 25% of the variation in the firm value is explained by blockchain technology investment, whereas adjusted R-squared =.252. Model 2 also indicated a significant positive effect of blockchain technology on the firm value, F-value of 10.362 with p-value= <.001, which supported H2.

The third research hypothesis examined the effect of blockchain technology investment on financial performance, and the results of that hypothesis were presented in column 4 of table 4. Model 3 supported H3 and indicated a significant positive effect of blockchain technology investment on financial performance, where the F-value = 60.06 with p-value of <.001 and an adjusted r-squared of .566.

The third research hypothesis is divided into two hypotheses (H3a and H3b), the first one examined the effect of blockchain technology

investment on return on assets and the results of that hypothesis are presented in model 4, column 5 of table 4. The model supported H3a, whereas the results suggested that 62.5% of the variance in the return on assets is explained by the blockchain technology investment, the adjusted r-squared =.625 with p-value of <.001. The results also indicated a significant positive effect of blockchain technology investment on the return on assets, the F-value of 76.55 with p-value of <.001.

The second research hypothesis of H3, which is H3b is presented in model 5 and examined the effect of blockchain technology investment on the return on equity. The results of that hypothesis are presented in column 6 of table 4 and supported the hypothesis and produced a significant positive effect of blockchain technology investment on return on equity, with F-value of 58.464 and p-value of <.001. The model also produced a 56.1% of the variance in the return on equity is explained by blockchain technology, whereas the adjusted r-squared =.561.

Table 4. Regression Results.

Independent Variables	Model (1), dependent variable is stock market reaction	Model (2), dependent variable is firm value	Model (3), dependent variable is financial performance ROA & ROE)	Model (4), dependent variable is ROA	Model (5), dependent variable is ROE
Blockchain technology investment T-value Sig	2.037 .044	3.742 <.001	10.795 <.001	12.765 <.001	8.758 <.001
Firm size T-value Sig	3.777 <.001	4.468 <.001	-.744 .458	-1.116 .266	-.586 .559
Firm growth T-value Sig	.842 .402	-.722 .472	4.37 <.001	4.329 <.001	-1.093 .276
Leverage T-value Sig	4.077 <.001	3.438 <.001	-5.012 <.001	-4.339 <.001	-4.883 <.001
Adjusted R-squared	.186	.252	.566	.625	.561
F-statistics Sig	7.340 <.001	10.362 <.001	60.060 <.001	76.552 <.001	58.464 <.001

V. Research Conclusion, Limitations, and Areas for Future Research.

This research aimed to examine the effect of blockchain technology investment on the stock market reaction, firm value, and financial performance. Using a sample of 26 financial firms with 182 observations to examine the effect of blockchain technology investment on financial performance, the results indicated that blockchain technology investment has a significant positive effect on financial performance. Whereas the return on assets and return on equity are higher in the period of adopting blockchain technology than the period that before the adoption. Further, the study depended on 112 observations of 16 financial firms that invest in blockchain technology and are listed on the Egyptian exchange to examine the effect of blockchain technology investment on the stock market reaction and firm value. The results revealed a significant positive effect of blockchain technology investment on the firm value measured by Tobin's q. In addition, the results produced a significant positive effect of blockchain technology investment on the stock market reaction measured by the abnormal return of stocks.

This research, like any empirical study, is not without limitations, which will be areas for future research. First, this research focused on the effect of the blockchain technology investment on the stock market reaction, firm value, and financial performance, thus, this research was limited to examining the impact of blockchain technology investment on other factors, such as supply chain management and firms' agility, so future research should examine the relationship between blockchain technology investment and supply chain sustainability, and other studies should study the relationship between blockchain technology and firms' agility. Second, this study depended on 112 observations of 16 Egyptian financial firms to examine the effect of blockchain technology investment on firm value and stock market reaction, so the sample size is small, because blockchain technology is an emerging topic, therefore, future research should depend on a large sample, and different sectors such as information technology, health care, or chemical sectors. In addition, they should do an event study to examine the effect of blockchain technology announcements on the stock prices and investors' reactions. Moreover,

future research should also examine the characteristics of the first-mover firms adopting advanced technology and examine the success factors of adopting blockchain technology in the emerging markets. Third, this study covered the periods of 2014 and 2020 and focused on the firms that invest in blockchain technology and examine its effect on the stock market reaction, firm value, and financial performance. Future research should focus on two samples of firms that invest in blockchain technology and those that do not invest in blockchain technology to examine the relationship between blockchain technology investment and stock firm value and compare the results of the two samples. Finally, future research should examine the benefits of adopting new technologies and compare first mover and followers' firms.

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