

# Blockchain Technology in Corporate Governance: Advantages and Limitations

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**Abstract:** *This paper is a literature review paper. We discussed the influence and results of using blockchain in corporate governance. In this paper, we considered both the advantages and disadvantages of using blockchain technology. Our research areas included distributed ledgers, smart contracts, corporate governance, DAO “hack” case (2016), blockchain distributed platform, the decentralized autonomous organization (DAO), customer loyalty plan using blockchain, the proof-of-work system using blockchain, and the blockchain technology in international business. We selected a sample of around 20 articles on blockchain to study the benefit of using blockchain in corporate governance. Based on the convenience and effectiveness of using blockchain, we made the hypothesis that using blockchain in corporate governance would be able to have more transparent, real-time, reliable, cost-effective, verifiable, and accessible transaction records. We hypothesize that using blockchain in corporate governance has more benefits than using the database. Blockchain technology also has some disadvantages such as shareholder protection weakness, fraud transactions, anonymous voting, etc. Generally speaking, based on our analysis of selected articles and literature reviews, we made the following conclusion that blockchain technology will have more benefits in corporate governance compared to traditional systems and other database management systems.*

**Keywords:** *Blockchain, Corporate governance, Database system, Distributed ledgers, Cryptocurrency, Smart contract, Accounting information system, Triple-entry accounting information system*

## 1. Introduction

Blockchain technology has been largely developed in recent years. This new technology has been used in many industries so far, such as banking and finance, insurance, SCM, marketing and advertising, etc. Our literature reviews will specifically discuss the use of blockchain technology in corporate governance, also the advantages and limitations of using blockchain.

Our hypothesis about blockchain technology in corporate governance is: using blockchain in corporate governance would be able to be more transparent, real-time, reliable, cost-effective, verifiable, and accessible transaction records. Blockchain technology also has some disadvantages such as shareholder protection weakness, fraud transactions, anonymous voting, etc.

We selected the literature reviews based on the academic background of the authors, the number of citations, and the level of the journals or conferences. Among all the considerations for selecting the works of literature, the most important criteria are to select the works of literature that are closely related to our topic, corporate governance using blockchain technology. For example, we selected a paper written by Yermack<sup>[1]</sup>. Yermack<sup>[1]</sup> published seminal research on the Review of Finance and the citation figure of this paper is 733 so far. David Yermack<sup>[1]</sup> is a professor of finance at the New York University Stern School of Business. Yermack<sup>[1]</sup> has published over 17 peer-reviewed papers in finance and economics journals. This paper is sponsored by NYU Stern School of Business and the National Bureau of Economic Research. The topic of the paper is corporate governance and blockchains. The contents of this paper are closely related to our topic.

Our literature research showed that the works of literature we have selected were organized in the following two parts: literature reviews, empirical studies, or case studies. These papers are without bias. The research in the selected papers includes both advantages and limitations when implementing blockchain in corporate governance. For example, Brennan et. al. <sup>[2]</sup> discussed the limitation and weaknesses of using blockchain-distributed ledgers. With the decentralized platform and the platform's immutable nature, fraud behaviors might not be restrained by the blockchain. Also, to maintain the good functionality of the blockchain, the size of the blockchain has to be large. The cost of the transaction

could be high and the time for processing the transactions could be slow, which is not efficient for business trading behaviors.

Our paper selected papers mostly from the recent ten years because this blockchain technology is still newly developed. This paper is a literature review paper. We studied the aspects and conclusions related to corporate governance. With the limitation of resources, there could be more papers in a related field that we haven't included in our paper yet. There could be more improvement in the future as technology is changing fast. The technique and science of blockchain have not been included in the discussion of this paper so far.

Our paper is limited to the literature reviews of journals and publications. There is a gap in digging into the data testification and there is a limitation in the number of journals that we reviewed. For further study in the future, we suggested enlarging the sample of articles and generating more accurate results.

Our literature review included recent seminal or principal papers published in academic journals or conferences. We compared and evaluated the blockchain in corporate governance based on the sample of selected articles. This paper included an introduction, an evaluation of the literature, and a conclusion. We selected around 20 articles that studied using blockchain in corporate governance. We will focus on the contents, methodology, and results of the selected articles. Based on the analysis and literature review, we concluded that using blockchain in corporate governance will be a benefit to our business.

We selected 77 Asian blockchain companies and used a linear regression model to research how well these blockchain companies are compared to non-blockchain traditional companies.

## 2. Evaluation of literature

Blockchain techniques have been largely used nowadays. Innovation in technology helps businesses to have competitive advantages so that they would be able to generate a bigger market and higher profit. The researchers showed that for those organizations, their success comes from their large quantity of innovations and these innovations helped the companies in many different ways. For example, the research showed that when there are new products, the market shares usually increase. There is a correlation between maintaining, and increasing market shares, and new products offering<sup>[3]</sup>. Blockchain technology is a newly developing innovation. Blockchain technology has been largely used by companies all over the world. According to recent research, a survey of applying blockchain technology in Norwegian Companies, with these new blockchain techniques, the digitally-enabled distributions are increased and marketing cost has been reduced down to 10% with well-defined and more efficient pricing models and supply chains<sup>[4]</sup>. This decentralized crypto-economy is privately managed by entrepreneurs, not by governments, which could explain the diversity of blockchain innovations. Meanwhile, blockchain entrepreneurs can develop more market opportunities. Blockchain is a hot area in recent market and research, and it is time to start thinking about the security, scalability, and efficiency of service provided by blockchain<sup>[5]</sup>. Blockchain is also a new information technology that will lead to a commercial revolution in the future<sup>[6]</sup>.

Piazza<sup>[7]</sup> evaluated the strengths and weaknesses of using the blockchain and bitcoin as tools for corporate governance. Piazza<sup>[7]</sup> published her paper on using blockchain as a tool for corporate governance on Bocconi Legal Papers and also published in Penn State Journal of Law and International Affairs. Piazza's research<sup>[7]</sup> paper has been cited 64 times by other papers so far. Piazza<sup>[7]</sup> has worked at the US and Italian law firms, Federal Trade Commission, etc. Piazza<sup>[7]</sup> started her research on blockchain because she noticed that there is a lack of legal certainty. She sooner expanded her research on using blockchain in corporate governance.

Piazza<sup>[7]</sup> cited authoritative works of literature for the evaluation. Piazza's research<sup>[7]</sup> contributed by comparing the advantages and disadvantages of using blockchain in corporate governance, such as in the fields of accounting and ownership reporting, and corporate voting. Compared to other papers, Piazza<sup>[7]</sup> especially discussed the legal status of using blockchain in business. Piazza<sup>[7]</sup> also proved that blockchain is typically useful in corporate voting. The results are following other sources. Corporate voting is a major area of corporate governance. Piazza's research<sup>[7]</sup> proved our hypothesis that blockchain is useful in corporate governance. Piazza<sup>[7]</sup> mentioned several advantages of using blockchain in corporate governance. For example, Piazza<sup>[7]</sup> used the paper published by the United Kingdom Government Chief Scientific Adviser (GCSA)<sup>[8]</sup>. The conclusion supported our hypothesis that using blockchain in corporate governance will be a benefit for the company. Piazza<sup>[7]</sup> mentioned in 2016, the United Kingdom Government Chief Scientific Adviser (GCSA)<sup>[8]</sup> published a paper that talked about distributed

ledger technology. This paper discussed that different from the traditional ledgers or ledgers using the database, distributed ledgers allow every user within the network to visit, maintain and visualize the ledgers through the cryptographic keys and signatures (GCSA)<sup>[8]</sup>. The distributed ledgers prohibited unauthorized users to access the ledgers, and in this way to increase security and privacy. The distributed ledgers using blockchain technology at least have the following advantages compared to the ledgers managed by the database system. The distributed ledgers provide more secure substitute plans because of their resistance to hackers. Distributed ledgers are decentralized systems. Different from the centralized system, if the hackers want to attack the system, they have to attack every shared copy within the network successfully to all. If there is a change or a vicious edit, the users would be easier to notice than under-distributed ledgers<sup>[7]</sup>.

Another advantage of distributed ledgers is that by using the blockchain, it is possible to securely track the transaction between one ledger to another ledger (Economist, 2016). Song<sup>[9]</sup> examined the amended Delaware General Corporation Law (DGCL) and the cases following the amended law to testify to the usefulness of using blockchain in maintaining distributed ledgers. Song's research<sup>[9]</sup> is published in Harvard Business Law Review. The citation number of her research is 10 times. Song<sup>[9]</sup> also received the Women in M&A scholarship from the American Bar Association (ABA).

The case study following the analysis is accordant to our hypothesis that using blockchain and distributed ledgers is convenient and has the following advantages. For example, the distributed ledgers would be able to exchange transaction data transparently, uniformly, and in real time. Instead of using the secondary market redundant and error-prone transactions and database, distributed ledgers could be less liquidity and less credit risk. The blockchain provided cheaper and more abundant market reference data<sup>[9]</sup>. This contribution of Song's research<sup>[9]</sup> is to provide a real case of using blockchain technology in corporate governance. Delaware amended the corporate law and allowed their corporations to use distributed blockchain to create and maintain their records. Song<sup>[9]</sup> studied the real-world case to illustrate how blockchain will be a benefit in corporate governance.

Both Piazza<sup>[7]</sup> and Song<sup>[9]</sup> discussed the advantages of using blockchain in corporate governance. Piazza<sup>[7]</sup> is more focused on data security, while Song<sup>[9]</sup> is more concentrated on the continence and efficiency of using blockchain in corporate governance. Song<sup>[9]</sup> provided the legal practice of using blockchain in corporations and also proved that using blockchain in corporate governance could bring more economic benefits. Both Piazza<sup>[7]</sup> and Song<sup>[9]</sup> agreed that blockchain will generate more benefits in corporate governance from different perspectives. The sources they used are reliable and their research both proved that blockchain technology is beneficial in corporate governance, which is accordant with our hypothesis.

Lewtan, et. al.<sup>[10]</sup> studied the use of blockchain to improve financial reporting and corporate governance. Their research was published at the Hawai'i Accounting Research Conference (HARC) in 2018. The HARC is an annual global accounting conference that is held at the University of Hawai'i at Manoa (UHM) each year. The authors are MPAc Candidates and Accounting professors at Bryant University. Their research has also been published in the UK in 2018. The citation number of this paper is 5 up until now. Their research is focused on how blockchain will be a benefit in corporate governance from the accounting perspective.

The implementation of smart contract with blockchain will largely decrease human interaction in the revenue recognition reporting cycle. The corporate managers could determine how they will recognize the revenue and then write the governance rules into the smart contract. Therefore, there will be no human interaction in revenue recognition once the governance has been written into the smart contract<sup>[10]</sup>. Using blockchain in corporate governance could increase the efficiency and effectiveness of the business. For example, because it releases the human interaction in the business cycle, auditors could examine the standards made by corporate governance instead of tracking the sample transactions to discover fraud or errors during the recording or maintaining the financial data<sup>[10]</sup>.

Different from Piazza's research<sup>[7]</sup> and Song's research<sup>[9]</sup>, Lewtan<sup>[10]</sup> discussed the benefit of using blockchain in financial reporting. Using blockchain in financial reporting will increase the transparency and monitoring aspects of corporate governance. Lewtan<sup>[10]</sup> further used the revenue recognition reporting cycle as an example. Lewtan's research<sup>[10]</sup> proved our hypothesis that using blockchain will be a benefit for corporate governance. Lewtan's contribution<sup>[10]</sup> is to study the use of blockchain in corporate governance from an accounting perspective and prove the benefits both in financial reporting and auditing. However, there are many reporting cycles in financial reporting, such as purchase, expense, property, plant, and payment (PPE), etc. It is useful to understand how blockchain will be helpful to corporate governance in different financial reporting cycles as well.

Daluwathumullagamage and Sims<sup>[11]</sup> published their research on blockchain-enabled corporate governance and regulation in the *International Journal of Financial Studies*. This paper has been cited 4 times so far. Dr. Dulani works at the University of Auckland in New Zealand. She has 10 publications so far and Dr. Dulani's research areas include blockchain and cryptocurrencies. The contribution of Daluwathumullagamage's research<sup>[11]</sup> is that it collected data from a sample of 851 systematic review words and a sample of 183 final articles. Daluwathumullagamage's research<sup>[11]</sup> of blockchain in corporate governance is from a managerial perspective. The sources and data collection are reliable. The results of Daluwathumullagamage's research<sup>[11]</sup> proved our hypothesis that using blockchain in corporate governance is beneficial.

Daluwathumullagamage and Sims<sup>[11]</sup> researched how blockchain could enable corporate governance and also corporate regulation. Their research used a systematic survey and empirical analysis. The systematic survey included the theoretical study of previous research and works of literature, the market roles, and how corporates adopted the blockchain. They also collected investment data related to blockchain companies. The conclusions of their study are following our hypothesis and other works of literature. The blockchain could increase transaction transparency. Blockchain could make corporate governance more efficient, accurate, and accessible<sup>[11]</sup>.

Different from other articles, Daluwathumullagamage's sources<sup>[11]</sup> and data are from systematic review records and final articles. The conclusion is accordant to Lewtan's paper<sup>[11]</sup>. Daluwathumullagamage<sup>[11]</sup> believed that using blockchain will increase transparency in transactions and increase the effectiveness of corporate governance.

Derbali et. al.<sup>[12]</sup> wrote a paper that discussed how blockchain will change corporate governance. The authors are faculties at Taibah University in Saudi Arabia. The paper was published in the *International Journal of Business and Risk Management* in 2019. It is a recently published paper and has 2 citation numbers so far. Derbali<sup>[12]</sup> discussed the advantages of security and audibility by using blockchain in corporate governance.

Derbali et. al.<sup>[12]</sup> studied the significance of blockchain to corporate governance. In conclusion, they found that blockchain and smart contracts offered a solution to lower the cost of the company. Blockchain will bring security and audibility to the business. They concluded with five advantages of using blockchain. The five advantages are following our hypothesis and other works of literature. The five advantages are as follows. (1) The decentralized blockchain can connect the users without intermediate agents using the algorithm and high-level cryptography. (2) The decentralized mechanism used distributed nodes and the check by the users followed the majority rules. (3) Because the ledgers are with the timestamps, it is possible to track the transactions to their origins. (4) The decentralized blockchain is transparent and auditable. Auditors would be able to look for the history of the transactions. (5) The blockchain decentralized ledgers ensured the immutable privacy of the data.

Derbali's paper<sup>[12]</sup> summarizes the advantages of using blockchain in corporate governance. The advantages Derbali<sup>[12]</sup> has discussed in their paper are following other papers we have studied and following our hypothesis. Derbali<sup>[12]</sup> included both the advantages of security and audibility in this paper. Derbali's research<sup>[12]</sup> is a combination of Piazza's paper<sup>[8]</sup> and Lewtan's research<sup>[10]</sup>.

Avdzha<sup>[13]</sup> published their thesis at Tilburg University. The paper is under the supervision of Ivona Skultetyova and 5 citation number so far. Ivona Skultetyova is a PhD. Senior Researcher at Tilburg European Crowdfunding Network. Ivona Skultetyova is also a member of the working group on blockchain policy and framework conditions at the EU Blockchain Observatory and Forum. Avdzha's paper<sup>[13]</sup> discussed different aspects of blockchain such as securities on blockchain, blockchain eVoting, blockchain accounting, etc. However, we only discussed the aspect of using blockchain in corporate governance.

Similarly, Avdzha<sup>[13]</sup> at Tilburg University published his research paper on the usage of blockchain technology in corporate governance. This paper also studied the possible blockchain corporate governance framework. Avdzha<sup>[13]</sup> also concluded that using blockchain in corporate governance not only decentralized the decision power but also increased transparency and accountability. Different from other corporate governance, using blockchain could monitor and change the cost or profit of the business. Avdzha<sup>[13]</sup> used a company case study to examine the benefits of using blockchain, which proved his hypothesis. For example, the accounting system implemented by Deloitte used blockchain technology to record the same transaction entry on a single ledger of a blockchain framework, rather than to record on different ledgers for different companies. The companies, banks, tax authorities, and auditors could visit and check the transaction at the same time. On the other hand, courts, banks, and tax authorities could monitor other continuous transactions. This blockchain-recording ledger technology decreases

operational costs and increases transaction security.

We could relate Avdza's paper<sup>[13]</sup> with Song's research<sup>[9]</sup>. Song<sup>[9]</sup> also used a real case that involved amended Delaware General Corporation Law (DGCL) and Delaware's corporations using blockchain in corporate governance. Avdza<sup>[14]</sup> used Deloitte as an example to prove the advantages of using the blockchain, such as economic benefits and security benefits.

A similar methodology of the case study has been used by Morrison et. al. <sup>[14]</sup>. Morrison et. al. <sup>[14]</sup> used the DAO "hack" in 2016 as a case study example. Different from Avdza's research<sup>[13]</sup> and Song's research<sup>[9]</sup>, Morrison's research<sup>[14]</sup> is more focused on the advantage of the security that using blockchain in corporate governance. DAO "hack" is a famous case and the conclusion proved our hypothesis.

Morrison et. al. <sup>[14]</sup> published a paper about DAP "hack" in 2016. The authors are from the University of Canterbury in New Zealand. Professor Stephen C Wingreen is expertise in blockchain and cryptocurrencies. Their paper was published on the *Frontiers in Blockchain* in 2020. It was recently published and have 5 citation number so far.

Morrison et. al. <sup>[14]</sup> also used the DAO "hack" in 2016 as a case study example to study the accountability and reliability of blockchain corporate governance. DAO is an investment company. It used the Ethereum network smart contracts to manage the company and make business decisions. This "hack" case is solved by solutions agreed upon by users in this network. This is a typical case to show a trustful decentralized corporate governance using blockchain. The company could be operated without executors or decision-makers. The authors also mentioned that the DAO case is not just one specific case, however, it is an origin of a new theory in corporate governance and required further study.

Murray et. al. <sup>[15]</sup> published their research in the *Academy of Management Perspectives* 2019. Their research also discussed the Decentralized Autonomous Organization (DAO) for blockchain and smart contracts. Alex Murray<sup>[15]</sup> is an assistant professor at the University of Oregon. His projects included blockchain-based firms and the DAO. Scott Kuban is a professor in the management department at Tulane University. Kuban's research areas included how technology is changing the nature of corporations. Matthew Josefy and Jon Anderson are professors at Indiana University. This paper is recently published and already has 27 citation numbers.

Murray et. al. <sup>[15]</sup> at the University of Oregon, Tulane University, and Indiana University published their research at the *Academy of Management Perspectives*. The research introduced the concepts of blockchain and explained the mechanism. They did a large number of literature reviews on the potential of how blockchain technology will change the market and contracts in the future. They also discussed how blockchain will decrease the cost and increase the profit of business transactions. Their study is accordant with our hypothesis and the conclusions contributed to the understanding of our topic. This paper included the most recent theories we have discussed so far. The authors researched the blockchain distributed ledgers. This paper introduced the transparent, immutable characteristics of distributed ledgers and even the more complicated algorithm, smart contracts. Moreover, this paper also researched the new organization format, the decentralized autonomous organization (DAO). The DAO uses cryptography and protocol to manage the smart contract rather than the human resources. Comprehensively, the development of technology showed that blockchain technology influenced the contracts' setup and execution, lowered the cost of agent managers, and even changed corporate governance fundamentally. The authors also suggested scholars continuously study smart contracts and DAO in the long run.

Different from Morrison's paper<sup>[14]</sup> which studied a particular DAO "hack" case in 2016. Murray<sup>[15]</sup> is focused on the DAO in general and how blockchain will change corporate governance. The conclusion proved our hypothesis. Their research also discussed the economic benefit of using blockchain. Murray's paper<sup>[15]</sup> contributed to the discussion that how blockchain could avoid agency costs during transactions.

Barile et. al.<sup>[15]</sup> published their research in the journal *New Challenges in Corporate Governance: Theory and Practice* 2019. Sergio Barile<sup>[16]</sup> is a full professor of management at the University of Rome, Italy. Francesco Caputo is from the University of Salerno, Italy. Pietro Vito is also from the University of Rome. The paper discussed how blockchain is changing corporate governance in the areas of information transfer and knowledge sharing.

Barile et. al. <sup>[16]</sup> also researched blockchain technology in corporate governance, its advantages, and challenges. Barile<sup>[16]</sup> first introduced new technologies, new theories of development, and how technology development influenced business and corporate governance in general. Based on the literature reviews, this paper classified the research which is related to corporate governance into three categories. The first category included corporate governance research related to the composition of the board of

directors, the process of business decisions, and the assessment mechanism. The second category included corporate governance research related to internal pressures and the decisions by interest parties. The third category included the corporate governance research related to internal operations. This paper mentioned that blockchain-distributed ledgers could record effective and verifiable transactions immutably. At the same time, the distributed ledgers also let the data collection process be shared with all interested parties. The advantages of blockchain-distributed ledgers discussed in this paper are accordant with our hypothesis.

The contribution of this paper is to analyze the influence of blockchain technology from three categories: board of directors, interest parties, and internal operation. The conclusion that blockchain will be a benefit in corporate governance is accordant to our hypothesis. The advantages of using blockchain discovered by this paper are similar to other scholars' research. For example, this paper also found that using blockchain will increase the effectiveness of the transactions, which is the same result as Piazza's research<sup>[7]</sup> and Song's research<sup>[9]</sup>.

Yermack<sup>[1]</sup> published seminal research on the Review of Finance and the citation figure is 733 so far. David Yermack<sup>[1]</sup> is a professor of finance at the New York University Stern School of Business. Yermack<sup>[1]</sup> has published over 17 peer-reviewed papers in finance and economics journals. This paper is sponsored by NYU Stern School of Business and the National Bureau of Economic Research. The research is very useful in this blockchain topic and the conclusions are accordant with our hypothesis as well. This paper organized and analyzed every aspect of the influences that using blockchain in exchange and recording transactions. For example, Yermack<sup>[1]</sup> has discussed that using blockchain in corporate governance will make ownership more transparent and increase liquidity. Because blockchain-distributed ledgers increase transparency and liquidity, the technology will change many aspects of corporate governance. In Yermack's research<sup>[1]</sup>, it talked about the possible changes and impacts on managers, investors, and activists, market structure, corporate elections, and real-time accounting.

Yermack<sup>[1]</sup> wrote that using blockchain technology would be able to generate distributed ledgers. Every member in the same network such as shareholders and interest parties would be able to see the arrangement and update of ownership. Therefore, distributed ledgers increase the transparency of ownership. Using blockchain also could shorten the time and lower the cost for a large number of data transactions within a limited time. For example, blockchain distributed ledgers could be used as a stock registration and exchange platform, which increases liquidity than using another database platform.

The increase of transparency and liquidity in blockchain-distributed platforms could provide benefits in corporate governance. Yermack<sup>[1]</sup> mentioned that investors would like to use blockchain technology because investors want to have more information and participation in corporate governance. However, Yermack<sup>[1]</sup> also mentioned that some activists might think that the increase in transparency will increase the cost of the business. Therefore, those activists might suggest not investing in blockchain. Using blockchain-distributed ledgers would make stock transactions more transparent. Investors and shareholders could have access to insider stock trade information. Certain insider stock trades to managers encourage managers to make more business performance. Yermack<sup>[1]</sup> mentioned that with more transparency of such insider trades, managers will be limited in earning a profit on such insider trades. Blockchain-distributed ledgers will change the market structures, such as increasing the identity transparency of traders, prohibiting insider trades, etc. As to corporate governance, blockchain-distributed ledgers will increase the transparency of corporate elections and make the voting process more convenient. Anonymous voting could be a problem. However, most companies don't use anonymous voting in corporate elections. Blockchain-distributed ledgers could also make financial accounting and reporting immutable and in real-time. These opinions are following other works of literature and further testify to our hypothesis.

Brennan et. al.<sup>[2]</sup> from the University College Dublin in Ireland, the RMIT University in Australia, and the Auckland University of Technology in New Zealand published their research on corporate governance an overview of disruptive technology. Blockchain technology has been largely discussed in this paper. This paper is published in *The British Accounting Review*. This paper is published in 2019 and the citation number is 14.

Along with other works of literature we have discussed so far, the literature reviews of this paper, the discussion, and the conclusions are following our hypothesis. Brennan<sup>[2]</sup> discussed that blockchain technology builds distributed ledgers and uses cryptography to protect the data during transactions. The distributed ledgers provide secure, reliable, transparent, and accessible transaction recordings. The distributed ledgers also provide immutable, real-time financial accounting ledgers. The accounting ledgers are verifiable and transparent. Blockchain-distributed ledgers are an accounting information

system because they can keep monitoring, auditing, and recording the sanctions, even prohibiting fraud. However, Brennan et. al. <sup>[2]</sup> also discussed the limitation and weaknesses of using blockchain-distribute ledgers. For example, with the decentralized platform and its immutable nature, fraud behaviors might not be restrained by the blockchain. Also, to maintain the good functionality of the blockchain, the size of the blockchain has to be large. The cost of the transactions could be high and the time for processing the transaction could be slow, which is not efficient for business trading behaviors.

Brennan et. al. <sup>[2]</sup> also mentioned in this paper that corporate governance could be improved in the following dimensions. For example, these areas include how to improve corporate governance from management resources and interest perspective, from business decisions and solving conflicts, and involving different related interest parties in the process.

Brennan's research<sup>[2]</sup> discussed how blockchain will help in corporate governance while making business decisions and solving the conflicts among the board of directors and related interest parties. Brennan's research<sup>[2]</sup> and Barile's research<sup>[16]</sup> both proved the benefits of using blockchain from the board of directors, interest parties, and internal operation aspects. Brennan's paper<sup>[2]</sup> also discussed certain disadvantages such as the large volume of transactions and low speed of data transfer. However, Brennan's research<sup>[2]</sup> could further dig into the advantages of using blockchain compared to the disadvantages of using blockchain. From the different sources, perspectives, and case studies that we studied, we concluded that there are still more advantages to using blockchain in corporate governance.

A typical example of using blockchain technology in corporate governance is the customer loyalty plan.

Through Applying blockchain technology could help build a more secure and customer-centric open market<sup>[17]</sup>. To obtain new customers and maintain good relations with customers, companies usually have a customer loyalty plan. The plan encourages customers to continue purchasing companies' services and goods or related products. For example, the Starbucks rewards plan will reward free coffee on the number of coffees purchased. American Airlines will reward tickets for the number of miles that customers have flown. Customers could have many membership cards, but using blockchain technology, companies could develop a blockchain loyalty plan. Under this plan, customers do not need to bring many membership cards with them anymore. This blockchain loyalty plan can be linked to customer memberships with their cellphone number. Therefore, from companies' perspectives, using blockchain technology would be able to decrease the indirect cost related to the administration and management fees of the loyalty plans, which will be a benefit to the companies.

There are some disadvantages to consumer loyalty plans, however, these disadvantages could be solved by blockchain technology. For example, customers sometimes forgot to use their rewards and can feel frustrated when their rewards are expired<sup>[18]</sup>. Also, another disadvantage is that there isn't a consumer loyalty plan that could embrace different brands<sup>[19]</sup>. Blockchain technology would be able to integrate different parts, such as consumer royalty plans planters, marketers, consumers, information system managers, call centers, sales departments, and other departments which take part in this consumer royalty plan. By integrating different parts of information, blockchain technology could help to change the way marketers design, track, and deliver useful information to consumers, therefore blockchain changes the customers' experience, increasing the degree of brand loyalty<sup>[20]</sup>. Blockchain technology could also integrate information among different brands. Different brands and companies would be able to design and develop consumer loyalty plans together and even be able to exchange reward points altogether to give consumers a better experience<sup>[21]</sup>.

Ferreira et. al.<sup>[22]</sup> developed a theory and a proof-of-work system. The system is working to verify the transactions in the blockchains. They also created a system with suppliers of goods and services. From this model, they examined the blockchain system and the governance in managing large-size companies. This paper is written by Daniel Ferreira<sup>[22]</sup> at the London School of Economics, Jin Li at Northwestern University, and Radoslaw Nikolowa at the Queen Mary University of London. Their research is published at European Corporate Governance Institute (ECGI) – Finance Working Paper in 2019. The citation number of this paper is 16 so far. This paper proved that stakeholders are willing to participate in corporate governance considering their benefits and interests. Meanwhile, the corporation would be able to capture the governance of equipment producers. This paper is different from other literature review sources in that this paper created the blockchain ecosystem models and verified the influence and functions in large-size firms' corporate governance. In the model of this paper, the miners, mining equipment producers, and mining services providers are the three interest parties with conflict interests. This proof-of-work blockchain model is a decentralized recording and maintaining technology. The interest parties have trusted one company to protect their interests. This experiment showed us a good

example and case study. The results and conclusions of this experiment are quite useful to testify our hypothesis. Meanwhile, the results also showed a possibility for further study on the difference between decentralized blockchain systems and traditional financial intermediate companies.

Magnier and Barban<sup>[23]</sup> published their research in the Journal for the International and European Law, Economics, and Marketing Integrations. The paper discussed the potential impact of using blockchains in corporate governance from the shareholders' perspective. This paper has 7 versions and the citation number is 11 so far. Veronique Magnier<sup>[23]</sup> is a professor at Paris-Sud or Paris-Saclay University and also the director of Institute Droit Ethique Patrimoine. Patrick Barban is a professor at Le Havre-Normandie University. This paper is useful to study the advantages of using blockchain in corporate governance. However, the authors also discussed some limitations and weaknesses of this new technology. Magnier and Barban's research<sup>[24]</sup> showed that this new technology blockchain distributed ledgers provided the evolutionary application of cryptography and information science. Blockchain-distributed ledgers are different from traditional financial accounting reporting. This new technology is presumed to lower the cost, increase liquidity, maintain the financial recording more accurately in transaction data, and be more transparent in ownership. This paper also mentioned the weaknesses of using blockchain. For example, the anonymity of the shareholders is difficult in the blockchain. This new technology might also change the corporate governance balance among managers, institutional investors, small shareholders, and other parties which participate in corporate governance. The advantages and disadvantages of using blockchain discussed in this paper are accordant with other literature reviews that we have discussed so far. The specific weaknesses discussed in this paper have drawn attention and possibly required further technique breakthroughs to lower the risks. For example, Magnier and Barban<sup>[23]</sup> found that because blockchain does not require intermediate agents, the cost of tracking the transactions would be lowered. Also, if someone could obtain more than 50% of miners' computing power, the reliability of the data which is stored on the blockchain could be questioned. Another disadvantage is that in the blockchain-distributed system, there is no quality control of the data and information except for public users. Therefore, if the users stored fake data on the blockchain it could be difficult to monitor or edit.

Heminway and Sulkowski<sup>[24]</sup> discussed the blockchain, corporate governance, and also the legal issues which could be involved. The paper was published in Wayne Law Review in 2019. There is 6 citation number already. Joan Macleod Heminway<sup>[24]</sup> is the Rick Rose distinguished professor of law at the University of Tennessee College of Law. Adam J. Sulkowski is a professor at Babson College.

The aspects and contents that this paper has discussed are consistent with the other works of literature we have talked about so far. The contents related to corporate governance on blockchains include shareholder recordkeeping and voting, insider trading, and disclosure-related considerations such as monitoring. Those contents are the areas that we have discussed before. In the conclusion of this paper, it said that blockchain as a recording maintenance technology has the potential to fundamentally change the most significant aspects of corporate governance, especially when the changes involved data tracking or telecommunication. The information tracking using blockchain is more real-time, transparent, and reliable in the majority of opinions. Also, using the blockchain in corporate governance could make the transactions more transparent to outsiders of the company.

Heminway and Sulkowski's research<sup>[24]</sup> is more focused on blockchain data transferring in corporate governance. They discussed the advantages of transparency and data tracking by using blockchain in corporate governance. This paper is in accord with Yermack's research<sup>[1]</sup>. They both agreed that using blockchain in corporate governance will increase transparency in data transactions.

Hooper and Holtbrügge<sup>[25]</sup> published their research on using blockchain technology in international business and how this new technology will be a benefit to international trade in general. The paper is published in the Review of International Business and Strategy in 2020. This paper has 2 versions and has 13 citation numbers. Both Amanda Hooper and Dirk Holtbrügge<sup>[25]</sup> are from the Department of International Management, School of Business, Economics, and Society at the University of Erlangen-Nurnberg in Germany.

Following our hypothesis, this paper also discussed that blockchain technology could help protect property rights and lower transaction costs. The methodology that Hooper and Holtbrügge<sup>[25]</sup> used is based on the literature reviews and case studies of corporations. The case study is useful to examine the hypothesis and theory practically. The results of this case study are following previous literature review results and further approve the reliability of our hypothesis. The authors divided the corporations into three categories: international finance, banking and insurance, international SCM and logistics, and international marketing and advertising. For example, under the international SCM and logistics category,



the results of the case study showed that by using blockchain in corporate governance, Toyota has lower transaction costs. IBM-Maersk has more property rights and lower transaction costs. Under the international finance, banking, and insurance category, using the blockchain in corporate governance, Barclays has lower transaction costs. Signature Bank has more property rights. Under the international marketing and advertising category, using the blockchain in corporate governance, companies like Comcast, Facebook, and Algebraix all would be able to have more property rights. This paper is contributed to using company case studies to demonstrate the benefits of using blockchain in corporate governance.

Lombardi's research<sup>[26]</sup> contributed to the systematic literature reviews and future research. Their research provided a systematic literature review of the influence of blockchain technology in auditing, future trends, related research areas, etc. Based on the previously published literature, the authors concluded the following three main research areas of blockchain in auditing. The first research area is that blockchain could help auditing professionals improve the business system, thus saving time and preventing fraud. The second research area is the smart contract. The third research area is Cryptocurrency and initial coin offerings (ICOs)<sup>[26]</sup>.

Blockchain technology has huge potential in the future. As this paper mentioned, for future study, blockchain technology would be able to be largely used in different industries such as banking and finance, insurance, SCM, marketing and advertising, etc.

### 3. Theory, data, and methods

In our paper, we selected 77 blockchain companies to conduct the data analysis. The database is from S&P Capital IQ of the year 2020. We selected the following company database variables: company type, buyer type, total revenue, gross profit, number of total investments, number of prior investments, number of current investments, number of total professionals profiled, number of current professionals profiled, goodwill and intangibles (net), goodwill (net), intangibles (net). The results are shown in the following tables and figures.

Firstly, we conducted the statistical summary analysis of each variable from Table 1 to Table 10.

*Table 1: Statistical Summary of Total Revenue (USD mm)*

Variable	Obs	Mean	Std. dev.	Min	Max
TotalRevenue	77	733.8456	3039.854	-19.7	23997.8

*Table 2: Statistical Summary of Gross Profit (USD mm)*

Variable	Obs	Mean	Std. dev.	Min	Max
GrossProfit	77	255.2288	1246.036	-19.7	10460.5

*Table 3: Statistical Summary of several Total Investments / Subsidiaries*

Variable	Obs	Mean	Std. dev.	Min	Max
ofTotalInv	77	17.31169	30.48868	0	196

*Table 4: Statistical Summary of several Prior Investments / Subsidiaries*

Variable	Obs	Mean	Std. dev.	Min	Max
ofPriorInv	77	2.818182	7.516171	0	61

*Table 5: Statistical Summary of several Current and Pending Investments / Subsidiaries*

Variable	Obs	Mean	Std. dev.	Min	Max
ofCurrenta	77	14.49351	24.90911	0	140

Table 6: Statistical Summary of Number of Total Professionals Profiled

Variable	Obs	Mean	Std. dev.	Min	Max
NumberofTo~r	77	25.14286	40.09322	1	216

Table 7: Statistical Summary of Number of Current Professionals Profiled

Variable	Obs	Mean	Std. dev.	Min	Max
NumberofCu~s	76	8.986842	11.68531	0	83

Table 8: Statistical Summary of Goodwill and Intangibles (Net) [Latest Annual] (USD mm, Historical rate)

Variable	Obs	Mean	Std. dev.	Min	Max
Goodwillan~L	77	0	0	0	0

Table 9: Statistical Summary of Goodwill (Net) [Latest Annual] (USD mm, Historical rate)

Variable	Obs	Mean	Std. dev.	Min	Max
GoodwillNe~l	77	22.31887	79.19485	0	471.8

Table 10: Statistical Summary of Intangibles (Net) [Latest Annual] (USD mm, Historical rate)

Variable	Obs	Mean	Std. dev.	Min	Max
Intangibles	77	13.54504	61.00101	0	212.0

As shown in Figure 1, most companies are strategic buyers and only very few companies are financial buyers.



Figure 1: Buyer Type Distribution between Financial Buyer and Strategic Buyer (Pie Chart)

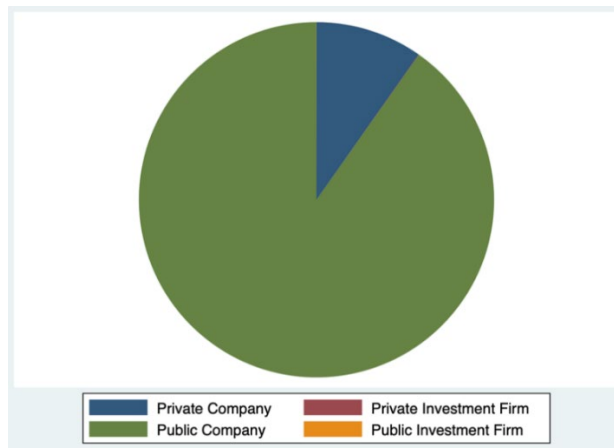


Figure 2: Company Type Distribution (Pie chart)

As shown in Figure 2, these sample companies are mostly public companies. Figure 3, it is blockchain companies have more current investments. Figure 4 showed that blockchain companies have more intangibles than goodwill. Figure 5 showed that number of total professionals profiled below 50. Figure 6 showed that in most companies the number of current professionals profiled is below 20.

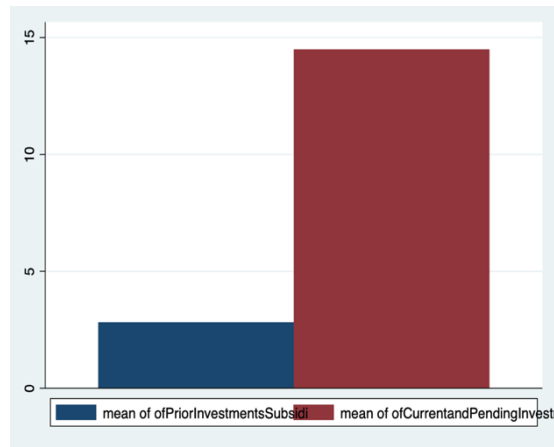


Figure 3: Comparison of mean of Prior Investments and Current Investments (Bar Chart)

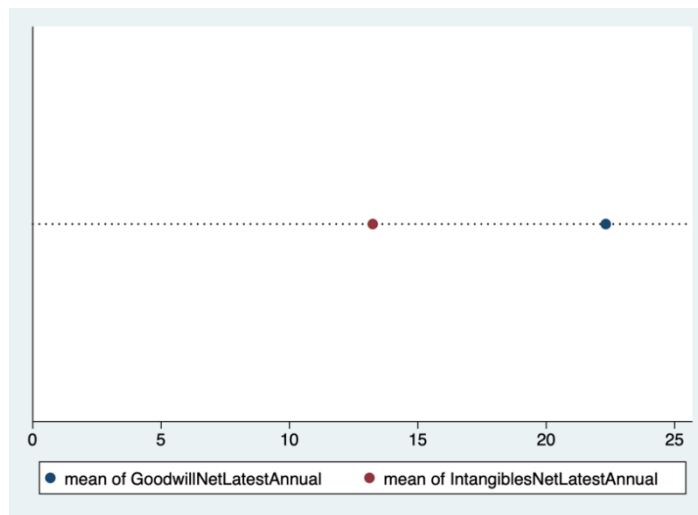


Figure 4: Comparison of mean of Goodwill and Intangibles (Dot Chart)

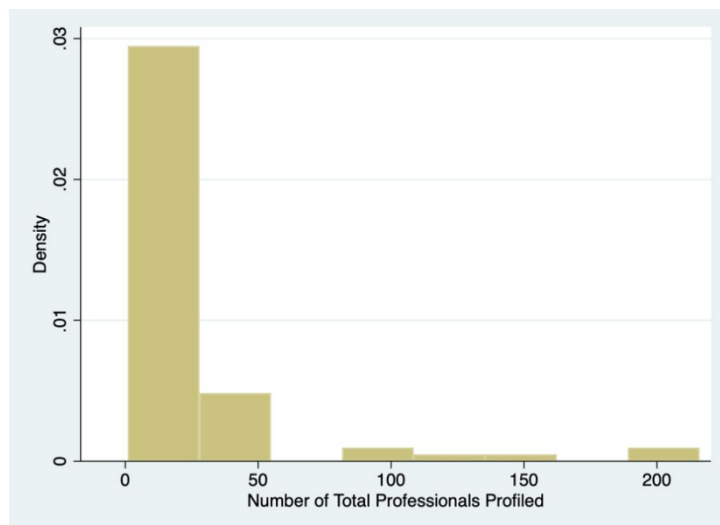


Figure 5: Distribution of the Number of Total Professional Profiled (Histogram)

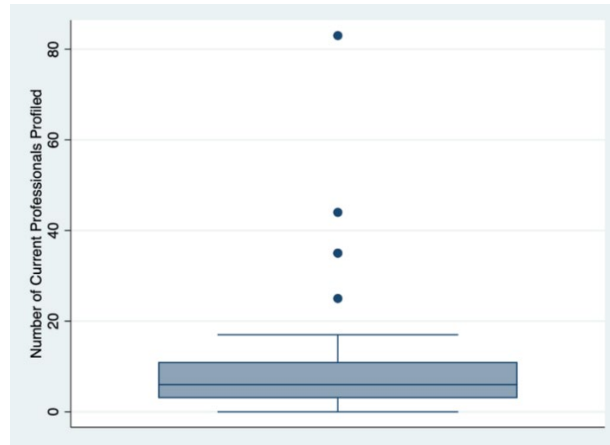


Figure 6: Distribution of the Number of Current Professionals Profiled (Box Plot)

This research also analyzes the frequency distribution of the variables. From the analysis, we concluded that more companies with a smaller number of total professionals profiled. Most companies are strategic buyers rather than financial buyers. The data analysis is mostly based on public companies. Most companies have below 10 tangibles. Most companies don't have any goodwill or intangibles so far.

Table 11: Cross-tabulate Test to examine the relationship between buyer type associated with company type.

Key		Company Type				Total
Buyer Type	Private..	Private..	Public ..	Public ..		
Financial Buyer	0 0.00	2 40.00	0 0.00	3 60.00	5 100.00	
Strategic Buyer	10 13.89	0 0.00	62 86.11	0 0.00	72 100.00	
Total	10 12.99	2 2.60	62 80.52	3 3.90	77 100.00	

Pearson chi2(3) = 77.0000 Pr = 0.000  
Cramér's V = 1.0000

Table 12: Regression model of Revenue and Profit Relations with Non-blockchain Companies as Dummy Variables

```
. regress TotalRevenueCY2020USDmm GrossProfitCY2020USDmm dummyvariable
```

Source	SS	df	MS	Number of obs	=	310
Model	9.0563e+09	2	4.5281e+09	F(2, 307)	=	824.84
Residual	1.6854e+09	307	5489741.79	Prob > F	=	0.0000
Total	1.0742e+10	309	34762622.8	R-squared	=	0.8431
				Adj R-squared	=	0.8421
				Root MSE	=	2343

TotalRevenueCY2020US~m	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
GrossProfitCY2020USDmm	1.078333	.0265812	40.57	0.000	1.026028	1.130637
dummyvariable	-112.7973	308.2342	-0.37	0.715	-719.3163	493.7218
_cons	571.2688	154.6831	3.69	0.000	266.8956	875.6419

#### 4. Results

From the tables, we concluded that more companies with a smaller number of total professionals profiled. Most companies are strategic buyers rather than financial buyers. The data analysis is mostly based on public companies. Most companies have below 10 tangibles. Most companies don't have any goodwill or intangibles so far. Compared with non-blockchain companies, blockchain companies have more relations between profit and revenues (Table 11, Table 12).

#### 5. Conclusions

Based on the convenience and effectiveness of using blockchain, we made the hypothesis that using blockchain in corporate governance would be able to have more transparent, real-time, reliable, cost-effective, verifiable, and accessible transaction records. Blockchain technology also has some disadvantages such as shareholders protection weakness, fraud transactions, anonymous voting, etc. Generally speaking, based on our literature reviews, we concluded that blockchain technology will have more benefits in corporate governance compared to traditional systems and other database management systems. Blockchain technology provides the possibility of using a new decentralized corporate governance system. The content included the following areas that have been discussed in this paper: distributed ledgers, smart contracts, corporate governance, DAO "hack" case (2016), blockchain distributed platform, the decentralized autonomous organization (DAO), customer loyalty plan using blockchain, the proof-of-work system using blockchain, and the blockchain technology in international business.

We selected works of literature mostly from the recent ten years since this blockchain technology is still new. From the works of literature that we have studied so far, most research showed results that using blockchain technology will be a benefit in corporate governance in the fields of transaction tracking, lowering cost and fees, and shareholders' ownership protection. The case study results are very promising. We could assume that there will be more corporations trying to apply blockchain technology in corporate governance, especially for large-size firms.

From our study, there are not any significant flaws or gaps in the existing works of literature. Even though the technology is new, however, these papers would be able to use corporate governance theories to evaluate their results and make rational, legitimate conclusions based on the theories and data.

We hypothesized that using blockchain in corporate governance would be able to have more transparent, real-time, reliable, cost-effective, verifiable, and accessible transaction records. Blockchain technology also has some disadvantages such as shareholders protection weakness, fraud transactions, anonymous voting, etc. The answer to our hypothesis is yes based on the literature reviews.

We defend the answer to our hypothesis based on the sample of selected articles. We studied the contents, methodology, data sources, and conclusions of the selected articles about blockchain in corporate governance. The selected articles included the areas of distributed ledgers, smart contracts, corporate governance, DAO "hack" case (2016), blockchain distributed platform, the decentralized autonomous organization (DAO), customer loyalty plans using blockchain, the proof-of-work system using blockchain, and the blockchain technology in international business. From the analysis of the sample articles, they all agreed that using blockchain in corporate governance is beneficial from accounting, legal, financial, economic, and technological perspectives. Using blockchain in corporate governance also benefits the board of directors, interest parties, and internal operation aspects. From the case studies and sample surveys of article reviews as the sources in the selected papers, the results also proved that using blockchain in corporate governance is more beneficial to a business than the normal database. Our article reviews proved our hypothesis that using blockchain is more beneficial in corporate governance compared to using the database.

We have found that most works of literature also discussed the same advantages and limitations in general. Based on the previous theories and literature reviews, we found that there is some paper that discussed the case study and the decentralized blockchain models that they have built. For example, under the international SCM and logistics category, the results of the case study showed that by using blockchain in corporate governance, Toyota has lower transaction costs. IBM-Maersk has more property rights and lower transaction costs. Ferreira et al. [22] developed a theory and a proof-of-work system. The system is working to verify the transactions in blockchains. They also created a system with suppliers of goods and services. From this model, they examined the blockchain system and corporate governance in managing large-size companies. Based on the literature studies and case studies we concluded that our

hypothesis is legitimate and reasonable.

There is still a lot of work to do in the future as this blockchain technology is still new. In the future, the large application of blockchain technology in corporations, required more knowledge and implementation in international law, information technology, and maybe also in other disciplines. This type of research still needs more empirical research and data collection. The industries could involve business, technology, and science. Besides corporations, some country governments also have projects in implementing blockchain in city governance. This study is mostly focused on large-size firms. In the future, there could be more studies focusing on medium and small-size firms. Innovation helps the company to grow and there is a great need for innovations in the market as well. The technology of blockchain will continue to develop, providing better business services in the future.

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