Blockchain Announcements in the U.S.

Erasmus University Rotterdam

Erasmus School of Economics

Economics and Business

MSc. Financial Economics

Daan Oostdijk, 452189

452189do@student.eur.nl

Supervisor: dr. Jan Lemmen

Second reader: dr. Haikun Zhu

Date: 29-03-2021

Acknowledgments

I would like to thank dr. Jan Lemmen for supervising my thesis. I especially want to thank him for his very quick responses and feedback on the questions I encountered during the process. The tips he gave were very useful and helped me write a better thesis.

Abstract

This thesis investigates the effect of blockchain related announcements on stock prices of companies in the U.S in the period December 2015 until January 2021. A unique sample of 78 announcements is acquired of several blockchain related announcements, ranging from joining a blockchain alliance to blockchain partnerships, and many more. The classic event study methodology is used to test whether there are some effects on the stock prices after these blockchain related announcements. Over the event window of [-1;+1] the CAAR amounts to 3.1% in this sample, but without any statistical significance. Furthermore, several firm-specific characteristics and two Bitcoin related variables are tested to have an influence on the CARs, but none of the variables tested appear to have a statistical significant relationship to the CARs of the companies. In conclusion, there is no statistical significant effect on the stock prices after blockchain related announcements in this sample.

Table of Contents

1. Introduction

Technology is increasingly important in today's economy, and innovations are at the heart of these developments. Innovations can be very modest to even life-changing. Some life-changing innovations from more recent periods are for example; television, mobile phones and the internet itself. These innovations have changed the world we live in and the entire economy. More recent innovations in the financial world are, among others, peer-to-peer lending, artificial intelligence, and blockchain (and many more).

This paper will focus on the blockchain innovations, especially on how the market reacts on the adoption of blockchain. Blockchain has gained attention from the general public with the introduction of Bitcoin (2008). Hileman & Rauchs (2017) define blockchain as 'a type of database that is replicated over a peer-to-peer (P2P) network.' This database can be used to store various types of information, the most well-known is the application in payments, like Bitcoin. However, it can be used for other applications, such as storing medical records. A major advantage of blockchain is that it keeps track of all the past transactions. Unlike other databases, it is more than just a snapshot in time.

A blockchain consists of a chain of blocks. Each block stores some type of information and each block has a certain 'hash' which can be compared to the fingerprint of the particular block. Each block also contains the hash of the previous block, which means that if someone changes the information in the block (which also changes the hash), every block that comes after this block in the chain will change. This makes it difficult to tamper with the blocks.

Blockchain uses a P2P network to verify the blocks, eliminating the need for a third party. If someone creates a block, the P2P network has to reach consensus about the information in this block. Only if the network reaches consensus, the block will be added to the blockchain. Furthermore, blockchain makes sure that the 'double spending' problem (the same information transferred multiple times) is no longer relevant. This is a brief overview of what blockchain is and does, but the scope of blockchain is much larger. For further details regarding the technological aspects, the paper by Hileman & Rauchs (2017) provides an excellent overview.

As Casey et al. (2018) mention, blockchain has the potential to change many aspects of the financial services sector and the broader economy. Blockchain is increasingly important in today's economy, and is adopted by almost every big company in some way. The most well-known adoption of blockchain is cryptocurrencies. Cryptocurrencies have become a very large market over the past few years, with a lot of people making loads of money from speculating on the rise of these cryptocurrencies. Bitcoin is obviously the cryptocurrency that most catches the eye, but other currencies like Ethereum are also increasingly popular over the past few years.

A lot of studies try to capture the influence blockchain might have on the future of financial markets, or even the economy as a whole. The study by Holotiuk et al. (2017) investigates the effect of blockchain on payments. As they say themselves, their results indicate that blockchain allows the offering of new services and renders some of the current ones obsolete. They conclude that blockchain might have a very big influence on payments in the future.

The influence on payments is not necessarily just by creating cryptocurrency, but it can also help make international money transfers easier (Wüst & Gervais, 2018). Blockchain usage eliminates the need of a third party (such as a bank) in money transfers and could therefore help people without a bank in these kind of transactions. This is also where Facebook tries to jump in with the launch of their currency, Libra. The international payments application of blockchain is seen as one of the most socially beneficial applications of the technology. International payments today can be very costly, sometimes even impossible to people without a bank. Blockchain can provide a solution to these kind of problems.

Blockchain can also have a huge impact on the storage of medical records, as the framework proposed by Chen et al. (2019) shows. They mention that blockchain can very well be used to safely store medical data. Another paper that provides a framework for using blockchain in the medical sector is the paper by Shahnaz et al. (2019). The authors state: ‘the healthcare sector stands to benefit immensely from the blockchain technology due to security, privacy, confidentiality and decentralization.’ They also provide a framework for blockchain applications in the healthcare sector.

There are many more examples to think of where blockchain could have an immense impact (Zīle & Strazdiņa, 2018). They list four different sectors in which blockchain could particularly be interesting: data management, data verification, financial, and other. They also state examples for each sector for different types of blockchain applications and the accompanied applier of the application. Some examples are: cloud storage and data monitoring in the data management industry, photo & video proofing and academical certification in the data verification sector, P2P payments and central bank issuing money in the financial sector, and voting in elections and social rating creation/monitoring in other sectors. Overall, this research shows the potential impact that blockchain could have on a variety of different applications.

The applications described are only a handful of applications in the entire blockchain spectrum. However, it is evident that blockchain can have an immense impact on the financial sector, and on the economy as a whole. This thesis mainly focusses on the financial side of the blockchain adoption. More specifically, how do investors react to blockchain related announcements in the U.S.?

There is ample research available investigating the impact that blockchain might have on several sectors. The consensus in the literature is that blockchain will have a great impact on the future of the financial markets, but do investors feel the same way? This thesis will use an event study methodology to check what the effect on company stock prices is after a blockchain related announcement by the firm. Thus, the main question in this thesis is the following:

What is the effect of blockchain-related announcements on the stock prices of listed companies in the U.S.?

There are several events that classify as blockchain related events. For example: a technology development, ICO (Initial Coin Offering), or other cryptocurrency related events, but also a name change or a merger/acquisition. These events are manually selected to acquire a unique dataset with blockchain events. Well-known resources, such as Bloomberg and Newswire are then used to identify the events and the specific dates of those events and these sources are double checked with the company reports. Furthermore, Compustat is used to acquire some company specific variables, such as total long term debt, net income, total assets, book value per share and shares outstanding. These variables are used to check if company-specific factors have an influence on the investor reactions after the blockchain announcements. Additionally, Yahoo Finance provides the prices of Bitcoin in the sample period. These are also linked to the CARs to check for a potential relationship.

The dataset finally consists of 78 blockchain related announcements. These announcements form a unique dataset, with 58 companies. The announcements range from December 2015 up until January 2021. The announcements vary to a large extent, from joining a blockchain related strategic alliance, to a blockchain related merger/acquisition, the filing of blockchain related patents, blockchain partnerships, and many more. These announcements are the core of the thesis and the event study performed.

Regarding the methodology, the classic event study methodology will be used to measure the reaction of the investors. The event study methodology compares the return before the event to the return during/after the event to measure the valuation by investors. The event study tool by the Erasmus Data Service Centre (EDSC) will be used to perform this event study. This tool requires to fill in the company specific ISIN codes and the announcement dates of the firms, together with the chosen event window and the control window.

A brief closer look into the event study: Ball & Brown (1968) and Fama et al. (1969) are often seen as the founders of the event study methodology. They were the first to adopt a methodology similar to the regular event study that we use today. Several follow up papers finetuned the process, such as Bowman (1983), Brown & Warner (1980), Strong (1992) and Peterson (1989). All these papers had an influence on how the event study methodology looks today. The following sector will briefly give an introduction on the process.

With an event study, the returns of the company are compared to a certain index. In this paper, the index will be the S&P500 and the market model will be used to calculate the abnormal returns. Two windows are identified. Firstly, days [-250;-50] (relative to the announcement date), will be used as a control window. This window is used to calculate the 'normal returns'. Secondly, the event window has to be computed. The event window in this thesis will be days [-1;+1]. During the event window, there will be checked if the returns differ significantly from the normal returns described. This will lead to a cumulative abnormal return over the event window, which is the central result of the event study.

After acquiring the cumulative abnormal returns, a standard t-test is used to check whether these abnormal returns are significantly different from zero. In addition, a regression with robust standard errors is used as a robustness check. If the first hypothesis is accepted (Cumulative Average Abnormal Returns are larger than zero), that means that investors have a significant reaction to blockchain related announcements.

Further, to verify what could drive the results of the CAR, several firm-specific characteristics are investigated. Linear regression models are used in this research to verify whether the firm size, the leverage ratio, the type of announcement, the price and return of Bitcoin, and the return on assets (ROA) have an influence on the company's CAR. As mentioned before, the company-specific data is acquired from Compustat. The 30-day lagged price of Bitcoin, as well as the 30 day return will be investigated to check if they affect the reactions of the investors.

The results show that there is no significant effect of blockchain related announcements on the stock price. The first hypothesis (the Cumulative Abnormal Returns are larger than zero) is rejected based on the statistical evidence in this sample. It appears that, at least in this sample, the investors reactions on these blockchain announcement are not as large as expected.

Additionally, several determinants of the CAR were tested using a linear regression. Size, leverage, ROA, and announcement type were central in these regressions, but none of them seem to have a significant effect on the CAR. Also after adding all variables into one model, none of them appeared to have a significant effect on the CAR of the company. The Bitcoin related variables (30-day lagged price and 30-day return) have no statistical significant effect on the CAR of the companies, also when incorporated in the full regression model.

The remainder of this thesis is structured in the following way. The next section will provide the theoretical framework and will state the hypotheses. After that, the data and methodology will be discussed in a more extensive way. Thereafter, the results will be presented from both the event study as well as the regressions for the CAR determinants. The conclusion is drawn in the final section.

2. Theoretical Framework

As mentioned, the main purpose of this thesis is to investigate the effect of blockchain announcements on the stock price of American companies. In other words, how do investors react to blockchain announcements? Do they believe that the adoption of blockchain will increase the overall value of the company, or are investors more skeptical about the effect that using blockchain will have on a certain company? Will there be an effect on the stock prices? And what are possible determinants of this effect? The literature review part of this paper will be used to come up with expectations regarding this effect and its possible determinants by using previously conducted research. This part will structure the base of this investigation and will give insights into the theoretical framework of this study.

2.1 Event Study Methodology

Event studies have become a widely used tool in the economic environment over the last few decades. It is well known that an event study investigates the effect of a certain event on the price of a company over a specified event period. The very first event study comes from the late 1960s, when the first framework for the event study we know now was introduced. The authors investigated the effect of the release of the annual report on the stock prices of the company (Ball & Brown, 1968).

Another paper that is often mentioned as one of the founding fathers of the event study methodology is the paper by Fama et al. (1969), which investigated the relationships between returns and stock splits. They concluded that firms with high growth potential mostly offered stock splits, and therefore the stock splits were found to have a positive effect on the returns of the companies. The main things that are still used for the event study we know today is the abnormal performance index from Ball & Brown, as well as the cumulative abnormal returns used by Fama et al.

When economic literature evolved, so did the event study methodology in the following decades. There are several papers from 1980 up until 2000 that extended the event study methodology compared to the previously mentioned papers. Bowman (1983) dedicated his paper in the early 1980s to describe the event study methodology, providing some sort of guideline for future researchers. Bowman describes the five basic steps that one should use in conducting event studies, building a structure for future papers.

A little later in time, Peterson (1989) again reviewed the event study methodology. During these times, event studies were already a widely used method for investigating economic phenomena and the effect they had on stock prices. Peterson decided to structure all variations of the event study methodology and naming the issues and potential improvements of the tool.

A final noteworthy contribution to the event study (before moving to more specific event study results over more recent years) is the study by Thompson (1995). Thompson mentions the difficulties that researchers face when performing an event study. He paints a picture where researchers have to choose between different estimation windows, different event windows, what statistical tests to use, etc. Thompson contributes to the existing literature on event study methodologies by closely describing the tradeoffs that a researchers has to make in the previously mentioned areas (as well as some other decision that have to be made in the framework).

2.2 Event Study Results

It is evident that event studies have become an increasingly important tool in the economic environment. The previous sections describe the base of the event study methodology and how this has developed over the past few decades. This section will provide some extra papers that used the event study methodology to measure investor reactions for several different events investigated.

An event that is widely investigated using an event study, is the stock split. Van der Sar (2018) defines stock splits as: 'Original stocks are exchanged for at least 25% more new stocks with a pro rata lower nominal value per stock'. This means that the total market value of the company should remain the same. However, several studies have found that investors react positively to a stock split, because it can signal a high growth potential. Fama et al. (1969) were the first to come to this result. More recently, Aduda & Chemarum (2010), Lamoureux & Poon (1987) and Wulff (2002) are a few of many authors that find similar results. Overall, a stock split appears to have a favorable effect on the stock price of a company.

Another economic phenomenon that is widely investigated by using the event study methodology is a share repurchase. Share repurchases means that the company buys back shares from their existing shareholders, which is often used as a signal that the company is doing well and might have some excess cash lying around. Peyer & Vermaelen (2009) investigate the nature and persistence of these so called 'anomalies'. They try to find out if buybacks can generate profits for investors, and conclude that this is indeed the case. Bhargava & Agrawal (2015) conduct an event study in India, but they contradict the findings of Peyer and Vermaelen by concluding that the average abnormal returns are not significant. Alberto & Martins (2020) conclude that the returns after the buyback announcement are significantly positive in the Brazilian market. Overall, the event study is widely used to investigate share repurchases, but the results seem to be country specific.

2.3 Technology Related Event Studies

The two phenomena described in the previous section are more general economic events. However, more technology related events might be interesting to look at for this thesis. If the general reaction of investors to technological developments appears to be positive, this could also be the case for blockchain related announcements.

An example of such a study is the one conducted by Im et al. (2001). The authors investigate the effect of IT related announcements on the stock price by using an event study methodology. As they say themselves: ‘This study provides optimism on the stock market reaction to IT investment announcements’. Overall they conclude that IT related investments seem to lead to an increase in the stock price, at least for the short term.

Another research that is relevant for this paper is the research by Akyildirim et al. (2020). The authors investigate the impact of blockchain related name changes on the stock prices of these companies. They conclude that name changes related to blockchain have a significant positive effect on the stock price. Jain & Jain (2019) reach the same conclusion. This could be a sign that investors believe that blockchain can have a high added value to a company.

Furthermore, Ante & Fiedler (2020) investigate the effect of large Bitcoin transfers on prices. The overall results seem to be insignificant, but when further analyzing transfer motives there are some significant price effects. This can also be seen as a piece of evidence that investors view investments in bitcoin/blockchain favorably, depending on the motive of the investment.

The study by Cahill et al. (2020) investigate several blockchain related announcements, and finds a 5% price increase on average around the announcement date. They investigate several markets, and conclude that the CAR after the announcements is particularly high in the U.S.

Another interesting study in the blockchain environment is the study by Corbet et al. (2020), a case study on KODAKCoin. They investigate the ICO announcement of Kodak and try to find out if Kodak was trying to ride the cryptocurrency bubble. Eventually, the authors conclude that the price of the Kodak stock significantly increased after the announcement.

Overall, the previous papers seem to conclude the same thing. Investors tend to react strongly to technological announcements, and also to blockchain related announcements. Based on the forementioned papers, the first hypothesis will be as follows:

Hypothesis 1: The cumulative average abnormal returns around the blockchain related announcement will be significantly larger than zero (CAAR > 0)

2.4 Firm-Specific Characteristic in the CAR

Whether there is an effect of a blockchain announcement on the stock price or not can depend on several firm-specific variables. The CAR after the announcement can differ based on these characteristics, and are therefore important to investigate. This part explores several characteristics and will describe what to expect from these variables.

The first variable that comes to mind which most likely has an effect on the investor reaction, is the size of the company. The first to investigate the relation between size and returns was Banz (1981). This paper links the market value of the company with their returns, and concludes that smaller firms have higher returns than larger firms. When looking at abnormal returns, the first to investigate this was Bamber (1986). She looked at earnings announcements and concluded that there were higher effects for smaller firms compared to big firms after these announcements. She attributes this result to the fact that there is fewer information about smaller firms, and that in this case the earnings announcements were more surprising, therefore triggering a sudden reaction.

Another paper that studied the size effect on the CAR is the paper by Ajlouni & Toms (2008), which investigates the effect of director trading on the stock prices of the companies. They perform an event study and test the determinants of their results. The authors conclude that the effect seems to be significantly larger for smaller firms, meaning that the share price increases heavier compared to large firms.

The paper mentioned before by Im et al. (2001) also investigates whether there could be a size effect in the results that they found. As mentioned, the authors find a significant price change after IT related announcements in their sample. Interestingly, they also find (comparable to the previously mentioned papers) that smaller firms tend to react more strongly to these kind of announcements.

Overall, all literature seems to point in one direction, the stock price of smaller firms react more strongly to announcements compared to larger firms. Therefore, the second hypothesis is as follows:

Hypothesis 2: The returns after the blockchain related announcements will be more profound for smaller firms relative to larger firms.

Another firm-specific factor that might have an influence on the CAR is the leverage ratio of the company. In this thesis, the leverage ratio will be defined as total long-term debt divided by the total assets. This indicates the level of debt that the company has compared to its assets and signals how healthy the company is.

The leverage ratio is something that is widely used and tested as a determinant of the CAR. For example, Gan et al. (2017) investigate share repurchases in China in the period 2000 to 2012 and try to link some company-specific determinants to the acquired CAR. The authors also link the leverage to these abnormal returns, but find no significant relationship between the two.

A well-known study by Maloney et al. (1993) links the capital structure of a firm to returns of the companies participating in mergers and acquisitions. For acquisitions, the authors find a positive significant relationship between the leverage ratio of the acquirer and the abnormal returns after the announcement. Furthermore, for mergers the authors find a similar relationship in this paper. Overall, the conclusion of this investigation is that the leverage ratio has a significant effect on the CAR in their sample.

Additionally, Dhaliwal et al. (1991) investigate unexpected earnings announcement and link the returns to the financial leverage. The authors find a significant relationship between these factors in their paper. Sivaprasad & Muradoglu (2009) also find a positive relationship between leverage and abnormal returns in their paper, as well as Adami et al. (2010).

In conclusion, the literature seems to be split between different results over different papers and therefore it is difficult to formulate a hypothesis. However, the expectation of this study is that leverage does have some effect on the CAR after blockchain related announcements in line with several of the previously mentioned papers. Therefore, the hypothesis will be as follows:

Hypothesis 3: The leverage ratio has a significant, positive effect on the CAR after blockchain related announcements.

Furthermore, the type of blockchain announcement that the company makes might be interesting to look at. Do investors react similarly to all blockchain related announcements, or is there a difference in the effect? The announcements in this study vary to a large extent, from strategic alliances and partnerships, to patents and investments. However, there is a certain group of announcements that occurs more often in the dataset: the company joining a blockchain related alliance.

The first major alliance that is used in this study is the Enterprise Ethereum Alliance (EEA). They summarize their goal as follows on their website (Enterprise Ethereum Alliance, n.d.): 'The EEA enables organizations to adopt and use Ethereum technology in their daily business operations. We empower the Ethereum ecosystem to develop new business opportunities, drive industry adoption, and learn and collaborate with one another.'

The second large alliance that is used in this research is Hyperledger. Hyperledger is stated to be the largest blockchain project on the planet. The mission on Hyperledger, as stated on their website, is fourfold (Hyperledger, 2016). A brief overview:

1. Create a distributed ledger framework on which users can build and run applications to support business transactions
2. Create a community focused on blockchain
3. Promote participation of leading members of the ecosystem
4. Host the infrastructure for HLP (Hyperledger Project)

The final major alliance that is used with the announcements is MediLedger. This is solely meant for pharmaceutical companies. They state on their website (MediLedger, n.d.): 'It brought together pharmaceutical manufacturers and wholesalers in a working group to explore the potential of blockchain to meet the Drug Supply Chain Security Act requirements for a track and trace system for US drugs by 2023.'

The specific announcements will be more extensively covered in the data section, but overall there are two sorts of announcements in the data sample: the joining of one of the previously mentioned alliances, or other blockchain related announcements. The other announcements vary to a large extent and will be covered in a later part of this thesis.

There are reasons to believe that the CAR between these two groups will be different. The first and main reason is the fact that mainly large cap firms tend to join these kind of alliances. This is the case since it requires a certain investment, especially with an active participation. As described with the second hypothesis, larger firms tend to have less pronounced stock price reactions after announcements, and therefore this might also be different in the case of the joining of a strategic alliance relative to other announcements.

In addition, several of the other announcements have been investigated in the past, and have yielded high returns after the announcements. This is the case for example for blockchain related name changes. The previously mentioned research by Akyildirim et al. (2020) as well as the paper by Jain & Jain (2019) show that there is a significant reaction to a blockchain related name change. Furthermore, the study by Corbet et al. (2020) shows that there is a large reaction to the KODAK stock price after the announcement of the release of their own coin. These papers use various benchmarks, such as CRSP, S&P500, or other indices where the stocks are traded. They conclude that for each benchmark tested, the results are positively significant.

Since these announcements have been investigated in the past, and are also part of the 'other announcements' in this sample, a difference between these two groups is likely. Adding this to the expectation that larger firms will have a smaller reaction to the blockchain related announcement, the fourth hypothesis is as follows:

Hypothesis 4: The CAR for the announcements regarding the joining of a blockchain related strategic alliance will be lower compared to other announcements in the sample.

Another thing that is likely to have an influence on the CAR of blockchain related announcements is the price and the past returns of Bitcoin. Bitcoin is probably the most well-known application of blockchain, therefore it might be the case that the performance of Bitcoin has a significant effect on how investors react to blockchain related announcements. For example, Cahill et al. (2020) investigate the influence of blockchain adoption on the stock prices and links Bitcoin performance to the CARs acquired. They find that the Bitcoin price levels are significantly positively related to the CAR of the companies.

Furthermore, the study previously mentioned by Corbet et al. (2020) also links Bitcoin prices to the price of the Kodak stock. They find that after the announcement of the KODAKCoin, the correlation between the stock price and the general stock market began to break down. In addition, they find that the correlation between the stock price and the price of Bitcoin increased over the same period.

Following these studies, a relationship between Bitcoin and the CAR after the blockchain related announcements is likely. This paper will look into the prices of Bitcoin, as well as the Bitcoin returns to check for potential effects on the CARs after the announcements. The expectation is that the effect of the prices and the returns is positive on the CARs. This leads to the following hypothesis:

Hypothesis 5: The price of Bitcoin and the returns of Bitcoin before the blockchain related announcements are positively related to the CAR.

A final company specific determinant that potentially has an influence on the CAR after blockchain related announcements is the profitability of the company. In this thesis the profitability will be captured by the ROA (Return On Assets), measured by the net income divided by the total assets. It measures to what extend the assets of the company lead to a profit. In other words, a ratio of 0.2 means that every dollar of assets lead to 0.2 dollar income.

Fama & French (2006) investigate the profitability in relation to stock returns. They conclude in their paper that more profitable firms have higher returns, after controlling for other factors such as book-to-market ratio and expected investment. Further, Novy-Marx (2013) concludes that profitable firms generate significantly higher returns. Ball et al. (2015) and Ball et al. (2016) also conclude that profitability is a significant driver of stock returns.

Overall the literature seem to point in the same direction, more profitable firms yield higher stock returns. The expectation of this study is that this is the same for the CAR after blockchain related announcements. The last hypothesis will therefore be:

Hypothesis 6: The profitability of the firm (measured by the ROA) will have a significant positive effect on the CAR after blockchain related announcements.

These six hypotheses will help in answering the research question formulated in the introduction. The data and methodology used to test these hypotheses will follow in the coming parts of this thesis.

3. Data

The companies used in this thesis were manually selected by searching for blockchain related announcements on Google. The main purpose of this search was to identify blockchain related announcements by firms in the U.S. Initially, the sample consisted of 91 announcements. However, due to a variety of reasons, the final sample consists of 78 announcements, covered over 58 unique companies. There are companies with multiple announcements in the sample, but these announcements are at least six months apart to make sure that there is no overlap in the investor reactions. One exception is FedEx, which announced two blockchain related things on the same day. The full sample of announcements can be found in the appendix.

The analysis covers companies ranging from small cap to large cap, traded on NYSE, NASDAQ, and over the counter. The announcement dates are double checked with reliable sources, such as Bloomberg, Newswire, the website of the particular alliance, or the website of the specific company to make sure that the announcement dates are reliable. The period of the announcements ranges from December 2015 up until January 2021.

The announcements itself range from several different adoptions of blockchain technology. A large part of the dataset is the participation in blockchain related strategic alliances (Hyperledger, Enterprise Ethereum Alliance, MediLedger), but there are several other blockchain adoptions that are included in this unique data sample. Including but not limited to: blockchain investments (such as cryptocurrency), filing of blockchain related patents, blockchain partnerships, an ICO, creation of blockchain platforms, and many more. A detailed view of all the announcements types can be found in the appendix.

To go more specific in how the announcements were found and what the criteria of the announcements were, this section provides a brief insight in the process. Overall, a Google search was used to identify blockchain related announcements. By googling on several relevant key words, such as ‘blockchain partnership’, ‘blockchain name change’, ‘blockchain investment’, ‘blockchain patent’, etc., 91 unique announcements related to blockchain were identified. These searches mainly lead to blockchain specialized websites (such as cointelegraph) in which a lot of blockchain news is shared. After the announcement was found to be useful, the announcement date had to be checked by using more reliable sources, such as the sources previously mentioned. This was then double checked by verifying this with company specific sources. If this all checked out, the announcement was added to the dataset.

The dataset obtained is the main data of this paper and is used for the core investigation of the paper, the event study. The event study will show a possible investor effect on the blockchain announcements, and will provide a certain Cumulative Abnormal Return (CAR) over the specified event period (this will more extensively be covered in the methodology part of this paper).

Furthermore, to check for possible determinants of the CAR retrieved from the event study, extra company data is necessary. Compustat is used here to get the company specific data. In this database, the data for the total liabilities, total assets, book value per share, net income, and shares outstanding is used. This data, combined with the event study data, provides the book-to-market ratio, the leverage ratio, the return on assets and the size of the company. All of these variables are used to check for possible effects on the CAR. In addition, Yahoo Finance is used for the day-by-day prices of Bitcoin (necessary for the fifth hypothesis).

Along the way, some companies could not be retrieved when performing the event study, others were missing in Compustat. It is important for this study that both of these are available, so all hypotheses can be tested with the same sample. Therefore the decision was made to delete observations with missing values. After these missing companies were deleted, the full sample consists of 78 unique announcements. The descriptive statistics of these announcement can be seen in the table shown below (Table 1).

Table 1: the descriptive statistics of the sample of announcements. The CAR is calculated over the event window [-1;+1] with the S&P500 as the benchmark index. The market value shown is in million dollars. The leverage ratio is calculated as total long term debt divided by total assets. The book-to-market (BM) value is obtained from multiplying the book value per share (acquired from Compustat) with the number of shares outstanding divided by the share price multiplied by the number of shares outstanding. There are negative values here because of some companies having a negative book value per share. BitcoinL30 stands for the price of Bitcoin 30 days before the announcement (lagged 30 days) and BitcoinReturn is the return over the period [-30;-1] relative to the announcement. ROA is calculated by dividing the net income by the total assets.

	CAR	Size	Leverage	BM	BitcoinL30	BitcoinReturn	ROA
Average	3.12%	177,060.20	20.41%	32.66%	7,922.44	21.12%	5.88%
Median	0.56%	75,584.20	20.07%	21.12%	6,710.80	21.39%	5.53%
Std. Deviation	20.02%	269,160	12.31%	33.09%	6,704.39	33.51%	7.51%
Min	-4.16%	154.12	0.01%	-15.93%	330.36	-45.27%	-29.17%
Max	176.53%	1,612,774	61.27%	181.19%	39,381.77	105.20%	27.84%

4. Methodology

Now that the data used in this study is clear, this part will explain the methodology used to test the hypotheses covered in the theoretical framework. The event study methodology will be explained, which is used to test the first hypothesis. Thereafter, the regression techniques used to test the other hypotheses will be covered.

4.1 Event Study Methodology

There are a lot of different choices a researcher has to make when performing an event study. These choices contain for example the amount of event days, the length of the control period, and many more (Thompson, 1995)**.** This part of the thesis will go more deeply into the event study methodology and the choices that were made regarding these factors.

An event study seeks to find whether a certain set of announcements, on average, has any influence on the stock prices of the companies involved. For each event in the sample, the returns will be compared to a reference market by using the market model. By comparing these returns and statistically testing them, a conclusion can be drawn regarding the first hypothesis.

4.1.1 Abnormal Returns

A term that is very important here, is the abnormal return. The abnormal return is basically the difference between the observed return and the so-called 'normal return'. Constructing these abnormal returns is the first step in the event study methodology. Armitage (1995) tests several different normal returns, and conclude that the market model returns are the best when conducting an event study. The methodology described in his paper will also be the base for the methodology used in this thesis. Thus, this thesis will also use the market model as the reference point. As the previously mentioned paper shows, the formula for the market model normal returns is as follows:

$$NR_{it} = \alpha_i + \beta_i R_{mt} + e_{it} \qquad (1)$$

As mentioned, abnormal returns can be seen as the observed returns minus the normal returns. This can be formally seen as:

$$AR_{it} = R_{it} – NR_{it} \qquad (2)$$

Adding (1) and (2) together makes the abnormal returns as follows:

$$AR_{it} = R_{it} – (\alpha_i + \beta_i R_{mt}) \qquad (3)$$

Overall, this formula represents the way stock i deviates from its normal returns over time t, relative to the market performance R_{mt}, where R_{it} is the observed return over the same time period. The market-related volatility is shown by β_i and the performance relative to this benchmark is shown by α_i. Finally, e_{it} is the error term. This study uses the S&P500 as the benchmark index, which means that there will be checked whether the returns following the announcements will outperform the S&P index.

4.1.2 Different Windows

Before moving on to the calculation of the CAR and the following steps in the event study, it is important to identify the windows of the event study. More specifically, an estimation window as well as an event window have to be constructed to investigate the effect in a certain time period. Several choices have to be made regarding these periods, which will briefly be covered in the following section.

First, it is crucial to identify the announcement day, which will be set to 'day 0'. As mentioned in the data part of this study, the announcement dates are checked using reliable sources and can therefore be seen as correctly identified.

Secondly, the event period has to be determined. Regarding the event window, there is a tradeoff between accuracy (a longer event window leads to higher accuracy) and potential breaks in the data (a longer event window is more likely to include breaks unrelated to the event). Furthermore, days before the event window are often included to account for potential information leakage before the announcement itself. However, since this research is conducted in America this is less relevant, as the market in America is more efficient compared to emerging markets. For blockchain related announcements, it is likely that there is some kind of 'hype' in the market for these new technologies, and therefore especially the announcement day itself and the day after the announcement is relevant in this case. In conclusion, this study will use an event window of [-1;+1]. Looking at the statistics of the AAR (formula in the following section) it can be seen that especially day 0 and day 1 appear to have a larger return than the other days, supporting the decision for this event window. A more detailed overview of all the returns over the event days ranging from 10 days before to 10 days after the announcement can be found in Table 6 in the appendix.

The final decision that has to be made is the length of the estimation window. As Armitage (1995) described in his paper, the length of the event period is not really relevant if the period is larger than 100 days. Following his conclusion, but still ensuring that the normal returns really capture the trend of the particular stock, the estimation window will be 200 days and will be calculated over days [-250;-50]. A period between the estimation window and the event window is used to make sure that there is no overlap between the reaction on the blockchain related announcement and potential information leakage or other events. Overall, with choosing the event window and the estimation window, the potential of information leakage can entirely be ruled out in this research.

4.1.3 CAR

After conducting the abnormal returns and determining the appropriate windows, it is important to cumulate them over the event period. The cumulative abnormal returns show the total effect of the announcement on the stock price over the event period (the duration of the event period will be covered later in this section). Formally shown, the CAR is calculated is as follows:

$$CAR = \sum AR_{it} \quad (4)$$

Basically, formula (3) of a certain stock i is used an the sum of these abnormal returns on the event period chosen is the CAR over the event period. However, this is not the final step, since the CAR of the entire sample has to be constructed to identify whether there is an effect on the stock price after blockchain related announcements. Thus, to make sure that the effect of the entire sample is studied, the average abnormal return will be calculated, which will be used to calculate the cumulative average abnormal returns. So first, the average abnormal return for each day in the event window has to be computed, which can be seen as:

$$AAR = (\sum AR_{it})/N \quad (5)$$

In this formula AR_{it} is the previously conducted abnormal return for each company. The sum of all abnormal returns of all the companies combined over a specific day is taken, and then divided by the total number of observations. This all together is the average abnormal return over a single day. The final step is to acquire the cumulative average abnormal return over the event period, the CARs of all the companies is calculated. The formula is as follows:

$$CAAR = (\sum CAR)/N \quad (6)$$

So this means that taking the sum of all the company-specific CARs and dividing them by the number of observations provides the CAAR. This CAAR is the average reaction of the sample compared to the S&P500 and therefore this is the center in answering the first hypothesis. As a further robustness check, the NASDAQ will also be used as a benchmark index, to test whether results remain the same for using different indices.

For performing the event study itself, the Event Study Tool by the Erasmus Data Service Center (EDSC) is used. This tool requires the ISIN codes of the companies, together with the announcement dates for these firms. After deciding for several variables, as described in the previous section, this tool provides the abnormal returns for the companies and over the event dates. The abnormal returns from days [-10;+10] are acquired from this tool, allowing for multiple analysis regarding different event windows and robustness checks.

After conducting these measures, it is important to test the statistical significance of the results. As mentioned in the theoretical framework, the first hypothesis is that the CAAR is larger than zero. The most straight forward way of testing that the CAAR is significantly different from zero is by performing a t-test. Again following Armitage (1995), who states that the standard t-test is the best way to test for significance of the CAAR. He states that there is not much to win by using very complicated statistical measures. To quote the paper: 'There is no evidence that more complicated prediction error or GLS estimation increases the power of tests, though the prediction error method is quite widely used.'

Also the event study guide by Princeton (2008) proposes to use the t-test to test for significance. A further suggestion they do is to calculate the CAAR of all companies by performing a regression and using the p-value from the regression to check for significance. They state that this might be even better than using a regular t-test because it is possible to perform this test with robust standard errors. This thesis will use both the standard t-test, as well as the regression with robust standard errors to test for significance of the CAAR.

4.2 Firm Specific Characteristics in CAR

The following hypotheses test whether there are certain firm-specific characteristics that have a significant effect on the CAR of the company. These methods will be used for testing the hypotheses 2 until 6. The regressions will first be done on just the CAR, and also checked with more controls whether potential effects persist with other variables added as well.

But first, as mentioned in the previous section, a linear regression model with robust standard errors will be used to verify if the results with the regular t-test still hold when using robust standard errors. The formula for this is as follows:

$$CAAR = \alpha + \varepsilon \qquad (7)$$

The alpha will then be the intercept of the CAAR and will simultaneously be tested by Stata on statistical significance. As said, this is used to verify whether the results with the standard t-test still hold in this case.

4.2.1 Size

The first variable that is expected to have an effect on the CAR of the companies, is the size (total market value) of the firms. The market value is calculated by using the shares outstanding and multiplying this with the share price at the same date. The results from this calculation are used as the size variable in this research.

The first thing that is done to verify if there is a size effect in the CAR, is to perform a linear regression with just size as the independent variable. This can be formally shown as:

$$CAR = \alpha + \beta Size + \varepsilon \qquad (8)$$

Thereafter, the sample is split into five quintiles based on the total market value, to test whether there are significant differences in the sample between the largest and the smallest firms. The formula for this is as follows:

$$CAR = \alpha + \beta_1 Size_{Q2} + \beta_2 Size_{Q3} + \beta_3 Size_{Q4} + \beta_4 Size_{Q5} \qquad (9)$$

The separate betas can here be seen as the difference between the specific quintile to the base quintile (smallest firm quintile in this case). The alpha here is the average CAR of the smallest firm quintile, and is (as mentioned in the theoretical framework) expected to be the highest of all the quintiles.

To make sure that the difference between small and large cap firms is captured, a dummy variable is created. This dummy variable equals 1 for large cap firms and zero otherwise. The final regression regarding size will therefore be:

$$CAR = \alpha + \beta MarketCap + \varepsilon \qquad (10)$$

4.2.2 Leverage

The second variable that is expected to have an effect on the CAR of the companies, is the leverage ratio. The leverage ratio is defined as the total long-term debt divided by the total assets of the company. Again, the first thing that is done is a one-on-one regression of the leverage ratio on the CAR. The formula:

$$CAR = \alpha + \beta Leverage + \varepsilon \qquad (11)$$

The beta will here be the effect on the CAR and will be statistically tested using robust standard errors. The results will later be compared to the full model, which is described later in this section.

4.2.3 Type of Announcement

As described in the theoretical framework, the fourth hypothesis will test whether there is a difference between different sets of announcement. To be more precise, the test tries to find out if differences between joining a blockchain alliance leads to different reactions compared to other types of announcements. In this case, a dummy variable will be used to check for potential differences between the two. The regression is as follows:

$$CAR = \alpha + \beta AnnouncementType + \varepsilon \tag{12}$$

The variable will be one when the announcement is to join a blockchain alliance, and zero otherwise. The beta will show the differences between the two groups, with the alpha being the average effect of the 'other announcement' groups.

4.2.4 Bitcoin

The next thing to be investigated is the relationship of Bitcoin performance and the CARs after blockchain related announcements. Following the study by Cahill et al. (2020), this thesis will also investigate the effect of Bitcoin related variables on the CARs acquired. The study uses the Bitcoin price at day -30, as well as the Bitcoin return a month prior to the announcement until the announcement day (return over days -30 until -1) in trying to explain CAR drivers. In line with this study, the natural logarithm of the Bitcoin prices and returns are taken, which make the regressions as follows:

$$CAR = \alpha + \beta \ln(BTCL30) + \varepsilon \tag{13}$$

And:

$$CAR = \alpha + \beta \ln(BTCReturn) + \varepsilon \tag{14}$$

The first regression takes the lagged Bitcoin price into account, the second will investigate the effect of Bitcoin returns from days [-30;-1]. The beta's are interpreted differently because of the natural logarithm, this will be further explained in the results part.

4.2.5 Profitability

The final company-specific factor that is tested to have an influence on the CAR after blockchain related announcements is the profitability of the company. The profitability is here defined by the net income divided by the total assets and measures how well the company can turn their assets into profits. As with the other variables, a one-on-one linear regression is used to investigate the effect:

$$CAR = \alpha + \beta ROA + \varepsilon \tag{15}$$

The beta will capture the effect that ROA has on the CAR of the companies. As a further check, the ROA will also be taken into account together with all the variables mentioned in the previous sections in a full model regression.

4.2.6 Full Model

As a final check, the results of the regressions described in the previous sections will be checked with more controls. The question this model then answers: is there a change in effect compared to the previous models, when all variables are added? Besides from the variables used in the previous models, the book-to-market ratio is also added as an extra control variable. The book-to-market is defined as the book value per share times the number of shares outstanding, divided by the share price times the shares outstanding (book value/market value). The full model is as follows:

$$CAR = \alpha + \beta_1 MarketCap + \beta_2 Leverage + \beta_3 AnnouncementType + \beta_4 BM + \beta_5 ln(BTCL30) + \beta_6 ln(BTCReturn) + \beta_7 ROA + \varepsilon \quad (16)$$

5. Results

This part will structure the results of the hypotheses formulated in the theoretical framework. The first part will focus on the event study, the parts thereafter on the regression analysis regarding the determinants of the CAR.

5.1 Event Study Results

The event study is the base of this thesis, and the most important hypothesis to test the research question formulated. In the methodology part, the appropriate windows are determined for conducting this event study. This section will show the results of the event study performed.

First, the CAAR is determined as described in the methodology part. In short, this is determined by adding the AARs of the days [-1;+1]. The results of the separate AARs and the CAAR following from that are as follows:

Table 2: the Average Abnormal Returns over the relevant event days [-1;+1]. The acquired Cumulative Average Abnormal Return is retrieved from adding the AARs from the event window together. The benchmark index used here is the S&P500.

Event Day	**-1**	**0**	**1**
AAR	0.005399831	0.017989449	0.007896697
CAAR			0.031285977*

As can be seen in the table, the AAR around the announcement date is the highest, with more than twice the effect on day +1 and more than three times the effect compared to day -1. Adding the average abnormal returns over the relevant period gives the cumulative average abnormal return. Overall, the stock price increases with an average of 3.1% over the relevant event window (* indicates the significance at the 10% level, based on the one-sample t-test).

After this is identified, it is crucial to check for possible statistical significance. Following Princeton (2008), the first test conducted is the simple one-sample t-test, and the second will be a one-on-one regression. Performing the t-test gives a p-value of 0.0858, which means that the CAAR is not statistically significant at the 5% level, but it is significant at the 10% level.

Furthermore, the single regression is performed to be able to use the robust standard errors to control for heteroskedasticity. The robust standard errors will not change the constant, but it is possible that it changes the significance. This is indeed the case, the p-value changes to 0.172, making it less significant compared to the one-sample t-test.

The results are tested over multiple event windows to ensure robust results. The event windows further tested are: [-10;+10], [-5;+5], [-3;+3], [0;+1], but none of them leads to increasing significance.

As a further robustness check, the NASDAQ is used as a benchmark index to check for potential different results. Table 7 and Table 8 from the appendix show the results for all the event days, as well as the results for the event window used for the main results (with the corresponding CAAR). The CAAR for the event window are in this case 2.9%, but the results are not statistically significant (p-value of 0.189, using robust standard errors).

Overall, the conclusion that can be drawn from investigating the first hypothesis, is that (when taken as a whole) there is no statistical significant investor effect in this sample of announcement, meaning that the first hypothesis is rejected. However, the 3% increase in the stock prices might have some economic consequences. Especially for institutional investors a 3% price increase might have a significant effect if they have very large positions in a certain company. In conclusion, the low statistical significance does not mean that there is no economic impact for several parties, the effect is still something to take into account.

Furthermore, there might be differences between several company characteristics, making the CARs possibly statistically significant for different subsamples. The results of these tests will be discussed in the following parts.

5.2 Company-Specific factors on the CAR

Firm-specific characteristics might have an influence on how investors respond to blockchain related announcements. Several characteristics will be explored in this part, verifying whether there are certain effects that play an important role in the CAR.

5.2.1 Size

The first factor that likely has an influence on the CAR, is the market value of a company. As formulated in the second hypothesis, there is expected to be a negative relation between the size of a company, and the CAR after the blockchain related announcement. In other words, the expectation is that smaller firms respond heavier to these kind of announcements compared to larger firms.

The first thing to be investigated, is whether a single regression gives a significant size effect on the CAR. However, the single regression yields non-significant results (p-value of 0.466). This is not surprising, since a small decrease in the total size of the company is not likely to have a large effect on the CAR. What might be more interesting, is to look into different size quintiles and see what the differences are between the smallest size quintile and the other quintiles. Bootstrap Standard Errors are used, following the study of Koenker & Hallock (2001) in performing a quintile regression. The results of this regression can be seen in the following table:

Table 3: the results of the regression from different size quintiles on the CAR. The higher the quintile, the larger the size of the company. Bootstrap standard errors are used and p-values can be found in the final column.

	Coefficient	**Bootstrap Standard Error**	**P-Value**
Constant	0.1283431	0.1245989	0.303
Quintile 2	-0.1207193	0.1250918	0.335
Quintile 3	-0.1205103	0.1252075	0.336
Quintile 4	-0.1262148	0.1241359	0.309
Quintile 5	-0.1207193	0.1248216	0.325

Looking at the table, the return for the smallest firm quintile (the constant in this case) yields indeed the highest returns as expected. The coefficients of all the other quintiles are negative, however not significant. Based on this there cannot be concluded that there is a size effect in the CAR. But, it could be the case that there are more large cap firms in the sample and that the quintiles do not paint a good picture regarding the size effect.

Because of the forementioned reason, another test is conducted where large cap stocks are compared to small cap stocks. The definition of large and small cap stocks differ between different brokerage houses, but large cap firms are generally defined to have a market value larger than $10 billion. This classification is made by Ross (2021) on Investopedia. After making this classification, and using robust standard errors again, the results are still non-significant for small cap versus large cap with a p-value of 0.268.

Similar to the first hypothesis, the results on the statistical significance does not mean that there is no economic effect of the results. The coefficients for the smallest firms in each of the tests is as expected (smaller firms respond heavier to blockchain related announcements), which means that for large numbers, the effect can still have a significant economic impact on the returns for (for example) institutional investors.

Overall, three different tests have tried to identify differences between small cap stocks and large caps stocks and their effect on CAR. All the tests performed lead to the same outcome, the coefficients show that small firms respond heavier to blockchain related announcement, but the p-values show that there is no statistical significance of these results. In other words, the second hypothesis that the effect for smaller firms is larger is rejected based on the statistical evidence.

5.2.2 Leverage Ratio

The second factor tested on the CAR is the leverage ratio. The leverage ratio is defined as the total long term debt divided by the total assets, and is a variable that indicates how healthy a company is. Put differently, it shows how easy it will be for a company to pay back their long term debts.

As described in the methodology section, a one-on-one regression will be used to test for potential influence of the leverage ratio on the CAR. The coefficient is negative, but using robust standard errors, the effect seems to be non-significant with a p-value of 0.281. The leverage ratio appears to have no significant effect on the CAR of the companies. A noteworthy results in this case is that the coefficient has a different sign than expected, which is surprising.

In conclusion, the third hypothesis (there is a significant positive effect between the leverage ratio and the CAR) is rejected.

5.2.3 Type of Announcement

The next determinant that is linked to the company specific CARs is the type of announcement. A distinction is made between the joining of a blockchain strategic alliance (Hyperledger, Enterprise Ethereum Alliance, MediLedger) and other blockchain related announcements (patents, name changes, partnerships, etc.).

A single regression is performed with a dummy variable that equals one for strategic alliance announcements, and zero otherwise. Again using robust standard errors, the effect of the joining of the strategic announcement is lower relative to other announcements, but non-significant with a p-value of 0.330.

In conclusion, there is no significant difference between joining an alliance relative to other announcements regarding their effect on the CAR. The fourth hypothesis that there are higher reactions for other blockchain related announcements is rejected. However, as mentioned before, this does not mean that there is no significant economic impact for these results, as the coefficient is as expected. For some investors the effect might still be important.

5.2.4 Bitcoin

The following variable that is linked to the company specific CARs is the performance of Bitcoin. As mentioned in the methodology part, both the Bitcoin prices as well as the Bitcoin returns are linked to the CAR to check for a relationship.

First, a single regression is performed between the lagged Bitcoin price (price from day -30) and the CAR. The natural logarithm is taken, which makes the coefficient a little different from the previous variables. The effect appears to be positive with a coefficient of 0.24, which means that a 1% increase in the price of Bitcoin increases the CAR by 0.0024% (0.01*0.024), following the interpretation of Stock & Watson (2015). Using robust standard errors, the p-value is non-significant (0.290).

The next thing that is tested are the Bitcoin returns over the month before the announcement and their effect on the CAR. Again, the natural logarithm of the returns are taken and regressed on the CAR. The effect seems to be slightly negative with a coefficient of -0.002, which means that the effect on CAR is very small (0.01*-0.002 = 0.00002%). The p-value (0.297) shows that the effect is non-significant.

Overall, the one-on-one regressions point to the fact that Bitcoin related variables are not significantly related to the CARs. Both variables tested have a small statistical and economic impact on the CARs after blockchain related announcements. The effects will again be tested in the full model, shown in a later paragraph.

5.2.5 Profitability

The final variable that is tested is the profitability. As discussed, the profitability is defined by dividing the net income by the total assets and is expected to be positively related to the CARs after the announcements.

A single regression is performed to test the relationship. Surprisingly, the coefficient is negative (-0.35), and non-significant (p-value of 0.271). The coefficient has a different sign than expected, but is not significantly related to the CAR. The statistical insignificance does not mean that the variable is not important to take into account. As with several of the other variables discussed, the economic implications for large amounts of money can still be important to take into account.

5.2.6 Full Model

To test whether there are differences in results when all variables are tested at the same time, the final regression is a full regression with all the forementioned variables. Furthermore, the book-to-market ratio is added as an additional control variable.

Regarding size, the dummy variable which differentiates large cap from small cap firms is added. Furthermore, the announcement type dummy is added, together with the leverage ratio, ROA, the natural logarithm of the price of Bitcoin, and book-to-market ratio. The return of Bitcoin is not added in the full model due to some lost observations (natural logarithm of negative numbers don't exist). None of the variables are significant with robust standard errors, so none of the conclusions stated in the previous paragraphs change. The following table (4) shows all the models tested, with the coefficients and the (adjusted) R-Squared.

Table 4: the results of all models tested. At the bottom the (Adjusted) R-Squared and the observations of each separate model.

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
Cons	0.165	0.099	0.0468	0.521	-0.176	0.005	0.108
Size	-0.158						-0.158
Lev		-0.332					-0.394
Type			-0.03781				-0.019
ROA				-0.345			-1.312
BitPrice					0.024		0.021
BitReturn						-0.003	
BM							-0.0749
R2	0.082	0.041	0.009	0.016	0.017	0.018	0.173
Adj. R2	0.07	0.028	-0.004	0.003	0.004	0.000	0.101
Obs	78	76	78	76	77	56	76

Overall, the tests performed in this part all point in the same direction: the announcement returns are non-significant, also when tested with different firm characteristics. The full sample returns were positive, but non-significant with the event study methodology. The regression analysis showed that also company specific characteristics do not have explanatory effect regarding the obtained CAR from the event study and that the performance of Bitcoin is unrelated to the reactions on the announcements. Overall, all the variables tested in the full model are non-significant.

The coefficients of most of the variables are as expected, which has implications on economic consequences. The CAAR, the size variables, and the announcement type has the signs expected, but the high standard errors lead to non-significant statistical results. Additionally, the logarithm of the price of Bitcoin is also positively related to the investor reaction, which is as expected. The leverage ratio and the ROA are the only firm-specific variables that have surprising signs. The signs of the variables are important to notice, because for some investors the results can still be very important (despite the fact that the variables are not statistical significant) and might be crucial for them to take into account.

6. Conclusion

This thesis investigates the investor reactions regarding blockchain related announcements in the U.S. The announcements range from the period December 2015 until January 2021. Six hypotheses were formulated to answer the research question:

What is the effect of blockchain-related announcements on the stock prices of listed companies in the U.S.?

This part will conclude these hypothesis and give an answer to the research question.

Firstly, the reaction from investors regarding blockchain related announcements was investigated using an event study. The event window of [-1;+1] yielded cumulative abnormal returns of 3.1% on average. This means that on average, the stock price of the company with the blockchain related announcement, increased 3.1% over the event window. This is largely in line with the study by Cahill et al., (2020), who find a CAR of around 5% over their sample.

However, when testing this for statistical significance, the returns were tested to be non-significant. Two different tests were performed, but the cumulative abnormal returns were found to be not significant. Furthermore, multiple event windows as well as a different benchmark were investigated to test for robustness of the results, but the window chosen yielded the most significant results and using the NASDAQ as a benchmark did not change results. Overall, the first hypothesis that the cumulative average abnormal return is larger than zero is rejected.

Moving further, several tests were performed to check for different firm-specific characteristics that were likely to have an effect on the CAR. The first hypothesis regarding CAR determinants, and the second hypothesis overall, tests the effect of the firm size on the CAR. This was tested in three different ways. First, a one-on-one linear regression between the market value of the company (stock price times shares outstanding) and the CAR was performed. Using robust standard errors, the results were non-significant.

The second method was by dividing the sample into quintiles based on size, and regressing these on the CAR using bootstrap standard errors. The results of all quintiles appear to be not significantly different from the smallest firm quintile. The final test was to use a dummy variable to investigate the difference between large cap stocks and small cap stocks. This variable also turned out to be non-significant when testing it against the CAR. Overall, all these tests point into the same direction, the firm size does not have an effect on the CAR in this sample.

The second firm-specific characteristic that is tested is the leverage ratio. The leverage ratio is defined by taking the total long term debt of the company and dividing that by the total assets in the same year. Using a linear regression with robust standard errors, the variable does not have a significant effect on the CAR.

Additionally, the effect of the type of announcement on the CAR is investigated. This thesis makes a distinction between two separate types of announcements. The first is the joining of a blockchain related strategic alliance (such as Enterprise Ethereum Alliance, Hyperledger, and Mediledger). The second group is the other types of announcements. These announcements range from partnerships to mergers, acquisitions, investments, and many more. A dummy variable is used to investigate the effect of the type of announcement on the CAR of the firms, but the variable is insignificantly related to the CAR.

Furthermore, the performance of Bitcoin is related to the CAR of the companies. It is possible that a better performance of Bitcoin increases the investor reaction, but this does not appear to be the case. The linear regression between the 30-day lagged price of Bitcoin and the CAR after the announcement is positive, but non-significant. The return of Bitcoin in the month before the announcement is also related to the CAR in this research, but the effect of the return on the CAR is close to zero. In conclusion, there is no statistical significant relationship between the performance of Bitcoin and the CAR of blockchain related announcements.

The final firm characteristic that is tested to have an influence on the CAR is the ROA (Return On Assets), defined by the ratio of the net income and the total assets. The regression analysis with robust standard errors shows that there is a negative effect of ROA on the CAR after the announcements, but the effect is not statistically significant.

As a final check on all these firm characteristics, they are all incorporated in a final model to see if any of them has any influence on CAR when controlling for each of the factors. Overall, the size dummy, the leverage ratio, the ROA, and the announcement type dummy are added together with the book-to-market ratio and the Bitcoin related variables as an extra control. The regression analysis performed does not bring any contradicting results, none of the variables become significant in the full model. In conclusion, this means that all the hypotheses about the CAR determinants cannot be accepted. None of the determinants appear to have a significant effect on the CAR of the sample tested.

This thesis tests the effect on the stock price after blockchain related announcements by using an event study methodology. The reactions of the investors do not appear to be significant in this sample. Furthermore, several firm-specific determinants of the CAR have been tested using a regression analysis, but none of these variables seem to have an effect on the CAR. Overall, the general research question can be answered using the results of all six hypotheses. There does not seem to be an effect on the stock prices of U.S. listed companies after blockchain announcements, also after testing for firm-specific variables in this sample.

A limitation of this research might be the sample size. 78 different blockchain related announcements were tested in this sample, which is relatively low compared to other researches. Lots of different sources were checked for blockchain related announcements in America, and this is the sample required from that. However, other markets might be taken into account as well (such as Canada) to acquire more announcements. Another reason for the non-significant results is possibly the time period. The release of Bitcoin was already in 2008, so quite some time ago. It is potentially the case that around these time periods, the reactions of the investors were heavier compared to the more recent time periods. In other words, the hype might be over in the time period investigated. Finally, a limitation of this thesis is that the U.S. market is the only market tested, results might be different in more developing markets or maybe European markets.

These limitations are simultaneously suggestions for further research. To investigate whether the potential blockchain hype existed more closely to the launch of blockchain, the time periods around the Bitcoin release could be investigated. Furthermore, using more announcements ranging from small cap to large cap could also have an influence on the results and might be a recommendation for future researchers to investigate. More blockchain related announcements could then also be investigated over multiple markets, to see whether there are differences between the U.S. market and less developed markets for example. It could potentially be that the expectations this thesis presented regarding the CAR and the determinants of the CAR are in these cases more precise and accurate.

7. Bibliography

Adami, R., Gough, O., Muradoglu, G., & Sivaprasad, S. (2010). Returns and leverage. *2010 Oxford Business & Economics Conference Program*.

Aduda, J. O., & Chemarum, C. (2010). *Market reaction to stock splits*.

Ajlouni, M. M., & Toms, S. (2008). Signalling Characteristics and Information Content of Directors' Dealings on the London Stock Exchange. *Journal of Risk and Governance*, *1*(1).

Akyildirim, E., Corbet, S., Sensoy, A., & Yarovaya, L. (2020). The impact of blockchain related name changes on corporate performance. *Journal of Corporate Finance*, *65*, 101759.

Alberto, J. G. C., & Martins, H. C. (2020). Effect of Corporate Governance on the Returns of the Shares Due to the Share Buyback Announcement. *Journal of Accounting, Management and Governance*, *23*(3), 294–308.

Ante, L., & Fiedler, I. (2020). Market reaction to large transfers on the Bitcoin blockchain-Do size and motive matter? *Finance Research Letters*, 101619.

Armitage, S. (1995). Event study methods and evidence on their performance. *Journal of Economic Surveys*, *9*(1), 25–52.

Ball, R., & Brown, P. (1968). An empirical evaluation of accounting income numbers. *Journal of Accounting Research*, 159–178.

Ball, R., Gerakos, J., Linnainmaa, J. T., & Nikolaev, V. (2016). Accruals, cash flows, and operating profitability in the cross section of stock returns. *Journal of Financial Economics*, *121*(1), 28–45.

Ball, R., Gerakos, J., Linnainmaa, J. T., & Nikolaev, V. V. (2015). Deflating profitability. *Journal of Financial Economics*, *117*(2), 225–248.

Bamber, L. S. (1986). The information content of annual earnings releases: A trading volume approach. *Journal of Accounting Research*, 40–56.

Banz, R. W. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics*, *9*(1), 3–18.

Bhargava, S., & Agrawal, P. (2015). Announcement effect of share buyback on share price at National Stock Exchange: An empirical investigation. *Annual Research Journal of Symbiosis Centre of Management Studies*, *3*, 89–105.

Bowman, R. G. (1983). Understanding and conducting event studies. *Journal of Business Finance & Accounting*, *10*(4), 561–584.

Brown, S. J., & Warner, J. B. (1980). Measuring security price performance. *Journal of Financial Economics*, *8*(3), 205–258.

Cahill, D., Baur, D. G., Liu, Z. F., & Yang, J. W. (2020). I am a blockchain too: How does the market respond to companies' interest in blockchain? *Journal of Banking & Finance*, *113*, 105740.

Casey, M., Crane, J., Gensler, G., Johnson, S., & Narula, N. (2018). *The impact of blockchain technology on finance: A catalyst for change*.

Chen, Y., Ding, S., Xu, Z., Zheng, H., & Yang, S. (2019). Blockchain-based medical records secure storage and medical service framework. *Journal of Medical Systems*, *43*(1), 1–9.

Corbet, S., Larkin, C., Lucey, B., & Yarovaya, L. (2020). KODAKCoin: A blockchain revolution or exploiting a potential cryptocurrency bubble? *Applied Economics Letters*, *27*(7), 518–524.

Dhaliwal, D. S., Lee, K. J., & Fargher, N. L. (1991). The association between unexpected earnings and abnormal security returns in the presence of financial leverage. *Contemporary Accounting Research*, *8*(1), 20–41.

Enterprise Ethereum Alliance (n.d.). Retrieved from: https://entethalliance.org/

Fama, E. F., Fisher, L., Jensen, M. C., & Roll, R. (1969). The adjustment of stock prices to new information. *International Economic Review*, *10*(1), 1–21.

Fama, E. F., & French, K. R. (2006). Profitability, investment and average returns. *Journal of Financial Economics*, *82*(3), 491–518.

Gan, C., Bian, C., Wu, D., & Cohen, D. A. (2017). Determinants of share returns following repurchase announcements in China. *Investment Management and Financial Innovations*, *14,№ 2*, 4–18.

Hileman, G., & Rauchs, M. (2017). Global blockchain benchmarking study. *Cambridge Centre for Alternative Finance, University of Cambridge*, *122*.

Holotiuk, F., Pisani, F., & Moormann, J. (2017). *The impact of blockchain technology on business models in the payments industry*.

Hyperledger (2019). Retrieved from: https://www.hyperledger.org/about/charter

Im, K. S., Dow, K. E., & Grover, V. (2001). A reexamination of IT investment and the market value of the firm—An event study methodology. *Information Systems Research*, *12*(1), 103–117.

Jain, A., & Jain, C. (2019). Blockchain hysteria: Adding “blockchain” to company’s name. *Economics Letters*, *181*, 178–181.

Koenker, R., & Hallock, K. F. (2001). Quantile regression. *Journal of Economic Perspectives*, *15*(4), 143–156.

Lamoureux, C. G., & Poon, P. (1987). The market reaction to stock splits. *The Journal of Finance*, *42*(5), 1347–1370.

Maloney, M. T., McCormick, R. E., & Mitchell, M. L. (1993). Managerial decision making and capital structure. *Journal of Business*, 189–217.

MediLedger (n.d.). Retrieved from: https://www.mediledger.com/

Novy-Marx, R. (2013). The other side of value: The gross profitability premium. *Journal of Financial Economics*, *108*(1), 1–28.

Peterson, P. P. (1989). Event studies: A review of issues and methodology. *Quarterly Journal of Business and Economics*, 36–66.

Peyer, U., & Vermaelen, T. (2009). The nature and persistence of buyback anomalies. *The Review of Financial Studies*, *22*(4), 1693–1745.

Princeton (2008). Event Studies with Stata. Retrieved from: https://dss.princeton.edu/online_help/stats_packages/stata/eventstudy.html#test

Ross, S. (2021). Small Cap Stocks vs. Large Cap Stocks: What's the Difference? Retrieved from: https://www.investopedia.com/articles/markets/022316/small-cap-vs-mid-cap-vs-large-cap-stocks-2016.asp

Shahnaz, A., Qamar, U., & Khalid, A. (2019). Using blockchain for electronic health records. *IEEE Access*, *7*, 147782–147795.

Sivaprasad, S., & Muradoglu, Y. G. (2009). An empirical analysis of capital structure and abnormal returns. *Cass Business School Research Paper*.

Stock, J. H., & Watson, M. W. (2015). *Introduction to Econometrics*.

Strong, N. (1992). Modelling abnormal returns: A review article. *Journal of Business Finance & Accounting*, *19*(4), 533–553.

Thompson, R. (1995). Empirical methods of event studies in corporate finance. *Handbooks in Operations Research and Management Science*, *9*, 963–992.

van der Sar, N. (2018). *Stock Pricing and Corporate Events* (4de dr., p. 58).

Wulff, C. (2002). The Market Reaction to Stock Splits—Evidence from Germany. *Schmalenbach Business Review*, *54*(3), 270–297.

Wüst, K., & Gervais, A. (2018). Do you need a blockchain? *2018 Crypto Valley Conference on Blockchain Technology (CVCBT)*, 45–54.

Zīle, K., & Strazdiņa, R. (2018). Blockchain use cases and their feasibility. *Applied Computer Systems*, *23*(1), 12–20.

8. Appendix

Table 5: the full sample of announcements used in this research in alphabetical order

Company	Event Date	Type of announcement
Accenture	27-02-2017	Joining EEA
Amazon	28-11-2018	Releases details on amazon quantum ledger database and amazon managed blockchain
AMD	13-12-2019	Joining of blockchain game alliance
AMD	27-10-2020	Acquires Xilinix
American Express	19-10-2017	Blockchain-related patent
American Express	30-01-2017	Joining of Hyperledger
American Express	13-11-2018	Blockchain related patent filing
AmerisourceBergen	02-05-2019	Joining of MediLedger
Apple	07-12-2017	Blockchain related patent filling
AT&T	13-12-2018	Blockchain related patent filing
Baidu	17-10-2017	Joining of Hyperledger
Bank of New York Mellon	28-02-2017	Joining EEA
Broadridge Financial Solutions	19-05-2016	Joining of Hyperledger
Cerner	14-01-2021	Announcement of creating a vaccination passport using blockchain
Change Healthcare	14-01-2021	Announcement of creating a vaccination passport using blockchain
Cisco	17-12-2015	Joining of Hyperledger
Cisco	25-07-2017	Becoming a premier member of Hyperleger
Cisco	17-02-2020	Blockchain partnership with NEC
CME Group	09-02-2016	Joining of Hyperledger
CME Group	16-12-2020	Announce the availability to trade in Ethereum futures on their platform
Cognizant	22-01-2020	Joining of Hyperledger
ComCast	21-12-2018	Usage of blockchain in advertising

Dell	17-11-2019	Announces to use blockchain to track down plastic waste
Eli Lilly and Company	25-01-2018	Joining of Hyperledger
Facebook	18-06-2019	Libra whitepaper release
FedEx	26-09-2018	Joining EEA
FedEx	26-09-2018	Joining of Hyperledger
Ford	27-03-2018	Blockchain related patent filing
GM	28-11-2017	Joining of Hyperledger
Goldman Sachs	09-08-2020	Announces new head of digital assets and working on developing a coin
Google	23-07-2018	Blockchain partnership
Hewlett-Packard	27-02-2019	Blockchain partnership with Continental
HMS	22-04-2019	Partnership with blockchain startup
Honeywell	26-09-2018	Joining of Hyperledger
Honeywell	17-12-2018	Usage of blockchain in buying and selling aviation parts
IBM	22-08-2017	Announce own blockchain platform
Intel	27-02-2017	Joining EEA
JP Morgan	27-02-2017	Joining EEA
JP Morgan	14-02-2019	Announce a digital coin for payments
JP Morgan	27-10-2020	Create a blockchain unit
Kodak	09-01-2018	Announcement of own coin
Kroger	22-08-2017	Partnership with IBM to use blockchain to strengthen customer confidence in the food industry
Marathon Patent Group	25-01-2021	Investment of $150 million in Bitcoin
Marsh & McLennon companies	14-03-2018	Joining EEA
Mastercard	11-09-2019	Blockchain partnership with R3
McCormick and Company	22-08-2017	Partnership with IBM to use blockchain to strengthen customer confidence in the food industry
McKesson corp.	02-05-2019	Joining of MediLedger
Metlife inc.	10-06-2019	Subsidiary will use blockchain to automate life insurance claims

Microsoft	27-02-2017	Joining EEA
Microsoft	18-06-2019	Joining of Hyperledger
Microsoft	14-01-2021	Announcement of creating a vaccination passport using blockchain
Morgan Stanley	08-01-2021	Blockchain related investments in MicroStrategy
Oracle	29-08-2017	Joining of Hyperledger
Oracle	14-01-2021	Announcement of creating a vaccination passport using blockchain
Overstock	12-08-2019	Their currency available to investors
Paypal	21-10-202.	Announce to launch a new service allowing trading in crypto
Pfizer	02-05-2019	Joining of MediLedger
Premier Inc.	02-05-2019	Joining of MediLedger
Salesforce	18-06-2019	Joining of Hyperledger
Salesforce	06-03-2017	Blockchain partnership with IBM
Salesforce	14-01-2021	Announcement of creating a vaccination passport using blockchain
Shopify	20-05-2020	Blockchain partnership and adds crypto to their services
Silicon Valley Bank	27-03-2019	Joining of Hyperledger
Square	08-10-2020	$50bn Bitcoin investment
Square	19-09-2019	Adding three highly rated members to their crypto team
Tesla	08-02-2021	Converts cash into Bitcoin
Thomson Reuters	27-02-2017	Joining EEA
Thomson Reuters	29-03-2016	Joining of Hyperledger
Tyson Foods	22-08-2017	Partnership with IBM to use blockchain to strengthen customer confidence in the food industry
Visa	09-09-2020	Joining of Hyperledger
Visa	19-02-2020	Blockchain partnership with Coinbase

VMWare inc.	18-11-2020	Launch of blockchain platform
Walmart	03-03-2020	Joining of Hyperledger
Walmart	01-03-2018	Blockchain related patent filing
Wells Fargo	17-12-2015	Joining of Hyperledger
Xerox	13-11-2018	Blockchain related patent filing

Table 6: all the average abnormal returns (AARs) over the event window. The numbers shown are the averages of all the abnormal returns of the event day mentioned for all the firms in the sample. The index used to compare the returns to is the S&P500 in this case.

Event Day	**AAR**
-10	0.10%
-9	0.04%
-8	-0.16%
-7	-0.02%
-6	-0.15%
-5	0.11%
-4	-0.13%
-3	-0.32%
-2	-0.30%
-1	0.54%
0	1.80%
1	0.79%
2	-0.77%
3	0.64%
4	-0.02%
5	-0.05%
6	0.00%
7	0.02%
8	0.08%
9	0.25%
10	0.17%

Table 7: all the average abnormal returns (AARs) over the event window. The numbers shown are the averages of all the abnormal returns of the event day mentioned for all the firms in the sample. The index used to compare the returns to is the NASDAQ in this case.

Event Day	AAR
-10	0.23%
-9	0.34%
-8	-0.06%
-7	0.15%
-6	-0.12%
-5	-0.10%
-4	-0.18%
-3	-0.02%
-2	-0.02%
-1	-0.29%
0	2.29%
1	0.40%
2	-0.89%
3	0.69%
4	-0.54%
5	0.02%
6	0.15%
7	0.18%
8	-0.15%
9	0.25%
10	-0.73%

Table 8: the Average Abnormal Returns over the relevant event days [-1;+1]. The acquired Cumulative Average Abnormal Return is retrieved from adding the AARs from the event window together. The benchmark index used here is the NASDAQ.

Event Day	-1	0	1
AAR	0.00293	0.02286	0.00401
CAAR			0.02981