Announcement effect of Blockchain investment on stock prices for Financial Companies

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ABSTRACT

The blockchain technology refers to "a full distributed system for cryptographically capturing and storing a consistent, immutable, linear event log of transactions between networked actors." It is one of the hottest innovative topics in recent years. The technology attracts a dramatic increasing amount of capital investment. The financial institutions are the major participant in blockchain development and application. This paper attempt to find out questions like: why blockchain technology catches companies, whether it is worth investing, and how it affects the firm's value. To solve these questions, the event study methodology applied to the research. In the study, I differ three R&D project stages of blockchain technology and I find the announcements of blockchain investment positively affect the stock price of financial Companies and the effects are different at the three R&D process stages. The sample consists of 80 announcements that selected from news database Lexis Nexis and company's news release center.

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Keywords

Blockchain technology, announcement effect, event study, market model, abnormal return, R&D project stages.

1. INTRODUCTION

Looking at recent news from the public journals and social media platforms, one of the hottest innovative topics is blockchain technology. The blockchain technology refers to "a full distributed system for cryptographically capturing and storing a consistent, immutable, linear event log of transactions between networked actors."(Risius & Spohrer, 2017). On the other words, blockchain is a decentralized software mechanism that enables a public distributed ledger system. The technology maintains the typical chain features such as continuity and reliability that form the paraphrase of integrity (Biktimirov et al., 2017). The continuity can be explained by the word blocks, which indicate links in a chain. Each block follows one another in a sequence specified in the formation of a blockchian. Moreover, replacing or removing a block from the chain is impossible, which demonstrated the feature of reliability. Catalini (2017) stated five basic principles that how blockchain works underlying the technology: "1. Distributed database. 2. Peer-to-peer transmission. 3. Transparency with pseudonymity. 4. Irreversibility of records. 5. Computational logic." The blockchain technology initially underly Bitcoin (Beck & Müller-Bloch, 2017) which led it to acquire fame, but is currently expanded to other areas of application (Worner et al., 2016). The blockchain implementations mainly toward validation and consensus building aim for different balances regarding availability, consistency, and trustworthiness (Tschorsch & Scheuermann 2016). Based on that, some scholars propose that the disrupted technology can change the way for entirely new business models. They expected a trust-free economy that the untrustworthy partners could make transactions without any additional measures of precaution under the technology.

As a result, due to the great expectations of the technology, more and more listed companies announced recently that they join and invest the development and applications of blockchain technology. The IBM Institute for Business Value (2016) surveyed 200 banks in 16 countries on the experience and expectation with blockchain. It summarized that around 91% of surveyed banks are investing in blockchain solutions. Moreover, the world's leading Services Company Cognizant (2017) reported that approximately all of respondents (98%) believe blockchain save the firm money, with 39% expecting savings of more than 5%. The financial service institute PwC (2017) indicated that the cumulative total investment in blockchain startups increases from 16 million in 2011 to 1.6 billion in 2017, which shows a huge growth trend for the future investment. All of the statistical data above illustrates the steam of blockchain investment. On the other hand, firm's investment decisions mostly result from the high expectation of return and the potential of increasing firm's value. One of the indicators of firm's value is the stock price. It sensitively changed by the firm's activities that include the investment decisions and announcements of news. The blockchain technology not only attracts public's attention but also received large investments from many companies. Regarding to this, some issues are coming. Why blockchain technology catches companies' concern? Where is it worth investing? How does it affect the firm's value?

In order to answer these questions, the paper reviews the existing empirical literature of blockchain technology applications and adds the analysis of the announcement effects of investing on the technology. The results of the announcement effects analysis will reflect the real values of the new innovative technology, and indicate whether the blockchain technology is worth to invest and increase company's stock price. The method of event study will be applied to the research to achieve the aim of analyzing how the announcement of blockchain technology investment affects the company's stock price.

The next section describes a brief review of relevant literature to support the hypotheses in section 3. Section 4 overviews the research design and data collection. Section 5 shows the results of data analysis and section 6 concludes.

2. LITERATURE REVIEW

This section elaborates the market efficiency theory and announcement effect theory, which are the two bases of the research. Moreover, the illustration of the development of blockchain states the attractiveness for investment and its power of effect to the stock price.

2.1 Market Efficiency theory

The most widely accepted definition of market efficiency is an efficient market price fully reflect all available information, which is originally developed by professor Eugene Fama (1970). The theory of efficient market hypothesis (EMH) maintains all stocks are perfectly priced according to their inherent investment properties, the knowledge of which all market participants possess equally. The EMH assumes that all investors perceive all available information in precisely the same manner.

2.1.1 Forms of Efficient Market Hypothesis

According to Fama and Samuelson (1970), there are three forms of EMH: weak form, semi-strong form, and strong form. The difference between them is that each is based on a different set of information. First, the weak-form market efficiency states that current security prices fully reflect all currently available security market data. Which means the past price and market information will have no predictive power for the future direction of security prices. Second, the semi-strong form market efficiency indicates current security prices fully reflect all publicly available information, which includes all past security market information and nonmarket information available to the public. Third, the strong-form market efficiency says that security prices fully reflect all information from both public and private sources which include all types of information.

2.1.2 Factors that affect the market's efficiency

Whether the market is efficient or not, are affected by the degree of informational efficiency. On the basis of the empirical study, some factors affect a market's efficiency. Firstly, the number of market participants such as investors, analysts, and traders could vary through time and across countries. The larger the number of these market participants who follow an asset market, the more efficient the market. Second, the availability of information has a significant impact on the market efficiency. We can see from the world's larger and developed markets that the information is more plentiful and the markets are quite efficient, like the New York Stock Exchange. On the contrary, in emerging markets, the information availability is lower and the market prices are less efficient. Third, the prices in different markets are often different, which result in buying an asset in one market and then selling it at a higher price in another market to get margin. The activity of buying and selling of asset refers to arbitrage. The impediments to arbitrage will reduce market efficiency. The last but not least, the costs of transaction, information, analysis and trading also impact the market efficiency. If the costs are higher than the potential profit from trading securities, the market price will be inefficient and the risk of returns will become high. Furthermore, the random

events are entirely acceptable under an efficient market. There is no doubt that such eventualities must be considered under market efficiency, prices respond nearly instantaneously with the release of new information that can be expected to affect a stock's investment characteristics.

2.2 Announcement effect

The Announcement Effect defined as the impact of news on financial markets. It is one of the most important theories in the research. The theory reflects the market efficiency theory that information will affect the market prices. Many empirical studies show that the news a listed company announced will leads to a change in its stock price. Good news has the positive influence on the stock market, vice versa. The timing of the announcement matters, scholars indicate that the event that two announcements within the same category are released simultaneously is rare. Therefore, the effect of each event can be stated as a solo effect.

The announcement affects the market prices from different perspectives. On the capital market, when the announcement of external financing is made, the firm's market value should go up (Hillierey et al., 2014). A number of researchers have studied that one of the plausible reasons for the announcement effect is the managerial information. The managers make a decision based on the superior information about the market trends and the firm's value. Thus, the information is a predictor that what decision that the firm will take. Besides, the announcements of dividend, new investments, M&A will affect the market prices. Moreover, Klein (1986) showed evidence that the announcement affects the returns and the study stated significant positive effects between the announcement and returns.

The blockchain is a new and disruptive technology, which is an outcome of the technological research and development. Regarding the empirical study of the announcement effect in the R&D sector, there is evidence that the stock price and the R&D announcement have a positive relationship (Mohamad & Nassir, 1997). The announcement effect is mainly reflected by the abnormal return on stock price. Scholar's states there is statistically significant abnormal return in the R&D announcement (Zantout & Tsetsekos, 1994).

For R&D innovation, the trailblazers and follower have different competitive advantages. Zantout & Tsetsekos (1994) stated that a firm announced an R&D project might result in an intra-industry information transfer. The announcing firms will be the first movers and the other companies will be the followers. Regard for the different impact of the first mover and followers, there are two hypotheses that argued by Zantout et al and Mohamad et al are considered here. One is the follower have disadvantages to lose the chance to be the first to innovate. Another is follower firms are free riders of technology spillovers with more benefits from the R&D projects. The first to innovate hypothesis signals negative abnormal returns of stock price and announcement effect for other firms. Whereas, the spillover hypothesis predicts positive abnormal returns of stock prices and announcement effect for follower firms with advantages. The blockchain is a new and innovative technology, it just becomes popular in recent years. Thus, the most firms that already invested in the technology are the first movers. Based on the IBM's research (2017), the statistics denote that 15% of financial institutions invested in the blockchain technology before 2017 belongs to the first mover. Between 2018 and 2020, there will be a period of the massive adapter and after 2020 the follower will start to participate the investments. Therefore, in the paper, the firms that invested in blockchain technology will not be divided by the first mover or follower.

On the other hand, scholars stated that the R&D project should be identified as a process, each stage linked sequentially (Kelm et al, 1995). Stages of R&D process also impact the response of stock price. The R&D process included three stages, which were project initiation, project continuation, and new product introduction (Kelm et al, 1995).

The project initiation refers to the first introduction of a new project.

The project continuation defines as a stage after project initiation and prior to product introduction.

The new product introduction is a stage that after the development the new product can be introduced to the public.

Different type of projects would focus on different stages in order to facilitate the appropriate results. The response of the announcements of different stages would lead to various responses in the stock market. Some scholars provide empirical evidence that the stock market often positively respond to the final stage of the R&D project, which is new product introduction (Chancy et al, 1991). Generally speaking, the blockchain development is still in the initial stage currently, therefore the most blockchain projects are in the first two stages of the R&D process. Examples of announcements in different stages for blockchain projects are listed in appendix 9.1.

2.3 Blockchain development and applications

2.3.1 Blockchain development

Blockchain just became popular recently, but it already attracted high expectations on its great potential. Blockchain technology was originally developed from the cryptocurrencies, the most well-known application of the technology is Bitcoin. It is designed to maintain the features of continuity and reliability that form the paraphrase of integrity (Biktimirov et al., 2017). The blockchain has four key features, which are the decentralized systems, distributed ledger, minting, and safer and secure ecosystem. The total capitalization was USD 140 billion in September 2017 that compared with just USD 16 billion in January 2017(Olstinski, 2017), the increase in the capitalization is dramatic. The research on venture investment in blockchain that is reported by PwC shows in figure 1, which also demonstrates an increased interest in the blockchain technology. The public attention is also be attracted by the innovative technology. The figure 2 below has shown the web search trend of Blockchain on Google search engine. An increasing trend was indicated in the chart, the peak season was at the end of 2017. Coincidently, many companies announced the blockchain related news around that period. The blockchain applies to two types of industries, one is financial and another is the non-financial application (Crosby et al., 2016). The financial industry is a primary user of the blockchain technology, and it also is the targeting research group in the study.
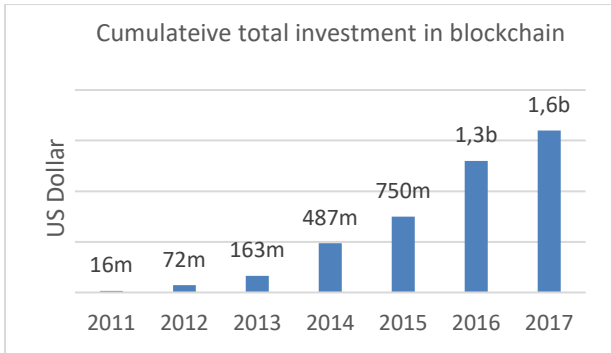
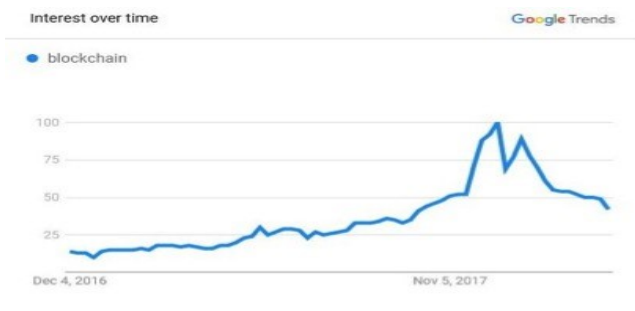**Figure 1 Venture capital shows increased interest in Blockchain by PwC**

Figure 2. Web search trend of Blockchain on Google.

2.3.2 Blockchain application

One of the blockchain utilization is the Smart contract, which executing a contract by combining computer protocols and user interfaces. the concept of blockchain can be utilized more easily in several aspects. Payments can be automatically made in a transparent manner for each contract if all the participating entities involved and preconfigured condition are met in a contractual agreement. For example, lawyers and banks that are involved in contacts for asset deals can be replaced depending on predefined aspects (Fairfield, 2014). Normally, signing a contract have to include lawyer and bank as legal counsel and intermediary, whereas using the smart contract all the requirements can be predefined in the system. Thus, lawyers and banks can be replaced. On the other side, the smart contract can also be applied to control the ownership of properties, which was defined as another concept of smart properties. The smart properties can be used both on physical and non-physical, such as car, house, smartphone, and share of a company. It is worth noting that the bitcoin is also about controlling the ownership of money.

Another remarkable blockchain application project is the Initial Coin Offering (ICO). ICO is a new financing model that be developed on the basis of blockchain technology and smart contracts. It is a new type of crowd funding financing model that generally referred to blockchain listing (Bitcoin magazine, 2017). There are many blockchain companies that have tried to finance through this model. The blockchain company uses the self-built Internet platform to issue virtual tokens. The virtual tokens are usually linked to bitcoin or other crypto-currencies. Investors can subscript the virtual tokens with the commitment from the Internet platform, then the virtual tokens can be assigned at the exchange platform after a period of time. On the other words, the nature of ICO financing is also a public offering, but the underlying assets have become virtual tokens.

Due to the reason that the current regulations and legislation of the financing model are not complete and clear, start-up companies can quickly and simply raise huge amounts of money in a short period of time by providing a financing report. Another advantage of ICO financing is that it can bring higher liquidity to the capital investment compared with the traditional investment system. It beneficially satisfies the requirements of liquidity for investors. Scholars argued that the ICO financing model is considered to be comparable to IPO and can change the future financing method. The DAO was the first attempt at fundraising for a new token on Ethereum who raised over 150 million dollars (Bitcoin magazine, 2017).

Resulting from the considerably growing attention of blockchain, the other technical companies are also following the trend. Some large companies like Apple, Google, Microsoft and IBM have been investing blockchain for a long time. The significant advantage of saving costs attracts many technical companies attention (Olstinski, D., 2017). Referring to Nofer et al. (2017) and Crosby et al. (2016), the blockchain application can be categorized in the table below.

Table 1 Blockchain Applications

Type	Application	Examples
Financial applications	Crypto-currencies	Bitcoin, Litecoin, Ripple, Monero
	Securities issuance, trading and settlement	NASDAQ private equity, Medici, Blockstream
	Insurance	Everledger
Non-financial applications	Notary public	Stampery, Viacoin
	Music industry	Imogen heap
	Decentralized proof of existence of documents	Proof of existence
	Decentralized storage	Storj
	Decentralized internet of things	Filament ADEPT
	Anti-counterfeit solutions	Blockverify
	Internet applications	Namecoin

2.3.3 Advantages of Blockchain application in the financial industry

Crosby et al. (2016) stated that the advantages of Blockchain technology outweigh the regulatory issues and technical challenges. Many firms in the financial industry from banks, insurers to auditing and professional service firms are investing in blockchain solutions. These firms believe that block can truly disrupt the industry and make the processes more democratic, secure, transparent, and efficient (techracers, 2017). Furthermore, the World Economic Forum reported in 2016 that blockchain has captured the imaginations, and wallets, of the financial services ecosystem. The report showed the global interest that over 24 countries investing in blockchain, and around 80% of banks predicted to initiate blockchain projects by 2017. In addition, over US$1.4 billion is in investments of blockchain over the past three years. There are many associations claimed reports of the blockchian trend. The Euro Banking Association stated that distributed ledgers had the

potential to lower costs, increase speed and improve product offerings. The FinTech 2.0 paper wrote by the Oliver Wyman and Anthemis Group illustrated distributed ledger technology could save banks money by eliminating central authorities and bypassing slow, expensive payment networks. All of these demonstrated that the blockchain investments affect the development of economics. The financial industry, a trailblazer of using the disruptive technology, is benefited from several perspectives. Two major benefits in the financial industry are explained below.

2.3.3.1 Increasing operational efficiencies
Blockchain mainly applies as a globally distributed ledge, which runs on millions of devices. In the other words, it is able to record anything of value (Tapscott & Tapscott, 2017). The ledgers are recorded digitally and saved by the Internet. Thus, it provides the possibility that companies and their accountants can share the ledgers and use the information for reporting in the real-time processing. Instead of the traditional work system that producing batching data collected over time together, the blockchain able to prepare documents simply by the information that already carried on a block, such as transaction dates, transaction prices, and dividends. For instance, Nasdaq and Citi treasure and Trade Solutions announced in May 2017 that they would apply blockchain to payments and transactions, which implemented the blockchain's advantages of real-time processing. Moreover, the Australian Stock Exchange announced in December 2017 to convert to a blockchain based system to record and process equity trades.

2.3.3.2 Saving costs
In the financial sector, especially in the reconciliation and audit, the audit analytics shows that costs of financial services audits are approximately 0.1% of gross revenue, which means the cost is measured in billions. Nevertheless, the blockchain technology is able to eliminate the costs resulting from the working process. Referring to a news that one of the world largest investment company Vanguard announced in December 2017 to use smart contract to manage the index funds in order to reduce costs (Peterson, 2018). Furthermore, the coindesk.com published a News in 2015 that indicated the blockchain technology could save banks $20 billion a year.

2.3.3.3 Increasing security and accuracy
Nowadays, Internet and computer system are used everywhere, whereas the problems have occurred concomitantly. One of the significant issues is hacking. According to the news reporting the Dutch banks were attacked twice in 2018, which led to an enormous panics and damages to both customers and bank itself. For the financial institutions, the security and accuracy are more important. With blockchain, the decentralized feature and the structure of block and chain increase the data security and accuracy. The features and nature of the technology decide that the system is self-defending, thus unauthorized people are not allowed to change any data or steal any information. Besides, Crosby et al. (2016) also stated that using blockchain technology can not only eliminates the need for expensive fees but also help to maintain the comprehensive and accurate distributed database.

2.3.4 The challenges of Blockchain
Regardless the blockchain technology has significant advantages, the treacherous have existed in any technical revolution. The blockchain is a breakthrough technology; most applications of the technology are a radical innovation. There are six limitations of blockchain that stated by Bauerle (2017). First, the technology is entirely new and complex. It required highly specialized industry for the implementation. Crosby et al. (2016) also stated that the behavior will be changed by the

new technology, but the resistance to change exists. Some experts and technology developers could understand and adopt a new technology easier and quicker. However, the normal customers and other parties need more time to get used to the new electronic transactions and believe that it is safe, secure and complete. For instance, the large international banks initially invested into the blockchain development and application because they have more experts finding the benefits of the new technology. But the traditional banks are still hesitating to join in, such as the Industries and Commercial bank of China, they are concerned about unknown technology and risky results.

Second, blockchain required a more extensive network of users. "If a blockchain is not a robust network with a widely distributed grid of nodes, it becomes more difficult to reap the full benefit." (Bauerle, 2017).

Third, there are weaknesses of the higher costs and slower transactions (Fauvel, 2017). In 2016, only seven transactions can be processed per second and each transaction has notable costs (Bauerle, 2017). Moreover, moving the existing contracts or business documents to the new blockchain based methodology requires enormous tasks of migration. In the case of Real Estate ownership, it is time and costs consuming to migrate the existing documents that lying in county or escrow companies to the blockchain form. (Crosby et al., 2016).

Forth, the human error dangers the accuracy of the recorded data, which will harm the feature of trustworthy. According to the nature of blockchain transactions, someone probably misuses the technology for fraudulent activities like money trafficking. (Crosby et al., 2016). Fifth, the security flaw is unavoidable.

So the last, governmental politics lead to disagreements between community sectors. "Governments may slow down the adoption by introducing new laws to monitor and regulate the industry for compliance." (Crosby et al., 2016). For example, the United States may help to adoption as playing an agency to carry customer trust. Conversely, in more controlled economies like China, the adoption will face more limitations.

3. HYPOTHESES FORMULATION
According to the study of literature in the previous chapter, the hypotheses will be formulated in this section. First of all, the market efficiency theory corresponds to the assumption of the announcement effect theory. The stock market prices are expected to react with the announcement of an event in the surrounding period. Furthermore, listed companies are more diversified and less chance to fail. The asymmetric information increases the risks in the company. If an investor has less information about the company, he/she will demand higher returns against the risk taken. Based on the literature review of EMH, the more information of the company's actives is available, the more efficiency the market price will be. The stock price of a company will react with its available information and the changes of stock prices will be observed by the certain event window. According to the theories and empirical research study, I realized that the blockchain technology has a great potential to drive simplicity and efficiency of different industries. Of course, which will lead to the high expectations on the return of the investment of blockchain. Additionally, Corbet etal. (2018) concluded in their study of KODAKCoin "the existence of a new form of asymmetric information as sock value is found to increase dramatically through the simple announcement of any plan relating to a cryptocurrency based on blockchain technology."

In the certain period after the announcement, the stock price will be increase or decrease. Therefore, the announcement affects the cumulative average returns (Klein, 1985). So that I assume once a company announced that the investment activities on blockchian, the company's stock price would be positively affected by the news. Concerning theories and empirical evidence above, I hypothesize that:

H1: The announcements of blockchain investment will positively affect the stock price of financial Companies.

Second, the announcement effect theory describes especially the impact of news on the financial market. It means when the event of blockchain investment is liable to have an impact on the company's results, its announcement will lead investors to revise their expectations. The greater the informative content of the event, the greater will be the variation in prices. Depending on whether the information is favorable or unfavorable, price variations will be positive or negative respectively (Delattre, 2007). Refer to the statements in section 2.2, the announcement of company's high technical R&D activities will positively affect the company's stock price. Additional, the project stages also impact the stock price. The new product introduction is a stage that easiest to identify. The stage reflects achievement of the project. Investors can examine the wealth of the final results in this stage to see whether it creates value for the firm. Besides that, the information of the R&D project and status of the project process would already reach to the market before the last stage of R&D process. In the other worlds, the expected benefits of the project will be identified in the project initiation and continuation stages. Chancy et al. (1991) argued that the stock market often positively responds to the final stage of new product introduction in the R&D project. For the blockchain investment, investors have high expectations for its end product, thus I hypothesized that:

H2: The announcements of Blockchain investment project in different stages have different extent of impact to the stock prices.

4. METHODOLOGY AND DATA

In the paper, I will follow the standard methodology of an event study that investigates the changes of the selected listed companies' stock prices before and after the announcement posted. The event study methodology has two major functions. One is to test the null hypothesis that the market efficiently incorporates information, and the second is under the maintained hypothesis of market efficiency, to examine the impact of some event on the wealth of the firm's security holders (Binder, 1998). I will mainly focus on the second one to identify whether the announcement of blockchain investment effects on the companies' return. The research method also includes the information about data collection.

4.1 Methodology

The event study methodology is used to analyze the announcement effect of the blockchain investment of listed companies. Delattre (2007) used eight stages to implement the event study, which also is applied in the other studies of financial issues (Chong et al., 2006). In the paper, I only use the first seven stages to conduct my research. The last step is not applicable to the thesis. In the thesis, I mainly focus on identifying whether the announcement of blockchain investment will affect the stock price of the selected listed companies. The final stage of measurement of influence variables can be another topic of study in the future.

4.1.1 Stage 1: Inventory of events

I will firstly select announcements that relating to the blockchain investment of listed financial companies. The key words of announcements include "blockchain", "blockchain technology", "blockchain investment", "cryptocurrency", "bitcoin". The search period is designed between 2015 and 2018. The announcements with the key words that companies published on its official website or news website from the September 2016 to the end of June 2018 will be select. The sources will include not only the company official website but also the news database Lexis Nexis.

On the other hand, the three R&D project stages will be distinguished by different key words. For example, the project initiation will have words like "first", initial", and "new". The new product introduction will have words like "launch", establish" and "new product". Besides the first and last stages, the other announcements will be categorized as the project continuation.

4.1.2 Stage 2: Identification of announcement dates

In the second stage, I choose the date of the first public announcement. In the other words, it is the data that the announcement goes to the public through the company's website of some news website such as yahoo finance, the Bloomberg news, or the financial news websites. Commonly, the certain information probably is explored to some investors before the date, especially the investment decision. The investors, managers and shareholders will make the decision first then announce it to the public. Thus, at the first public announcement date, the markets could already react to the consequences. Choosing the date of the first public announcement is rather than the date of the event itself.

4.1.3 Stage 3: Data "cleaning" and selecting the final sample

In this stage, I will select data from the sample company's stock price. Then exports the raw data to excel sheet. The data will be checked to ensure the data is consistent and reliable. The unavailable stock prices will be removed from the sample in this step. A clear and structured data sheet will be prepared for next steps.

4.1.4 Stage 4: Choosing an event window

Based on scholars' opinions, the impact of events is most often determined on the basis of the day-to-day movements of stock prices to improve the effectiveness of the method (Mackinlay, 1997). Thus, I choose an event window of altogether 11 days ranging from −5 to +5 days as the measured period. The date 0 will be the date of the first public announcement.

4.1.5 Stage 5: Choosing a model for determining the abnormal return

This is one of the most important steps. The abnormal return refers to the yield gap between observed return and expected return in the absence of the event (Martinez, 2002). Abnormal return for stock i at time t (ARit) is therefore defined as: $AR_{it} = R_{it} − E(R_{it})$,

Where R_{it} is the observed return for stock i and $E(R_{it})$ is the expected return.

In order to get the abnormal return, we need to know the observed/actual return and expected return in advance. The observed return (R_{it}) is "usually measured on the basis of the day's closing prices." (Delattre, 2007). The expected return is the return if the event had not occurred. To calculate the expected return, I will use the single-index model in a pre-

announcement period to estimate the regression parameters. The single-index model (also called market model in some studies) assumes that there is only one macroeconomic factor that causes the systematic risk affecting all stock returns and this factor can be represented by the rate of return on a market index. The expected return is estimated below (Chong et al., 2006):

$$E(Rit)=\alpha i + \beta i\ E(Rmt)$$

Where E(Rit): expected return of stock i at time t in the absence of event (theoretical return)

αi: part of the price of stock i not explained by the market, which is the return that exceeds the risk-free rate.

βi: slop coefficient of the price of stock i at the market index.

The parameters of αi and βi are estimated by the Ordinary Least Squares (OLS) regression over a 100-trading day period before the initial announcement. In this case, I use the S&P 500 market index for E(Rmt).

4.1.6 Stage 6: Measuring the impact of the event on stock prices

Moreover, I will find out abnormal daily stock price return around the blockchain investment announcement of the sample firms.

Then evaluated by average abnormal return (*AARt*) at time t, which is:

$$AARt = \sum_{i=1}^{Nt} \frac{ARit}{Nt}$$

Where ARit is the estimator of the abnormal return for stock i,

Nt is the number of firms in the sample during time t.

If the average abnormal returns are summed across months, I will use the average cumulative abnormal return (CAAR) to measure the effect on the sample from the event window time T1 to time T2.

$$CAAR(T1,T2) = \sum_{t=T1}^{T2} AARt$$

4.1.7 Stage 7: evaluating the significance of the results

In this step, I use the statistical test to identify whether the announcement is significant or not. If the test result is statistically significant, then it means that the event announcement of blockchain investment has a real effect on the company's stock price. While the most studies use a simple t-test (Steiner & Heinke, 2001), I will use the simple t-tests too. The test formulated by diving the average abnormal return by its standard error (Boehmer et al., 1991). The test will be produced by SPSS. The formula is shown below:

$$t = \frac{ARM\ t}{\sqrt{\frac{1}{n(n-1)}\sum_{i=1}^{n}(ARit-ARmt)^2}}\ ,\ \text{with } ARm\ t = \frac{1}{n}\sum_{i=1}^{n} ARit$$

Where ARm is abnormal return (mean). (Steiner, M., & Heinke, V., 2001).

Based on the result of the statistical test, the conclusion can be summarized whether the announcement of blockchain investment will positively affect the stock price of Public Listed Companies.

4.2 Data

Referring to the previous section Methodology, I have mentioned how to collect samples. Those key words that

indicated before were searched on both Google and the news database Lexis Nexis. The stock prices of each company are derived mainly from Yahoo finance. I choose to use the daily stock price to track its movement, in terms of reducing the risk of non-representativeness and increasing the sample size. The daily stock price is available for the selected event window of altogether 11 days ranging from −5 to +5 days, which was already stated in the previous section. The announcement date is selected from the news websites such as Investing news.com and CEBIT.de, and also be checked by the company's official website and the news database. Each announcement would be treated as an event.

Searching by the news database, I initially searched the key word blockchain investment within all of the English news. Then I narrowed the results by the high similarity matching between the search key word and results. The search results showed that the industries of Banking & Finance and Computing & Information Technology had the largest number of news that related to the blockchain investment, which was around 886 and 861 separately. But the other industries only had less than 100 pieces of news. My study focuses on the financial industry, thus, I continually selected from the 886 pieces of news. After that, I narrowed the results by selecting the financial institutions. The 886 items of news were not just included the financial companies so that I deleted the non-financial companies. Then the last results were 128 pieces news that consisted of 44 financial institutions. Next, the repeated news was excluded. Besides that, I also selected the announcements from companies' press release center. The final sample included 80 announcements, which contained the key words that were mentioned in the previous section. The sample companies consist of financial service institutions, banks and investment companies. The list of sample firms showed in appendix 9.2.

In order to analyze the impact of blockchain investment announcements to different R&D processes. I identified the sample announcements to three stages of project initiation, project continuation, and new product introduction. In the sample, there are 18 announcements are project initiation, 42 announcements are project continuation, and 20 announcements are project continuation. Since the blockchain technology is still in the development step, the sample size of the project continuation is obviously larger than the other two stages.

5. RESULTS

In this section, the results and analysis of the research questions will be elaborated here. Table 2 indicates the descriptive statistics and test results of the abnormal returns surrounding the announcement of blockchain investment for the full sample and three project stages. The analysis of research results will examine whether the hypotheses are accepted. The robustness test and an additional analysis of size effect will be including at the end of this section.

5.1 Analysis of all events

According to the results in Table 2, the mean value of all 80 announcements changes during the event window [-5, 5]. The two largest average abnormal returns is on the event day one day before the event day, which is 1.3 percent and 1.6 percent separately. It responses with a statement of market efficiency theory and announcement effect that the information of the announcement probably is explored to some investors before the event day, these available information lead to changes on the firm's stock prices. Moreover, the P-value is positively significant different from zero at 5 percent level on the event

day. Which means that the announcement effect of blockchain investment is positive on financial firms' stock prices. On the other words, the first hypothesis can be accept. However, the positive rate on the event day is only 48%, which describes that only 48% of the abnormal returns are positive in the 80 announcements. The number of positive rate is relatively lower than days after event day, which are 54%, 54% and 54% at the first, fourth and fifth day separately. To sum up, the results show that the announcement of blockchain investment affect stock prices of financial firms significantly on the event day, and a positive effect occurs surrounding the event day. The results conform to the market efficiency theory that stock price reflects by available information, and events in the market respond to the stock prices. Meanwhile, the price reacts immediately surrounding the news release period. Furthermore, the rate of positive abnormal returns and statistical data from table 2 all prove that the first hypothesis is true. With the concepts of the high expectations of blockchain development and applications in the future, market efficiency and announcement effect, I can state that the blockchain investment announcement positively affect the stock price of financial firms.

5.2 Analysis of three R&D project stages

Table 2 also displays the statistical results of three R&D project stages. There are 18 sample announcements in the first stage project initiation. The largest positive abnormal returns are 1.7, 1.6 and 1.7 percent at five days before event day (day -5), one day before event (day -1) and the day of announcing blockchain investment. Thereinto, the day -5 and day -1 have positive significant abnormal returns from zero at 10 percent. Moreover, the positive abnormal returns at day -5 and day -1 are 67% and 56%, which indicate a positive effect of announcing blockchain investment on firm's stock prices. Additionally, after the second day of event date, the positive rates are relatively higher than before.

For the stage of project continuation, 42 announcements were involved in the sample. The mean value of abnormal returns for

the project continuation is significantly high at day -1 and event day, which are 3.1% and 1.7% separately. One cause of the point can be the blockchain technology is still in the developing state, the first mover firms already invested in the blockchain project and are continuing investment. Thus, the information of the project continuation will be exposed in advance. Meanwhile, the P-value shows a significant difference at 10 percent level from zero at the event day. Furthermore, the positive abnormal return at event day is 50% and increasing to 60% one day after the event day. This means that the positive abnormal return is larger than the negative abnormal returns in this stage. The mean, P-value and positive rate all denote that the announcement of blockchain investment positively affect stock prices at the stage of project continuation.

The last stage of R&D process is the new product introduction. 20 announcements included in this part. Recalling the literature review of the R&D process, in the stage, the project is almost finalized and the product is ready to the public. The mean value in the stage is relative lower than the other stages, but the positive abnormal returns at event day (50%) and a day after (55%) are larger than negative abnormal returns. Which means the stock price is higher than expected return for firms investing in blockchain technology especially on the event day and a day after. Looking at the P-value, the results demonstrate different information from the second hypothesis. The abnormal returns are significant at 5 percent level on three days before and three days after the event day. However, analyzing the mean and P-value of day -3 and day 3, I find there is a negative significant at 5 percent. The positive rate is also low at the two days. Therefore, I can summarize that the announcement of blockchain investment has significant effect on stock prices of financial firms, but it trends to a negative effect. The blockchain is a developing technology and there are only rarely end products in the market now, and most of them do not go public yet. Thus, the effect of stock price is negative at the moment.

Tabel 2 Abnormal returns of all samples and 3 R&D process stages

Day	All sample (80)			Project Initiation (18)			Project Continuation (42)			New Product Introduction (20)		
	Mean	P-value	Pos%	Mean	P-value	Pos%	Mean	P-value	Pos%	Mean	P-value	Pos%
-5	0,004	0,548	46%	0,017	0,072*	67%	0,000	0,997	36%	0,002	0,651	50%
-4	0,000	0,931	46%	-0,004	0,667	50%	0,002	0,720	48%	0,000	0,973	40%
-3	0,001	0,906	39%	0,012	0,361	33%	-0,003	0,684	43%	-0,003	0,137	35%
-2	0,001	0,881	41%	0,013	0,306	44%	-0,003	0,698	43%	-0,002	0,425	35%
-1	0,016	0,366	43%	0,016	0,094*	56%	0,025	0,467	36%	-0,001	0,557	45%
0	0,013	0,027**	48%	0,017	0,355	39%	0,017	0,034**	52%	0,000	0,843	45%
1	0,005	0,275	54%	0,013	0,279	44%	0,002	0,717	60%	0,002	0,340	50%
2	-0,002	0,693	48%	0,008	0,366	61%	-0,007	0,229	43%	0,002	0,677	45%
3	-0,003	0,618	39%	0,005	0,516	61%	-0,005	0,692	31%	-0,008	0,034**	35%
4	0,003	0,653	54%	0,001	0,920	56%	0,007	0,521	52%	-0,004	0,406	55%
5	0,003	0,322	56%	0,005	0,560	56%	0,003	0,550	62%	0,002	0,373	45%

The column "pos%" means the abnormal returns on specific days are positive.
* Significant at 10 percent level.
** Significant at 5 percent level.

Tabel 3 Abnormal returns of size effect

	Small Firms (25)			Large Firms (55)		
Day	Mean	P-value	Pos%	Mean	P-value	Pos%
-5	0,019	0,356	48%	-0,002	0,577	45%
-4	-0,003	0,747	36%	0,002	0,398	51%
-3	-0,001	0,939	44%	0,001	0,760	36%
-2	0,005	0,744	44%	-0,001	0,667	40%
-1	0,044	0,441	48%	0,003	0,282	40%
0	0,039	0,030*	64%	0,001	0,592	40%
1	0,010	0,424	68%	0,002	0,436	47%
2	-0,011	0,335	40%	0,003	0,330	51%
3	-0,010	0,645	44%	-0,001	0,868	36%
4	0,007	0,691	56%	0,001	0,841	53%
5	-0,005	0,547	52%	0,007	0,011*	58%

The column "pos%" means the abnormal returns on specific days are positive.
* Significant at 5 percent level.

Tabel 4 Robutness test of abnormal returns for all samples and 3 R&D process stages

	All sample (80)			Project Initiation (18)			Project Continuation (42)			New Product Introduction (20)		
Day	Mean	P-value	Pos%	Mean	P-value	Pos%	Mean	P-value	Pos%	Mean	P-value	Pos%
-5	0,006	0,440	46%	0,010	0,126	61%	0,005	0,687	38%	0,002	0,627	50%
-4	0,000	0,901	36%	-0,010	0,194	28%	0,005	0,448	40%	0,000	0,870	35%
-3	0,000	0,940	38%	0,000	0,971	28%	0,002	0,783	45%	-0,005	0,014**	30%
-2	0,002	0,742	41%	0,008	0,466	56%	0,001	0,897	40%	-0,003	0,241	30%
-1	0,017	0,365	46%	0,004	0,471	50%	0,031	0,395	48%	0,000	0,983	40%
0	0,012	0,053*	49%	0,011	0,551	44%	0,017	0,054*	50%	0,001	0,411	50%
1	0,003	0,424	56%	0,005	0,540	50%	0,002	0,690	60%	0,002	0,390	55%
2	-0,002	0,505	45%	0,003	0,642	61%	-0,005	0,415	38%	-0,002	0,487	45%
3	-0,002	0,760	43%	0,000	1,000	61%	-0,001	0,954	40%	-0,006	0,018**	30%
4	0,002	0,656	46%	-0,003	0,515	56%	0,009	0,372	48%	-0,006	0,174	35%
5	0,003	0,159	61%	-0,001	0,866	56%	0,006	0,115	69%	0,001	0,509	50%

The column "pos%" means the abnormal returns on specific days are positive.
* Significant at 10 percent level.
** Significant at 5 percent level.

To sum up, from the descriptions and discussions in the previous paragraphs of the abnormal returns for the three project stages, one can say that the announcement effect is positively significant at the event day in the project initiation and project continuation stages surrounding the event day. But the effect is negative in the last stage. The results align with the argument of Kelm et al. (1995), the stages of R&D process change the stock price, and different stages lead to various responses in the stock market. These results above supported the second hypothesis that announcements of blockchain investment have different extent of impact to the stock price in the three stages. However, the results do not reflect to the argument of Chancy et al. (1991) that the stock prices often positively respond to the final stage - new product introduction.

5.3 Size effect

Table 3 indicates the effect of company size to the abnormal returns. The firms are divided by its market capital to small firms and larger firms. There are 25 announcements are made by small firms, and 55 are announced by larger firms. For the small firms, the results show a significant different of abnormal returns from zero at 5 percent level on the event day. Which has 3.9% of average abnormal return and 64% positive rate. The mean values and positive rates are higher at the period from day -1 to day 1 than the other days. These means the small firm size has significant effect on the abnormal returns. On the other side, the results of large firms only have a significant different at 5 percent on five days after the event day. The positive rate just becomes higher at day 4 and 5.

Thereby, the small financial firms have more significant effect on its stock prices than large firms when announcing blockchian investment.

5.4 Robustness test

In order to test the robustness of results, I used the market - adjusted model to test whether the results are same. The market - adjusted model is a simple model and robust for narrow event windows (Brown & Warner, 1985). The model assumes $\beta = 1$, abnormal return is observed return subtracts the market return, which is $AR_{it} = E(R_{it}) - E(R_{mt})$.

The results of using market - adjusted model is shown in Table 4. For all 80 samples, the abnormal returns are positively significant at the event day at 10 percent level. The mean value at the day is relative high, which is 1.2% and the positive rate is 49%. But the positive rate of abnormal return increases to 56% a day after the event day. This result denotes that the announcement effect of blockchain investment is positive on stock prices for financial firms. On the other words, the data shows that the results of market model that I used are relatively robust. The first hypothesis can be accepted.

On the other hand, the test results of market – adjusted model for the project initiation show that there are no significant different of abnormal return. While the positive rate increase after the event has be announced. Differing from the results of first stage, there is a positive significant at 10 percent level on the event day. Its positive abnormal return is 50%, and mean value is 1.7% at the day and 3.1% at a day before the announcement day. The results are basically same as the conclusion of market model test. For the last stage new product introduction, the results of robustness test is same as the results of market model that the abnormal returns are negative significant at day -3 and day 3 at 5 percent level.

Based on the results of robustness test in Table 4, I can conclude that the test results are robust. And the market model is a robust method incorporating specific and systematic risks.

6. CONCLUSION

There are many items of news about blockchain that are reported by multi-sources everyday triggering a question that how does the blockchain technology affect the firm's value. The stock price is one of the good representing of the firm value. Besides, the financial industry is a major participant in the technology development and application. Therefore, the research of abnormal returns of financial institutions answers the question of the blockchain investment announcement effect. In this paper, a research on the empirical study of blockchain technology is an initial. Three main advantages of blockchain application in financial industry attract dramatically increasing the amount of investment. The advantages contain increasing operational efficiency, saving costs and increasing security and accuracy.

The theories of announcement effect and market efficiency also contribute to the hypotheses formulation. The scholars statements of the R&D process stages play a vital role in the paper. The event study methodology was applied to this research. The abnormal return, average abnormal return and cumulative average abnormal return have been observed and analyzed. 80 announcements were selected from news database and company's official website, to compose a sample. The OLS was used to estimate the expect returns and compute the regression. According to the analysis of research results and the conformation of literatures that discussed in the paper, I can conclude that the hypotheses can be accepted. For the first hypothesis, the announcements of blockchain investment positively affect the stock price of the financial companies. Second, the announcement of blockchain investment has different impact for the three R&D project stages, whereas, the last stage – the new product introduction does not have a positive effect on its stock prices than the project initiation and

project continuation. Moreover, the test of size effect says that the small financial firms have more significant effect on its stock prices than large firms when announcing blockchian investment.

7. LIMITATIONS

This paper aims to discover announcement effect of the new blockchain technology to financial industry. The sample used in this study consists of 80 announcements of 32 financial firms. These announcements generated from the news database Lexis Nexis and company's news release center. But the sample size is quite small, thus the results may be not representing for the entire industry. The biases of small sample exist. Besides, the blockchain technology is an emerging topic, firms that participating in the technology development belong to the first mover. So that the firm related factors did not be considered in this research. The selection of variables is not comprehensive enough may lead to an influence of the other factors to the final results. Although there are still some limitations of this study need to be taken into consideration. The further study could consider more perspectives like the firm size, the first mover and followers, and firm related factors to have more comprehensive study.

8. ACKNOWLEDGMENTS

9. REFERENCE

B., D., C., & S. (2017). Blockchain technology: Universal structure and requirements. Automatic Documentation and Mathematical Linguistics, 51(6), 235-238. doi:10.3103/S0005105517060036

Bauerle, N. (2017, March 15). What are Blockchain's Issues and Limitations? CoinDesk. Retrieved from https://www.coindesk.com/information/blockchains-issues-limitations/

Beck R, Muller-Bloch C. (2017). Blockchain as radical innovation: a framework for engaging with distributed ledgers. In: 50th Hawaii international conference on system sciences, Waikoloa, DOI: 10.24251/HICSS.2017.653

Biktimirov, M. R., Domashev, A. V., Cherkashin, P. A., & Shcherbakov, A. Y. (2017). Blockchain Technology: Universal Structure and Requirements. Automatic Documentation and Mathematical Linguistics, 51(6), 235-238. doi:10.3103/s0005105517060036

Binder, J. (1998). The event study methodology since 1969. Review of Quantitative Finance and Accounting, 11(2), 111-137. doi:10.1023/A:1008295500105.

Bitcoin Magazine. (2017, August 10). What Is an ICO? Retrieved from https://bitcoinmagazine.com/guides/what-ico/

Boehmer, E., Masumeci, J., & Poulsen, A. (1991). Event-study methodology under conditions of event-induced variance. Journal of Financial Economics, 30(2), 253-272. doi:10.1016/0304-405X(91)90032-F.

Brown S.J. and Warner J.B. (1985), Using daily stock returns: the case of event studies, Journal of Financial Economics, 14, 1, 3-31.

Catalini. C. (2017, March 2). How Blockchain Applications Will Move Beyond Finance. Harvard Business Review, Retrieved from https://hbr.org/2017/03/how-blockchain-applications-will- move-beyond-finance

Chaney, P. K., Devinney, T. M., and Winer, R. S., (1991). The Impact of New Product Announcements on the Market Value of the Firm, Journal of Business 64, 573-610.

Chong, B., Liu, M., & Tan, K. (2006). The wealth effect of forced bank mergers and cronyism. Journal of Banking and Finance, 30(11), 3215-3233. doi:10.1016/j.jbankfin.2005.12.004

Corbet, S., Larkin, C. J., Lucey, B. M., & Yarovaya, L. (2018). Kodakcoin: A Blockchain Revolution or Exploiting a Potential Cryptocurrency Bubble? SSRN Electronic Journal . doi:10.2139/ssrn.3140551

Crosby M, Nachiappan Pattanayak P, Verma S, Kalyanaraman V., (2016). Blockchain technology: Beyond bitcoin. Applied Innovation Review 2:6–19

Delattre, E. (2007). Event study methodology in marketing. Recherche Et Applications En Marketing (english Edition), 22(2), 57-75. doi:10.1177/205157070702200204

Fairfield J (2014) Smart contracts, Bitcoin bots, and consumer protection. Wash Lee L Rev Online 71:35–299

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

Fauvel, W. (2017, August 11). Blockchain Advantage and Disadvantages ? nudjed ? Medium. Retrieved from https://medium.com/nudjed/blockchain-advantage-and-disadvantages-e76dfde3bbc0

Financial Services: Building Blockchain One Block at a Time. (2017, June). Cognizant. Retrieved from https://static.financieel-management.nl/documents/16489/financial-services-building-blockchain- one-block-at-a-time.pdf

Hillier, Clacher, Ross, Westerfield, Jordon.(2014). Fundamentals of Corporate Finance, McGraw-Hill, 2nd European Edition.

Kelly, J., (2016, September 7). Barclays says conducts first blockchain-based trade-finance deal. Retrieved from https://www.reuters.com/article/us-banks-barclays-blockchain/barclays-says-conducts-first-blockchain-based-trade-finance-deal-idUSKCN11D23B

Kelm, K., Narayanan, V., & Pinches, G. (1995). The response of capital markets to the r&D process. Technological Forecasting & Social Change, 49(1), 75-88. doi:10.1016/0040-1625(94)00088-E

Klein, A. (1985, December 28-30). The Timing and Substance of Divestiture Announcements: Individual, Simultaneous and Cumulative Effects. The Journal of Finance, Vol. 41, No. 3, New York, pp. 685-696.

Leading the pack in blockchain banking: Trailblazers set the pace. (2016, October 13). Retrieved from https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=GBP03467USEN&

MacKinlay A.C. (1997), Event studies in economics and finance, Journal of Economic Literature, 35, 1, 13-39.

Martinez I. (2002), The influence of the family character of companies on the stock market price, French Review of Management, 28, 139, 91-106.

Nofer M, Gomber P, Hinz O, Schiereck D., (2017). Blockchain. Bus Inf. Syst Eng 59(3):183–187

Olstinski, D. (2017, September 20). Blockchain shares: Where is it worth investing? - Blockchain. Retrieved from https://www.cebit.de/en/news-trends/news/blockchain-shares-where-is-it-worth-investing-2113

Peterson, M. (2018). Blockchain and the future of financial services. The Journal of Wealth Management, 21(1), 124-131. doi:10.3905/jwm.2018.21.1.124

Price waterhouse Coopers. (2017, December). Blockchain in financial services. Retrieved from https://www.pwc.com/us/en/industries/financial-services/research-institute/top- issues/blockchain.html

Risius, M., & Spohrer, K. (2017). A blockchain research framework. Business & Information Systems Engineering, 59(6), 385-409. doi:10.1007/s12599-017-0506-0

Sharma, R. (2017, October 17). JPMorgan Unveils Blockchain Money Transfer Project; So Much For 'Bitcoin Is A Fraud'. Retrieved from https://www.investopedia.com/news/jpmorgan-unveils-blockchain-money-transfer-project-so-much-bitcoin-fraud

Steiner, M., & Heinke, V. (2001). Event study concerning international bond price effects of credit rating actions. International Journal of Finance & Economics, 6(2), 139-157. doi:10.1002/ijfe.148

Tapscott, A., & Tapscott, D. (2017, March 1). How Blockchain Is Changing Finance. Retrieved from https://hbr.org/2017/03/how-blockchain-is-changing-finance

Techracers. (2017, December 6). 4 Key Features of Blockchain | Blockchain Development Studio | Techracers. Retrieved from https://www.techracers.com/blockchain-key-features

Tschorsch F, Scheuermann B (2016) Bitcoin and beyond: a technical survey on decentralized digital currencies. IEEE Commun Surv Tutor 18(3):2084–2123

World Economic Forum., & Deloitte Touche Tohmatsu (Firm). (2016). The future of financial infrastructure: An ambitious look at how blockchain can reshape financial services. Geneva: Prepared by World Economic Forum in collaboration with Deloitte.

Worner D, Von Bomhard T, Schreier Y-P, Bilgeri D. (2016). The bitcoin ecosystem: disruption beyond financial services? In: 24th European conference on information systems, Istanbul

Zantout, Z., & Tsetsekos, G. (1994). The wealth effects of announcements of r&d expenditure increases. Journal of Financial Research, 17(2), 205-205.

10. APPENDIX

10.1 Examples of announcements in different stages for blockchain projects

Project initial: Chapmans announced to establish its Blockchain Industry Advisory Board in December 2017.

Project continuation: JPMorgan Unveils Blockchain Money Transfer Project, which is not the first time that JPMorgan has used blockchain to streamline processes and make them more efficient. October 16, 2017. (investopedia, 2017).

The new product introduction: Barclays and an Israel-based start-up company have carried out what they say is the world's first trade transaction using blockchain technology. September 7, 2016. (Returns, 2016).

10.2 company list

1. Chapmans Limited
2. Motif
3. Lykke
4. MGT Capital Investments, Inc.
5. Bank of America
6. First Growth Funds (FGF) Limited
7. Goldman Sachs Group Inc
8. ING
9. Absa
10. Vanguard Group
11. Mogo Finance Technology Inc
12. ADVFN PLC
13. Planet Ventures Inc.
14. GMP Securities L.P
15. National Bank of Canada
16. BNP Paribas
17. BNY Mellon
18. Mizuho Bank
19. Sberbank
20. U.S. Global Investors, Inc.
21. Standard
22. J.P. Morgan
23. Santander
24. UBS
25. Deutsche Bank
26. Barclays
27. CIBC
28. Credit Suisse
29. HSBC
30. State Street
31. China Construction Bank
32. Royal Bank of Canada