

The Impact of Pfizer-BioNTech COVID-19 Vaccine Development on the Companies Involved

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ABSTRACT

The COVID-19 pandemic has varying degrees of negative impact on economies and stock markets around the world. However, vaccine development and rising demand for drugs may have a different impact on the pharmaceutical industry. This paper aims to examine the impact of Pfizer-BioNTech COVID-19 Vaccine development on the companies involved. Using an event study method, the study finds evidence of a positive Abnormal Return (AR) on Pfizer and BioNTech around the period when the vaccine was declared to be more than 90% effective. The degrees of influence of the vaccine development on them are different as BioNTech has a greater AR and higher correlation with the number of vaccinations.

Keywords: COVID-19, event study, stock price, abnormal return

1. INTRODUCTION

1.1. Vaccine General Information

Pfizer-BioNTech COVID-19 Vaccine (Name: BNT162b2) is manufactured by Pfizer, Inc., and BioNTech. It is a type of mRNA vaccine requiring 2 shots [1]. It is the first COVID-19 vaccine to be authorized for emergency use by the regulatory authorities and approved for routine use [2,3]. The vaccine was first approved in the UK on 2 December [4,5]. To date, residents of 112 countries worldwide have been vaccinated with this vaccine. An interim analysis of the clinical trial, which first began in April 2020, on 9 November showed a potential efficacy of 91.3% in preventing asymptomatic infections within 7 days of the second dose [6].

1.2. About Pfizer, Inc. and BioNTech

Pfizer Inc. is an American multinational pharmaceutical and biotechnology corporation. It was established in New York in 1849 by two German immigrants. Pfizer develops and manufactures drugs and vaccines for a wide range of biological and neurological applications. The major classes of drugs in Pfizer can each generate over US\$1 billion in annual revenue [7].

BioNTech SE (short for Biopharmaceutical New Technologies) is a German biotechnology company that develops and manufactures active immunotherapies against diseases. An mRNA-based human therapeutic for intravenous administration has been developed by the company and its own production process has been established. The company has developed an mRNA-based human therapy for intravenous injection and has established its own production process [8].

Pfizer and BioNTech have been working together since 2018 to develop mRNA-based influenza vaccines. The collaboration, based on BioNTech's proprietary mRNA vaccine platform, rapidly advances multiple COVID-19 vaccine candidates into human clinical trials, and draws on Pfizer's extensive expertise in vaccine development, regulatory capabilities, and global manufacturing and distribution networks [9]. They are working together to ensure rapid global access to vaccines [10].

2. LITERATURE REVIEW

Few studies have been conducted specifically focusing on the effect of vaccination on the stock market. However, some studies have analyzed the impact of COVID-19 on different economies since the beginning of the pandemic and the lockdown. Ramelli and Wagner (2020) found that investors initially avoided US stocks of

China and internationally oriented companies as the epidemic spread through China; and as the situation in China improved relative to Europe and the US, investors became more favorable to these companies [11]. As the virus spread through Europe and the US and economies went into lockdown, the market saw wild swings. They also concluded that the real economic impact of this health crisis was magnified through financial channels [11]. Mohammad Noor ALAM, Md. Shabbir ALAM and Kavita CHAVALI (2020) investigated the impact of the lockdown period caused by COVID-19 on the Indian stock market and found that there is a positive AR around the current lockdown period until the epidemic improves in India and that the lockdown period has a positive impact on stock market performance [12]. Pinglin He, Yulong Sun, Ying Zhang & Tao Li (2020) pointed out that there was a negative impact of the pandemic on stock prices on the Shanghai Stock Exchange, however, it had a positive impact on stock prices on the Shenzhen Stock Exchange [13]. The pandemic greatly affected the transport, mining, electricity and heating and environmental sectors, but the manufacturing, information technology, education and healthcare sectors benefited from the pandemic [13]. The reason behind this is that when COVID-19 broke out, mining companies postponed projects and closed mines. Agricultural activities came to a large-scale halt. Roads were closed and the transportation industry was hit. At the same time, industries that relied heavily on infrastructure construction encountered labor shortages. And the outbreak of COVID-19 inspired manufacturing industries to rapidly ramp up production of medical equipment. Information technology played an important role in the isolation of crowds, and the success of the Chinese medical sector in combating the outbreak and the successful promotion of online classes gave investors' confidence in these industries. Kamphol Panyagometh (2020) analyzed the impact of pandemic events on the stock exchange of Thailand and found that the epidemic generated positive returns for businesses in the commercial sector, particularly some companies that act as distributors of pharmaceutical products and services [14]. These studies found a similar result for a positive AR for pharmaceutical industries during the pandemic. However, the further study on how and how much one vaccine, Pfizer-BioNTech COVID-19 Vaccine, could have a specific impact on the market performance of the companies directly involved is in the need.

3. RESEARCH METHODS

3.1. Research Model

In this paper, it is a deep study about the impact of the Pfizer-BioNTech vaccine on two companies: Pfizer Inc. (PFE) & BioNTech SE (BNTX). It mainly focuses on two main aspects: the abnormal returns of the two companies for observing how their returns respond to the success of

vaccine development and the relationship between the cumulative abnormal return (CAR) for the two companies and the cumulative number of vaccines (Pfizer-BioNTech) administered.

The study contains three models to calculate the abnormal returns: the adjusted return rate model, the market index returns rate model and the market model. To begin with, daily adjusted closing prices was collected and these used for calculating the daily return series by using:

$$R_t = \frac{P_t^C - P_{t-1}^C}{P_{t-1}^C} \quad (1)$$

The t indexes the day and C denotes closing. Since a macro event such as the success of vaccine research and development (R&D) will have a great impact on the whole market, the difference in difference is applied through the data analysis, using the daily market index return of S&P500 to check this market with the following two models:

$$R_t = \alpha + \beta R_{mt} + \varepsilon_t \quad (2)$$

$$R_{mt} = \mu_m + u_t \quad (3)$$

Where R_{mt} represents the daily return on the market index on day t . Therefore, the estimated values of $\alpha, \beta, \sigma_\varepsilon^2, \mu_m, \sigma_u^2$ came out by calculating, through the estimation window. For the estimated value of them, hats are used to denote.

Based on the market model, the first test used was as follow:

$$AR_{mt} = R_{mt} - \hat{\mu}_m, t = 1, \dots, E \quad (4)$$

$$CAR_{mt} = \sum_{s=1}^t AR_{ms}, t = 1, \dots, E \quad (5)$$

with confidence bonds $\pm Z_{\alpha/2} \hat{\sigma}_u$ and $\pm Z_{\alpha/2} \sqrt{t} \hat{\sigma}_u$ respectively.

Based on the firm abnormal return in the event window, the second test used was as follow:

$$AR_t = R_{it} - \hat{\alpha} - \hat{\beta} R_{mt}, t = 1, \dots, E \quad (6)$$

$$CAR_t = \sum_{s=1}^t AR_{ts}, t = 1, \dots, E \quad (7)$$

with confidence bonds $\pm Z_{\alpha/2} \hat{\sigma}_\varepsilon$ and $\pm Z_{\alpha/2} \sqrt{t} \hat{\sigma}_\varepsilon$ respectively. Then, the total CAR and its confidence interval were derived.

3.2. Event Window and Data Selection

Since January 21, 2020, the new coronavirus has been spreading rapidly in the United States, and confirmation of the disease has been released in various states. Therefore, the period (2020-1-21 to 2020-5-30) is used to represent the estimation window when the vaccine had not been developed. To consider the epidemic, 2020-1-21, the date of 1st confirmed case for the novel coronavirus in the United States [15], is took as the starting point of the estimation window. While the ending date, 2020-5-30, was chosen to avoid the volatile impact on the stock market caused by the large number of

vaccine companies starting to put in the research. For choosing the event window, taking the date 2020-11-9, when Pfizer issued that their third round of Pfizer-BioNTech (the vaccine developed jointly by Pfizer and BioNTech) has an efficacy rate above 90% [6], as the beginning point, and the whole window is ended on 2021-8-1. Therefore, there are 183 days of records being traced back.

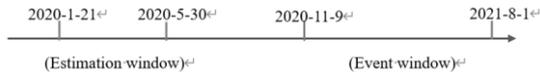


Figure 1 The timeline of the event

As shown in Figure 1, it is the whole timeline of the event. The estimation window and event window studied also demonstrated in Figure 1. The stock’s closing price and stock index data included in this research are obtained from Yahoo Finance [16-18]. The daily administered number of Pfizer-BioNTech were compiled

Table 1 The abnormal return of Pfizer and BioNTech

Time window	Ticker Symbol	CAR	AAR
Estimation window (21 January 2020 - 30 May 2020)	PFE	-0.0026726	-0.0000294
	BNTX	0.09316517	0.00102379
Event window (9 November 2020 - 1 August 2021)	PFE	0.04183624	0.00022861
	BNTX	1.30333086	0.00712203

Table 1 shows that the data results by analyzing the CAR of two companies base on the market model. These data refer that Pfizer-BioNTech’s R&D had positive abnormal returns for both two companies involved to varying degrees.

4.2. Interpretations for data results

Through these data results, it’s clear that although Pfizer-BioNTech was developed together by the two companies, the benefits received by the two companies, as a result, were very different. BioNTech’s abnormal benefits far outweighing those of Pfizer, both before the vaccine was developed (after the outbreak) and after it was successfully developed.

However, there are some puzzles. Why the performance of the famous medical company falls short when compared with the small and young company in this event? Why did this dramatic epidemic not bring an expected huge advantage for PFE? To have a deeper understanding of this phenomenon, the research went further into the reasons behind it. And based on the investigation, listed two main possible causes.

It is highly related to the distinct scale of the two companies. BioNTech’s primary business is the development and production of effective

immunotherapies for the treatment of serious diseases for specific patients, which is almost based on research of mRNA. And mRNA is the core technology of Pfizer-BioNTech. However, Pfizer, the largest pharmaceutical company in the world, owns businesses that include discovers, develops, manufactures, markets distribute, and sells biopharmaceutical products worldwide. It offers medicines and vaccines in various therapeutic areas and serves wholesalers, retailers, hospitals, clinics, government agencies, pharmacies, and individual provider offices, as well as disease control and prevention centers. So, the vaccine development is just a small fraction of its business, and the share return of PFE is hard to have a reflection on any single positive factor.

from disclosure documents from the CDC (Center of Disease Control and Prevention), an agency of the U.S. Department of Health and Human Services [19].

For the further step to test the relationship between the number of vaccines administered and the total abnormal returns of the stock price, the linear regression is applied for CAR and the cumulative number of Pfizer-BioNTech vaccines administered per day.

4. RESULTS AND DISCUSSION

4.1. Findings

The result shows that the Pfizer-BioNTech R&D had positive abnormal returns for both companies involved, BioNTech & Pfizer, to varying degrees. However, the following data results were observed:

(1) The factor of expectations and surprise could not be overlooked when observing the stock market reaction. According to the public documents, the cooperation between Pfizer and BioNTech is in the form that BioNTech provides mRNA technology for their research, while Pfizer provides high standard R&D equipment, regulatory, manufacturing, and distribution infrastructure [10]. Thanks to the outbreak of covid 19, worldwide people know the potential value of mRNA vaccination, which also is the focus of BioNTech for recent years. So, the stockholders have increasing confidence in the future development of BioNTech. But Pfizer's comprehensive

and systematic R&D platform comes as no surprise to stockholders.

4.3. Limitations

Indeed, there are some limitations to the study. There are a lot of factors affecting stock price returns, which have not been considered. For example, macroscopically, the U.S. government has introduced various macroeconomic policies following the four meltdowns, which greatly stimulated the development of the U.S. stock market. This made the S&P 500 more volatile, which reduced the predictive power of the model. On a micro level, vaccines were also developed by Moderna, Inc. (MRNA) and Johnson & Johnson (JNJ). Especially, the result of the third-round trial for the Moderna vaccine was published earlier than it of Pfizer-BioNTech. The result of the third round of trials for Moderna was published which was days earlier than those of Pfizer-BioNTech. This puts a lot of pressure on both companies. In addition to external factors, due to Pfizer's internal reason, the CEO of Pfizer sold off Pfizer shares on the day the vaccine was announced to be over 90% effective reported [20,21]. It made the confidence of the

stockholders shaken. Plus, the vaccine itself also had an impact on their share price, due to reports of side effects after use of Pfizer-BioNTech and the limitation that it was developed and designed not to be stored at room temperature (must be stored at low temperature), which increase the cost and difficulty for store and transport [22,23].

4.4. Further Research

An interesting phenomenon during the research was observed: while the share prices of the two companies did not change very much before and after the successful development of the vaccine, a relatively significant surge in the share prices of both companies was observed when the vaccine was officially distributed and served to the public. With that, a new question about whether there is any relationship between the CAR of successful vaccine development between the number of people vaccinated popped up.

By using linear regression to these two data, it is found:

Table 2 The correlation between the CAR and the cumulative number of people got vaccinated

Ticker Symbol	The time window of when Pfizer-BioNTech is being administrated (14 December,2020 – 30 July,2021)		
	Correlation Coefficient	T stat	Null hypothesis test
PFE	0.11643222	1.4595	Reject Ho
BNTX	0.9364438	33.233	Can't Reject Ho
<i>Note.</i> Significance at 5% level of significance.			

Table 2 clearly demonstrates a quite high correlation between BNTX and the daily cumulative number of people who vaccinated Pfizer-BioNTech. And it shows that the abnormal revenue of BNTX has increased steadily with the increase of the vaccination population during the vaccination period.

Furthermore, there is a pharmaceutical company, Moderna, which developed vaccines for novel coronavirus as well in this period. And Moderna has a similar size as BioNTech. Then, compared these two company's abnormal returns, it shows that they have close value, and it is also obviously positive CAR.

4.5. Recommendations

On the other hand, although the return on Pfizer is not as high as thought, such an excellent research and manufacturing platform is rare, so it is difficult for other pharmaceutical companies to replace it. Such prerequisites gain it an absolute advantage and facilitate

the stable development of Pfizer in the future. At the same time, this event is the best proof that companies with real core technologies and techniques will be more likely to get better development in the future.

5. CONCLUSIONS

In this paper, a positive CAR on Pfizer and BioNTech around the period the vaccine which was declared to be more than 90% effective was detected. From November 9, 2020, to August 1, 2021, although Pfizer-BioNTech vaccine was developed by the together-work of two companies, BioNTech Inc. had thirty times more CAR than Pfizer Inc. Besides, BioNTech also showed a higher correlation with the number of vaccinations than Pfizer. In addition, by further comprising these two companies with Moderna, Moderna obtained a great enhance in the stock return.

The results showed that the different scales of companies played a significant role in the different

market performances and the innovation and master of core biotechnology would lead shareholders to have a higher expectation. In this regard, in the future of the pharmaceutical industry, a company's mastery of core technologies will be their core competency in the stock market.

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