Did the Stocks of Pfizer and Moderna Show Abnormal Returns Different from Zero on Approval of COVID-19 Vaccines by FDA?

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ABSTRACT

Government actions and stock market performances are often interrelated. One such example is the actions of U.S. government agency the Food and Drug Administration (FDA) and their impact on the stock prices of pharmaceutical companies. In the recent COVID-19 pandemic, researchers have reported the impact of the announcement of vaccines that affected the trading volatility of the stock of the pharmaceutical companies that offer these vaccines. However, prior research has yet to report the impact of FDA's Emergency Use Approval (EUA) of the vaccines on the stock prices of these firms. Specifically, prior research reported that the volatility in the trading of Pfizer and Moderna was impacted after the announcement of COVID-19 vaccines (Mason and Elkassabgi, 2022). Mason and Elkassabgi (2022) reported that Pfizer stock returns were significantly higher (above the mean) immediately just before positive COVID-19 vaccine development information was made public. Our research hypothesis here shows that the null hypothesis that the abnormal return of Pfizer stock is zero one day after the EUA can be rejected. However, the hypothesis that the abnormal return of Pfizer stock on the day of EUA is zero cannot be rejected. Further, our research has also shown that the null hypothesis of abnormal return of Moderna stock is zero cannot be rejected on the day of EUA and on the following day. Our results are different from the earlier study (Mason and Elkassabgi, 2022).

Keywords: COVID-19, Pfizer, Moderna, event study, abnormal returns.

1. INTRODUCTION

Government policies (e.g., regulatory policies of privatization of industry, debt policy, environmental regulations, among others) and stock market responses have been investigated by many scholars (e.g., Ferguson & Lam, 2016, Kong et a., 2014, Najid & Rahman, 2011). The interactions of policies and stock market performances are reported in many countries worldwide (e.g., in African countries by Asongu, 2012, in Malaysia by Najid and Rahman, 2011, in China by Kong *et al*., 2014, in Vietnam by Nguyen and Vo, 2020). Of particular relevance to this paper is the U.S. government agency the Food and Drug Administration (FDA) actions and the stock performance of pharmaceutical companies. It is well documented that the bottom lines of pharmaceutical companies

depend on FDA approval of their drugs (Torabzadeh *et al*., 1998). There are multiple levels and types (e.g., clinical trials, drug approval submission, phase 3 and 4 clinical trials, and others) of FDA actions from approval of different stages to announcement of special occasion (fda.gov). One such type of action is the Emergency Use Authorizations (EUA), which is the focus of this paper.

A national emergency was declared in the United States in early March of 2020 with the rapid spread of the COVID-19 pandemic. Two pharmaceutical companies, Pfizer and Moderna began immediately working on the rapid development of vaccines to fight COVID–19 viruses. On December 11, 2020, FDA issued EUA for the Pfizer-BioNTech COVID-19 Vaccine for individuals 16 years of age and older adults (December 11, 2020, FDA News Release), On December 18, 2020, FDA issued EUA for the second vaccine to fight the virus, developed by Moderna (December 18, 2020. FDA News Release).   The goal of the current research is to determine whether the news events of issuances of EUA by FDA, had led to statistically significant abnormal returns of Pfizer stock on and around December 11, 2020, and of Moderna stock on and around December 18, 2020.

We propose that the issuance of EUAs for the vaccines developed by Pfizer and Moderna impacted the financial returns of the equities of these two companies in the United States. So far, there has been no past research on how the significant events could have affected the financial performances of these companies. The present study fills this gap in the literature. Our main hypothesis is that equities of Pfizer and Moderna could enjoy abnormal returns in response to FDA approval of their vaccines for public use. Thus, the primary objective of this study is to determine the abnormal returns (if any) of the stocks of Pfizer and Moderna on the day these vaccines were approved by FDA for public use.

There is a reason to believe that the EUA declarations had an impact on the returns of the equities of Pfizer and Moderna based on the uncertainty information hypothesis (Brown *et al*., 1988) and on the findings from past studies supporting this hypothesis (e.g., Pantzalis *et al*., 2000). This leads to our hypothesis that the EUAs of the two vaccines had significant impact on the performance of the equities of Pfizer and Moderna. This study used an event study methodology to evaluate the effect of the declaration of EUAs by FDA national emergency on the abnormal returns of these pharmaceutical companies. To conduct the empirical analysis for this study, we collected stock price data of the Pfizer listed on New York Stock Exchange (NYSE), and Moderna listed on NASDAQ exchange. The next section provides a brief literature review on the methods of evaluating abnormal returns, which is then followed by the results section, the discussion section, and finally the concluding section.

2 . LITERATURE REVIEW

2.1 FDA actions and stock performance

The actions of U.S. government agency FDA and the stock performance of pharmaceutical companies are highly related (e.g., for biotechnology firms by Williamson and Spicer, 2023, for oncology drugs Rothenstein *et al*., 2011, for dermatology drugs Mazmudar *et al*., 2020). The stock prices of pharmaceutical companies move in the anticipation of FDA announcement (e.g., Bohmann & Patel, 2022), and at the same time the stock prices also move after FDA announcements (e.g., Chen *et al*., 2021, Rothenstein *et al*., 2011).

Research results suggested that for positive FDA decisions (i.e., approval) announcements stock prices went up and for negative FDA decisions (i.e., disapproval) announcements stock prices went down (Rothenstein *et al*., 2011). Furthermore, researchers found that market losses from FDA rejections are larger than market gains from FDA approvals resulting in an asymmetrical market response to FDA decisions (Sharma & Lacey, 2004) to include abnormal returns after negative announcement lasting longer than abnormal returns after positive announcement (Hwang, 2013). Research findings further concluded that positive stock price responses are larger for smaller than for larger pharmaceutical companies (Lakonishok *et al*., 1992). FDA actions also impact the stock performance of pharmaceutical firms outside of the U.S. as the main customers of these non-U.S. firms are in the U.S. (e.g., Bangladesh pharmaceutical firms by Kumar *et al*., Taiwan firms by Chen *et al*., 2021).

2.2 Event-Study Methodology

Fama *et al*. (1969) and Fama (1970, 1991) proposed a methodology for event study. This methodology is based on the efficient market hypothesis ensuring that security prices fully reflect all available market information. According to Fama (1991), past event studies indicated that stock prices would adjust within one day of an event announcement. He reported that this quick adjustment of stock price in response to an event announcement is consistent with efficient market hypothesis. Corrado (2011) in his detailed review of event studies pointed out that the event study methodology, originally developed for empirical research in finance and accounting, is now widely adopted in other disciplines including economics, history, law, management marketing, and political science.

Past research reported mixed results concerning the impacts of major political events on stock market performance. On the one hand, some researchers found that election results had no impact on stock market performance. Repousis (2016) studied the impact of the 2000, 2004, and 2007 Greek elections on bank stocks using the event study methodology but found no evidence for the effects of these elections on stock prices. He therefore concluded that the two major political parties were unable to manipulate the stock prices of Greek banks for political purposes. In other words, stock market trading can efficiently absorb market information, which implies market efficiency. On the other hand, some researchers found that election results impacted domestic stock market performance. Ying *et al*. (2016) analyzed the returns to Malaysian stocks before and after the elections in Malaysia from 2004 to 2013 and reported that both AAR (Average Abnormal Return) and CARR (Cumulative Average Abnormal Return) within the 15-day window before and after the elections were statistically significant. They therefore concluded that the Malaysian stock market did not show the properties of the semi-strong form of market efficiency in the dissemination of news about the elections. Similarly, Ahmad *et al*. (2017) reported significant impacts of political events on the abnormal returns in the Karachi Stock Exchange (KSE)100 Index and found significant CARRs of the KSE100 Index in the windows of 20 days before and 20 days after significant political events in Pakistan.

Nandy & Sussan (2020) extended their event-study to overseas stock markets and reported that the news of the 2014 parliamentary elections in India affected the short-term returns of ADRs and those of underlying equities traded in Indian. They found that the CAARs of ADRs were lower than those of the underlying Indian equities immediately before and after

the elections, suggesting that the market was efficiency in absorbing information.

2.3 Event Study on Stock Returns during COVID-19

Various studies have reported the impact of the pandemic on abnormal stock returns in markets worldwide (e.g., in the U.S. by Kwan & Martens, 2020, India by Rao *et al*. 2021, Taiwan by Lee & Lu, 2021, China by Lee *et al*. 2023, among others). Most of these studies reported market-wide negative stock returns (e.g., Kwan and Martens 2020 for the U.S, Rao et el. 2020 for India, Lee and Lu, 2021 for Taiwan, Lee and Lu 2023 for the U.S. and China) with selective studies that reported positive market-wide stock returns (e.g., Rao *et al*. 2020). However, some studies reported returns for specific industries (e.g., Kwan & Martens, 2020, Nandy & Sussan, 2021) or specific company activities (e.g., Lee & Lu, 2021 on CSR activities). Some studies focus on specific companies (e.g., Mason & Elkassabgi, 2022 on pharmaceutical companies, Nandy & Sussan, 2021 on fintech companies). Below are more details of these studies.

For the U.S. market, Kwan and Martens (2020) reported that the news about the COVID-19 pandemic affected asset prices to varying degrees across different sectors of the U.S. economy. They used an event study methodology to show that the standardized cumulative abnormal returns of equities in the utilities, real estate, and energy sectors were negative during the pandemic, while the standardized cumulative abnormal returns were positive in the information technology, healthcare, and telecommunication sectors. Lee *et al*. (2023) studied the abnormal returns in the US and the Chinese stock markets at the beginning of the COVID-19 outbreak. These authors used event study methodology to find that a significant negative impact appeared immediately after the Wuhan lockdown in the Chinese markets, while the US market was more brutally affected after COVID-19 was labeled a global threat.

Again the U.S. but for a specific industry, Nandy & Sussan (2022) reported the abnormal returns stocks of Fintech companies in response to the national emergency declaration during the COVID19 pandemic on March 13,2020 but did not reject the null hypothesis that the abnormal returns of Fintech digital payment companies are zero in the week following the declaration of national emergency.

For the Indian market, the research findings are mixed. Using the number of COVID cases and the number of casualties caused by the pandemic, Rao *et al*. (2021) investigated and found both positive and negative returns varying from industry to industry. Specifically, these authors found pharmaceutical, FMCG, and telecom enjoyed a positive return, and banking and financial services suffered from a negative return, with entertainment, oil and power, auto and metal sectors with not significant results. They further used event study methodology to investigate the impact of 4 phases of lockdowns in India (1st lockdown from March 25th to April 13th, 2.0 from 14th April to May 3rd, 3.0 from May 4th to 17th , and 4th from May 18th to 31st) on India stock market performance and reported the varying degree of negative cumulative abnormal returns in the stocks traded in the Indian stock market during the lockdown period.

From a different perspective that investigated company level activities, Lee and Lu (2021) compared companies that engage in and did not engage in corporate social responsibility (CSR) activities and their stock return during COVID-19 outbreak in Taiwan. Similar to

other studies, they used an event study approach (-3, +10 or three days prior to outbreak and 10 days after outbreak) choosing the outbreak day of Jan 21, 2020 to examine the returns in the stock prices of companies that are committed to CSR versus the companies that did not commit to CSR activities. Among the 941 companies listed in Taiwan stock exchange or TWSE, 86 companies were classified as CSR companies that have won CSR awards from CommonWealth magazines. The empirical results indicated that the stock prices of all companies generated significantly negative abnormal returns and negative cumulative abnormal returns after the outbreak of the pandemic. However, the CAR of non-CSR companies was significantly larger than those of CSR companies indicating that CSR companies are less adversely affected by the pandemic and their stock prices were relatively resistant.   to the fall and they recovered faster.

Specifically relevant to this research about pharmaceutical companies, Mason & Elkassabgi (2022) reported that the announcement of the news on the development of the COVID -19 vaccines by Pfizer and Moderna affected the volatility in the trading of these stocks.   Mason *et al*. (2022) studied the volatility and returns of Pfizer stock with time-series regression analysis. Mason *et al*. (2022) wrote that Pfizer stock returns were significantly higher (above the mean) immediately just before positive COVID-19 vaccine development information was made public. These authors also observed volume volatility in these stocks before significant news about the development of COVID-19 vaccine.

Based on the above research findings, we have reason to believe that the abnormal returns (A_o) of the Pfizer and Moderna will differ from zero on the event day. More formally, we hypothesize:
H_1: Ceteris Paribus, the A_{oi} will differ from zero.

3. DATA COLLECTION

A brief introduction of each company that we have studied is as follows:
Pfizer Inc. is listed on New York Stock Exchange (NYSE) with the ticker symbol of PFE and has a market capitalization of \$202 billion. Pfizer Inc. discovers, develops, manufactures, markets, distributes, and sells biopharmaceutical products worldwide (Yahoo: Pfizer, 2023). Moderna, Inc., a biotechnology company is listed on NASDAQ with the ticker symbol of MRNA and has a market capitalization of \$38 billion. Moderna Inc. is involved in the discovery, development, and commercialization of messenger RNA therapeutics and vaccines such as COVID-19 (Yahoo: Moderna, 2023), Stock market prices of these two companies were obtained from Yahoo Finance website.

4. METHODOLOGY

In the current research event-study method is used to determine the abnormal returns of the stocks of Pfizer and Moderna following FDA issuance of EUA for Pfizer BioNTech COVID-19 Vaccine on December 11, 2020, and for Moderna on December 18, 2020. We have determined the cumulative abnormal returns for three days before and after FDA's announcement of EUA use for both vaccines. Daily equity prices for one year prior to the announcement (250 trading days for each equity from mid- December 2019 to mid-December 2020) were obtained from https://finance.yahoo.com/.

The return of equity i on day t is calculated as follows:

$R_{it} = (M_C - M_O)/M_O$

where, R_{it} = Market return on day t for equity i, M_O = Market opening price of equity i on day t and M_C = Market closing price of equity i on day t.

The CAPM (Capital Asset Pricing Model) model is used to evaluate the abnormal return of Pfizer stock on the day of the event as:

A_{oi} (Pfizer) $= R_{it} - (\alpha_i + \beta R_{mt})$,

where A_{oi} = abnormal return of equity i, R_{mt} = return of New York Stock Exchange Index on day t, α_i and β, are parameters obtained from ordinary least squares regression between R_{it} and R_{mt}.

The CAPM (Capital Asset Pricing Model) model is also used to evaluate the abnormal return of Moderna stock on the day of the event as:

A_{oi} (Moderna) $= R_{it} - (\alpha_i + \beta R_{mt})$,

where A_{oi} = abnormal return of equity i, R_{mt} = return of NASDAQ Average index on day t, α_i and β, are parameters obtained from ordinary least squares regression between R_{it} and R_{mt}.

The control period used for linear regression contained n days – beginning with $n + 5$ days prior to the event date and ending on 3 days before the event date (Corrado, 2011). A value of $n = 250$ days was chosen to represent the number of trading days in a calendar year. Under a null hypothesis of no abnormal performance, the event date abnormal return A_o has an expected value of zero and a variance given as (Corrado, 2011):

$Var(A_o) = \sigma_e^2[1 + (1/n) + \{(RM_o - RM_{av})^2/\Sigma(RM_b - RM_{av})^2\}]$

where the summation is carried out starting from $n + 5$ days prior to the event date and ending on 3 days before the event date, $Var(A_o)$ is the variance of abnormal return A_o, σ_e denotes the standard error of the regression used to obtain the market model parameters α_i, and β_i. RM_o indicates the market return on the event day, RM_{av} indicates the average of n market returns, starting with $n+5$ days prior to the event day and ending 3 days before the event date, and RM_b indicates the market return on each day starting from $n+5$ days prior to the event day and ending 3 days before the event date.

The t-statistics for each equity were calculated as follows (Corrado, 2011)

$t = A_o/S_{Aio}$ where S_{Aoi} = standard deviation of $A_o = (Var(A_o))^{0.5}$

with df (degrees of freedom) = n-2.

The cumulative absolute return (CAAR) is calculated as:

CAAR $[-10,10] = \Sigma A_0$, where the summation of the abnormal returns (A_0) is carried out from ten days before happening of the event to ten days after the event.

5. RESULTS

Table 1 shows the actual returns of Pfizer stock on three days before and three days after December 11, 2020, the date of approval of EUA (Exceptional Use Authorization) by FDA of Pfizer vaccine.

Table 1: Actual Returns of Pfizer stock during a three-day period before and after FDA approval of EUA of Pfizer COVID-19 vaccine on December 11, 2020.

Equity	Dec 8	Dec 9	Dec 10	Dec 11	Dec 14	Dec 15	Dec 16	Cumulative
Pfizer	0.028	-0.028	-0.002	-0.020	-0.058	-0.009	-0.009	-0.098

It is observed from Table 1 that the actual returns of Pfizer stock is significantly negative on December 14, 2020, one trading day after the day of FDA approval. The cumulative accrual return from December 4th through December 16th is also negative.

Table 2 shows the returns of Pfizer during the same period as predicted by the CAPM model.

Table 2: Returns of Pfizer stock as predicted by CAPM (Capital Asset Pricing Model) during December 8 through December 16,2020

Equity	Dec 8	Dec 9	Dec 10	Dec 11	Dec 14	Dec 15	Dec 16	Cumulative
Pfizer	0.003	-0.001	-0.002	0.002	-0.003	0.005	0.000	0.004

By comparing the actual returns of Pfizer stock (from Table 1) with the returns predicted by CAPM model (from Table 2), it is observed that the actual returns are more negative than those predicted by CAPM.

Table 3 shows the abnormal returns of Pfizer stock from December 8 through December 16, 2020. The corresponding *t*-values and the *p*-values are also listed.

Table 3: Abnormal Returns of Pfizer stock from December 8, 2020, through December 16, 2020

	Dec 8	Dec 9	Dec 10	Dec 11	Dec 14	Dec 15	Dec 16	Cumulative
Abnormal Return	0.025	-0.027	-0.002	-0.022	**-0.055**	-0.014	-0.009	**-0.104**
t-statistic	1.756	-1.901	-0.17	-1.565	**-3.905**	-1.004	-0.649	**-7.439**
p-value	0.08	0.058	0.865	0.119	**0.000**	0.316	0.517	**0.000**

Based on the *p*-values, the null hypothesis that the abnormal return is zero cannot be rejected on six days, which are: December 8th, 9th, 10th, 11th, 15th, and 16th. However, based on the *p*-value of 0, the null hypothesis that the abnormal return is zero can be rejected on December 14, one trading day after the day of approval from FDA.   This set of information is shown in bold in Table 3. The cumulative abnormal return is negative during the entire period as shown in the last column of this table. Based on the p-value, the null hypothesis that the cumulative return is zero can be rejected. This set of information is shown in bold in the last column of Table 3.

In addition to the most commonly used single index model or SIM (Sorokina *et al.*, 2013) reported above, it is recommended adding more factors modeling a multifactor model or MFM will improve the variance explained (Fama and French 1993). As such we added an additional Index, in this case NASDAQ to the previous model. Using the estudy command in STATA (Pacicco *et al.*, 2018), the results are reported below in Tables 4 and 5.

Table 4: Cumulative Average Abnormal Returns. Security PFE and Index NYSE

Event date:	11-Dec-20				
Event windows:	6				
Security:	PFE				
Index list:	NYSE				
CAAR[-10,10]	CAAR[-5,5]	CAAR[-5,0]	CAAR[0,5]	CAAR[-3,0]	CAAR[0,3]
-6.56%	-6.71%	0.05%	-8.87%***	-2.34%	-8.72%***

*** p-value <0 .01, ** p-value <0.05, * p-value <0.1

Table 4 presents cumulative abnormal returns for the equation with one stock (PHE) and one index (NYSE) for event windows including ten days before and after the event, five days before and after the event, five days before the event, five days after the event, three days before the event, and three days after the event. The p-values support the results presented in Table 3 and demonstrate abnormal returns within five and three days after the event.

Table 5: Cumulative Average Abnormal Returns. Security PFE and Indexes NYSE and NASDAQ

Event date:	11-Dec-20				
Event windows:	6				
Security:	PFE				
Index list:	NYSE, NASDAQ				
CAAR[-10,10]	CAAR[-5,5]	CAAR[-5,0]	CAAR[0,5]	CAAR[-3,0]	CAAR[0,3]
-6.66%	-6.74%	0.08%	-8.93%***	-2.28%	-8.81%***

*** p-value <0 .01, ** p-value <0.05, * p-value <0.1

Table 5 presents cumulative abnormal returns for the equation with one stock (PHE) and two indexes (NYSE and NASDAQ). The estimation results are similar to the one-index case. Table 6 shows the actual returns of Moderna stock on three days before and three days after the date of approval from FDA on December 17, 2020.

Table 6: Actual Returns of Moderna stock during a three-day period before and after FDA approval of EUA of Moderna COVID-19 vaccine on December 18, 2020.

Equity	Dec15	Dec 16	Dec 17	Dec18	Dec 21	Dec 22	Dec 23	Cumulative
Moderna	-0.062	-0.005	0.044	-0.009	-0.018	-0.094	0.086	-0.059

It is observed from Table 6 that the actual return of Moderna stock is negative on December 21, 2020, a trading day after the FDA approval day. The cumulative actual return (shown in the last column) from December 15th through December 23rd is also negative.

Table 7 shows the returns of Moderna during the same period as predicted by the CAPM model.

Table 7: Returns of Moderna stock as predicted by CAPM during December 8 through December 16,2020

	Dec15	Dec 16	Dec 17	Dec18	Dec 21	Dec 22	Dec 23	Cumulative
Abnormal Return	0.001	0.001	0.000	-0.002	0.005	0.000	-0.003	0.002

Table 8 shows the abnormal returns of Moderna stock from December 15 through December 23, 2020. The corresponding t-values and the p-values are also listed.

Table 8: Abnormal Returns of Moderna stock from December 15, 2020, through December 23, 2020

	Dec15	Dec 16	Dec 17	Dec18	Dec 21	Dec 22	Dec 23	Cumulative
Abnormal Return	-0.063	-0.006	0.044	-0.007	-0.023	-0.094	0.089	-0.062
t-statistic	-1.196	-0.116	0.823	-0.123	-0.425	-1.782	1.674	-1.145
p-value	0.233	0.908	0.411	0.902	0.671	0.076	0.095	0.253

Based on the p-values, the null hypothesis that the abnormal return of Moderna stock is zero cannot be rejected on from December 15 through December 23, 2020, Similarly, based on the p-value, the null hypothesis that the cumulative return is zero cannot be rejected.

Similar to Pfizer stock analysis above, we further analyze the stock returns using a multifactor model or MFM (Fama and French 1993) by adding an additional Index, in this case NYSE to the previous model. Using the estudy command in STATA (Pacico *et al.*, 2018), the results are reported below in Tables 9 and 10.

Table 9 presents cumulative abnormal returns for the equation with one stock (MRNA) and one index (NASDAQ) for event windows including ten days before and after the event, five days before and after the event, five days before the event, five days after the event, three days before the event, and three days after the event. The p-values support the results presented in Table 8 and reject abnormality of returns for the selected windows.

Table 9: Cumulative Average Abnormal Returns. Security MRNA and Index NASDAQ

Event date:	18-Dec-20				
Event windows:	6				
Security:	MRNA				
Index list:	NASDAQ				
CAAR[-10,10]	CAAR[-5,5]	CAAR[-5,0]	CAAR[0,5]	CAAR[-3,0]	CAAR[0,3]
-26.13%	-20.41%	-9.22%	-11.73%	-2.69%	-2.93%

*** p-value <0 .01, ** p-value <0.05, * p-value <0.1

Table 10 presents cumulative abnormal returns for the equation with one stock (MRNA) and two indexes (NYSE and NASDAQ). The estimation results are similar to the one-index case.

Table 10: Cumulative Average Abnormal Returns. Security MRNA and Indexes NASDAQ and NYSE

Event date:	18-Dec-20				
Event windows:	6				
Security:	MRNA				
Index list:	NASDAQ, NYSE				
CAAR[-10,10]	CAAR[-5,5]	CAAR[-5,0]	CAAR[0,5]	CAAR[-3,0]	CAAR[0,3]
-26.40%	-20.18%	-9.00%	-11.75%	-2.79%	-2.91%

*** p-value <0 .01, ** p-value <0.05, * p-value <0.1

6. DISCUSSION

It is interesting to note that our results deviate from a previous study. Mason and Elkassabgi (2022) observed that Pfizer stock returns were significantly higher (above the mean) immediately just before positive COVID-19 vaccine development information was made public. However, these authors did not employ the event-study methodology as proposed and developed by Fema (1991) and Corrado (2011). We have observed negative actual and abnormal returns of Pfizer stock on one day before, and on one day after the EUA by FDA of Pfizer vaccine. The actual return of Pfizer stock on December 14 (one day after the approval by FDA) was significantly negative leading to a highly negative and significant abnormal return. One reason for this could be that the stock traders were not fully convinced that the Pfizer vaccine would completely eradicate COVID-19 virus, and therefore, they sold Pfizer stocks the day after EUA by FDA - leading to a strong decline in the price of Pfizer stock on December 14, 2020. Overall, we have observed a strong negative cumulative abnormal return of Pfizer stock from December 8 through December 11, 2020. The highly negative t-value and the corresponding very low p-value has led us to reject the null hypothesis that the cumulative abnormal return of Pfizer stock during the

period is zero.

We have also observed negative actual returns of Moderna stocks on one day before and on one day after the EUA by FDA of Moderna vaccine. One reason for this could be that the stock traders were not convinced that the Moderna vaccine would completely eradicate COVID-19 virus, and therefore, they sold Moderna stock the day after EUA by FDA - leading to a decline in the price of Moderna stock on December 14, 2020. On the overall, we have observed a negative cumulative abnormal return of Moderna stock from December 15 to December 23, 2020. Although the test statistic for the cumulative return of Moderna stock is negative, the p value is high leading us to not reject the null hypothesis that the cumulative abnormal return during the period is zero.

This research work has demonstrated that Pfizer stock has shown a significant negative abnormal return the day after EUA by FDA. Moderna stock also has shown a negative abnormal return on the day after EUA by FDA but it is not statistically significant. This may be because the traders were less bullish on Pfizer stock than they were on Moderna stock.

7. CONCLUSION

This research addresses the impact of FDA announcement or decisions on the performance of pharmaceutical companies using an event study method to illustrate such an impact. We found results of Pfizer stock showing a statistically significant negative abnormal return the day after EUA by FDA but not for Moderna stock. These results demonstrate that different stocks react differently from the same FDA announcement. Future studies should investigate firm-specific factors leading to such a difference. More specifically in the highly competitive biotechnology space, do smaller firms differ from larger firms in terms of market response to information? The fact that there is a one-week gap (Pfizer Dec 11, 2020, Moderna Dec 18, 2022) between the announcements, future research should consider including the impact of Pfizer during this week on Moderna. It is possible that the quality of the information from the later announcement differs from the information from an earlier announcement resulting in a discounting effect.

REFERENCES

[1] Ahmad, W., Khan, N., Usman, A., Ahmad, F., & Khalil, Y. (2017). Stock Market
[2] Reaction to Political Event 'Sit-In' (Evidence from Pakistan). Journal of Managerial Sciences. 11(1). 23-37.
[3] Asongu, S. A. (2012). Government quality determinants of stock market performance in African countries. Journal of African Business, 13(3), 183-199.
[4] Bohmann, M. J., & Patel, V. (2022). Informed options trading prior to FDA announcements. Journal of Business Finance & Accounting, 49(7-8), 1211-1236.
[5] Brown, KC, Harlow, WV, & Tinic, S.M. (2008). Risk Aversion, Uncertain Information, and Market Efficiency. Journal of Financial Economics, 22(2), 355-385
[6] Chen, Y. J., Feng, Z. Y., Li, Y. P., & Huang, H. W. (2021). The economic consequences of US FDA new drug approvals: evidence from Taiwan pharmaceutical and biotech companies. Innovation, 23(3), 354-374.
[7] Corrado, C. (2011). Event Studies: A Methodology Review. *Accounting and Finance.*

51. 207-234.Fama, E., Fisher, I., Jensen, M., & Roll, R. (1969). The adjustment of stock prices to new information. International Economic Review, 10(1), 1-27.

[8]   Fama, F. (1970). Efficient capital markets: a review of theory and empirical work. Journal of Finance, 25(2). 388-417

[9]   Fama, F. (1991). Efficient Capital Markets: II. (1991). Journal of Finance. 46(5). 1575-1616.

[10] Fama, E. F., & French, K. R. (1996). Multifactor explanations of asset pricing anomalies. The journal of finance, 51(1), 55-84.

[11] FDA News Release. FDA Approves First COVID-19 Vaccine. (December 11, 2020). https://www.fda.gov/news-events/press-announcements/fda-approves-first-COVID-19-vaccine#:~:text=The%20first%20EUA%2C%20issued%20Dec,trial%20of%20thousands%20of%20individuals. (Accessed on August 10, 2023)

[12] FDA.gov. How Drugs are Developed and Approved. https://www.fda.gov/drugs/development-approval-process-drugs/how-drugs-are-developed-and-approved (Accessed on April 19, 2024).

[13] FDA News Release. FDA Takes Additional Action in Fight Against COVID-19 By Issuing Emergency Use Authorization for Second COVID-19 Vaccine (December 18, 2020). https://search.usa.gov/search?affiliate=fda&sort_by=&query=https%3A%2F%2Fwww.fda.gov%2Fnews-events%2Fpress-announcements%2Ffda-takes-additional+action-fight-against-COVID-19-issuing-emergency-use-authorization-second-COVID.&commit=Search (Accessed on August 10, 2023)

[14] Ferguson, A., & Lam, P. (2016). Government policy uncertainty and stock prices: The case of Australia's uranium industry. Energy Economics, 60, 97-111.

[15] Hwang, T. J. (2013). Stock market returns and clinical trial results of investigational compounds: an event study analysis of large biopharmaceutical companies. PloS one, 8 (8), e71966.

[16] Kong, D., Liu, S., & Dai, Y. (2014). Environmental policy, company environment protection, and stock market performance: Evidence from China. Corporate Social Responsibility and Environmental Management, 21(2), 100-112.

[17] Kwan, S. H., & Martens, T. M. (2020). Market Assessment of COVID-19. Federal Reserve Bank of San Francisco Economic Letter. May 28, 2020. 1-6.

[18] Lakonishok, J., Shleifer, A., & Vishny, R. W. (1992). The impact of institutional trading on stock prices. Journal of financial economics, 32(1), 23-43.

[19] Mason, A.N. & Elkassabgi, A. (2022). Evidence of Abnormal Trading on CIVID-19 Pfizer Vaccine Development information. *Journal of Risk and Financial Management*. 15(7), 299.

[20] Mazmudar, R. S., Tripathi, R., Ezaldein, H. H., & Scott, J. F. (2020). United States stock market response to FDA approval of new dermatologic drugs. *Journal of drugs in dermatology*: JDD, 19(6), 639-645.

[21] Najid, N. A., & Abdul Rahman, R. (2011). Government ownership and performance of Malaysian government-linked companies. *International Research Journal of finance and economics*, 61(1), 1450-2887.

[22] Nandy, S. & Sussan, F. (2020). Parliamentary Elections and Stock Performance: A Comparison of American Depository Receipts and their Underlying Equities in India. *Review of Integrative Business and Economics Research*,9(1). 51-62

[23] Nandy, S.& Sussan, F (2022). COVID Emergency Declaration and Digital Fintech

Companies' Performance. *Review of Integrative Business and Economics Research*. 11(1). 51-62.

[24] Nguyen, M. H., & Vo, Q. T. (2020). Government Control and Privatized Firms' Performance: Evidence from Vietnam. *The Journal of Asian Finance, Economics and Business*, 7(10), 663-673.

[25] Pacicco, F., Vena, L., & Venegoni, A. (2018). Event study estimations using Stata: The estudy command. The Stata Journal, 18(2), 461-476.

[26] Pantzalis, C., Strangeland, D.A., & Turtle, H.L. (2000). Political Elections and the Resolution of Uncertainty: the International Evidence. *Journal of Banking and Finance,* 24 (10), 1575-1604.

[27] Rao, P., Goyal, N., Kumar, S., Hassan, M. K. & Shahimi, S. (2021). Vulnerability of financial markets in India – the contagious effect of COVID -19. *Research in International Business and Finance*, 59. 101462

[28] Repousis, S. (2016). Stocks' prices manipulations around national elections? An event study for the case of Greek banking sector. Journal of Financial Crime, 28(2). 218-256

[29] Rothenstein, J. M., Tomlinson, G., Tannock, I. F., & Detsky, A. S. (2011). Company stock prices before and after public announcements related to oncology drugs. Journal of the National Cancer Institute, 103(20), 1507-1512.

[30] Sharma, A., & Lacey, N. (2004). Linking product development outcomes to market valuation of the firm: The case of the us pharmaceutical industry. Journal of Product Innovation Management, 21 (5), 297–308

[31] Sorokina, N., Booth, D. E., & Thornton Jr, J. H. (2013). Robust methods in event studies: Empirical evidence and theoretical implications. Journal of Data Science, 11.

[32] Torabzadeh, K. M., Woodruff, C. G., & Sen, N. (1998). FDA decisions on new drug applications and the market value of pharmaceutical firms. American business review, 16(2), 42.

[33] Yahoo, Pfizer (2023). Available at. https://finance.yahoo.com/quote/PFE?p=PFE&.tsrc=fin-srch (Accessed on August 10, 2023)

[34] Yahoo, Moderna (2023). Available at: https://finance.yahoo.com/quote/MRNA?p=MRNA&.tsrc=fin-srch (Accessed on August 10, 2023)

[35] Ying, T. L., Rasiah D., & Ming L.M. (2016). Behavior of Stock Returns in Relation to General Elections: Evidence from Malaysian Markets. Information, 19(7B), 2955-2959.