

Market Reactions to Pfizer's Paxlovid Phase II/III Clinical Trial Results: An Event Study of Abnormal Returns and Trading Volume

Yirui Lai^{1*}, Ziyan Wang², Xinyi Feng³, Junhao Fan⁴

¹*School of Management, University of Xi'an Jiaotong-Liverpool, Suzhou, China*

²*School of Business, University of Shandong, Weihai, China*

³*High School No7 Chengdu, Chengdu, China*

⁴*School of Economics, University of Warwick, Coventry, United Kingdom*

**Corresponding Author. Email: Larry030924@outlook.com*

Abstract. This paper examines the stock market impact of Pfizer's announcement of Phase II/III clinical results for its oral COVID-19 treatment, Paxlovid, released on November 5, 2021. Using the event study methodology, we investigate whether this milestone generated statistically significant abnormal returns (AR), cumulative abnormal returns (CAR), and abnormal trading volume, while comparing responses with major competitors Moderna and Merck & Co. The results reveal a decisive positive reaction for Pfizer: the firm experienced significant abnormal gains on the announcement day and a sustained CAR, translating into approximately USD 34 billion in increased market capitalization. By contrast, Moderna and Merck suffered significant negative CARs and market value losses, reflecting investor capital reallocation. These findings confirm that the announcement conveyed unanticipated, firm-specific, and economically meaningful information. The study not only provides fresh evidence for the semi-strong form of market efficiency but also highlights the strategic and financial significance of pharmaceutical innovations during global crises.

Keywords: Event Study Methodology, Paxlovid Clinical Trial Announcement, Pharmaceutical Stock Market Reactions, Semi-Strong Market Efficiency.

1. Introduction

1.1. Research background

The COVID-19 pandemic profoundly impacted global public health, economies, and financial markets. Lockdowns and restrictions disrupted supply chains, slowed economic activity, and increased market volatility, making vaccine and therapeutic development crucial to ending the crisis.

The biopharmaceutical industry, characterized by high investment, risk, and return, gained significant attention. Innovations like mRNA technology were rapidly advanced, and companies competed intensely to develop effective solutions. Success promised not only public health benefits

but also substantial commercial rewards—government contracts, market exclusivity, and enhanced brand value.

Pfizer emerged as a key player, demonstrating strong R&D capability through its collaboration on an mRNA vaccine and independent development of the oral antiviral drug Paxlovid. For comparative analysis, Moderna—focusing narrowly on mRNA vaccines—and Merck, leveraging its small-molecule expertise for antivirals, serve as control groups. Their differing strategies provide a solid basis for evaluating market responses to Pfizer's clinical milestones.

1.2. Research object

Based on the macro and industry background mentioned above, our article focuses on a specific and milestone event as the core case for analysis, that is, our research object: the impact of Pfizer's release of Paxlovid Phase 2/3 clinical data on its stock price.

1.3. Research questions and objectives

After clarifying the research object, in order to further explore the related effects brought by the event, this study aims to answer the following key questions:

Has this approval announcement generated statistically significant abnormal returns (AR) and cumulative abnormal returns (CAR)?

How does Pfizer's stock price react compared to the overall market?

What are the similarities and differences in Pfizer's stock price response compared to its main competitors such as Moderna and Merck&Co?

Does the market's response pattern conform to the characteristics of the semi strong efficient market hypothesis?

1.4. Research value

The research conducted on the above issues makes this article having values as follows:

(1) Theoretical value

Provide a classic case study for the application of event study method in extreme events. Provide new evidence for the market efficiency hypothesis.

(2) Practical value

For investors: Understand how major regulatory decisions affect the valuation of specific companies and the entire industry, and provide reference for investment decisions.

To the management of the company: demonstrate the enormous shareholder value that successful research and regulatory strategies can create.

To policy makers: Revealing the speed and degree of capital market response to public health policies.

1.5. Refer annual report

The financial statement has a decisive impact on the choice of the stock research window period, but it is not only the 'silent period' at the regulatory level, but also refers to the 'sample period' that we manually plan to verify the validity of an investment decision-making event or factor. If the research is compared to an experiment, the financial report is the timer and filter that determines 'when to sample, how long to collect, and which companies'. From Table1 we can clearly find that the total revenue of 2021 is very high and has risen sharply compared with 2022. And the vaccine revenue in

2021 has increased by 10 times compared with 2021,so we choose to limit the window to 2021.From Table 2, found that the profits in the third and fourth quarters were particularly high ,whether compared with the same quarter of last year or the first two quarters of that year, so we tend to put the window period in the second half of the year.

Table 1. Pfizer's annual revenue and expenses (2020-2023)

(\$ in millions)	2020	2021	2022	2023
Total revenue	41654	81288	100330	
Vaccines revenue	3395	32010		
Adjusted SI&A Expense	11597	12703	14446	13049
Adjusted SI&A Expense	9393	13829	10568	11409
Research and development expenses	9393	13829	11428	10679
Acquired in-progress research and development expenses	3348	3700	953	194

Table 2. Quarterly vaccines revenue of Pfizer (2020 vs. 2021)

First-quarter (\$ in millions)		Second-quarter (\$ in millions)		Third-quarter (\$ in millions)		Fourth-quarter (\$ in millions)	
2020	2021	2020	2021	2020	2021	2020	2021
1611	4894	1247	9234	1717	14583	2001	13914

2. Literature review

2.1. Application of event study methodology in the context of the pandemic

Against the backdrop of the COVID-19 pandemic, the event study methodology has been widely applied to assess the impacts of pandemic prevention and control measures, economic policy responses, and medical breakthroughs on financial markets. Through a cross-country analysis, Masuhara and Hosoya found that different countries adopted distinct balancing strategies between infection control and economic stability, and these policy differences led to significantly varying stock market reactions [1].

Studies have shown that countries demonstrated different risk attitudes and economic preferences when responding to the pandemic, which directly affected the extent of their impacts on the stock market. Norway was most effective in curbing the number of deaths while resuming production and consumption, achieving an optimal balance between public health and economic development. In contrast, due to its relatively lower patience and higher risk tolerance, the United States, despite a higher number of deaths, achieved a stable economic recovery. These studies illustrate how the event study methodology can assist in evaluating market responses to different policy choices [1].

2.2. Market reactions to vaccine development announcements

The event study methodology plays a crucial role in assessing the impact of vaccine development announcements on the stock market [2,3]. Luo et al. applied this methodology to analyze the influence of COVID-19 vaccine development announcements on the stock returns of vaccine companies [4]. They found that for vaccine firms, announcements regarding the initiation and completion of COVID-19 vaccine R&D are significant milestone events [4]. When most of these

events occurred, stock prices rose significantly, indicating that the market held a positive attitude toward such progress.

As a leading enterprise in COVID-19 vaccine research and development, Pfizer, in collaboration with BioNTech, developed the BNT162b2 mRNA vaccine, which has become a key tool for global pandemic prevention and control. On November 18, 2020, Pfizer announced that the Phase III clinical trial of this vaccine showed an efficacy rate of 95%. This announcement led to a cumulative abnormal return (CAR) of over 7% for Pfizer within the event window $[-1, +1]$ [4]. This market response demonstrates that investors not only recognize the commercial value of the vaccine itself but also are optimistic about the long-term reputational gains and technological platform advantages that Pfizer will obtain from this successful R&D project [4,5].

2.3. Application of event study methodology in pandemics and vaccine development

Against the backdrop of the COVID-19 pandemic, the event study methodology has been widely used to assess the impacts of pandemic prevention and control measures, economic policy responses, and medical breakthroughs on financial markets [2,3]. Particularly in the field of vaccine research and development, this methodology can acutely capture the volatility effects of key announcements and scientific research progress on the stock prices of relevant pharmaceutical enterprises [3,4]. Luo et al. applied the event study methodology to analyze the impact of COVID-19 vaccine development announcements on the stock returns of vaccine companies [4]. The study found that for vaccine companies, announcements regarding the initiation and completion of COVID-19 vaccine research and development are crucial milestone events. The research matched the announcements of the start and end of vaccine development from three leading vaccine companies, and used the event study method to examine the relationship between COVID-19 vaccine development events and changes in stock returns. It was found that stock prices rose when most of these events occurred [4].

2.4. Application of event study methodology in Pfizer's vaccine development

As a leading enterprise in COVID-19 vaccine research and development (R&D), Pfizer, in collaboration with BioNTech, developed the BNT162b2 mRNA vaccine—a product that emerged as a critical tool for global pandemic prevention and control[5]. Given the vaccine's far-reaching impact on public health and financial markets, numerous studies have employed the event study methodology to systematically examine how key milestones in Pfizer's vaccine R&D process influenced the company's stock price, quantifying market reactions to these high-stakes events [2,3,4].

3. Data and research design

3.1. Data sources and sample selection

This study selects November 5, 2021, as the event day, corresponding to the announcement date of Pfizer's release of Phase II/III clinical data for Paxlovid. The rationale for choosing this date lies in the significant abnormal fluctuations in the company's stock price and the sharp increase in trading volume following the announcement, which meets the identification criteria for “unexpected material information” in event studies [3].

The data required for the research primarily fall into three categories. Event information is obtained from official announcements published on Pfizer's website, ensuring the accuracy of the

event date [5]. Stock price data, including daily closing prices for Pfizer Inc., Moderna Inc., and Merck & Co., are sourced from the Investing.com financial database, which provides complete, accurate, and adjusted time series data suitable for empirical research [2,6,7]. The market index, represented by the S&P 500 Index, serves as the benchmark for market returns and is also sourced from Investing.com [6].

Regarding the time window settings, the estimation window is set from January 1, 2018 to December 31, 2019, encompassing 500 trading days. This period precedes the COVID-19 pandemic, thereby avoiding distortions in parameter estimation caused by pandemic-related shocks [7]. The event window spans 7 trading days before to 7 trading days after the event date (October 29, 2021 – November 16, 2021), which is sufficient to capture both potential information leakage and delayed market reactions [8].

For effective comparative analysis, this study specifically selects Moderna Inc. and Merck & Co. as control groups. Moderna, as a company also focused on mRNA technology, presents a clear competitive relationship with Pfizer. Merck & Co., having concurrently announced clinical results for its oral antiviral drug Molnupiravir, forms a direct comparison with Paxlovid. This carefully designed comparison scheme helps control for industry common factors, thereby better isolating the pure effect brought by the release of Paxlovid's data [1,4,9,10].

Table 3. Raw data list

Data Type	Content	The Logic behind the Choice	Sources
Event Date	November 5, 2021 (Pfizer releases Paxlovid Phase 2/3 clinical data)	Significant changes in price increase and explosive growth in trading volume	Pfizer official website press release
Research Object: Pfizer's stock price and trading volume	Event Window: [-7, +7]2021.10.29-2021.11.16 Estimation Window: 2018.1.1-2019.12.31	Covering market expectation leakage (early response) and information digestion period (delayed response) Avoiding abnormal fluctuations during COVID-19 and ensuring the stability of market model parameters	
Control Group	Moderna's stock price and trading volume Event Window: ditto Estimation Window: ditto	Belonging to the mRNA technology route, with clear competitive relationships	The official website: investing
	Merck&Co's stock price and trading volume Event Window: ditto Estimation Window: ditto	At the same time, the inferior effect results of Molnupiravir taken orally by COVID-19 were announced	
S&P 500 Index	Event Window: ditto Estimation Window: ditto	Widely representing the overall performance of the US stock market	

3.2. Model specification and calculation methods

This study adopts an event-study design, a prevalent empirical technique in financial economics for assessing how discrete announcements affect firm value [2,3]. Our central question is whether Pfizer's November 5, 2021 disclosure of Phase 2/3 results for its oral COVID-19 therapy, Paxlovid,

produced statistically significant abnormal returns. By contrasting realized equity returns with model-implied normal returns, the approach gauges the extent to which markets embed new information into prices. The framework is anchored in the semi-strong Efficient Market Hypothesis (EMH), which holds that public information is incorporated rapidly and without systematic bias [11,12]. Accordingly, conditional on ruling out confounding news, any abnormal performance observed around the announcement can be attributed to the disclosure itself [3,11,13]. We estimate abnormal returns via the standard market model. The model posits a linear relation between a firm's return and the market return and is estimated using ordinary least squares (OLS) [8]. Formally,

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

where R_{it} represents the return of stock "i" on day "t", R_{mt} denotes the return of the market portfolio, that is S&P 500, on the same day, and ε_{it} is the random error term.

After obtaining the parameter estimates through ordinary least squares (OLS) regression, the expected normal return for each day within the event window is calculated:

$$E(R_{it}) = \hat{\alpha}_i + \hat{\beta}_i R_{mt}$$

The abnormal return (AR) is then derived as follows:

$$AR_{it} = R_{it} - \hat{R}_{it}$$

To summarize the multi-day effect, we compute cumulative abnormal returns (CAR):

$$CAR_{i(t_1, t_2)} = \sum_{t=t_1}^{t_2} AR_{it}$$

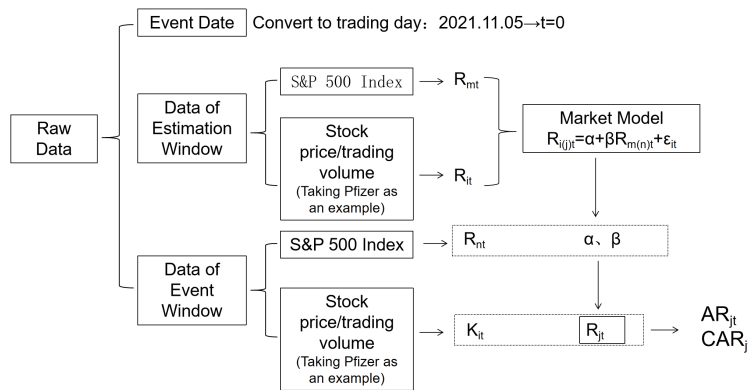


Figure 1. Data processing approach

4. Empirical results

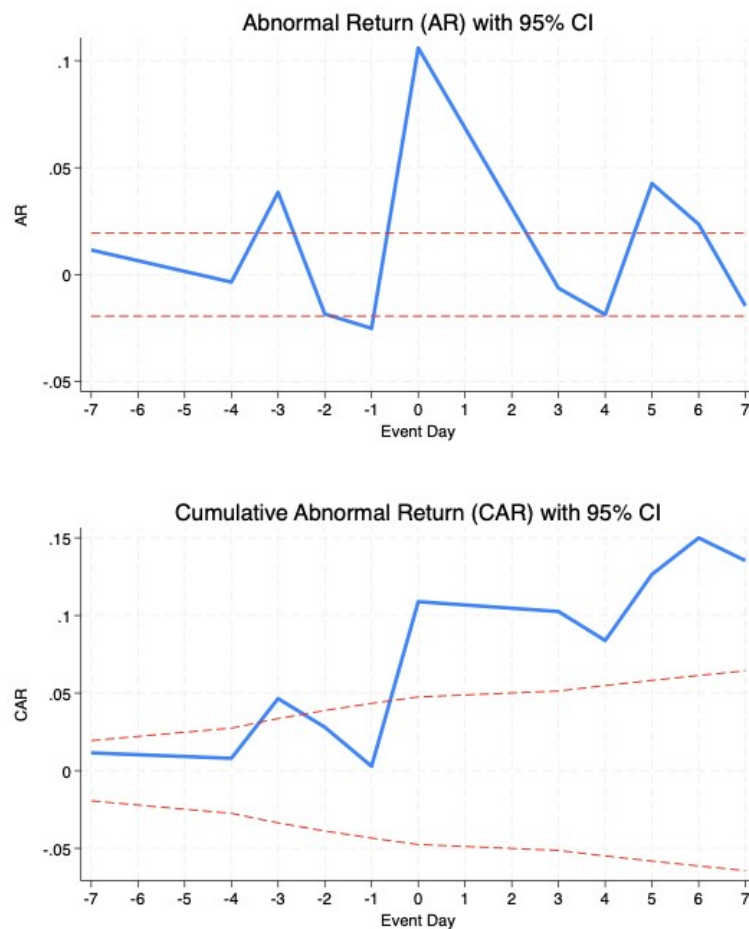


Figure 2. Pfizer's Abnormal Return and Cumulative Abnormal Return during event window

4.1. Abnormal Returns (AR) analysis

Figure 2 shows that Pfizer's abnormal returns during the event window provide strong evidence of the market's sensitivity to the Paxlovid announcement. On the announcement day (Day 0), Pfizer's stock exhibited a statistically significant positive abnormal return, clearly exceeding the standard deviation confidence interval under the null hypothesis of zero abnormal returns. This result indicates a decisive and immediate positive reaction from investors in response to the announcement. In contrast, the pre-event abnormal returns, spanning Days -7 to -1, remained consistently within the confidence interval, which suggests that there was no significant information leakage or market anticipation prior to the public disclosure. Following the announcement, abnormal returns persisted for several days, gradually returning to within the confidence bounds by approximately Day +4. This pattern reflects market efficiency, with investors promptly absorbing and adjusting to the newly available information.

4.2. Cumulative Abnormal Returns (CAR) analysis

Moreover, the cumulative abnormal return (CAR) presented in Figure 2 trajectory further substantiates the initial findings. Starting from the event day, Pfizer's CAR demonstrated a

pronounced and sustained upward trend, quickly exceeding the confidence interval and remaining statistically significant throughout the post-announcement period (Days +1 to +7). This strong CAR performance underscores the market's recognition of the potential commercial value and strategic importance of Paxlovid. Meanwhile, the absence of significant cumulative abnormal returns prior to the event further supports the assertion that the announcement conveyed previously unknown and economically meaningful information to the market.

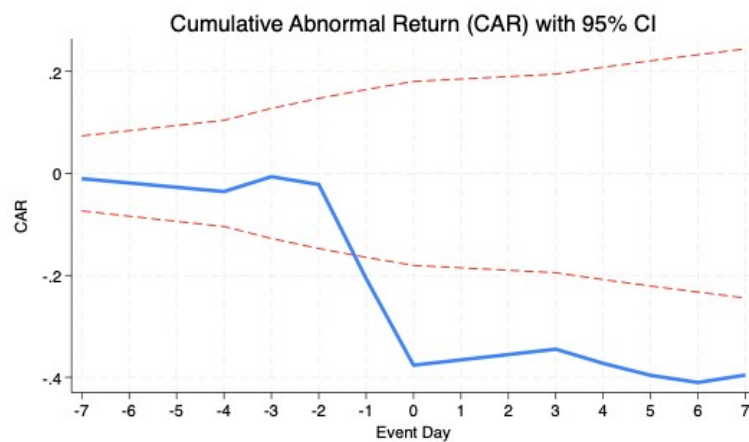


Figure 3. MRNA's Cumulative Abnormal return during the ± 7 event window

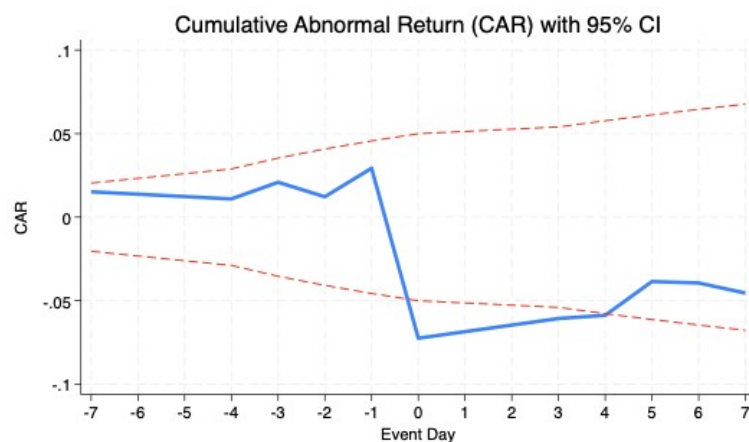


Figure 4. MRK's Cumulative Abnormal return during the ± 7 event window

4.3. Comparative analysis with Moderna and Merck & Co.

To contextualize Pfizer's market response, a comparative analysis was conducted using two major pharmaceutical peers: Moderna (MRNA) and Merck & Co. (MRK). Both companies experienced statistically significant negative cumulative abnormal returns as shown in Figure 3 and Figure 4, in the days following Pfizer's announcement, with their CAR values falling below the lower bounds of the 95% confidence interval. This negative spillover effect suggests that investors interpreted Pfizer's announcement as competitively disadvantageous to its rivals, likely due to expected shifts in market share or revenue. The contrast between Pfizer's positive reaction and its competitors' decline further reinforces the firm-specific nature and economic relevance of the announcement.

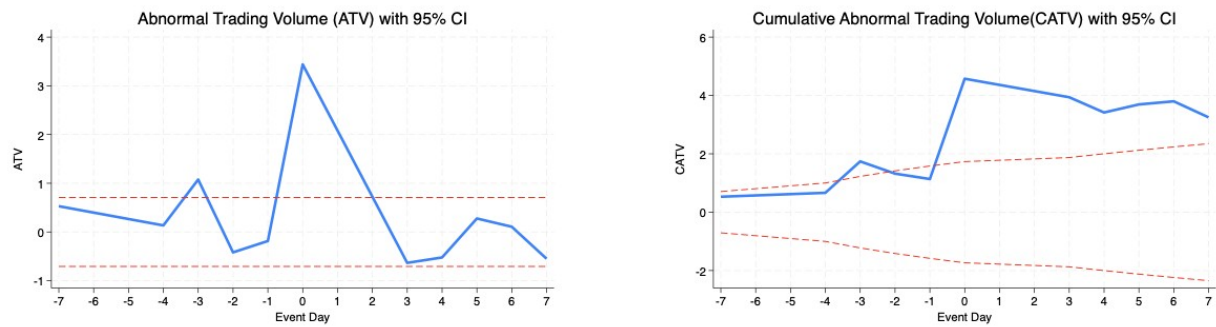


Figure 5. Pfizer's abnormal trading volume and cumulative trading volume

4.4. Trading volume event studies

To further enrich the robustness analysis, we conducted an independent event study using trading volume as the metric of interest, applying the same methodology used for returns.

As Figure 5 shows, Pfizer's trading volume event study confirmed a dramatic surge on the announcement day (Day 0), with daily trading activity approximately four times the historical average. The CAR of trading volume peaked sharply on Day 0 and then fell back toward the baseline over the following days, a pattern consistent with intense but short-lived market attention. This surge reflects an influx of buy orders, aligning with the strongly positive abnormal returns and sustained CAR for Pfizer's stock.

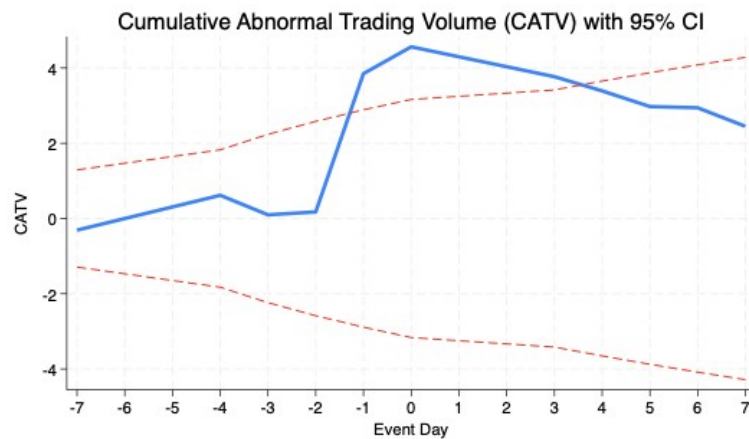


Figure 6. MRNA's cumulative trading volume

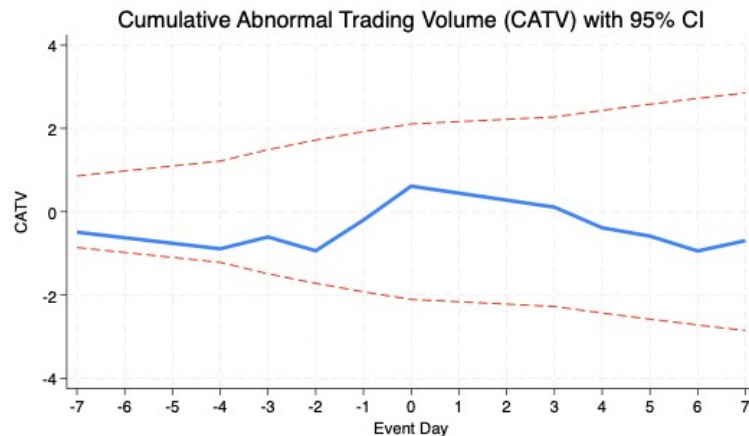


Figure 7. MRK's cumulative trading volume

For peer firms Moderna and Merck & Co., the volume event study yielded a mirror-image pattern in both magnitude and interpretation. In Figure 6 and 7, Moderna's cumulative abnormal trading volume spiked significantly around the event date, while the CAR for returns was sharply negative during the same period. Similarly, Merck & Co. experienced a marked rise in trading volume concurrent with a pronounced drop in its CAR of returns. These simultaneous increases in volume and declines in price suggest that a substantial proportion of the abnormal volume was driven by sell orders, indicating investors' pessimism about these firms' future prospects in light of Pfizer's competitive advantage.

The joint observation of heightened trading volume and negative price performance for Moderna and Merck & Co. supports the conclusion that the market perceived Pfizer's announcement as a substantial competitive threat. The evidence is consistent with the hypothesis that investors reallocated capital away from these firms toward Pfizer, further indicating the firm-specific and market-shifting nature of the event announcement.

4.5. Wealth effects

Translating percentage returns into dollar terms, we compute the change in market capitalisation over the full event window (29 Oct – 16 Nov 2021). Using end-2021 shares-outstanding—5.6 billion for Pfizer, 2.53 billion for Merck, and 0.405 billion for Moderna—the price changes imply that Pfizer shareholders gained approximately US \$34 billion. Conversely, Merck and Moderna shareholders lost about US \$10 billion and US \$46 billion, respectively. These magnitudes reinforce the abnormal-return evidence, confirming that the announcement generated substantial positive value for Pfizer while simultaneously eroding expected cash flows and market capitalisation for key competitors.

4.6. Summary of empirical results

Taken together, the empirical findings demonstrate that Pfizer's announcement regarding Paxlovid elicited a significant and timely positive market response. The pattern of abnormal returns indicates both the efficiency and the impactfulness of the event, while the absence of pre-event abnormal activity supports the interpretation that the information was unanticipated. The observed negative abnormal returns for competitors such as Moderna and Merck & Co. further highlight the

competitive implications of the announcement. Overall, the results offer robust empirical support for the conclusion that the event was firm-specific, credible, and economically meaningful.

5. Conclusion

This paper investigated the impact of Pfizer's announcement of Phase II/III Paxlovid clinical results on November 5, 2021, applying the event study methodology [2,3]. The empirical findings indicate that Pfizer generated statistically significant positive abnormal returns on the event day, with cumulative gains sustained throughout the post-event window. In value terms, this corresponded to an increase of approximately USD 34 billion in Pfizer's market capitalization.

Conversely, Moderna and Merck & Co. exhibited significant negative cumulative abnormal returns and market value losses of roughly USD 46 billion and USD 10 billion, respectively. The simultaneous increase in trading volume and decline in stock performance for these competitors suggests a substantial reallocation of capital towards Pfizer. These outcomes support the interpretation that the announcement conveyed previously unanticipated, firm-specific information with material economic consequences.

The results are consistent with the semi-strong form of the Efficient Market Hypothesis (EMH) [11], indicating that markets responded rapidly, the effect was concentrated around the event, and there was no evidence of information leakage prior to the announcement. From a broader perspective, the study contributes to the literature by providing new evidence on how financial markets incorporate clinical trial milestones in the pharmaceutical sector, while also offering practical implications for investors, corporate managers, and policymakers.

Nonetheless, the analysis is limited to a single case study and a short event window. Future research could extend the framework by examining multiple firms, cross-country market responses, or long-term valuation effects of pharmaceutical innovations.

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