UNIVERSITY OF TARTU

Faculty of Social Sciences

School of Economics and Business Administration

Shakhlokhon Rustambekova

ABNORMAL STOCK RETURNS OF PUBLIC GERMAN PHARMACEUTICAL COMPANIES DURING THE FIRST WAVE OF THE COVID-19 PANDEMIC

Bachelor Thesis

Supervisor: Junior lecturer Mark Kantšukov
Lecturer Helen Poltimäe

Tartu 2023

I have written this Bachelor Thesis independently. Any ideas or data taken from other authors or other sources have been fully referenced.

Table of contents

Introduction

Followed by the official announcement of COVID-19 as a pandemic by WHO on March 11, 2020 (Ducharme, 2020), various major stock market indices around the world declined significantly with 2 largest stock market indices, Dow Jones Industrial Average (DJIA) and S&P 500 having plunged 13.74% and 12.51% respectively over the month of March 2020, "the worst month since October 2008" (Imbert, 2020).

While different sectors, like real estate, tourism, construction, arts and other services, transport, retail, have experienced the negative effects of the pandemic (Canton et al., 2021; European Commission, 2021), there is some ground to believe that specifically the healthcare sector could have experienced the opposite effect. The daily growing number of cases of COVID-19 has created a shortage of medications needed to treat the patients, which in turn led to an increase in demand for them (Bookwalter, 2021). Hence, the author believes that an increase in demand for medications was followed by an increase in sales making the stock prices of public companies operating in the healthcare sector, specifically in the pharmaceutical industry, go up, which could have led to positive stock returns.

Although studies have examined the stock performance of public companies operating in the healthcare sector (Alam et al., 2020; Behera & Rath, 2021; Mittal & Sharma, 2021) and found statistically significant positive stock returns during the COVID-19 pandemic, the findings of Al-Awadhi et al (2020) study turned out to be not statistically significant. In addition, statistical significance of findings was not tested at all in Aravind & Manojkrishnan (2020) study, which leaves us with a question whether public companies operating in the healthcare sector were really able to generate positive stock returns during the COVID-19 pandemic.

The aim of the Bachelor thesis is to clarify whether public companies operating in the healthcare sector managed to produce positive abnormal returns during the first wave of the COVID-19 pandemic. Since, to the best of author's knowledge, the stock performance of listed companies operating in the healthcare sector, specifically pharmaceutical subsector, was not studied within the scope of the European stock market, the author would try to fill in the research gap and evaluate their performance in the example of the German stock market.

The author would complete the following research tasks to achieve the set objective of the Bachelor thesis:

- to summarize the impact of epidemics and pandemics on stock markets
- to give an overview of healthcare sector stocks as defensive stocks

- to analyze studies already conducted on the impact of the COVID-19 pandemic on stock returns of listed companies in the healthcare sector
- to collect daily closing stock prices of public healthcare companies selected for the study and calculate daily abnormal returns followed by average abnormal returns
- to compare the findings of the author's work with the results of similar studies already conducted
- to draw the conclusions on changes in stock returns of publicly listed healthcare companies during the COVID-19 pandemic.

Evaluating stock returns of public companies operating in the healthcare sector during the COVID-19 pandemic could assist policymakers with regards to proper allocation of funds to various sectors during the times of pandemics. The findings of the current study could also be helpful to investors with setting up various portfolio diversification strategies. However, possible limits of my study could be the fact that singling out public companies, which specialize in the pharmaceutical industry alone, is hard, as those same companies could be involved in manufacturing not only drugs or vaccines but also medical equipment or could be operating a chain of private hospitals or clinics, which in turn makes it difficult to see the real effect of the pandemic on the pharmaceutical industry itself. Hence, the author believes much more detailed research needs to be carried out in the future, when the pandemic is fully over, to see the actual impact of the pandemic on the sector.

The following thesis is divided into 2 main parts: theoretical background and empirical analysis. Theoretical background part in turn consists of 3 subchapters, which would provide an overview of the impact of epidemics and pandemics on stock markets, provide a recap of healthcare sector stocks as defensive stocks and their performance during times of crises and lastly, go over earlier research conducted on the subject matter to understand where the current bachelor thesis stands and what aspects of stock performance of public companies operating in the healthcare sector have already been investigated. The second part of the current work is also divided into 3 subchapters, whereby data selection and methodology description, overview of the author's findings and comparison of author's findings with studies already conducted on the topic, would be described one after another.

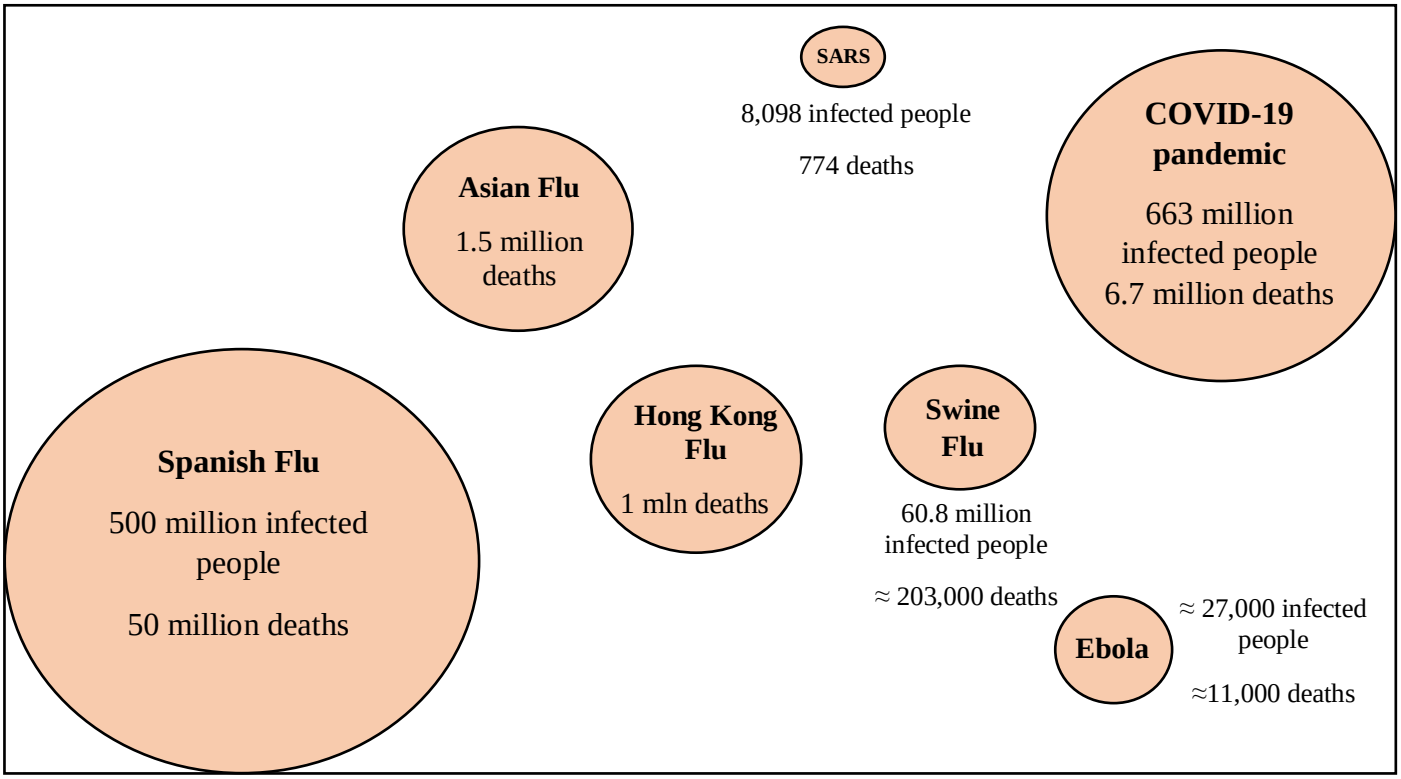
Keywords: COVID-19 pandemic, abnormal returns, stock market, epidemics and pandemics, stock performance, stock return, investor behavior.

1. Stock performance of healthcare sector companies during epidemics and pandemics

1.1. Impact of epidemics and pandemics on stock markets

Market sentiment, also known as „investor sentiment“, which „refers to the overall attitude of investors toward a particular security or financial market“ (Smith & Rhinehart, 2022), have been found to have a significant impact on stock markets. While Kiruba and Vasantha (2021) found that factors, like fear and risk perception, influence investors' decision-making during the times of pandemics, Baig et al. (2021) came to the conclusion that public fear surrounding the pandemic is one of the contributors to market instability and illiquidity. Moreover, negative emotions, pessimism around the pandemic, pandemic-induced fear were found to have a significant negative impact on stock returns (Li et al., 2021; Su et al., 2021; Naseem et al., 2021) making investors more likely to pull out of the stock market during the times of uncertainty. A phenomenon, named herding behavior, whereby within the financial sector, „investors follow what they perceive other investors are doing, rather than relying on their own analysis“ (Hayes et al., 2022) could serve as a possible explanation as to why investors tend to behave the way they do during the times of uncertainty. Pandemic-related risk was found to have a statistically significant impact on the herding behavior of investors as well as stock market analysts. (Abdeldayem & Dulaimi, 2020; Chiang & Lin, 2019) Hence, it increases the chances of investors making either the same or similar investment decisions when market sentiment is high, which cumulatively can have a huge impact on stock market dynamics.

The author would continue providing examples of the impacts of past pandemics and epidemics on stock markets further on to support the claims and assumptions made earlier. The case of the Spanish Flu (1918-1920), Asian Flu (1957-1958), Hong Kong Flu (1967-16-968), SARS outbreak (2002-2003), Swine (H1N1) flu (2009-2010) and Ebola outbreak (2014-2016) would be analyzed (Major epidemics of the Modern Era, 2022). Figure 1 below presents the scope of the impact of epidemics and pandemics experienced so far in the example of the number of infected people and deaths (Spanish Flu (Centers for Disease Control and Prevention (CDCP), 2023); Asian Flu (Asian Flu (1957 Influenza Pandemic), 2023); Hong Kong Flu (CDCP, 2023); SARS (CDCP, 2023); Swine Flu (CDCP, 2023); Ebola (CDCP, 2023)).



Notes. *pr stands for present, since the COVID-19 pandemic is still ongoing

Figure 1. Casualties resulting from the viruses

Source: compiled by the author

While Thompson and Wollscheid (n.d.) find that pandemics alone or not always are the causes of stock market crashes, the author finds opposing results having analyzed other authors' works. Even though S&P 500 index has been pretty stable and positive throughout 1918 to 1919 (Burdekin, 2020) and Dow Jones Industrial Average (DJIA) index was positive during the Spanish Flu, from March 1918 to March 1919 (Thompson & Wollscheid, n.d.), major stock market indices of European countries, like Denmark, Italy, Norway, Sweden, Spain, have demonstarted consistent steep declines throughout the year (Burdekin, 2020). Since the timeline in both studies (Burdekin, 2020; Thompson & Wollscheid, n.d.) coincides with the timeline of World War I to some extent, it makes it harder to see the actual impact of the pandemic on stock markets. However, Angel et al. (2021) find that the pandemic had a significantly negative impact on nine sectoral indices of the US stock market, having analyzed the period from 1918 to 1920 and the Spanish Flu was still a threat until 1920 (Amenabar, 2020). Annual return of the S&P 500 from 1957 to 1958, which is the timeline of

the “Asian flu”, was negative at -6.54%, a similar pattern is observed a decade later during the Hong Kong flu outbreak from 1968 to 1969 (S&P 500 at -3.39% annual return) (Thompson & Wollscheid, n.d.), which is supported by the analysis of Hall et al. (2013) work.

Although Shanghai stock index was increasing up until April 2003, drastic decline was observed from around mid-April of 2003 to May of the same year (Feng & Li, 2021), which coincides with the findings of Chong et al. (2010), Chen et al. (2009) and Chen et al. (2007), who studied the impact of the SARS outbreak on a sectoral level on Chinese and Taiwanese stock markets. Regardless of the difference in the event window selected for each study, cumulative abnormal returns (CARs) of public companies operating in the hospitality industry turned out to be significantly negative especially after April 21/22 of 2003, which was selected as the event day in Chong et al. (2010), Chen et al. (2009) and Chen et al. (2007) works. Since the majority of publicly listed companies researched were companies specializing in managing hotels, because of the imposed travel restrictions, they saw a decline in the number of clients, as a result of which they started offering discounts to customers, which led to decreases in profits or no profits at all were made (Chong et al., 2010; Chen et al., 2009; Chen et al., 2007). In contrast, major stock market indices of countries, like Japan, South Korea, Philippines, Indonesia, Singapore (countries that were also affected by SARS outbreak), stayed positive throughout March to July-end of 2003, while Hong Kong Hang Seng (HKHS) index was negative from March 12 to April 30 of 2003 (Siu & Wong, 2004). One possible assumption that can be derived from the observation is even though the long-term impact of the SARS outbreak was not negative on stock market indices of the affected countries, the short-term impact was certainly reflected in the negative stock market indices of the affected countries. In addition, while stock markets were slowly recovering from the financial crisis of 2008, the outbreak of the Swine (H1N1) flu did affect them with stock markets indices, like DJIA, MSCI, HKHS and Shanghai Composite index, going down from mid-2009 until mid-2010 (Hall et al., 2013).

While both Giudice and Paltrinieri (2017) and Ichev and Marinc (2017) find heavy media coverage of the Ebola outbreak had a negative effect on stock prices of public companies, Ichev and Marinc (2017) found that small-sized publicly listed companies were also more vulnerable to the impact of the Ebola outbreak. Negative CARs were found in public companies operating in US and Europe (Ichev & Marinc, 2017; Schell et al., 2020) with negative CARs of publicly listed companies operating in West African regions being significantly larger in comparison, on the event day of the Ebola outbreak. Since the Ebola

virus was mainly affecting the countries of Guinea, Liberia and Sierra Leone in West Africa (Shang et al., 2021), investors' overreaction to the possible implications of the virus spread in the regions resulted in them pulling their investments out of the stock market (Giudice and Paltrinieri, 2017).

During the COVID-19 pandemic, some of the major stock market indices, like Nikkei 225 of Japan, TPE TAIEX of Taiwan, IMOEX.ME of Russia and GSPTSE of Canada, went significantly down and negative after the event day of January 20 of 2020 (Liu et al., 2020). In additon, during the first few months of the COVID-19 outbreak in 2020, stock market indices, like DAX of Germany, S&P 500, Nikkei 225 of Japan, CAC-40 of France and Korea Composite index, have generated negative mean returns in response to the pandemic (He et al., 2020).

Some of the conclusions that could be drawn from the findings of studies discussed earlier, is negative market sentiment in case of pandemics, namely pandemic-induced fear, risk perception, pessimism around the pandemic, leads to lower stock market returns generated during the pandemic. Furthermore, short-term impact of pandemics on stock markets tends to support the idea that investors tend to overreact to pandemics initially, which can result in market instability in the initial phases of pandemics.

1.2. Rationale behind investing in stocks of healthcare sector companies

Defensive stock is „a stock that provides consistent dividends and stable earnings regardless of the state of the overall stock market" (Chen & Boyle, 2020). Because of their tendency to perform better in relation to the broader market during market downturns, defensive stocks have a lower chance of facing bankruptcy in comparison to other stocks. Stocks of listed companies that produce consumer staples, operate in the healthcare sector (manufacturing drugs, managing a chain of hospitals, laboratories, research facilities), apartment real estate investment trusts (REITs) and water, gas and electric utilities are all examples of defensive stocks, as regardless of the state of the conomy, there is always going to be demand for those products. (Chen & Boyle, 2020) This is in sharp contrast with cyclical stocks, which tend to perform in accordance with market ups and downs (Kavanagh, 2022).

Because of the travel restrictions and lockdowns during the COVID-19 pandemic, the number of flights between countries has decreased significantly affecting the financial performance of airline companies. As stated by Maneenop and Kotcharin (2020) and Atems and Yimga (2021), stock prices of listed airline companies have reacted negatively to the COVID-19 pandemic having declined drastically after the announcement of COVID-19 as a global pandemic. In addition, as found by Yigit and Canoz (2020), stock prices of public

European airline companies have generated statistically significant negative cumulative average abnormal returns (CAARs) at the beginning of the COVID-19 pandemic. Negative reaction of stock prices of public companies operating in the hospitality industry has also been proven by Wu et al. (2021), Lee et al. (2021) in the example of the Chinese stock market and by Lin and Falk (2022) in the example of the Nordic stock market. Stock prices of listed companies operating in sectors, like tourism, transportation and banking, on Chinese (He et al., 2020), Turkish (Ozturk et al., 2020) and Saudi (Sayed & Eledum, 2021) stock markets have demonstrated consistent declines for several days in the post-event period. As it can be seen from the studies, cyclical sectors', like hospitality, transportation, banking and airline, stocks indeed tend to move in accordance with the market condition.

As noted by Glascock (2007), REITs, one example of defensive stocks, tend to have lower betas during bear markets (when the economy is slowing down), meaning those stocks tend to be less volatile in comparison to the overall market, increasing the chances of investors earning long-term gains with lower risk from investing in defensive stocks. Having studied more or less similar periods, Sharma and Banerjee (2015) (from April 2006 to March 2014) and Argule (2012) (from 2000 to 2009) found that stock prices of listed companies operating in sectors, like healthcare, consumer goods and consumer staples, turned out to be less volatile throughout the whole period compared to the overall market with their betas being less than that of the overall market in the example of Indian and Johannesburg stock markets respectively. The findings of both studies serve as good examples of defensive stocks performance during the times of crises, as the financial crisis of 2007-2008 falls in the timeline of both works. Similar findings were uncovered in the work of Artikis et al. (2022), which analyzed the stock prices of listed companies operating in the healthcare sector over the timeline of 1989-2020 in the example of the US stock market. The findings of this paper provide strong evidence of defensive stocks performance during market downturns, as a significant number of financial and health crises, like the Asian financial crisis of 1997 (Carson & Clark, 2013), SARS outbreak of 2002-2003, financial crisis of 2007-2008, Swine (H1N1) flu of 2009-2010, Ebola outbreak of 2014-2016 and COVID-19 outbreak of 2019, have taken place throughout 1989-2020 (Major epidemics of the Modern Era, 2022). While Thorbecke (2021) supported the findings of works by Sharma and Banerjee (2015), Argule (2012) and Artikis et al. (2022) in the example of the Korean stock market during the COVID-19 pandemic, both Salisu et al. (2020) and Liew and Ruah (2020) came to the conclusion that investing in stocks of publicly listed companies operating in the healthcare sector have proven to be good examples of a hedging strategy during economic downturns.

Even though Chong et al. (2010) and Chen et al. (2009) have analyzed the stock prices of listed companies in different sectors, pharmaceutical and biotechnology respectively, during the SARS outbreak, essentially both sectors are part of the healthcare sector, as "biotechnology is a science-driven industry sector that uses living organisms and molecular biology to produce healthcare-related products" (Kagan & Catalano, 2022). Moreover, regardless of the difference in event windows selected for each study, 40 trading days before and after the event in Chong et al. (2010) and 20 trading days before and after the event in Chen et al. (2009), statistically significant positive CAARs have been generated by healthcare sector stocks during the whole event window period, indicating that the healthcare sector stocks have actually benefitted from the SARS outbreak. While Ichev and Marinc (2017) support the findings of Chong et al. (2010) and Chen et al. (2009) in a way that on the event day during the Ebola outbreak, stocks of listed companies in healthcare equipment, pharmaceutical and biotechnology sectors, have generated statistically significant positive returns, not all positive stock returns generated during the event window period during the Ebola outbreak are statistically significant.

Healthcare sector is a broad sector and even though Saltman et al. (2002) and Ledesma et al. (2014) have provided their classifications of the healthcare sector, Healthcare sector (2022) has provided more detailed categorization of the sector, which can be seen from Figure 2.

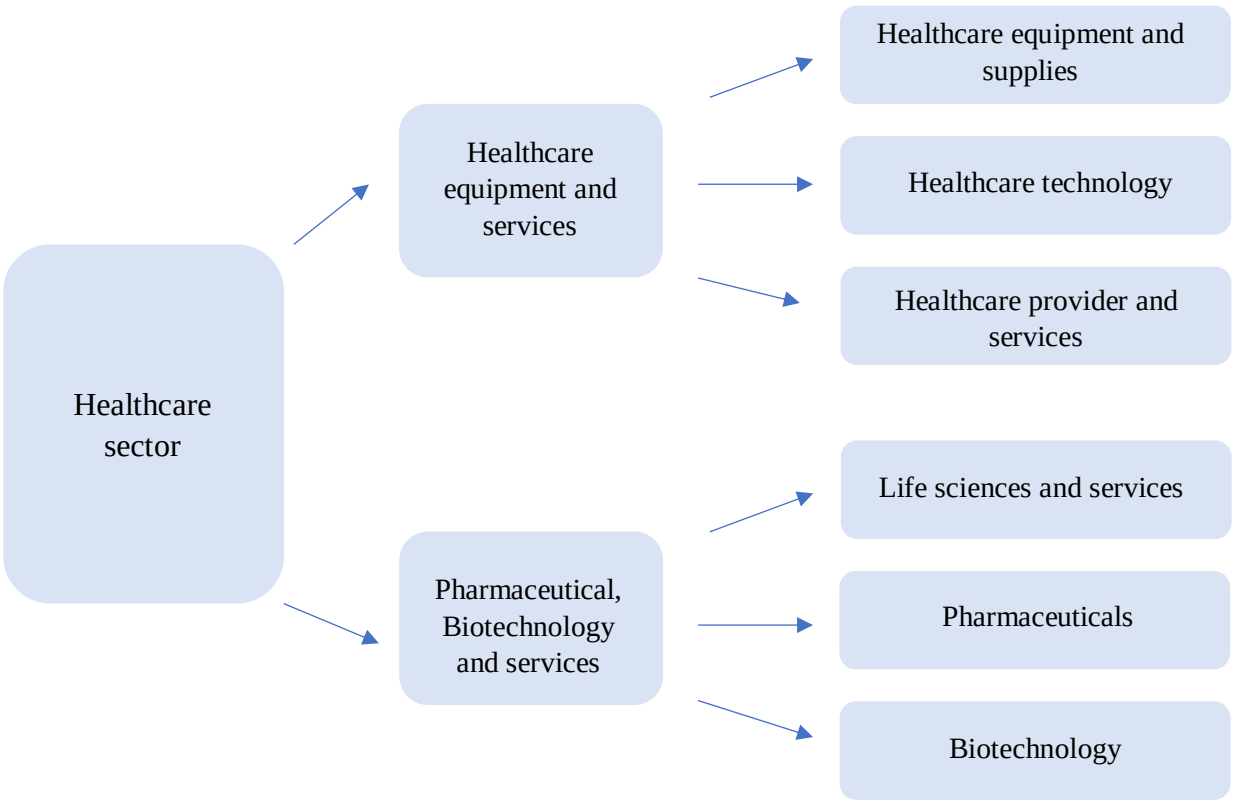


Figure 2. Classification of the Healthcare sector

Source: Healthcare sector (2022)

Opting for the whole healthcare sector and analyzing all the companies operating in the healthcare sector would have been impossible, as there are 784,626 companies registered in the US healthcare sector alone (Smiljanic, 2022). In addition, on average around 200 companies operating in the healthcare sector have been going public on an annual basis since 2015 (Kalia & Rupawala, 2021).

The official definition of the pharmaceutical industry provided by Encyclopedia Britannica is "the discovery, development, and manufacture of drugs and medications (pharmaceuticals) by public and private organizations" (Pharmaceutical industry, 2022). The daily growing number of cases of COVID-19 has created a shortage of medications needed to treat the patients, which in turn led to an increase in demand for them (Bookwalter, 2021). Since pharmaceutical companies are the ones involved in the developmental and manufacturing stages of drugs and medications, the author opted for them to see how their stock prices have performed during the COVID-19 pandemic.

To summarize, investing in the stocks of public companies operating in the healthcare sector can serve as a good hedging strategy during the times of uncertainty, as they are more likely to provide stable and lower risk earnings for investors being an example of defensive stocks. Since the healthcare sector is very broad consisting of several subsectors, the author decided to evaluate the stock performance of publicly listed companies operating in the pharmaceutical industry, representing the healthcare sector, to see if the higher demand in medications since the start of the COVID-19 pandemic could have played a role in those companies' stock performance.

1.3. Stock performance of pharmaceutical companies during the COVID-19 pandemic – results of previous studies

Several studies have been conducted on changes in stock returns of listed companies operating in the healthcare sector during the COVID-19 pandemic (see Table 1). Hence, the author would go through them and analyze their main findings.

Table 1

Results of pharmaceutical stock returns during COVID-19 pandemic

Authors	Period studied	Event day	Stock market	Methodology
Narayan et al. (2021)	01.04.2010-10.09.2020	-	Australia	Quantile regression
Mittal & Sharma (2021)	15.05.2019-24.04.2020	12.03.2020	India	Event study analysis
Aravind & Manojkrishnan (2020)	03.09.2019-28.02.2020	-	India	Event study analysis
Behera & Rath (2021)	03.12.2019-28.05.2020	30.01.2020	India	Event study analysis
Al-Awadhi et al. (2020)	10.01.2020-16.03.2020	-	China	Panel data regression analysis
Alam et al. (2020)	13.02.2020-12.03.2020	27.02.2020	Australia	Event study analysis

Source: compiled by the author

Since both Aravind and Manojkrishnan (2020) and Behera and Rath (2021) have studied Indian public companies operating in the pharmaceutical sector, it's worth pointing out that they analyzed 6 overlapping listed companies, which can be found from Appendix A. While the output for the pre-crisis period for the company of Aurobindo Pharma Ltd in both studies is similar, the results for the post-crisis period is different with the majority of abnormal returns in Behera and Rath (2021) study being positive, while the average abnormal return in Aravind and Manojkrishnan (2020) study is negative. Completely opposite results are also observed in the case of Cipla Ltd, where although Aravind and Manojkrishnan (2020) found positive abnormal returns for both pre-crisis and post-crisis periods, Behera and Rath (2021) study generated the opposite output. In the case of Sun Pharma, even though the pre-crisis period output in Behera and Rath (2021) study is in tune with Aravind and Manojkrishnan (2020) study with the returns being negative, the post-crisis time results are in contradiction to one another. Similar outcomes can be pointed out in the case of Lupin Ltd, Dr. Reddy's Laboratories. The differences in outcomes can be due to the fact that studies chose various time periods for both the pre-crisis period and post-crisis period. As in Aravind and Manojkrishnan (2020) work, the pre-crisis time period is much longer compared to that one of Behera and Rath (2020), meaning a lot more stock prices were involved, which could have affected the returns turning out to be positive or negative.

In the case of Mittal and Sharma (2021) study, which also looked into the stock returns of publicly listed Indian companies, the stock performance was analyzed on a sectoral

level. Hence, while the majority of sectors, including oil and gas, real estate, transport, performed pretty well before the pandemic hit, all of the returns generated from companies operating in all those sectors turned out to be negative during the post-event period from February 1, 2020 to April 24, 2020, except for the positive returns generated from companies operating in the healthcare sector during the same time period, therefore, proving the point the author was making earlier about the possibility of public companies in the healthcare sector having performed well during the pandemic in contrast to other sectors. Nevertheless, though both Aravind and Manojkrishnan (2020) and Behera and Rath (2021) studies both found negative abnormal returns for some companies during the post-crisis period, which is in complete contrast to the findings of Mittal and Sharma (2021), it is worth mentioning that Mittal and Sharma (2021) studied the stock performance of public companies in the example of all listed companies in the healthcare sector, whereas Aravind and Manojkrishnan (2020) and Behera and Rath (2021) sample sizes were not big enough, each study having covered 10 and 9 public pharmaceutical companies respectively. And the healthcare sector is a broad sector and different companies specializing in various activities, like producing drugs, medical equipment, providing medical insurance, managing a chain of hospitals, clinics, labs, are part of the healthcare sector as well. Hence, the possibility of getting more positive stock returns increases when listed companies operating in a variety of medical fields are included in the study, as during the COVID-19 pandemic the demand for not only producing and selling medical drugs, which is considered to be the main specialty of companies operating in the pharmaceutical sector, but also medical equipment, medical treatment at hospitals, tests at clinical labs has significantly increased.

While Alam et al. (2020) work is similar to that one of Mittal and Sharma (2021) in a way that both studies have examined the stock returns of public companies on a sectoral level, Alam et al. (2020) studied stock returns of pharmaceuticals and healthcare as separate sectors. Regardless of that, the stock performance of public companies based in Australia is not any different than those of based in India, in a way that sectors, like real estate, transportation, especially the energy sector, have experienced the negative impact of the COVID-19 pandemic by generating negative abnormal returns during the window period (February 12, 2020 to March 12, 2020). Although during the post-event period (February 12, 2020 to february 26, 2020) listed companies operating in both pharmaceutical and healthcare sectors have generated quite a few negative stock returns, they were able to recover quickly having generated positive stock returns on 9 out of 10 days in the window period for the healthcare sector and 8 days for the pharmaceutical sector. The findings of both Alam et al.

(2020) and Mittal and Sharma (2021) works can be supported by the ones in Narayan et al. (2021) study, where it was found that the healthcare sector along with other sectors, like consumer staples and information technology, performed well during the pandemic in contrast to sectors, like energy, communications and consumer discretion.

It is interesting to observe that despite the negative correlation found between the stock returns of companies listed on the Chinese stock exchange and daily growth in confirmed COVID-19 cases and daily growth in COVID-19 fatalities, Chinese public companies specializing in medicine manufacturing were able to generate significantly positive stock returns during the time period selected for the study. Almost analogous results are observed in companies specializing in providing health and nursing services, except the positive stock returns calculated did not turn out to be statistically significant (Al-Awadhi et al, 2020). Since the time period being analysed comes down to the beginning stages of the COVID-19 pandemic spread in China (from January 10, to March 16, 2020), one assumption is the demand for medical drugs was higher at the time than for other medical services, meaning companies specializing in producing medical drugs were able to generate more profits that other companies in the medical field owing to an increased demand for medical drugs. Nevertheless, the findings of the study by Al-Awadhi et al (2020) are analogous to the ones of Mittal and Sharma (2021) and Alam et al. (2020) in a way that the healthcare sector outperformed other sectors, like transportation, hotels, during the pandemic.

Based on the findings of studies discussed earlier, being an example of defensive stocks, stocks of listed companies operating in the healthcare sector have performed better compared to stock performance of public companies specializing in other sectors, like the energy sector, transportation and hospitality, during the COVID-19 pandemic. However, even though most of the studies mentioned have found positive stock returns for public companies operating in the healthcare sector, the author believes it is still early to make certain conclusions as the stock performance of publicly listed companies operating in other continents, like Europe or America, have not yet been confirmed. Therefore, the author believes analyzing public companies in other countries, besides, China, India and Australia, would give more insight into the stock performance of listed companies in the healthcare sector.

2. Abnormal stock returns of German pharmaceutical companies – empirical analysis

2.1. Data and methodology

Stocks of public companies operating in the healthcare sector have performed relatively better compared to the general market during the COVID-19 pandemic (Reiff, 2022), especially the biotechnology subsector, which has seen an immense amount of capital invested into since the start of the pandemic (Lovelace & Towey, 2021). However, the author decided to select the pharmaceutical subsector to see if there were any significant changes in the stock performance of listed companies operating in the pharmaceutical industry, as the beginning of the COVID-19 pandemic was followed by shortages of not only medical equipment but also pharmaceuticals (Aeppel, 2021; Khot, 2020), which makes the author believe an increase in demand for them could have led to an increase in capital invested in the sector, eventually resulting in higher stock prices. In addition, the healthcare sector is very broad consisting of several subsectors (Healthcare sector, 2022) with 784,626 companies operating in US alone (Stasha, 2022), 570,458 companies in Germany alone (Healthcare companies Germany, 2022) and so many more in other countries, making it harder to analyze the whole industry.

To the best of author's knowledge, companies listed on European stock markets have not yet been analyzed on their stock performance during the COVID-19 pandemic, which is why it was chosen for the author's work. Since the majority of public pharmaceutical companies based in Europe were listed on German stock markets, the author decided to evaluate the stock performance of public pharmaceutical companies during the COVID-19 pandemic in the example of the German stock market. The companies were selected out from companiesmarketcap.com website and based on the availability of data for the period selected for the study (January 29, 2020 to April 27, 2020), 25 public pharmaceutical companies listed on various German stock markets, like Frankfurt stock Exchange, Berlin stock Exchange, XETRA stock Exchange and Munich stock Exchange, were selected for the current study (see appendix B).

The timeline for the study was selected based on the Event Study Methodology (ESM), one of the most common analysis methods used to assess the impact of significant (company earnings announcements, initial public offerings, major catalysts) events on securities of companies (Ullah et al., 2021; Kliger & Gurevich, 2014). Event study methods are often used to put the Efficient Market Hypothesis (EMH) to the test, as according to EMH stocks tend to immediately reflect all the available information in their prices (Kothari & Warner, 2006). Hence, the event study analysis is oftentimes employed to see if some major events, like the outbreak of some infectious diseases or company mergers and acquisitions, impacted the stock prices of public companies and generated certain abnormal returns for

companies. As during the times of crisis investors tend to become risk-averse, switch to safer stocks, or pull out of the market until market recovery, which in conjunction with investor's herding behavior tend to lead to major positive or negative market changes depending on the event (Hoffmann et al., 2013; Papaioannou et al., 2013).

Furthermore, „an abnormal return describes the unusually large profits or losses generated by a given investment or portfolio over a specified period". The abnormal return can be both negative and positive and is the „one that deviates from an investment's expected return". Abnormal return is the difference between the actual realized return and the expected return. (Barone & Estevez, 2021) From this point on, when referring to abnormal returns, the author refers to abnormal stock returns of public pharmaceutical companies.

Daily stock prices of all 25 listed pharmaceutical companies were collected from Yahoo Finance website for the time period of January 29, 2020 to April 27, 2020. Since not all public companies pay out dividends, the author proceeded with daily closing prices not adjusted for dividends. Followingly, daily stock returns were calculated in Excel using the following formula:

$$R = ln\frac{P_t}{P_{t-1}} \qquad (1)$$

where R equals daily stock return, P_t is the price of a stock on day t and P_{t-1} is the price of a stock on day t-1 (day before).

The reason why the author decided to proceed with daily data rather than monthly or yearly is because daily data enables more accurate assessment of abnormal stock returns of companies. In addition, since long-horizon event study tests are more sensitive to risk adjustments than short-horizon ones, where according to Kothari and Warner (2006, p.25) „errors in adjusting for risk would not lead to significant errors in calculating abnormal performance of stocks" and also since the choice of one specific model for the calculation of expected returns still seems to be an issue in long-horizon ones, as depending on the choice of the model, the results might vary; the author opted for a short-horizon time line, which is roughly 2 months in the case of the study. (Kothari & Warner, 2006)

In ESM after selecting the event, which could affect or could have affected the stock prices of public companies, an event day needs to be selected, which is essentially the day when the event under observation was announced or started. Afterwards, an event window needs to be selected, which is usually 10 or 20 days before and after the event announcement. Hence, the whole timeline is divided into 2 parts, before and after the event day to see if there are any significant changes in stock prices or returns during both periods. (MacKinlay, 1997)

In the current study, the event is the COVID-19 pandemic and even though the event started in China in December of 2019 (CDCP, 2022), because it did not reach Europe at the same time, the author decided to choose the date of March 11, 2020, which is when COVID-19 was officially declared a global pandemic by WHO (Ducharme, 2020). As for the event window time period, the author decided to select 30 days for pre and post-event days separately (from January 29, 2020 to April 27, 2020) in an attempt to get a better overview of stock performance of public pharmaceutical companies.

Since the aim of the following bachelor thesis is to evaluate the stock performance of publicly traded pharmaceutical companies to see whether they were able to outperform the general market during the first wave of the COVID-19 pandemic by having generated positive abnormal returns, the author further calculated abnormal returns using the following formula:

$$AR_t = R_t - R_{mt} \quad (2)$$

where AR_t is the abnormal return on day t, R_t is the return on day t and R_{mt} is the benchmark (market) index return on day t.

Added to that, since the author is analyzing the stock performance of public companies listed on the German stock market, the DAX index was selected as the benchmark index for the study. DAX index is the „benchmark index for the German equity market, which tracks the performance of 30 selected German blue chip stocks traded on the Frankfurt Stock Exchange, which represent around 80 percent of the market capitalization listed in Germany“ (Germany stock market index (DE40), 2022). Since daily index returns are needed for the calculation of the abnormal return, daily returns were calculated for the index too, the same way as it was for company daily returns. Followingly, daily abnormal returns for the whole event window was calculated as the difference between company daily returns and index daily returns. Abnormal return is calculated this way to see if the stocks of listed pharmaceutical companies outperformed the general market, as the positive difference woud indicate the stock returns of public pharmaceutical companies were higher compared to returns generated by the benchmark index, whereas the negative difference would indicate the benchmark index returns were higher than public pharmaceutical company ones.

After having calculated daily abnormal returns, average abnormal returns (AAR) were calculated for both pre and post-event periods to conduct the Dependent samples t-test. To further test if average abnormal returns during pre and post-event periods were any diferent from each other, the author used the Dependent samples t-test in SPSS. Since studies conducted before on stock performance of public companies operating in the healthcare

sector during the COVID-19 pandemic, which used the event study methodology, have generated results differing from each other, the author decided to use a different analysis method to see if it would lead to different results.

To further proceed with the Dependent samples t-test, hypotheses were set up to see if the differences between pre and post-event average abnormal returns were statistically significant.

H_0: pre-event average abnormal return is equal to post-event average abnomal return

H_1: pre-event average abnormal return is not equal/different from post-event average abnormal return

Figure 3 below provides a brief overview of the methodology selection for the author's work.

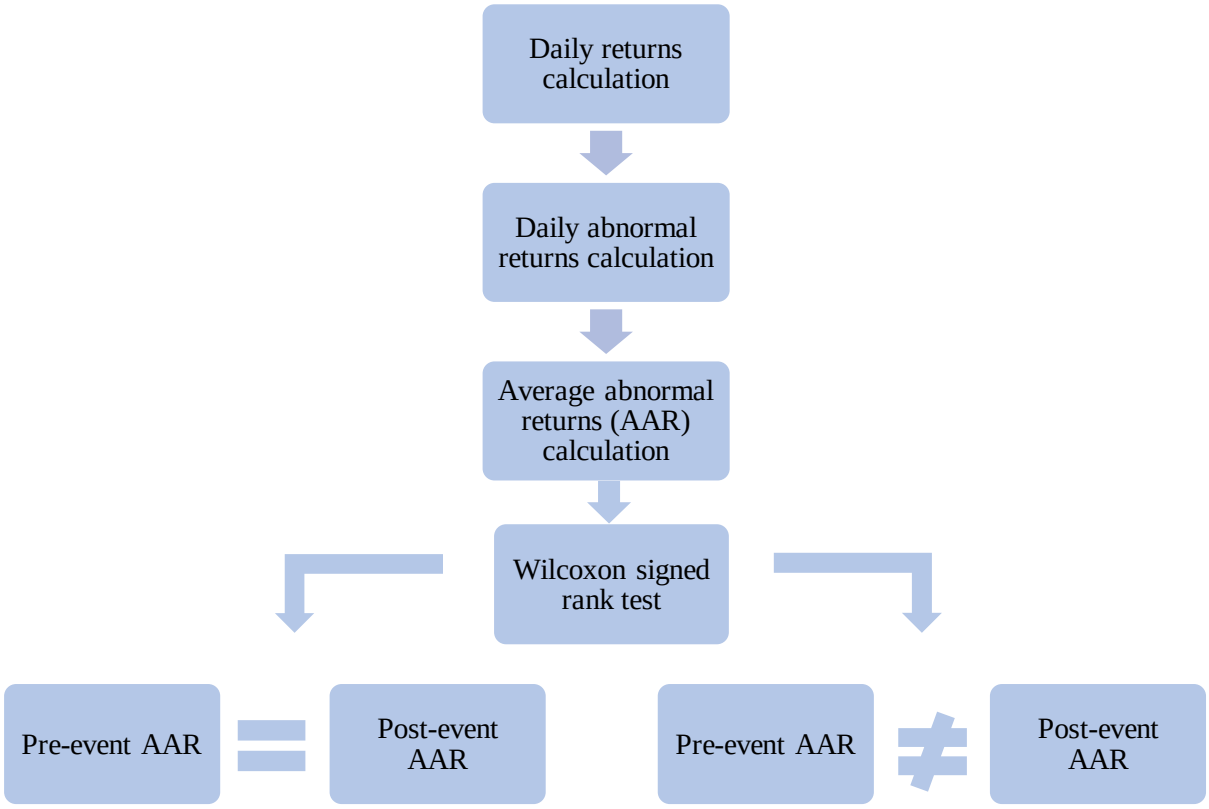


Figure 3. Brief overview of methodology selection

Source: compiled by the author

Since there are a number of assumptions that need to be verified in the data first before conducting the Dependent samples t-test, the author checked whether they were met in the analysis or not. In the case of the Dependent samples t-test, the assumptions are the following: the dependent variable is continuous, there are no outliers in the data, dependent

variable is approximately normally distributed. While the dependent variable is continuous in the data, there were some outliers in the data and the dependent variable was not normally distributed. In addition, since the sample size in the current study is not that big (25), a non-parametric equivalent of the Dependent samples t-test, which is Wilcoxon signed rank test, was selected to further continue with the analysis. 0.05 significance level was used in the author's work to see if the pre-event average abnormal returns are equal to post-event average abnormal returns of public German pharmaceutical companies.

2.2. Results of empirical analysis

Before conducting the Wilcoxon signed rank test, descriptive statistics for author's sample was compiled with minimum and maximum average abnormal returns having been presented separately for pre and post-event periods, which can be seen from Appendix C. Based on Wilcoxon signed rank test findings (see Table 2 and Appendix D), asymptotic significance value is equal to 0.093, which is higher than 0.05, meaning we accept H_0, whereby it states that pre-event average abnormal returns are equal to post-event average abnomal returns. Hence, author's findings are not statistically significant in the example of public pharmaceutical companies listed on German stock exchanges. Such outcome might be due to the selection of daily observations, whereby the differences in stock prices could have been insignificant, rather than monthly or yearly observations, and also the timeline selected for the study could have played a role in abnormal returns differences turning out to be not statistically significant.

Table 2

Wilcoxon signed rank test results

Null Hypothesis	Test	Sig.	Decision
The median of differences between Pre-vent and Post-event equals 0	Related-Samples Wilcoxon Signed Rank Test	0.093	Retain null hypothesis

Source: compiled by author

It is interesting to note that the average abnormal returns percentage changes for both pre-event and post-event periods are positive in the case of 12 of the companies (see Table 3). Each one of the below mentioned companies were one way or another involved in the COVID-19 pandemic either through expenses in the form of donations to COVID-19 patients or through increased sales of products due to increased demands.

Table 3

Positive average abnormal returns percentage changes

Company	Pre-event average abnormal return (AAR)	Post-event average abnormal return (AAR)
Ascendis Pharma	0.03%	0.08%
Astellas Pharma	0.13%	0.22%
Avadel Pharmaceuticals	0.71%	0.80%
Bristol Myers Squibb	0.12%	0.10%
Cosmo Pharmaceuticals	0.13%	0.07%
Eli Lilly	0.32%	0.18%
Evotec	0.03%	0.01%
Galapagos	0.03%	0.20%
Merck	0.09%	0.01%
Perrigo	0.10%	0.09%
Pfizer	0.03%	0.14%
Takeda Pharmaceutical	0.15%	0.07%

Source: compiled by author

To illustrate, Evotec was involved in the „manufacture of monoclonal antibodies against COVID-19“ (Evotec, 2020, p.30) and during the first 2 quarters of 2020, Evotec shares outperformed the benchmark indexes, like MDAX and TecDAX (Evotec, 2020). In the case of Avadel Pharmaceuticals, net income per share was not only higher but also positive in 2020 compared to negative ones in both 2019 and 2018 (Avadel Pharmaceuticals pls, 2020). Merck was one of the many companies heavily involved in the research and development of COVID-19 vaccines, working with different partners and labs (Sagonowsky, 2020). All this involvement got reflected in company's net sales in 2020, which saw an increase of 8.6% compared to the year before. In addition, earnings per share saw an increase of 50.3% compared to 2019, amounting to €4.57 in 2020. (Merck, 2020) Perrigo saw an increase in demand in March and April of 2020 for some of it's products, like OTC and infant nutrition products, which they „attributed to consumer reaction to the outbreak of COVID-19“ (Perrigo, 2020, p.6). The company also noted that the „demand for certain products in our pain and sleep-aids and vitamins, minerals and supplements ("VMS") categories increased“, which they also linked to „consumer dynamics related to the COVID-19 pandemic“ (Perrigo, 2020, p.10). Added to it, earnings per share of the company were much higher during the first quarter of 2020 compared to the rest of quarters or even a year earlier (Perrigo, 2020). Although earnings per share (EPS) is not the same as stock prices, a positive correlation between the 2 has been established, indicating that an increase in EPS would also increase the stock price of a company (Agrawal & Bansal, 2021). Besides being a generic drug manufacturer, Pfizer is also involved in the biotechnology sector, which contributed heavily to company's revenues due to the development of the COVID-19 vaccine. The company

made a net profit of $9.1 billion through the sale of drugs and the COVID-19 vaccine. (Kollewe, 2022)

Nevertheless, while the COVID-19 related dynamics could have played a role in generating excess profits and returns for companies, the author believes it might not be the only reason why the pandemic could have played out well for them. The author believes the firm size and age could have played in favor of the companies. Several studies have found that firm size has a positive effect on firm profitability in the example of publicly traded companies (Sritharan, 2015; Akbas & Karaduman, 2012; Dogan, 2013) and age of companies seemingly also has an effect on company's financial performance, meaning older firms tend to have higher profits and lower debt levels as they age (Coad et al., 2010). The majority of the above mentioned companies were established during 1850s-70s (Perrigo (A history of convenient healthy solutions, 2022), Pfizer (Company timeline, 2022), Bristol Myers Squibb (A heritage of improving lives, 2022) and Eli Lilly (About Lilly, 2022)), during 1990s (Evotec (History, 2022) and Cosmo Pharmaceuticals (History, 2022)), if not earlier (Takeda Pharmaceuticals in 1781 (History, 2022) and Merck in 1668 (History, 2022)). Moreover, having acquired other pharmaceutical companies the majority of above mentioned companies have subsidiaries in different countries, which are listed on several stock exchanges. Added to it, some of the above listed companies operate in other subsectors besides the pharmaceutical one, which, as the author believes, could be another one of the reasons behind companies' positive AARs during both pre and post-event periods.

On the other hand, some pharmaceutical companies (see Table 4) have generated negative AARs during both pre and post-event periods. Due to the COVID-19 pandemic rapid spread Amarin had to stop the launch of one of it's most promising drugs (Vascepa), which was about to positively affect the financial performance of the company. In addition, the drug itself proved to be ineffective in treating COVID-19 patients, further jeopardizing Vascepa sales. (Blankenship, 2020; Urquhart, 2021) In the case of Amneal Pharmaceuticals, as mentioned in the company's annual report of 2020, because of the disruptions in supply and manufacturing of drugs, the company experienced lost sales, further affecting the company's market capitalization (Amneal Pharmaceuticals, Inc., 2020). The same pattern was observed in the case of Jazz Pharmaceuticals and Faes Farma (Jazz Pharmaceuticals, 2020; Faes Farma, 2020).

Table 4

Negative average abnormal returns precentage changes

Company	Pre-event AAR	Post-event AAR
Amarin Corporation	-0.23%	-0.86%
Amneal Pharmaceuticals	-0.25%	-0.17%
Faes Farma	-0.04%	-0.06%
Jazz Pharmaceuticals	-0.09%	-0.18%

Source: compiled by author

Despite the differences in AARs during both pre and post-event periods for some companies, it is interesting to note that the majority of companies (18 of them) generated positive AARs during the whole event window period (60 days), while only 7 of them generated negative AARs during the event window period (see Table 5).

Table 5

AARs percentage changes during the whole study period (60 days)

Company	AARs
Alk-Abello	0.07%
Alkermes	0.08%
Amarin	-0.55%
Amneal	-0.21%
Ascendis Pharma	0.06%
Aspen Pharmacare	-0.12%
Astellas Pharma	0.17%
Avadel Pharmaceuticals	0.76%
Bayer	0.01%
Brilstol Myers Squibb	0.12%
Cosmo Pharmaceuticals	0.10%
Eisai Co	0.02%
Eli Lilly	0.25%
Endo	-0.05%
Evotec	0.02%
Faes Farma	-0.05%
Galapagos	0.11%
Gedeon Richter	0.04%
Gilead Sciences	0.24%
Jazz Pharmaceuticals	-0.13%
Merck	0.05%
Perrigo	0.09%
Pfizer	0.09%
Takeda Pharmaceutical	0.12%
Verona Pharma	-0.41%

Source: compiled by the author

Hence, while one cannot deny the negative impact of the COVID-19 pandemic on the German stock market, in general, during the first wave of the COVID-19 pandemic public

pharmaceutical companies listed on the German stock market, generated higher returns compared to the benchmark index of DAX due to several reasons, some of them being the increased demand for drugs, firm size and age of the company under observation.

2.3. Discussion of results

In Alam et al. (2020) study, whereby the performance of listed companies operating in healthcare or pharmaceutical industry were tested out separately, statistically significant positive ARs were observed on the event day, which coincides with the positive ARs in the case of 20 of public companies (see Table 6) in the author's work despite the difference in the selection of the event day. While in Alam et al. (2020) study publicly traded companies operating either in the healthcare or pharmaceutical sectors have generated more positive ARs in the post-event period compared to the pre-event period, in author's work the majority of companies have generated more or less the same number of both positive and negative ARs in both pre and post-event periods. The difference between the author's work and Alam et al. (2020) study could be explained by the difference in the timeline selected for the study. The number of COVID-infected people started growing drastically from mid-March of 2020 in Australia (Total Coronavirus cases in Australia, 2022) and the last day under observation in Alam et al. (2020) study is March 12, which makes the author believe public pharmaceutical and healthcare companies in Australia were not heavily exposed to COVID-19 yet, which could explain 8 (out of 10 observations) positive ARs generated in the post-event period. As one interesting observation found from the author's analysis is some German listed pharmaceutical companies were generating negative ARs for several days in a row after the event day before slowly recovering and generating positive ARs. However, as noted in The first year of COVID-19 in Australia (2022) and the Effects of COVID-19 on Australia (2022), COVID-19 burden for Australia in 2020 was relatively modest compared to the rest of the world.

Table 6

Event day ARs percentage changes

Company	Event day AR (11.03.2020)
Alk-Abello AS	2.94%
Alkermes plc	1.70%
Amarin	1.53%
Amneal Pharmaceuticals	6.91%
Aspen Pharmacare	4.15%
Avadel Pharmaceuticals plc	2.63%
Bristol Myers Squibb	3.21%
Eisai Co	4.64%
Eli Lilly	2.01%
Evotec	3.06%
Faes Farma	2.43%
Galapagos	0.72%
Gedeon Richter	5.19%
Gilead Sciences	4.41%
Jazz Pharmaceuticals	5.22%
Merck	2.06%
Perrigo	2.60%
Pfizer	2.91%
Takeda Pharmaceutical	1.53%
Verona Pharma	4.20%

Source: compiled by author

Mittal and Sharma (2021), who analysed the stock returns of listed healthcare companies over a longer timeline/event window (from May 16, 2019 to April 24,2020), found that the mean returns for both pre and post-event periods is positive, which again conincides with the author's findings in the case of 20 listed pharmaceutical companies (see Table 4). While the findings are similar, it is worth pointing out that not only the longer timeline played a role in the outcome generated by Mittal and Sharma (2021) but also the fact that they analysed the whole healthcare sector, which consists of several subsectors. Hence, the author believes the increased demand for various medical essentials, ranging from medical equipment to pharmaceuticals, has played a role in generating positive mean returns for both pre and post-event periods. Furthermore, the post-event period in Mittal and Sharma's work (2021) was followed by an abundance of positive ARs, especially during April month of 2020, which coincides with March-end to April-start in the case of the author's analysis, both indicating that stock returns of pharmaceutical and healthcare sector started slowly recovering from April of 2020.

Despite the difference in the timeline selected for the analysis in Manojkrishnan and Aravind's study (2020) and author's work, 3 months and 1 month respectively, selected for

both pre and post-event periods, both studies have found companies that generated positive AARs during both pre and post-event periods: 11 companies in author's analysis and 2 companies in Manojkrishnan and Aravind's study (2020). Lupin Ltd and Sun Pharmaceutical ltd went from generating negative AARs in the pre-event period to positive AARs in the post-event periood (Manojkrishnan and Aravind, 2020), which is similar in the case of Ascendis Pharma AS and Endo International in author's analysis. While Manojkrishnan and Aravind (2020) point out „the brand presence and investor's trust and strong supply chain management" (p.34) as some of the leading contributors to positive AARs for companies in the post-event period, in the case of Endo International, it was established that while the beginning of the first quarter of 2020 was followed by decreased sales of some of their products (XIAFLEX and SUPPRELIN LA), late first quarter of 2020 has seen an increase in sales in some of their products, like VASOSTRICT, all due to changes in consumer demand during the COVID-19 pandemic (Endo International, 2020).

It is interesting to note that in Behera and Rath's study (2021) 7 out of 9 public pharmaceutical companies generated negative ARs on the event day, which is around 78% of companies in the study. In author's work, only 20% of companies generated negative ARs on the event day, while the rest 80% (20 companies) generated positive ARs on the event day. Such difference might be due to the selection of the event day: the author believes that because news related to the spread of the COVID-19 pandemic was already circulating in media, investors could have been prepared by having taken the steps already (investing in the pharmaceutical industry) by the time the pandemic was officially declared one by WHO on March 11, 2020 (Ducharme, 2020), whereas in India because the first COVID-19 case got registered on January 30 of 2020 (event day in Behera and Rath's study (2021)), it could have come as a shock to investors, which could have got reflected on stock prices of pharmaceutical companies listed on the Indian stock market.

Covering more or less the same timeline as in the author's work, publicly traded companies listed on the Chinese stock market operating in drug manufacturing and health & nursing services have outperformed the general market by having generated higher returns (Al-Awadhi et al., 2020), indicating once again that during the first wave of the COVID-19 pandemic the healthcare sector have outperformed the market on several stock markets around the world. Some reasonable conclusions can be derived from the findings of Narayan et al. (2022), whereby stock returns of public companies (listed on the Australian stock market) operating in the healthcare sector has been analysed over a timeline of a decade (from 2010 to 2020). It was found that the stock returns of listed healthcare companies were

positive throughout the decade regardless of the quantiles the results were in and since outbreaks of several infectious diseases, like Swine (H1N1) flu in 2009-2010, MERS outbreak in 2012, Ebola during 2014-2016 (Major epidemics of the Modern Era, 2022), happened during that decade, it is worth pointing out that despite the outbreaks of several infectious diseases, the healthcare sector has performed better than other sectors.

Even though the differences in AARs in both pre and post-event periods based on the results of Wilcoxon signed rank test did not turn out to be statistically significant, 12 of the analyzed public pharmaceutical companies have generated positive AARs in both pre and post-event periods, while 18 out of 25 publicly traded pharmaceutical companies generated positive AARs during the whole study period (60 observations). While the majority of the public pharmaceutical companies listed on the German stock market were one way or another affected by the COVID-19 pandemic either through decreased sales volume of some drugs or increased sales volume due to changes in consumer demands, the author believes COVID-19 pandemic is not the only reason behind the ARs generated. It was discussed that factors, like firm size, age of the company and involvement in other healthcare subsector activities, could have also played a role in company's stock performance. In addition, although not all the findings generated by other authors and by the author of the current study as well did not turn out to be statistically significant, a general pattern got formulated based on the results, which states that regardless of the stock market, listed companies operating in the healthcare sector for the most part have outperformed the general market having generated higher positive ARs during the first wave of the COVID-19 pandemic.

While the stocks of public companies operating in the healthcare sector in the example of the pharmaceutical subsector on average have outperformed the general market during the first wave of the COVID-19 pandemic based on the author's findings, there is some ground to believe that stock performance of listed companies operating in other subsectors of the healthcare sector could have been similar, especially in the case of the biotechnology subsector. Since the start of the COVID-19 pandemic, „more than 5.51 billion people worldwide have received a dose of a Covid-19 vaccine", making up roughly 70% of the world's population (Holder, 2023), meaning sales of public companies involved in vaccine development and manufacturing, which is some of the main specializations of companies in the biotechnology sector, have gone up getting reflected in their financial performance. Moreover, having some insights from the stock performance of listed companies operating in the healthcare sectors of Chinese, Indian, Australian and German stock markets, one conclusion that could be drawn is stock performance of public companies

specializing in the healthcare sector has been more or less the same in all stock markets across countries during the first wave of the COVID-19 pandemic, considering the pandemic has affected the whole world one way or another. As for the stock performance of public companies in the healthcare sector after the study period, the author believes stock returns could have gone up even more, considering the number of COVID-19 cases started increasing significantly from 2021 (Cumulative confirmed COVID-19 cases, 2023), meaning the demand for them could have increased accordingly getting reflected on companies' financial performance.

Conclusion

During the times of pandemics or epidemics, when there is a lot of uncertainty involved, fear-induced behavior around the pandemic tends to serve as one of the leading factors affecting investor's decision-making, which oftentimes has a negative impact on market stability. Hence, it comes as no surprise that during the times of crises stock markets tend to be volatile or illiquid with some major stock market indices going down. In addition, while stock markets do tend to recover from the negative effects of pandemics in the long-run, short-term negative impacts of pandemics usually get reflected in decreased stock market returns for investors.

Serving as an example of defensive stocks, stocks of public companies operating in the healthcare sector have proven to be more stable and reliable to invest in during the times of economic and health crises, ranging from the financial crisis of 2007-2008 to outbreaks of several infectious diseases. While there is always going to be demand for the products and services offered by the healthcare sector, one possible explanation for the stable performance of stocks of listed healthcare companies during the times of pandemics is the increased demand for products of the healthcare sector, which leads to increased sales for companies further on getting reflected on companies' stock prices.

Based on the findings of studies that analysed the stock performance of public companies operating in the healthcare sector during the COVID-19 pandemic, certain assumptions could be made:

- regardless of the timeline selected for the analysis, during the first wave of the COVID-19 pandemic stocks of listed companies in the healthcare sector have performed better compared to other sectors or the general market
- regardless of the difference in the selection of stock markets, stocks of publicly traded companies in the healthcare sector have proven to be good investments in the times of crises in the example of Indian, Australian and Chinese stock markets.

Since the stock performance of public healthcare companies during the first wave of the COVID-19 pandemic have not yet been analyzed in the example of the European stock market to the best of author's knowledge, the author decided to analyse them to see if their performance would be any different from the findings of other studies. Added to that, analysing the stock performance of all public companies in the healthcare sector requires a lot of resources, considering the healthcare sector is very broad consisting of several subsectors, which is why the pharmaceutical subsector has been selected as the primary study group representing the healthcare sector. Since the majority of public pharmaceutical companies were listed on different German stock markets, daily stock returns of German-based publicly traded pharmaceutical companies were calculated along with daily ARs as the difference between companies' daily returns and daily returns generated by the benchmark index of DAX representing the German stock market. Furthermore, to see if AARs generated in the pre-event period were any different from AARs in the post-event period, Wilcoxon signed rank test has been conducted, since some of the assumptions were not fulfilled for the selection of the Dependent samples t-test.

Although the differences in AARs in pre and post-event periods did not turn out to be statistically significant based on Wilcoxon signed rank test results, it got established that 12 of public companies generated positive AARs during both pre and post-event periods, while 18 out of 25 of selected companies generated positive AARs during the whole study period. Even though there were some differences in the findings of the author's work and the studies already conducted on the stock performance of public healthcare companies during the first wave of the COVID-19 pandemic due to the differences in the selection of the study period or companies, it was observed that on average the stocks of public companies operating in the healthcare sector have performed better either compared to other sectors or the general market, indicating once again that stocks of public healthcare sector companies could serve as good investment options for investors during the times of crises and also for portfolio diversification purposes. While the COVID-19 pandemic did play a role in healthcare sector companies' stock performance directly or indirectly via the increased or decrased sales volumes, it was also observed that involvement of companies in other subsectors, firm size and age could have been some of the other factors that played a role in companies' stock performance.

Since the findings of the author's work did not turn out to be statistically significant, the author believes further research needs to be conducted to get a better understanding of the stock performance of public companies operating in the healthcare sector. Maybe analysing

the stock performance of listed healthcare companies over the timeline of 2 years (2020 to 2022) could provide interesting results considering there were several phases of the pandemic so far and a lot of people got vaccinated, which could have affected companies' sales volumes.

References

1. A heritage of improving lives through innovation. (2022). Bristol Myers Squibb. Retrieved from https://www.bms.com/about-us/our-company/history-timeline.html.
2. A history of convenient healthy solutions. (2022). Perrigo. Retrieved from https://www.perrigo.com/history-convenient-healthy-solutions.
3. Abdeldayem, M.M., & Dulaimi, S.H.A. (2020). Investors' herd behavior related to the pandemic-risk reflected on the GCC stock markets. *Journal of Economics and Business: Proceedings of Rijeka, 38*(2), 563-584.
4. About Lilly. (2022). Lilly. Retrieved from https://www.lilly.com/who-we-are/about-lilly.
5. Aeppel, T. (2021). *COVID creates shortages of an array of US medical supplies.* Retrieved from https://www.reuters.com/world/the-great-reboot/covid-creates-shortages-an-array-us-medical-supplies-2021-09-20/.
6. Agrawal, O.P., & Bansal, P.K. (2021). A critical study on relationship of EPS and stock price. *Materialstoday: Porceedings, 37*(2), 3011-3015.
7. Akbas, H.E., & Karaduman, H.A. (2012). The effect of firm size on profitability: an empirical investigation on Turkish manufacturing companies. *European Journal of Economics, Finance and Administrative Sciences, 55*, 21-27.
8. Amenabar, T. (2020, September 3). „*The 1918 flu is still with us": The deadliest pandemic ever is still casuing problems today*. Retrieved from https://www.washingtonpost.com/history/2020/09/01/1918-flu-pandemic-end/.
9. Amneal Pharmaceuticals, Inc. (2020). *Annual report.*
10. Angel, M.D., Fohlin, C., & Weidenmier, M.D. (2021). Do Global Pandemics matter for stock prices? Lessons from the 1918 Spanish Flu. *National Bureau of Economic Research.*
11. Arguile, W.P. (2012). Performance of defensive shares on the JSE during financial crisis: evidence from analysis of returns and volatility.
12. Artikis, P.G., Diamantopoulou, L.G., & Kampouris, Ch.G. (2022). Risk factors and stock price performance of U.S sectors: a quintile approach. *Theoretical Economics Letters, 12*(3), 859-881.
13. Asian Flu (1957 Influenza Pandemic). (2023). SinoBiological. Retrieved from https://www.sinobiological.com/research/virus/1957-influenza-pandemic-asian-flu.
14. Atems, B., & Yimga, J. (2021). Quantifying the impact of the COVID-19 pandemic on US airline stock prices. *Journal of Air Transport Management, 97.*
15. Avadel Pharmaceuticals plc. (2020). *Annual report.*

16. Baig, A.S., Butt, H.A., Haroon, O., & Rizvi, S.A.R. (2021). Deaths, panic, lockdowns and US equity markets: the case of COVID-19 pandemic. *Finance Research Letters, 38.*
17. Barone, A., & Estevez, E. (2021). *Abnormal return: Definition, Causes, Example*. Retrieved from https://www.investopedia.com/terms/a/abnormalreturn.asp.
18. Blankenship, K. (2020). *Amarin sidelines field sales team for Vascepa amid growing COVID-19 pandemic.* Retrieved from https://www.fiercepharma.com/marketing/amarin-sidelines-field-sales-team-for-vascepa-amid-growing-covid-19-pandemic.
19. Bookwalter, M.Ch. (2021, February 12). Drug shortages amid the COVID-19 pandemic. *U.S. Pharmacist, 46*(2), 25-28.
20. Burdekin, R.C.K. (October 5, 2020). Death and the stock market: international evidence from the Spanish Flu. *Applied Economis Letters, 28*(17), 1512-1520.
21. Carson, M., & Clark, J. (2013). *Asian Financial crisis.* Retrieved from https://www.federalreservehistory.org/essays/asian-financial-crisis.
22. Centers for Disease Control and Prevention. (2022). *CDC Museum COVID-19 timeline*. Retrieved from https://www.cdc.gov/museum/timeline/covid19.html#.
23. Centers for Disease Control and Prevention. (2023). *1918 Pandemic (H1N1 virus).* Retrieved from https://www.cdc.gov/flu/pandemic-resources/1918-pandemic-h1n1.html#:~:text=It%20is%20estimated%20that%20about,occurring%20in%20the%20United%20States.
24. Centers for Disease Control and Prevention. (2023). *1968 Pandemic (H3N2 virus).* Retrieved from https://www.cdc.gov/flu/pandemic-resources/1968-pandemic.html#:~:text=The%20estimated%20number%20of%20deaths,a%20seasonal%20influenza%20A%20virus.
25. Centers for Disease Control and Prevention. (2023). *2009 H1N1 Pandemic (H1N1pdm09 virus).* Retrieved from https://www.cdc.gov/flu/pandemic-resources/2009-h1n1-pandemic.html.
26. Centers for Disease Control and Prevention. (2023). *Ebola Report: Ebola by the numbers.* Retrieved from https://www.cdc.gov/about/ebola/ebola-by-the-numbers.html.
27. Chen, Ch.D., Chen, Ch.Ch., Tang, W.W., & Huang, B.Y. (2009). The positive and negative impacts of the SARS Outbreak: a case of the Taiwan Industries. *The Journal of Developing Areas, 43*(1), 281-293.
28. Chen, J., & Boyle, M.J. (2020). *Defensive stock.* Retrieved from https://www.investopedia.com/terms/d/defensivestock.asp#:~:text=Key%20Takeaway

s,A%20defensive%20stock%20is%20a%20stock%20that%20provides%20consistent%20dividends,Cola%2C%20are%20considered%20defensive%20stocks.

29. Chen, M.H., Jang, S.Ch., & Kim, W.G. (2007). The impact of the SARS outbreak on Taiwanese hotel stock performance: An event-study approach. *International Journal of Hospitality Management, 26,* 200-212.
30. Chiang, M.T., & Lin, M.Ch. (2019). Market sentiment and herding in analysts' stock recommendations. *North American Journal of Economics and Finance, 48*, 48-64.
31. Chong, T.T.L., Lu, Sh., & Wong, W.K. (2010). Portfolio Management during Epidemics: the case of SARS in China. *Social Science Research Network.*
32. Coad, A., Segarra, A., & Mercedes, T. (2010). Like milk or wine: does firm performance improve with age? *Papers on Economics and Evolution, 1006.*
33. Company timeline: a Legacy of Innovation. (2022). Pfizer. Retrieved from https://www.pfizer.com/about/history.
34. Cumulative confirmed COVID-19 cases by world regioon. (2023). Our World in Data. Retrieved from https://ourworldindata.org/grapher/cumulative-covid-cases-region.
35. Dogan, M. (2013). Does firm size affect the firm profitability? Evidence from Turkey. *Research Journal of Accounting and Finance, 4*(4).
36. Dritharam, V. (2015). Does firm size influence on firm's Profitability? Evidence from listed firms of Sri Lankan hotels and travels sector. *Research Journal of Finance and Accounting, 6*(6), 201-207.
37. Ducharme, J. (2020, March 11). *World Health Organization declares COVID-19 a "Pandemic". Here's what it means*. Retrieved from https://time.com/5791661/who-coronavirus-pandemic-declaration/.
38. Effects of COVID-19 on Australia. (2022). Parliament of Australia. Retrieved from https://www.aph.gov.au/Parliamentary_Business/Committees/Joint/Foreign_Affairs_Defence_and_Trade/FADTandglobalpandemic/Report/section?id=committees%2Freportjnt%2F024552%2F73973#:~:text=While%20the%20health%20effects%20of,in%20the%20country's%20health%20system.
39. Endo International. (2020). *Annual report.*
40. Evotec. (2020). *Annual report.*
41. Faes Farma. (2020). *Annual report.*
42. Feng, Y., & Li, X. (April 22, 2021). Causal estimation of COVID-19 and SARS on China's stock market: evidence from a time series counterfactual prediction. *Economic Research – Ekonomska Istrazivanja, 35*(1), 1734-1751.

43. Germany stock market index (DE40). (2022). Trading Economics. Retrieved from https://tradingeconomics.com/germany/stock-market#:~:text=The%20DAX%20Index%20is%20the%20benchmark%20index%20for%20the%20German%20equity%20market.

44. Giudice, A.D., & Paltrinieri, A. (2017). The impact of the Arab Spring and the Ebola outbreak on African equity mutual fund investor decisions. *Research in International Business and Finance, 41*, 600-612.

45. Glascock, J.L. (2007). Securitized real estate: American REIT experience, history, lessons, and recommendations.

46. Hall, A.M., Lampert, M., & Cesare, S.D. (2013). Using stock market indexes to anticipate elevated public health risk: a socionomic view of epidemic disease. *Social Science Research Network.*

47. Hayes, A., Anderson, S., & Velasquez, V. (2022). *Herd Instinct.* Retrieved from https://www.investopedia.com/terms/h/herdinstinct.asp.

48. He, P., Sun, Y., Zhang, Y., & Li, T. (2020). COVID-19's impact on stock prices across different sectors – an event study based on the Chinese stock market. *Emerging Markets Finance and Trade, 56(*10), 2198-2212.

49. He, Q., Liu, J., Wang, S., & Yu, J. (2020). The impact of COVID-19 on stock markets. *Economic and Political Studies, 8*(3), 275-288.

50. Healthcare companies Germany. (2022). BoldData. Retrieved from https://bolddata.nl/en/companies/germany/healthcare-companies-germany/.

51. Healthcare sector. (2022). Corporate Finance Institute (CFI). Retrieved from https://corporatefinanceinstitute.com/resources/knowledge/trading-investing/healthcare-sector/.

52. History. (2022). Cosmo. Retrieved from https://www.cosmopharma.com/company/history.

53. History. (2022). Evotec. Retrieved from https://www.evotec.com/en/about/history.

54. History. (2022). Merck. Retrieved from https://www.merckgroup.com/en/company/history.html.

55. History. (2022). Takeda. Retrieved from https://www.takeda.com/who-we-are/company-information/history/foundation-modernization/.

56. Hoffmann, A.O.I., Post, T., & Pennings, J.M.E. (2013). Individual investor perceptions and behavior during the financial crisis. *Journal of Banking & Finance, 37*(1), 60-74.

57. Holder, J. (2023). *Tracking Coronavirus vaccinations around the world*. Retrieved from https://www.nytimes.com/interactive/2021/world/covid-vaccinations-tracker.html.

58. Ichev, R., & Marinc, M. (2017). Stock prices and geographic proximity of information: evidence from the Ebola outbreak. *International Review of Financial Analysis, 56,* 153-166.

59. Jazz Pharmaceuticals. (2020). *Annual report.*

60. Kagan, J., & Catalano, T.J. (2022). *Biotechnology.* Retrieved from https://www.investopedia.com/terms/b/biotechnology.asp.

61. Kalia, P., & Rupawala, H. (2021, January 26). *More healthcare companies go public in 2020 than prior 5 years.* Retrieved from shorturl.at/lwDEP.

62. Kavanagh, R. (2022). *Cyclical stocks move in tandem with the economy, which can lead to boom-and-bust returns for investors*. Retrieved from https://www.businessinsider.com/personal-finance/what-are-cyclical-stocks?r=US&IR=T#:~:text=A%20cyclical%20stock%20is%20a,%2C%20entertainment%2C%20and%20luxury%20retail.

63. Khot, U.N. (2020). *Navigatng Healthcare supply hortages during the COVID-19 pandemic.* Retrieved from https://www.ahajournals.org/doi/full/10.1161/CIRCOUTCOMES.120.006801.

64. Kiruba, A.S., & Vasantha, V. (2021). Determinants in Investment Behavior during the COVID-19 pandemic. *The Indonesian Capital Market Review, 13*(2), 71-84.

65. Kliger, D., & Gurevich, G. (2014). *Event studies for financial research.* Palgrave Macmillan.

66. Kollewe, J. (2022). *Pfizer accused of pandemic profiteering as profits double.* Retrieved from https://www.theguardian.com/business/2022/feb/08/pfizer-covid-vaccine-pill-profits-sales.

67. Kothari, S. P., & Warner, J.B. (2006). Econometrics of Event Studies. *Handbook of Corporate Finance: Empirical Corporate Finance, A.*

68. Ledesma, A., McCulloh, C., Wieck, H., & Yang, M. (2014). Health care sector overview.

69. Lee, Ch.Ch., Lee, Ch.Ch., & Wu, Y. (2021). The impact of COVID-19 pandemic on hospitality stock returns in China. *International Journal of Finance & Economics.*

70. Li, M., Li, W., Wang, F., Jia, X., &Rui, G. (2021). Applying BERT to analyze investor sentiment in stock market. *Neural Computing and Applications, 33,* 4663-4676.

71. Liew, V.K.S., & Puah, Ch.H. (2020). Chinese stock market performance in the time of novel coronavirus pandemic. *Munich Personal RePEc Archive (MPRA).*

72. Lin, X., & Falk, M.T. (2022). Nordic stock market performance of the travel and leisure industry during the first wave of COVID-19 pandemic. *Tourism Economics, 28*(5), 1240-1257.

73. Liu, H.Y., Manzoor, A., Wang, C.Y., Zhang, L., & Manzoor, Z. (2020). The COVID-19 outbreak and affected countries stock markets response. *International Journal of Environmental Research and Public Health, 17.*

74. Lovelace, B., & Towey, R. (2021). *COVID has made biotech companies the hot new tech sector as investor demand drives record IPOs.* Retrieved from https://www.cnbc.com/2021/09/29/covid-has-made-biotech-companies-the-hot-new-tech-sector-as-investor-demand-drives-record-ipos.html.

75. MacKinlay, A.C. (1997). Event studies in Economics and Finance. *Journal of Economic Literature, XXXV,* 13-39.

76. Major Epidemics of the Modern Era. (2022). Council on Foreign Relations. Retrieved from https://www.cfr.org/timeline/major-epidemics-modern-era.

77. Maneenop, S., & Kotcharin, S. (2020). The impacts of COVID-19 on the global airline industry: an event study approach. *Journal of Air Transport Management, 89.*

78. Merck. (2020). *Merck Annual report 2020*.

79. Naseem, S., Mohsin, M., Hui, W., Liyan, G., & Penglai, K. (2021). The Investor Psychology and Stock market behavior during the initial ear of COVID-19: a study of China, Japan, and the United States. *Frontiers in Psychology, 12*.

80. Ozturk, O., Sisman, M.Y., Uslu, H., & Citak, F. (2020). Effects of COVID-19 outbreak on Turkish stock market: a sectoral-level analysis. *Hitit University journal of Social Sciences Institute, 13(*1), 56-68.

81. Papaioannou, M.M.G., Park, M.J., Pihlman, J., & Hoorn, H. (2013). *Procyclical behavior of institutional investors during the recent financial crisis: Causes, impacts, and challenges.* International Monetary Fund.

82. Perrigo. (2020). *2020 Annual report*.

83. Pharmaceutical industry. (2022). Britannica. Retrieved from https://www.britannica.com/technology/pharmaceutical-industry.

84. Reiff, N. (2022, November 30). *Top Healthcare Stocks.* Retrieved from https://www.investopedia.com/investing/top-healthcare-stocks/.

85. Sagonowsky, E. (2020). *Merck KGaA's manufacturing group could see billions from COVID-19 work: analyst*. Retrieved from

https://www.fiercepharma.com/pharma/merck-kgaa-s-contract-manufacturing-group-could-see-billions-from-covid-19-work-analyst.

86. Salisu, A.A., Raheem, I.D., & Eigbiremolen, G.O. (2020). The behavior of U.S stocks to financial and health risks. *International Journal of Finance & Economics.*
87. Saltman, R.B., Busse, R., & Mossialos, E. (2002). *Regulating entrepreneurial behavior in European health care systems*. Open University Press.
88. Sayed, O.A., & Eledum, H. (2021). The short-run response of Saudi Arabia stock market to the outbreak of COVID-19 pandemic: an event-study methodology. *International Journal of Finance & Economics.*
89. Schell, D., Wang, M., & Huynh, T.L.D. (2020). This time is indeed different: a study on global market reactions to public health crisis. *Journal of Behavioral and Experimental Finance, 27.*
90. Shang, Y., Li, H., Zhang, R. (2021, March 12). Effects of Pandemic Outbreak on Economies: Evidence from Business History Context. *Frontiers in Public Health, 9.*
91. Sharma, Ch., & Banerjee, K. (2015). A study of correlations in the stock market. *Physica A, 432,* 321-330.
92. Siu, A., & Wong, Y.C.R. (2004). Economic impact of SARS: the case of Hong Kong. *Asian Economic Papers, 3*(1), 62-83.
93. Smiljanic, S. (2022, March 5). *The State of Healthcare Industry – Statistics for 2022.* Retrieved from https://policyadvice.net/insurance/insights/healthcare-statistics/.
94. Smith, T., & Rhinehart, Ch. (2022). *What is Market Sentiment? Definition, indicator types, and example*. Retrieved from https://www.investopedia.com/terms/m/marketsentiment.asp.
95. Stasha, S. (2022). *The state of the Healthcare Industry – Statistics for 2022.* Retrieved from https://policyadvice.net/insurance/insights/healthcare-statistics/#:~:text=There%20are%20784%2C626%20companies%20in,annual%20revenue%20of%20%24208.3%20billion.
96. Su, Z., Liu, P., & Fang, T. (2021). Pandemic-induced fear and stock market returns: evidence from China. *Global Finance Journal.*
97. The first year of COVID-19 in Australia: direct and indirect health effects. (2022). Australian Institute of Health and Welfare. Retrieved from https://www.aihw.gov.au/reports/burden-of-disease/the-first-year-of-covid-19-in-australia/summary.

98. Thompson, N., & Wollscheid, J.R. (n.d.). The Effects of Pandemics on Stock Market Returns and Volatility.

99. Thorbecke, W. (2021). How the coronavirus crisis is affecting the Korean economy: evidence from the stock market. *Asia and the Global Economy, 1*.

100. Total Coronavirus cases in Autralia. (2022). Worldometer. Retrieved from https://www.worldometers.info/coronavirus/country/australia/.

101. Ullah, S., Zaefarian, G., Ahmed, R., & Kimani, D. (2021). How to apply the event study methodology in STATA: *An overview and a step-by-step guide for authors. Industrial Marketing Management, 99,* A1-A12.

102. Urquhart, L. (2021). *AHA 2021 – Amarin not prepared in COVID battle*. Retrieved from https://www.evaluate.com/vantage/articles/news/snippets/aha-2021-amarin-not-prepared-covid-battle.

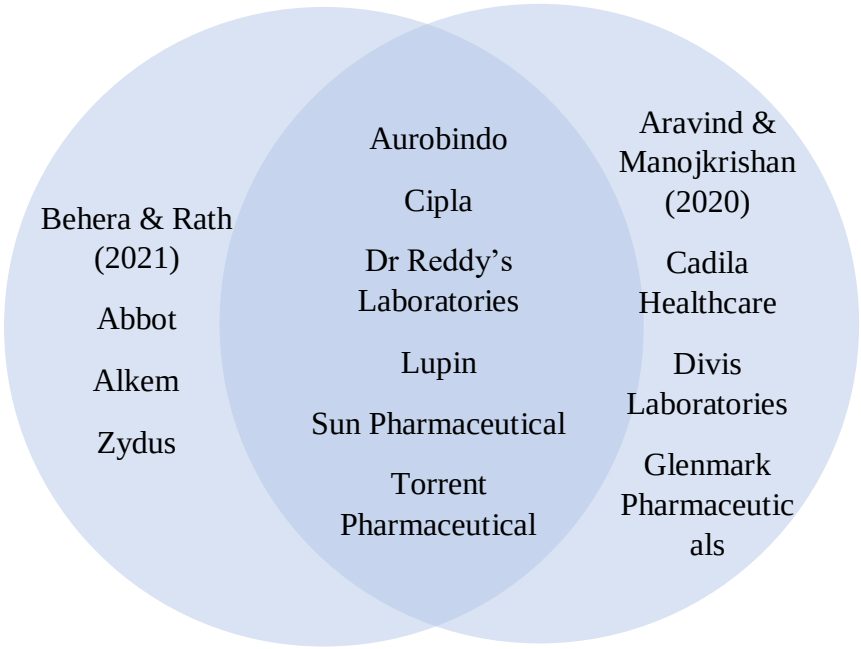
103. Wu, W., Lee, Ch.Ch., Xing, W., & Ho, Sh. J. (2021). The impact of the COVID-19 outbreak on Chinese-listed tourism stocks. *Financial Innovation, 7*(22).

104. Yigit, F., & Canoz, I. (2020). The reaction of airline stocks in Europe to the COVID-19 pandemic: an event study methodology. *Istanbul Ticaret Universitesi Sosyal Bilimler Dergisi, 39*(3), 1309-1326.

Appendices

Appendix A

Overlapping companies in Behera & Rath (2021) and Aravind & Manojkrishnan (2020) studies



Source: compiled by the author

Appendix B
List of companies selected for the author's work

Company name	Stock exchange where it is listed
Alk-Abello AS	Frankfurt stock exchange
Alkermes plc	Munich stock exchange
Amarin	Frankfurt stock exchange
Amneal Pharmaceuticals	Frankfurt stock exchange
Ascendis Pharma AS	Frankfurt stock exchange
Aspen Pharmacare	Frankfurt stock exchange
Astellas Pharma	Frankfurt stock exchange
Avadel Pharmaceuticals	Frankfurt stock exchange
Bayer	Frankfurt stock exchange
Bristol Myers Squibb	Frankfurt stock exchange
Cosmo Pharmaceuticals	Frankfurt stock exchange
Eisai Co	Frankfurt stock exchange
Eli Lilly	Frankfurt stock exchange
Endo	Frankfurt stock exchange
Evotec	Frankfurt stock exchange
Faes Farma	Frankfurt stock exchange
Galapagos	Berlin stock exchange
Gedeon Richter	Berlin stock exchange
Gilead Sciences	Frankfurt stock exchange
Jazz Pharmaceuticals plc	Frankfurt stock exchange
Merck	Frankfurt stock exchange
Perrigo	Frankfurt stock exchange
Pfizer	Xetra stock exchange
Takeda Pharmaceutical	Frankfurt stock exchange
Verona Pharma	Frankfurt stock exchange

Source: compiled by author

Appendix C
Descriptive statistics

Pre-event Frequency data	
Total number of observations	25
Minimum average abnormal return	-0.0025
Maximum average abnormal return	0.0071
Mean of average abnormal returns	0.0011
Standard deviation	0.0022

Source: compiled by the author

Post-event Frequency data	
Total number of observations	25
Minimum average abnormal return	-0.0089
Maximum average abnormal return	0.0080
Mean of average abnormal returns	-0.0004
Standard deviation	0.0033

Source: compiled by the author

Appendix D
Wilcoxon signed rank test results

Related-Samples Wilcoxon Signed Rank Test Summary	
Total N	25
Test Statistic	100,000
Standard Error	37,165
Standardized Test Statistic	-1.682
Asymptotic Sig. (2-sided test)	0.093

Source: compiled by the author

Resümee

SAKSAMAA NOTEERITUD FARMAATSIA ETTEVÕTETE AKTSIATE ANORMAALNE TOOTLUST COVID-19 PANDEEMIA ESIMESE LAINE AJAL

Järgneva bakalaureusetöö eesmärk oli hinnata ravimitööstuses tegutsevate (tervishoiusektorit esindavate) riigiettevõtete aktsiate tootlust COVID-19 pandeemia esimese laine ajal. Varasemate uuringute tulemuste põhjal arvas autor, et tervishoiusektoris tegutsevate börsil kaubeldavate ettevõtete aktsiate tootlus kipub tervisekriiside või šokide ajal olema parem võrreldes teiste sektorite või üldise turuga, kuna riigi tervishoiusektori ettevõtete aktsiad on näiteks kaitseaktsiaid, mis on tavaliselt usaldusväärsed investeerimisvõimalused, mis pakuvad madalama riskiga investoritele stabiilset tulu.

Kuna avaliku tervishoiusektori ettevõtete aktsiate tootlust COVID-19 pandeemia ajal ei ole autorile teadaolevalt veel Euroopa aktsiaturu näitel analüüsitud, valis autor selle, et näha, kas nende tootlus erines aktsiate omast. teistel aktsiaturgudel noteeritud avaliku tervishoiusektori ettevõtete tulemused. Autori töösse on valitud farmaatsia alamsektor esindama tervishoiusektorit ning analüüsitud on 25 Saksamaa börsil noteeritud riikliku farmaatsiaettevõtte aktsiate tootlust. Kuigi autori leiud ei osutunud statistiliselt oluliseks, tekitas 12 riigiettevõtet positiivseid AAR-e nii sündmuseeelsel kui ka -järgsel perioodil, samas kui 25-st valitud ettevõttest 18 positiivsed AAR-id kogu uuringuperioodi jooksul.

Kuigi COVID-19 pandeemia mängis otseselt või kaudselt oma rolli tervishoiusektori ettevõtete aktsiate käekäigus müügimahtude suurenemise või vähenemise kaudu, täheldati ka seda, et ettevõtete seotus teistes allsektorites, ettevõtte suurus ja vanus võis olla üks põhjusi. muud tegurid, mis mängisid rolli ettevõtete aktsiate tootluses. Kuna autori töö tulemused ei osutunud statistiliselt oluliseks, on autori hinnangul vaja teha täiendavaid uuringuid, et paremini mõista tervishoiusektoris tegutsevate riigiettevõtete aktsiate tootlust.

Non-exclusive licence to reproduce thesis and make thesis public

I, Shakhlokhon Rustambekova,

1. herewith grant the University of Tartu a free permit (non-exclusive licence) to reproduce, for the purpose of preservation, including for adding to the DSpace digital archives until the expiry of the term of copyright,

---

ABNORMAL STOCK RETURNS OF PUBLIC GERMAN PHARMACEUTICAL COMPANIES DURING THE FIRST WAVE OF THE COVID-19 PANDEMIC

supervised by Mark Kantšukov and Helen Poltimäe

2. I grant the University of Tartu a permit to make the work specified in p. 1 available to the public via the web environment of the University of Tartu, including via the DSpace digital archives, under the Creative Commons licence CC BY NC ND 3.0, which allows, by giving appropriate credit to the author, to reproduce, distribute the work and communicate it to the public, and prohibits the creation of derivative works and any commercial use of the work until the expiry of the term of copyright.

3. I am aware of the fact that the author retains the rights specified in p. 1 and 2.

4. I certify that granting the non-exclusive licence does not infringe other persons' intellectual property rights or rights arising from the personal data protection legislation.

Shakhlokhon Rustambekova

12.01.2023