

REVIEW ARTICLE

IMPACT OF COVID-19 PANDEMIC ON THE STOCK PRICES OF THE NYSE-LISTED PHARMACEUTICAL COMPANIES

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ABSTRACT

The global spread of the epidemic has affected a wide range of industries. The number of COVID-19 infections has continued to increase over the past year, while the stock prices of pharmaceutical companies have shown exponential growth. This paper conducts a regression analysis based on data of the number of monthly COVID-19 infections in New York State and government spending on COVID-19 vaccines. Does the number of COVID-19 infections affect pharmaceutical companies' stock prices of pharmaceutical companies? The analysis results confirmed that: an increase in total domestic spending on healthcare services is associated with higher stock prices of pharmaceutical companies listed on the New York Stock Exchange (NYSE).

KEYWORDS

Stock Prices, Pharmaceutical Companies, COVID-19, Healthcare Services

1. INTRODUCTION

The COVID-19 pandemic has significantly impacted the economy more negatively. For example, reduced consumption of consumer goods has forced companies to scale back their operations and halt expansion plans. The reduction in business led them to cut costs by lowering average work hours. Some industries, such as hotels and hotel management, experienced massive business losses, prompting them to close some locations and putting thousands of people out of work. High unemployment inhibits consumption and hurts businesses in what is a vicious cycle. Despite this widespread recession, some sectors have remained unaffected. Some sectors seem to be doing well as they fill unique economic gaps. The pharmaceutical industry is undoubtedly the largest economic beneficiary of the COVID-19 pandemic. Their spending on research and design has produced a variety of medical solutions that have helped humans minimize the damage caused by the virus (Yunus et al., 2020). Companies such as Pfizer have launched a vaccine whose uptake has been encouraging. Given the central role the industry is playing in this pandemic, any economics enthusiast will want to know if it has grown in value and revenue. Given the pharmaceutical industry's role in helping to manage coronaviruses, I am curious to know the economic returns it has reaped. Therefore, my research question for this paper is as follows: Does the number of COVID-19 infections affect the stock price of pharmaceutical companies? Core hypothesis: The increase in COVID-19 infections over the past year has positively affected the stock prices of pharmaceutical companies.

Researching this topic is important because it's a thought-provoking phenomenon between Covid-19 and Pharmaceutical Companies. Over the past year, the dramatic increase in demand for medical services and drugs over the past decade, but the number of industry participants has remained relatively constant given the barriers to entry faced

by potential entrants. Other research papers shows that the largest customers of these companies are organizations such as the government. Considering the level of government spending over the past 18 months to protect the population from viruses, including spending on vaccines, pharmaceutical companies have benefited greatly. Some companies, such as Pfizer and Johnson & Johnson, have the advantage of wielding vaccine patents, thus giving them a clear competitive advantage (Self et al., 2021).

The dependent variable for this topic is the stock prices of pharmaceutical companies listed on the New York Stock Exchange. Financial performance and investor sentiment are assumed to be reflected in this value (Buszko et al., 2021). I take the monthly prices of 46 listed pharmaceutical companies. The independent variables I will choose are the monthly number of COVID-19 infections in New York State and government spending on the COVID-19 vaccine. I will then perform a regression analysis on the collected data to determine if the dependent and independent variables are correlated. I will then calculate the covariance and correlation coefficient values and develop a linear regression model using the following equation. This model will prove my hypothesis correct if increased government spending on the COVID-19 vaccine and COVID-19 infection translate into increased stock prices of pharmaceutical companies

2. LITERATURE REVIEW

COVID-19 pandemic has a significant impact on various sectors of the economy. The pandemic has both short and long-term effects on the economy. Previous studies have primarily discussed these impacts on the economy. The pharmaceutical sector is one of the affected sectors that has experienced challenging times. Pharmaceutical companies listed in NYSE, including Johnson & Johnson, and Pfizer have engaged

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in continuous research and design to yield various medical solutions (Zhang, 2021). The increase in the number of COVID-19 infections has made these companies enjoy economic benefits due to the supply of vaccines and other medications that support COVID-19 victims' recovery. Previous studies have extensively explored numerous impacts of the COVID-19 pandemic on the economy. However, these studies have not explored in deeper detail the impact of the pandemic on the stock prices of NYSE-listed companies.

Some papers stated that the pandemic has led to an increase in stock prices of these companies due to increased demand for pharmaceutical drugs and vaccines (Self et al., 2021). The rise in demand is due to the increase in a number of COVID-19 infections and deaths across the world. "Various governments are concerned about measures to help prevent further spread, which lead to an increase in the purchase of drugs and vaccines. They argue that the law of supply and demand leads to an increase in the stock price of pharmaceutical companies since they produce products that other companies cannot produce" (Self et al., 2021). As a result of increased infections and deaths, the products produced by these companies are highly desired and deemed necessary. This leads to an increase in stock price due to high demand. These companies supply pharmaceutical products both locally and internationally; thus, demand is higher than supply. Various authors argue that pharmaceutical companies have embraced effective and efficient production and management changes due to increased COVID-19 infections. This enables these companies to meet market demand; thus, contributing to an increase in stock price (Zhang, 2021).

As a result of the barrier to entry into the pharmaceutical industry, the number of firms participating in the production of required pharmaceutical products that control the further spread of the disease remains the same. This makes these companies enjoy considerable market share, thus, high profits. As a result, this leads to the rise of stock prices. Efficiency can result from the management team, strategies, and style in production, which boosts overall effectiveness; thus, increased profits contribute to the share price rise (Zhang, 2021). The current study seeks to determine whether the increase in government expenditure on COVID-19 vaccines and other medications leads to an increase in the stock price of pharmaceutical companies. In the last few months, the federal government has significantly increased its expenditure to reduce the impact of COVID-19 on the economy. The government has been clients for these companies buying vaccines and drugs and acquiring medical services. In previous years before the pandemic outbreak, the government spent little on pharmaceutical drugs, vaccines, and other products; thus, low demand with high supply led to a decrease in stock price.

Previous studies view the impact of the pandemic on the stock price increase or decrease from the approach of CSR. Manuel et al. (2020). Argue that pharmaceutical companies have embraced CSR activities that benefit from mutual communication with customers (Manuel et al. 2020). This increases information opacity, thus, the collapse of stock price risk. The authors argue that firms with improved CSR performance have increased levels of information disclosure, making it easy to control the decrease of stock price (Manuel et al. 2020). Generally, CSR activities improve company reputation and social trust in the market. Therefore, companies practicing CSR activities can enjoy more sales and market share; thus, increasing profits. These companies are more likely to provide their financial reports as they have restricted earnings management behavior, resulting in high-quality earnings. Authors from previous studies demonstrate that investment in CSR activities during the COVID-19 pandemic has benefited pharmaceutical companies more, especially during the financial crisis due to trust, higher employee productivity, and more substantial growth (Manuel et al. 2020). However, the current study aims to determine how COVID -19 pandemic directly impacts the stock price, primarily through increased expenditure on pharmaceutical products.

Current studies assume that investor sentiment and financial performance are reflected in stock price value. Previous studies argue that changes in investor sentiment can lead to stock fluctuations. These studies use heterogeneity analysis to determine the effect of the pandemic on investor sentiment. They analyze the impact based on firm or sector ownership. The authors of their research argue that the

pandemic outbreak positively affected the pharmaceutical industry, especially investor sentiment (Buszko et al., 2021). As a result, the COVID-19 pandemic has significantly impacted stock prices due to the rise in demand for medical supplies. Therefore, these studies conclude that the government has spent more financial resources on the pharmaceutical industry; thus, increasing investors' expectations.

Zhang et al., (2021) involve social science research addressing casualty. The authors explain the relationship between the effect and the cause using various COVID-19 vaccines. Glied et al., (2020) use regression discontinuity which measures the impact of COVID-19 treatment through the application of treatment mechanism. Treatment is assigned to a certain group of people based on age; thus, RDD is used to determine the variation in outcomes of victims. However, the current study seeks to determine whether pharmaceutical companies enjoy significant benefits due to government expenditure on their products (Buszko et al., 2021). The current study is different from other studies as it focuses explicitly on the dependent variable stock price of NYSE-listed pharmaceutical companies. The study aims to use regression analysis which is different from other studies, to determine the coefficient correlation between the dependent and independent variables. This would help determine whether the government increase of expenditure on COVID-19 drugs and vaccines leads to a rise in stock price. The hypothesis of the current study supposes that an increase in COVID-19 infections in the past twelve months has had a significantly positive impact on the stock price of pharmaceutical companies.

3. BACKGROUND INFORMATION

With the COVID-19 pandemic, the pharmaceutical firm increased their sales and thus their income saw enormous growth. Positive changes in the income earned by these companies are likely to spur an increase in their stock prices (Yunus et al., 2020). However, the stock price changes are associated with multiple drivers, including competition and industry growth. This analysis aimed at understanding the influence of changes in the expenditure on health care during COVID-19 on the stock prices of the pharmaceutical firms. To measure the changes in the stock prices of the pharmaceutical firms associated with expenditure on COVID-19, this analysis compared the trends in the stock prices of the DRG index which comprises the pharmaceutical firms listed in the NYSE, and the quarterly expenditure on prevention and treatment of COVID-19 infections in the US for the period between January 2019 and June 2021. Practically, it was believed that increased COVID-19 infections led to an increased expenditure on healthcare services across the US states to prevent further infections and cure existing ailments (Self et al., 2021). Therefore, using the health care spending in place of the number of coronavirus infections for a particular period was sufficient. Also, using the number of COVID-19 infections posed a challenge because of the unreported cases and prevention measures costs. Further, obtaining the accurate number of COVID-19 infections faced a challenge because of cases reported late to the Center of Disease Control (CDC) department.

4. RESEARCH HYPOTHESES

This analysis intended to test whether changes in expenditure on COVID19 vaccines and prevention of COVID19 infections influenced changes in the stock prices of the pharmaceutical firms listed in the New York Stock Exchange. Primarily, the study hypothesizes that increased expenditure on COVID19 vaccines and COVID 19 infections' prevention triggers price increase in the stocks of pharmaceutical firms. However, the study also sought to determine whether the stock price changes were associated with the future stock price.

Null Hypothesis 01: The change in expenditure on COVID19 vaccines and COVID 19 infections prevention does not affect the stock prices of the pharmaceutical firms

Alternative Hypothesis i: The change in expenditure on COVID19 vaccines and their infections triggers price increase in the stock prices of pharmaceutical firms

Null Hypothesis 02: Previous changes in stock prices for the pharmaceutical companies listed on the NYSE do not influence future prices

Alternative Hypothesis ii: Previous changes in stock prices for the pharmaceutical companies listed in the NYSE influence future prices

5. EMPIRICAL STRATEGY AND MODEL

The analysis deployed a correlational technique to examine the relationship between the change in the stock prices of the pharmaceutical firms and the expenditure on health care during the COVID-19 pandemic. The empirical equation for estimating this relation was expressed as

Where Y is the stock price, X1 is the expenditure on health care, and X2 is the change in stock prices. This mathematical expression models the linear association between DRG stock prices and the spending on health care in the US while controlling for the effect of first differences from the stock prices.

The formulas for calculating the coefficient and slope of regression were helpful in estimating the direction and magnitude of the relationship between stock prices and the expenditure on health care.

$$a = \frac{(\sum y)(\sum x^2) - (\sum x)(\sum xy)}{n(\sum x^2) - (\sum x)^2}$$

$$b = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$$

6. DESCRIPTION OF THE DATASET

The research paper mainly focus on three variables: AdjClose Stock DRG Price; the price difference in DRG Stock, and the Health Care Expenditure (% GDP). The independent variable is the monthly government expenditure on health services. The values are obtained from US spending and are expressed as a percentage of the GDP. The monthly data on US government expenditure regarding healthcare and related services was not available, and thus, quarterly approximations are used. Initially, the current study intended to use raw values of government expenditure on COVID 19 vaccines and infections control but only annual data was available, which could not suffice regression purposes for the research hypothesis. The study recorded values for the government expenditure on healthcare between January 2019 and June 2021. The dependent variable for the study is pharmaceutical company stock prices. The DRG, a composite index for the pharmaceutical companies listed in the New York Stock Exchange (NYSE) was selected to represent the general stock prices of the pharmaceutical firms. The adjusted close stock prices for the DRG composite between January 2019 and June 2021 were collected. An additional independent variable, firstly differences of the stock prices, was added to the regression model because stock prices are prone to random walk problems in which the current stock prices affect the next stock price. First differences are obtained through. An adjusted close stock price represents the average price for the daily mean prices, obtained by summing the stock's low and high daily expenses in the market and dividing them by 2.

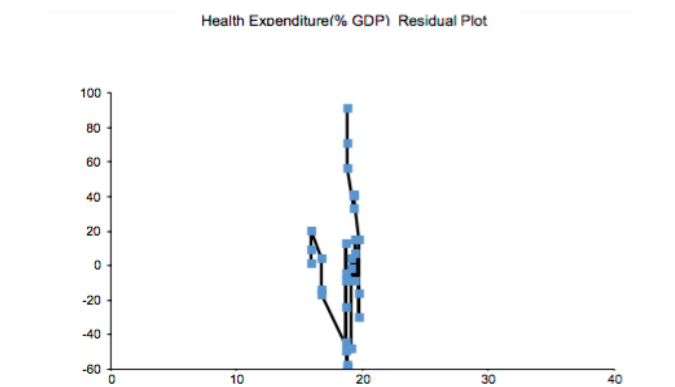


Figure 1: Trend Analysis of the Stock Prices and Government Expenditure on Healthcare Services

A random sample of n=30 was obtained in which Ordinary Least Squares is conducted. A preliminary analysis in preparation was conducted to

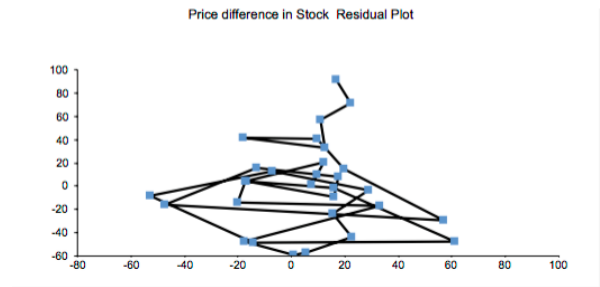


Figure 2: A scatterplot of the Stock Prices and expenditure on health

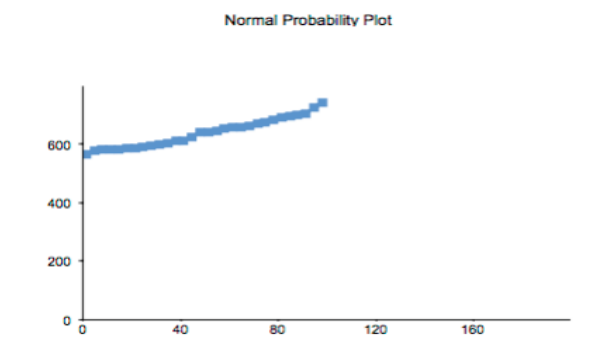


Figure 3: Normal Probability Plot

establish the feasibility and validity of the OLS parameter.

Figure 1: Trend Analysis of the DRG Stock Prices and Government Expenditure on Healthcare Services between Jan 2019 and June 2021.

The above figure indicates that DRG prices had an increasing trend between January 2019 and June 2021 although there were some irregular drops. June 2021 recorded the highest DRG stocks prices. The percentage of GDP expenditure on health care services showed a steady but a very small increase during the period.

7. CORRELATION ANALYSIS

A scatterplot above of the DRG Stock Prices and expenditure on health care Services between Jan 2019 and Jun 2021. The graph showed some positive relationship between the GDP expenditure on health care in the US and DRG stock prices for the period between January 2019 and June 2021. This showed a positive trend between the two variables.

The correlation coefficient between the DRG stock price and the government expenditure on healthcare is $r(28)=0.56$ indicating that there is a moderate positive linear relationship between the stock prices and expenditure on COVID19 Vaccines and infections. However, there is a weak positive linear relationship between the DRG stock prices and the first difference of the price, $r(28)=0.11$.

7.1 Estimation Model

The equation for estimating the relation between the DRG stock prices and the GDP Expenditure on COVID19 vaccines and infection is shown below. Where Betas 1 and 2 are coefficient estimates for the model and Beta 0 is the intercept.

$$a = \frac{(\sum y)(\sum x^2) - (\sum x)(\sum xy)}{n(\sum x^2) - (\sum x)^2}$$

$$b = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$$

7.2 Regression Results

The regression analysis results showed that the DRG stock price was a positive function of the previous price and the government expenditure,

| Table 1: Summary statistics of the selected variables | | | |
|---|--------------------------|-----------------------------------|---------------------------------|
| Statistic | AdjClose Stock DRG Price | The Price Difference in DRG Stock | Health Care Expenditure (% GDP) |
| Mean | 637.6613 | 5.661 | 18.51 |
| Median | 640.545 | 10.295 | 18.8 |
| Standard Deviation | 49.39893 | 25.17443 | 1.182152 |
| Kurtosis | -0.90212 | 0.756605 | 0.591792 |
| Skewness | 0.367995 | -0.1727 | -1.37928 |
| Range | 178.11 | 113.85 | 3.8 |
| Minimum | 565.3 | -52.68 | 15.9 |
| Maximum | 743.41 | 61.17 | 19.7 |
| Count | 30 | 30 | 30 |

| Table 2: The regression analysis results | | | | | | |
|--|--------------|----------------|----------|----------|-----------|-----------|
| | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% |
| Intercept | 211.9812 | 112.5246 | 1.883866 | 0.070395 | -18.9002 | 442.8625 |
| The Price Difference in Stock | 0.677855 | 0.285032 | 2.378171 | 0.024737 | 0.093017 | 1.262692 |
| Health Expenditure (% GDP) | 22.79 | 6.069879 | 3.754605 | 0.000844 | 10.33563 | 35.24436 |

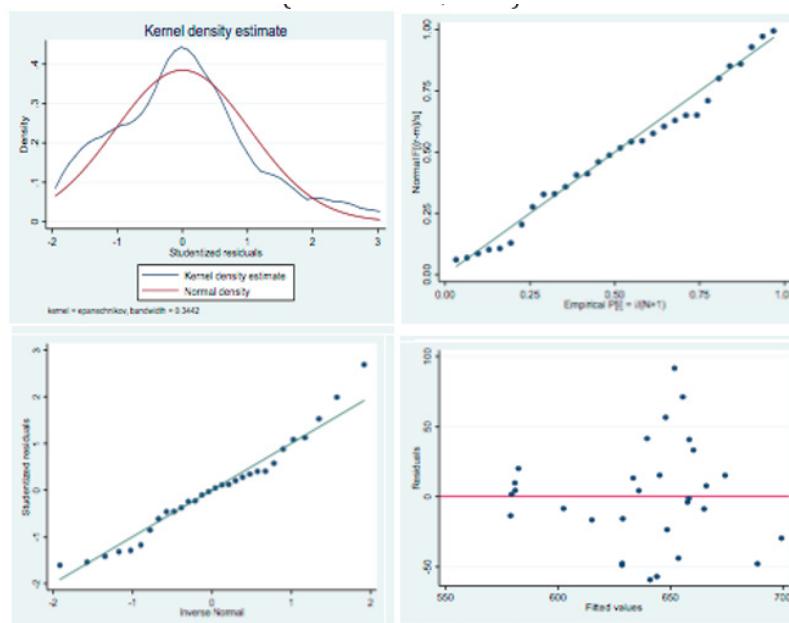


Figure 4: Distribution of residuals

| Table 3: Variance Inflation Checks | | |
|------------------------------------|-------|-------|
| | VIF | 1/VIF |
| Health Expenditure GDP | 1.001 | 0.999 |
| Price difference in S~k | 1.001 | 0.999 |
| Mean VIF | 1.001 | - |

| Table 4: Heteroskedasticity Checks | | | | | | |
|------------------------------------|-----------|-----------|--------|-------|-----------|----------|
| AdjClose St~e | Coef. | Std. Err. | t | P>t | 95%Conf. | Interval |
| _hat | 4.503 | 7.476 | 0.600 | 0.552 | -10.836 | 19.842 |
| _hatsq | -0.003 | 0.006 | -0.470 | 0.643 | -0.015 | 0.009 |
| _cons | -1100.122 | 2350.860 | -0.470 | 0.644 | -5923.689 | 3723.445 |

explaining around 43.11% of the variations in the composite stock prices. A unit positive change in the difference of the stock prices was associated with a 0.68 dollar increase in the DRG stock prices, $t(29)=2.38, P<0.05$. A percentage positive change in government expenditure on the COVID19 vaccines and infections was associated with a 22.79 dollar increase in the DRG stock price, $t(29)= 3.75, P<0.05$. The model fitness test was found to be significant for predicting the DRG stock prices although, less than half of the variation was explained, $F(2, 29)= 10.23, P<0.05$.

8. ROBUSTNESS CHECK

8.1 Distribution of Residuals: Normality and Homoscedastic Variance

The plots below include density curve, Percentage plot, quantile plot, and residual versus fitted values plot. All are consistent that residuals of the model are normally distributed with constant variance and static mean (Lu and White, 2014).

8.2 Model Specification Error and Multicollinearity

The results of omitted variable bias and variance inflator checks indicate that the model had no specification error and the first difference in DRG stock prices was not highly correlated with GDP expenditure on health care services in the US (Lu and White, 2014).

9. CONCLUSION

The analysis findings confirm the research hypothesis that the increased gross domestic expenditure on health care services is associated with an increase in the stock prices of the pharmaceutical companies listed in the New York Stock Exchange (NYSE). There is a large magnitude of change, 22.79, in the stock prices by a unit percentage change in the GDP expenditure on health care service in the United States. However, the price differences for the last time also affect the future stock prices of the pharmaceutical companies. However, the magnitude of a change associated with first differences on DRG stock prices is tiny, on average 0.68.

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