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The Effect of COVID-19 Increasing Cases on Movement of Stocks

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Abstract

The Coronavirus pandemic that was first identified in China and infected individuals in more than 200 nations around the world has become a very hot research topic recently. A large part of the country's economy is suffering due to the epidemic and most businesses have completely shut down which affected the global economy and the financial market negatively. Many papers study the negative impact COVID-19 on the economy, but our paper studies the possible positive impact of COVID-19 pandemic mainly on the biopharmaceutical and cleaning product stocks. We aim to find the correlation between the daily number of Coronavirus registered cases in the USA on the movements of ten indices. We used Granger causality and Pearson correlation test to investigate the correlation between the number of Coronaviruses registered cases in the USA on the movements of Biopharmaceutical and Cleaning Sector Stocks. Then, we used a linear regression analysis to determine whether a daily number of registered COVID-19 cases can successfully predict companies daily closing price directions. The experimental results indicate that the number of COVID-19 daily cases does cause stock prices to fluctuate and can be used to make valuable investment decisions.

Keywords— Granger-causality; COVID-19 Cases; Biopharmaceutical Sector Stocks; Cleaning Product Stocks, Pearson Correlation analysis, Linear Regression Analysis.

I. INTRODUCTION

The Coronavirus pandemic was first identified in China and infected individuals in more than 200 nations around the world. In the first months of 2020 the virus, also known as COVID-19 spread rapidly around the world, to cross 10 million confirmed cases by the end of June.
Coronavirus become a very hot research topic and many researchers are trying to predict Coronavirus movement trends [1],[2][3].However, these researches was not able to achieve high accuracy result in forecasting the predestination of the epidemic. The insufficient understanding of the new epidemic, the high degree of uncertainty, and the dynamic social-political forces that affect the new virus widespread made Coronavirus trend forecasting extremely tough work.

In [4] a leading professor at Harvard University warned the world about the possibility of virus infection to contaminate

40-70% of the world population. Besides the significant biopharmaceutical issues, the environmental damage, the Supply chain disruption, and the economic depression all create a global alarm [5],[6].

A large part of the country's economy is suffering. Most businesses have completely shut down, and the remainder of society locks themselves off from the Coronavirus which decreased the consumption of products and goods [7].
Amid growing of a new recession and financial crisis, times such as these call for robust and effective leadership in the health care system, industry, government, and the broader society [8].

A British Plastics Federation (BPF) survey illustrated how COVID-19 impacts manufacturing industries in the United Kingdom(UK), more than 80 % of the participants expected a decrease in revenue over the next two years, with 98% of respondents expressed fears about the negative effects of the epidemic on business operations (https://www.bpf.co. UK/article/plastics-trade-body-publishes-first-study-of-Coronavirus-impact-1602)[9].The COVID-19 effect on the global market is also enormous. In March 2020, financial markets collapsed. Many equities worldwide have reported their worst one-day drop. The Dow Jones Index, for instance, recorded the biggest drop ever on a day (2.977 points on March 16, 2020). And in a few days, many well-known companies saw their stock values falling by more than 80 percent [10].

However, as many papers tried to study the negative impact of COVID-19 on the economy, our paper study the possible positive impact of COVID-19 pandemic mainly on the biopharmaceutical and cleaning product stocks by employing the Granger causality and Pearson Correlation test. We aim to find the correlation between increasing cases of the COVID-19 infection in the USA on the movements of ten indices namely, Clorox Company (CLX), Regeneron Pharmaceuticals(REGN), Stepan Chemical (SCL), Gilead Sciences (GILD), Moderna Inc. (MRNA) stocks, Church & Dwight develops(CHD), XBiotech Inc. (XBIT), Ecolab Inc. (ECL), MedMiraInc (MIR.V),and Vertex Pharmaceuticals (VRTX) company. The rest of the paper is organized as follows.
Section 2 provides a review of the related work. Section 3 contains information about the dataset used in this research. Section 4 describes the Granger Causality hypothesis and the result of the test. Section 5containsa Pearson Correlation test and the result of the test. Section 6 illustrates the Linear regression analysis and the result. Finally, section 7 concludes this work.

II. Related Work

A large number of studies have been available addressing the specific issue of a financial and global crisis and its correlation to stock market fluctuation.

In [11] the study examines the connections between the stock markets of the world's largest financial canters, such as New York, London, and Tokyo, in two separate periods, specifically before and during the global economic crisis that occurred in 2007, and the main aim was to decide if stock markets correlate more strongly during the crises. The results of the study, performed through multiple regressions, indicating that the ties between the three stock markets during the crisis were more strong, overall on a decreasing trend than before the economic chaos, when the stock prices had an upward trend. Greater similarities between the three indices during the recession, especially during the time of down turn which indicates that investor fear during a recession is much more extreme than the feeling of optimism during periods of increase.

[12] Paper analyzed stock index data for eight advanced and ten emerging countries, with nine stock market crises occurred from 1970 to 1997.During and after these incidents, stock price adjustments are analyzed to record the pre-crisis price fluctuations and post-crisis market recovery. During crises, they track the severity of the contagion and analyze how the connection between stock market indexes moves during periods of severe falling prices. The result of the experiments indicates that Prices are dropping quickly and steeply for emerging markets and will take a long time to recover, ordinarily in three years or less. Prices decreased for all markets for at least three years following the healing from the crisis. Also, there is a contagion phenomenon, which means that the recession in most other markets will be accompanied by a recession in other markets. Moreover, For long-term U.S. investors, international investment is profitable even during periods of downturn in the market.

[13] Explored the latest global financial crisis effect on the United Kingdom (FTSE 100), the United States (S&P 500), and Japan (NIKKEI 225).The authors applied the nonlinear bivariate causality test to examine the causality of stock returns and gold returns, then perform the same test again to examine the causality of gold returns and stock market fluctuation. In the article, measurements based on the bivariate model present significant signs of the nonlinear direct relationship among variables for all mentioned regions during the financial crisis span. Due to the bidirectional interdependence between the return on gold and the returns on stocks, as well as the uncertainty of the stock market, these findings suggest that gold can't be considered as a secure investment during the financial crisis cycle and can’t be used effectively to decrease portfolio risk in the crisis period.

[14] Research examines the impact of the recent financial crisis on six main stock markets. To determine the effect of the crisis on the global financial markets. An auto-regression vector (VAR) model was adopted and Granger causality tests were performed. The time series of daily stock market indices closing price was used for analysis. The main aim of the paper was to discuss the co-movement of six big returns on capital markets before, after, and during the 2007–2008 financial crisis. Results indicate that there is an essential amount of links between different stock markets during the financial crisis. Moreover, overall global stock-market swings continue after the crisis and have been higher in some economies.

Covid-19 like other crisis also create long term negative impact on the stock market. The financial news reveals that the drop in the global indices was unprecedented since the great depression in 1929 [15].

Another study reveals the consequence of the COVID-19 crisis on global financial markets. The rising number of days’ lockouts, financial market decisions, and global prohibitions on travel seriously affected the degree of economic activity. Which explains why Global stock markets lost about $6 trillion in prices over six days from 23 to 28 February [16].

Report issued by the New York Times [17] indicates that Global Financial markets impacted negatively to the pandemic, for instance, S&P 500, DowJones, Nasdaq Composite, the FTSE 100, and the Nikkei 225 drop around 30-40% by the end of March from their January prices(https://www.nytimes.com/2020/03/12/business/stock-market-today.html).

However, while many studies show the negative impact of Covid-19 on the global stock prices, the studies that try to find the possible positive impact of the pandemic on biopharmaceutical and cleaning sector stocks are scarce. In this study, we aim to find the correlation between increasing cases of the COVID-19 infection in the USA on the movements of cleaning and pharmaceutical sector stocks. In general, this study shows the effect of the pandemic on the movements of ten indices namely CLX, REGN, SCL, GILD, MRNA, CHD, XBIT ,ECL, MIR.V, and VRTX.

III. DataSet

In the following section, we will describe our datasets of Coronavirus cases that were registered in the USA and collected from reliable websites, as well as the corresponding stock closing price of ten companies that mainly operates in the cleaning and Pharmaceuticals domain. The details of these datasets are described as follows.

A. Coronavirus Cases in the USA

We collected the Coronavirus daily cases that were registered in the USA in the period from 18/02/2020 to 08/05/2020.All All the data was collected from the website (https://www.worldometers.info/Coronavirus/country/us/)[18].
which is a well-known website that
provides charts and figures for the different subjects promptly and recently gained more popularity due to serving statistics about the Coronavirus pandemic.

B. Stocks Prices

We collected the daily closing prices of ten stock indices in the period between18/02/2020 to 08/05/2020 from Yahoo Finance website. We have chosen the previous companies because they are expected to positively correlate to the increasing number ofCOVID-19 infections. The company's business domains all mentioned on the website (https://stocknews.com/stock)[19] except for MIR.V which illustrate here (https://www.ldmicro.com/profile/mir.v)[20] and all are summarised as below:

Clorox Company (CLX) was Established in 1913 and located in California, USA. The company produces and sells consumer products worldwide such as cleaning, household, and lifestyle material [21].

Regeneron Pharmaceuticals(REGN) is a renowned biopharmaceutical firm focused on medical science which was established in 1988 and is located in New York. The company finds, develops, and sells medicines for treating severe medical conditions such as arthritis, and asthma[22].

Stepan Chemical (SCL) company was established in 1932 and is located in Illinois, USA, and is a key manufacturer of specialty chemicals used in a wide range of industrial cleaning materials[23].

Gilead Sciences (GILD) is a biopharmaceutical company that discovers, develops, and sells medicines in areas of unrivaled medical needs such as HIV/AIDS disease[24].

Moderna, Inc. (MRNA) company was established in 2010 and is located in Cambridge. The company is interested in the development of innovative drugs such as prophylactic vaccines and cancer vaccines[25].

Church & Dwight develops(CHD) company was established in 1846 and is located in New Jersey and it produces household goods, personal care, and specialty products[26].

XBiotech Inc. (XBIT)biopharmaceutical company was established in 2005 and is located in Austin, Texas. The company specialized in developing antibodies for the treatment of multiple diseases[27].

Ecolab Inc. (ECL)company was established in 1923 and is located in Minnesota. The company produces cleaning products to do laundry, clean the floor, prevent bugs, and filter water[28].

MedMiraInc(MIR.V)is a biotechnology company that is specialized in the development and producing fast diagnostics devices for various diseases. Most of company sales come from North America.[20]

Vertex Pharmaceuticals (VRTX) company was established in 1989 and is located in Boston, Massachusetts.The companies are experts in developing and manufacturing drugs for patients with serious diseases[29].

IV. Granger-Causality Test

Granger Causality hypothesis test first proposed by C.J Granger [30] is used to determine the direction of causality and the short-term interaction between specific historical data.In the economy, the test measures the capability to forecast the coming values of a time series by exploiting previous time-series data.In the Granger causality statistical test, if two variables are co-integrated, then bidirectional or unidirectional causality should occur. The bidirectional Granger causality procedure aims to recognize the causal relation of each variable.It is, therefore, indicated that, if time series data are not stationary at I(0), and there is no cointegration available between the values, therefore, it is crucial to adjust the series by calculating first difference at I(1) and equation (1) would be computed as follows[31]:

$$Q\ prob\ (Wt + n \mid \Theta t = Q\ prob(W\ t+n \mid G\Theta t) \qquad (1)$$

where: Qprob represents a conditional probability, ‘Θt’ is the information set, which was adjusted at ‘t’ period, Meanwhile, for the time series values ‘Wt+n’and ‘ωt’,are the information, which is consist of distinct values, and ‘t+n’ represent the period. Equation (1) represents unrestricted regression, which then used to calculate the unrestricted residual sum of square(RSSR) and also eliminate the lagged numbers of specific macroeconomic variables.
consequently,the F test is calculated to check the null hypothesis as follows:

$$F = \frac{RSSR - {RSSUR}/{k - k0}}{{RSS}/{N - k}} \qquad (2)$$

From equation (2), we conclude that if the F-value of a statistic is greater than the critical value at a specific level of significance, and if the p-value related to F-statistic is less than 0.05 then the null hypothesis is rejected. Granger causality hypothesis is used in this research to identify the causality link between the research variables i.e. to inspect whether COVID-19 cases are linked to stock trends and also applied to mark the short-run balanced relationship.

Results of Granger-causality Test

In this work Granger-Causality test is used to investigate the causality relationship between the number of Covid-19 cases and many market indices that may be affected positively during the COVID-19 crises like Biopharmaceutical and Cleaning Sector Stocks.

As table 1 identified there was no causality link among each of CHD, SCL,and ECL stock prices and Covid-19 increasing cases in all lags period ie. the null hypothesis is NOT rejected as the p-value is greater than 0.05.On the other hand, there is a unidirectional causality relationship for each of CLX,REGN,GILD,MRNA,XBIT,MIR.V,and VRTX. stocks, with Covid-19 increasing cases in the different lag periods.

Also, relations between MRNA stock prices and COVID-19 cases are much higher than other studied stocks in all lag periods which explained by investors desire to buy stocks which may develop innovative drugs or vaccine for protection against COVID-19.

Table 1 Results of the Granger Causality test

Stock Ticker Symbol	**Num. of Lag**	**SSR based F Test**	**Parameter F Test**
CLX	1	F=7.5548 **p=0.0081**df_denom=54 df_num=1	F=7.5548 p=0.0081 df_denom=54 df_num=1
	2	F=4.3607 **p=0.0179**df_denom=51 df_num=2	F=4.3607 p=0.0179 df_denom=51 df_num=2
	3	F=5.7099 **p=0.0020**df_denom=48 df_num=3	F=5.7099 p=0.0020 df_denom=48 df_num=3
REGN	1	F=5.8760 **p=0.0187**df_	F=5.8760 p=0.0187 df_denom=54 df_num=1

		denom =54 df_num=1	
	2	F=2.5055 p=0.0916 df_denom=51 df_num=2	F=2.5055 p=0.0916 df_denom=51 df_num=2
	3	F=2.7353 p=0.0538 df_denom=48 df_num=3	F=2.7353 p=0.0538 df_denom=48 df_num=3
MRNA	1	F=7.4452 **p=0.0086**df_denom =54 df_num=1	F=7.4452 p=0.0086 df_denom=54 df_num=1
	2	F=8.0064 **p=0.0009**df_denom =51 df_num=2	F=8.0064 p=0.0009 df_denom=51 df_num=2
	3	F=6.0791 **p=0.0014**df_denom =48 df_num=3	F=6.0791 p=0.0014 df_denom=48 df_num=3
GILD	1	F=7.4610 **p=0.0**	F=7.4610 p=0.0085 df_denom=54

		085df_denom=54 df_num=1	df_num=1
	2	F=3.7184 **p=0.0311**df_denom=51 df_num=2	F=3.7184 p=0.0311 df_denom=51 df_num=2
	3	F=2.4899 p=0.0715 df_denom=48 df_num=3	F=2.4899 p=0.0715 df_denom=48 df_num=3
CHD	1	F=1.3327 p=0.2534 df_denom=54 df_num=1	F=1.3327 p=0.2534 df_denom=54 df_num=1
	2	F=0.9079 p=0.4098 df_denom=51 df_num=2	F=0.9079 p=0.4098 df_denom=51 df_num=2
	3	F=0.6804 p=0.5684 df_denom=48 df_num=3	F=0.6804 p=0.5684 df_denom=48 df_num=3
SCL	1	F=1.8929	F=1.8929 p=0.1746 df_denom=54

		p=0.1746 df_denom=54 df_num=1	df_num=1
	2	F=1.2516 p=0.2947 df_denom=51 df_num=2	F=1.2516 p=0.2947 df_denom=51 df_num=2
	3	F=1.2635 p=0.2974 df_denom=48 df_num=3	F=1.2635 p=0.2974 df_denom=48 df_num=3
ECL	1	F=1.5755 , p=0.2148 , df_denom=54 , df_num=1	F=1.5755 , p=0.2148 , df_denom=54, df_num=1
	2	F=2.8074 , p=0.0697 , df_denom=51 , df_num=2	F=2.8074 , p=0.0697 , df_denom=51, df_num=2
	3	F=2.6521 , p=0.0592 , df_denom=48 ,	F=2.6521 , p=0.0592 , df_denom=48, df_num=3

		df_num=3	
XBIT	1	F=0.0044 , p=0.9477 , df_denom=54, df_num=1	F=0.0044 , p=0.9477 , df_denom=54, df_num=1
	2	F=1.9932 , p=0.1467 , df_denom=51, df_num=2	F=1.9932 , p=0.1467 , df_denom=51, df_num=2
	3	F=2.9958 , **p=0.0398**, df_denom=48, df_num=3	F=2.9958 , p=0.0398 , df_denom=48, df_num=3
VRTX	1	F=7.5249 , **p=0.0082**, df_denom=54, df_num=1	F=7.5249 , p=0.0082 , df_denom=54, df_num=1
	2	F=2.3772 , p=0.1030 , df_denom=51, df_num=2	F=2.3772 , p=0.1030 , df_denom=51, df_num=2

	3	F=1.5985 , p=0.2020 , df_denom=48, df_num=3	F=1.5985 , p=0.2020 , df_denom=48, df_num=3
MIR.V	1	F=0.0328 , p=0.8569 , df_denom=54, df_num=1	F=0.0328 , p=0.8569 , df_denom=54, df_num=1
	2	F=1.0659 , p=0.3520 , df_denom=51, df_num=2	F=1.0659 p=0.3520 df_denom=51 df_num=2
	3	F=4.5969 , **p=0.0066**, df_denom=48, df_num=3	F=4.5969 , p=0.0066 , df_denom=48, df_num=3

IV. Pearson Correlation

The Pearson correlation analyses determine the strength of the linear relationship between the two factors. In this research, a Pearson correlation analysis is used to determines the strength of the relationship between the daily number of registered COVID-19 cases and the company's daily closing prices for the same period.

Cohen's scale is adopted to measure the strength of the linear association, where the coefficients between .10 and .29 indicate a weak correlation, the coefficients between .30 and .49 indicate a medium correlation, and the coefficients above .50 imply a strong correlation value [32]. A Pearson correlation demands a linear correlation among each pair of factors [33].However, this hypothesis is considered false if there is a bending between the scatter plot values of each pair of nodes.

RESULT OF PEARSON CORRELATION ANALYSIS

The result of the correlation was examined based on an alpha value of 0.05 and table 2 illustrates the results. A significant positive correlation was observed between the number of COVID-19 registered cases and the closing price for most companies understudy. The strongest positive correlation was observed for MRNA with a correlation coefficient of (0.94) indicating a large effect size followed by MIR.V, REGN,and VRTX companies with correlation coefficient values equal to 0.88, 0.85, 0.82 subsequently. This correlation indicates that as COVID-19 cases increases, closing prices for these companies tend to increase. For the SCL stock, the correlation coefficient was 0.29, indicating a small effect size.On the other hand, for CHD and ECL there were no significant correlations between the number of COVID-19 registered cases and the closing price of the companies. The result of Pearson Correlation tests indicates that the increasing number of COVID-19 registered cases will positively affect some of the cleaning product stocks and most of Biopharmaceutical companies.

Table 2 Pearson Correlation Results Between COVID-19 and Close Price

PEARSON CORRELATION BETWEEN COVID-19 CASES AND STOCK CLOSE PRICES	R_P	**95% CI**	***P***
CLX	0.81	[0.71, 0.89]	< .001
GILD	0.69	[0.53, 0.80]	< .001
CHD	**0.18**	[-0.08, 0.42]	.177
ECL	**0.20**	[-0.07, 0.43]	.141
MIR.V	0.88	[0.81, 0.93]	< .001
MRNA	**0.94**	[0.91, 0.97]	< .001
REGN	0.85	[0.76, 0.91]	< .001
SCL	0.29	[0.04, 0.51]	.027
VRTX	0.82	[0.71, 0.89]	< .001
XBIT	0.73	[0.58, 0.83]	< .001

V. LINEAR REGRESSION ANALYSIS

Linear regression analysis is used to determine whether the daily number of registered COVID-19 cases can successfully predict companies daily closing price directions. The presumption of normality was tested by measuring the values of the approach residue with the observed values of the Chi-square distribution, also known as the Q-Q scatterplot [34].

To satisfy the principle of normality, the residual values must not deviate significantly from the hypothetical values. High anomalies could reveal that measurements of the variable are not reliable.In our case, because there was only one indicator variable, multi-collinearity does not exist and variance inflation factors have not been determined. The residues are determined and the absolute values are measured with the observation values to determine influential points[35],[36] .Studentized residues are determined by dividing the residual factor by the approximate residual standard deviation. Evaluation with a residual student larger than 3.24 in absolute value, at the distribution of 0.999 quartiles with 57 degrees of freedom was expected to have a crucial impact on the results of the model.

RESULT OF LINEAR REGRESSION ANALYSIS

The linear regression model analysis indicates that some cleaning product companies closing price movements are predicted by the number of registered COVID-19 cases. For example, 66% of the CLX

company closing prices are predicted by COVID-19 increasing cases.Also,for SCL company approximately 8% of the variance in close prices is predictable by COVID-19 cases. While CHD and ECL stocks movement can not be predicted by the number of COVID-19 cases. On the other hand, all of the biopharmaceutical company's closing prices is predicted by the number of COVID-19 registered cases. For instance, MIR.V, MRNA, and REGN stock prices are predicted by COVID-19 cases with approximately 78,89,and 72 percent respectively.
Overall, the result of Linear regression analysis indicates that all of the biopharmaceutical stocks can be predicted by the number of COVID-19 registered cases while some cleaning products stocks can be predicted by the COVID-19 cases. Table 4 summarizes the results of the linear regression model.

Table 3:Results for Linear Regression with COVID-19 cases predicting Close price.

STOCK	**VARIABLE**	***B***	***SE***	**95% CI**	**B**	***T***	***P***
CLX	(Intercept)	171.78	1.24	[169.30, 174.27]	0.00	138.30	< .001
	Covid	0.00	0.00	[0.00, 0.00]	0.81	10.52	< .001
GILD	(Intercept)	72.94	0.53	[71.88, 74.00]	0.00	137.85	< .001
	Covid	0.00	0.00	[0.00, 0.00]	0.69	7.13	< .001
CHD	(Intercept)	69.17	0.77	[67.64, 70.71]	0.00	90.19	< .001
	Covid	0.00	0.00	[-0.00, 0.00]	0.18	1.37	.177
ECL	(Intercept)	175.09	3.29	[168.50, 181.68]	0.00	53.25	< .001
	Covid	0.00	0.00	[-0.00, 0.00]	0.20	1.49	.141
MIR.V	(Intercept)	0.00	0.01	[-0.02, 0.02]	0.00	0.27	.785
	Covid	0.00	0.00	[0.00, 0.00]	0.88	14.01	< .001
MRNA	(Intercept)	25.12	0.63	[23.85, 26.39]	0.00	39.65	< .001
	Covid	0.00	0.00	[0.00, 0.00]	0.94	21.22	< .001
REGN	(Intercept)	455.73	4.50	[446.73, 464.74]	0.00	101.39	< .001
	Covid	0.00	0.00	[0.00, 0.00]	0.85	12.08	< .001
SCL	(Intercept)	88.75	1.17	[86.40, 91.10]	0.00	75.68	< .001
	Covid	0.00	0.00	[0.00, 0.00]	0.29	2.27	.027
VRTX	(Intercept)	226.40	2.11	[222.17, 230.62]	0.00	107.33	< .001

	Covid	0.00	0.00	[0.00, 0.00]	0.82	10.67	< .001
XBIT	(Intercept)	11.22	0.23	[10.76, 11.69]	0.00	48.22	< .001
	Covid	0.00	0.00	[0.00, 0.00]	0.73	8.01	< .001

VI. Conclusion and Future Work

In this research, we study the possible positive impact of COVID-19 pandemic mainly on biopharmaceutical and cleaning product stocks. We used Granger causality test and Pearson correlation test to investigate the correlation between increasing cases of the COVID-19 infection in the USA on the movements of many companies stocks namely, Clorox Company (CLX), Regeneron Pharmaceuticals(REGN), Stepan Chemical (SCL), Gilead Sciences (GILD), Moderna Inc. (MRNA) stocks, Church & Dwight develops(CHD), XBiotech Inc. (XBIT), Ecolab Inc. (ECL), MedMiraInc (MIR.V),and Vertex Pharmaceuticals (VRTX) company.The Linear regression test was also employed to determine whether or not the number of COVID-19 daily cases can be used to predict stock movements.The outcome shows that the number of COVID-19 daily cases does cause stock prices to fluctuate for some stocks and can be used to make valuable investment decisions.

The result of Pearson Correlation and Granger causality tests indicates that an increasing number of COVID-19 registered cases will positively affect some of the cleaning product stocks and most of Biopharmaceutical companies that encouraged investors to buy Biopharmaceutical stocks during the COVID-19 crises. Also, the panic buying results from rising demand trigger an increase in prices of many cleaning product stocks. In the future, we could add more stocks for analysis to make a more robust conclusion and for a longer time. Also, we could include more correlation statistical tests to get more precise results.

Abbreviations

Correlation Coefficient (r): Scales from-1 to 1; defines the importance of the relationships among the variables.

Critical Value: The minimum value at which an observed correlation coefficient is statistically significant.

p-value: The probability of obtaining the observed results if the null hypothesis is true. A result is usually considered statistically significant if the p-value is ≤ .05.

95% Confidence Interval (95% CI): An interval that estimates the range one would expect B to lie in 95% of the time given the samples tested comes from the same distribution.

Degrees of Freedom (df): Used with the F ratio to determine the p-value.

F Ratio (F): Used with the two df values to determine the p-value of the overall model.

p-value: The probability that the null hypothesis (no relationship in the dependent variable by the independent variable) is true.

Residuals: Usually relates the difference between the expected value for the dependent variable and the real value for the dependent variable.

R-Squared Statistic (R2): Shows how much variation in the dependent variables is described by the predictor variables.

Standardized Beta (β): Ranges from -1 to 1; gives the strength of the relationship between the predictor and dependent variable.

Studentized Residuals: Residuals that are scaled by diving each residual by the estimated standard deviation of the residuals.

t-Test Statistic (t): Used with the df to determine the p-value; also can show the direction of the relationship between the predictor and dependent variable.

Unstandardized Beta (B): The slope of the predictor with the dependent variable.

Standard Error (SE): How much the B is expected to vary.

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