

Impact of COVID-19 on Stocks - An Empirical Evidence from Vaccine - Developing Pharmaceutical Companies in India and the USA

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Abstract: *The world experienced the first global pandemic of the 21st century- COVID-19. The highlights which play a significant role in COVID-19 pandemic include- national/state lockdowns, role of healthcare specialists, essential service providers, relaxations in lockdowns, economic stimulus packages announcements, etc. There is significant literature in regards to the socio-economic conditions globally during a pandemic but each pandemic varies based on intensity of spread, geographic reach, symptoms, etc. A pandemic has significant impact on the global as well as individual country's economy and its financial markets. The present paper gives the glimpse into the rise of the global pandemic COVID-19 and its growth over the span of 1 year- 2020. This paper presents the case of 2 most affected countries- India and the USA and establishes a cause-and- effect relationship between the increase in COVID-19 cases in the respective countries and the stockprices of vaccine-developing pharmaceutical companies listed in these countries. The paper conducts a least square regression analysis and establishes the hypothesis.*

Keywords: COVID-19, Stock prices, BSE, NASDAQ, India, USA

1. Introduction

The spread of any disease that causes havoc and tension on a global level and results in death and chaos can be the perfect description of a pandemic. Ever since the Antonine Plague (165-180 AD) the first ever pandemic recorded in history, the world has recorded the occurrence of 19 other pandemics including the 2 major ongoing pandemics- HIV/AIDS and COVID-19. COVID-19 ranks 9th in the rank of most deadly pandemics in history in terms of the total death toll. In the last month of 2019, at the capital city of Hubei Province- "Wuhan", People's Republic of China, the first ever human case of the so- called Coronavirus disease 2019 (COVID-19). The outbreak in Wuhan City was initially reported for respiratory illness and on detailed research it was found to be illness caused by SARS CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2). The health damage to a healthy state of individual by this SARS CoV-2 was renamed as COVID-19. The genetic study of the COVID-19 virus revealed that it is a virus that usually affects animals but underwent mutation making it capable enough to affect human beings. One present explanation of the source of Covid-19 mutated virus is bats.

By the month of February- March 2020 a number of countries across the world started reporting cases of COVID-19. This caused the local governments to take immediate steps to control the medical emergency and this coincided with the WHO officially announcing COVID-19 as a global pandemic on March 11, 2020. With the increasing reported cases and death toll across the globe several countries finding themselves helpless with no cure to the virus declared lockdowns on the country level and closed their borders and local activities to a major extent to stop the community spread of the virus. The global lockdowns and chaos due to medical emergencies called for medical professionals and security services- police, emergency service providers, etc. to rise to the occasion as real heroes of society and saving the day.

By mid-February, 2020 the daily reported cases of COVID-19 increased and this struck governments of countries across the

world as an alarming bell concerning their regular trade with China and its impact. By mid- March, 2020 the WHO had announced COVID-19 as a global pandemic and all countries were at different stages of defense mechanisms against health emergencies. Countries like Italy, France, etc. were amongst the first few to experience major death toll however with cases increasing in other countries and USA, India, Brazil, Russia, etc. announcing lockdown, the world economy and logistics took a major hit. With the strike of the first wave of COVID-19 cases, each of the countries began to control the regional chaos and spread awareness about preventive measures and symptoms of COVID-19. The pharmaceutical industries began to pace up their research and technology processes to come up with a cure for the deadly virus.

With the increasing spread of the Covi-19 cases and economic havoc impacting international logistics to financial markets, this pandemic can in a way be described to have damaged global economy in worse terms than the Financial Crisis of 2007-2008. This called for governments in different countries to come-up with strategic financial and other stimulus packages which could stabilize the financial markets. With all participants of the economy into play to strengthen and maintain the equilibrium of the global economy, the socio- economic factors play a very essential role in the study of COVID-19 pandemic.

As of 31st December, 2020, the most affected countries due to COVID-19 in terms of cases recorded in the world are- USA, Brazil, India, Russia, South Africa, etc. With heavy damage to global businesses and economies due to lockdowns, countries started to loosen lockdown restrictions in phases with regional travel and gradually to international travel. The total confirmed cases as of January 2021 have been 107M+ with a confirmed death of 2.34M+.

Table 1.1: Category and Market Capitalization in India and the USA

Category	Market Capitalization India(in INR)	Market Capitalization USA (in USD)
Small Cap	Upto Rs. 5000 Cr	\$ 300M - \$ 2B

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Mid Cap	Rs. 5000 Cr- Rs. 20000 Cr	\$ 2B - \$ 10B
Large Cap	Rs. 20000 Cr +	\$ 10B - \$ 200B
Mega Cap (Only in USA)	-	\$200B +

Table 1.2: Indian Companies in the COVID-19 vaccine development process

Company name (Listed)	Market Capital (in Cr)	Vaccine name
Zybus Cipla	60,120.56(Large Cap)	Generic variant of Remdesivir
Panacea Biotec	1,164.99(Small Cap)	N/A
Bharat Immunologicals	129.32(Small Cap)	N/A
Sun Pharma Ind	1,24,549.48(Large Cap)	AQCH
Pfizer Ltd.	22,965.36(Large Cap)	BNT162b2
Cadila Healthcare	43,979.98(Large Cap)	ZyCoV-D
Aurbindo Pharma Ltd.	49,860.45(Large Cap)	Pneumococcal Conjugate Vaccine (PCV)
Laurus Labs	15,160.62(Mid Cap)	Hydroxychloroquine and Vaccine clinical trials

Table 1.3: USA listed companies in the COVID-19 vaccine development process

Company name	Vaccine name	Market Capital (NASDAQ)	Market Cap. Category
Gilead Sciences	Remdesivir	76,427,611,245	Large Cap
Moderna	MRNA-1273	36,860,396,281	Large Cap
“Amgen” and Adaptive Biotechnologies	Otezla	135,319,272,173	Large Cap
“Altimmune” w/ Uni. of Alabama	AdCOVID	314,505,400	Small Cap
BioNTech	BNT162	20,931,490,035	Large CAP
CytoDyn (Canadian Company)	Ieronlimab	N/A	
GlaxoSmithKline	AS03 Adjuvant sys for vaccine	93,198,662,539	Large Cap
Heat Biologies	N/A	164,641,226	Micro Cap
J&J	N/A	393,170,248,063	Mega Cap
Sanofi	Kevzara	126,315,333,328	Large Cap
Pfizer		200,324,613,428	Mega Cap

2. Literature Review

Global economy as a whole is suffering the adverse impact of COVID-19 pandemic- rising unemployment, business losses, change in lifestyle. On the other hand, as the vaccine making and approval race is getting intense some big Pharma companies- Gilead and Eli Lilly are experiencing positive stock growth, etc. Companies like Astra Zeneca, Gilead, Eli Lilly, Pfizer, Bayer, etc are all in some way or the other extending their hand in service of the society by donating free masks, diabetes medicines, etc in an attempt to stabilize the emergency medical needs of the people. Each of these companies are equivalently working for the development of COVID-19 vaccine in an attempt to earn high profits from

minimum royalties in such times of compassion from drug development and also to save and improve their reputation on a global platform. (Healthcare, 2020)

Market expectation is a major cause behind stock price fluctuations on a day to day basis. The imposition of lockdown seems to have shrunk the market expectation for a large number of sectors, on the contrary there has been a positive inclination of market expectation especially towards the Pharmaceutical sector which is seeing a Q-o-Q growth along with the entire healthcare sector. (Mabiyani, 2020)

India is the 3rd largest drug producer by volume and produces 60% of global vaccine demand. The global strategic plan to combat COVID-19 depends on Active Pharmaceutical Ingredient sourcing (APIs). India is one of the major API source exporters. Indian manufacturers have always depended for ingredients from China. The GOI could possibly extend finance and tax relaxation, SEZ Pharma hub creation, Reliable SCM in an attempt to promote domestic API manufacturing. (Dadhich, 2020)

G7 member nations in the month of March announced a country- wide lockdown along with travel ban inter and intra state (depending country-to-country) and economic stimulus packages. The control on the emergence of new COVID-19 positive cases as a response to lockdown and other measures reinstated confidence among market speculators thus resulting in positive effect on stock markets of G7 nations. (Narayan, BachPhan, & Liu, 2021)

In the early period of the COVID-19 pandemic- between 22nd January and 17 April, 2020 the stock markets of 64 countries responded negatively to the growth in COVID-19 cases. The study finds that the stock market proactively responded to growth of COVID-19 cases as compared to Death toll in the country. The stage of wave and number of cases all have a direct impact on market expectations. (Ashraf, 2020)

The outbreak of COVID-19 disease in December, 2019 soon took the form of Global Pandemic of the 21st century. Different countries tried different techniques and medications for diagnosis and treatment of patients. CT Scan and RT-PCR have been really helpful in diagnosis procedure and besides all other plasma therapy is expected to show promising results in near future. (AnkitAwasthi, et al., 2020)

In the early days of the spread of COVID-19 virus, there was a chaos internationally to cope with a temporary solution for the disease and one of the treatments to be tested under observation in clinical trials was HCQ or hydroxychloroquine. The supply chain of HCQ export internationally was expected to be coordinated by global co-operation among governments. India is the lead HCQ drug manufacturer globally. (Zhang & Zhong, 2020)

India is globally competitive and recognized for its generic version drug supply at low cost. However, India is highly dependent on its Eastern neighbor China for 70% of APIs. The lockdown and new quarantine norms between countries in regards to export and restraints caused concerns among the industry. The GOI is strategizing reforms to support and

grow API manufacturing in the country. (Chatterjee, 2020)

Major announcements in regards to the global COVID-19 pandemic have resulted in high volatility in the Indian stock market. NIFTY is almost 31% down to its recent record high and a majority of the companies that constitute NIFTY are blue-chip names and are trading at multi-year lows. (C, Ganapathyraman', & Sugumaran, 2020)

The paper studies the relation between the reporting of new COVID-19 cases and death ratio in the United States and the global numbers and their impact on the volatility in the stock prices of S&P 500 index. The results are very clear and prove that prolonged volatility is opposing the risk management process. (Albulescu, 2021)

The paper attempts to study risk associated with COVID-19 pandemic to different industries in a US stock market. Both positive as well as negative news in regards to pandemic affect stock prices however there exist a negativity bias which causes major distress in the regular functioning and increases threat to different industries. (Baek, K.Mohanty, & Glambosky, 2020)

COVID-19 outbreak questions the impact that disease outbreaks have upon economies and stock markets globally. The study takes different pandemic and epidemic data and studies its impact on different stock exchanges. The results show that stock markets have recovered quickly to outbreaks within a span of 79 days except for COVID-19. The volatility caused by COVID-19 outbreak is more as compared to other outbreaks and also spans for a longer period of time. (S.A.Davida, Jr., & Machado, 2021)

The study attempts to compare 2 composite Indian indices namely BSE 500 and BSE Sensex along with 8 BSE sectoral indices with 3 global indices- S&P 500, Nikkei 225 and FTSE 100 and compare the volatility using various statistical methods. The Indian stock indices proved to be more volatile than the global indices. (Chaudhary, Bakhshi, & Gupta, 2020)

The global pandemic has revolutionized the lifestyle for all of humanity. The healthcare and pharma industry is experiencing the most convulsive change. This change is characterized by- rival collaborations, secret academic sharing, higher employment, intergovernmental cost sharing. The future beholds the solution and strong partnership and compassion is the key. (How COVID-19 has and will change the pharma sector, 2020)

With the successful acceptance of Pfizer-BioNTech vaccine by different nations, countries globally began to check their infrastructure and financial potential and placed advance order for the vaccine. India, one of the potentially big markets for vaccines, had raised concerns regarding the high price of the vaccine as well as the need for highly cold infrastructure needed for the vaccine. This caught the attention of the company which may negotiate for the pricing with the GOI. (Das, 2020)

December 13th marked the beginning of a new and hopefully the last chapter of the fight against the COVID-19 pandemic.

The chapter begins with the FDA approval given to Pfizer company to give its vaccine to people as the death toll in the US reached the milestone 3,00,000. Sandra Lindsay, a nurse is the first ever person to be vaccinated who will be followed by the CEO of Pfizer and others to instill confidence among people as the world's largest vaccine drive begins. (India, 2020)

Pfizer and BioNTech joint venture partners for the development of the COVID-19 vaccine came through with flying colors as they received FDA approval for emergency usage. The approval had varying results to the stock prices of both the organizations on the US stock exchange. The stock price of Pfizer saw nearly 0.2% increase while surprisingly BioNTech stock took a 1% dip. (Gatlin, 2020)

In the early days of the COVID-19 outbreak, post 40 days when the global records of COVID-19 cases were being reported by the WHO, the data was being studied to analyze the fear factor in people's mind and its impact on the stock market. The death ratio on daily bases globally had a positive impact on the volatility index. As the number of countries impacted increased so did the volatility in the global financial market. (Albulescu, Coronavirus and financial volatility: 40 days of fasting and fear, 2020)

The paper compares two volatility measuring instruments and their effectiveness based on in-sample and out-of-sample impacts. VIX index which has been used for a long time is more effective in case of in-sample case while EMV trackers show empirical results in the case of out-of-sample impacts. EMV trackers are found to be more efficient in predicting volatility in the US markets. (Zhu, Liu, Wang, Wei, & Wei, 2019)

The rapid spread of the COVID-19 virus came as a sudden jolt to the global economy and its people. The pandemic in the short-run increased levels of risk causing heavy losses to investors in the global capital market. The paper attempts to find the impact of this sudden chaos in the global economy on country-specific policies like- US zero percent interest rate implementation, etc. and how the implementation in these crucial times will increase uncertainty. (Zhang, Hu, & Ji, 2020)

The outbreak of the COVID-19 pandemic had quite a damaging impact on the global economy and especially the capital markets. Several countries came up with rescue measures and packages which came as a relief for the investors and led to significant recovery of the capital markets. This recovery however was different in terms of strength and time span for different countries. The greater fiscal rescue package proposed by the country the greater and stronger was the recovery and vice versa. Country's recovery performance was also dependent on natural resources and tourism revenues. (Seven & Yilmaz, 2021)

The paper attempts to examine the financial contagion and its causes and impact between firms located in China and other G7 nations. The study finds that the financial and non-financial firms in these countries show additional conditional correlation in their stock prices during the COVID-19 period. The study also finds that the overall cost of financial

hedging has seen a significant increase in the COVID-19 span. (Akhtaruzzaman, Boubaker, & Sensoyd, 2021)

The study has a theoretical model that explains the relationship between occurrence of pandemics and the breakdown of the banking industry. The study explains the short term and long-term reaction of people to pandemics and its impact on bank deposits and reserves and how this stabilizes over a period of time. (Lagoarde, Patrick, & L.Leoni, 2013)

The paper aims to study the damaging impact that COVID-19 pandemic has caused to the global financial markets as it swiftly shifts from its epicenter China to Europe and into USA. The study finds that the spread of the virus affected the investor's mentality in terms of risk and the market experienced high volatility globally. The Chinese markets however recovered quickly by Q3 of 2020-21 but the other global markets found themselves to be highly vulnerable at the same time. (Ali, Syed, & R.Rizvi, 2020)

The study attempted to study the significant increase in COVID-19 cases per million in freer countries and so-called less-free countries. It is astonishing that the stock market return in less-free countries seem to have been more affected by the increase in cases as compared to the freer countries. (Erdem, 2020)

The paper attempts to study the predictability of a variety of securities- currency, bonds, commodities and the stock returns in the US capital markets. Based on LASSO approach and CAUCHY errors technique the study found that corporate bonds had the highest significant level of predictability. (Ciner, 2021)

The paper attempts to study the US equity market and analyze the damage and concerns that COVID-19 pandemic has raised. The paper finds that increased number of cases and reported deaths along with extended lockdowns and restrictions are the major cause for volatility in the equity market and illiquidity. The negative sentiment on news regarding the pandemic and its impact is damaging for the stability in the stock market. (S.Baiga, Anjum, Haroona, & R.Rizvia, 2021)

The paper attempted to use quantile regression technique to study the degree and structure of risk-return dependence in the US stock market. The paper also takes Google Search Index for Coronavirus into examination. The results of the study prove that COVID-19 has changed the risk-return dependence relationship and the GSIC dependence is asymmetric. (Azimli, 2020)

The Union Minister of India in his first announcement for 2021 said that India is preparing for having 4 different vaccines to fight COVID-19. The country has already approved the use of AstraZeneca, ZyCoV-D and NVX-CoV2373 and the Bharat BioNTech vaccine is under discussion. The country is conducting clinical trials for 6 different vaccines at present and is hopeful for starting vaccine drive soon. (Ghosh, 2021)

India a country which has been an epicenter for the

production and distribution of low cost and effective vaccines is hoped to be the savior for the whole world. The country's government and the pharmaceutical companies seem to be highly optimistic about being able to deliver vaccines. This however concerns some scientists who are of the opinion that India will struggle to make and distribute vaccines for its own people who are geographically distributed around a vast landscape. (Vaidyanathan, 2020)

The final week of the year 2020 was quite a shocker with people going out on Christmas spree and a spike in COVID-19 with low count and reporting. Besides this the stock prices of vaccine making companies- Moderna and BioNTech experienced the worst day of the month. The stocks slumped approximately 9% and 5.5% respectively. The respective companies have been on notice based on volume of trade ever since their vaccine got approval from respective agencies but they are attempting to tackle the threat of the new strain of COVID-19. (Flanagan, 2020)

The potential of vaccine rollout and its supply across the globe to billions of people has created an opportunity for growth of a large number of businesses and this has brought about an optimism in the investors mind. Investors are actively researching the opportunity to invest and earn supernormal returns. Businesses like- cold storage, supply chain companies, vaccine making pharmaceutical companies are most focused upon by investors globally. (Reidy & Coniam, 2020)

In the United States of America with the entire political chaos created between the Republicans and the Democrats the focus of everyone was also on the governments focus on measures for COVID-19 and its vaccination rollout. As of 21st of January, the Centers for Disease Control and Prevention have given 15.1 million people at least 1 dose of the vaccine. The entire vaccination started in the last week of 2020 with the hope that the new strain does not spread across the world from the UK and other EU nations. (Ivory, Smith, Lee, & Walker, 2020)

With approximately 3,00,000+ deaths and 16.5 million+ reported cases in the US itself, the final hope from the vaccine rollout brought questions in the minds of citizens of US and across the globe. The rollout of vaccine brought in several questions and potential technical challenges as well. With FDA approval- Pfizer, Moderna and BioNTech are working at maximum capacity to speed up the rollout. (Matza, 2020)

The rapid growth of COVID-19 cases and death toll globally have triggered fears of global recession and economic crisis. Several industries have taken a major hit except the Pharmaceutical and Healthcare industry along with the Agriculture industry. Lockdown and social fears have resulted in almost 25% increase in helpline calls for domestic violence, cases of sexual abuse, mental trauma and attempts to suicide. (Nicola, et al., 2020)

3. Research Methodology

COVID-19 became one of the most historical yet terrifying memory for people across the world and is recorded as one of

the greatest pandemics of the 21st century. The paper attempts to analyze and prove the impact that increase in COVID-19 cases in countries- India and USA had on the stock market closing prices of Pharmaceutical companies especially those which are working on vaccine development to curb the damage that COVID-19 pandemic can potentially cause.

3.1 Objective of the Study

The COVID-19 virus which originated in China rapidly spread across the world and the countries which reported maximum cases include- USA, Brazil, India, etc. This brings out several questions and thus the main objective of this paper is to determine the effect of increase in COVID-19 cases on the stock price of vaccine-developing Pharmaceutical companies in India and the USA.

The paper in aspects is a sub-part of fundamental analysis as it is an impact research of investor sentiment and perspective on economic conditions like spread of COVID-19 cases in the country and globally and how it can positively or negatively impact the business of the firm they have invested in. Thus, the paper establishes a cause-and-effect relationship between increasing Covid-19 cases and stock price of Vaccine-development focused Pharmaceutical companies. In order to achieve such a resourceful analysis, it was important to get accurate and reliable Quantitative data:

- Daily COVID-19 cases reported data which with the help of the WHO, the Government of India- Ministry of Health and Family Welfare and U.S Department of Health and Human Services
- Daily closing stock prices of listed companies in USA and India. This data was possible with the help of stock exchange websites- NYSE, NASDAQ and BSE.

For the entire purpose of study, the only means of data used is- Secondary data. To avoid manipulations and problems associated with delays in daily reporting of COVID-19 cases during the Christmas festivity period, the study only accounts for data till 18th December, 2020. The dataset was also checked for any missing outliers. The data by characteristics can be described as Panel data as it contains data collected over a period of time (approximately 1 year) for multiple entities.

The daily COVID-19 cases data was brought into alignment with the stock prices data which were not accountable for each day since stock markets do not function every day of the week. Based on the adjustments to the data the total amount of data for India accounts for 243 days of data and 245 days of data for USA.

In order to produce a reliable and resourceful result from the research, the data was prepared as mentioned earlier. On completing the necessary steps for verification, the datasets for India and USA were separately analyzed using the EViews 11 software. The main aim behind choosing the software was its highly efficient, easy, reliable performance in managing data and conducting econometric and statistical data analysis.

The test conducted for establishing the cause-and-effect

analysis and proving the hypothesis was- Least Square Regression test. The Least Square Regression test helped in explaining how the dependent variable changes with an explanatory independent variable change. For the research the analysis between the independent variable and the dependent variables was conducted on a individual basis.

4. Data Analysis and Interpretation

Overview

The underlying question attempted to find a solution to by the course of this research is- does an increase in COVID-19 cases in a specific country have an impact on the stock prices of Pharmaceutical companies especially those working on the development of vaccine as a cure to the global pandemic. The main reason behind choosing India and USA for the purpose of study is the total number of cases both the countries have recorded over the period of time- ranking USA at 1st position with maximum cases in the world and India ranking 3rd with Brazil on the second rank. Due to insufficient data on daily COVID-19 cases in Brazil and also the insufficient number of vaccines making pharmaceutical companies, the country was not chosen for the study.

Data and Hypothesis

There are a large number of regression analysis techniques which are developed or established in order to perform different type of roles on different types of data. Today with advancements in native educational fields, the use of regression analysis has increased from its native applications and is expanding even into data science, etc. In order to get the desired result, it becomes essential to choose the correct analysis tool and test. In this study I have fit the Least Square regression model to predict and prove the cause-and-effect relationship between the increasing COVID-19 cases and the stock price of vaccine-developing pharmaceutical companies. In order to conduct the test, it is important to create a proposition which will be tested in the process or the so- called hypothesis.

Table 4.1: Hypothesis for the purpose of the study

For Indian COVID-19 cases and listed companies	H0: An increase in COVID-19 cases in India does not cause any increase in the stock price of vaccine developing pharmaceutical companies listed in India
	H1: An increase in COVID-19 cases in India causes an increase in the stock price of vaccine developing pharmaceutical companies listed in India
For USA COVID-19 cases and listed companies	H0: An increase in COVID-19 cases in USA does not cause any increase in the stock price of vaccine developing pharmaceutical companies listed in the USA
	H1: An increase in COVID-19 cases in USA causes an increase in the stock price of vaccine developing pharmaceutical companies listed in the USA

5. Results of the Study and Interpretation

Table 4.2: Descriptive statistics of Vaccine making Indian Pharmaceutical companies and Indian COVID-19 cases data

Variable	Mean	Median	Standard Deviation	Skewness	Kurtosis
COVID-19 cases	2724386	566840	3483218	0.93	2.24
Panacea Biotec	168.51	180.75	37.76	-0.15	1.94
Bharat Immunologicals	20.99	19.06	11.59	0.33	1.81
Laurus Labs	167.78	107.37	96.85	0.57	1.65
Cipla Ltd.	627.56	641.20	132.07	-0.44	1.79
Sun Pharma Ind.	473.47	481.95	52.70	-0.61	3.26
Pfizer Ltd.	4491.28	4436.35	428.02	0.35	1.76
Cadila Healthcare	352.49	361.85	64.24	-0.10	1.9
Aurobindo Pharma Ltd.	697.73	776.00	165.86	-0.62	2.02

Table 4.3: Descriptive statistics of Vaccine making USA listed Pharmaceutical companies and Indian COVID-19 cases data

Variable	Mean	Median	Standard Deviation	Skewness	Kurtosis
COVID-19 cases	4254910	2461586	4504704	1.07	3.35
Gilead Sciences	69.19	68.58	6.71	0.09	1.73
Moderna Inc.	60.62	64.21	32.29	1.07	4.72
Amgen	231.53	232.44	15.32	-0.61	3.37
BioNTech	64.03	60.17	24.87	0.62	2.61
Altimmune	9.90	9.24	7.79	0.98	3.17
CytoDyn	2.93	2.95	1.44	0.62	3.56
GSK	40.1	40.53	3.23	0.30	3.03
Heat Biologics Inc.	6.68	6.09	3.88	1.45	6.24
Pfizer Inc.	34.89	35.07	2.54	-0.25	3.94
Johnson and Johnson	145.55	147.30	6.63	-2.02	8.50
Sanofi Inc.	49.37	50.17	2.76	-1.53	5.61
AstraZeneca	51.93	53.07	4.19	-1.13	4.16

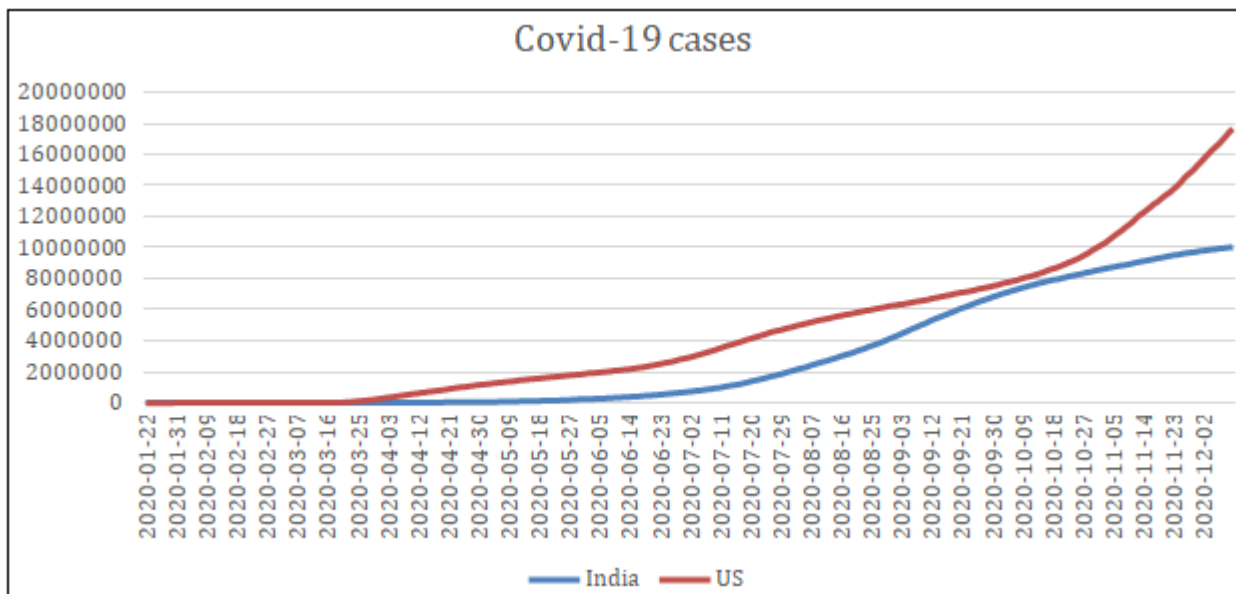


Figure 4.1: Rise of COVID-19 cases in India and the USA

The line graph above depicts the trend of the increase in the COVID-19 cases. It can be observed that the COVID-19 cases in the USA saw a relatively steeper growth curve as compared to growth of COVID-19 cases in India. Between the months of March and June when India had strict lockdown the rise in cases was relatively low however with relaxations

in lockdown post June, the increase in cases was sharp. The arrival of festival times also was one of the reasons for the increase in cases as the gatherings increased which was one of the reasons for community spread. Besides these causes there were several other economic conditions which had an impact on the growth of COVID-19.

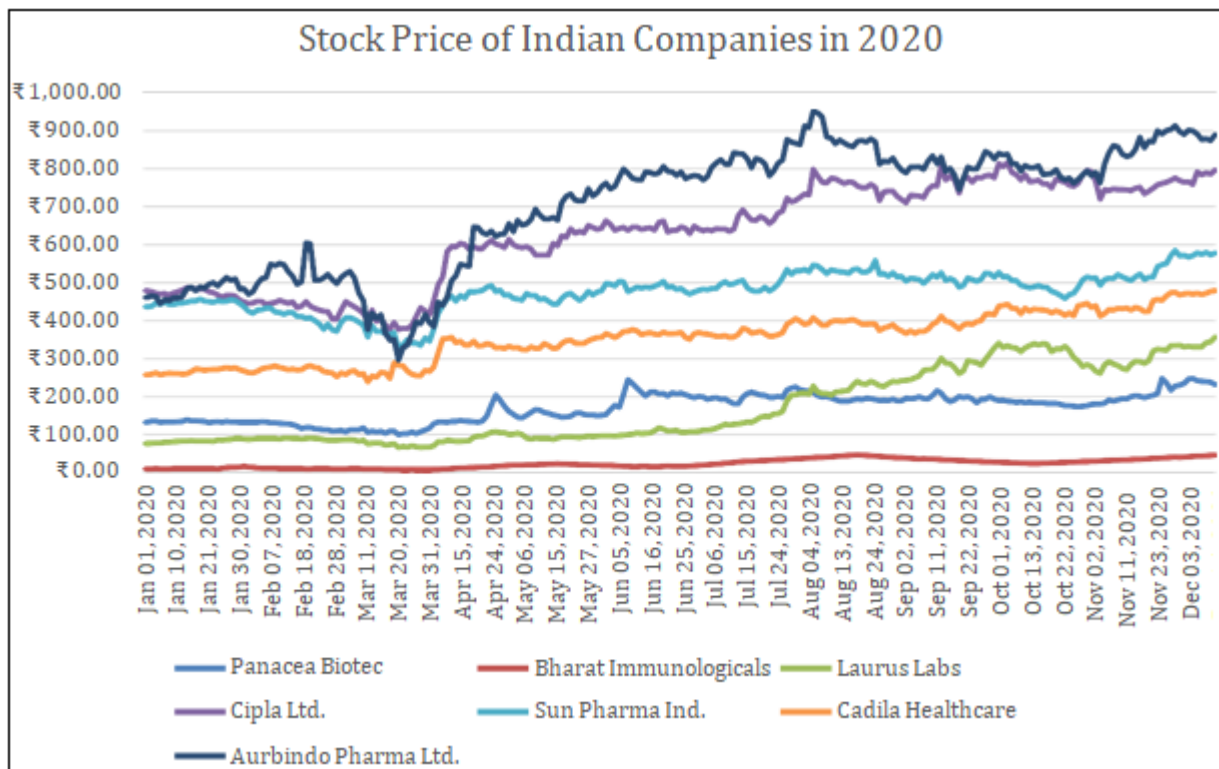


Figure 4.2: Line graph of closing stock prices of Indian vaccine developing companies

The graph shows the movement of stock prices of different vaccine-developing Pharmaceutical companies in India (BSE) over the period of 49 weeks in the year 2020. Different companies experienced different level of growth in

stock prices which varied because of the stage of development they reached and other alliances they developed in the period.

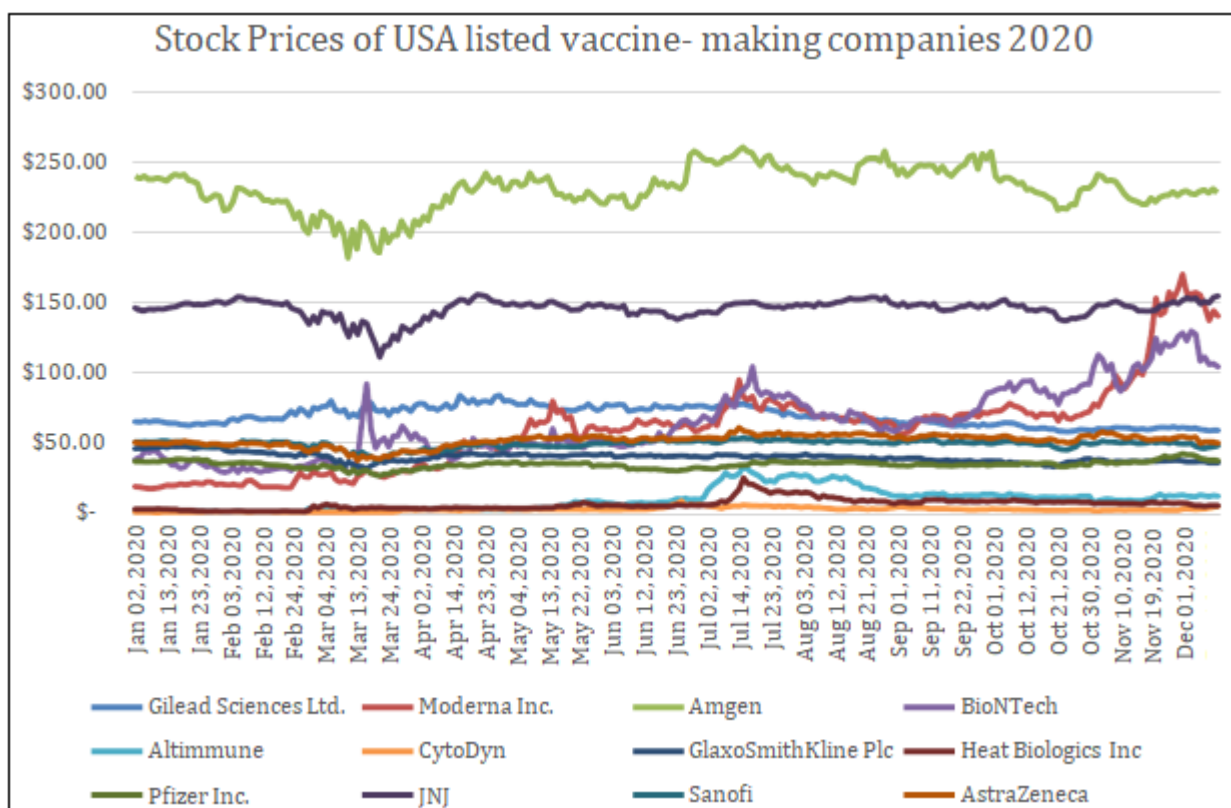


Figure 4.3: Line graph of closing stock prices of the USA listed vaccine developing companies

The graph shows the movement of stock prices of different vaccine-developing Pharmaceutical companies in the USA (NASDAQ-NYSE) over the period of 49 weeks in the

year 2020. Different companies experienced different level of growth in stock prices which varied because of the stage of development they reached and other alliances they

developed in the period.

Table 4.4: Least Square Regression analysis results for listed Indian COVID-19 vaccine-developing pharmaceutical companies

Stock Prices	Coefficient (Slope)	Standard Error	t-Statistics	Probability
Panacea Biotech	6.56	5.56	11.79	0.00
Bharat Immunologicals	2.32	1.54	15.09	0.00
Laurus Labs	2.67	5.10	52.30	0.00
Cipla Ltd.	2.88	1.59	18.07	0.00
Sun Pharma Ind.	9.68	7.49	12.92	0.00
Pfizer Ltd.	0.000109	3.70	29.36	0.00
Cadila Healthcare	1.54	6.51	23.72	0.00
Aurobindo Pharma Ltd.	3.02	2.37	12.74	0.00

On looking at the results of the Least Square regression analysis, with COVID-19 cases in India as independent variable and the daily stock prices of multiple companies as dependent variable the results are as shown above. The Coefficient values are basically the slope of the effect of x variables (dependent) on the y variable (independent). The probability values for each of the cases being less than 0.05 prove that the independent variables are “Significantly” impacted by the independent variable. The probability value being significant proves that the value of coefficient is not equal to 0. Thus, for all the above cases it can be concluded in unisons that Null Hypothesis is Rejected and Alternate Hypothesis is Accepted.

Table 4.5: Least Square Regression Analysis for USA COVID-19 vaccine-developing Pharmaceutical companies

Stock Prices	Coefficient (Slope)	Standard Error	t-Statistics	Probability
Gilead Sciences	-1.02	6.97	-14.61	0.00
Moderna Inc.	6.39	2.08	30.76	0.00
Amgen	8.39	2.11	3.97	0.00
BioNTech	4.98	1.53	32.66	0.00
Altimmune	7.89	9.87	7.99	0.00
CytoDyn	9.22	1.96	4.71	0.00
GSK	-4.20	3.73	-11.26	0.00
Heat Biologics Inc.	3.54	5.04	7.00	0.00
Pfizer Inc.	2.81	3.14	8.94	0.00
Johnson and Johnson	3.90	9.12	4.27	0.00
Sanofi Inc.	1.43	3.83	3.73	0.0002
AstraZeneca	4.37	5.28	8.26	0.00

On looking at the results of the Least Square regression analysis, with COVID-19 cases in the USA as independent variable and the daily stock prices of multiple companies as dependent variable the results are as shown above. The Coefficient values are basically the slope of the effect of x variables (dependent) on the y variable (independent). The probability values for each of the cases being less than 0.01 (which is the Critical/ Significant level undertaken for the test) prove that the independent variables are “Significantly” impacted by the independent variable. The probability value being significant proves that the value of coefficient is not equal to 0. Thus, for all the above cases it can be concluded in unisons that Alternate hypothesis is Accepted and Null Hypothesis is Rejected.

6. Conclusion

The present study was successful in establishing a cause-and-effect relationship between the increasing COVID-19 cases and the stock prices of vaccine-developing Pharmaceutical companies. The study resulted in accepting the hypothesis and has added to the existing lack of literature on this subject. The study is appropriate as it is for a period from 1st January to 18th December, just the right time to end the research as the very first vaccine was accepted in this period. Ever since, several other companies have had the approval from FDA and other organizations for emergency use based on the success rate of their clinical trials. The study takes and assumes a lot of factors which alongside increase in COVID-19 cases impact the stock price of vaccine-developing pharmaceutical companies one possible factor is market capitalization or the so-called availability of assets which brings focus on capacity and resources a company has invested into research and development of vaccine. With developments of development and clinical trials there was some hope developed in financial markets which can be studied in detail by focusing on investor's behavior. The present study founded that all companies taken as in a sample had positive significance to the independent variable- COVID-19 cases. This means the rise of COVID-19 had a significant impact on the stock market and vaccine-developing stocks in the Indian (NSE, BSE) and the USA (NASDAQ, NYSE) stock markets.

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