

# Vaccine Stock Analysis during the COVID-19 Pandemic

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Vaccine Stock Analysis during the COVID-19 Pandemic

```
[91]: import numpy as np
import pandas as pd

from functools import reduce
```

Covid Dataset

```
[92]: df = pd.read_csv("us_covid19_cases.csv")
```

```
[93]: df.columns
```

```
[93]: Index(['iso_code', 'continent', 'location', 'date', 'total_cases', 'new_cases',
'new_cases_smoothed', 'total_deaths', 'new_deaths',
'new_deaths_smoothed', 'total_cases_per_million',
'new_cases_per_million', 'new_cases_smoothed_per_million',
'total_deaths_per_million', 'new_deaths_per_million',
'new_deaths_smoothed_per_million', 'reproduction_rate', 'icu_patients',
'icu_patients_per_million', 'hosp_patients',
'hosp_patients_per_million', 'weekly_icu_admissions',
'weekly_icu_admissions_per_million', 'weekly_hosp_admissions',
'weekly_hosp_admissions_per_million', 'total_tests', 'new_tests',
'total_tests_per_thousand', 'new_tests_per_thousand',
'new_tests_smoothed', 'new_tests_smoothed_per_thousand',
'positive_rate', 'tests_per_case', 'tests_units', 'total_vaccinations',
'people_vaccinated', 'people_fully_vaccinated', 'total_boosters',
'new_vaccinations', 'new_vaccinations_smoothed',
'total_vaccinations_per_hundred', 'people_vaccinated_per_hundred',
'people_fully_vaccinated_per_hundred', 'total_boosters_per_hundred',
'new_vaccinations_smoothed_per_million',
'new_people_vaccinated_smoothed',
'new_people_vaccinated_smoothed_per_hundred', 'stringency_index',
'population', 'population_density', 'median_age', 'aged_65_older',
'aged_70_older', 'gdp_per_capita', 'extreme_poverty',
'cardiovasc_death_rate', 'diabetes_prevalence', 'female_smokers',
'male_smokers', 'handwashing_facilities', 'hospital_beds_per_thousand',
'life_expectancy', 'human_development_index',
'excess_mortality_cumulative_absolute', 'excess_mortality_cumulative',
'excess_mortality', 'excess_mortality_cumulative_per_million'],
```

```
dtype='object')
```

```
[94]: covid_df = df[['date', 'new_cases', 'new_deaths', 'new_tests',  
    ↪ 'new_vaccinations']]
```

```
[95]: covid_df.head()
```

```
[95]:
```

	date	new_cases	new_deaths	new_tests	new_vaccinations
0	1/22/2020	NaN	NaN	NaN	NaN
1	1/23/2020	0.0	NaN	NaN	NaN
2	1/24/2020	1.0	NaN	NaN	NaN
3	1/25/2020	0.0	NaN	NaN	NaN
4	1/26/2020	3.0	NaN	NaN	NaN

```
[96]: covid_df.dtypes
```

```
[96]: date                object  
new_cases              float64  
new_deaths            float64  
new_tests             float64  
new_vaccinations      float64  
dtype: object
```

#### Stock Datasets

```
[97]: df2 = pd.read_csv("moderna.csv")  
moderna_df = df2[['date', 'close', 'volume', 'rsi']]  
  
df3 = pd.read_csv("jnj.csv")  
jnj_df = df3[['date', 'close', 'volume', 'rsi']]  
  
df4 = pd.read_csv("astra-zeneca.csv")  
astra_zeneca_df = df4[['date', 'close', 'volume', 'rsi']]  
  
df5 = pd.read_csv("biontech.csv")  
biontech_df = df5[['date', 'close', 'volume', 'rsi']]  
  
df6 = pd.read_csv("novavax.csv")  
novavax_df = df6[['date', 'close', 'volume', 'rsi']]  
  
df7 = pd.read_csv("pfizer.csv")  
pfizer_df = df7[['date', 'close', 'volume', 'rsi']]
```

#### Merge Datasets

```
[98]: stock_df = [moderna_df, jnj_df, astra_zeneca_df, biontech_df, novavax_df,  
    ↪ pfizer_df]  
  
stock_merged = reduce(lambda left, right: pd.merge(left, right, on=['date'],  
    ↪ how='outer'), stock_df)
```

```
stock_merged.columns = ['date', 'moderna_closing_price', 'moderna_volume',
    → 'moderna_rsi', 'jnj_closing_price', 'jnj_volume', 'jnj_rsi',
    → 'astra_zeneca_closing_price', 'astra_zeneca_volume', 'astra_zeneca_rsi',
    → 'biontech_closing_price', 'biontech_volume', 'biontech_rsi',
    → 'novavax_closing_price', 'novavax_volume', 'novavax_rsi',
    → 'pfizer_closing_price', 'pfizer_volume', 'pfizer_rsi']
```

```
[99]: stock_merged.head()
```

```
[99]:      date  moderna_closing_price  moderna_volume  moderna_rsi  \
0  2022-04-08          160.84      5454415.0      45.310068
1  2022-04-07          159.00      5720873.0      45.059303
2  2022-04-06          154.62      7401800.0      44.465273
3  2022-04-05          162.05      6641095.0      45.279139
4  2022-04-04          172.54      5908675.0      46.455614

      jnj_closing_price  jnj_volume  jnj_rsi  astra_zeneca_closing_price  \
0          182.12      7144703.0  58.007217          71.14
1          181.76      7385291.0  57.800809          71.01
2          182.23      9991790.0  58.166612          69.07
3          177.61      7279617.0  55.450641          67.05
4          176.47      6595724.0  54.740074          66.67

      astra_zeneca_volume  astra_zeneca_rsi  biontech_closing_price  \
0          9082865.0          62.388493          170.26
1          8310168.0          62.271561          169.11
2          5596805.0          60.474451          166.65
3          6953316.0          58.455160          180.82
4          3987163.0          58.060152          186.24

      biontech_volume  biontech_rsi  novavax_closing_price  novavax_volume  \
0          886206.0          47.024802          60.63          3603222.0
1          1505572.0          46.875633          59.50          4367650.0
2          2275843.0          46.560180          62.44          5162016.0
3          1878969.0          48.174997          65.23          6661778.0
4          2350714.0          48.809551          75.29          2642969.0

      novavax_rsi  pfizer_closing_price  pfizer_volume  pfizer_rsi
0          41.168775          55.17      23128622.0      55.231783
1          40.924147          55.16      36292543.0      55.220421
2          41.362681          52.87      31718155.0      52.515858
3          41.779037          51.24      21027857.0      50.427343
4          43.319900          50.94      20491602.0      50.030928
```

```
[100]: stock_merged.dtypes
```

```
[100]: date                object
moderna_closing_price      float64
moderna_volume             float64
```

```

moderna_rsi                float64
jnj_closing_price          float64
jnj_volume                 float64
jnj_rsi                    float64
astra_zeneca_closing_price float64
astra_zeneca_volume        float64
astra_zeneca_rsi           float64
biontech_closing_price     float64
biontech_volume            float64
biontech_rsi               float64
novavax_closing_price      float64
novavax_volume             float64
novavax_rsi                float64
pfizer_closing_price       float64
pfizer_volume              float64
pfizer_rsi                 float64
dtype: object

```

```

[101]: covid_df['date'] = pd.to_datetime(covid_df['date'])
stock_merged['date'] = pd.to_datetime(stock_merged['date'])
covid_df['new_vaccinations'] = covid_df['new_vaccinations'].fillna(0) # The NaN
    ↳value in this column cannot be simply dropped since we also need to analyze
    ↳the data before the vaccination process.
df_merged = pd.merge(covid_df, stock_merged, on='date').dropna()

```

```

[102]: float_cols = covid_df.columns[covid_df.dtypes.eq('float64')]
df_merged[float_cols] = df_merged[float_cols].apply(pd.to_numeric,
    ↳errors='ignore').astype(int)

```

```

[103]: df_merged = df_merged[(df_merged['date'] >= '2020-03-01') &
    ↳(df_merged['date'] < '2022-04-01')]

```

```

[104]: df_merged.head(10)

```

```

[104]:
      date  new_cases  new_deaths  new_tests  new_vaccinations  \
27 2020-03-02         23          5        515              0
28 2020-03-03         19          1        620              0
29 2020-03-04         33          4        891              0
30 2020-03-05         77          1       1203              0
31 2020-03-06         53          2       1523              0
32 2020-03-09         75          1       2399              0
33 2020-03-10        188          6       3481              0
34 2020-03-11        365          5       4833              0
35 2020-03-12        439         10       8891              0
36 2020-03-13        633          8      11732              0

      moderna_closing_price  moderna_volume  moderna_rsi  jnj_closing_price  \
27                29.88      33084026.0      64.837624      140.020004
28                27.91      17599114.0      61.075243      135.589996

```

29	27.49	11817666.0	60.313849	143.479996
30	28.01	14669976.0	60.929202	142.009995
31	29.61	21097488.0	62.742982	142.029999
32	24.29	14124076.0	54.205308	136.440002
33	22.34	13019516.0	51.580159	141.639999
34	23.61	14825434.0	53.089965	131.800003
35	22.30	11305347.0	51.402919	125.410004
36	21.30	11853052.0	50.161307	134.289993

	jnj_volume	...	astra_zeneca_rsi	biontech_closing_price	\
27	11508200.0	...	40.456508	36.60	
28	13662500.0	...	39.738102	38.48	
29	10560500.0	...	48.025686	39.19	
30	11339200.0	...	47.549072	37.12	
31	12239100.0	...	45.738435	38.09	
32	13848600.0	...	41.449773	33.48	
33	12698100.0	...	45.268621	33.96	
34	17763400.0	...	41.437368	32.17	
35	21539200.0	...	36.278622	28.55	
36	20084200.0	...	39.344643	30.93	

	biontech_volume	biontech_rsi	novavax_closing_price	novavax_volume	\
27	185100.0	50.791524	12.02	14261700.0	
28	297900.0	52.850212	10.78	9957300.0	
29	127100.0	53.598311	11.32	10977400.0	
30	77000.0	51.182375	12.87	14057100.0	
31	279200.0	52.212347	12.48	13250800.0	
32	190200.0	47.365959	10.02	8328800.0	
33	327500.0	47.879960	10.65	12365400.0	
34	119000.0	46.164460	10.51	9052100.0	
35	184100.0	42.986160	9.29	5488400.0	
36	197600.0	45.503257	8.41	6115400.0	

	novavax_rsi	pfizer_closing_price	pfizer_volume	pfizer_rsi
27	62.899608	33.092979	42034469.0	37.171087
28	59.621290	32.542694	46174475.0	35.568345
29	60.535314	34.535103	38712155.0	44.422057
30	62.989154	33.643265	35096303.0	41.798627
31	61.999390	33.225807	40931036.0	40.651919
32	56.304878	32.030361	43183856.0	37.634936
33	57.329068	32.817837	40548329.0	40.598216
34	57.025971	30.521822	65350213.0	35.569873
35	54.465420	28.481974	62731445.0	31.979150
36	52.722981	31.034157	60553038.0	39.744867

[10 rows x 23 columns]

```
[105]: df_merged.dtypes
```

```
[105]: date                      datetime64[ns]
      new_cases                  int64
      new_deaths                 int64
      new_tests                  int64
      new_vaccinations           int64
      moderna_closing_price      float64
      moderna_volume             float64
      moderna_rsi                float64
      jnj_closing_price          float64
      jnj_volume                float64
      jnj_rsi                   float64
      astra_zeneca_closing_price float64
      astra_zeneca_volume       float64
      astra_zeneca_rsi          float64
      biontech_closing_price     float64
      biontech_volume           float64
      biontech_rsi              float64
      novavax_closing_price      float64
      novavax_volume            float64
      novavax_rsi               float64
      pfizer_closing_price       float64
      pfizer_volume             float64
      pfizer_rsi                float64
      dtype: object
```

#### Data Analysis

Q1: How did each pharmaceutical stock perform during the pandemic, and is there a trend between performance and COVID-19 cases?

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[ ]:
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Q2: Is there a positive or negative relationship between COVID-19 cases and pharmaceutical stock prices of the aforementioned companies? Could a rise in COVID-19 cases be used as a factor to predict a rise in pharmaceutical stock prices?

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[ ]:
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Q3: Assuming there is a pattern/relationship, what are the nuances that explain any breaks from the pattern between COVID-19 cases and stock prices?

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[ ]:
```