Stock Reactivity to COVID-19 Trends

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Introduction

Overview:
Investigate how US stock market reacted to COVID pandemic & extract insights on stock market behavior which can be utilized for making decisions in the future.

Structure of Presentation:

1. Introduction
2. Overview of Data
3. Analysis, Conclusions, & Implications for each of the 4 questions

Questions:

1. How did the stock prices of major tech companies respond to significant peaks in COVID-19 cases?
2. Were certain industries more resilient to severity of COVID-19 outbreaks?
3. How did COVID-19 case counts in specific regions of the US affect the stock market?
4. Predict stock market movement based on covid cases, deaths and temporal details.

Data Overview

Data Sources & Key Features:

- COVID-19 Data from JHU:
  - Key Variables: Date, COVID-19 cases & deaths by state
  - Size: 1142 entries, 3343 variables
  - Preprocessing: Aggregated from county to state level, data type standardization, outlier removal
- 2019-2024 US Stock Market Data:
  - Key Variables: Date, prices & volumes for commodities & major indices
  - Size: 1243 entries, 37 variables; missing values present
  - Preprocessing: Standardized column names, Date conversion to DateTime, missing value imputation using neighborhood mean

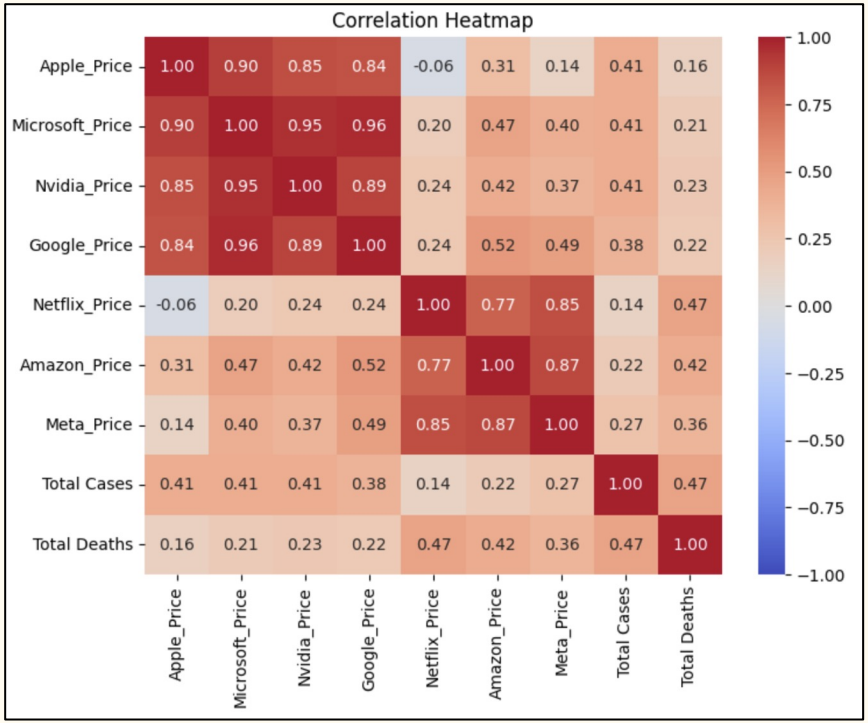
Merging & Alignment:

- Common Dates: 772 overlapping dates
- Final Shape: 772 rows, 101 columns
- Created Additional Feature: 'S&P_500_Price_Direction' to track stock movement
- Each week was classified based on the count of days with rising cases:
  - Boom ($\geq$4 days rise)
  - Stagnate (3 days)
  - Fall ($<$3 days rise).

Question 1: Impact on Major Tech Companies

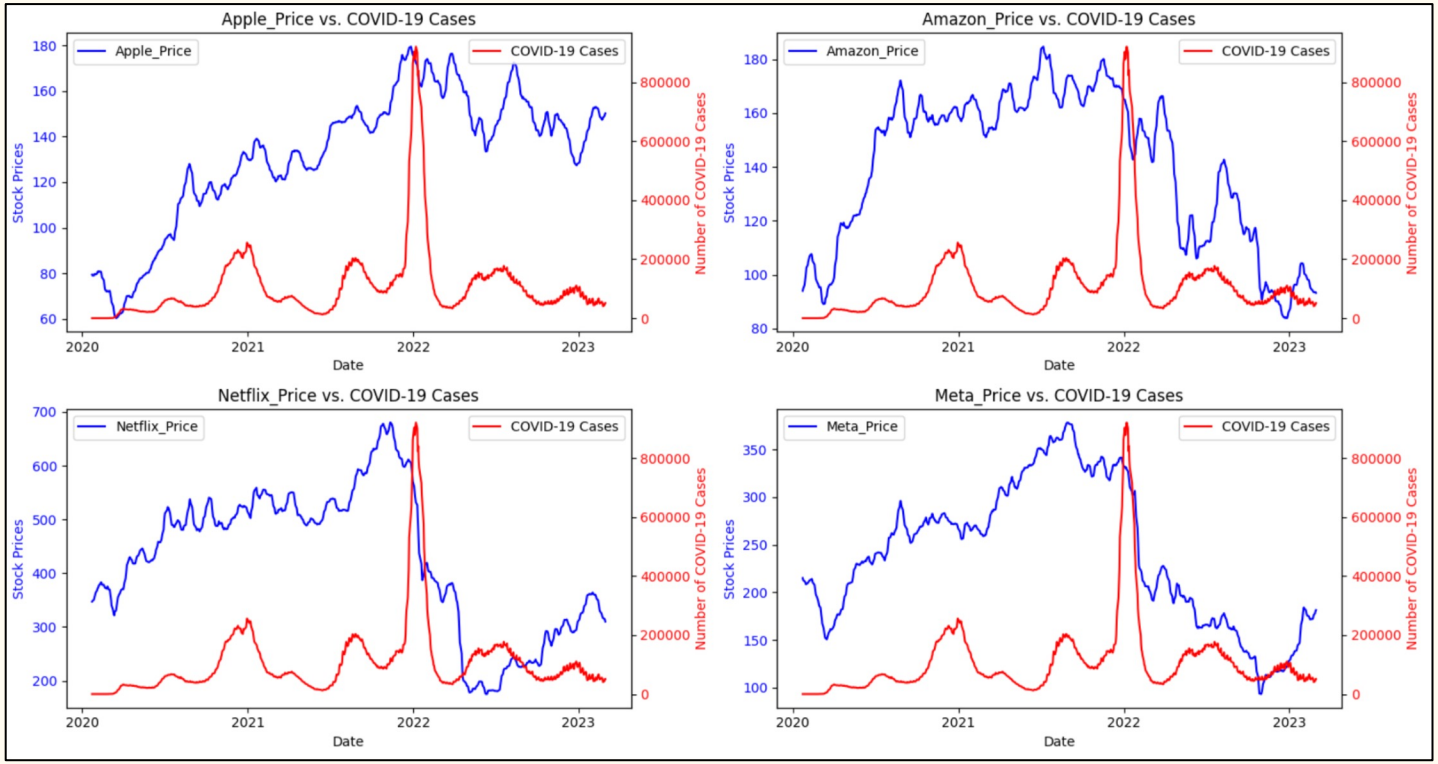
Key Findings:

- Apple & Meta: Increased stock prices correlated with COVID-19 case peaks, driven by rising demand for technology.
- Netflix & Amazon: Surprisingly, stock prices dropped during case peaks despite increased demand for digital & delivery services - logistical & production challenges.



Correlation Heatmap of Stocks and COVID-19.

Question 1: Impact on Major Tech Companies

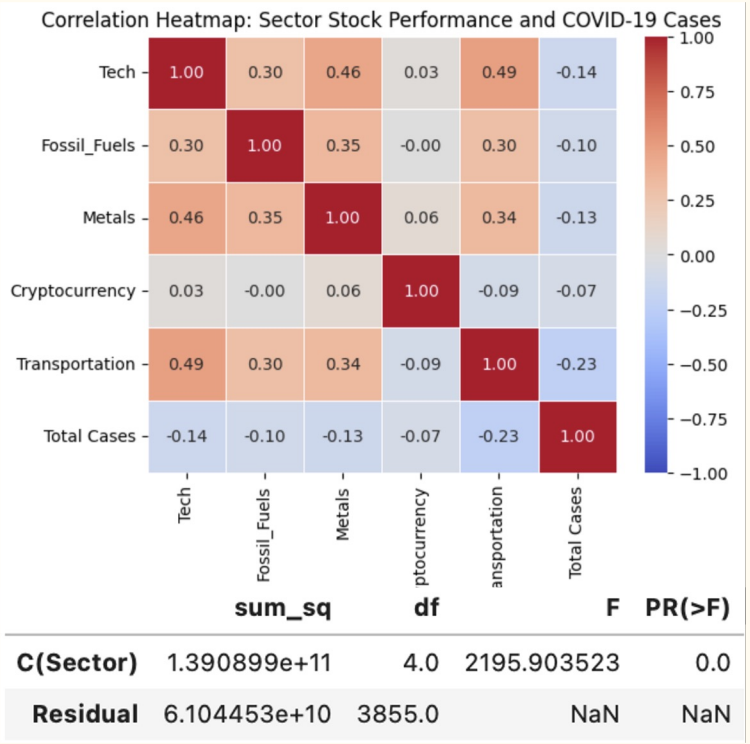


Line chart showing stock price trends of Apple, Meta, Netflix, and Amazon against COVID-19 case peaks.

Question 2: Sector Resilience

Key Findings:

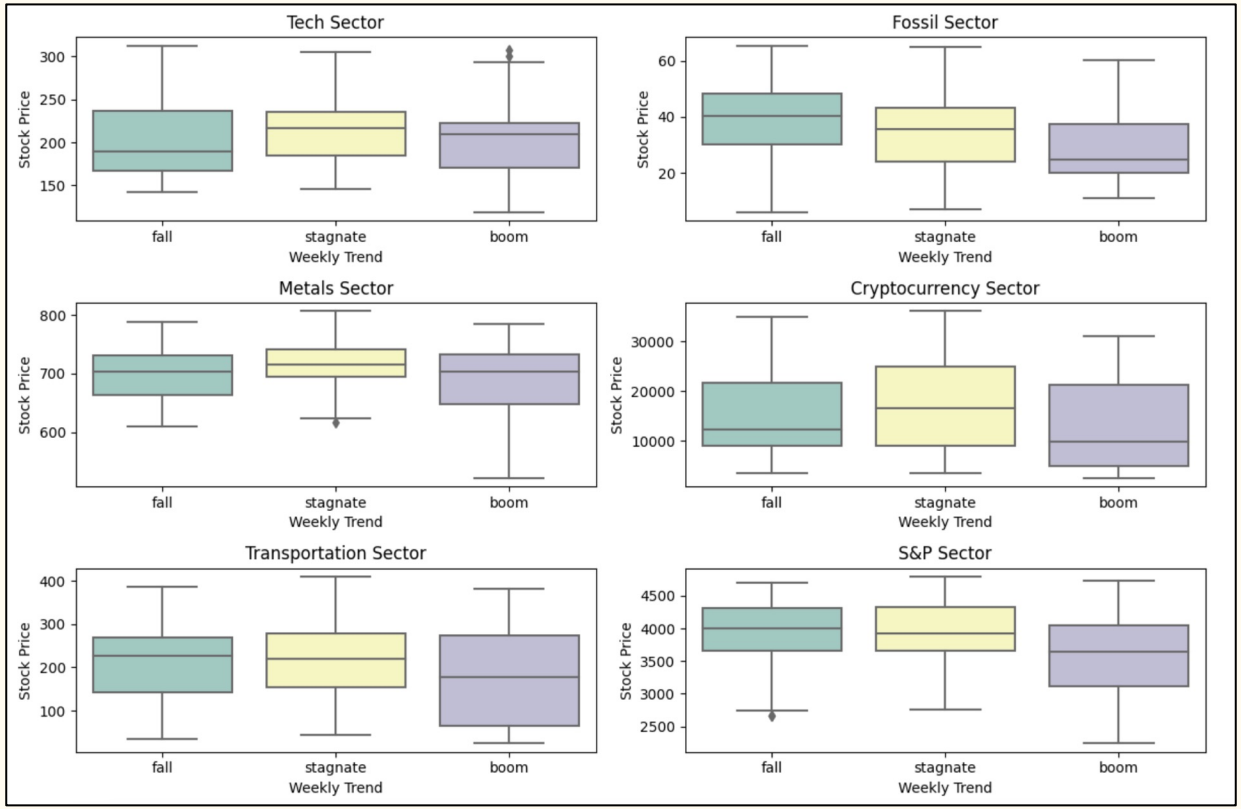
- ANOVA model confirms significant effect of sector on stock prices - Different sectors exhibited varied levels of resilience to COVID-19 impacts.
- Resilience order: Cryptocurrency > Fossil Fuels > Metals > Tech > Transportation.
- Potential investment guidance: Sectors with closer-to-0 correlations may be considered safer for investment amidst uncertainties.
- Despite expectations, tech sector showed moderate variability, suggesting adaptability.



	sum_sq	df	F	PR(>F)
C(Sector)	1.390899e+11	4.0	2195.903523	0.0
Residual	6.104453e+10	3855.0	NaN	NaN

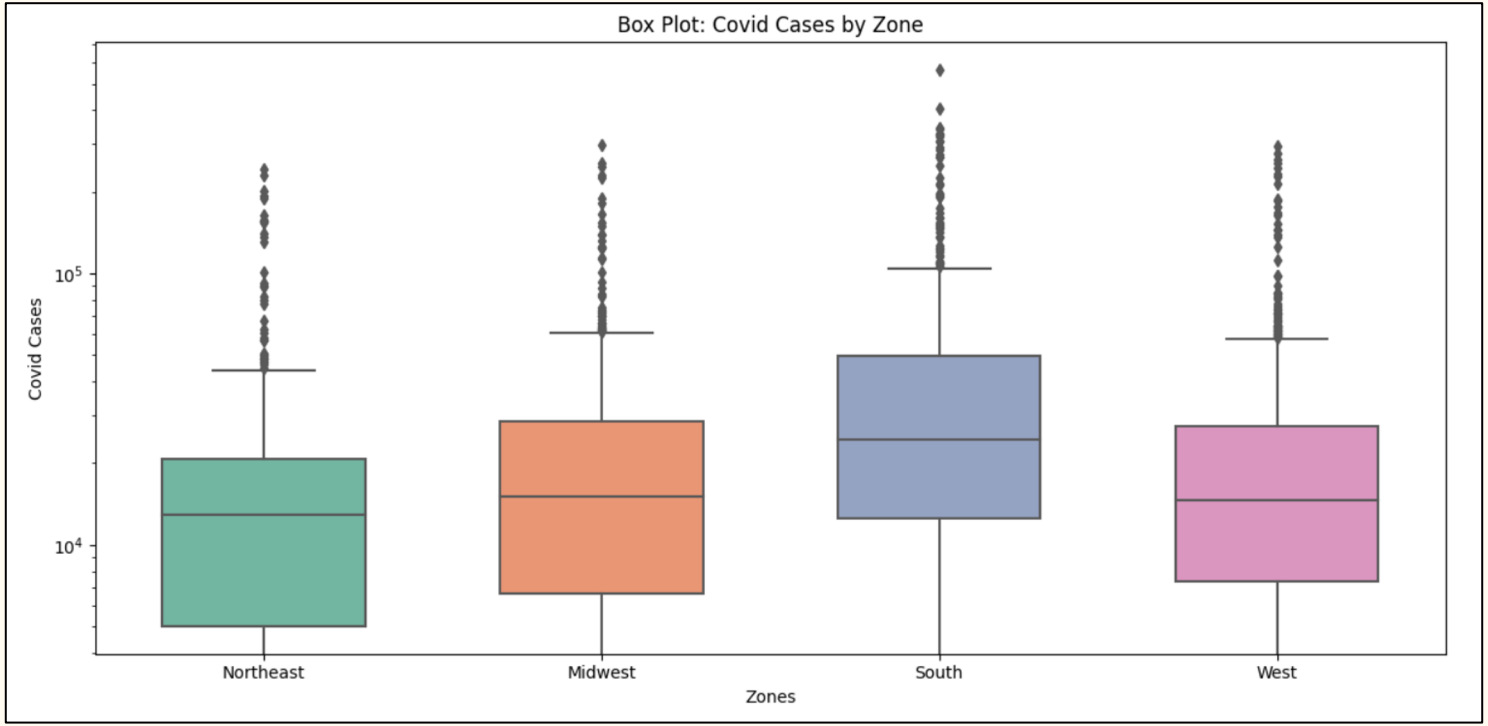
ANOVA of Stock_Price ~ C(Sector)

Question 2: Sector Resilience



Box plots illustrating sector-specific stock price distributions during COVID-19 phases.

Question 3: Zone Specific Analysis



Box plots illustrating zone-specific COVID cases distributions.

Question 3: Zone Specific Analysis

Key Findings:

- Different zones seem to have different intensity of Covid case counts. This supports the intuition that each zone may have different impacts on the market.
- The Midwest zone has the highest positive impact whereas the West zone has the highest negative impact on the S&P 500 Stock Price.

OLS Regression Results

Dep. Variable:	S&P_500_Price	R-squared:	0.166
Model:	OLS	Adj. R-squared:	0.161
Method:	Least Squares	F-statistic:	38.12
Date:	Wed, 20 Mar 2024	Prob (F-statistic):	4.10e-29
Time:	04:08:21	Log-Likelihood:	-5877.4
No. Observations:	772	AIC:	1.176e+04
Df Residuals:	767	BIC:	1.179e+04
Df Model:	4		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	3704.2963	22.743	162.880	0.000	3659.651	3748.941
Northeast	0.0014	0.001	1.090	0.276	-0.001	0.004
Midwest	0.0056	0.001	4.216	0.000	0.003	0.008
South	0.0026	0.001	3.558	0.000	0.001	0.004
West	-0.0036	0.001	-2.520	0.012	-0.006	-0.001

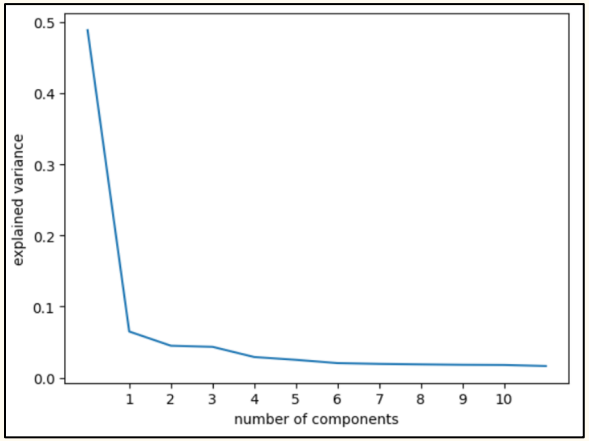
Omnibus:	37.783	Durbin-Watson:	0.072
Prob(Omnibus):	0.000	Jarque-Bera (JB):	36.929
Skew:	-0.490	Prob(JB):	9.57e-09
Kurtosis:	2.565	Cond. No.	1.16e+05

OLS results using zones as predictors.

Question 4: Predict Market Movement

Preprocessing:

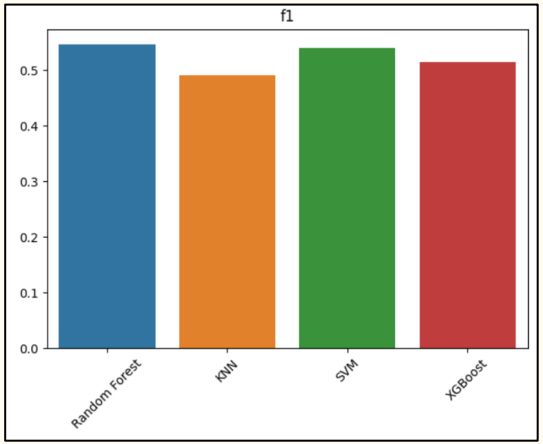
- Making dates into cyclic features.
- PCA Dimensionality reduction on statewise data. Reducing dimensions from 50 to 4.
- Standard scaling predictors.



PCA Scree Plot

Classifiers used:

- Random Forest
- KNN
- SVC
- XGBoost



F1 Score of Models

Conclusion

Potential Misleading Factors:

- External Macroeconomic Influences: government interventions, global market trends, changes in consumer behavior
- COVID-19 Data Limitations: Inconsistencies in reporting across states
- NOTE: Correlation observed between COVID-19 cases and stock market performance does not imply causation.
- Stock Market inherently unpredictable.

Scope for Improvement:

- Extended Data Range: Incorporating data beyond pandemic period.
- Inclusion of More Variables: consumer sentiment, global market trends, and sector-specific news.
- Cross-Sector Analysis: A deeper comparative analysis between sectors.

Thank You!

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