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| Logo  Description automatically generated  Stock Market Performance of Food and Beverages Sector During COVID-19      **Sreeja Thazhathethil**  **Yagna Himachalapathy**  **Bensy Chitteth**  **Kalpesh Odedra**  **Thy Pham**        **MGMT 4018 Data Mining and Modeling Spring 2021** |

Contents

[Abstract 3](#_Toc78752698)

[Introduction 3](#_Toc78752699)

[Research Objectives 3](#_Toc78752700)

[Research Questions 4](#_Toc78752701)

[Significance of Research 4](#_Toc78752702)

[The Innovativeness of Research 4](#_Toc78752703)

[Structure of the Research Report 4](#_Toc78752704)

[Literature Review 4](#_Toc78752705)

[1. Food industry before COVID-19 4](#_Toc78752706)

[2. How covid is shaping the stock market and food industry 4](#_Toc78752707)

[3. Global crisis before COVID-19 pandemic 5](#_Toc78752708)

[4. Food Industry post-COVID-19 5](#_Toc78752709)

[Research Methodology 5](#_Toc78752710)

[Overview of the Methodology 5](#_Toc78752711)

[Data collection process and techniques 6](#_Toc78752712)

[Data cleaning process 6](#_Toc78752713)

[Overview of Data Analysis 6](#_Toc78752714)

[1. Trend Analysis 6](#_Toc78752715)

[2. Correlation Analysis 10](#_Toc78752716)

[3. Checking for Outlier 11](#_Toc78752717)

[4. Descriptive Statistics 12](#_Toc78752718)

[5. Wilcoxon signed ranks test (Comparative analysis) 13](#_Toc78752719)

[Research Implications and Conclusion 14](#_Toc78752720)

[Practical Recommendations 14](#_Toc78752721)

[Theoretical Recommendations 15](#_Toc78752722)

[Study Limitations 15](#_Toc78752723)

[Conclusions 16](#_Toc78752724)

[References 17](#_Toc78752725)

[Appendix 19](#_Toc78752726)

[Abbreviation 19](#_Toc78752727)

# Abstract

Coronavirus has been expanding globally, with the epidemic affecting nearly every country. The food and beverages which is one of the most crucial industries also received negative impact from the pandemic and as governments close restaurants and bars, when compared to the same period last year, restaurant daily traffic has plummeted all over the world. Restaurant closures had a knock-on effect on allied industries like food production, liquor, wine, and beer manufacture, as well as food and beverage transport. The aim of this study is to analyse the stock market performance of the Food industry during the first and second wave of Covid-19.

To support this study, we extracted the dataset related to stocks of 15 companies randomly chosen from 2019 top 100 food and beverages companies list (Food Engineering Magazine, 2019). For analysis, we used Python programming language to extract data from Yahoo Finance platform as well as perform trend and correlation analysis. Excel is the second software used in this research to check for outliers, to conduct Descriptive Statistics, and Wilcoxon Signed Rank Test. In the result of our analysis, we observed a wide fluctuation in the overall trend of stock prices with the largest dip in the beginning of the pandemic. This type of a crisis requires innovative measures to maintain confidence in the operation of a business. Due to the nature of Covid-19 crisis, these innovations were required to be in the form of contact less business operations and sales of their products along with deeper insights on the changing behaviour of their customers. Therefore, this study is concluded with some practical and theoretical recommendations for the sector to overcome the obstacles it has faced and boost its economic growth.

# Introduction

In Wuhan, Hubei Province, China, a viral outbreak of severe pneumonia of unknown origin was first detected. Initially, only a few instances were documented, but as the number of patients grew, this unexplained pneumonia was identified as Novel Coronavirus, COVID-19. The Novel Coronavirus (COVID-19) outbreak was labeled a global pandemic by the World Health Organization (WHO) on March 11, 2020, after it spread globally (Cucinotta & Vanelli, 2020). As of July 30th, 2021, there are approximately 197,385,409 active COVID-19 cases, 178,537,192 recovered cases, and 4,214,933 deaths globally (Worldometer, 2021).

The World Health Organization (WHO) issued guidelines with advice for clinical practice and public health policy as the virus spread fast. The governments of the affected countries around the world enforced restrictions and placed cities under lockdown to control and stop the spread. (Almurisi, Khalidi, Japairai, Mahmood, Chilakamarry, Kadiyala, Mohananaidu, 2020). As a result, schools, education centers, higher learning institutions, and a variety of industries, including the Food industry, were forced to close.

## Research Objectives

The Food industry is one of the most important industry industries that contribute to economic development where the whole process from the field, business to the consumer is dependent on it. Hence, the objective of this study aims to analyze and understand the stock market performance of the Food industry during the first and second waves of COVID-19. We have used Yahoo Finance data to conduct some analysis and come up with a relevant conclusion to our research.

## Research Questions

This study also focuses to answer the following questions:

* What is the company's stock price, and does it vary in terms of selling volume?
* What is the relationship between the companies that were chosen, and how did their services differ significantly in terms of consumer stock?
* How will businesses ever return to their prior ways of doing things?

## Significance of Research

This research will provide another aspect of financial analysis focusing on comparing the performance of food industry with the impact of COVID-19. It also has the practical contribution of providing the overall picture and relationship between the chosen companies to the managerial decision-making process.

## The Innovativeness of Research

There are many studies about the stock performance during the pandemic. However, there are not many of those focusing on the food sector particularly. Therefore, this research’s purpose is to fill in the gap

## Structure of the Research Report

The structure of the remaining sections of the report is as follows:

* Literature Review is the next section of this report which describes a broader definition and the state of the food business before, during (first and second waves), and after Covid-19.
* The following section is the research methodology which includes the data collection and data cleaning process, and an overview of data analysis.
* The research implications are the final section of this report which contains the practical and theoretical recommendations along with the conclusion.

## Literature Review

### Food industry before COVID-19

Before COVID-19, the food industry is a complex network of supply and consumption of food products and services across the world. It is an essential part of our lives. There are also large, diversified demands in the food industry related to different cuisines and nutrition diets. Therefore, it is one of the sectors with highest number of employments. In 2006, the food industry accounted for over 1.5 million jobs in USA and around 1 million jobs in Canada (Statistics Canada).

Replying on the physical food industry, the food sector stock market is also large and reliable. Some of the biggest players in the market are the companies with long history of achievements.

### How covid is shaping the stock market and food industry

In the first month of the pandemic, we saw a historical and rapid declines across all sectors. The market crash began on March 9, 2020, with a 7.79% drop in the Dow Jones Industrial Average score, followed by 9.99% drop in March 12 and 12.9% drop in March 16. They are the history’s largest point plunges in the stock market up to that date. They were caused by the fears about a global pandemic by the spread of corona virus. It was also a sign for 2020 recession which was predicted before (Frazier, 2021).

After the first wave, the second wave of the pandemic also negatively impacted on the global stock market. The Dow Jones score down 8.2% on September 2, 2020, was the signal of the second wave effect on the market. Even though the decrease was not as hard as the first wave, the overall sentiment was negative with the belief that the declines were not over (Rechtschffen, 2020).

Food industry had the similar effect on the stock market to other sectors. There were large plunges in the hit of first wave and second wave. However, due to the critical position of the industry in citizen’s lives, the decease was less serious compared to other sectors such as traveling and oil.

### Global crisis before COVID-19 pandemic

Following the timeline, the first famous stock market crash would be the 1929 Great Depression. The crash in the stock market signaled the beginning of the Great Depression which collapsed the US economy and made millions of people lost their jobs (Khan Academy, n.d.)

The second famous market crash caused by the 2001 dotcom bubble which was a rapid and unsteady rise in the US technology stock equity. The Nasdaq index which measures largest technology companies’ performance in US market saw an approximately 77% drop. It took 15 years for the Nasdaq reach its peak again after the 2001 crisis (Hayes, 2019).

The nearest stock market crisis before COVID-19 would be the 2008 financial crisis. The cause was the overheated real estate market and the loose in banking government. From 2007 to 2009, the Dow Jones score had dropped more than 50%. The unemployment rate increasing to 3.9% after the crisis and millions of Americans lost their homes were the consequences.

### Food Industry post-COVID-19

Compared to other financial crisis, we saw a larger drop in intraday trading at the beginning of COVID-19 pandemic. However, the belief in recovery is more positive during this time more than ever.

After the difficult time at the beginning of COVID-19, there was an increasing trend in the food industry, especially for the packaged food and beverages retailers. As consumers tried to stock up their house with grocery and frozen food, the industry took advantage of this mindset and applied new strategies in their business. Thanks to the technology development, most of the business can adapt quickly to the new changes. The signal for recovery is already set for the food industry in the stock market.

# Research Methodology

## Overview of the Methodology

Yahoo Finance is a popular website that offers financial news, data, and analysis, as well as stock quotations, press announcements, financial reports, and original content. (“Yahoo Finance – Wikipedia"). An analytical and data mining tool is utilized to harvest data from the food industry in order to examine and comprehend trends in its economic growth prior to Covid-19 and also during the pandemic emergency (i.e., during the first and second wave).

## Data collection process and techniques

Following the identification of a problem or opportunity, data collection is a vital step. We used Yahoo Finance as our data source, and we looked at the performance of a few companies (Unilever PLC, PepsiCo, Inc., Kellogg Company, The Coca-Cola Company, Nestle S.A, Heineken N.V., The Hershey Company, Conagra Brands, Inc., Tyson Foods, Inc., The Kraft Heinz Company, Suntory Beverage & Food Limited, Anheuser-Busch InBev SA/NV, Mondelez International, Inc., Campbell Soup Company, Ajinomoto Co., Inc.). Since their products and services were widely used during the epidemic, the mentioned companies were chosen. The data was collected from the Yahoo Finance website between December 2019 and June 2021 (i.e., before and during the pandemic) but we brought up our analysis comparing the 1st wave (1/01/2020-30/06/2020) and 2nd wave (1/07/2020-31/06/2020). We used python code to run the libraries like pandas, NumPy, finance, seaborn, and matplotlib in the Jupyter Notebook to perform some analysis. Additionally, we have used excel to perform descriptive statistics and to identify the outliers.

## Data cleaning process

To obtain accurate findings or insights, data cleaning is a vital process that removes incorrect, incomplete, irrelevant, duplicated, or incorrectly formatted items. Once the data has been collected from Yahoo Finance, the data cleaning procedure is carried out using Jupyter Notebook by adding date filters. The column names have been tweaked a little bit.

## Overview of Data Analysis

### Trend Analysis

The figure 1 and 2 shows the overall trends of stock price and volume for all the selected companies between December 2019 and June 2021 (i.e., before and during the pandemic). From the obtained graph we can see that the stock price for all the companies was initially high in Dec 2019 which gradually decreased in Apr 2020 and again there has been a sudden rise seen between May 2020 and July 2021(i.e., during the pandemic) with slight fluctuations. Also, the stock volume for selected companies shows a varied trend with major fluctuations throughout the selected duration. We can see that from all the selected companies “The Hershey Company” has the highest stock price and the “Suntory Beverage & Food Limited” and “Ajinomoto Co., Inc.” has the least. Whereas, in case of stock volume “Coca-Cola Company” has the highest and “Nestle S.A” seems to have the lowest volume.

During the 1st wave (1/01/2020-30/06/2020), from the figures 3 and 4, we can see that the stock price for all the companies was initially low in Jan 2020 but later in the mid of Jan 2020 there was a rise in price, which in turn suddenly decreased at the end of Mar 2020 and then it increased again in April 2020 but gradually the was again a decrease in price between May 2020 and Jun 2021 with slight fluctuations. The stock volume shows a major fluctuation at the same level between the timeframes. In the second wave (1/07/2020-31/06/2020) considering the figures 5 and 6, we can see that the stock price of the selected companies increased between Jul 2020 and Dec 2020 whereas the stock volume like that of the first wave shows a major fluctuation at the same level between the timeframe as well. When comparing between the two period, the stock prices fluctuated more in the first wave which was the beginning of the pandemic. The higher the stock price, the higher level of fluctuation appeared in the company’s timeline. The same trend was shown in the volume graphs.

Chart, line chart

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*Figure 1. Trend Analysis for Stock Adjacent close Price*

*Chart, line chart, histogram

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*Figure 2 - Trend Analysis for Stock Volume*

*Chart

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*Figure 3 - Trend Analysis for 1st wave - Stock Price*

*Chart, histogram

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*Figure 4 - Trend Analysis for 1st wave - Stock Volume*

*Chart, line chart

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*Figure 5 - Trend Analysis for 2nd wave - Stock Price*

*Histogram

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*Figure 6 - Trend Analysis for 2nd wave - Stock Volume*

### Correlation Analysis

The heat map from figure 7 shows that there is a strong correlation between MDLZ & HSY (0.92), BUD & HINKF (0.89), MDLZ & PEP (0.88), BUD & KO(0.86) ,BUD & TSN(0.85), HSY & HINKF(0.83) , HSY & PEP(0.80), and HINKF & KO(0.80); whereas, a weak and negative correlation between AJINY & K(-0.43), AJINY & STBFY(-0.56), STBFY & CAG (-0.35), CPB & AJINY(-0.29), and STBFY & KHC(-0.29). We assume that the weak and negative correlation may be because of the variation in the products or business. Also, the cluster map in the figure 8 shows that companies clustered in the same manner.

Chart, treemap chart

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*Figure 7 – Heat Map*

Chart, treemap chart

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*Figure 8 – Cluster Map*

### Checking for Outlier

From figure 9., when taking a close look at the stock price of the companies. We observe that PepsiCo, Inc. (PEP), Nestle S.A(NSRGF), Kellogg Company(K), Mondelez International (MDLZ), Campbell Soup Company (CPB), and Ajinomoto Co., Inc. (AJINY) have outliers except for Hershey Company (HSY), Unilever PLC(UL), Heineken N.V(HINKF), Tyson Foods, Inc. (TSN), Anheuser-Busch InBev SA/NV (BUD), Coca-Cola Company (KO), Conagra Brands, Inc. (CAG), The Kraft Heinz Company (KHC), and Suntory Beverage & Food Limited (STBFY). From figure 10. Considering the stock volume, we could see that all the companies except for Nestle S.A(NSRGF), Heineken Company (HINKF), Suntory Beverage & Food Limited (STBFY), and Ajinomoto Co., Inc. (AJINY) have outliers, but the extreme ones are found in Coca-Cola Company (KO), The Kraft Heinz Company (KHC), PepsiCo, Inc. (PEP), and Mondelez International (MDLZ).

Chart, box and whisker chart

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*Figure 9 – Box plot for Stock Price*

*Chart, box and whisker chart

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*Figure 10 - Box plot for Stock Volume*

### Descriptive Statistics

From figure 7., the descriptive statistics for the stock price describes that the Median (i.e., the average) represents a dataset’s middle number of them. We can observe from the statistics that the SD is low and not close to the mean. The kurtosis checks for outliers, which we have in this data set, and the skewness assesses the precision of the data, which in this case is the skewness to the right.

Table

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*Figure 11 – Descriptive Statistics for Stock Price*

### Wilcoxon signed ranks test (Comparative analysis)

Wilcoxon signed rank test null hypothesis is that the two datasets/samples tested are from the same population. This test helps us find if the tested samples differ from each other significantly. (statistics solution)

From figure 12, we can see that Sum of positive ranks(W+) is 6 while sum of negative ranks(W-) is 114 indicating a high number of negative difference values. The p value of W statistic is less than 0.05, therefore we can reject the null hypothesis that both the samples are from the same population. This indicates that the stock prices difference in wave 1 and wave 2 differ significantly. Since we are looking at prices between the two waves, such a high difference in negative to positive ranks indicates that prices were significantly higher in the second wave than in the first wave.

*Table

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*Figure 12 – Wilcoxon signed ranks test (Comparative Analysis)*

# Research Implications and Conclusion

## Practical Recommendations

During covid-19 contact less service delivery of products to customers and delivery of inventory keeping in mind all the new regulations because of COVID-19 restrictions are vital. And more importantly, communicating these changes and innovations to the public and stockholders to ease their concerns during the crisis, increasing consumer and stockholder confidence in the business is extremely important.

Some of the companies which have compatible infrastructure could look into changing their business model such as switching to production of hand sanitizers or alcohol required to make hand sanitizers. Some companies can even switch to production of masks and PPE to remain operational and keep the lights on during a crisis.

Food companies especially have to remain vigilant since some of the inventory has low shelf-life. Adding discounts, coupons or bundling products to sell inventory quickly is one such strategy that these companies can adopt.

There has been an increase in ingredient box subscription services during the pandemic as more and more people look to getting their groceries to be delivered to their homes. These companies can collaborate with one of such service companies to provide their products bundled with the box services. For e.g., Heineken can send beers along with an ingredient box for a full dinner experience.

## Theoretical Recommendations

At times such as these a lot of regression and prediction models fail since such a crisis is first of its kind on a global scale. This shows that companies should focus more on segmenting their customers and find out their best and most loyal customers and keep them happy. Clustering customers data and performing RFM analysis on each cluster reveal the best and most loyal customers. These customers will remain with the company even in such trying times.

For future, the behaviour indicated during corona can be analyzed to create a plan where if in future the situation is replicated, the company is quick to take action.

Businesses moving to online services should look into cloud data warehousing services such as amazon redshift and google big query for collection and storage of all the new online data that they are collecting. This data can be used in future for in depth analysis.

Moving to cloud computing provides additional opportunity to automate tasks such as data collection, data wrangling and transformation for further analysis.

Marketing strategies that increase online participation should be introduced to swiftly and seamlessly transition customers towards online and contactless services.

Text and sentiment analysis of customers’ reviews and social media data can reveal bottlenecks in operations that are leading to unhappy customers. Such analysis can be vital when there is a lot of doubt in the business

## Study Limitations

The limitations while conducting this study are:

* Only a few companies could be selected to perform the analysis. Therefore, it might not perfectly represent the whole population.
* Finding datasets for this study was not easy. An appropriate dataset could make the analysis better and accurate.
* This study is more of an exploratory analysis in the stock performance of selected companies during covid-19, these companies’ data can be further analyzed for a more in-depth analysis such as cluster analysis, sentimental analysis to look at attitude of investors, support and resistance of stock prices etc.
* Prices of stocks are dependent on a lot of factors, not all of them are apparent by looking only at stock price and traded volumes. This study is therefore limited in analyzing only changes in volume and prices, rather than trying to find relevant factors that affected them.

## Conclusions

The trend analysis shows the dip of the selected companies in March 2020 during the first wave of Covid-19. The Hershey company experienced the highest dip compared to other selected companies followed by Tyson Foods Inc. (Figure 1). Looking at the trend chart of stock volume gives an overview of how volatile the inter-day trading was for each of the selected companies. The coca cola company topped among all other companies with most volatility followed by Kraft Heinz company. During March the dip and volatility can be attributed to Covid-19 and economic closure and though the prices slowly stabilized at the end of the year, the volatility in the market remained (figure 2). This volatility can be further apparent when we look at box plots of individual companies. Hershey and Pepsi had most outliers in stock prices while volume box plots reveal that almost all companies had a lot of outliers for the selected duration. This means that all the companies faced volatility in traded stocks for the entire duration. Since we are looking at a lot of companies from the food and beverage industry, we can attribute this volatility to the whole industry. Correlation analysis shows how companies with similar types of products have the same movement of stock prices. Wilcoxon signed rank test indicate how the stock prices in the second waves are significantly higher than the first, showing that even the dip in prices were historically high, most companies recovered and there wasn't that big of dip in prices during second wave. This might be since the companies and public had time to adjust to Covid-19 crisis and therefore there wasn't as much of panic during second wave.

Overall, the study shows that Covid-19 crisis had an adverse effect on the entire food and beverage industry where the stock volume had major fluctuations in size whereas the stock price increased gradually. Despite the fact that few issues have been identified in the food industry thus far, the future remains unknown. As a result, each country must recognise the gravity of the situation and may need to tighten or loosen restrictions in response to the pandemic's progress.

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# Appendix

## Abbreviation

UL: Unilever PLC,

PEP: PepsiCo, Inc.,

K: Kellogg Company,

KO: The Coca-Cola Company,

NSRGF: Nestle S.A,

HINKF: Heineken N.V.,

HSY: The Hershey Company,

CAG: Conagra Brands, Inc.,

TSN: Tyson Foods, Inc.,

KHC: The Kraft Heinz Company,

STBFY: Suntory Beverage & Food Limited,

BUD: Anheuser-Busch InBev SA/NV,

MDLZ : Mondelez International, Inc.,

CPB: Campbell Soup Company,

AJINY: Ajinomoto Co., Inc.