Data Analysis and Visualization for Dow & Jones Industrial Average Facing COVID-19 Pandemic

Haolin Xiong

The University of North Carolina at Chapel Hill, Chapel Hill27514, United States

Abstract. This paper investigates the Dow Jones Industrial Average performance facing the crash triggered by COVID-19. We find that all constitute stocks experienced negative returns during the peak of a collision, but different constitutive sectors show us different elasticity in responding to the crisis. There are three sectors that offer such striking performances: Technology, Pharmacy&Biotech, and Oil that we conducted most parts of the research for analyzing these sectors. The Technology and Pharmacy&Biotech sectors had a satisfactory rate of loss compared to other sectors, whereas the Oil sector's stock values fell dramatically. The analysis reveals not only the reasons why the index and its sectors reacted differently to the crash but also how should investors or anyone interested in the stock market conduct proper investment strategies for a potential future crisis.

Keywords: COVID-19 pandemic; Dow & Jones Industrial Average; Technology Stocks; Oil Stocks; Pharmacy&Biotech Stocks.

1. Introduction

On January 30, 2020, the World Health Organization (WHO) deemed the COVID-19 outbreak a worldwide emergency. Over 950,000 people had died as a result of the COVID-19 pandemic nine months later, with approximately 31.12 million confirmed cases. Due to the implementation of border closures, travel restrictions, and quarantines by the governments of the world's greatest nations, there is now widespread concern about an imminent global crisis and economic problems. The pandemic has also affected the global economy, from restrictions on exports and imports to local stores' and restaurants' shutdowns. Without a doubt, the U.S. stock market, as one of the worldwide economic yardsticks, experienced harmful consequences during the pandemic.

Dow Jones Industrial Average (DJIA, or Dow), the S&P 500, and the Nasdaq Composite Index are considered measures of market performance on any given day. There are three main points of difference between the Nasdaq Composite, the S&P 500, and the Dow: coverage universe and the sectors, method of assigning weights to individual companies, and criteria used to select constituents. In general, the Nasdaq Composite Index narrowly reflects only the performance of the technology sector, and S&P 500 covers too many sectors and relatively small companies, which makes the index tends to be more volatile than the Dow. By contrast, Dow tracks the performance of key companies that are household names and are supposed to comprise a subset of the American economy (Sharma 2022). Therefore, it is reasonable to believe Dow is a solid subject for analyzing the negative influences brought to the U.S. stock market or even the global economy by the COVID-19 pandemic.

The main purpose of this paper is twofold. First, we model stocks' performance to the crash by visualizing their rate of return before, during, and after the pandemic to obtain each constitutive sector of Dow elasticity of the economic crisis. By comparing striking performed sectors, either good or bad, and analyzing the reasons, we can conclude useful methods to restrain a single sector or even the whole stock market's uncontrollable decline in the next economic crisis. Plus, investors or anyone interested in the stock market may conclude their own investment strategy from different aspects of this article's analysis on the Dow, sectors, or a particular stock.

This paper contributes to the literature by enriching stock market data and its visual resources. We shed light on the Dow and its components from January 2, 2018, to June 30, 2022, which period includes the COVID-19 pandemic period. Also, this paper includes abundant data visualizations that provide ways to analyze stocks through different aspects.

The rest of the paper is organized as follows. In Section 2.1, we briefly review the overall performance of Dow in the last five years and choose the most representative period that can exhibit

the pandemic's negative influence on Dow. Then we visualize each stock's rate of return during the period sorted by sector and find the most striking ones. From 2.2 to 2.4, we analyze the sectors whose performances during the crisis were most worthy of analyzing and seeking the reasons causing the differences. Lastly, section 4 concludes the research and

2. Dow & Jones Industrial Average

Over more than a century, the stock market—represented here by the Dow Jones Industrial Average —would expand by magnitudes as the U.S. became the world's leading economic power. But it wasn't a straight line upward. The 1929 Crash gave back all the Roaring '20s' gains and plunged the nation into the Great Depression. More crashes and recessions followed. War and disease rocked the market, but it always roared back (Pringle 2021).

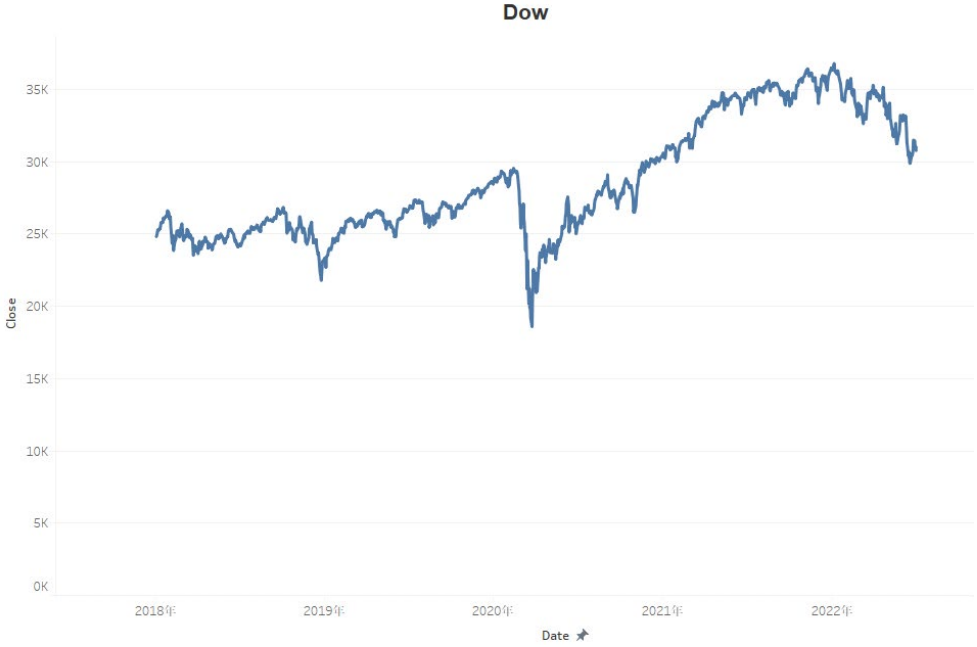


Figure 1. Direction map

From Figure 1, which covers Dow's closing price from January 2, 2018, to June 30, 2022, we can still see an overall stable growth over the five years. However, a conspicuous jump-starting at the beginning of 2020 clearly sabotaged the jawless trend momently, which was caused by the pandemic. To be more specific, two years ago, on March 16, 2020, stock markets suffered a one-day 12% drop. From February 19 to March 23 of that year, when the S&P 500 Index finally hit bottom, it lost about 34% of its value (Konish 2022). Meanwhile, Dow also experienced a harsh collision. To determine the exact drop, we define the darkest movement of this crash from February 12, 2020, to March 23, 2020, and Dow hit a 37.1% decline during this period. According to the sort of incident, stocks often respond in a way that either investors or traders see as good or negative. Contrary to corporate events, black swan occurrences like COVID-19 are uncommon, and very little research has been done to examine their effects. Based on how COVID-19 may impact corporate operations, stocks across all sectors responded to it differently.

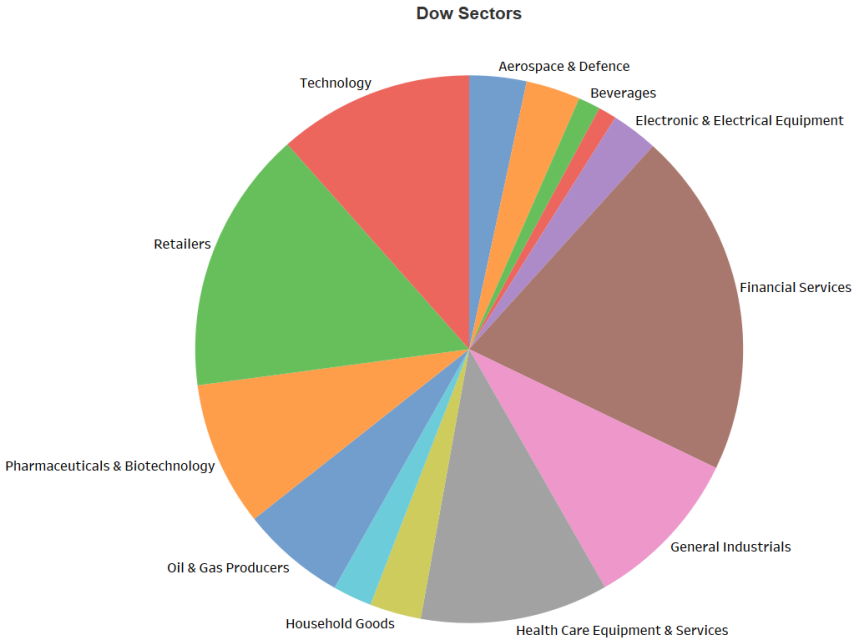


Figure 2. Dow Sectors

Figure 2 shows the current constitution of Dow sorted by each company's main acknowledged business area and weighted by each sector's real assigned weight. Based on the criteria, we build the graph that reflects each sector's rate of loss from February 12, 2020, to March 23, 2020.

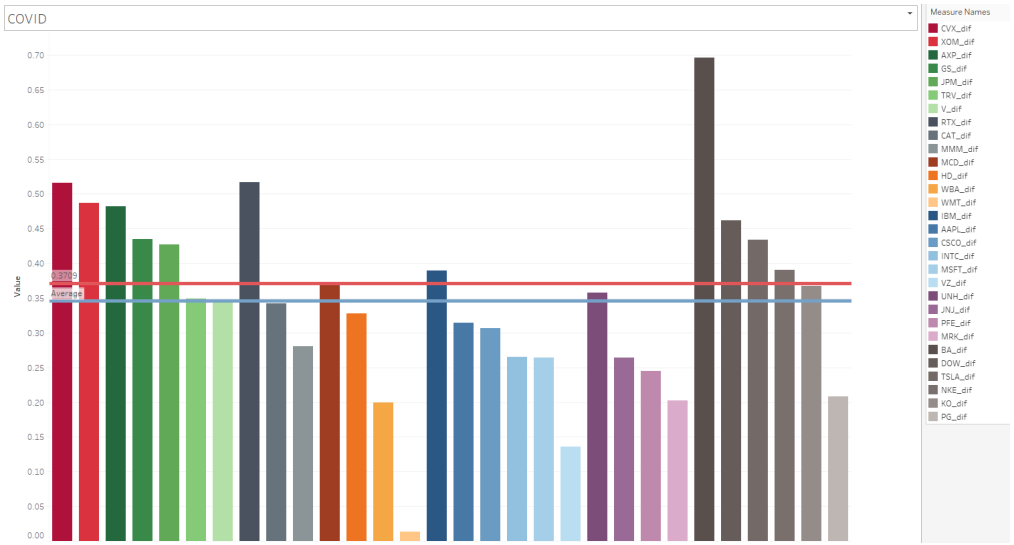


Figure 3. Loss rate

In figure 3, each bar represents a single stock's rate of loss during the time, and each color represents a different constitutive sector of Dow. From left to right, red represents the oil sector; green represents the financial sector; grey represents the industry sector; orange represents the retailer sector; blue represents the technology sector; purple represents the pharmacy&biotech sector; and brown represents the best stocks. Although stocks performed differently, they all somewhat declined like Dow. To make a direct perception of how each company performed, there are also two horizontal lines on the graph, the red line is the Dow index's rate of loss at the same time, and the blue line is the average rate of loss of all thirty companies. Through the graph, it is pretty obvious that the oil sector (red bars) is the most hurt sector as the two stocks' rate of return both excess Dow's and the average. On the other hand, the technology and parhmarcy&biotech sectors seem to have done well as there was only one stock from each sector that had a greater loss than the average. As the most striking three sectors during the crisis, the rest section will specifically discuss them.

2.1 Oil Sector

It has been estimated that oil is the most common energy source, with approximately 1/3 share of overall energy consumption. Not only is oil the single most widely used energy material, but it is also a unique natural resource that bestows political and economic power to those countries possessing abundant oil reserves (Bashir 2020). There are two companies belonging to Dow's oil sector: Chevron Corporation (CVX) and Exxon Mobil Corporation (XOM); both of their stock values fell over 48 percent from February 12, 2020, to March 23, 2020. On the other hand, this crisis seems only a booster to their slow decline before the pandemic.



Figure 4. Oil Sector

Although there are nuanced differences, the two companies' stock price drift is extremely alike. As the graph shows, there has been an apparent falling trend since the start of 2018.

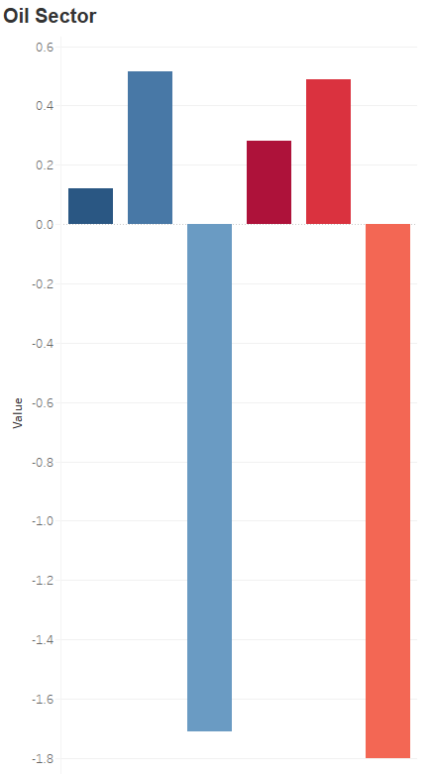


Figure 5. Loss rate

To be more specific, we made the bar chart to demonstrate each stock's rate of loss during the three periods since 2018; each color represents a company: blue bars are CVX, and red bars are XOM; from left to right, the first bar's period is from January 2, 2018, to February 11, 2020; the second one is from February 12, 2020, to March 23, 2020, the last one is from March 24 to June 30, 2022. Before the pandemic, CVX hits a 12.2% loss, and XOM hits a 27.9% loss.

Despite the fact that both companies have diversified businesses, with assets both on the upstream (oil drilling) and downstream (refining and chemicals) sides, sentiment around the price of oil is and always has been a big driver of the stock prices in the energy industry. Oil, meanwhile, is known for often swift and dramatic price. In 2018, oil hit a particularly nasty downdraft in the final months of the year. That drop, which quickly wiped out months of steady gains, pushed oil into a bear market. The prices of most oil-related names followed oil lower (Brewer 2019). In fact, their stock prices all roughly mirrored the price of oil through most of last year. Sadly, oil ended on a weak note, and so did these companies' stock prices.

The situation got more severe during the pandemic crisis: both companies reached about a 50% rate of loss. The shock can theoretically be explained through the supply and demand sides. From the supply perspective, oil exploration, production, and processing all have the characteristics of being labor-intensive. Measures taken by governments in response to the COVID-19 epidemic, such as workplace closures, restricted the normal market workforce and affected the production of many enterprises. At the same time, measures such as the closure of public transport, restrictions on internal movement, and suspensions of international travel negatively influenced the transportation of oil, increasing the cost of oil storage for enterprises and thus affecting the oil supply. From the perspective of oil demand, the slowdown in global economic growth has put heavy pressure on the energy industry, especially oil, as it is the most representative and frequently traded commodity. Government responses to the COVID-19 epidemic have led to shrinking industries, falling transport usage, and a halt in air traffic (Chen 2021).

With the recovery of the whole stock market and consumption power, the oil stocks gradually recover from the crash. Both the two companies' stock value is more than doubled compared to the price at the end of the crash.

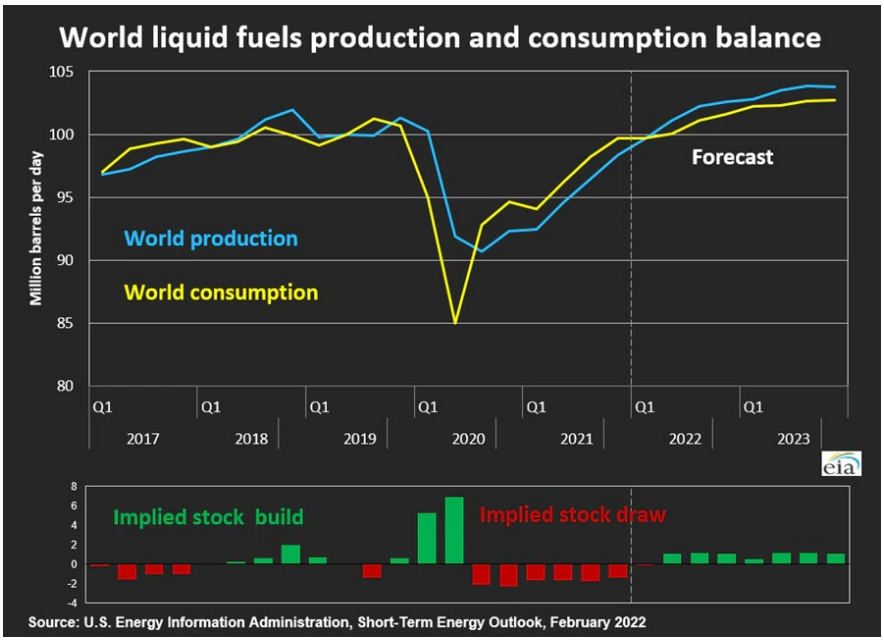


Figure 6. World liquid fuels production and consumption balance

According to the U.S. Energy Information Administration, from the middle of 2020 to 2022, the world consumption of liquid fuels exceeded production again, which caused the price of oil rises and incited the stock prices to mount up. More importantly, Russia started the War with Ukraine at the beginning of 2022, and the West introduced financial sanctions that made it difficult to clear Russian

oil transactions through Western banks. Russian oil normally accounts for about 10% of the global oil supply, so now there is a huge supply gap. With superfluous demand but limited supply, the price of oil becomes like a launching rocket, and so as the stock price.

2.2 Technology Sector

Technology stock is always one of the hottest topics among investors due to its promising potential and great success from previous cases, and it has a large weight on Dow; there are six components: Apple (AAPL), Cisco Systems Inc (CSCO), Intel Corporation (INTC), Microsoft Corporation (MSFT), Verizon Communications Inc (V.Z.), and International Business Machines Corporation (IBM). However, if turning the perspective to the stocks in the technology sector of Dow, it can be concluded that not all technology stocks do well in the last five years. We can only see a huge price jump from Apple and Microsoft; the others seem stable.

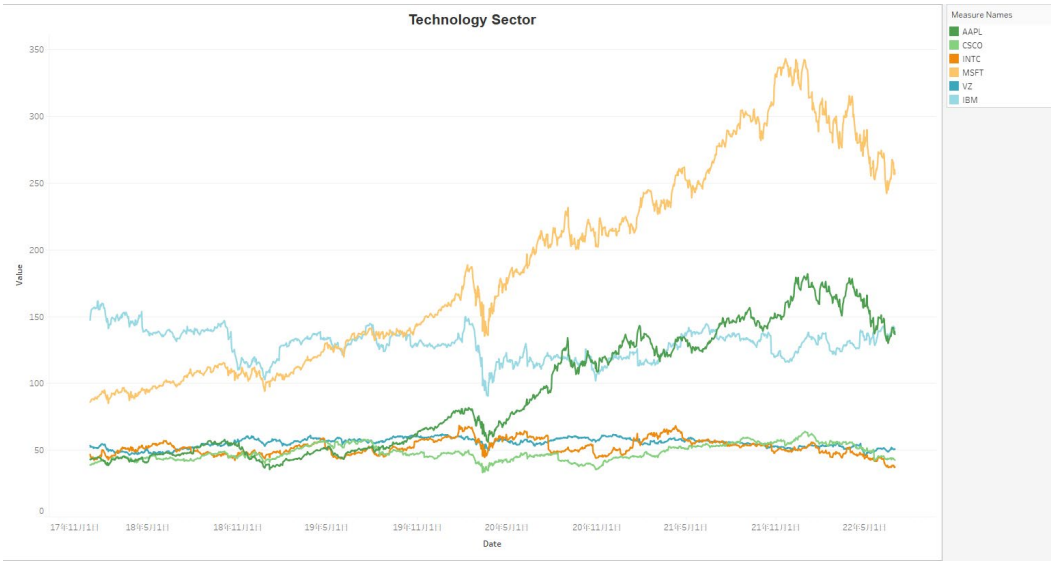


Figure 7. Technelogy Sector

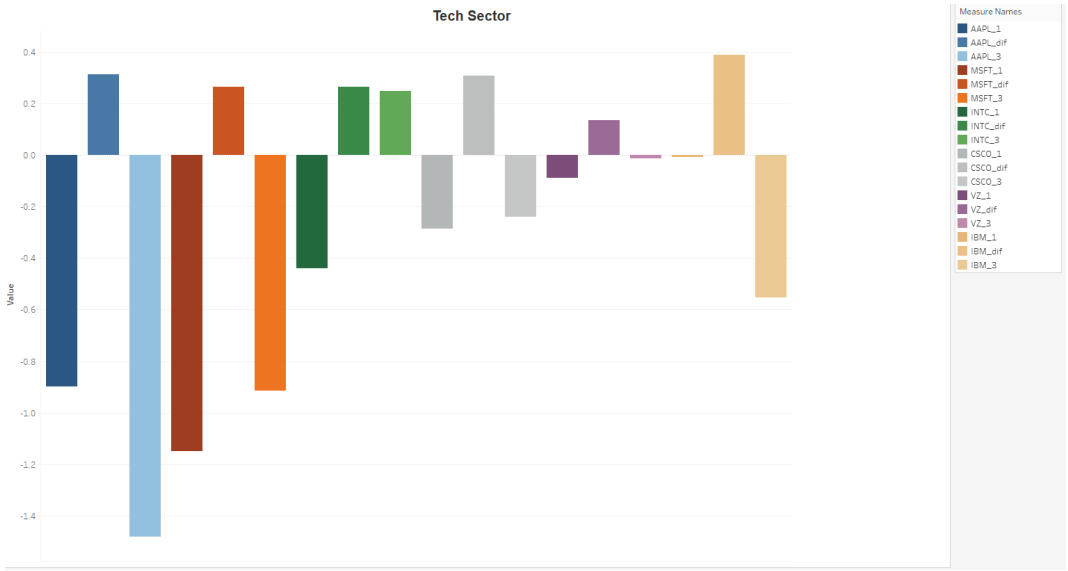


Figure 8. Tech Sector

Like Figure 8, the bar chart also represents each stock's rate of loss throughout the three periods. From left to right, blue bars represent Apple, red bars represent Microsoft, green bars represent Intel, grey bars represent Cisco, purple bars represent Verizon, and brown bars represent IBM. Most technology companies show alike satisfactory returns before and after the pandemic and relatively acceptable losses during the pandemic compared to other sector companies' performance.

Technology stocks always represent the most promising and high-return sector to the whole stock market, especially in America, where tons of top technology companies in the world were born. Therefore, it is totally not surprising to see their growth. As for during the pandemic, most technology companies' businesses were not heavily influenced by the virus as they seemed far away from the negative impacts like stores shutdown, limitations on exports and imports, etc. Meanwhile, many technology companies conducted solutions to the pandemic rapidly to keep them from serious loss: allowing employees to work at home, rejecting or decreasing the number of new employees, etc. On the other hand, there is technological benefit from this pandemic like Zoom, which is a company that provides support for remote learning and working. Then why would the stock prices still drop during the crisis? The stock market is not only about data, analysis, and techniques but also a game of emotions. When more than half of the market stocks and basic indexes drop dramatically, many investors feel fear, worrying if their owned stocks will fall in the next second. At this time, most of them tend to sell their shares "when the price is still high enough." As the more investors sell their shares, the lower the price will drop, which was the main reason why many technology stocks' prices fell during the pandemic. Once the whole stock market starts recovering from the crash, investors' emotion becomes stable, and the rising trend of technology stocks simply resemble the pre-pandemic period.

2.3 Pharmacy&Biotechnology Sector

Compared to the Oil and Technology sector, Pharmacy&Biotechnology is a pretty stable sector, especially for those big firms with mature systems and chemical basis. These stocks thus fall under the category of "defensive stocks." This indicates that a business is capable of paying dividends on a regular basis and is mostly unaffected by market volatility. The stability of the firm is influenced by its business strategy, the products and services it provides, and the strength of its brand. The epidemic does, however, provide the industry an opportunity to shine.

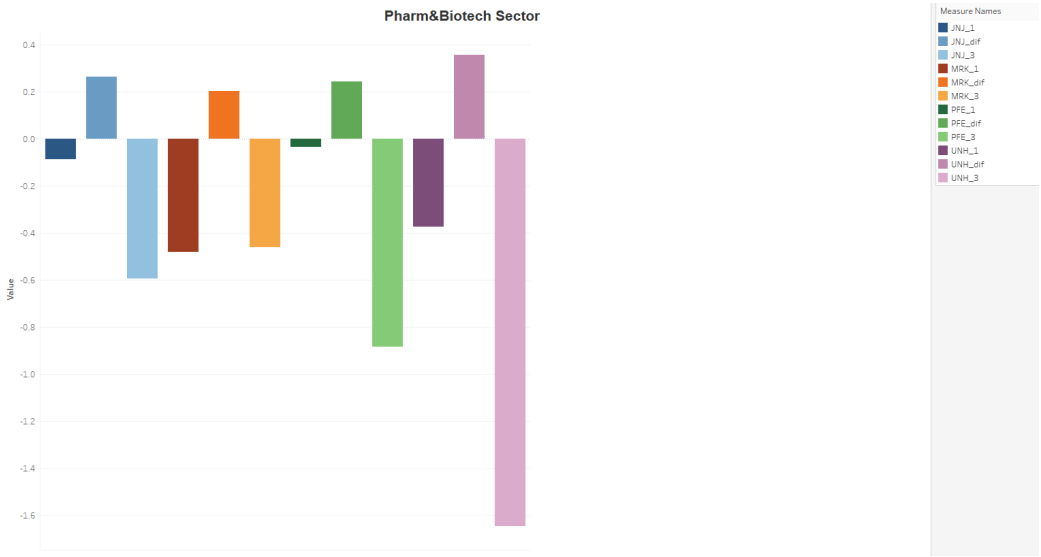


Figure 9. Pharm& Biotech Sector

Like the previous bar charts, from left to right, blue bars represent Johnson & Johnson (JNJ), orange bars represent Merck & Co., Inc. (MRK), green bars represent Pfizer (PFE), and purple bars represent UnitedHealth Group Inc (UNH). As the figure shows, these four companies both kept a stable, rising trend pre-pandemic, which reflects their trait as defensive stocks.

Even during the pandemic crisis, this sector shows a strong resistance and the least dropping rate among all other sectors. This tenacity should be first attributable to the industry's stability, but many of them also benefited from the approval of their Covid-19 vaccines and antibody treatments. Passing through the darkest movement, the pharmacy&biotech sector rebounds rapidly and bulkily. Rebounding medical spending as families who put off medical care at the height of the epidemic

started to return was a significant aspect that contributed to the positive performance. JP Morgan Chase analysis indicates that total healthcare spending would rise by 23% to $1,350 per household in 2021 from $1,100 in 2019 and 2020.

3. Conclusion

The current study aims to deepen the understanding of the stock market performance over the recent years related to the covid pandemic. This paper provides significant insights through an analysis of Dow30 and three of these most outstanding sectors during the crisis. The primary analysis was conducted to identify the exact influence pandemic brought to the stock market and then seek deeper reasons for what caused the sectors to perform differently. As stated, governmental restrictions, suspensions of international travel, international tensions, and industry's intricate propensity are all factors leading to these differences not only in these three sectors' performances but also in many other sectors.

Lastly, oil stocks seem to be a bold choice for radical investors who try to reach high returns, but they would be highly influenced by great recessions and international events. On the other hand, for investors looking for a stable portfolio, technology stocks and pharmacy&biotech stocks are all very good choices, especially the leading enterprises; the graphs show their steady trend before the pandemic, relatively lower losses during the crisis, and rapid recovery and vigorous growth after the crash.

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