The Effects of Pandemics on Stock Market Returns and Volatility

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ABSTRACT

On December 31, 2019, the World Health Organization (WHO) received word of a cluster of pneumonia cases in Wuhan, Hubei Province, China, identified as COVID-19. As COVID-19 progressed throughout the world, it created upheaval throughout various markets. For example, the S&P 500 stock market index declined from 3,386.15 on February 19, 2020, to 2,237.40 on March 23; however, the S&P 500 reached a new all-time high of 3,395.06 on August 18, 2020. This paper explores the issue by comparing past pandemics' stock market returns and volatility to COVID-19 by expanding the time period to one year, along with comparing to previous pandemics' returns. We postulate that the unprecedented government intervention through NPIs, government spending, increased unemployment benefits, and loans to companies along with quantitative easing will result in significantly higher financial returns and volatility in the stock market during COVID-19 compared to previous pandemics.[1]

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[1] This is a working paper that has not undergone the peer-reviewed process.

1   INTRODUCTION

The outbreak of COVID-19 coincided with one of the most turbulent periods ever recorded in the U.S. stock market. On December 31, 2019, the World Health Organization (WHO) received word of a cluster of pneumonia cases in Wuhan, Hubei Province, China, later identified as COVID-19 (Park, 2020). On March 11, 2020, the WHO declared COVID-19 a global pandemic (Cucinotta & Vanelli, 2020). As COVID-19 progressed, the S&P 500 U.S. stock market index declined from 3,386.15 on February 19, 2020, to 2,237.40 on March 23, 2020. However, this decline was short-lived, as the S&P 500 reached a new all-time high of 3,395.06 on August 18, 2020. The forceful stock market reaction to COVID-19 emphasizes the importance of the relationship between stock market performance and pandemics. To study this relationship, we compare stock market returns and volatility during past pandemics to COVID-19.

The dramatic stock market response to COVID-19 may have roots in investor expectations and behavior, influenced by the working class becoming more affected by stock market fluctuations in recent years. Gustman et al. (2010) find that workers are becoming more vulnerable to stock market crashes because of the ongoing shift from defined benefit plans to defined contribution plans. This phenomenon results in workers having a substantial portion of their wealth invested in the stock market as they approach retirement. As workers continue to have increased wealth invested in the stock market relative to their pensions, the impact of stock market movements on the working class grows. Hanspal et al. (2020) find that U.S. households responded to the COVID-19 stock market crash with upward adjustments of expectations about retirement age, desired working hours, and household debt. Changes in how investors store their

wealth are forcing U.S. workers and households to make complex investment decisions in the wake of global economic crises like COVID-19. Because of this, investors stand to benefit from greater insight as to whether the stock market returns and volatility seen during COVID-19 are typical of pandemics.

A significant amount of uncertainty existed in the initial stages of the COVID-19 outbreak. Altig et al. (2020) find that most measures of economic uncertainty reached their highest values on record. Baig et al. (2021) find that declining sentiment and the implementation of restrictions caused a deterioration of liquidity and stability in financial markets. Ali et al. (2020) find that even assets that some investors consider safer than equities, such as gold, declined. However, since the initial panic caused by the pandemic, many positive catalysts have pushed stocks higher. U.S. policymakers acted dramatically to counteract economic uncertainty and stabilize financial markets. Government spending to GDP reached an all-time high in the second quarter of 2020 (U.S. Bureau of Economic Analysis, 2021a, 2021b), and M2 increased by 25% during the year (Board of Governors of the Federal Reserve System, 2021). The U.S. stock market experienced a full recovery following these dramatic policy actions.

As the pandemic lengthens, the research surrounding the effects of COVID-19 on financial markets is expanding. Al-Awadhi et al. (2020) find that stock returns during COVID-19 are negatively related to daily growth in total confirmed cases and total deaths caused by COVID-19. Zhang et al. (2020) find that the severity of the COVID-19 outbreak in a country affects the stock market reaction in the country. The impact of COVID-19 on the stock market extends beyond just the health consequences. Zaremba et al. (2020) find that non-pharmaceutical policy interventions (NPIs) increased stock market volatility. Not all government policies interact with stock returns in the same way. Ashraf (2020) finds that social distancing measures

negatively affect stock returns, while containment policies and income support packages result in positive stock returns. The evidence suggests that the health consequences and government actions resulting from COVID-19 impacted the stock market.

Most financial literature has focused on measuring the effects of COVID-19 on the stock market. There has been little research testing whether these effects existed during past pandemics or are unique to COVID-19. Addressing agendas for future research, Goodell (2020) notes that there is limited prior research on how pandemics impact financial markets. Baker et al. (2020) find that no previous infectious disease outbreak in the first few months had such a considerable impact on stock market volatility compared to COVID-19. They used VIX data since 1985 and newspaper-based data since 1900 to measure stock market volatility, with periods ending on April 30, 2020. Over a year removed from the start of the pandemic, other developments have had time to influence the relationship between COVID-19 and stock market returns and volatility.

Given the unprecedented crash and subsequent recovery of the U.S. stock market during COVID-19, investors need more clarity about the impact of pandemics on financial markets. COVID-19 tasked a growing number of U.S. workers and households with making investment decisions based on rapidly-changing information regarding public health, the economy, and the policy responses of world governments. These investors would benefit from greater insight into whether pandemics systematically affect stock markets or if the stock market reaction to COVID-19 was an anomaly. We explore this issue by comparing past pandemics' stock market returns and volatility to COVID-19 by expanding the time horizon to one year, along with comparing pandemics' returns to returns in an average year.

2.   HYPOTHESIS

There is a deep set of financial literature showing that significant events impact the stock market. Kim and Mei (2001) find that political events significantly impacted stock market returns and volatility. Schneider and Troeger (2006) find that the stock market reacts to international crises. Eldor and Melnick (2004) find that terror attacks hurt stock market prices. Investors may reason that these effects extend to pandemics. Fama (1970) notes that prices fully reflect all available information in an efficient market and provide accurate signals for resource allocation. Historically, adverse economic outcomes have followed pandemics. Jordà et al. (2020) find that low returns on assets have occurred following pandemics. Ma et al. (2020) find that global disease outbreaks have decreased real GDP growth, corporate profitability, and employment. Investors may assume in an efficient market that the adverse economic outcomes of pandemics coincide with consistently negative stock market outcomes.

Although it may at first seem reasonable to assume that different pandemics affect the stock market in similar ways, there are reasons to believe that COVID-19 may differ from prior pandemics in terms of its impact on the stock market. Béland et al. (2020) find that the U.S. government issued widespread stay-at-home orders in response to COVID-19, resulting in decreased hours worked and reduced labor force participation. Bayer et al. (2020) find that an extraordinary fiscal policy response took place during COVID-19, including transfers to households and transfers to firms. Hartley and Rebucci (2020) find that many central banks engaged aggressively in quantitative easing policies, attempting to counteract the economic downturn caused by COVID-19. Motivated by the extreme stock market reaction to COVID-19 and the unique circumstances of COVID-19 compared to previous pandemics, we investigate whether COVID-19 affected the stock market differently than past pandemics. We propose the following hypotheses:

Hypothesis 1: Stock market returns during COVID-19 were not equal to stock market returns during past pandemics.

Hypothesis 2: Stock market volatility during COVID-19 was not equal to stock market volatility during past pandemics.

We postulate that the unprecedented government intervention through NPIs, government spending, and increased unemployment benefits and loans to companies along with quantitative easing will result in the financial return and volatility from the stock market during COVID-19 being significantly higher than previous pandemics.

3.   DATA AND METHODOLOGY

In examining the impact of pandemics on stock market performance, we look at significant pandemics in the last one hundred years. The past pandemics are chosen based on a timeline published by the Centers for Disease Control and Prevention (CDC) listing the major pandemics, which include the Spanish Flu beginning in spring 1918, the Asian Flu beginning in February 1957, the Hong Kong Flu beginning in September 1968, and H1N1 beginning in spring 2009 (CDC, 2018). Following the CDC, the dates correspond to the beginning of each pandemic and the first trading day to the last trading day of their respective weeks during the first year. For example, we choose to utilize March 18, 1918, to March 15, 1919, to correspond to the first year of the Spanish Flu pandemic. The dates corresponding to the Asian Flu, Hong Kong Flu, and H1NI are February 4, 1957- January 31, 1958; September 3, 1968- August 29, 1969; and April 13, 2009- April 9, 2010. To account for possible differences in the number of trading days during the week for the stock market during these periods, we utilize weekly measures to maintain consistency across pandemics. Thereby, we are limited to 52 observations to examine how each

pandemic affected the stock market after its first year of emergence. In COVID-19, the start date used is January 6, 2020, the first trading day after the WHO published the first disease outbreak news on COVID-19 (WHO, 2020), and we utilize the 52 weeks following.

To compare the stock market performance and variability across the pandemics, we compare both the returns and volatility during the COVID-19 period to the returns and volatility of each prior pandemic period. Additionally, we provide historical data for the S&P 500 dating back to January 2, 1928, to provide greater historical context for the returns of pandemics. Following Baker et al. (2020), we use the Dow Jones Industrial Average to proxy for the U.S. stock market during the Spanish Flu and the S&P 500 to proxy for the U.S. stock market during all other pandemics. Using the Dow Jones Industrial Average in the case of the Spanish Flu results from the S&P 500 not having existed at the time of the Spanish Flu. The S&P 500 has become accepted as a feasible alternative to approximate the U.S. stock market because investors cannot trade the actual market portfolio (Vijh, 1994), which is the reason we use the S&P 500. We obtain the historical prices used to calculate returns and volatility from Measuring Worth for the Dow Jones Industrial Average and Yahoo Finance for the S&P 500. We do not include dividends when calculating returns. We calculate the weekly returns using the weekly returns of each week in the 52 weeks and we calculate the weekly volatility using the standard deviation of returns for each week in the 52 weeks. We utilize z-tests and regressions to search for significant differences between COVID-19 and each prior pandemic regarding returns and volatility.

4. RESULTS

Table 1 shows the periods, annual returns, mean weekly returns, and standard deviation of weekly returns of the five major pandemics. The annual returns of the pandemics are primarily positive, ranging from -6.54% during the Asian Flu to 39.44% during H1N1. In three of the five

pandemics, the annual return is greater than the historical average of the S&P 500 of 7.79%. The mean weekly return is primarily positive during the pandemics ranging from -0.12% during the Asian Flu to 0.67% during H1N1. In three of the five pandemics, the average weekly return is greater than the historical average of the S&P 500 of 0.14%. During the pandemics, the standard deviation of weekly returns ranges from 1.56% during the Asian Flu to 4.40% during COVID-19. The standard deviation of weekly returns for every pandemic except COVID-19 was less than the historical average of the S&P 500 of 2.49%. The positive returns and low standard deviation of returns during the pandemics indicate that pandemics alone are not reasons for investors to pull out of the stock market, contrary to the investor behavior seen during COVID-19. We find that pandemics do not consistently correspond to adverse stock market outcomes, revealing that investor underperformance could result from market timing which Friesen and Sapp (2007) find is a common problem for the individual investor.

[Insert Table 1]

Table 2 provides the periods, mean weekly volatility, and standard deviation of weekly volatility of the five major pandemics. The volatility measure indicates that COVID-19 had the highest volatility of all the pandemics at a value of 1.54%. De Bondt and Thaler (1985) find that investors tend to overreact to unexpected and dramatic news events. News sentiment and news coverage are factors that could have contributed to the atypical spike in stock market volatility during COVID-19. Buckman et al. (2020) find that a rapid decline in news sentiment and rapid increase in news coverage occurred during COVID-19. Investors may have reacted to the dramatic headlines published during COVID-19 rather than making rational investment decisions based on economic conditions. Headlines during COVID-19 such as "Dow drops nearly 3,000 points, as coronavirus collapse continues; worst day since '87" (Imbert, 2020) sent negative

signals to investors. Despite GDP declines in Q1 and Q2, GDP recovered in subsequent quarters (U.S. Bureau of Economic Analysis, 2021b), a reality that investors who read the dramatic headlines may not have anticipated. We find that volatility was unusually high during COVID-19, consistent with the expectation that investors tend to overreact to the news.

[Insert Table 2]

Table 3 exhibits the differences between the returns of past pandemics and COVID-19. We find no significant differences between the returns of past pandemics and the returns of COVID-19. Our findings reject Hypothesis 1, which states that stock market returns during COVID-19 were not equal to stock market returns during past pandemics. Despite the unprecedented government intervention through NPIs, government spending, and quantitative easing, the financial return of COVID-19 was the same as past pandemics. Our findings demonstrate that even unparalleled government action was insufficient to influence stock market returns during COVID-19 compared to previous pandemics.

[Insert Table 3]

Table 4 displays the differences between the volatility of past pandemics and COVID-19. We find significant differences between the volatility of past pandemics and the volatility of COVID-19. Our findings confirm Hypothesis 2, which states that stock market volatility during COVID-19 was not equal to stock market volatility during past pandemics. Consistent with Baker et al. (2020), we find the stock market volatility of COVID-19 to be unprecedented. We discover that the findings of Baker et al. extend not only to the first few months of COVID-19 but also to a time horizon of one year. The heightened stock market volatility during COVID-19 could result from investor expectations and behavior regarding NPIs, government spending,

quantitative easing, and news coverage. Our findings suggest that the unique circumstances of COVID-19 produced an investing climate that fostered a period of elevated stock market volatility not seen during previous pandemics, albeit with no difference in returns.

[Insert Table 4]

Table 5 shows the coefficients and t-statistics of a COVID-19 dummy variable when returns are a lagged dependent variable in a regression model. Whether we use one, two, or three lags, the impact of COVID-19 on returns is not statistically significant and has adjusted R^2 values of -0.01, -0.01, and 0.00, respectively. The results of the regression models reinforce the findings of the z-test exhibited in Table 3, indicating stock market returns during COVID-19 were equal to stock market returns during previous pandemics. As three of the five pandemics have returns above the historical average of the S&P 500, investors should not assume that pandemics have an inherently negative impact on stock market returns or that COVID-19 is an anomaly among pandemics regarding returns.

[Insert Table 5]

Table 6 provides the coefficients and t-statistics of a COVID-19 dummy variable when volatility, rather than returns, is used as a lagged dependent variable in a regression model. When using one, two, or three lags, the impact of COVID-19 on volatility is statistically significant. The models have R^2 values of 0.53, 0.54, and 0.55, respectively. The results reaffirm the findings of the z-test in Table 4, suggesting that stock market volatility during COVID-19 was not equal to stock market volatility during previous pandemics.

[Insert Table 6]

5. CONCLUSION

Although COVID-19 did not influence returns, COVID-19 impacted volatility significantly, resulting in an investment climate that was hostile to investors. Benartzi and Thaler (1995) find that investors have "myopic loss aversion," or loss aversion combined with a short evaluation period. Hwang and Satchell (2010) find that investors are far more loss-averse during bull markets than bear markets. The unprecedented volatility during COVID-19 affected the stock market abruptly and disrupted a multi-year bull market in the United States, impacting investors at a time when their loss aversion was likely higher than in other periods. The outbreak of COVID-19 and the notable events that followed fostered a noteworthy period of stock market volatility, unlike the volatility of prior pandemics.

Moving forward, there is a need to better understand how retail investors versus more professional money managers handle periods of higher volatility. As more individuals become responsible for the performance of their retirement accounts moving forward, it is important to understand how volatility influenced their decision-making process.

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Table 1: Summary Statistics – Returns

Pandemic	Period	Annual Return	Weekly Returns	
			M	**SD**
Spanish Flu	March 18, 1918 – March 15, 1919	11.02%	0.22%	2.21%
Asian Flu	February 4, 1957 – January 31, 1958	-6.54%	-0.12%	1.56%
Hong Kong Flu	September 3, 1968 – August 29, 1969	-3.39%	-0.05%	1.57%
H1N1	April 13, 2009 – April 9, 2010	39.44%	0.67%	2.38%
COVID-19	January 6, 2020 – December 31, 2020	16.11%	0.38%	4.40%
S&P 500	January 2, 1928 – December 31, 2020	7.79%	0.14%	2.49%

Note. Each pandemic includes 52 weeks. Pandemics and periods are chosen based on a timeline published by the CDC. Weekly returns are measured using the weekly returns of each week in the period. Annual return for the S&P 500 is calculated as the average annual return of each year in the period. We do not include dividends when calculating returns.

Table 2: Summary Statistics – Weekly Volatility

Pandemic	Period	M	SD
Spanish Flu	March 18, 1918 – March 15, 1919	0.74%	0.31%
Asian Flu	February 4, 1957 – January 31, 1958	0.69%	0.49%
Hong Kong Flu	September 3, 1968 – August 29, 1969	0.42%	0.27%
H1N1	April 13, 2009 – April 9, 2010	1.04%	0.54%
COVID-19	January 6, 2020 – December 31, 2020	1.54%	1.58%

Note. Each pandemic includes 52 weeks. Pandemics and periods are chosen based on a timeline published by the CDC. Weekly volatility is measured using the standard deviation of returns for each week in the period. We do not include dividends when calculating returns.

Table 3: Past Pandemics vs. COVID-19 – Weekly Returns

Pandemic	Difference vs. COVID-19	P-Values
Spanish Flu	-0.16%	. 8145
Asian Flu	-0.50%	.4378
Hong Kong Flu	-0.43%	.4975
H1N1	+0.29%	.6825

Note. Difference vs. COVID-19 is the difference between the average weekly return of the pandemic and the average weekly return of COVID-19. P-values are obtained from the z-test.

[*] p < 0.10, [**] p < 0.05, [***] p < 0.01

Table 4: Past Pandemics vs. COVID-19 – Weekly Volatility

Pandemic	Difference vs. COVID-19	P-Values
Spanish Flu	-0.80%	.0003***
Asian Flu	-0.85%	.0002***
Hong Kong Flu	-1.12%	<.0001***
H1N1	-0.50%	.0330**

Note. Difference vs. COVID-19 is the difference between the average weekly volatility of the pandemic and the average weekly volatility of COVID-19. P-values are obtained from the z-test.

[*] $p < 0.10$, [**] $p < 0.05$, [***] $p < 0.01$

Table 5: Regressions – Weekly Returns

	(1) Returns	(2) Returns	(3) Returns
COVID-19	0.0019	0.0024	0.0030
	(0.31)	(0.38)	(0.46)
N	255	250	240
adj. R^2	-0.01	-0.01	-0.00

Note. T-statistics in parentheses.

[*] $p < 0.10$, [**] $p < 0.05$, [***] $p < 0.01$

Table 6: Regressions – Weekly Volatility

	(1) Volatility	(2) Volatility	(3) Volatility
COVID-19	0.0026**	0.0023**	0.0028**
	(2.35)	(2.06)	(2.24)
N	255	250	240
adj. R^2	0.53	0.54	0.55

Note. T-statistics in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$