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Pandemics and Stock Price Volatility: A Sectoral Analysis

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Abstract: In this paper, we assess the impacts of the five most recent pandemics on the volatility of stock prices across forty-nine sectors of the economy in the United States. These five most recent pandemics are the 1957–1958 Asian flu, the 1977 Russian flu, SARS-CoV-1, swine flu and COVID-19. Applying the GJR-GARCH model, we find that pandemics other than COVID-19 have heterogeneous impacts on the volatility of stock returns. The results of our analysis indicate that COVID-19 has increased the volatility of stock returns in all sectors. Similarly, stocks in more than seventy percent of sectors in our study declined during the ongoing pandemic, perhaps reflecting the severity of the pandemic. In addition, our results on sectors such as healthcare and natural gas diverge from other literature. The mixed results on SARS-CoV-1 are partially explained by the fact it emerged at a time when stock valuations were particularly pessimistic. In the case of Russian flu, it was relatively short-lived and limited in spread relative to other pandemics in our study.

Keywords: sectoral stock returns; GJR-GARCH; pandemics; COVID-19

JEL Classification: G12; C58; C22

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1. Introduction

The COVID-19 pandemic and the public policy response to it have had significant negative impacts on the global economy. Shutdowns curtailed travel and resulted in sharp decreases in employment and production. This led to high levels of anxiety and uncertainty among investors and had negative impacts on financial market activity, especially trading and investments. These impacts, driven in part by information flows (Smales 2021; Huberman and Regev 2001) have been studied over the last several years by examining various indicators of financial market activity. These indicators include liquidity (Zhang et al. 2020; Haroon and Rizvi 2020a; Baig et al. 2020), risk and volatility (Shigemoto and Morimoto 2022; Setiawan et al. 2021; Khan et al. 2023; Albulescu 2020; Jin et al. 2022; Wu et al. 2022; Zaremba et al. 2020; Haroon and Rizvi 2020b), financial performance (Mirza et al. 2020), stock price returns (Ramelli and Wagner 2020; Baker et al. 2020), contagion (Akhtaruzzaman et al. 2021; Okorie and Lin 2021), uncertainty (Salisu et al. 2020; Lyócsa and Molnár 2020), sentiment (Sergi et al. 2021; Cox et al. 2020; Harjoto et al. 2021) and new financial instruments (Corbet et al. 2020). Other studies examine the effect of policy responses to the pandemic on stock market behavior (Burdekin and Harrison 2021; Bouri et al. 2021; Cox et al. 2020). However, there is limited literature on the comparative effects of COVID-19 and similar pandemics on stock price volatility, either in general or across sectors or industries. We aim to contribute to filling this gap.

Existing studies on the comparative effects of COVID-19 are limited to two or three pandemics; these studies include Baker et al. (2020) who focus on stock price returns and limited analysis of volatility across COVID-19 and three other pandemics (1918–1919, 1957–1958 and 1968). They find that public policy measures and economic structure (particular service-oriented economies) largely explain why COVID-19 caused the largest stock price declines relative to other pandemics. Similarly, Mazur et al. (2021) focus on sectoral analysis; they examine the stock price returns of subsectors within the S&P500 during the COVID-19 pandemic. They find positive returns for such sectors as food, healthcare, natural gas and software while petroleum, hospitality, entertainment and real estate experienced negative returns. In contrast, we analyze stock market behavior across forty-nine sectors during health crises starting with the 1957–1958 Asian flu up to the COVID-19 pandemic. The main differences between our work and Baker et al. (2020) are that we compare stock price volatility across forty-nine sectors of the economy, rather than a single stock and we study five pandemics instead of four. For further analysis on the effects of COVID-19 relative to other pandemics, see Burdekin (2021); Barro et al. (2020).

Our paper represents an opportunity to examine the historical lessons of pandemics and stock price volatility as well as the differential effects on various sectors within the economy. What, if anything, is different for the COVID-19 pandemic relative to other past epidemics in various industries? What lessons can be drawn from these differences? Our paper attempts to answer these questions by examining stock price volatility across five different pandemics and forty-nine sectors. Using generalized autoregressive conditional heteroscedastic models, we find asymmetric behavior of stock prices across different sectors during health emergencies. Stock prices in the health and drugs sectors face more significant positive volatility while food, soda and leisure industries bear the most significant losses. Evidence on the relative performance of the stock market during different pandemics in the sample indicates that COVID-19 has the largest impact on stock price fluctuations. Interestingly, much of the changes in stock prices during COVID-19 were observed when the Federal Home Order was enforced from 1 March 2020 till 31 May 2020. Further analysis suggests that, among previous pandemics, only the H2N2 pandemic of 1957–1958 appears to have significant impacts on stock price fluctuation after COVID-19. The rest of our paper is organized as follows: we outline methods and data in Section 2, present results in Section 3 and provide conclusions in Section 4.

2. Methodology and Data

Our study is based on secondary sources of data. Data on daily stock returns of different sectors are collected from the website of Professor Kenneth French. The website provides daily data on stock price returns of 49 industries from 1 June 1926 to 29 October 2021. To analyze the impacts of pandemics on sectoral returns, we use the GJR-GARCH model of stock market volatility. The GJR-GARCH model developed by Glosten et al. (1993) and Zakoian (1994) is used to capture positive and negative shocks to financial variables. We use the GJR-GARCH model over the usual GARCH model due to the established facts in the literature that the GJR-GARCH model captures the observed negative shocks at time $t-1$, which have stronger impacts on the variance at time t than the positive shocks (see, for example, Glosten et al. 1993; Zakoian 1994). The use of the GJR model to study the pandemics is based on our assumption that pandemics induce pessimism among consumers, investors and policymakers which tends to contribute towards volatility that negatively affects stock prices. The GJR-GARCH model can be expressed as:

$$h_t = \alpha_0 + \sum_{j=1}^{q} \alpha_i \epsilon_{t-1}^2 + \sum_{j=1}^{p} \beta_i h_{t-1} + \sum_{k=1}^{r} \gamma_i I_{t-1} \epsilon_{t-1}^2. \tag{1}$$

In Equation (1), α_0 is an intercept term in the volatility equation. α_i represent ARCH parameters while β_i are GARCH parameters. The GJR-GARCH model is an extension of the standard GARCH model in the sense that the model contains an asymmetric component, i.e., $\gamma_i I_{t-1} \epsilon_{t-1}^2$. In Equation (1), the parameter $I_t = 1$ if $\epsilon_t < 0$ (bad news) and $I_t = 0$ otherwise. So good news (positive errors) has an impact of α_i while bad news (negative errors) has an impact of $\alpha_i + \gamma_i$. The impact of news on conditional variance is asymmetric if γ is significantly different from zero. In the equation, the persistence of volatility for a given shock can be expressed as $(\alpha + 0.5 * \gamma + \beta)$.

Additionally, we introduce a dummy variable in the conditional mean and the variance equations to investigate the impacts of pandemics on sectoral stock returns. Thus, the new GJR-GARCH model with different pandemics can be expressed as:

$$R_t = \mu + \rho R_{t-1} + \epsilon_t + \gamma_1 D_1, \tag{2}$$

$$h_t = \alpha_0 + \sum_{j=1}^{q} \alpha_1 \epsilon_{t-1}^2 + \sum_{j=1}^{p} \beta_1 h_{t-1} + \sum_{k=1}^{r} \gamma_i I_{t-1} \epsilon_{t-1}^2 + \lambda_1 D_1. \tag{3}$$

In Equation (2), R_t indicates sectoral stock returns and ρ is the persistence of the return process. ϵ_t is an error process. The dummy variable, γ_1, in the mean equation captures the impact of pandemics on stock returns across industries. Similarly, the coefficient on the dummy variable, λ_1, in the new volatility Equation (3) estimates the impacts of each pandemic considered on the conditional volatility of the sectoral stock returns. The dummy variable D assumes the value of 0 for each pre-pandemic era and 1 during each pandemic era. The dummy variable is chosen in such a way that it assumes the value of 0 for at least 3 months before a pandemic starts. We consult various sources like the World Health Organization (WHO) and the Center for Disease Control (CDC) to determine the actual dates of the pandemic start and end. These dates are reported in Table 1. In our study, we focus our analysis on the global health crises starting in 1957. Specifically, we focus on the 1957 influenza pandemic, the Russian flu of 1989–1990, SARS-I, swine flu and COVID-19. Table 1 reports the start and end dates of the pandemics considered in the paper.

Table 1. Pandemic names, and start and end dates.

S.N.	Pandemic	Start Date	End Date	Source
1.	Asian Flu	June 1957	December 1959	WHO
2.	Russian Flu	May 1977	December 1970	WHO
3.	SAARS-CoV-1	February 2003	May 2003	WHO and Lee and McKibbin (2004)
4.	Swine Flu	June 2009	August 2010	WHO
5.	COVID-19	20 January 2022	30 January 2022	Data Collected from Worldometer in June 2022

Notes: Table 1 reports the start and end dates of pandemics considered in this paper along with the sources.

A negative and statistically significant coefficient on the dummy variable would mean that a pandemic causes a reduction in the volatility of stock returns of an industry. However, a positive and significant dummy coefficient would mean a pandemic would increase the volatility of stock returns of a given sector.

In this paper, we focus our analysis on 49 sectors as categorized in the website of Prof. Kenneth French. However, due to missing data and requirements for GARCH model estimation, the exact numbers of industries considered in each pandemic vary. The lists of industries and descriptive statistics of stock returns in the respective industries are presented in Tables A1–A7 in the Appendix A. In the tables, large negative skewness with higher kurtosis values indicate are indicative of higher likelihood of losses in sectoral stock prices. Large positive values for skewness are indicative of high potential positive returns in stock prices.

3. Pandemics and Stock Market: GJR-GARCH Model Results

3.1. Asian Flu and Sectoral Stock Returns

In this subsection, we present the impacts of Asian flu on sectoral stock returns and volatility using the framework in Equations (2) and (3). The 1957–1958 flu was a global pandemic of influenza A virus subtype H2N2 that originated in southern China. It is estimated that the pandemic may have infected more than the 1918 Spanish flu pandemic. A report published by the World Health Organization (WHO) in 2013 suggests that global excessive deaths due to the 1957–1958 pandemic range from 1 to 4 million (WHO 2013). In the US alone, the Center for Disease Control (CDC) estimates excessive deaths of 70,000–116,000. The pandemic also had negative impacts on financial markets. It is estimated that the Dow Jones Industrial Average lost 15% of its value in the second half of 1957 and the US experienced a recession (Pinsker 2020). In this paper we examine these effects relative to other pandemics, with special emphases on sectoral impacts. Table 2 summarizes the findings of GJR-GARCH model estimation across different sectors for the 1957–1958 Asian flu. The results suggest that the Asian flu of 1957–1958 has asymmetric impacts on different industries. Of the forty sectors studied under the Asian flu pandemic, twelve indicate positive returns (as indicated by a positive coefficient estimate of γ_1 in the mean equation) while twenty-eight of them experienced negative returns (as indicated by a negative coefficient estimate of γ_1 in the mean equation). However, only recreation experienced positive and statistically significant returns while entertainment and to a lesser extent machinery show statistically significant evidence of negative returns. Industries like aircraft, agriculture, automobiles, banks, printing publishing, chemicals, electronic equipment, coal, business supplies, retail, recreation and utilities recorded positive stock performance. Stock prices in beer, construction materials, shipping containers, business services, apparel, construction, trading, food products, entertainment, consumer goods, insurance, measuring equipment, machinery, restaurants, medical equipment, mining, and natural gas and petroleum industries record negative performance. Across all industries, the Asian flu pandemic has the largest and significant positive impacts on the recreational sector. The largest, statistically significant negative impacts of the Asian Flu pandemic can be observed in machinery.

Table 2 also presents the estimated results of the GJR-GARCH(1, 1) model with sectoral stock returns. In Table 2, the coefficients on GARCH, (β_1) have positive and significant values in every sector implying the presence of volatility clustering in sectoral stock returns. The asymmetric component of the GJR-GARCH model, γ_i, of sectoral returns reflects the presence of asymmetric effects, indicating the impacts of negative shocks on volatilities dominate the effects of positive shocks. However, the asymmetric coefficient, γ_i, is negative and statistically significant in personal services and negative but statistically insignificant in medical equipment, business supplies and insurance industries. This reflects the dominant impacts of positive shocks over negative shocks. To capture the impacts of the pandemic on stock volatility, a dummy variable, D_1, is introduced in the volatility equation as in the mean equation. D_1 takes the value of 0 and 1 for before and during the pandemic era, respectively. The results show that the coefficient of the dummy variable for automobiles, banks, electrical equipment, business supplies, steel works, and to a lesser extent electronic equipment and shipbuilding is positive and statistically significant. This implies that the stock return volatility in those sectors increased during the pandemic. However, the coefficient of the dummy variable in the volatility equations is negative and statistically significant for pharmaceutical products, entertainment and personal services, suggesting a decrease in volatility in returns across those sectors during the Asian flu pandemic.

Table 2. Asian flu of 1957–1958 and impacts on sectoral stock returns.

Sectors	**Aircraft**	**Agriculture**	**Automobiles**	**Banks**	**Beer**	**Construction Materials**	**Printing Publishing**
Mean Eqn Parameters	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	−0.17 (0.18)	−0.133	−0.17 (0.19)	0.014 (0.07)	0.22 * (0.13)	0.07 (0.09)	−0.07 (0.22)
ρ	0.19 *** (0.05)	0.18 *** (0.1)	0.07 (0.1)	0.12 ** (0.06)	0.07 (0.05)	0.14 (0.06)	−0.001 (0.07)
γ_1	0.02 (0.19)	0.08 (0.21)	0.14 (0.19)	0.07 (0.08)	−0.21 (0.13)	−0.05 (0.1)	0.15 (0.23)
Variance Equation Parameters							
α_o	0.0014 (0.03)	0.04 (0.03)	−0.02 (0.02)	0.015 (0.01)	0.09 * (0.05)	0.01 (0.02)	0.068 (0.04)
α_1	−0.016 (0.028)	0.004 (0.03)	−0.008 (0.014)	−0.05 *** (0.014)	−0.07 *** (0.0002)	0.03 (0.03)	−0.004 (0.02)
β_1	0.89 *** (0.03)	0.93 *** (0.03)	0.95 *** (0.03)	0.91 *** (0.04)	0.67 *** (0.13)	0.9 *** (0.03)	0.89 *** (0.03)
γ_i	0.26 *** (0.06)	0.17 *** (0.055)	0.09 *** (0.03)	0.13 *** (0.04)	0.15 *** (0.04)	0.14 *** (0.05)	0.14 *** (0.05)
λ_1	0.04 (0.04)	−0.03 (0.03)	0.03 ** (0.02)	0.013 *** (0.0002)	0.07 (0.045)	0.002 (0.02)	0.03 (0.05)
Sectors	**Shipping Containers**	**Business Services**	**Chemicals**	**Electronic Equipment**	**Apparel**	**Construction**	**Coal**
Mean Eqn Parameters	**Coefficients**	**Coefficients**	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	0.05 (0.13)	0.03 (0.17)	−0.05 (0.16)	−0.11 (0.14)	0.11 (0.11)	0.38 (0.25)	−0.41 * (0.23)
ρ	0.12 * (0.06)	−0.06 (0.05)	0.16 (0.06)	0.04 (0.6)	0.06 (0.06)	0.14 ** (0.05)	0.11 * (0.07)
γ_1	−0.05 (0.14)	−0.03 (0.16)	0.03 (0.17)	0.15 (0.17)	−0.14 (0.11)	−0.42 (0.26)	0.31 (0.24)
Variance Equation Parameters							
α_o	0.02 (0.02)	0.04 (0.04)	0.02 (0.03)	0.003 (0.023)	0.02 (0.02)	−0.02 (0.03)	0.078 (0.075)
α_1	0.011 (0.03)	0.02 (0.04)	−0.04 (0.02)	0.06 *** (0.02)	0.065 * (0.04)	−0.035 *** (0.0087)	−0.0013 (0.04)
β_1	0.91 *** (0.04)	0.85 *** (0.11)	0.91 *** (0.03)	0.0015 (0.03)	0.89 *** (0.04)	0.98 ** (0.01)	0.81 *** (0.05)
γ_i	0.098 *** (0.04)	0.082 (0.056)	0.18 *** (0.03)	0.91 *** (0.028)	0.05 * (0.03)	0.097 *** (0.014)	0.27 *** (0.07)
λ_1	0.004 (0.02)	−0.02 (0.028)	0.01 (0.03)	0.067 * (0.04)	−0.01 (0.02)	0.032 (0.03)	0.01 (0.08)
Sectors	**Pharmaceutical Products**	**Electrical Equipment**	**Trading**	**Food Products**	**Entertainment**	**Consumer Goods**	**Insurance**
Mean Eqn Parameters	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	0.19 (0.27)	−0.10 (0.11)	0.11 (0.13)	0.04 (0.14)	0.11 (0.069)	0.094 (0.086)	0.14 (0.27)
ρ	0.19 ** (0.07)	0.13 (0.05)	0.13 ** (0.06)	0.17 *** (0.06)	0.069 (0.05)	0.02 (0.053)	0.01 (0.07)
γ_1	−0.034 (0.27)	0.073 (0.11)	−0.11 (0.14)	−0.004 (0.14)	−0.16 ** (0.08)	−0.09 (0.091)	−0.08 (0.28)
Variance Equation Parameters							
α_o	0.31 *** (0.07)	−0.01 *** (0.0031)	0.032 (0.03)	0.07 (0.05)	0.05 *** (0.001)	0.021 (0.015)	0.65 (0.45)
α_1	0.0096 (0.051)	−0.067 *** (0.01)	0.014 (0.03)	−0.02 (0.07)	−0.069 *** (0.0001)	−0.015 (0.04)	0.19 *** (0.06)
β_1	0.41 *** (0.15)	1.01 *** (0.00062)	0.91 *** (0.03)	0.38 *** (0.13)	1.002 *** (0.0001)	0.78 *** (0.095)	0.46 ** (0.18)
γ_i	0.46 *** (0.133)	0.11 *** (0.012)	0.091 *** (0.029)	0.53 *** (0.14)	0.11 *** (0.002)	0.22 *** (0.077)	−0.066 (0.086)
λ_1	−0.09 *** (0.02)	0.022 *** (0.003)	−0.004 (0.03)	−0.02 (0.04)	−0.04 *** (0.0007)	0.04 (0.025)	−0.07 (0.356)
Sectors	**Measuring Equipment**	**Machinery**	**Restaurants Hotels**	**Medical Equipment**	**Mining**	**Petroleum and Natural Gas**	**Business Supplies**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	0.11 (0.17)	0.18 (0.13)	0.13 (0.17)	0.08 (0.24)	0.08 (0.21)	0.011 (0.14)	−0.098 (0.24)
ρ	−0.006 (0.068)	0.16 *** (0.06)	0.002 (0.06)	0.15 * (0.08)	0.05 (0.06)	0.12 * (0.06)	0.15 ** (0.06)
γ_1	−0.04 (0.18)	−0.23 * (0.13)	−0.19 (0.19)	−0.014 (0.24)	−0.014 (0.21)	−0.04 (0.14)	0.023 (0.25)
Variance Equation Parameters							
α_o	0.18 (0.15)	0.02 * (0.011)	−0.005 (0.03)	0.45 * (0.26)	0.13 (0.09)	0.05 (0.032)	0.082 (0.11)
α_1	0.14 *** (0.04)	−0.065 ** (0.02)	−0.007 (0.013)	0.19 *** (0.06)	0.03 (0.06)	0.04 (0.03)	0.10 (0.068)
β_1	0.56 *** (0.16)	0.95 *** (0.025)	0.91 *** (0.04)	0.25 (0.24)	0.57 *** (0.15)	0.83 *** (0.06)	0.69 *** (0.18)
γ_i	0.13 (0.12)	0.21 *** (0.038)	0.16 *** (0.05)	−0.06 (0.12)	0.35 ** (0.15)	0.21 *** (0.1)	−0.08 (0.1)
λ_1	0.2 (0.17)	−0.011 (0.012)	0.04 (0.03)	0.19 (0.23)	0.054 (0.08)	−0.005 (0.03)	0.36 * (0.18)
Sectors	**Personal Services**	**Real Estate**	**Retail**	**Shipbuilding**	**Rubber and Plastic Products**	**Steel Works**	**Communication**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	0.21 (0.41)	0.33 (0.15)	−0.03 (0.084)	0.07 (0.14)	0.1 (0.22)	0.02 (0.13)	0.07 (0.13)
ρ	−0.11 (0.1)	0.03 (0.06)	0.17 *** (0.05)	0.16 *** (0.05)	0.04 (0.064)	0.088 * (0.05)	0.14 * (0.07)
γ_1	−0.08	−0.31 (0.16)	0.05 (0.088)	−0.12 (0.14)	−0.15 (0.23)	−0.13 (0.13)	−0.07 (0.14)
Variance Equation Parameters							
α_o	0.7 ** (0.33)	0.17 (0.12)	0.012 (0.007)	−0.002 (0.009)	0.28 (0.18)	0.009 (0.01)	0.02 (0.02)
α_1	0.12 (0.11)	0.06 (0.088)	−0.03 ** (0.015)	−0.05 *** (0.00001)	0.22 ** (0.11)	−0.11 *** (0.004)	0.166 *** (0.038)
β_1	0.53 ** (0.26)	0.49 ** (0.22)	0.94 *** (0.03)	0.96 *** (0.00001)	0.37 * (0.19)	0.98 *** (0.012)	0.77 *** (0.02)
γ_i	−0.26 * (0.14)	0.24 * (0.13)	0.14 *** (0.02)	0.15 *** (0.007)	0.036 (0.12)	0.22 *** (0.02)	0.26 *** (0.076)
λ_1	−0.08 *** (0.0009)	0.17 (0.15)	−0.005 (0.007)	0.018 * (0.01)	−0.01 (0.111)	0.034 *** (0.01)	−0.022 (0.02)

Table 2. *Cont.*

Sectors	**Recreation**	**Transportation**	**Textiles**	**Utilities**	**Wholesale**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients
μ	−0.4 ** (0.19)	0.042 (0.2)	0.004 (0.123)	0.04 (0.04)	0.07 (0.25)
ρ	0.07 (0.06)	0.2 *** (0.06)	0.28 *** (0.06)	0.31 *** (0.051)	0.16 ** (0.05)
γ_1	0.45 ** (0.19)	−0.06 (0.2)	−0.03 (0.13)	0.0033 (0.04)	−0.09 (0.25)
Variance Equation Parameters					
α_o	−0.002	−0.03 (0.04)	0.033 (0.04)	0.003 *** (0.001)	0.03 *** (0.013)
α_1	0.028 (0.03)	−0.011 (0.03)	0.06 (0.04)	0.005 (0.004)	−0.11 *** (0.0001)
β_1	0.91 *** (0.02)	0.91 *** (0.032)	0.77 *** (0.06)	0.91 *** (0.03)	0.99 *** (0.01)
γ_i	0.093 *** (0.04)	0.19 *** (0.05)	0.26 *** (0.083)	0.11 ** (0.05)	0.17 *** (0.013)
λ_1	0.04 (0.05)	0.05 (0.04)	−0.0003 (0.04)	−0.007 (0.008)	−0.011 (0.012)

Notes: Standard errors are in parenthesis. *** Significant at 1% level. ** Significant at 5% level. * Significant at 10% level.

3.2. The 1977 Russian Flu and Sectoral Stock Returns

The 1977 Russian flu was an influenza pandemic that was first reported by the Soviet Union in 1977. The pandemic lasted till 1979. The pandemic resulted in approximately 700,000 deaths worldwide and affected mostly the population younger than 25 or 26 years of age (WHO 1999). The virus first reached the United States in January 1978 (Gregg et al. 1978) and the first outbreak in the U.S. was reported in Cheyenne, Wyoming, where the clinical attack rate was more concentrated on school children (Mermel 2009). There is little to no literature on the behavior of stock prices during this pandemic. However, data (see appendix for comparison of descriptive statistics before and during the pandemic) suggests that the pandemic might have influenced the moments of sectoral stock returns. Thus, we aim to uncover the effects of this pandemic on sectoral returns using the GJR-GARCH(1, 1) model. The results of the GJR-GARCH model are presented in Table 3 below. The results in Table 3 suggest that the Russian Flu of 1977 had positive but statistically insignificant impacts on mean returns (given by positive coefficients on γ_1 of the mean equations) for more than half of the sectors in our fitted model (for example, aircraft, automobiles, banking, shipping containers, business services, electronic equipment, apparel, pharmaceutical products, food products, entertainment, computers, healthcare, consumer goods, insurance, measuring and control equipment, machinery, restaurants, medical equipment, candy and soda, communication, utilities, and soda). The rest of the sectors had negative mean returns. Also, the computer and restaurant sectors are the only two sectors that experienced strong and statistically significant positive mean returns. Shipbuilding and railroad sectors show only statistically weak evidence of strong negative returns, i.e., significance at 10%.

Table 3 also presents the impacts of the pandemic on the conditional volatility of sectoral stock price returns. In Table 3, the coefficient on GARCH, (β_1), has statistically insignificant estimates on automobiles, banking, coal, pharmaceutical products, healthcare, consumer goods, machinery, restaurants, business supplies, shipbuilding and communication representing the lack of volatility clustering in the stock returns. However, β_1 has statistically significant estimates for the rest of the sectors, indicating the presence of volatility clustering in stock returns during this pandemic.

The asymmetric component of the GJR-GARCH(1, 1) model, γ_i, is negative and statistically significant in aircraft, agriculture, construction materials, electronic equipment, fabricated products and precious materials, all reflecting dominant impacts of positive shocks rather than those of negative shocks on volatilities. However, γ_i is positive and statistically significant in coal, restaurants, hotels and motels, petroleum, and natural gas, all indicating the dominating impacts of negative shock on volatilities. The coefficient remains statistically insignificant in the case of other sectors.

Table 3 also shows the coefficients of the dummy variable, λ_i, which captures the impacts of the pandemic on sectoral stock market volatility. The results show that the Russian flu had negative impacts on stock market volatilities in the following sectors: automobiles, construction materials, banking, shipping construction, electronic equipment, apparel, construction, coal, pharmaceutical products, electronic equipment, fabricated products, food products, precious metals, defense, computers, healthcare, consumer goods, insurance, measuring and control equipment, restaurants, medical equipment, petroleum, business supplies, real estate, rubber, ship building, candy and soda, and utilities. These sectors represent about 75% of total sectors considered in the study. Such adverse impacts are statistically significant on the following sectors: apparel, medical equipment, and petroleum and natural gas. The decrease in volatilities of stocks during the pandemic is perhaps related more to the Federal Reserve's change in its stance regarding inflation than with the pandemic itself. Furthermore, the mortality rate in the USA due to the pandemic is calculated to be 5 per 100,000 population, less than that of the typical seasonal influenza (6 per 100,000 population) (Rozo and Gronvall 2015). The relatively benign nature of the pandemic might have added less volatility to stock prices. In contrast, stock returns in the following sectors gained volatilities during the pandemic: aircraft, agriculture, business supplies, chemicals, entertainment, machinery, industrial mining, communication, transportation and wholesale. However, the volatility rise is statistically significant only in the entertainment sector.

Table 3. Russian flu and sectoral stock returns.

Sectors	**Aircraft**	**Agriculture**	**Automobiles and Trucks**	**Banking**	**Construction Materials**	**Shipping Containers**	**Business Services**
Mean Eqn Parameters	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
μ	0.033 (0.08)	0.037 (0.097)	−0.05 (0.09)	−0.042 (0.066)	0.012 (0.057)	−0.02 (0.08)	0.02 (0.057)
ρ	0.21 *** (0.064)	0.005 (0.064)	0.15 *** (0.06)	0.29 *** (0.061)	0.25 *** (0.065)	0.16 ** (0.074)	0.28 *** (0.06)
γ_1	0.0005 (0.10)	−0.01 (0.13)	0.063 (0.10)	0.05 (0.82)	−0.033 (0.072)	0.0078 (0.097)	0.036 (0.072)
Variance Equation Parameters							
α_0	0.099 * (0.06)	1.59 *** (0.26)	0.31 (0.31)	0.21 (0.21)	0.026 ** (0.011)	0.098 (0.11)	0.045 (0.074)
α_1	0.11 * (0.062)	0.04 *** (0.0005)	−0.044 (0.067)	−0.04 (0.07)	0.099 ** (0.038)	0.081 (0.087)	0.054 (0.076)
β_1	0.81 *** (0.11)	−0.73 *** (0.19)	0.61 (0.43)	0.43 (0.55)	0.91 *** (0.037)	0.78 *** (0.21)	0.79 *** (0.30)
γ_i	−0.14 * (0.08)	−0.097 *** (0.013)	−0.04 (0.078)	0.15 (0.14)	−0.12 ** (0.049)	−0.047 (0.083)	−0.016 (0.082)
λ_1	0.0032 (0.024)	0.039 (0.24)	−0.08 (0.101)	−0.035 (0.06)	−0.008 (0.007)	−0.02 (0.03)	0.0022 (0.0145)
Sectors	**Chemicals**	**Electronic Equipment**	**Apparel**	**Construction**	**Coal**	**Pharmaceutical Products**	**Electrical Equipment**
Mean Eqn Parameter	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
μ	−0.014 (0.069)	0.0017 (0.0043)	−0.0014 (0.072)	0.026 (0.08)	−0.001 (0.12)	−0.09 (0.07)	0.041 (0.073)
ρ	0.24 *** (0.063)	0.18 *** (0.007)	0.22 *** (0.06)	0.22 *** (0.065)	0.10 *** (0.03)	0.27 *** (0.06)	0.16 *** (0.059)
γ_1	−0.015 (0.087)	0.02 (0.05)	0.06 (0.08)	−0.01 (0.09)	−0.11 (0.15)	0.13 (0.096)	−0.02 (0.092)
Variance Equation Parameters							
α_0	0.13 (0.17)	1.011 *** (0.005)	0.96 *** (0.15)	0.045 (0.042)	1.56 (1.35)	0.14 (0.29)	0.027 *** (0.007)
α_1	−0.02 (0.06)	0.046 *** (0.015)	−0.012 (0.045)	−0.01 (0.02)	−0.10 *** (0.03)	0.03 (0.069)	−0.03 *** (0.011)
β_1	0.74 ** (0.37)	−1.03 *** (0.015)	−0.90 *** (0.091)	0.91 *** (0.078)	0.0889 (0.84)	0.72 (0.60)	1 *** (0.0000001)
γ_i	−0.055 (0.08)	−0.02 ** (0.006)	−0.045 (0.052)	0.06 (0.05)	0.11 ** (0.058)	0.002 (0.082)	−0.022 (0.033)
λ_1	0.03 (0.034)	−0.16 (0.12)	−0.35 ** (0.16)	−0.007 (0.01)	−0.54 (0.47)	−0.00001 (0.03)	−0.0002 (0.0048)
Sectors	**Fabricated Products**	**Food Products**	**Entertainment**	**Precious Metals**	**Defense**	**Computers**	**Healthcare**
Mean Eqn Parameters	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
μ	0.10 (0.10)	−0.042 (0.05)	−0.04 (0.097)	0.12 (0.10)	0.076 (0.092)	−0.097 (0.08)	−0.03 (0.15)
ρ	0.12 ** (0.056)	0.21 *** (0.061)	0.13 ** (0.063)	0.097 * (0.057)	0.13 ** (0.06)	0.08 (0.06)	0.27 *** (0.061)
γ_1	−0.0004 (0.11)	0.06 (0.06)	0.20 (0.13)	−0.11 (0.124)	−0.07 (0.11)	0.19 * (0.099)	0.23 (0.18)
Variance Equation Parameters							
α_0	0.41 *** (0.023)	0.052 (0.052)	0.0889 (0.064)	0.036 ** (0.02)	1.66 *** (0.263)	0.053 *** (0.006)	0.90 (1.25)
α_1	0.007 (0.05)	0.02 (0.077)	−0.04 (0.03)	0.016 (0.019)	0.127 *** (0.05)	−0.07 *** (0.012)	−0.046 *** (0.00002)
β_1	0.54 *** (0.064)	0.72 *** (0.25)	0.94 *** (0.054)	1.002 *** (0.023)	−0.89 *** (0.063)	1.01 *** (0.00002)	0.48 (0.77)
γ_i	−0.123 *** (0.044)	0.11 (0.09)	−0.03 (0.044)	−0.082 *** (0.03)	0.014 (0.053)	−0.017 (0.02)	0.033 (0.058)
λ_1	−0.255 *** (0.00002)	−0.01 (0.01)	0.023 * (0.013)	−0.016 (0.0111)	−0.053 (0.31)	−0.0000009 (0.0003)	−0.35 (0.47)

Table 3. *Cont.*

Sectors	**Consumer Goods**	**Insurance**	**Measuring and Control Equipment**	**Machinery**	**Restaurants, Hotels, Motels**	**Medical Equipment**	**Industrial Mining**
Mean Eqn Parameters	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
μ	−0.11 (0.08)	0.0042 (0.055)	−0.046 (0.10)	0.046 (0.065)	−0.14 (0.089)	−0.11 (0.09)	0.025 (0.064)
ρ	0.09 * (0.055)	0.39 *** (0.062)	0.20 *** (0.069)	0.32 *** (0.0635)	0.29 *** (0.05)	0.13 ** (0.059)	0.23 *** (0.05)
γ_1	0.11 (0.1)	0.02 (0.069)	0.10 (0.12)	−0.062 (0.085)	0.24 ** (0.11)	0.21 (0.11)	−0.143 (0.087)
Variance Equation Parameters							
α_0	0.96 ** (0.44)	0.025 (0.021)	0.22 (0.19)	0.36 ** (0.166)	0.75 (0.66)	0.11 ** (0.058)	0.028 (0.0212)
α_1	0.0034 (0.08)	0.049 (0.063)	0.11 (0.09)	0.036 (0.76)	−0.11 *** (0.00008)	−0.0545 (0.0386)	0.0339 (0.035)
β_1	−0.399 (0.68)	0.86 *** (0.11)	0.75 *** (0.21)	−0.03 (0.39)	0.07 (0.84)	0.92 *** (0.056)	0.89 *** (0.082)
γ_i	−0.10 (0.07)	0.039 (0.0739)	−0.16 (0.11)	0.182 (0.131)	0.12 *** (0.84)	0.039 (0.051)	0.01 (0.044)
λ_1	−0.153 (0.18)	−0.004 (0.007)	−0.0078 (0.086)	0.0131 (0.075)	−0.16 (0.19)	−0.036 ** (0.019)	0.004 (0.012)
Sectors	**Petroleum and Natural Gas**	**Business Supplies**	**Real Estate**	**Rubber and Plastic Products**	**Shipbuilding and Railroad Equipment**	**Candy and Soda**	**Communication**
Mean Eqn Parameters	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
μ	0.023 (0.048)	−0.057 (0.087)	0.064 (0.076)	0.082 (0.06)	0.14 (0.09)	−0.07 (0.09)	0.008 (0.044)
ρ	0.25 *** (0.052)	0.27 *** (0.055)	0.144 ** (0.068)	0.14 ** (0.065)	−0.03 (0.07)	0.02 (0.07)	0.087 (0.06)
γ_1	−0.026 (0.07)	−0.005 (0.10)	−0.01 (0.097)	−0.045 (0.0832)	−0.18 * (0.11)	0.12 (0.12)	0.005 (0.057)
Variance Equation Parameters							
α_0	0.022 *** (0.0027)	0.55 (0.43)	0.064 (0.0577)	0.0242 *** (0.005)	0.31 (0.455)	0.24 * (0.14)	0.096 (0.16)
α_1	−0.066 *** (0.000015)	0.012 (0.079)	0.008 (0.043)	−0.069 *** (0.0255)	0.069 (0.11)	0.13 (0.09)	0.06 (0.10)
β_1	0.998 *** (0.000002)	0.18 (0.66)	0.85 *** (0.133)	1.022 *** (0.00013)	0.51 (0.69)	0.56 *** (0.21)	0.41 (0.91)
γ_i	0.032 ** (0.0135)	−0.08 (0.11)	0.06 (0.076)	−0.0051 (0.03)	−0.01 (0.13)	0.086 (0.094)	−0.068 (0.11)
λ_1	−0.003 * (0.002)	−0.096 (0.096)	−0.003 (0.02)	−0.002 (0.003)	−0.04 (0.084)	−0.04 (0.062)	0.008 (0.02)
Sectors	**Transportation**	**Utilities**	**Wholesale**				
Mean Eqn Parameters	Coefficient	Coefficient	Coefficient				
μ	0.001 (0.064)	0.012 (0.033)	−0.009 (0.051)				
ρ	0.199 *** (0.07)	0.41 *** (0.06)	0.21 *** (0.065)				
γ_1	−0.02 (0.08)	0.02 (0.042)	0.021 (0.067)				
Variance Equation Parameters							
α_0	0.03 (0.02)	0.012 (0.008)	0.033 (0.031)				
α_1	0.078 (0.056)	−0.022 (0.033)	0.047 (0.054)				
β_1	0.87 *** (0.082)	0.89 *** (0.09)	0.79 *** (0.15)				
γ_i	−0.052 (0.054)	0.0731 (0.05)	0.065 (0.068)				
λ_1	0.0034 (0.0096)	−0.002 (0.002)	0.00577 (0.013)				

Notes: Standard errors are in parenthesis. *** Significant at 1% level. ** Significant at 5% level. * Significant at 10% level.

3.3. SARS-CoV-1 and Sectoral Stock Returns

Severe acute respiratory syndrome coronavirus 1 (SARS-1-CoV) is a strain of coronavirus that causes severe acute respiratory syndrome (SARS), which is the illness that was responsible for the 2002–2004 SARS outbreak. According to WHO, a total of 8098 people worldwide were infected and 774 of them died (Center for Disease Control and Prevention 2013). In the United States, only eight people were infected by the virus. However, SARS-CoV-1 negatively impacted stock prices. For instance, S&P 500 lost 12.8% of its total value after Chinese authorities reported the outbreak of the SARS to WHO. Furthermore, all S&P 500 sectors declined during the SARS outbreak, with information technology, financial and communication services among the biggest losers, falling 14%, 16% and 26%, respectively (Li 2020). Given such a behavior of stock prices during the pandemic, it is important to understand the volatility of sectoral stock prices during the pandemic, relative to other pandemics. Our results on SARS-COV-1 are presented in Table 4. Table 4 shows the estimation results of the GJR-GARCH(1, 1) model, which contains mean equation results on the first half of the table and volatility parameters on the second half. The mean equation results suggest that the pandemic had mostly positive impacts on stock price returns in more than two-thirds of industries in our fitted model. Specifically, out of all, five industries (agriculture, food products, defense, restaurants and hotels) had positive and statistically significant returns while healthcare and industrial mining had statistically weak positive returns. The pandemic caused losses in the following sectors: printing and publishing, shipping containers, apparel, coal, fabricated products, computers, shipbuilding and railroad, computer software, candy and soda, and communications. Among these sectors, stocks in the coal sector suffered the largest losses, followed by fabricated products and candy, as given by the values of $\gamma_1 = -0.21$, -0.14 and -0.18, respectively. However, none of these losses were shown to be statistically significant.

The volatility equation estimations in Table 4 suggest that the pandemic reduced the conditional volatility of stock returns across all industries except insurance, i.e., $\lambda = 0.017$. The decrease in conditional volatility, given by the coefficient on λ_i, is statistically significant in just under half of the sectors in our model fit. The decrease in conditional volatility in sectors such as agriculture, banking, beer, shipping, fabricated products, electrical equipment, construction, food products, precious metals, defense, restaurants, medical equipment, petroleum, business supplies, real estate, rubber, shipbuilding, recreation and transportation were not statistically significant.

The volatility equation estimation also suggests that the coefficient on GARCH, β_1, is positive and significant in most sectors, reflecting volatility clustering in sectoral returns except in electrical equipment, medical equipment, real estate, rubber, recreation and utilities. The asymmetric coefficient in the volatility equation, γ_i, is negative and statistically significant in beer, business services, chemicals, electronic equipment, apparel, coal, fabricated products, petroleum and natural gas, real estate, rubber, tobacco, computer software, steel works, communication, recreation, transportation and utilities, suggesting that impacts of negative shocks on stock volatility dominate positive shocks. Also, the positive asymmetric coefficients on agriculture, automobiles, banking, construction materials, printing, shipbuilding, construction, electrical equipment, food products, entertainment, precious metals, healthcare, consumer goods, measuring equipment, machinery, restaurants, medical equipment, business supplies, personal services, retail, shipbuilding and candy indicate that impacts of positive shocks on volatility dominate negative shocks.

Table 4. SARS-CoV-1 and sectoral stock returns.

Sectors	**Agriculture**	**Automobiles and Trucks**	**Banking**	**Beer and Liquor**	**Construction Materials**	**Printing and Publishing**	**Shipping Containers**	**Business Services**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coeffiicent	Coefficient
μ	−0.09 (0.142)	−0.099 (0.21)	0.072 (0.096)	0.066 (0.17)	−0.06 (0.16)	0.24 (0.29)	0.17 (0.26)	0.12 (0.17)
ρ	−0.035 (0.042)	0.003 (0.055)	−0.10 ** (0.04)	−0.087 (0.06)	−0.04 (0.05)	−0.085 (0.069)	−0.16 *** (0.056)	0.05 (0.05)
γ_1	0.32 ** (0.16)	0.30 (0.22)	0.10 (0.1)	0.14 (0.1831)	0.24 (0.16)	−0.13 (0.29)	−0.091 (0.27)	0.14 (0.17)
Variance Equation Parameters								
α_o	0.11 ** (0.049)	0.16 *** (0.031)	0.24 * (0.13)	1.14 * (0.66)	0.033 *** (0.006)	0.33 *** (0.02)	0.66 (0.57)	0.067 *** (0.018)
α_1	−0.03 *** (0.009)	0.02 (0.032)	−0.093 ** (0.045)	0.11 (0.076)	−0.02 (0.019)	0.014 (0.03)	0.04 (0.04)	−0.033 *** (0.0001)
β_1	0.87 *** (0.029)	0.89 *** (0.045)	0.57 *** (0.22)	0.28 (0.36)	0.98 *** (0.025)	0.88 *** (0.035)	0.79 *** (0.13)	0.99 *** (0.0000039)
γ_i	0.2022 *** (0.038)	0.076 ** (0.038)	0.25 * (0.13)	−0.11 (0.09)	0.041 (0.025)	0.09 * (0.056)	0.052 (0.065)	−0.008 (0.0141)
λ_1	−0.014 (0.046)	−0.102 *** (0.00002)	−0.13 (0.091)	−0.33 (0.30)	−0.02 *** (0.0003)	−0.27 *** (0.0003)	−0.44 (0.423)	−0.042 *** (0.013)
Sectors	**Chemicals**	**Electronic Equipment**	**Apparel**	**Construction**	**Coal**	**Pharmaceutical Products**	**Electrical Equipment**	**Fabricated Products**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coeffiicent	Coefficient
μ	−0.1 (0.18)	0.31 (0.36)	0.19 *** (0.05)	0.16 (0.25)	0.41 (0.339)	0.045 (0.19)	0.04 (0.17)	0.28 (0.27)
ρ	−0.09 * (0.05)	0.11 * (0.06)	0.004 (0.047)	−0.01 (0.0545)	0.078 (0.066)	0.18 *** (0.046)	0.088 (0.066)	−0.10 (0.056)
γ_1	0.24 (0.19)	0.004 (0.38)	−0.0007 (0.17)	0.15 (0.26)	−0.212 (0.35)	0.24 (0.21)	0.22 (0.18)	−0.14 (0.27)
Variance Equation Parameters								
α_o	1.33 *** (0.42)	0.398 *** (0.009)	0.18 *** (0.007)	0.47 (0.38)	6.25 *** (1.27)	0.24 *** (0.035)	1.89 (1.28)	0.23 (0.18)
α_1	−0.005 (0.041)	−0.044 *** (0.00002	−0.03 * (0.018)	−0.033 (0.03)	0.45 *** (0.12)	−0.02 (0.014)	0.086 (0.056)	0.025 (0.017)
β_1	0.49 ** (0.2)	0.99 *** (0.00000012)	0.94 *** (0.023)	0.89 *** (0.087)	−0.04 (0.12)	0.93 *** (0.027)	−0.05 (0.61)	0.93 *** (0.037)
γ_i	−0.15 *** (0.05)	−0.02 ** (0.007)	−0.01 (0.027)	0.044 (0.047)	−0.38 *** (0.13)	−0.02 (0.016)	0.05 (0.15)	−0.009 (0.03)
λ_1	−0.69 *** (0.24)	−0.28 *** (0.000002)	−0.12 *** (0.000035)	−0.30 (0.25)	−4.29 *** (1.13)	−0.11 *** (0.00002)	−0.80 (0.70)	−0.15 (0.132)

Table 4. *Cont.*

Sectors	**Food Products**	**Entertainment**	**Precious Metals**	**Defense**	**Computers**	**Healthcare**	**Consumer Goods**	**Insurance**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coeffiicent	Coefficient
μ	−0.05 * (0.03)	0.078 (0.19)	−0.05 (0.4)	−0.29 (0.23)	0.35 (0.28)	−0.09 (0.17)	0.12 (0.17)	−0.092 (0.14)
ρ	0.04 (0.05)	−0.08 (0.05)	−0.03 (0.03)	−0.02 (0.044)	0.12 ** (0.05)	0.05 (0.048)	0.005 (0.06)	−0.06 (0.06)
γ_1	0.16 *** (0.05)	0.13 (0.198)	0.42 (0.41)	0.59 ** (0.24)	−0.069 (0.29)	0.35 * (0.18)	0.018 (0.177)	0.21 (0.16)
Variance Equation Parameters								
α_o	−0.002 (0.002)	2.36 *** (0.23)	5.92 (4.31)	1.91 * (1.05)	0.25 *** (0.008)	0.77 * (0.41)	0.22 *** (0.023)	−0.017 (0.019)
α_1	−0.04 *** (0.015)	−0.11 *** (0.00059)	−0.095 ** (0.037)	−0.033 (0.04)	−0.04 * (0.022)	−0.11 *** (0.04)	−0.06 ** (0.03)	−0.037 *** (0.01)
β_1	1.011 *** (0.0098)	0.098 (0.203)	0.41 (0.44)	0.47 ** (0.22)	0.99 (0.02)	0.68 *** (0.18)	0.89 *** (0.04)	0.99 *** (0.005)
γ_i	0.047 ** (0.024)	0.132 *** (0.045)	0.062 (0.052)	0.24 *** (0.081)	0.01 (0.02)	0.10 * (0.18)	0.12 ** (0.05)	0.08 *** (0.026)
λ_1	0.004 (0.003)	−1.42 *** (0.000002)	−0.064 (1.38)	−0.97 (0.67)	−0.17 *** (0.00002)	−0.42 * (0.25)	−0.14 *** (0.00001)	0.017 (0.02)
Sectors	**Measuring and Control Equipment**	**Machinery**	**Restaurants, Hotels, Motels**	**Medical Equipment**	**Industrial Mining**	**Petroleum and Natural Gas**	**Business Supplies**	**Personal Services**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coeffiicent	Coefficient
μ	0.13 (0.25)	0.07 (0.29)	−0.07 (0.13)	0.14 (0.14)	−0.21 (0.26)	0.12 (0.15)	−0.05 (0.16)	0.17 (0.19)
ρ	0.13 ** (0.05)	0.015 (0.05)	−0.08 (0.065)	0.20 *** (0.056)	0.069 * (0.041)	0.10 ** (0.054)	−0.09 * (0.05)	−0.08 (0.056)
γ_1	0.13 (0.26)	0.12 (0.3)	0.28 ** (0.144)	0.10 (0.15)	0.48 * (0.28)	0.11 (0.17)	0.19 (0.17)	0.13 (0.19)
Variance Equation Parameters								
α_o	1.37 ** (0.06)	0.29 *** (0.009)	0.37 (0.32)	0.79 (0.57)	1.78 * (0.86)	0.24 (0.18)	0.029 * (0.017)	0.23 *** (0.033)
α_1	−0.15 *** (0.00008)	−0.057 *** (0.02)	0.023 (0.044)	−0.059 (0.072)	−0.024 (0.036)	0.019 (0.031)	−0.0282 *** (0.006)	−0.023 (0.023)
β_1	0.72 *** (0.15)	0.96 *** (0.02)	0.63 ** (0.28)	0.33 (0.42)	0.42 * (0.24)	0.89 *** (0.08)	0.99 *** (0.000008)	0.89 *** (0.045)
γ_i	0.09 (0.058)	0.029 (0.021)	0.13 (0.096)	0.22 (0.14)	0.32 * (0.17)	−0.095 (0.06)	0.036 ** (0.02)	0.044 (0.037)
λ_1	−0.85 * (0.46)	−0.23 *** (0.00073)	−0.143 (0.16)	−0.39 (0.33)	−0.59 (0.47)	−0.12 (0.099)	−0.025 (0.02)	−0.13 *** (0.00003)
Sectors	**Real Estate**	**Retail**	**Rubber and Plastic Products**	**Shipbuilding and Railroad**	**Tobacco**	**Candy and Soda**	**Computer Software**	**Steel Works**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coeffiicent	Coefficient
μ	0.058 (0.12)	0.11 (0.19)	0.082 (0.64)	0.29 * (0.16)	−0.192 (0.32)	0.22 (0.15)	0.33 (0.26)	−0.045 (0.26)
ρ	−0.068 (0.06)	0.035 (0.05)	−0.19 (0.28)	−0.13 ** (0.06)	−0.002 (0.039)	−0.04 (0.06)	0.14 ** (0.059)	−0.027 (0.06)
γ_1	0.11 (0.13)	0.09 (0.19)	0.50 (0.73)	−0.14 (0.17)	0.49 (0.337)	−0.18 (0.16)	−0.042 (0.28)	0.26 (0.27)
Variance Equation Parameters								
α_o	0.58 * (0.32)	0.05 ** (0.023)	4.16 (3.56)	0.35 * (0.19)	3.43 *** (0.17)	1.78 *** (0.43)	0.25 *** (0.05)	6.67 *** (1.16)
α_1	0.26 ** (0.12)	−0.029 ***	−0.006 *** (0.00005)	0.02 (0.03)	0.026 (0.036)	−0.012 (0.06)	−0.05 *** (0.0003)	−0.04 (0.026)
β_1	0.25 (0.26)	1.002 *** (0.00002)	0.59 (0.37)	0.70 *** (0.11)	0.53 *** (0.069)	−0.132 (0.11)	1.002 *** (0.000005)	−0.77 *** (0.18)
γ_i	−0.01 (0.16)	0.015 (0.011)	−0.52 (0.39)	0.13 ** (0.05)	−0.11 *** (0.033)	0.22 *** (0.08)	−0.024 (0.023)	−0.016 (0.063)
λ_1	−0.31 (0.22)	−0.035 ** (0.02)	−0.016 (1.23)	−0.03 (0.11)	−1.92 *** (0.00003)	−0.83 ** (0.39)	−0.16 *** (0.036)	−4.03 *** (1.12)
Sectors	**Communication**	**Recreation**	**Transportation**	**Utilities**	**Other**			
Mean Eqn Parameters	Coefficients	Coefficient	Coefficient	Coefficient	Coefficient			
μ	0.41 (0.28)	0.13 (0.18)	0.02 (0.081)	0.01 (0.2)	0.001 (0.18)			
ρ	0.036 (0.051)	−0.04 (0.06)	−0.024 (0.05)	−0.09 (0.07)	−0.12 ** (0.059)			
γ_1	−0.128 (0.29)	0.016 (0.19)	0.21 (0.13)	0.12 (0.23)	0.19 (0.19)			
Variance Equation Parameters								
α_o	0.12	2.58 (1.65)	0.02 (0.02)	1.58 ** (0.64)	0.089 ** (0.046)			
α_1	−0.014 *** (0.00003)	0.063 (0.062)	−0.03 *** (0.0001)	0.32 *** (0.099)	−0.015 (0.017)			
β_1	1.0002 *** (0.00004)	−0.27 (0.69)	1.005 *** (0.000012)	0.25 (0.17)	0.95 *** (0.027)			
γ_i	−0.011 (0.011)	−0.008 (0.099)	0.038 *** (0.01)	−0.07 (0.123)	0.08 ** (0.035)			
λ_1	−0.097 ** (0.037)	−1.38 (1.02)	−0.012 (0.017)	−1.28 ** (0.58)	−0.065 ** (0.035)			

Notes: Standard errors are in parenthesis. *** Significant at 1% level. ** Significant at 5% level. * Significant at 10% level.

3.4. Swine Flu and Sectoral Stock Price

The 2009 swine flu pandemic was caused by the H1N1 influenza virus. It is estimated that the real number of cases including asymptotic and mild cases could be 700 million to 1.4 billion (Roos 2011). The number of lab-confirmed deaths reported to the WHO is 18,449. At the time of the swine flu, the global economy was emerging from the 2008 global financial crisis and stocks were significantly undervalued. In the US, the pandemic peaked and officially ended on 11 August 2010. From the start of the pandemic to the end, it is estimated that the Dow had risen by over 40% (Patton 2020). We examine mean returns on stocks and the nature of volatility during this period. Our results are presented in Table 5. Table 5 reports the estimation results of the GJR-GARCH(1, 1) model and contains mean and volatility equation results. The mean equation estimation suggests positive stock returns in every sector except trading and mining during the pandemic, as indicated by positive γ_1 coefficients. The mean equation estimation suggests that stocks in the textile industry gained the most during the pandemic, followed by real estate and banking (γ_1 = 0.64, 0.6 and 0.56, respectively). Sectors like defense, precious metals and electronic equipment gained the least, i.e., γ_1 = 0.002, 0.014 and 0.012, respectively. However, the positive impact of the pandemic on stock returns in the mean equation is statistically insignificant across all sectors. One possible reason is that the swine flu emerged in the context of deeply discounted stock prices and its effect on stock valuations was not significant.

Table 5 also highlights the effects of the pandemic on the volatility of stock returns across the industries in the GJR-GARCH(1, 1) setting. The results indicate that the conditional volatility of stock returns across almost every sector excluding trading, consumer goods and computer software has decreased during the pandemic period. In particular, more than half of the sectors in our fitted model show a statistically significant decrease in conditional volatility. The largest decrease in the conditional volatility occurred in real estate ($\lambda_1 = -4.87$) followed by metal mining ($\lambda_1 = -4.36$). The positive and significant coefficient on conditional volatility, β_1, across every industry represents the presence of volatility clustering in stock returns. Similarly, the positive coefficients on the asymmetric term, γ_i, implies that negative shocks to stock price volatility were larger relative to positive shocks. However, coefficients on asymmetric terms are negative in coal, entertainment and consumer goods suggesting otherwise.

Table 5. Swine flu and sectoral stock returns.

Sectors	**Aircraft**	**Automobiles and Trucks**	**Banking**	**Beer and Liquor**	**Construction Materials**	**Printing and Publishing**	**Shipping Containers**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	−0.12 (0.31)	0.14 (0.39)	−0.33 (0.65)	0.003 (0.19)	−0.23 (0.324)	−0.2 (0.432)	−0.025 (0.23)
ρ	−0.008 (0.06)	0.06 (0.05)	−0.17 *** (0.1)	−0.001 (0.06)	0.026 (0.055)	0.002 (0.0668)	0.029 (0.04)
γ_1	0.32	0.18	0.57 (0.76)	0.11 (0.20)	0.44 (0.345)	0.412 (0.412)	0.15 (0.24)
Variance Equation Parameters							
α_o	0.12 (0.17)	1.58 *** (0.068)	1.55 ** (0.67)	0.25 *** (0.026)	0.296 *** (0.035)	0.28 (0.26)	0.15 *** (0.017)
α_1	0.006 (0.032)	0.05 (0.041)	0.04 (0.026)	0.007 (0.025)	0.029 (0.028)	0.031 (0.031)	0.011 (0.026)
β_1	0.92 *** (0.03)	0.79 *** (0.05)	0.91 *** (0.022)	0.86 *** (0.036)	0.90 *** (0.031)	0.92 *** (0.026)	0.88 *** (0.031)
γ_i	0.12 ** (0.05)	0.089 ** (0.05)	0.0233 (0.031)	0.075 (0.056)	0.07 * (0.039)	0.078 * (0.045)	0.13 *** (0.042)
λ_1	−0.13 (0.16)	−1.36 *** (0.0003)	−1.49 ** (0.65)	−0.18 (0.000089)	−0.25 *** (0.00032)	−0.26 (0.25)	−0.12 *** (0.0002)
Sectors	**Business Services**	**Chemicals**	**Electronic Equipment**	**Apparel**	**Construction**	**Coal**	**Pharmaceutical Products**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	0.09 (0.27)	0.16 (0.34)	0.13 (0.33)	−0.016 (0.37)	0.02 (0.47)	−0.11 (0.91)	−0.036 (0.17)
ρ	−0.07 (0.058)	−0.06 (0.05)	−0.037 (0.06)	0.02 (0.054)	−0.01 (0.065)	−0.03 (0.059)	−0.024 (0.065)
γ_1	0.046 (0.28)	0.083 (0.35)	0.012 (0.34)	0.256 (0.39)	0.07 (0.49)	0.49 (0.94)	0.14 (0.18)
Variance Equation Parameters							
α_o	1.045 *** (0.04)	6.36 ** (3.14)	0.56 (0.35)	0.46 (0.32)	0.43 *** (0.033)	0.21 (0.15)	0.17 (0.12)
α_1	−0.07 *** (0.02)	−0.08 * (0.05)	−0.02 (0.02)	0.04 (0.04)	0.035 (0.037)	−0.015 *** (0.00087)	0.04 (0.049)
β_1	0.85 *** (0.03)	0.42 (0.25)	0.91 *** (0.042)	0.89 *** (0.04)	0.93 *** (0.028)	1.002 *** (0.0000068)	0.82 *** (0.061)
γ_i	0.14 *** (0.049)	0.06 (0.07)	0.085 ** (0.037)	0.05 (0.044)	0.013 (0.045)	−0.028 *** (0.005)	0.1 (0.07)
λ_1	−0.84 *** (0.00001)	−4.42 * (2.43)	−0.45 (0.31)	−0.41 (0.31)	−0.37 *** (0.00001)	−0.0009 (0.14)	−0.11 (0.094)
Sectors	**Electrical Equipment**	**Fabricated Products**	**Trading**	**Food Products**	**Entertainment**	**Precious Metals**	**Defense**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	−0.23 (0.42)	−0.0002 (0.49)	0.22 (0.51)	−0.11 (0.19)	0.035 (0.49)	0.27 (0.40)	0.07 (0.30)
ρ	−0.02 (0.063)	0.013 (0.059)	−0.16 ** (0.064)	−0.07 (0.04)	0.042 (0.05)	−0.05 (0.03)	−012 * (0.06)
γ_1	0.40 (0.43)	0.19 (0.5)	−0.06 (0.52)	0.22 (0.19)	0.28 (0.52)	0.014 (0.013)	0.002 (0.32)
Variance Equation Parameters							
α_o	0.41 (0.39)	0.79 *** (0.045)	1.48 *** (0.45)	0.072 *** (0.005)	0.72 (0.56)	1.18 *** (0.11)	0.93 (0.64)
α_1	0.014 (0.04)	0.013 (0.03)	−0.008 (0.02)	−0.02 (0.015)	0.025 (0.024)	−0.09 *** (0.0000325)	0.043 (0.067)
β_1	0.89 *** (0.04)	0.91 *** (0.032)	0.89 *** (0.031)	0.93 *** (0.014)	0.94 *** (0.038)	0.99 *** (0.000046)	0.82 *** (0.11)
γ_i	0.13 *** (0.048)	0.076 (0.005)	0.15 *** (0.032)	0.12 *** (0.04)	−0.016 (0.029)	0.014 (0.013)	0.005 (0.06)
λ_1	−0.37 (0.36)	−0.69 *** (0.00003)	0.15 *** (0.05)	−0.06 *** (0.00001)	−0.48 (0.42)	−0.67 *** (0.067)	−0.68 (0.5)

Table 5. *Cont.*

Sectors	**Computers**	**Consumer Goods**	**Insurance**	**Measuring and Control Equipment**	**Restaurants, Hotels and Motels**	**Medical Equipment**	**Metal Mining**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	0.11 (0.25)	−0.09 (0.32)	−0.22 (0.43)	−0.15 (0.25)	0.02 (0.27)	−0.06 (0.23)	0.36 (0.41)
ρ	−0.0061 (0.056)	−0.14 ** (0.059)	−0.17 *** (0.056)	0.029 (0.06)	−0.043 (0.055)	0.035 (0.062)	0.001 (0.05)
γ_1	0.13	0.24 (0.32)	0.46 (0.44)	0.31 (0.25)	0.16 (0.28)	0.18 (0.24)	−0.11 (0.44)
Variance Equation Parameters							
α_o	0.89 *** (0.056)	−0.017 (0.04)	0.26 *** (0.016)	0.48 *** (0.025)	0.17 (0.149)	0.11 (0.13)	7.15 *** (2.19)
α_1	−0.041 (0.03)	−0.0089 (0.0119)	0.064 (0.04)	−0.02 (0.032)	0.015 (0.04)	−0.0141 (0.041)	−0.089 *** (0.0006)
β_1	0.83 *** (0.045)	1.004 *** (0.00006)	0.90 *** (0.027)	0.87 *** (0.039)	0.92 *** (0.038)	0.92 *** (0.048)	0.64 *** (0.1)
γ_i	0.17 *** (0.047)	−0.0295 (0.0262)	0.03 (0.04)	0.18 *** (0.05)	0.073 (0.06)	0.124 ** (0.055)	0.09 (0.057)
λ_1	−0.71 *** (0.0002)	0.0262 (0.036)	−0.25 *** (0.00008)	−0.42 *** (0.0001)	−0.15 (0.14)	−0.07 (0.1)	−4.36 *** (1.58)
Sectors	**Petroleum and Natural Gas**	**Business Supplies**	**Personal Services**	**Real Estate**	**Retail**	**Rubber and Plastic Products**	**Shipbuilding and Railroad Equipment**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	−0.03 (0.32)	−0.16 (0.41)	−0.11 (0.277)	−0.24 (0.67)	0.023 (0.27)	−0.38 (0.39)	−0.038 (0.36)
ρ	−0.05 (0.07)	−0.07 (0.05)	0.023 (0.06)	−0.06 (0.06)	−0.003 (0.049)	−0.02 (0.06)	−0.03 (0.056)
γ_1	0.15 (0.33)	0.38 (0.42)	0.27 (0.29)	0.6 (0.69)	0.097 (0.29)	0.56 (0.41)	0.36 (0.37)
Variance Equation Parameters							
α_o	0.26 *** (0.042)	0.51 *** (0.012)	0.87 (0.56)	5.25 *** (0.13)	1.33 ** (0.57)	0.39 (0.30)	2.29 *** (0.23)
α_1	0.072 (0.05)	−0.00559 (0.012)	0.027 (0.035)	0.08 (0.05)	−0.045 *** (0.00006)	0.039 (0.033)	−0.05 *** (0.02)
β_1	0.89 *** (0.037)	0.95 *** (0.01)	0.83 *** (0.095)	0.75 *** (0.05)	0.71 *** (0.078)	0.89 *** (0.041)	0.75 *** (0.06)
γ_i	0.0018 (0.066)	0.009 (0.02)	0.02 (0.05)	0.14 * (0.07)	0.25 *** (0.078)	0.055 (0.047)	0.19 *** (0.067)
λ_1	−0.17 *** (0.00018)	−0.44 *** (0.00003)	−0.60 (0.42)	−4.87 *** (0.00006)	−1.132 ** (0.052)	−0.33 (0.27)	−1.43 *** (0.0003)
Sectors	**Tobacco Products**	**Computer Software**	**Steel Works**	**Communication**	**Recreation**	**Transportation**	**Textiles**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	−0.086 (0.17)	0.059 (0.28)	−0.013 (0.45)	−0.095 (0.29)	−0.1 (0.243)	−0.23 (0.46)	−0.42 (0.53)
ρ	−0.002 (0.05)	−0.089 (0.05)	0.02 (0.061)	−0.056 (0.066)	0.078 (0.053)	0.002 (0.062)	0.11 * (0.058)
γ_1	0.20	0.096 (0.29)	0.27 (0.48)	0.23 (0.29)	0.25 (0.25)	0.41 (0.45)	0.644 (0.54)
Variance Equation Parameters							
α_o	0.13 (0.12)	0.49 * (0.28)	0.49 *** (0.09)	0.34 (0.22)	0.33 *** (0.04)	1.19 *** (0.025)	0.71 (0.55)
α_1	0.015 (0.03)	−0.011 (0.03)	0.025 (0.04)	−0.01 (0.03)	0.0078 (0.03)	0.002 (0.06)	0.05 * (0.03)
β_1	0.87 *** (0.055)	0.87 *** (0.05)	0.89 *** (0.041)	0.91 *** (0.035)	0.84 *** (0.04)	0.89 *** (0.028)	0.90 *** (0.029)
γ_i	0.14 ** (0.067)	0.14 *** (0.05)	0.075 * (0.042)	0.13 ** (0.05)	0.27 *** (0.08)	0.11 *** (0.0383)	0.055 (0.04)
λ_1	−0.08 (0.08)	0.14 *** (0.05)	−0.31 *** (0.00007)	−0.31 (0.21)	−0.26 *** (0.00019)	−1.13 *** (0.00003)	−0.66 (0.53)
Sectors	**Utilities**	**Wholesale**	**Other**				
Mean Eqn Parameters	Coefficients	Coefficient	Coefficient				
μ	−0.065 (0.23)	0.11 (0.22)	−0.14 (0.42)				
ρ	0.007 (0.063)	−0.009 (0.059)	0.04 (0.063)				
γ_1	0.15	0.079 (0.22)	0.27 (0.43)				
Variance Equation Parameters							
α_o	0.22 (0.16)	0.16 *** (0.018)	0.38 (0.28)				
α_1	0.06 (0.06)	−0.01 (0.022)	0.034 (0.03)				
β_1	0.85 *** (0.07)	0.91 *** (0.027)	0.91 *** (0.032)				
γ_i	0.03 (0.065)	0.11 *** (0.039)	0.06 (0.043)				
λ_1	−0.15 (0.12)	−0.11 *** (0.00016)	−0.36 (0.28)				

Notes: Standard errors are in parenthesis. *** Significant at 1% level. ** Significant at 5% level. * Significant at 10% level.

3.5. COVID-19 and Sectoral Stock Returns

COVID-19 is a contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SAARS-CoV-2). The first known case was identified in China and later led to the global pandemic. The first case of COVID-19 in the USA was reported on 20 January 2020. According to the real time data tracking website worldometer (https://www.worldometers.info/coronavirus/hl) (accessed on 1 June 2022), as of 30 January 2022, death cases in the USA due to COVID-19 are reported to be 0.9 million while global deaths are reported to be about 5.66 million. The effect of COVID-19 on stock prices has been an ongoing popular topic in the literature due to emergence of new variants, slowing economy and availability of data. Some of the recent papers on this include Hohler and Lansink (2020); Kordestani et al. (2021). However, the existing literature has not assessed the stock market performance across industries during this pandemic and relative to other pandemics in the past. We contribute to the pandemic literature by assessing the sectoral stock returns during COVID-19 and comparing them with four other past pandemics. Table 6 reports our estimation results for a GJR-GARCH(1, 1) model, specifically for COVID-19.

The mean equation suggests that COVID-19 has asymmetric impacts on sectoral stock price, as represented by coefficients with opposite signs of the dummy variable, γ_1. More than seventy percent of the sectors in our fitted model show negative mean returns for the COVID-19 pandemic. In particular, steel works, and to a lesser extent petroleum and tobacco products are observed to have experienced a statistically significant decline in stock returns. Other notable sectors that suffered declines in mean returns include banks, real estate construction materials, chemicals, electronic equipment, apparel, construction, coal, pharmaceutical products, electrical equipment, healthcare, consumer goods, insurance, machinery, restaurants, medical equipment, communications, recreation, textiles and wholesale. Furthermore, about a third of the sectors in our fitted model experienced positive mean returns. Specifically, results of the mean equation suggest that the mean returns of stocks in aircraft, agriculture, automobiles, beer, business services, food products, entertainment, precious metals, defense, computers, business supplies, retail, candy, computer software, transportation and utilities industries increased during the COVID-19 pandemic. Out of these industries, agriculture, retail and precious metals industries witnessed the largest increase in mean stock returns, i.e., γ_1 = 0.28, 0.22 and 0.19, respectively. The lowest gain is observed in the entertainment, computer and beer industries, i.e., γ_1 = 0.002, 0.01 and 0.02, respectively. However, see that these increases in mean returns during the pandemic are statistically insignificant. These results contrast with other findings elsewhere; for example, Mazur et al. (2021) examine the stock price returns of subsectors within the S&P500 during the COVID-19 pandemic and find positive returns for such sectors as food, healthcare, natural gas and software while petroleum, hospitality, entertainment and real estate experienced negative returns.

Table 6 also shows the volatility equation estimates of the GJR-GARCH(1, 1) model with COVID-19. Our results indicate that the COVID-19 pandemic increased the volatility of stock returns across every sector, i.e., positive coefficients on λ_1. Out of the sectors under consideration, stock returns in coal show the largest volatility followed by automobiles and trucks, i.e., λ_1 = 4.6 and 1.82, respectively. In all, close to half of the sectors in our fitted model show statistically significant increases in conditional volatility and seven more show only statistically weak evidence of a rise in volatility. Consumer goods and defense industries produced the lowest volatilities on the stock returns, i.e., λ_1 = 0.089 and 0.096, respectively. In Table 6, it can be seen that the coefficient on conditional volatility, β_1, is positive and significant across all the sectors, representing volatility clustering in stock returns. The positive and statistically significant coefficient on the asymmetric term, γ_i, indicates that negative shocks contributes more to the conditional volatility than positive shocks in every sector.

Table 6. COVID-19 and sectoral stock returns.

Sectors	**Aircraft**	**Agriculture**	**Automobiles and Trucks**	**Banks**	**Beer**	**Construction Materials**	**Shipping Containers**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	−0.09 (0.09)	−0.12 (0.15)	0.16 (0.12)	0.06 (0.064)	−0.02 (0.07)	0.07 (0.07)	−0.001 (0.1)
ρ	0.01 (0.1)	−0.11 (0.08)	0.037 (0.073)	−0.08 (0.07)	−0.16 ** (0.078)	0.04 (0.063)	−0.12 * (0.07)
γ_1	0.002 (0.31)	0.28 (0.38)	0.092 (0.51)	−0.05 (0.28)	0.02 (0.11)	−0.056 (0.25)	−0.08 (0.24)
Variance Equation Parameters							
α_o	0.022 (0.02)	0.22 (0.19)	0.17 ** (0.08)	0.038 ** (0.015)	0.051 * (0.02)	0.03 *** (0.012)	0.05 (0.03)
α_1	−0.07 *** (0.004)	0.09 (0.09)	−0.08 ** (0.033)	−0.055 (0.04)	−0.03 (0.079)	−0.06 *** (0.02)	−0.07 * (0.04)
β_1	0.96 *** (0.02)	0.80 *** (0.09)	0.15 *** (0.053)	0.86 *** (0.05)	0.83 *** (0.068)	0.89 *** (0.03)	0.91 *** (0.04)
γ_i	0.19 *** (0.03)	0.05 (0.10)	0.90 *** (0.064)	0.33 *** (0.089)	0.31 *** (0.08)	0.29 *** (0.078)	0.24 *** (0.07)
λ_1	0.23 ** (0.1)	0.65 (0.41)	1.82 *** (0.67)	0.39 * (0.23)	0.043 (0.035)	0.35 * (0.2)	0.29 * (0.13)
Sectors	**Business Services**	**Chemicals**	**Electronic Equipment**	**Apparel**	**Construction**	**Coal**	**Pharmaceutical Products**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	0.05 (0.084)	−0.02 (0.09)	0.23 ** (0.10)	0.083 *** (0.02)	0.16 * (0.08)	−0.32 (0.23)	0.16 * (0.07)
ρ	−0.004 (0.08)	0.02 (0.07)	−0.17 ** (0.07)	0.07 (0.05)	0.02 (0.07)	0.056 (0.081)	−0.09 (0.08)
γ_1	0.08 (0.21)	−0.11 (0.26)	−0.18 (0.24)	−0.07 (0.06)	−0.05 (0.2)	−0.26 (0.63)	−0.21 (0.17)
Variance Equation Parameters							
α_o	0.04 (0.03)	0.05 (0.03)	0.083 ** (0.03)	0.02 *** (0.002)	0.07 ** (0.04)	1.04 * (0.59)	0.027 (0.017)
α_1	−0.03 (0.07)	−0.035 (0.049)	−0.11 *** (0.04)	−0.143 *** (0.0002)	0.17 * (0.09)	0.05 (0.059)	0.004 (0.004)
β_1	0.82 *** (0.05)	0.87 *** (0.05)	0.89 *** (0.04)	0.98 *** (0.00002)	0.67 *** (0.062)	0.74 *** (0.12)	0.84 *** (0.049)
γ_i	0.34 *** (0.12)	0.26 *** (0.074)	0.34 *** (0.072)	0.27 *** (0.00004)	0.36 *** (0.14)	0.098 (0.083)	0.84 *** (0.05)
λ_1	0.11 (0.09)	0.20 (0.13)	0.25 ** (0.11)	0.24 *** (0.03)	0.059 *** (0.00001)	4.6 * (2.62)	0.11 * (0.063)
Sectors	**Electrical Equipment**	**Fabricated Products**	**Trading**	**Food Products**	**Entertainment**	**Precious Metals**	**Defense**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	0.09 (0.09)	−0.05 (0.05)	0.18 ** (0.08)	0.013 (0.06)	0.06 (0.12)	0.09 (0.66)	0.06 (0.087)
ρ	−0.016 (0.08)	−0.04 (0.07)	−0.079 (0.074)	−0.15 ** (0.07)	−0.06 (0.07)	0.072 (0.84)	−0.05 (0.08)
γ_1	−0.23 (0.27)	−0.24 (0.36)	−0.16 (0.21)	0.017 (0.15)	0.002 (0.24)	0.19 (0.39)	0.046 (0.22)
Variance Equation Parameters							
α_o	0.026 (0.03)	0.036 *** (0.01)	0.051 ** (0.023)	0.046 *** (0.014)	0.25 *** (0.09)	0.08 (0.05)	0.069 ** (0.03)
α_1	−0.02 (0.05)	−0.08 *** (0.01)	−0.027 (0.059)	−0.033 (0.057)	−0.08 (0.07)	0.026 (0.045)	0.022 (0.04)
β_1	0.87 *** (0.045)	1.01 *** (0.00001)	0.76 *** (0.07)	0.81 *** (0.06)	0.77 *** (0.084)	0.91 *** (0.041)	0.84 *** (0.04)
γ_i	0.27 *** (0.083)	0.10 *** (0.0239)	0.44 *** (0.12)	0.322 *** (0.081)	0.37 *** (0.099)	0.0677 (0.054)	0.23 *** (0.076)
λ_1	0.26 (0.17)	0.92 *** (0.14)	0.31 (0.19)	0.11 *** (0.072)	0.411 (0.27)	0.35 (0.18)	0.096 (0.0977)
Sectors	**Computers**	**Healthcare**	**Consumer Goods**	**Insurance**	**Measuring and Control Equipment**	**Machinery**	**Restaurants, Hotels, Motels**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	0.02 (0.11)	0.17 * (0.09)	0.034 (0.0783)	0.098 * (0.06)	0.15 ** (0.089)	0.092 (0.068)	0.03 (0.09)
ρ	−0.18 ** (0.07)	−0.11 (0.074)	−0.055 (0.078)	0.024 (0.064)	−0.17 ** (0.07)	−0.01 (0.06)	−0.03
γ_1	0.015	−0.11 (0.25)	−0.066 (0.16)	−0.152 (0.233)	−0.12 (0.24)	−0.19 (0.24)	−0.14 (0.22)
Variance Equation Parameters							
α_o	0.11 *** (0.037)	0.048 (0.031)	0.0277 (0.021)	0.05 *** (0.017)	0.042 (0.03)	0.08 *** (0.016)	0.03 (0.02)
α_1	−0.077 ** (0.036)	0.01 (0.056)	0.019 (0.069)	−0.066 *** (0.0002)	−0.03 (0.047)	−0.095 *** (0.00098)	−0.025 (0.04)
β_1	0.88 *** (0.042)	0.82 *** (0.05)	0.81 *** (0.049)	0.733 *** (0.06)	0.84 *** (0.048)	0.86 *** (0.02)	0.86 *** (0.04)
γ_i	0.23 *** (0.06)	0.24 *** (0.09)	0.29 ** (0.11)	0.56 *** (0.15)	0.29 *** (0.08)	0.34 *** (0.04)	0.26 *** (0.08)
λ_1	0.43 ** (0.19)	0.19 (0.13)	0.089 ** (0.04)	0.53 *** (0.18)	0.21 * (0.15)	0.53 *** (0.18)	0.13 * (0.072)
Sectors	**Medical Equipment**	**Non-metallic and Industrial Mining**	**Petroleum and Natural Gas**	**Business Supplies**	**Personal Services**	**Real Estate**	**Retail**
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	0.028 (0.085)	0.04 (0.0976)	−0.095 *** (0.029)	0.04 (0.089)	0.009 (0.08)	0.096 (0.088)	0.006 (0.067)
ρ	−0.132 * (0.07)	0.02 (0.06)	−0.08 (0.06)	−0.11 * (0.06)	−0.042 (0.076)	−0.037 (0.067)	−0.16 ** (0.07)
γ_1	−0.034 (0.2121)	−0.32 (0.33)	−0.46 * (0.25)	−0.266 (0.243)	−0.26 (0.24)	−0.20 (0.25)	0.22 (0.19)
Variance Equation Parameters							
α_o	0.014 (0.014)	0.077 * (0.036)	0.041 *** (0.0092)	0.04 (0.024)	0.015 (0.013)	0.01 (0.02)	0.0246 ** (0.01)
α_1	−0.1 *** (0.03)	−0.09 *** (0.04)	−0.11 *** (0.00457)	−0.1 *** (0.027)	0.02 (0.05)	−0.039 (0.048)	−0.027 (0.049)
β_1	0.96 *** (0.02)	0.92 *** (0.032)	1.002 *** (0.000076)	0.94 *** (0.022)	0.88 *** (0.03)	0.91 *** (0.028)	0.87 *** (0.035)
γ_i	0.22 *** (0.045)	0.26 *** (0.07)	0.18 *** (0.000007)	0.23 *** (0.05)	0.15 (0.09)	0.23 *** (0.061)	0.222 *** (0.062)
λ_1	0.16 ** (0.06)	0.55 ** (0.27)	0.36 *** (0.078)	0.32 *** (0.11)	0.15 ** (0.063)	0.14 ** (0.06)	0.085 ** (0.035)

Table 6. *Cont.*

Sectors	Rubber and Plastic Products	Shipbuilding	Tobacco Products	Candy and Soda	Computer Software	Steel Works	Communication
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
μ	0.042(0.078)	0.05 (0.049)	0.17 * (0.09)	0.043 (0.077)	0.15 * (0.08)	−0.04 * (0.02)	0.025 (0.06)
ρ	−0.068 (0.07)	0.016 (0.05)	−0.049 (0.078)	−0.13 * (0.07)	−0.12 (0.08)	−0.033 (0.05)	−0.12 * (0.07)
γ_1	−0.088 (0.23)	−0.24 (0.26)	−0.41 * (0.21)	0.17 (0.13)	0.01 (0.22)	−0.59 *** (0.2)	−0.03 (0.175)
Variance Equation Parameters							
α_o	0.024 (0.018)	0.034 *** (0.007)	0.045 (0.037)	0.051 ** (0.022)	0.05 *** (0.02)	0.017 *** (0.001)	0.023 (0.015)
α_1	−0.019 (0.047)	−0.08 *** (0.0001)	0.073 (0.065)	−0.089 ** (0.035)	−0.01 (0.06)	−0.07 *** (0.0001)	−0.047 (0.06)
β_1	0.88 *** (0.039)	0.99 *** (0.000014)	0.79 *** (0.041)	0.85 *** (0.04)	0.79 *** (0.063)	0.99 *** (0.0000012)	0.86 *** (0.05)
γ_i	0.19 *** (0.065)	0.133 *** (0.005)	0.18 ** (0.075)	0.36 *** (0.09)	0.33 *** (0.087)	0.15 *** (0.0000036)	0.29 *** (0.09)
λ_1	0.19 ** (0.09)	0.38 *** (0.11)	0.26 ** (0.12)	0.066 * (0.036)	0.16 (0.11)	0.26 *** (0.076)	0.14 (0.08)
Sectors	**Recreation**	**Transportation**	**Textiles**	**Utilities**	**Wholesale**		
Mean Eqn Parameters	Coefficients	Coefficient	Coefficients	Coefficients	Coefficients		
μ	−0.11 (0.21)	−0.028 (0.08)	−0.05 (-0.15)	0.03 (0.06)	0.075 (0.06)		
ρ	−0.03 (0.089)	0.095 (0.07)	0.16 ** (0.066)	−0.003 (0.079)	−0.03 (0.07)		
γ_1	−0.12 (0.37)	0.015 (0.25)	−0.26 (0.42)	0.15 (0.15)	−0.1 (0.17)		
Variance Equation Parameters							
α_o	0.27 * (0.15)	0.08 ** (0.039)	0.13 *** (0.03)	0.043 ** (0.02)	0.022 * (0.011)		
α_1	−0.03 (0.03)	−0.08 * (0.044)	−0.032 *** (0.00039)	−0.0003 (0.07)	−0.08 *** (0.00006)		
β_1	0.90 *** (0.04)	0.80 *** (0.06)	0.92 *** (0.000003)	0.78 *** (0.063)	0.87 *** (0.03)		
γ_i	0.16 *** (0.04)	0.43 *** (0.13)	0.18 *** (0.03)	0.36 *** (0.13)	0.41 *** (0.09)		
λ_1	0.13 (0.19)	0.69 ** (0.34)	0.53 (0.33)	0.023 (0.05)	0.15 (0.11)		

Notes: Standard errors are in parenthesis. *** Significant at 1% level. ** Significant at 5% level. * Significant at 10% level.

4. Conclusions

In this paper, we study the impacts of five recent pandemics on sectoral stock returns and volatility. The pandemics considered include the 1957–1958 Asian flu, the 1977 Russian flu, SAARS-CoV-1, swine flu and COVID-19. Using the GJR-GARCH(1, 1) model, we find that pandemics have heterogeneous impacts on sectoral stock returns. Our empirical results suggest that pandemics other than COVID-19 have mixed impacts on conditional volatilities in sectoral stock markets. Among the five pandemics studied in this paper, only COVID-19 has increased the volatility of stock returns across every sector. Furthermore, some sectors like coal and automobiles record the largest volatility increase during the ongoing pandemic.

Additionally, relative to the other four pandemics, the largest number of sectors (seventy percent) experiencing a decline in mean stock returns is recorded for COVID-19, suggesting that the severity of the pandemic was strong enough to counteract the positive impacts of fiscal and monetary stimuli during the pandemic. This has serious implications for policy responses to similar future health crises. Specifically, a significant share of household wealth is invested in various financial instruments that were all subject to pandemic impacts. While the effects of job losses were mitigated via fiscal policy measures, trends in financial assets during the pandemic pose serious long term challenges for household wealth accumulation. This observation is consistent with evidence in Tobin et al. (2020) who find large wealth shocks during the pandemic that are more pronounced for middle-aged households and those higher in the wealth and income distributions. There is also evidence that exposure to stock markets during the pandemic has behavioral consequences, for example, expectations about retirement age, desired working hours and household debt (Tobin et al. 2021). The current literature on the consequences of the pandemic on the finances of households remains relatively limited and constitutes a rich area for further studies.

Furthermore, our findings indicate that some of the sectors (for example, healthcare) heavily affected by the pandemic also happen to comprise a considerable share of the U.S. economy. While our study focuses on the effect of the pandemic on stock prices, it would be interesting to know whether the strong negative impacts we find in financial assets in these sectors also reflect strong negative socio-economic impacts on the population employed in them. A comparative analysis that focuses on indicators other than financial instruments can generate further useful insights for policy in future similar crises. Additionally, our analysis focuses only on the United States, on account of data limitations. Specifically, this does do not allow us to conduct cross-country comparisons of sectoral stock market returns and volatilities. Such an exercise can yield useful insights on potential differences in regulatory, fiscal and monetary policy responses to the pandemic. The challenge would be to match sectoral classifications across jurisdictions that use different classification systems for their industries.

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Appendix A. Descriptive Statistics

Table A1. Descriptive Statistics: Asian Flu.

Industries	N	Std. Dev.	Minimum	Maximum	Kurtosis	Skewnwss
Agriculture	1259	1.012	−4.96	5.5	5.837	0.321
Food Products	1259	0.43	−4.7	1.56	15.6	−1.342
Beer and Liquor	1259	0.75	−5.9	3.78	7.375	−0.113
Tobacco Products	1259	0.73	−5.25	5.32	11.205	−0.578
Recreation	1259	1.19	−7.96	7.14	7.785	−0.035
Entertainment	1259	0.91	−8.46	3.88	10.208	−0.581
Print and Publications	1259	1.24	−8.54	9.13	10.256	0.04
Consumer Goods	1259	0.68	−5.83	3.31	8.98	−0.44
Apparel	1259	0.54	−4.6	4.76	14.92	−0.47
Medical Equipment	1259	1.11	−5.13	9.4	9.95	1.05
Pharmacy Products	1259	0.87	−6.49	5.22	8.23	−0.33
Chemicals	1259	0.85	−7.61	5.73	11.05	−0.55
Rubber Products	1259	0.94	−6.84	5.27	7.16	0.22
Textiles	1259	0.76	−7.06	3.75	11.23	−0.19
Construction Materials	1259	0.77	−5.77	4.69	13.043	−0.89
Construction Materials	1259	1.07	−8.95	5.87	5.96	−0.05
Steel Works	1259	1.11	−7.58	6.53	7.952	−0.487
Machinery	1259	0.79	−6.94	4.7	12.17	0.91
Electrical Equipments	1259	0.99	−7.61	5.57	6.94	−0.039
Automobiles	1259	1.04	−6.84	8.76	9.76	0.59
Aircraft	1259	1.339	−6.84	7.41	12.17	0.092
Shipbuilding	1259	0.94	−7.92	5.01	6.94	−0.186
Mining	1259	0.86	−6.94	5.08	9.76	−0.183
Coal	1259	1.17	−5.87	7.7	6.36	−0.058
Petroleum Products	1259	0.91	−8.94	5.03	7.76	−0.34
Utilities	1259	0.38	−6.84	2.55	6.94	−1.747
Communication	1259	0.51	−4.23	8.99	9.87	4.494
Personal Services	1259	1.084	−3.84	8.62	7.96	0.59

Table A1. *Cont.*

Industries	N	Std. Dev.	Minimum	Maximum	Kurtosis	Skewnwss
Business Services	1259	0.52	−5.78	2.33	21.52	0.13
Computers	1259	1.092	−3.39	8.02	87.2	0.712
Electronic Equipments	1259	1.37	−5.82	7.37	8.31	0.23
Measuring Equipment	1259	1.14	−6.89	7	5.4	0.21
Business Supplies	1259	1.29	−6.53	6	8.31	−0.009
Boxes	1259	0.77	−8.53	4.44	5.02	−0.73
Transportation	1259	0.9	−7.23	5.34	5.87	−0.44
Wholesale	1259	0.79	−7.07	3.84	5.28	−0.52
Retail	1259	0.55	−5.3	2.96	10.98	−0.812
Restaurants	1259	1.051	−5.49	6.31	8.64	0.392

Table A2. Descriptive Statistics: Russian Flu.

Industries	N	Std. Dev.	Minimum	Maximum	Kurtosis	Skewnwss
Agriculture	505	0.93	−3.77	3.34	4.08	−0.13
Food	505	0.52	−1.94	2	3.45	−0.02
Soda	505	0.93	−3.7	3.57	4.54	−0.104
Beer	505	0.82	−4.31	2.46	4.34	−0.136
Smoke	505	0.83	−3.53	3.21	4.58	−0.156
Toys	505	1.08	−3.74	4.25	3.74	0.117
Fun	505	1.1	−3.01	3.5	2.9	0.11
Books	505	0.65	−2.05	2.65	3.53	−0.021
Hshld	505	0.85	−2.42	3.21	3.2	0.173
Clths	505	0.79	−2.62	3.02	3.96	0.296
Hlth	505	1.15	−4.9	5.02	5.45	−0.088
MedEq	505	0.87	−3.69	2.54	3.65	−0.203
Drugs	505	0.84	−2.7	3.61	4.18	0.342
Chems	505	0.83	−3.59	2.42	3.54	−0.009
Rubbr	505	0.72	−1.97	2.36	3.241	0.023
Txtls	505	0.69	−2.05	3.19	4.42	0.449
Bldmt	505	0.69	−2.14	2.6	4.06	0.286
Cnstr	505	0.91	−2.9	3.28	3.44	−0.062
Steel	505	0.84	−3.65	2.72	3.66	0.076
Fabpr	505	0.92	−3.16	4.39	4.79	0.14
Mach	505	0.72	−2.09	2.31	3.24	0
Elceq	505	0.84	−2.56	2.89	3.46	0.24
Autos	505	0.85	−2.08	3.04	3.3	0.2
Aero	505	0.92	−3.01	3.44	3.54	−0.001
Ships	505	0.89	−2.2	3.86	4.19	0.39
Guns	505	1.03	−3.15	3.52	3.7	0.14
Gold	505	1.28	−3.85	4.73	3.78	0.365
Mines	505	0.69	−2.36	2.86	3.76	0.2
Coal	505	1.3	−3.63	4.95	4.2	0.42
Oil	505	0.71	−2.36	2.71	3.84	−0.028
Util	505	0.39	−1.32	1.83	4.13	−0.05
Telcm	505	0.55	−2.32	1.95	4.57	−0.134
Persv	505	0.91	−2.79	3.73	4.13	0.25
Bussv	505	0.65	−1.78	2.19	3.33	0.049
Hardw	505	0.94	−2.75	3.39	3.62	0.246
Softw	505	2.55	−14.03	18.11	13.21	0.85
Chips	505	0.86	−3.13	3.48	3.38	0.084
Labeq	505	1.054	−5.68	3.33	4.72	−0.17
Paper	505	0.85	−3.09	2.81	3.69	0.12

Table A3. Descriptive Statistics: SARS-COVID-1.

Industries	N	Std. Dev.	Minimum	Maximum	Kurtosis	Skewness
Agric	599	1.27	−5.640	12.43	18.536	1.331
Food	599	0.745	−2.360	3.13	3.708	−0.024
Soda	599	1.071	−4.670	4.61	5.291	−0.327
Beer	599	1.08	−3.810	7.41	7.8	0.702
Smoke	599	1.876	−8.610	7.18	4.676	0.044
Toys	599	1.085	−3.890	4.04	3.651	0.026
Fun	599	1.209	−4.270	5.66	4.449	−0.12
Books	599	1.139	−4.210	4.69	4.024	0.109
Hshld	599	1.005	−3.250	4.06	3.999	0.167
Clths	599	0.96	−3.270	3.99	3.746	0.078
Hlth	599	1.103	−3.610	3.84	3.785	−0.228
MedEq	599	0.981	−3.500	3.61	3.655	−0.4
Drugs	599	1.422	−4.340	4.61	3.217	−0.203
Chems	599	1.163	−3.210	6.2	4.339	0.299
Rubbr	599	1.715	−3.200	33.64	244.08	12.368
Txtls	599	1.596	−6.670	5.37	4.555	−0.088
BldMt	599	0.969	−3.980	3.76	3.759	−0.026
Cnstr	599	1.408	−5.140	5.16	3.81	−0.011
Steel	599	1.396	−4.110	5.69	3.322	0.128
FabPr	599	1.612	−4.540	7.39	4.814	0.513
Mach	599	1.227	−4.110	5.5	3.657	0.224
ElcEq	599	1.196	−3.920	4.6	3.32	0.065
Autos	599	1.363	−4.070	7.14	4.604	0.259
Aero	599	1.361	−4.730	4.93	4.021	0.173
Ships	599	1.346	−4.110	7.51	5.276	0.597
Guns	599	1.829	−6.090	16.39	14.379	1.426
Gold	599	3.416	−19.830	11.74	6.161	−0.31
Mines	599	1.774	−6.380	10.33	5.451	0.386
Coal	599	1.988	−12.400	9.11	7.459	−0.12
Oil	599	1.141	−4.160	5.57	4.107	−0.034
Util	599	1.087	−6.740	4.65	7.796	−0.409
Telcm	599	1.741	−6.250	6.47	4.099	0.19
PerSv	599	1.094	−4.110	6.84	6.98	0.52
BusSv	599	1.048	−3.630	4.12	3.369	−0.141
Hardw	599	1.698	−4.040	6.51	3.021	0.171
Softw	599	1.469	−4.040	4.6	2.864	−0.001
Chips	599	1.877	−4.700	6.62	2.955	0.143
LabEq	599	1.345	−3.410	3.65	2.827	0.029
Paper	599	1.05	−3.080	4.52	3.942	0.113
Boxes	599	1.62	−6.860	8.67	4.912	0.216
Trans	599	1.248	−4.300	5	3.544	0.113
Whlsl	599	0.951	−3.250	4.11	3.533	−0.178
Rtail	599	1.188	−3.720	5.14	3.869	0.098
Meals	599	0.93	−3.810	5.8	6.691	0.273
Banks	599	0.578	−2.540	2.46	4.171	−0.188
Insur	599	0.962	−3.250	4.01	4.103	0.09
RlEst	599	0.82	−3.540	4.13	4.287	0.174
Fin	599	1.091	−3.410	3.24	2.888	−0.045
Other	599	1.216	−3.790	5.09	4.535	0.186

Table A4. Descriptive Statistics: SARS-CoV-1.

Industries	N	Std. Dev.	Minimum	Maximum	Kurtosis	Skewnwss
Agriculture	599	1.27	−5.64	12.43	18.536	1.331
Food	599	0.745	−2.36	3.13	3.71	−0.024
Soda	599	1.071	−4.671	4.61	5.291	−0.327
Beer	599	1.08	−3.81	7.41	7.8	0.702
Smoke	599	1.876	−8.61	7.18	4.676	0.044
Toys	599	1.085	−3.89	4.04	3.651	0.026
Fun	599	1.21	−4.27	5.66	4.449	−0.12
Books	599	1.139	−4.21	4.69	4.024	0.109
Hshld	599	1.005	−3.25	4.06	3.99	0.167
Clths	599	0.96	−3.27	3.99	3.75	0.078
Hlth	599	1.103	−3.6	3.84	3.79	−0.23
MedEq	599	0.98	−3.5	3.61	3.66	−0.4
Drugs	599	1.42	−4.3	4.61	3.22	−0.203
Chems	599	1.16	−3.2	6.2	4.339	0.299
Rubbr	599	1.72	−3.2	33.64	244.08	12.368
Txtls	599	1.59	−6.67	5.37	4.56	−0.088
Bldmt	599	0.97	−3.99	3.76	3.76	−0.026
Cnstr	599	1.41	−5.14	5.16	3.81	−0.011
Steel	599	1.396	−4.11	5.69	3.322	0.13
Fabpr	599	1.612	−4.54	7.39	4.814	0.513
Mach	599	1.23	−4.11	5.69	3.32	0.12
Elceq	599	1.19	−3.72	5.14	3.87	0.098
Autos	599	0.93	−3.81	5.8	6.69	0.27
Ships	599	1.35	−4.11	7.51	5.28	0.59
Guns	599	1.83	−6.09	16.39	14.38	1.43
Gold	599	3.42	−19.83	11.74	6.16	−0.31
Mines	599	1.78	−6.38	10.33	5.45	0.39
Coal	599	1.99	−12.4	9.11	7.46	−0.12
Oil	599	1.14	−4.16	5.57	4.11	−0.034
Util	599	1.09	−6.74	4.65	7.79	−0.41
Telcm	599	1.74	−6.25	6.47	4.09	0.19
Persv	599	1.094	−4.11	6.84	6.98	0.52
Bussv	599	1.048	−3.63	4.12	3.369	−0.141
Hardw	599	1.698	−4.04	6.51	3.021	0.17
Softw	599	1.47	−4.04	4.6	2.864	−0.001
Chips	599	1.88	−4.7	6.62	2.96	0.14
Labeq	599	1.345	−3.41	3.65	2.83	0.029
Paper	599	1.05	−3.08	4.52	3.94	0.113

Table A5. Descriptive Statistics: Swine Flu.

Industries	N	Std. Dev.	Minimum	Maximum	Kurtosis	Skewnwss
Agriculture	404	2.18	−6.79	9.38	4.45	0.31
Food	404	1.38	−4.42	6.84	5.45	0.39
Soda	404	1.73	−7.4	9.04	6.86	0.62
Beer	404	1.44	−4.32	6.1	4.38	0.46
Smoke	404	1.66	−11.93	6.04	10.21	−0.82
Toys	404	1.96	−5.79	6.95	3.86	0.27
Fun	404	2.12	−6.52	7.36	4.16	0.11
Books	404	2.9	−8.05	12.96	5.19	0.45
Hshld	404	2.13	−6.49	13.42	7.53	0.74
Clths	404	2.15	−6.48	7.35	3.92	0.19

Table A5. *Cont.*

Industries	N	Std. Dev.	Minimum	Maximum	Kurtosis	Skewnwss
Hlth	404	1.54	−7.38	5.95	5.07	−0.27
MedEq	404	1.47	−5.55	5.99	4.57	0.05
Drugs	404	1.66	−5.04	6.34	4.15	−0.11
Chems	404	2.29	−7.9	13.76	6.77	0.35
Rubbr	404	2.18	−8.46	9.64	5.57	0.21
Txtls	404	2.59	−9.47	10.98	4.93	0.112
Bldmt	404	2.15	−6.61	9.66	4.461	0.033
Cnstr	404	3.5	−8.81	40.91	47.43	4.12
Steel	404	2.9	−10.01	11.98	4.56	0.025
Fabpr	404	2.68	−10.28	8.76	4.33	−0.079
Mach	404	2.35	−7.9	9.89	4.49	0.003
Elceq	404	1.95	−7.2	7.71	4.603	−0.096
Autos	404	2.84	−10.56	10.84	5.25	0.25
Aero	404	1.98	−7.02	8.37	4.699	−0.23
Ships	404	2.78	−9.78	9.54	3.86	0.142
Guns	404	2.091	−8.59	15.64	10.78	0.87
Gold	404	3.22	−10.37	13.18	3.86	0.265
Mines	404	2.68	−7.47	10.28	3.748	−0.018
Coal	404	3.95	−14.08	16.5	4.77	0.14
Oil	404	2.87	−11.17	10.78	4.47	−0.084
Util	404	1.28	−4.5	4.25	4.18	−0.38
Telcm	404	2.01	−7.28	7.43	4.479	−0.009
Persv	404	1.87	−5.91	7.62	4.324	0.041
Bussv	404	1.61	−4.66	6.3	4.032	−0.017
Hardw	404	1.79	−6.35	6.51	4.15	−0.027
Softw	404	1.64	−4.5	9.62	6.28	0.5
Chips	404	1.83	−5.89	7.44	4.006	0.03
Labeq	404	1.72	−6.92	6.79	4.9	0.14
Paper	404	2.53	−8.8	15.35	7.36	0.54

Table A6. Descriptive Statistics: COVID-19.

Industries	N	Std. Dev.	Minimum	Maximum	Kurtosis	Skewnwss
Agriculture	231	2.92	−14.49	10.73	7.19	−0.26
Food	231	1.69	−8.74	9.07	12.66	0.17
Soda	231	2.039	−9.27	6.54	7.19	−0.42
Beer	231	2.203	−11.28	11.46	13.79	−0.15
Smoke	231	2.26	−9.72	10.03	8.48	−0.47
Toys	231	2.94	−15.81	14.15	9.741	−0.6
Fun	231	2.44	−15.21	8.19	12.051	−1.45
Books	231	2.36	−12.72	8.52	8.61	−0.634
Hshld	231	1.99	−8.82	10.28	10.39	0.258
Clths	231	2.59	−13.82	13.65	11.12	−0.35
Hlth	231	2.55	−16.03	10.23	12.49	−0.87
MedEq	231	2.19	−11.68	11.06	10.129	−0.43
Drugs	231	1.81	−8.69	7.31	8.912	0.094
Chems	231	2.497	−12.88	11.21	9.32	−0.45
Rubbr	231	2.017	−12.02	8.17	10.303	−0.62
Txtls	231	3.82	−22.84	17.48	11.92	−0.54
Bldmt	231	2.98	−14.07	14.57	9.599	−0.368
Cnstr	231	3.17	−18.59	15.83	13.11	−0.47

Table A6. *Cont.*

Industries	N	Std. Dev.	Minimum	Maximum	Kurtosis	Skewnwss
Steel	231	3.12	−14.52	12.07	8.27	−0.36
Fabpr	231	3.77	−20.52	15.79	11.52	−0.661
Mach	231	2.73	−12.12	13.5	9.11	−0.242
Elceq	231	2.85	−13.82	13.85	9.27	−0.425
Autos	231	3.047	−14.73	15.01	9.74	−0.56
Aero	231	3.43	−16.89	15.03	11.38	−0.063
Ships	231	2.67	−12.12	9.24	6.48	−0.192
Guns	231	2.432	−12.32	10.55	11.421	−0.33
Gold	231	2.73	−10.78	14.09	11.132	0.74
Mines	231	2.965	−13.37	13.67	8.68	−0.34
Coal	231	4.324	−16.79	19.91	7.837	0.59
Oil	231	3.372	−19.88	16.11	12.18	−0.66
Util	231	2.39	−11.65	11.78	11.764	0.055
Telcm	231	1.93	−9.09	9.08	10.06	−0.345
Persv	231	2.45	−15.2	9.69	14.24	−1.27
Bussv	231	2.56	−14.55	13.08	12.421	−0.381
Hardw	231	2.284	−11.46	11.99	9.33	−0.14
Softw	231	2.252	−12.9	10.68	11.54	−0.43
Chips	231	2.56	−14.02	11.51	10.6	−0.39
Labeq	231	2.14	−9.34	10.09	8.42	0.073
Paper	231	2.062	−9.34	9.93	8.394	0.099

Table A7. Descriptive statistics: before and after the 1977 Russian flu.

	Before Pandemic (N = 90)		After Pandemic (N = 169)	
Sectors	**Mean**	**Std.**	**Mean**	**Std.**
Agriculture	0.05	0.94	0.025	0.92
Food Products	0.031	0.55	0.02	0.46
Candy and Soda	0.001	0.98	0.064	0.82
Beer and Liquor	−0.027	0.88	−0.02	0.71
Tobacco	0.043	0.88	0.033	0.72
Recreation	0.057	1.13	−0.052	0.98
Entertainment	0.027	1.16	0.13	0.98
Printing and Publishing	0.082	0.677	0.11	0.58
Consumer Goods	−0.02	0.89	−0.11	0.76
Apparel	0.085	0.88	0.064	0.59
Healthcare	0.096	1.21	0.27	1.02
Medical Equipment	−0.05	0.88	0.104	0.84
Pharmaceutical Products	−0.045	0.87	0.06	0.76
Chemicals	0.015	0.86	−0.05	0.75
Rubber and Plastic Products	0.0921	0.74	0.052	0.677
Textiles	0.045	0.74	−0.001	0.56
Construction Materials	0.1	0.74	−0.0035	0.59
Construction	0.075	0.98	0.03	0.76
Steel Works	0.076	0.84	−0.11	0.81
Fabricated Products	0.14	1.04	0.073	0.62
Machinery	0.1	0.74	−0.008	0.67
Electrical Equipment	0.0865	0.87	0.131	0.78
Automobiles and Trucks	0.086	0.92	−0.0013	0.73
Aircraft	0.143	0.943	0.62	0.87

Table A7. *Cont.*

	Before Pandemic (N = 90)		After Pandemic (N = 169)	
Sectors	**Mean**	**Std.**	**Mean**	**Std.**
Shipbuilding	0.112	0.94	−0.042	0.78
Defense	0.18	1.04	0.011	0.99
Precious Metals	0.069	1.38	0.019	1.07
Industrial Mining	0.073	0.68	−0.14	0.71
Coal	0.11	1.39	−0.095	1.08
Petroleum Products	0.094	0.733	0.0042	0.64
Utilities	0.082	0.40	0.045	0.36
Communication	0.095	0.59	0.02	0.43
Personal Services	0.072	0.96	0.16	0.79
Business Services	0.078	0.69	0.094	0.58
Computers	0.048	0.98	0.065	0.85
Computer Software	0.036	2.98	0.069	1.35
Electronic Equipment	0.096	0.939	0.021	0.71
Measuring Equipment	0.0177	1.145	0.076	0.85
Business Supplies	0.056	0.87	−0.093	0.78
Shipping Containers	0.03	0.83	−0.004	0.73
Transportation	0.076	0.79	0.003	0.69
Wholesale	0.065	0.685	0.04	0.57
Retail	−0.002	0.78	0.033	0.73
Restaurants	−0.05	0.98	0.17	0.82
Banking	0.06	0.73	−0.001	0.611
Insurance	0.097	0.71	0.06	0.59
Real Estate	0.15	1.02	0.07	0.733
Trading	0.088	0.61	0.039	0.49
Other	0.071	0.55	0.62	0.47

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