Understanding Market Risk for Black Swan Events: An Investigation of Health and Financial Crisis

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Abstract

Research evidence on several black swan events and their impact on equity markets are plenty. Most studies have examined the impact of specific events and have not compared the distinct impact of crises on global equity markets. Understanding the distinct impact of events on global equity markets can help investors and financial institutions better manage risk. This research aims to explore the distinct impact of health versus financial crisis on global equity markets. The focus of this study is to gain perspectives by examining two health crisis COVID 19 (2020), SARS (2003) vis-à-vis Global Financial Crisis (2008) on five major indices the S & P 500, FTSE 100, EURO STOXX 50, Shanghai Composite Index and NIFTY 50. To measure the early effect of black swan events on selected markets, risk velocity is calculated for 7 - trading days and 30 - trading days. Trend analysis is charted for a span of six months to trace the pattern of recovery. Daily price data of indices are mapped for a time span of one year starting from first day of the crisis with respect to each black swan event. ANOVA is conducted to verify the statistical significance of results. While both health and financial crisis had significant impacts on global equity markets, the duration and severity of the effects varied The GFC had a more prolonged impact, while the COVID-19 pandemic resulted in a sharp but relatively short-lived decline followed by a recovery in following weeks for all markets except Chinese stock market..

Keywords: Health Crisis, Financial Crisis, COVID 19, Coronavirus, SARS, Global Financial Crisis, Risk Velocity JEL Classification: G1; G10; G14

INTRODUCTION

BACKDROP:

'Rarity, extreme impact and retrospective predictability are the three attributes of black swan events.' (Taleb, N. N. 2001)

The Global Financial Crisis (GFC) of 2008, the SARS virus outbreak of 2003, and the COVID-19 pandemic of 2020 have all had significant impacts on global equity markets. The GFC resulted in a significant decline in global equity markets, with some indices losing nearly 50% of their value (World Bank Group, 2019). The impact of the GFC was felt most strongly in developed economies, particularly in Europe and North America (Goldman Sachs, 2020). The GFC led to a shift in investment strategies, with investors becoming more risk-averse and favouring defensive sectors such as healthcare and utilities (Federal Reserve Bank of New York, 2020).

The SARS virus outbreak led to a decline in global equity markets, particularly in Asia where the outbreak originated. The impact of the SARS outbreak was relatively short-lived, with markets recovering within a

few months of the outbreak (World Bank Group, 2019). The SARS outbreak led to increased investment in healthcare pharmaceutical companies, as investors sought to capitalize on the potential for new treatments and vaccines source (Shet et al., 2021; Chen et al., 2018). The COVID-19 pandemic led to a significant decline in global equity markets, with some indices losing over 30% of their value (World Economic Forum, 2020). The impact of the pandemic was felt across all regions and sectors, with some industries such as travel and hospitality being particularly hard hit. The pandemic led to innovation in new technology industries (K, 2020).

Financial and health crises can have different impacts on global equity markets and hence are addressed differently. Financial crises are typically addressed by central banks and governments through monetary and fiscal policy measures, such as lowering interest rates and injecting stimulus into the economy, while health crises require a different set of policy responses such as

testing, contact tracing, quarantine measures, and vaccination drives apart from fiscal measures (Avalos, 2020).

Definition of Black Swan Events:
Black Swans are outlier events with severe impact and hindsight bias like a war, natural disaster, any economic or financial crisis and outbreak of a virus. The metaphor was first introduced by John Stuart Mill (1843) and later on popularized in the financial context by Nassim Taleb in his book Fooled by Randomness (Taleb, N. N. 2001).

CRISIS AND EQUITY MARKETS:
 Recessions caused by epidemics is certainly an important area of study in research (Szlezak, P. C., Reeves, M., & Swartz, P. 2020; Avalos, 2020). Giovanella and Stegmüller (2014) investigate the impact of the 2008 financial crisis on health systems in Europe. They find that the crisis led to cuts in health spending in many countries, which had a negative impact on equity in access to healthcare. The leading stock indices of these nations during the SARS outbreak are compared with a non-SARS period as well as with the S&P 1200 Global Index. Conventional t-tests and the non-parametric Mann-Whitney test are used for the study. It is concluded that SARS had no adverse effects on the financial markets of Canada, China, Hong Kong Special Administrative Region of China, Indonesia, the Philippines, Singapore, Thailand, and Vietnam (Nippani & Washer, 2004).

An early study in HBR deliberates on how a health crisis can cause a recession and what are the scenarios are for growth and recovery (Szlezak, P. C., Reeves, M., & Swartz, P. 2020; Avalos, 2020). Observing markets signals and valuations across various asset classes, the research delves into the history of epidemics to identify the path ahead. Recovery from past epidemics such as Hong Kong Flu, Asian Flu, Spanish Flu are evaluated serving as a guidance for current crisis. Three broad scenarios for recovery V-U-L are presented. Exogenous demand shocks transmitted through financial markets leading to contraction of household wealth especially in economies where exposure to equity is high, pessimistic consumer outlook leading to discretionary spending and supply-side shocks caused by disruption in supply chain, halt in production, furloughs were the identified consequences of COVID 19. Opportunities for innovation, adoption of new business model just as the occurrence of SARS is credited with the evolution of online shopping among Chinese consumer were presented as the outlook for businesses (K, 2020; K, Szlezak, P. C., Reeves, M., & Swartz, P. 2020; Avalos, 2020).

Researchers observe the implications of COVID 19 on stock markets (Zhang et al., 2020; Shehzad et al., 2020; Onali, 2020; AlAli, 2020) through various dimensions. Some of the research is from China where the virus originated (He et al., 2020; Liu et al., 2020; Sansa, 2020; Bahrini & Filfilan, 2020). Changes in deaths and reported cases and their impact on stock market is studied using GARCH model ((Onali, 2020). Changes in volatility as assumed by VIX prices, changes in trading volume and day-of-the-week effect are observed. This is the first paper that assesses the impact of daily reported cases and deaths on the conditional mean and the conditional volatility of the returns of Dow Jones index and S & P 500 index. Results are reported for a period of one year up to 9 April 2020 considering the cases and deaths reported in US, UK, France, Iran, Italy, Spain and China. Change in the relationship between volatility expectations and stock market returns as envisaged by COVID 19 are additionally observed. Findings indicate that neither change in total cases nor total deaths affect stock market returns. However, changes in the number of cases and deaths have an impact on the volatility of Dow Jones and S & P 500 though they occurred in countries other than the US. Based on the data of eleven indices, the study by (Lyócsa et al., 2020, AlAli, 2020) compares the performance of stock markets for a period of 30 days before and after the first confirmed coronavirus case in the country. Six stock markets showed no impact. There was no difference in the mean returns for China, US, UK, Germany, Canada and South Korea indicating immediate government intervention to boost investor confidence. The results of the t-test show no difference in pre and post mean returns for six markets. The initial impact was felt in rest of the five markets of Japan, India, France, Europe and to some extent in Hong Kong. The fastest decline was witnessed in South Korean in the first 7 trading days. Fastest recovery was noticed in Shanghai and DAX indicating quick government intervention. Nikkei slumped during the 14-day trading period. Indicating weakness. All stock indices witnessed a deep fall during the 30 day trading period except the Shanghai index where the virus originated.

The general pattern of stock market reactions for COVID 19 for majorly affected countries based on data from John Hopkins Coronavirus Resource Centre (Zhang et al., 2020) is explored. Volatility analysis is captured through standard deviation of daily returns for the month of February and March when countries were experiencing the spread. Using weekly correlation matrix among 12 countries systemic risk is observed to understand spill over effects (Liu et al., 2020). Systemic connections among countries is investigated through Minimum Spanning Tree analysis and graph theory. Based on risk analysis, the study suggests that the pandemic has had a major influence on stock markets as observed by increasing standard deviations month after month. China the epicentre of virus in the month of February has experienced highest level of standard deviation and settles to lowest levels for the next month owing to stricter enforcement of containment efforts. US markets too witness elevated levels of risk which is consistent with the increase in cases. Countries witness low correlation for February which substantially increases in the first week of March to end again with low correlation levels due to policy interventions such as zero interest rate policy. Similar results are reported by studies that observe the relationship between

confirmed cases and financial markets impact (Sansa, 2020). Contrary to global markets, the financial markets of China remained resilient to the spread of novel corona virus. The findings underscores the importance of rapid prevention efforts by the government. Two different studies evaluate the impact of COVID-19 on nine countries and 21 leading indices in affected countries including China (He et al., 2020; Liu et al., 2020). Both the studies employ event study methodology comparing the mean returns of their stock indices in the disease-affected period vis-à-vis a pre-event period. Using t-tests and Mann–Whitney nonparametric tests (Q. He et al., 2020) the consequences of the crisis is tested. The study additionally benchmarks the stock markets' performance of affected countries against the S&P 1200 Global Index for to determine if they are below the global average. The study brings out that COVID 19 had a limited initial effect which intensified as the virus spread to European countries. Countries in Asia experienced more negative abnormal returns as compared to the European counter parts. In continuation of the same theme, a study by Heather (Liu et al., 2020; Banerjee et al., 2020) accounts for profit making strategies in a market affected by virus.

A highly unlikely event in the context of financial market presents itself in the form of extreme price variations (Manhire, 2018). This paper studies the price extreme theory that exist in financial market functions (ask and bid volumes) to determine the probability of Black Swan-type events. The study states empirically states that extreme price displacements exist in financial markets and the magnitude of black swan events are calculable but to know their occurrence in advance is practically impossible. Portraying black swan as a gap between what we know and what we perceive we know, a one of a kind study focuses on the unknown in the context of projects (Hajikazemi et al., 2016). Ignoring early signs of warning leading to black swan events has been customary of experienced project teams, an useful observation made by the authors. The study aims at identifying black swan situation in projects with a view to develop active mechanisms at the organizational level to deal with it rather than being caught by surprise. From the array of literature, it is evident that there is no particular study that considers impact on the stock returns of different black swan events.

RATIONALE FOR THE STUDY:
 Historically markets' reactions to black swan events have been temporary, with a rebound happening in six months to one year. While past studies make an important contribution to further our understanding, no two black swan events are identical. The business landscape of nations have changed largely from the past outbreaks. Economies are characterized by supply chain interconnections, financial integration, digital technologies and social-media driven news creating rapid 'spill over' effects. Therefore, studying the comparative effect of health versus financial crisis on global equity markets can provide important insights into how financial markets respond to major crises, and can help investors and policymakers better understand the risks associated with different crisis circumstances and therefore develop crisis-specific strategies while investing in equities. By analyzing the performance of different types of equities and sectors during these crises, investors can identify trends and patterns that may be useful in guiding their investment decisions in the future. The study is an endeavour to answer the pertinent research question how different is the derail of financial markets for a health crisis as compared to a financial crisis? The broad objective of the study is to illustrate the relationship between selected events and financial markets. Specifically, i) to measure the vulnerability of equity markets to health and financial crisis ii) to measure the magnitude of impact of identified events for the purpose of decision making. For this purpose, the study selects COVID 19, Severe Acute Respiratory Syndrome (SARS) and Global Financial Crisis on five major indices namely the S & P 500, FTSE 100, Shanghai Composite Index, Eurostoxx 50 and NIFTY 50.

Based on the objectives, the research proposes the following hypotheses:
- H01: There is no significant difference in the impact of SARS on various stock markets
- Ha1: There is significant difference in the impact of SARS on various stock markets
- H02: There is no significant difference in the impact of Global financial Crisis on various stock markets
- Ha2: There is significant difference in the impact of Global financial Crisis on various stock markets
- H03: There is no significant difference in the impact of COVID -19 on various stock markets
- Ha3: There is significant difference in the impact of COVID -19 on various stock markets

RESEARCH METHODOLOGY

Through this study, we compare two health crisis with global financial crisis across various time periods and geography. Impact of three global events namely COVID 19 (2020), SARS (2003) and global financial crisis (2008) are examined on five popular indices i.e S & P 500, Shanghai Composite, FTSE 100, Euro Stoxx 50 and Nifty 50. It is valuable for investors to contemplate the performance of different countries' indices as equity valuations cover both the local and global risks. Moreover, market fluctuations for each event are as varied as investors' concern for each event creating a differential effect on each country's stock market performance.

First of all, the rapid spread of COVID 19 throws a comparison with that of SARS (2003) a similar epidemic from China to understand if the magnitude of their effects have changed over time. Secondly we attempt a comparison of COVID 19 with that of Global

Financial crisis (2008), another globally devastating event to learn which has a higher impact.

i. The steps for analysis starts with calculation of risk velocity across three events for different stock indices. Risk velocity measures the pace of downfall in the valuation of an asset as a result of an event. The initial impact as captured by risk velocity is calculated for different intervals of 3-10-14-20-30-40 trading days. Risk Velocity of Index for a certain time period = Day t – Day t-1

Day t-1_____

n _____

Day t-1 = Index level at the time of occurrence; Day$t$ = Index level for the time period for which calculation is done; n = time difference between dates.

ii. To analyse the market response to identified events as they enter new phases each month, the market movements for six months period from the day when news of the event became public (Day 1) are mapped using trend analysis. The value of indices on Day zero are taken as base date with a base value of 100 to understand movement of indices and measure changes over time.

iii. Standard deviation of daily returns are computed for 2nd, 3rd months of the crisis mapping risk levels as markets enter a concerning phase. Indices are ranked month-wise based on standard deviation to understand elevated risk levels.

DATA SET:
To compute risk velocity, daily data of five indices namely the S & P 500, FTSE 100, Shanghai Composite Index, Eurostoxx 50 and NIFTY 50 for first 40 trading days are gathered in respect of identified events. To measure magnitude of impact, daily data for six months of indices are collected from Thomson Reuters for three events.

Risk Velocity Analysis:

TABLE 4: RISK VELOCITY OF IDENTIFIED EVENTS FOR VARIOUS INTERVELS							
EVENTS	**INDICES**	**3 Trading Days**	**10 Trading Days**	**14 Trading Days**	**20 Trading Days**	**30 Trading Days**	**40 Trading Days**
SARS	**S & P 500**	**288**	**87**	**63**	**44**	**30**	**23**
	SHANGAI COMPOSITE	**486**	**150**	**109**	**78**	**50**	**38**
	FTSE 100	**1249**	**373**	**268**	**190**	**129**	**99**
	EURO STOXX 50	**718**	**213**	**154**	**111**	**78**	**58**
	NIFTY 50	**331**	**100**	**71**	**48**	**31**	**23**
GLOBAL FINANCIAL CRISIS	**S & P 500**	**385**	**121**	**80**	**45**	**29**	**23**
	SHANGAI COMPOSITE	**643**	**229**	**164**	**100**	**61**	**44**
	FTSE 100	**1637**	**509**	**348**	**197**	**129**	**109**
	EURO STOXX 50	**1006**	**316**	**215**	**121**	**78**	**65**
	NIFTY 50	**1336**	**398**	**282**	**164**	**86**	**74**
COVID 19	**S & P 500**	**1080**	**333**	**239**	**169**	**100**	**60**
	SHANGAI COMPOSITE	**915**	**292**	**213**	**149**	**98**	**69**
	FTSE 100	**2528**	**743**	**532**	**369**	**224**	**132**
	EURO STOXX 50	**1259**	**373**	**271**	**192**	**112**	**63**
	NIFTY 50	**4059**	**1166**	**867**	**605**	**371**	**224**

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i. Market Response to Black Swan Events

SARS Impact
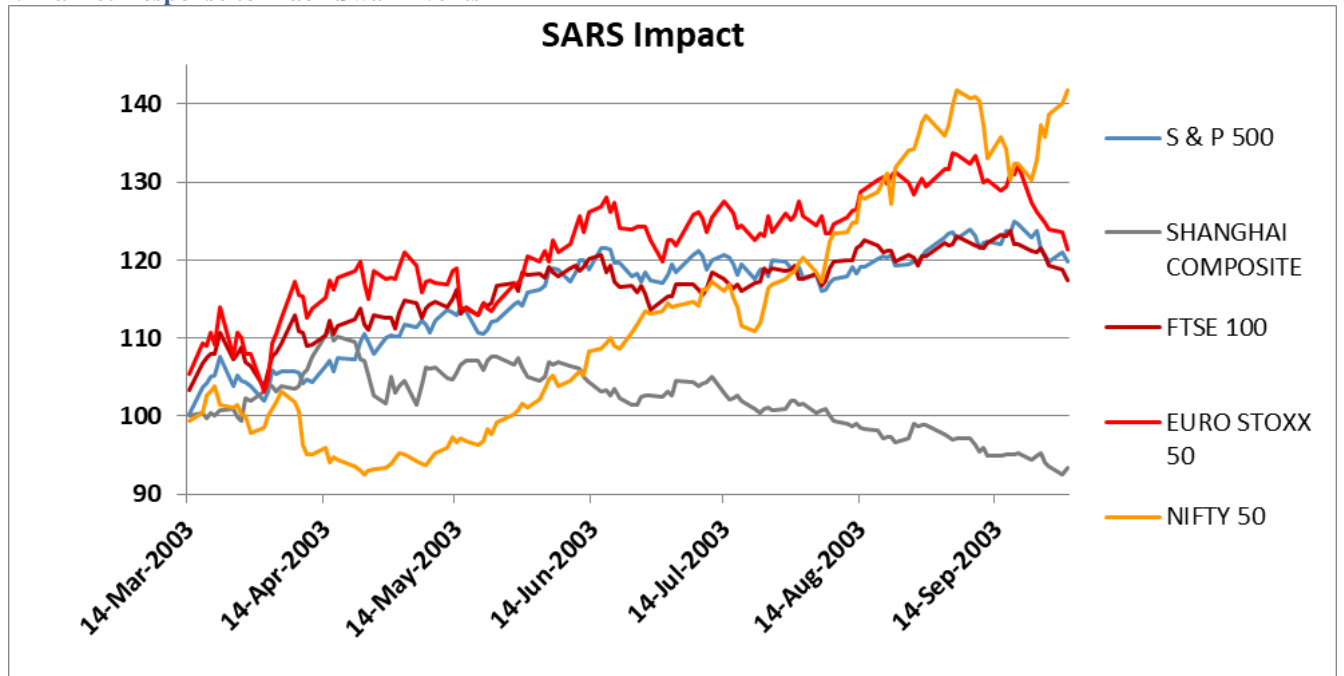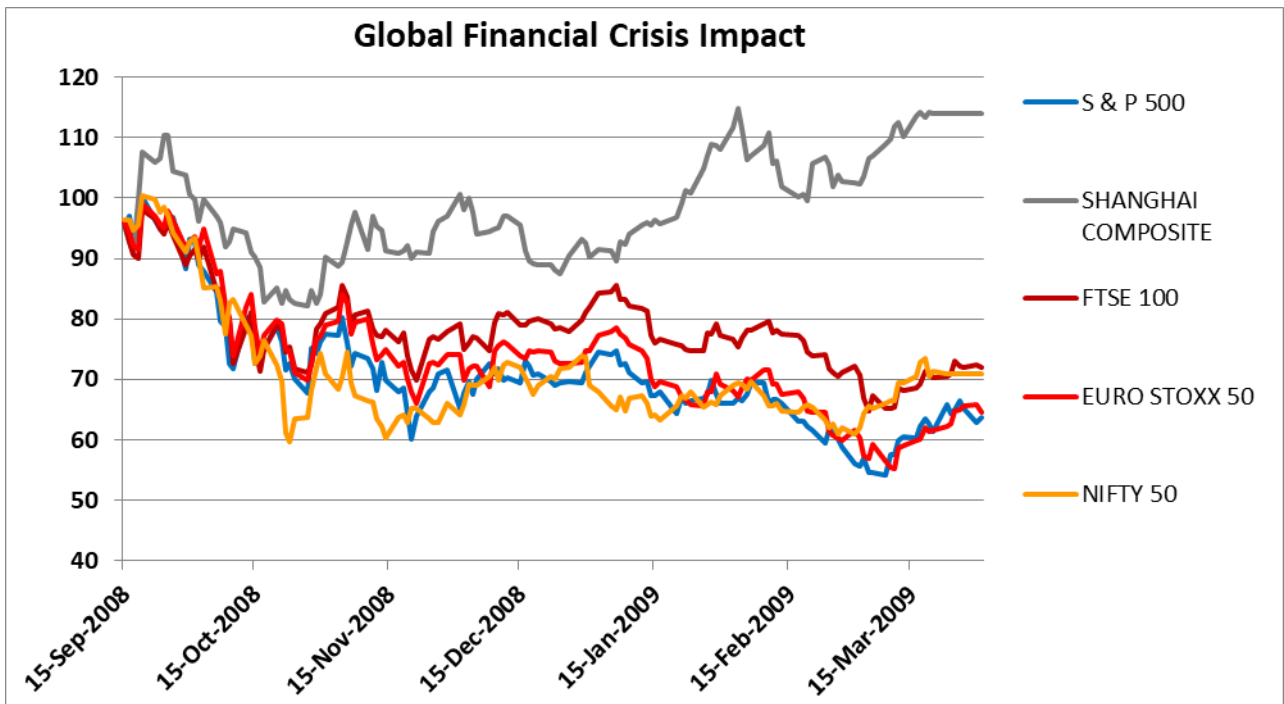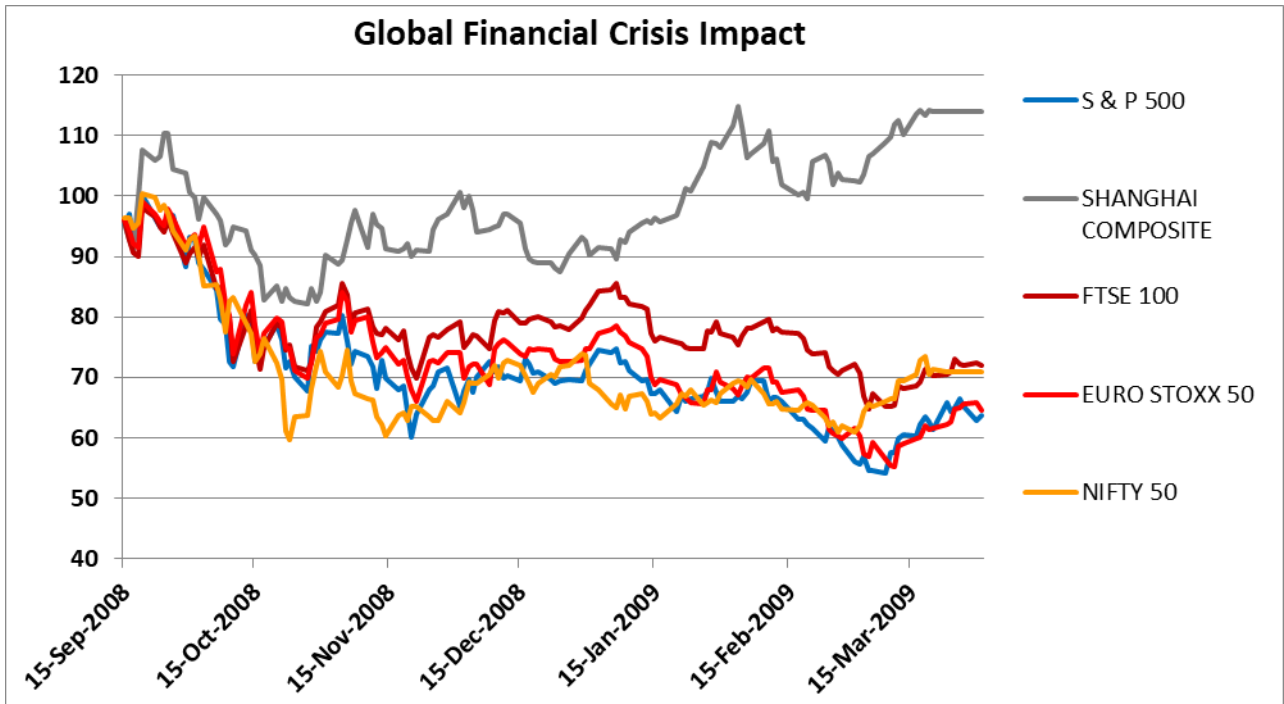
iii. Risk caused by black swan events

EVENT	STOCK MARKETS	STD DEV_APR 2003	RANK I	STD DEV_MAY 2003	RANK II
	S & P 500	18.85	5	12.82	5
	SHANGHAI COMPOSITE	42.73	3	22.46	4
SARS	FTSE 100	70.64	2	56.67	1
	EURO STOXX 50	71.83	1	47.85	2
	NIFTY 50	35.03	4	24.11	3

EVENT	STOCK MARKETS	STD DEV_APR 2003	RANK 1	STD DEV_MAY 2003	RANK 2
GLOBAL FINANCIAL CRISIS	S & P 500	78.04	5	60.67	5
	SHANGHAI COMPOSITE	121.33	4	102.94	4
	FTSE 100	335.78	2	200.81	1
	EURO STOXX 50	229.59	3	151.21	3
	NIFTY 50	406.94	1	175.13	2

EVENT	STOCK MARKETS	STD DEV_APR 2003	RANK 1	STD DEV_MAY 2003	RANK 2
COVID - 19	S & P 500	135.77	4	265.49	4
	SHANGHAI COMPOSITE	84.10	5	127.66	5
	FTSE 100	260.27	1	588.90	2
	EURO STOXX 50	148.72	3	332.19	3
	NIFTY 50	253.07	2	1252.82	1

TEST RESULTS

TABLE 5: SARS				
Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	40	35578.27	889.4568	674.0034
Column 2	40	4276.748	106.9187	9.739122
Column 3	40	61004.09	1525.102	2259.692
Column 4	40	4165.097	104.1274	10.53372
Column 5	40	153789.1	3844.727	11174.31

ANOVA					
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	381929217	4	95482304	33791.2	0	2.417963
Within Groups	551002.87	195	2825.656			
Total	382480219	199				

Table 5 shows f value (33791) is greater than the critical value (2.42) and p value 0.00 is less than alpha value (0.05) leading to rejection of null hypothesis. Hence we conclude that there is significant difference in the impact of SARS on various stock markets.

TABLE 6: Global Financial Crisis				
Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	40	41343.5	1033.5875	14983.46
Column 2	40	3302.988	82.57469841	95.63384
Column 3	40	1589573	39739.325	347.3532
Column 4	40	77983.22	1949.58055	29453.48
Column 5	40	3749.788	93.74470709	68.10011

ANOVA					
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	48641484141	4	12160371035	1352715	0	2.417963
Within Groups	1752973.211	195	8989.606209			
Total	48643237114	199				

Table 6 presents f value (1352715) which is greater than critical value (2.42) and p value is 0.00 which is less than alpha value (0.05). This leads to rejection of null hypothesis concluding that there is significant difference in the effect of Global financial crisis on various stock markets.

TABLE 7: COVID - 19

Groups	Count	Sum	Average	Variance
Column 1	40	123697.1	3092.4275	97961.42
Column 2	40	3723.853	93.09633476	88.78124
Column 3	40	1755556	43888.9	281.3231
Column 4	40	116002.5	2900.061478	12463.75
Column 5	40	3790.001	94.75002785	13.30433

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	57713639465	4	14428409866	651051.1	0	2.417963
Within Groups	4321534.441	195	22161.71508			
Total	57717960999	199				

Table 7 shows f value (651051.1) is greater than critical value (2.42) and p value is 0.00 which is less than alpha value (0.05). Here gain we reject the null hypothesis proving that there is significant difference in the impact of COVID – 19 on major stock markets.

OBSERVATIONS

According to test results, stock markets are vulnerable to black swan events, whether they involve a health crisis or a financial disaster. In the event of a health crisis, the reaction is just momentary, and markets quickly return to normal. Financial markets have been significantly impacted by the global financial crisis of 2008, which is often regarded as the worst catastrophe ever. SARS barely affected any of the financial markets. In the instance of COVID-19, the 2008 crash did not occur again. Even if the three events are distinct, there is one significant distinction from the perspective of market valuation: prior to the coronavirus, as opposed to December 2007, markets were at bargain prices. Before the pandemic outbreak, there were solid economic fundamentals, such as the current account and oil. The markets, however, were in a party mood in December 2007, as opposed to February 2020, before the Global Financial Crisis.

Research Implications:

When such crises occur, it's crucial to remember two fundamental principles. After the effects have subsided, (a) this crisis will also end, as with many others, and (b) maintaining asset allocation discipline is crucial. Crisis also makes us think of Warren Buffett's proverb, 'Be greedy when others are scared, and fearful when others are greedy.' In general, markets are myopic, which leads to stock price reactions that are disproportionate to short-term developments, such as the violent coronavirus reaction. In contrast, value is driven more by long-term assumptions, and DCF-based valuation does not change. Market risks being temporary, research suggests adopting short selling as an effective short term strategy for industries immediately and badly hit by any crisis like travel, tourism, entertainment.

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