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RESEARCH ARTICLE

EFFECT OF COVID 19 ON CAPITAL MARKET WITH REFERENCE TO S&P 500

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Abstract

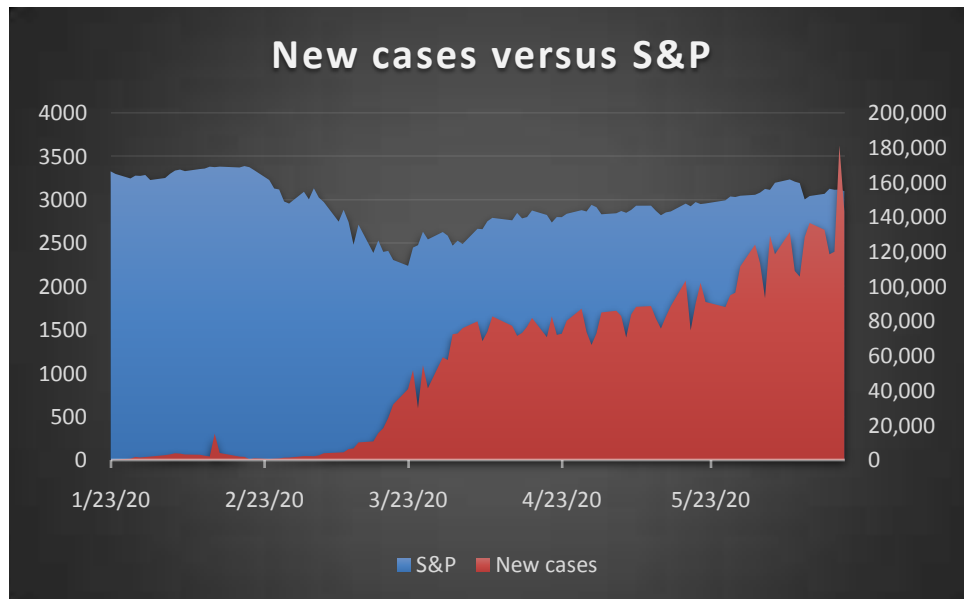
This paper has analyzed the movement of the US stock market during the COVID 19 pandemic. The paper has used time series analysis using the Vector Autoregression (VAR) model using data from Jan 23, 2020, to June 19, 2020. The finding suggests that the Standard and Poor Index which has been used as a reference for the capital market has shown negative causality with an increase in the number of new cases at the global level.

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Introduction:-

Background:

After the spread of COVID 19, it created a great deal of uncertainty among investors and that was reflected in the volatility of the stock market around the world by plummeted equity prices and loss in investor sentiments. The volatility condition in the global stock market has been comparable and even exceeded the previous crisis of 2008, 1930, and 1987. Hence, this trend has offered a motivation for research to quantify that how a global stock market like that of US reacts to the pandemic outbreak and hence this research has tried to measure the same by considering S& P market index as a dependent variable and number of new COVID cases as an independent variable.



Literature Review:-

There have been several pieces of research in the area about the effect of different shocks on the stock market and its return. Yan, Tu, Stuart, and Zhang (2020) in their research on Effect of COVID-19 On the Stock Market and Potential Investing Strategies has analyzed the effect of COVID 19 on the stock market by analyzing various industry such as technology, travel-related industry, gold, entertainment. The study has been analytical in nature and concluded that the pandemic can have an adverse effect in the short run but in long run, it will make a course correction and increase.

In the next study Liu, Manzoor, Wang, Zhang, Manzoor (2020) in their study the COVID-19 Outbreak and Affected Countries Stock Markets Response has made a study on the impact of corona outbreak in 21 affected countries. They have concluded that the outbreak has a significant negative impact on the stock market of the affected country and can cause an immediate fall in stock prices and return. The study has used the event study method and future panel fixed effect regression method and both of these methods support the conclusion.

Sansa (2020) in the study "The Impact of the COVID - 19 on the Financial Markets: Evidence from China and USA" have applied a simple regression model to find the effect. The study has used short term data to reveal that there is a positive significant impact of COVID outbreak on the Shanghai stock market and New York Dow Jones index.

Baker, Bloom, Davis, Kost, Sammon, Viratyosin (2020) in their working paper on The Unprecedented Stock Market Impact of COVID-19 has used the text-based method to describe the unprecedented effect of corona outbreak on the US stock market. The research suggests that government restrictions on commercial activity and voluntary social distancing, operating with powerful effects in a service-oriented economy, are the main reasons that the U.S. stock market is facing unprecedented effects than the previous pandemics in 1930, 1958 and 1968.

Though the studies tried to study the impact of COVID 19 on the stock market, most of them are either analytical or lack a quantitative approach and some suffer from very few numbers of data included for analysis. Hence, this research will help to resolve that issue in one hand while on the other hand, it will employ time series analysis different than those previously used.

Theoretical background:

Fama (1970) formulates the version of the Efficient market hypothesis (EMH) which states that an efficient stock market reflects all the available economic, industrial, and company information in its stock price. According to this hypothesis, in a weak form of EMH, the stock market reflects all trading information such as past prices and volumes. In a semi-strong form of EMH, stock prices reflect all publicly available information. In a Strong form of EMH, stock prices reflect all relevant information including private (insider) information. Hence, all versions assert that stock prices should reflect available information.

Hence, in line with that, the global market has shown huge volatility from the outbreak of corona reflected in plummeted stock price and lost investor confidence. Hence, the study has been motivated to make a quantitative analysis of the impact of pandemic (number of new cases around the world) on the performance of the New York Stock Exchange index Standard and Poor (S&P).

Methodology:-

This paper will use the time series method for the analysis. First of all, variables such as S&P and new cases will be tested for unit root process under Augmented Dickey fuller test to ensure that Vector Auto Regression (VAR) model can be used. This is because with a variable that does not satisfy stationarity conditions cannot use VAR. Hence, the test will be used and if any of variable will be found having not stationarity condition, then by taking the first difference they will be changed to stationary condition.

The Vector Autoregressive (VAR) model to analyze the effect of new cases of corona on changes in S&P value will be a bivariate VAR model. Sims in 1980 used the VAR model in Econometrica after which VAR became widely adopted in macroeconomics and finance.

$$y_t = c + \phi_1 y_{t-1} + \phi_2 y_{t-2} + \dots + \phi_p y_{t-p} + \epsilon_t, \epsilon_t \sim W.N. (\Omega)$$

1. N: number of examined variable

2. Y : $n \times 1$ vector of relevant variables
3. c : $n \times 1$ vector of constant
4. ϕ_i : $n \times n$ coefficient matrix

VAR consists of n regression models with regressing each variable on constant and lags of all variables. In this study we will use Bivariate VAR (2) model

$$\begin{aligned}
 y_{1t} &= c_1 + \phi_{11}y_{1,t-1} + \phi_{12}y_{2,t-1} + \phi_{21}y_{1,t-2} + \phi_{22}y_{2,t-2} + \epsilon_{1t} \\
 y_{2t} &= c_2 + \phi_{21}y_{1,t-1} + \phi_{22}y_{2,t-1} + \phi_{11}y_{1,t-2} + \phi_{12}y_{2,t-2} + \epsilon_{2t}
 \end{aligned}$$

$$\begin{pmatrix} \epsilon_{1t} \\ \epsilon_{2t} \end{pmatrix} \sim W.N. \left(\begin{bmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & \sigma_2^2 \end{bmatrix} \right)$$

The three tools play critical roles in VAR analysis. Granger Causality, Impulse response function, and (Forecast error) variance decomposition. Granger causality determines whether one variable is useful in forecasting another variable or not. Granger (1969, Econometrica) proposed the Granger causality that was based on the forecast in which a variable new case of the corona is said to Granger cause another variable S&P index change if S&P index change can be forecasted from past of new cases of corona and S&P together than just past of S&P value alone.

But an issue with the granger causality is the direction of causality and granger causality could be different and further it is qualitative than quantitative. Hence, Impulse response function and variance decomposition can compensate these points. Impulse response will evaluate the effects of a shock in one variable on another variable. Similarly, variance decomposition evaluates each variable's contribution in forecast error of each variable. Thus after granger causality impulse response function and variance decomposition will be used.

Data description:

In this research time-series, data will be used. This paper will use data for Standard and Poor (S&P 500) Index from yahoo.finance.com from the date of declaration of a pandemic by the World Health Organization (WHO) dated from Jan 23, 2020, to June 19, 2020.

Similarly, data for new cases have been obtained for the global total new cases over the same period from Jan23, 2020 to June 19, 2020. The descriptive statistics for these dates are shown below.

Date: 06/23/20 Time: 21:50 Sample: 1/23/2020 6/19/2020		Sample: 1/23/2020 6/19/2020	
<u>S_P</u>		<u>NEW CASES</u>	
Mean	2948.995	Mean	55580.21
Median	2954.065	Median	71154.50
Maximum	3386.150	Maximum	181232.0
Minimum	2237.400	Minimum	133.0000
Std. Dev.	282.5744	Std. Dev.	46100.65
Skewness	-0.362589	Skewness	0.200566
Kurtosis	2.473353	Kurtosis	1.966249
Jarque-Bera Probability	3.480702 0.175459	Jarque-Bera Probability	5.328044 0.069667
Sum	306695.5	Sum	5780342.

Source: Yahoo finance and statistica.com

Standard and Poor (S&P 500): It is a representative stock index of the US stock market. It can capture movement in the US stock market as it includes 500 largest stock with the highest market capitalization representing the major US industries and covers 80% of the capitalization of the US stock market.

New cases of Covid: It is the sum of total number of officially declared total new cases in all countries around the world each day.

Empirical Result:

Test of unit root process before forming vector Autoregression mode (VAR):

Null hypothesis:

The variable log of new cases is having unit root. Applying the Augmented Dickey-Fuller test.

Conclusion: Since the p-value is 0.0249, the null hypothesis is rejected at a 5% significance level. Thus, the log of "new cases" has no unit root and satisfies stationarity conditions.

Null Hypothesis: LNEWCASES has a unit root				
Exogenous: Constant				
Lag Length: 1 (Automatic - based on SIC, maxlag=12)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3.169982	0.0249
Test critical values:				
	1% level		-3.499910	
	5% level		-2.891871	
	10% level		-2.583017	
*Mackinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNEWCASES)				
Method: Least Squares				
Date: 06/27/20 Time: 17:01				
Sample (adjusted): 1/27/2020 6/19/2020				
Included observations: 96 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNEWCASES(-1)	-0.062032	0.019569	-3.169982	0.0021
D(LNEWCASES(-1))	-0.378365	0.100598	-3.761162	0.0003
C	0.732055	0.200275	3.655248	0.0004
R-squared	0.188692	Mean dependent var		0.074516
Adjusted R-squared	0.171245	S.D. dependent var		0.374825
S.E. of regression	0.341225	Akaike info criterion		0.718207
Sum squared resid	10.82845	Schwarz criterion		0.798343
Log likelihood	-31.47393	Hannan-Quinn criter.		0.750599
F-statistic	10.81486	Durbin-Watson stat		1.760658
Prob(F-statistic)	0.000060			

Null Hypothesis: variable S&P is unit root process:

Using Augmented Dickey Fuller test, it was found that null hypothesis cannot be rejected since the p value is 0.5890.

Null Hypothesis: S_P has a unit root				
Exogenous: Constant				
Lag Length: 1 (Automatic - based on SIC, maxlag=12)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-1.380072	0.5890
Test critical values:				
	1% level		-3.499910	
	5% level		-2.891871	
	10% level		-2.583017	
*Mackinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(S_P)				
Method: Least Squares				
Date: 06/27/20 Time: 17:10				
Sample (adjusted): 1/27/2020 6/19/2020				
Included observations: 96 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
S_P(-1)	-0.041794	0.030284	-1.380072	0.1709
D(S_P(-1))	-0.328856	0.096505	-3.407643	0.0010
C	118.3362	89.40282	1.323629	0.1889
R-squared	0.139175	Mean dependent var		-3.548332
Adjusted R-squared	0.120662	S.D. dependent var		89.36921
S.E. of regression	82.86647	Akaike info criterion		11.70309
Sum squared resid	638617.2	Schwarz criterion		11.78323
Log likelihood	-558.7483	Hannan-Quinn criter.		11.73548
F-statistic	7.517929	Durbin-Watson stat		1.918056
Prob(F-statistic)	0.000941			

Hence, we need to take difference to achieve stationarity condition and test again for ADF test.

Null hypothesis: The First difference is unit root process:

Null Hypothesis: DSP has a unit root Exogenous: Constant Lag Length: 0 (Automatic - based on SIC, maxlag=12)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-14.01170	0.0001
Test critical values:	1% level		-3.499910	
	5% level		-2.891871	
	10% level		-2.583017	
*Mackinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(DSP) Method: Least Squares Date: 06/27/20 Time: 17:14 Sample (adjusted): 1/27/2020 6/19/2020 Included observations: 96 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
DSP(-1)	-1.346592	0.096105	-14.01170	0.0000
C	-4.492290	8.502151	-0.528371	0.5985
R-squared	0.676228	Mean dependent var		-0.824791
Adjusted R-squared	0.672784	S.D. dependent var		145.5596
S.E. of regression	83.26424	Akaike info criterion		11.70253
Sum squared resid	651695.8	Schwarz criterion		11.75595
Log likelihood	-559.7214	Hannan-Quinn criter.		11.72412
F-statistic	196.3277	Durbin-Watson stat		1.921495
Prob(F-statistic)	0.000000			

Result:-

Since the p-value is 0.0001, at a 5% significance level null hypothesis can be rejected, and hence we conclude that the first difference satisfies stationarity condition.

Now we can design vector Autoregression model (VAR). Using EVIEWS, the estimated VAR model is

$$\widehat{DSP} = -105.2394 - 14.12LNEWCASES_{-1} + 24.50LNEWCASES_{-2} + 0.106DSP_{-1} - 105.23DSP_{-2}$$

$$LNEWCASES = 0.60 - 0.478LNEWCASES_{-1} + 0.46624.50LNEWCASES_{-2} - 0.000592DSP_{-1} - 0.000382DSP_{-2}$$

Vector Autoregression Estimates		
Date: 06/27/20 Time: 17:18		
Sample (adjusted): 1/28/2020 6/19/2020		
Included observations: 92 after adjustments		
Standard errors in () & t-statistics in []		
	LNEWCASES	DSP
LNEWCASES(-1)	0.478951 (0.08913) [5.37349]	-14.12549 (25.9784) [-0.54374]
LNEWCASES(-2)	0.466372 (0.08652) [5.39029]	24.50088 (25.2172) [0.97159]
DSP(-1)	-0.000592 (0.00036) [-1.62657]	-0.340549 (0.10616) [-3.20798]
DSP(-2)	-0.000382 (0.00037) [-1.03631]	0.106031 (0.10745) [0.98683]
C	0.670380 (0.18179) [3.68772]	-105.2384 (52.9634) [-1.98625]
R-squared	0.973082	0.195596
Adj. R-squared	0.971845	0.158612
Sum sq. resid	6.967386	591867.3
S.E. equation	0.282993	82.48074
F-statistic	786.2684	5.288651
Log likelihood	-11.83712	-533.9278
Akaike AIC	0.366024	11.71582
Schwarz SC	0.503078	11.85288
Mean dependent	10.13236	-2.247609
S.D. dependent	1.686534	89.91960

Now after the formation of the VAR model lag length of two was selected as suggested by Akaike Information Criterion (AIC).

VAR Lag Order Selection Criteria						
Endogenous variables: LNEWCASES DSP						
Exogenous variables: C						
Date: 06/27/20 Time: 17:27						
Sample: 1/23/2020 6/19/2020						
Included observations: 56						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-430.2594	NA	17362.84	15.43783	15.51017	15.46588
1	-354.1078	144.1441	1320.074	12.86099	13.07799	12.94512
2	-339.7755	26.10523	913.4069*	12.49198*	12.85365*	12.63220*
3	-338.1184	2.899920	994.7901	12.57566	13.08199	12.77196
4	-336.6751	2.422684	1093.169	12.66697	13.31797	12.91936
5	-334.7237	3.136176	1181.717	12.74013	13.53581	13.04861
6	-331.3499	5.181114	1216.807	12.76250	13.70284	13.12707
7	-323.2190	11.90607*	1059.970	12.61496	13.69997	13.03562
8	-320.8639	3.280224	1138.501	12.67371	13.90339	13.15046
9	-318.0313	3.743150	1206.702	12.71540	14.08975	13.24823
10	-315.7351	2.870230	1309.518	12.77625	14.29527	13.36517
11	-313.1006	3.104967	1411.333	12.82502	14.48870	13.47003
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Granger Causality Test:

Null hypothesis: There is no granger causality between new cases and the S&P index:

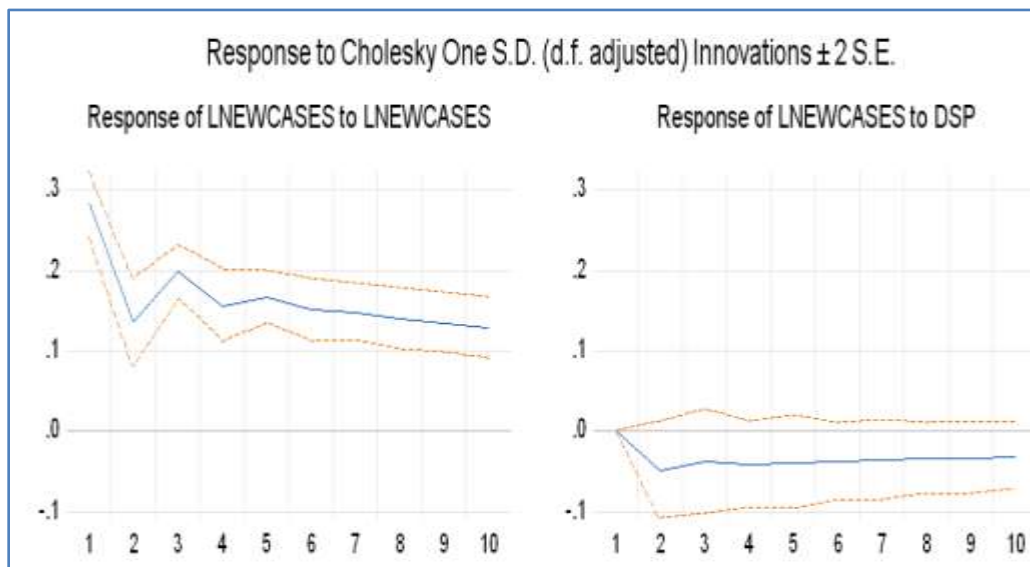
After setting the minimum information criterion, the granger causality test was conducted which shows a p-value of 0.0752 when DSP was taken as a dependent variable on LNEWCASES. Hence, at a 10% significance level, we can reject the null hypothesis that there is no Granger causality between new cases and the performance of S&P. This implies new cases granger cause S&P.

VAR Granger Causality/Block Exogeneity Wald Tests				
Date: 06/27/20 Time: 17:29				
Sample: 1/23/2020 6/19/2020				
Included observations: 92				
Dependent variable: LNEWCASES				
Excluded	Chi-sq	df	Prob.	
DSP	2.834959	2	0.2423	
All	2.834959	2	0.2423	
Dependent variable: DSP				
Excluded	Chi-sq	df	Prob.	
LNEWCASES	5.174362	2	0.0752	
All	5.174362	2	0.0752	

Now as we know granger causality just establishes direction, we have to conduct impulse response function and variance decomposition to find direction and magnitude of causality.

Impulse response function:

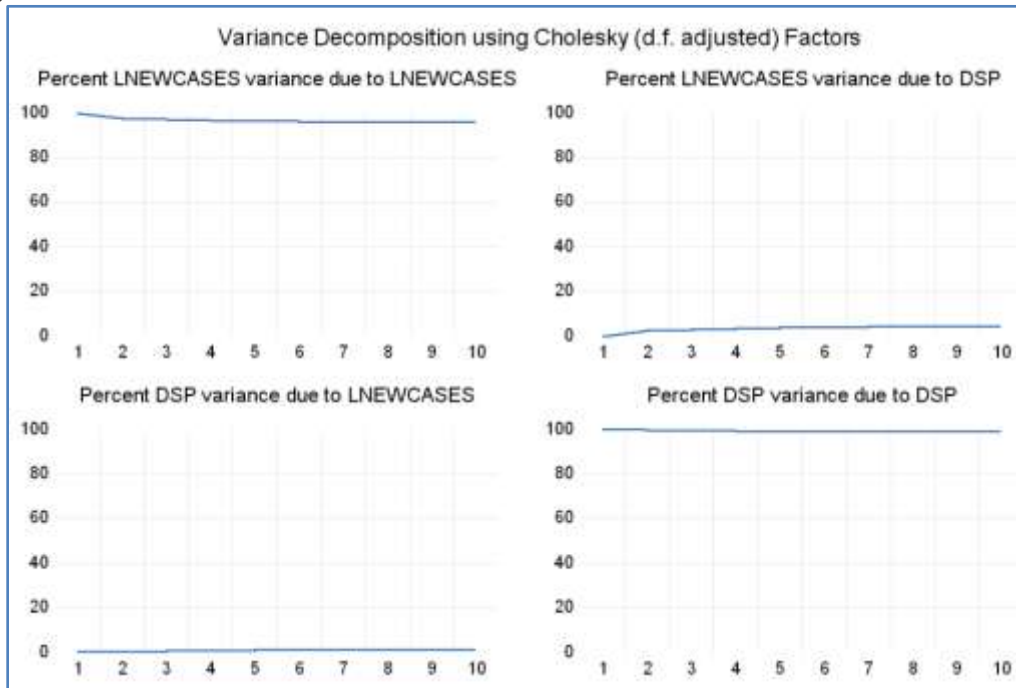
The analysis was done by using EViews and results were found as follows:



As we can see from the graph that the increase in the number of new cases has no effect on S&P on the same day but the following day, the rise in new cases by 0.2829 caused -0.04885 decrease in the index value. Similarly, a change in log value from 0.02829 to 0.1355 that represents a decrease in the number of cases causes changes in the difference in the value of the S&P index from the previous -0.04885 to -0.03026, which is the increase in a positive direction. Thus, we can say there is an inverse relationship between two which is quite intuitive as a general phenomenon of a decrease in market sentiments.

Variance decomposition:

After the impulse response function, an analysis was done to find the effect in one variable on others by measuring the forecast error in one variable to another.



Variance Decomposition of DSP:			
Period	S.E.	LNEWCASES	DSP
1	82.48074	7.93E-07	100.0000
2	87.22412	0.210295	99.78970
3	89.49764	0.708248	99.29175
4	90.09066	0.752847	99.24715
5	90.32666	0.951137	99.04886
6	90.38625	0.950080	99.04992
7	90.42703	1.020947	98.97905
8	90.43783	1.027867	98.97213
9	90.45308	1.061037	98.93896
10	90.46073	1.074218	98.92578

Cholesky Ordering: LNEWCASES DSP

As can be seen from the above result that, if we see the result in the table from, that the percentage variance described by new cases is small in magnitude, but it contributes to the variance in S&P.

Conclusion:-

Hence from all these analyses, it can be concluded that the number of new cases negatively affect the S&P 500 index and hence, we can derive that pandemic affects the stock market in a negative way when the number of cases rises and positive way when the number of cases reported decline though with very low magnitude.

The result is in line with the Efficient market hypothesis and the risk sentiments that can be seen at present among investors who are taking their funds in a safe-haven fund.

Limitation:

1. The analysis consists of data for a very short span of period. Hence, there is a limitation on the generalization of the result.
2. Impulse response function provides an analysis of a short period that is for a small period we can predict the magnitude in changes of one variable to another. The analysis will not be valid for a longer period.
3. The variable taken were just two S&P and new cases, but as we know the equity market is determined by a paramount number of factors. Hence, the results are under ceteris paribus condition and can differ if many variables are taken.

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