



Asymmetric impact of coronavirus news, fear index, oil price on United States equity market:
the first study on Infectious Disease EMV index

Asima Siddique

Department of Management Science, COMSATS University Islamabad, Islamabad, Pakistan

asimasiddique76@gmail.com

Ali Ijaz

Institute of Business Management and Administrative Sciences, The Islamia University of Bahawalpur,
Pakistan.

alijaz0092@gmail.com

Humaira Akram

Department of Management Science, Riphah International University

humairaakram006@gmail.com

Zeeshan Khan

University of Cordoba, Andalusia, Spain

cs2khkhz@uco.es

Muhammad Asif Khan

Department of Business and economics, University of Naples Parthenope, Naples, Italy

Crossponding author: asif_marwat1439@yahoo.com

Abstract

The first novel paper investigates the effect of the Coronavirus crisis (USCOVID-19), fear index, and oil price on the United States equity market price. Our study first time used the novel proxy of the fear index (Infectious Disease EMV index) developed by Baker et al. (2020). The recent paper collected the data from 21 January 2020 which is the start of novel coronavirus (COVID-19) in America (US) up till the 6 July 2021. The paper has used the linear model of Nonlinear Autoregressive distributed lag (NARDL) to confirm the causal factors (short-long run) of DJI. The result depicts that two out three exogenous (independent) variables USCOVID_19 and Infectious Disease EMV significantly negatively related to co-integrated with the United States equity market (DJI) in both positive and negative shocks except IDEMV negative shock are insignificant. While oil is significantly positively co-integrated with the DJI index in both positive and negative. In the case of long term co-integration all variables OIL, USCOVID_19, and Infectious Disease EMV are significantly co-integrated in case of positive shocks but insignificant in case of negative shocks. Our study is beneficial for individual and government investors by identify an important investment (Infectious Disease EMV index) when they want to diversify their portfolio. This incorporate the factor contagious Infectious Disease in EMV, so it is more helpful for sectoral investor when the measure asymmetric volatilities factors.

Keywords: fear index, IDEMV, oil price, Coronavirus (USCOVID_19)



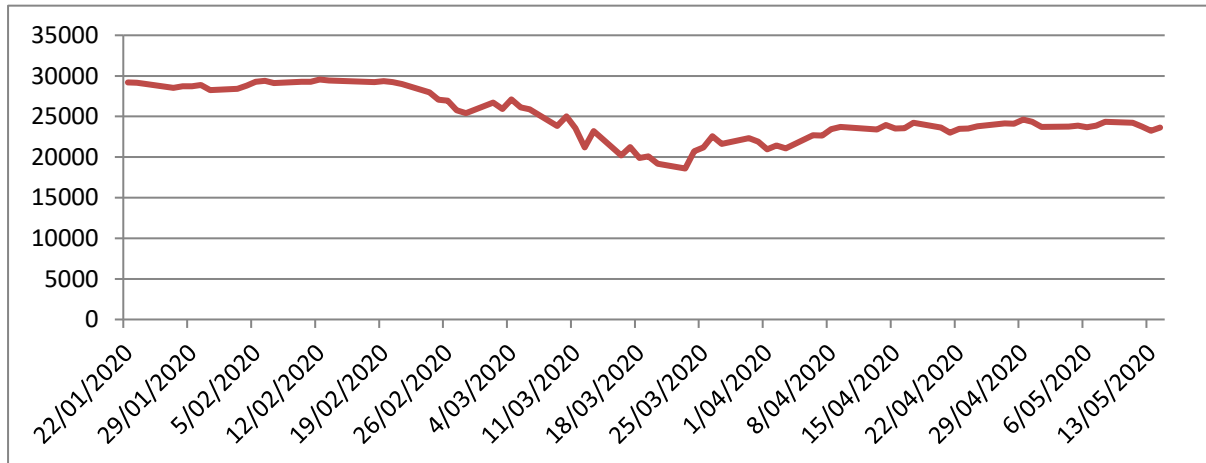
Introduction

After the introduction of internationalization, all financial markets are co-integrated, contagious, and more vulnerable to different external and internal events like disasters, news environmental sports and political events (Godil, Sarwat, Sharif, & Jermsittiparsert, 2020; Andrei, & Hasler, 2015; Zheng, 2014). The entire world equity market suffered during a natural disaster named as coronavirus (nCovid-19) period, which depicts that mountainous sell-off bind to the Covid-19. The FSTE 100 and DJIA index saw the biggest drops 25 percent and 25 percent, respectively since 1987 (Barro, Ursúa, & Weng, 2020). The epidemic Covid-19 respiratory disease (SARS-CoV-2) started from china affect human health and exponentially increased economic costs. The number of infected persons and deaths in the world is currently 45566956 and 304201 respectively. The most common symptoms of nCovid-19 virus infection include coughing, shortness of breath, high fever and the average time duration of this virus remains 1 to 14 days in the human body (Meninno, & Wolff, 2020). According to WHO latest update nCOVID-19 is unstoppable and novel viruses will never end and declared the emergency to make the vacation to cure the infected person due to COVID-19. Beyond the severe impact on human health, the novel epidemic nCOVID-19 hinders the social-economic welfare and economic performance of the countries. A research study conducted by the National Academy of Sciences (U.S), the overall income loss of the world due to novel Covid-19 exceed 60 billion dollar (Nishiura et al., 2020). A report issued by World Bank, the loss due to novel Covid-19 divide into four major categories: 1) reduction of the labour force and increased death ratio due to epidemic; 2) labour production sharply decreased; 3) resource indazole for the nCovid-19 control and cure; and 4) individual people bear a heavy amount of loss due to prevention policy and closure of production units. Covid-19 not only affect the developing countries but the United States and Europe are the most infected countries (Godil et al., 2020). Climate change and weather conditional of the U. S and Europe may further contribute the spread of the novel COVID-19 (Epstein, 2001). Among the infected countries, America is the top of the list with the highest infected people 468,895 and the numbers have grown exponentially. The only one country (U.S) alone accounts for almost 33 percent of the total infected people in the entire world

(Alqahtani, & Martinez, 2020). The COVID-19 news badly affects the united stock market, the DJIA index lost 35 percent of its value in just within a month (Barro, Ursúa, & Weng, 2020).

Figure 1

Daily of DJI index closing prices from 22 -01 -2020 to 14 - 05- 2020



News based events shape equity market performance. EMH hypothesis pointed out that the spread of an equal amount of news to all market participants, but the unequal distribution of news creates uncertainty for equity market performance. According to (Li, 2018) the news-based uncertainty could affect the investor's consumption and portfolio decisions which lead to a change in the asset prices. Moreover, investors are more conscious of negative news as compared to positive news. Therefore, accurately predict the behaviour of news-based economic market volatility and their causal relationship with the financial market is the one major task for the risk manager, financial economics, and researchers. Due to large destructions in the economy due to coronavirus (COVID-19), a new type of new based index is created named as Infectious Disease EMV index (Baker, et al., 2020).

American equity market index DJIA reached 30,000 points during February 2020 which is recorded at the highest level in the last 100 years. When equity market leptokurtic (positive returns) trends, individuals are optimistic and business performance further increase. On the other hand, equity market show platykurtic (negative returns) attitude, then volatility is enhanced also known as leverage effect. Due to negative news related to negative returns spread in the market and investors are showing herding behaviour and reluctant to invest in



any market. Due to the importance of news in the international equity market, a new type of index is created known as Equity Market Volatility (EMV) index created by Baker, Bloom, Davis, and Kost (2019). Scant academic studies (Meninno, & Wolff, 2020; Zhu, Liu, Wang, Wei, & Wei, 2019) are still available to examine the type of association between EMV and equity market of countries. Alqahtani, Wither, Dongc, and Goodwin (2020) pointed no co-integration prevails between the equity market and EMV. No evidence of a clear association between EMV and equity market found in the literature. A new type of fear index is recently created in 27 marches known as Infectious Disease Equity Market Volatility (EMV) index created by (Baker at el., 2020) based on the concept of EMV. But this index is the extension of the EMV index by incorporating the news related to Infectious Disease. This new index told me how much equity market Volatility is created due to natural disasters or different Infectious Diseases. No study currently this index, so our study is the very first and innovative study as we are using as Infectious Disease Equity Market Volatility (EMV) index and check their association with the United States equity market.

During the coronavirus (nCovid-19) period, the entire world economies would suffer because of the change in the prices of oil, increase uncertainty (volatility) level, and hinder equity market performance. So, in our recent study, we are going to examine the effect of coronavirus news, fear index and oil price on United States equity market performance by employing nonlinear autoregressive distributed lag (NARDL) model introduced by Shin et al. (2014). Our study carries several contributions in the finance literature. The first contribution of the study is by using coronavirus (covid-19) news data and wanted to investigate the role covid-19 news on stock market prices. Secondly, our study using EMV index which is very rarely used in literature as this index is developed in 2019 and finding are also not clear. Thirdly, the most important contribution is that our study incorporates the Infectious Disease Equity Market Volatility (EMV) index which is created 27 March 2020, and until not even a single study use this index. The last contribution is methodological as we are using co-integration and a nonlinear autoregressive distributed lag (NARDL) model based upon a co-integrated time series in our paper. Due to the progressive correction of the departure from long-run equilibrium by a succession of partial short-run adjustments, the co-



integration component is sometimes referred to as the error correction term. NARDL method is better as compared to the autoregressive distributed lag (ARDL) model because the ARDL target linearity problem but mostly finance data in non-linear and normal as well. So, NARDL is used to capture the asymmetric (non-linear) relationship between the variables of the study, and, the model captures the long and short-run asymmetries. Importantly, our model does not suffer the problem of standard bond testing procedure (Fetzer, Hensel, Hermle, & Roth, 2020.; Andrei, & Hasler, 2015; Bloom, 2009) to inquired long term effects between target variables regardless of the integration order of the concerned variables. Due to the series to advantages, our study has decided to use NARDL to decide the asymmetric relationship between United States Coronavirus news, IDEMV, oil prices, and the United States equity market (DJI index).

The remainder part of the study is arranged as follows. Section two discusses the literature review and section three provides information about methodology and data. Section four reports discussion of the results and findings while sections five conclude.

Literature Review

News plays an important in the equity market because investors' behaviour totally changed during negative and positive information spillover. In other words, investors behaviour highly dependent on the news. First and an initial study conducted by Niederhoffer, (1971) and concluded that news great and significantly influence the performance of the stock market and investors' investment decisions. Black (1976) pointed out that a negative association exists between equity market prices and their volatility, the term known as leverage theory. Some researchers conclude that volatility is increased by coming negative news Hung, 2019; Zhu, Liu, et al., 2019; Badeeb, & Lean,2018; Smales 2017). While other studies contradict the relationship between volatility and investors' fear through news, so conclude no relationship between investors' fear and equity prices. Epstein, (2001) pointed out that investor's distress creates and more volatility in the financial market by showing panic behaviours. Zheng (2014) reveals that significant and negative relationships found between investor investors' sentiments and equity market performance. This study used the VIX index prices to measure an investor's sentiments. A study result is contradictory and pointed significant positive



relationship between market volatility (VIX index as representative of the fear index) and returns of the equity market (Fleming et al., 1995). Smales (2017) conducted their study in use and tried to investigate investors' fear (sentiments) and equity market price by using the ARDL model. According to Li (2018), the news from governmental medial has a larger intensity impact than other media. And reveals a concern that positive news enhances the returns of the equity market and vice versa. The result is also consistent with paper (Su, Fang, Yin, 2018) who concluded that new based volatility (NVIX) creates much higher volatility in the equity market as compared to financial uncertainty (FU). Cepoi (2020) mentioned in their study develop a special fear index due to covid-19 and also investigate impact on equity market price pattern. The study used panel data and conclusion confirm the significant role while determine the market price of stock market. Mejova, & Kalimeri, (2020) study the impact word of mouth on investors behaviour. Data has been collected from fakebook and concluded that spread of misinformation inversely impact business and individual behaviour. In their study develop a special fear index due to covid-19 and investigate impact on equity market price pattern. The study used panel data and conclusion confirm the significant role while determine the market price of stock market. Zhu et al. (2019) recently conducted a study to clear the picture between stock market return and fear index. Two proxies are used (VIX and EMV) and results reveal the fact that EMV creating very low volatility (minimal) which should be ignored. The literature studies result is matched with arguments of Pal and Mitra, (2015) who pointed out that the return of equity market and volatility could be anything (negative or positive) over a specific period.

There is scant literature investigating the relationship between oil, coronavirus, natural disaster, and equity market (Barro, Ursúa., & Weng, 2020; Zhu, Liu, Wang, Wei, & Wei, 2019; Baker, Bloom, & Davis, 2016; Solomon, 2012). Oil and volatility in the global market always remained a serious concern for economists (Kumar, 2019; Fang, Qian, Chen & Yu 2018; Andrei, & Hasler, 2015). A study by Pal and Mitra (2015) pointed out that infectious diseases (SARS, HINI, and dengue fever) not only the ability to affect human health but inversely affect the country's economic growth. The study results also indicate that investor rationale (behaviour) deviate during the outbreak of different infectious diseases (The basic



rationale for equity prices, the prices of oil will automatically affect the cash flow of individual companies and hence cause a change in their stock prices (Jones & Kaul, 1996). Bloom (2009) conducted their research study to determine the type of association between equity price volatility and the outbreak of different natural disasters by using the GARCH methodology. The data of the study was collected from Australia from 1980 to 2003. The conclusion supports the idea that natural disasters outbreak in a country bring volatility in their equity prices. Hamdan and Hamdan (2018) conducted their study in Saudia Arabia and the major purpose of the paper is to investigate the major ingredients (causes) that create volatility in their equity market. The research paper used data specific data period 2007 to 2016 and employed the causality test to get found. The study found that oil cause volatility in the Saudia Arabia equity market largely. While Yin and Feng's (2019) finding reveals that no predictive association presents between the volatility of the stock market and prices of oil. Hoque et al. (2019) significant association present between oil price and investors uncertainty (EPU) in the case of Malaysia equity market prices. Conlon and McGee, (2020) conduct the cross correlation between equity market and oil before and after covid-19 and found no correlation exist present during covid-19 period. Barro et al (2020) conducted their study to investigate of psychological effect of the spreading the COVID-19 pandemic. The study results shows that investors behave differently during pandemic. The intensity of fear suddenly increased during COVID-19. Gharib, Muftah-Wali and Jabeur (2020) conduct the cross correlation between equity market and oil before and after covid-19 and found no correlation exist present during covid-19 period. A recent study conducted by Al-Awadhi et al. (2020) proves COVID-19 Creates massive volatility in china's equity market. Another recent study Fetzter et al (2020) tried to investigate the relationship between infectious disease EMV index and electricity volatility. The study used the recent data from 3 March 2020 to 6 April 2020. The results indicate that energy market is highly influenced by the volatility in infectious disease EMV index.

Based on the above previous literature review, the inconclusive relationship found between investors fear, oil price, natural disasters, and equity market volatility. Very limited studies used these variables in their studies. Moreover, our study is the first using Infectious Disease



EMV index also with other EMV indices during the current pandemic (COVID-19) environment. So, our first innovative study used fear index (EMV index and their sub-indices including Infectious Disease EMV index), oil price, coronavirus, and check their impact on the equity market of the super country (United States).

Table 2
Literature Review Summary

Research Studies	Sample Countries	Data	Aims/Objective	Key conclusions
Al-Awadhi, Al-Saifi, Al-Awadhi, & Alhamadi, (2020)	China	10 Jan – 31 Jan 2020	The current research paper tries to examine spillover and the contagious relationship between the equity market and COVID-19 by using panel regression.	The results depict that the death ratio and infected cases have a negative significant relationship with china’s equity market performance.
Nikkinen, & Peltomäki (2020)	United States	Jan 2010-2016 (weekly data)	In the current study, the author wanted to explore the information (demand and supply factor) and crash fear.	The finding told that individual web search is directly linked with the equity market and VIX.
Alqahtani, Wither, Dong, & Goodwin, (2020)	India, Hong Kong, and China	2001 – 2018	The main objective of this paper is to search out the nature of asymmetric correlation (co-integration) between international equity (three countries) market and a new based (fear) index by using the model of NARDL.	The conclusion of the paper reveals that negative non-linear relationship between the variables of this study except for the country of China.
Fetzer, Hensel, Hermle, & Roth (2020)	Worldwide (global) dataset	Feb 19, 2020 – March 16, 2020	The study's major and core objective to analyse the stress factor related to economic activity and Ncovid-19.	The research study result pointed out that stress factors related to economic activity exponentially increased by increasing Ncovid-19. Economic stress could be reduced by educating and giving awareness related to Ncovid-19.



Mo, Mu, & Zhang (2019)	China	2005 – 2017	The current academic study explores the correlation between macroeconomic ingredients, prices of oil, and equity market.	Research reveals that 3 macroeconomic ingredients, the exchange rate is the first in the ranking of a significant relationship with the china equity market during the bearish (stormy) period.
Zhu, Liu, Wang, Wei, & Wei (2019)	The United States four stock markets	1990 – 2019	This paper analysed the type of spillover relationship between VIX, EMV, and equity market of the U.S by employing GARCH-MIDAS.	The fear index study results show that the VIX index has comparatively great magnitude effects on the Us equity market than the EMV index.
Mo, Mu, & Zhang (2019)	United States	1980 – 2016	The research investigates the nature of volatility related to implied new based volatility and equity market of the U.S.	The conclusion statements state that weak short-term volatility presents while strong volatility exists between implied new based volatility and equity market of the U.S.
Fang, Qian, Chen & Yu (2018)	France, Italy, US, Japan, UK, Canada, and Germany	1998 – 2016	The research paper's major aim to investigate the response by NVIX in the equity market.	The academic paper concludes that only long term and significant associations present between NVIX and equity market.
Li (2018)	China	Feb 2017- April 2017 (intraday data)	The current research article core and the main purpose is to examine the relationship between the china equity market and news by employing OLS.	The result confirms the fact that positive endorse performance of china's equity while positive has an inverse impact on the equity market.
Smales (2017)	USA	Jan1990- Dec2015	The present research paper tried to guess the importance of investors' fear (sentiments) and equity market by using the ARDL model.	The finding reveals that short-run investors behave panic ally when any negative new comes compared to the long term.
Andrei &Hasler (2015)	Theoretic al paper	1969-2012	The present theoretical paper examines explore equity market volatility and investors'	If returns variance of equity market exponentially increase



			attraction.	investor panic behaviour and uncertainty enhanced.
Pal & Mitra (2015)	USA	1990 - 2012	The current paper has tried to examine the co-integration between the WTI oil market and the equity market of the U.S.	Oil is the main (key) input of every sector, therefore result indicates and gives the direction of the presence of co-integration between concerned variables of the study.
Peress (2014)	OECD Countries	1989 - 2010	The author tried to investigate the nature of the relationship (causal effects) between information from different media and equity markets.	The results depict that information helps to increase the efficiency of different markets, so highly suggested to improve the source of provided media information.
Solomon (2012)	IR firms	2002 - 2007	The present academic paper wanted to examine the core relationship behaviour between equity price and publicity selectivity (bad and good media coverage).	The conclusion consistent and prove the causal effect of IR firms on media return and their coverage as well.
Chen, Chen, Tang, & Huang (2009)	Taiwan	Sep 2002 – May 2003	The present research wanted to inquire about the negative and positive impact of SARS on the equity market.	The conclusion reveals that the SARS turmoil period spread negatively related to some sectors which include retail and wholesale sectors. While positive shock has observed in the biotechnology sector.
Sadorsky (1999)	U. S	1947 – 1996	One of the initial studies which aimed to examine between equity and oil market.	OV and OP have strong relationship with the equity market.

Methodology and Data

Our current study examines the asymmetric (non-linear) long and short run impact of United states COVID-19 news, IDEMV, oil prices on the United States equity market (DJI index).

The data is basically time series, but endogeneity issue could exist in panel data. And the basic equation is given below:

$$DJI = f(USCOVID - 19^+, USCOVID - 19^-, OIL^+, OIL^-, IDEMV^+, IDEMV^-)$$

The non-linear ARDL (NARDL) model is presented by Shin et al. (2014) and employed to test the long and short-run dynamic relationship between variables of interest. Our model is robust in the scene can be applied to a smaller sample size and the order of integration cannot matter. The unit root test is used to verify the order of integration in our study. More importantly positive and negative elements cover asymmetric and additional also cover extreme events like the financial crisis period etc (Raza, Shahzad, Tiwari, & Shahbaz, 2016).

The simple equation given by Shin et al. (2014) is.

$$Y_t = (x_0 + \gamma x_t^+ + \gamma x_t^- + u_t) \quad (3.1)$$

Where γ^+ and γ^- are considered long-term parameters of $k \times 1$ vector of independent variables (regressors) x_t , which are decomposed as:

$$X_t = (x_0 + x_t^+ + x_t^-) \quad (3.2)$$

Where $+x_t$, $(-x_t)$ are the partial sums of positive (negative) change in x_t as follows:

$$X_t^+ = \sum_{i=1}^t \Delta x_i^+ = \sum_{i=1}^t \max(\Delta x_{i,0}) \quad (3.3)$$

$$X_t^- = \sum_{i=1}^t \Delta x_i^- = \sum_{i=1}^t \min(\Delta x_{i,0})$$

The NARDL (V, W) Equation (3.4) form, the present form of non-linear (asymmetric) error correction model (AECM) can be categorized as

$$\Delta Y_t = v Y_{t-1} + \sigma^+ x_{t-1}^- + \sum_{i=1}^{v-1} \tau_j \Delta y_{i-1} + \sum_{i=0}^w (\pi_i^+ \Delta x_{t-l}^+ + \pi_i^- \Delta x_{t-l}^-) + u_t \quad (3.4)$$

Where $\sigma^+ = -v \gamma^+$ and $\sigma^- = -v \gamma^-$

Finally, the asymmetric (non-linear) aggregate dynamic the multiplier effect of a specific unit change in x_t^+ and x_t^- and $-y$ can be examined by respectively way given below:

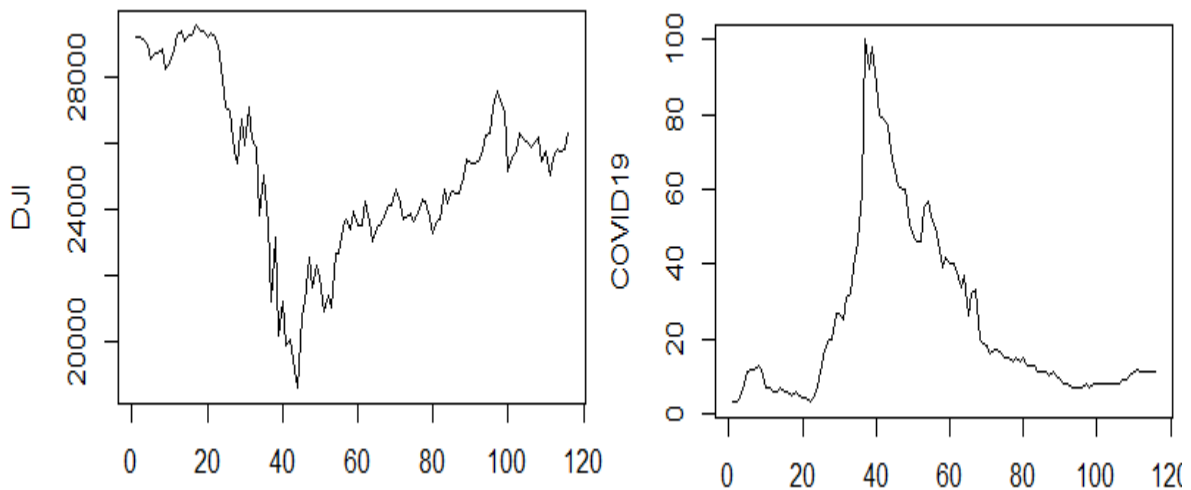
$$n_h^+ = \sum_{i=1}^h \frac{\delta y_{t+i}}{\delta x_{t+}}, \quad n_h^- = \sum_{i=1}^h \frac{\delta y_{t+i}}{\delta x_{t-}}, \quad h = 0, 1, 2, \dots$$

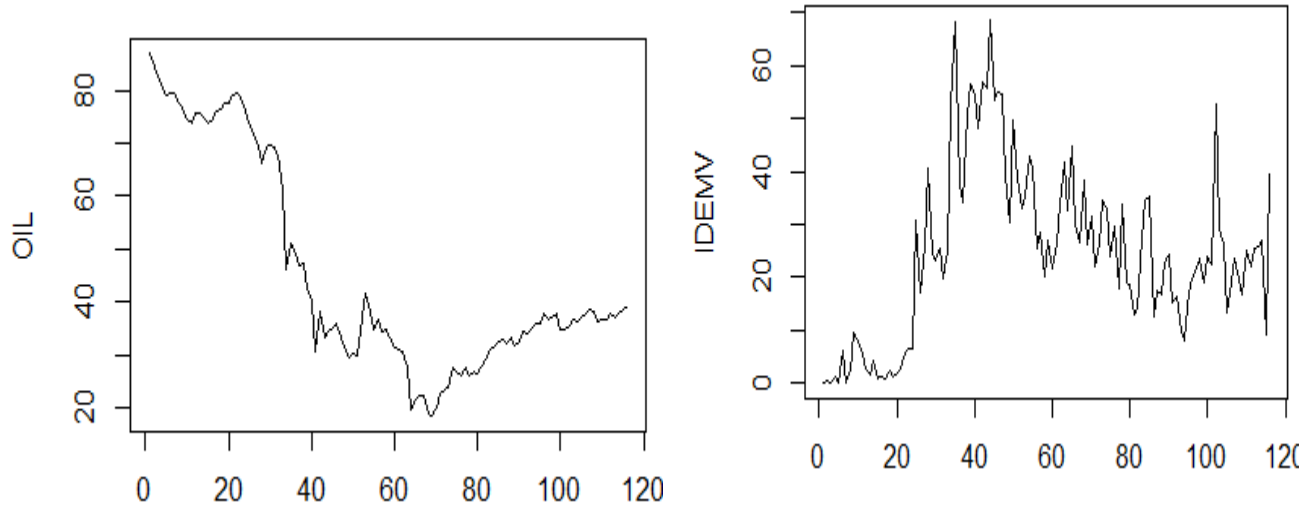


Data of the paper and graphical representation

The study has decided to used daily of all variables used in the study including Dow jones index of united states, daily searches of coronavirus news in the united states (USCOVID-19) obtained from Google trend, oil prices and Economic Market Volatility (EMV) index and one sub-indices infectious disease index daily data. The data is collected from 22 January 2020 to 6 July 2021 and all data is collected from yahoo finance and Fred website. EMV index is the new and recently developed index based on the text of United States paper and given by Baker et al. 2019 to measure volatility in the equity market of the US. And thirty-one sub-index and their related news affect the financial market volatility were also added in the EMV index. Recently an advance came in the EMV index, and the infectious disease index is added as a sub-index in the overall EMV presented by (Baker et al., 2020).) Due to the outbreak of novel coronavirus. By adding infectious disease index in the EMV indices; pandemic, disease, SARS, epidemic, Ebola, virus, MERS, coronavirus (COVID-19 and five other types), H1N1, H5N1, and flu news also be added and this news creating volatility in the US equity market. We have EViews and R software for the doing the analysis.

Figure 2





All variables individual time series graphs are shown that during the COVID-19 period (22 Jan-20 May). It has been observed that all variable shows a huge variation and show non-linear. Some variables have upward while other variables showed a downward trend which confirms the asymmetric behaviour of data.

Discussion of the results and findings

This part contains results and discussion descriptive statistic correlation matrix and NARDL model and other test used in this study.

Table 2

Descriptive statistics summary

	DJI	USCOVID_19	OIL	IDEMV
Mean	25095.86	381929.1	33.36835	26.16565
Median	24256.45	14250.00	28.70000	26.38000
Maximum	29440.47	1528568.	58.34000	68.37000
Minimum	19028.36	1.000000	-37.63	0.000000
Std. Dev.	3114.344	515216.2	16.21736	18.48145
Skewness	0.108179	0.975371	-0.73449	0.211439
Kurtosis	1.793385	2.388423	5.362189	2.169537



The descriptive statistics result shows that USCOVID-19 and DJI index has the highest means values (381929.1, 25095.86) and greater dispersion 515216.2 and 3114.344 respectively which shows that both variables are quite dispersed and far away from their average values. Moreover, oil prices a value deviates from bell shape and show highly negative skewed and leptokurtic behaviour which shows that oil prices quite go down during coronavirus period.

Table 3
 Narayan and Popp (2010) results at the intercept, intercept, and trend

Variables	Break in intercept				Break in intercept and trend			
	t-statistic	TB1	TB2	K	t-statistic	TB1	TB2	K
DJI	-3.816	5/03/2020	23/03/2020	0	-5.961	16/03/2020	21/03/2020	0
USCOVID_19	-12.520	30/04/2020	2/05/2020	5	-7.003	6/05/2020	15/05/2020	2
OIL	-2.169	11/03/2020	29/03/2020	3	-3.559	31/03/2020	12/04/2020	1
IDEMV	-6.304	28/04/2020	18/05/2020	0	-5.249	1/05/2020	28/05/2020	0

Notes: ***, ** indicate the p-value 1% and 5% null hypothesis criteria for unit root

Table 4
 Bound (co-integration) test.

Exploratory variable	F-statistics value	K	Lower-Bound value (90%)	Upper-Bound value (90%)	End conclusion
Dowse Jones index (DJI)	6.192585	3	3.77	5.61	Presence of Cointegration

Table 3 contains the result of Narayan and Popp (2010) two break structural break unit root test results to gain information regarding stationarity of the variables used in our paper. While using conventional test of unit root tests, the value of R square is too high (spurious regression). To avoid the problem our study used endogenously determined structural break Narayan and Popp (2010). The result of model 1 (Break in intercept) and model 2 (Break in intercept and trend) depicts that no variable stationary at level, the whole junks of the



variables (DJI, USCOVID-19, IDEMV, and OIL) are stationary at first difference. The all-structural breaks of DJI and OIL (M1 and M2) are in the month of march which depicts that oil prices cut down due to large oil supply and shortage of demand due the outbreak of COVID-19. The DJI breaks are in March shows that due to COVID-19, all productions units stopped which down affect the performance of DJI. DJI performance decreased up to 35 percent during March. COVID-19 structural breaks during the month of May and covid-19 cases at peak level during the same month. So, it means we can use the NARDL model to check the impact of all independent variables on the DJI index. But before that, we need to apply the bound test to know about the presence of co-integration. And 4.3 table confirms the presence of co-integration in our dependent variable. So, we can surely apply the NARDL model in this paper.

Table 4
NARDL model results

Variable	short run asymmetry				Long run asymmetry			
	Coefficient	Std. Error	t-Statistic	Prob.	Coefficient	Std. Error	t-Statistic	Prob.
<i>IDEMV</i> ⁺	-23.40671	7.015391	-3.33649	0.0013**	-129.09060	30.56938	-4.2228	0.0001*
<i>IDEMV</i> ⁻	2.08718	7.91494	0.26370	0.79250	-6.14379	22.91100	-0.26816	0.78910
<i>COV19</i> ⁺	-56.63202	16.49060	-3.43420	0.00090*	-75.67362	26.36366	-2.87038	0.00500*
<i>COV19</i> ⁻	-74.68131	28.86760	-2.58703	0.01110**	-28.61110	33.65200	-0.85021	0.39720
<i>OIL</i> ⁺	61.94166	26.88028	2.30435	0.02320**	182.33049	85.43090	2.13425	0.03520**
<i>OIL</i> ⁻	124.21280	30.53235	4.06824	0.00010*	36.75849	69.26826	0.53067	0.59680
C	-0.33972	0.07388	-4.59838	0.00000	29710.44688	562.46390	52.82196	0.00000

Before interpreting NARDL results, it would be necessary to explain the meaning of asymmetric based coefficients. For a negative NARDL coefficient for negative (positive) variations of an explanatory variable imply that when the regressor variable increases (decreases), the response variable tends to fall (rise). Again, for a positive coefficient for positive (negative) variations of an explanatory variable imply that when the regressor variable rises (falls), the response variable tends to rise (fall). The above 4.4 table presents the



analysis of NARDL the effects of the negative and positive shock of all independent variables on dependent on the variable (US equity market). Positive shocks of IDEMV negatively significant in both in both long and short-run period, while insignificant IDEMV in case of negative shock (both long and short-run period), The coefficient value of $(IDEMV)^+$ by increasing IDEMV, the price of new York stock market decreased dramatically. In other words, investors always feel fear and found that the outbreak of serious Infectious Disease through negative signals in the equity market and investors behave panicle, resulted decreased the performance of equity market (Baker et al., 2020). Our results exactly match with leverage theory where we found negative association between equity return negatively associated with financial asset's volatility. The negative relation is due to investors behaviour totally changed during the period of negative news as compared to positive news. Similarly, COVID-19 is negatively significant in both (negative and positive) cases during the short-run period, but the magnitude is high in positive shock, while in the long run, IDEMV is significant only in positive shocks. Our finding consists of the study (Meninno, & Wolff, 2020) who pointed out that COVID-19 virus news spread negative news and increases the vulnerability of the equity market and hinders the performance of the financial market. Lastly, Oil is also positively significantly linked in both positive and negative shocks during the short run, while in the long run, IDEMV is significant only in positive shocks. The results are consistent with the previous studies (Smales, 2017) indicate that increase in oil price enhances equity market performance while a downward push in the price of oil has an adverse impact on the equity market.

Conclusion

The sharply increases infected cases of COVID-19 all over the world have injected a downward trend in the financial equity market. The United States has become the number one country in the world with the highest number of cases and deaths from COVID-19. Therefore, the present study uses OIL, USCOVID_19, and Infectious Disease EMV (IDEMV) index. The recent paper collected the data from 21 January 2020 which is the start of novel coronavirus (COVID-19) in America (US) up till the 6July 2021. The paper has used



the linear model of Autoregressive distributed lag (NARDL) to confirm the causal factors (short-long run) of DJI.

The unit test results depict that the whole chunk of the variables (DJI, USCOVID-19, IDEMV, and OIL) are stationary at first difference. Moreover, descriptive, and bound tests also confirm the non-linear co-integration present between the variables of the study. Therefore, the study applies the NARDL model and results depict that two out three exogenous (independent) variables OIL, USCOVID_19 and Infectious Disease EMV significantly negatively related to co-integrated with the United States equity market (DJI) in both positive and negative shocks except IDEMV negative shock are insignificant. The finding confirms that by spreading coronavirus news in the United States and Infectious Disease EMV, the performance equity market of the United States hinders inversely. Oil is also significantly positively co-integrated with the DJI index. While in the case of long-run co-integration all variables OIL, USCOVID_19, and Infectious Disease EMV are significantly co-integrated in case of positive shocks but insignificant in case of negative shocks. Our recent study is beneficial for the equity investors by pointing out some major reasons for low return in the United States equity market. Especially incorporating the Infectious Disease EMV helps the portfolio find a new uncertainty factor that inversely affects the equity market performance by spreading information asymmetry. So, to diversify their investment government and individual investors should need to consider these important factors. The future of the studies can extend the time framework and incorporate more countries equity indices as the present study only limited to the U.S equity market.

Reference

- Al-Awadhi, A. M., Alsaifi, K., Al-Awadhi, A., & Alhammad, S. (2020). Death and contagious infectious diseases: Impact of the COVID-19 virus on stock market returns. *Journal of behavioural and experimental finance*, 27, 100326
- Alqahtani, A., Wither, M. J., Dong, Z., & Goodwin, K. R. (2020). Impact of news-based equity market volatility on international stock markets. *Journal of Applied Economics*, 23(1), 224-234.



- Andrei, D., & Hasler, M. (2015). Investor attention and stock market volatility. *The review of financial studies*, 28(1), 33-72.
- Badeeb, R. A., & Lean, H. H. (2018). Asymmetric impact of oil price on Islamic sectoral stocks. *Energy Economics*, 71, 128-139.
- Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring economic policy uncertainty. *The quarterly journal of economics*, 131(4), 1593-1636.
- Baker, S. R., Bloom, N., Davis, S. J., & Kost, K. J. (2019). Policy news and stock market volatility (No. w25720). *National Bureau of Economic Research*.
- Baker, S., Bloom, N., Davis, S. J., Kost, K., Sammon, M., & Viratyosin, T. (2020). The unprecedented stock market reaction to COVID-19. *Covid Economics: Vetted and Real-Time P*
- Barro, R. J., Ursúa, J. F., & Weng, J. (2020). The coronavirus and the great influenza pandemic: Lessons from the “spanish flu” for the coronavirus’s potential effects on mortality and economic activity (No. w26866). *National Bureau of Economic Research*.
- Black, F. (1976). Studies of stock market volatility changes. 1976 Proceedings of the American Statistical Association Business and Economic Statistics Section.
- Bloom, N. (2009). The impact of uncertainty shocks. *econometrica*, 77(3), 623-685.
- Cepoi, C. O. (2020). Asymmetric dependence between stock market returns and news during COVID19 financial turmoil. *Finance Research Letters*.
- Chen, C. D., Chen, C. C., Tang, W. W., & Huang, B. Y. (2009). The positive and negative impacts of the SARS outbreak: A case of the Taiwan industries. *The Journal of Developing Areas*, 281-293.
- Enamul Hoque, M., Soo Wah, L., & Azlan Shah Zaidi, M. (2019). Oil price shocks, global economic policy uncertainty, geopolitical risk, and stock price in Malaysia: Factor augmented VAR approach. *Economic research-Ekonomska istraživanja*, 32(1), 3701-3733.
- Epstein, P. R. (2001). West Nile virus and the climate. *Journal of Urban Health*, 78(2), 367-371.



- Fang, L., Qian, Y., Chen, Y., & Yu, H. (2018). How does stock market volatility react to NVIX? Evidence from developed countries. *Physica A: Statistical Mechanics and its Applications*, 505, 490-499.
- Fetzer, T., Hensel, L., Hermle, J., & Roth, C. (2020). Coronavirus perceptions and economic anxiety. *arXiv preprint arXiv:2003.03848*.
- Fleming, J., Ostdiek, B., & Whaley, R. E. (1995). Predicting stock market volatility: A new measure. *Journal of Futures Markets*, 15(3), 265-302.
- Gharib, C., Mefteh-Wali, S., & Jabeur, S. B. (2020). The bubble contagion effect of COVID-19 outbreaks: Evidence from crude oil and gold markets. *Finance Research Letters*, 101703.
- Godil, D. I., Sarwat, S., Sharif, A., & Jermisittiparsert, K. (2020). How oil prices, gold prices, uncertainty, and risk impact Islamic and conventional stocks? Empirical evidence from QARDL technique. *Resources Policy*, 66, 101638.
- Hung, N. T. (2019). Equity market integration of China and Southeast Asian countries: further evidence from MGARCH-ADCC and wavelet coherence analysis. *Quantitative Finance and Economics*, 3(2), 201-220.
- Jones, C. M., & Kaul, G. (1996). Oil and the stock markets. *The journal of Finance*, 51(2), 463-491.
- Kumar, S. (2019). Asymmetric impact of oil prices on exchange rate and stock prices. *The Quarterly Review of Economics and Finance*, 72, 41-51.
- Li, K. (2018). Reaction to news in the Chinese stock market: A study on Xiong'an New Area Strategy. *Journal of Behavioral and Experimental Finance*, 19, 36-38.
- Mejova, Y., & Kalimeri, K. (2020). Advertisers Jump on Coronavirus Bandwagon: Politics, News, and Business. *arXiv preprint arXiv:2003.00923*.
- Meninno, R., & Wolff, G. (2020). As Coronavirus Spreads, Can the EU Afford to Close Its Borders? *Economics in the Time of COVID*, 19.
- Mo, B., Mu, J., & Zhang, B. (2019). The relationship between news-based implied volatility and volatility of US stock market: What can we learn from multiscale perspective? *Physica A: Statistical Mechanics and its Applications*, 526, 121003.
- Narayan, P. K., Popp, S., 2010. A new unit root test with two structural breaks in level and slope



- Nelson, D. B. (1991). Conditional heteroskedasticity in asset returns: A new approach. *Econometric: Journal of the Econometric Society*, 347-370.
- Niederhoffer, V. (1971). The analysis of world events and stock prices. *The Journal of Business*, 44(2), 193-219.
- Nikkinen, J., & Peltomäki, J. (2020). Crash fears and stock market effects: evidence from web searches and printed news articles. *Journal of Behavioural Finance*, 21(2), 117-127.
- Nishiura, H., Kobayashi, T., Yang, Y., Hayashi, K., Miyama, T., Kinoshita, R., ... & Akhmetzhanov, A. R. (2020). The rate of under ascertainment of novel coronavirus (2019-nCoV) infection: estimation using Japanese passengers' data on evacuation flights. *Journal of clinical medicine*, 9(2), 419.
- Nishiura, H., Kobayashi, T., Yang, Y., Hayashi, K., Miyama, T., Kinoshita, R., ... & Akhmetzhanov, A. R. (2020). The rate of under ascertainment of novel coronavirus (2019-nCoV) infection: *Estimation using Japanese passengers' data on evacuation flights*.
- Pal, D., & Mitra, S. K. (2015). Asymmetric impact of crude price on oil product pricing in the United States: An application of multiple threshold nonlinear autoregressive distributed lag model. *Economic Modelling*, 51, 436-443.
- Peress, J. (2014). The media and the diffusion of information in financial markets: Evidence from newspaper strikes. *The Journal of Finance*, 69(5), 2007-2043.
- Sadorsky, P. (1999). Oil price shocks and stock market activity. *Energy economics*, 21(5), 449-469.
- Smales, L. A. (2017). The importance of fear: investor sentiment and stock market returns. *Applied Economics*, 49(34), 3395-3421.
- Solomon, D. H. (2012). Selective publicity and stock prices. *The Journal of Finance*, 67(2), 599-638.
- Yin, L., & Feng, J. (2019). Can investors' attention on oil markets predict stock returns? *The North American Journal of Economics and Finance*, 48, 786-800
- Zheng, Y. (2014). The linkage between aggregate stock market investor sentiment and commodity futures returns. *Applied Financial Economics*, 24(23), 1491-1513.



Zhu, S., Liu, Q., Wang, Y., Wei, Y., & Wei, G. (2019). Which fear index matters for predicting US stock market volatilities: Text-counts or option based measurement? *Physica A: Statistical Mechanics and its Applications*, 536, 122567.