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On the relation between Pandemic Disease Outbreak News and Crude oil, Gold, Gold mining, Silver and Energy Markets

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ABSTRACT

Fear of the disease outbreak news (DONs) has shocked commodity markets and raised the likelihood of economic uncertainty and recession globally. This article examines the unprecedented overreaction of investors sentiments in the commodities such as Crude oil, Gold, Gold Mining, Silver, and the Energy sector. The deadly effects of DONs-COVID-19 in the commodities market have been the worst in history; it appeared the first time higher than the common stock’s volatility. Covid-19 induced economic uncertainty has impacted severely through all commodities except the safe-haven Gold (GVZ). Importantly, ETF Options based Implied Volatility Index of Crude (OVX), Silver (VXSLV), and Energy (VXXLE) stocks have crossed the peak level what it was prevailing during the global financial crisis 2008. The unparalleled upsurge of the implied volatility index across all commodities indicates higher demand for the hedge funds to protects the commodity portfolio. ETF options on the commodity act as the best hedge against market uncertainty. Overburden on the put option results in an increased risk premium, henceforth higher expected volatility. ETF options truly measure the investor’s fear of predominant in the commodity market.

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1. Introduction

Commodity markets have perceived severe fear than the common stocks globally, along with worries of rising cases of infectious pandemic disease outbreak Covid-19. Consequently, it has raised more uncertainty for the natural resources such as crude oil, gold, and silver markets. Disease outbreak of novel coronavirus has increased the global health crisis, decreased consumption, and investment in the commodities. Unlike the disaster that occurred in the worldwide equity market, the commodity has shown more pronounced effects of Covid-19. Energy commodities have been harshly affected due to the contagious spread of the virus from Wuhan, China, and other parts of the world. The deadly effects of Covid-19 resulted in a decrease of West Texas Intermediate (WTI) crude oil price by 50%, except for bullion and other precious metal commodities that are likely to fall further in the near future (US Energy Information Administration EIA, 2020; and World Gold Council WCG, 2020). Hence, the study aims to measure the investors’ sentiment, trading in the commodities market. United States of America is the major supplier of various commodities like WTI crude, Silver, and precious metals; amid Covid-19, demand for commodities has slumped mostly in the first quarter of 2020. The commodities market investor has become more fearful and anxious about the future prices of commodities; hence, they trade into futures and options written on the commodities. Chicago Board Options Exchange (CBOE) has introduced options on the Exchange Traded Fund (ETF) available and imitating underlying commodities’ prices. VIX is the implied volatility index, a

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registered trademark of CBOE, and an estimate of the near term (30-days) stock market volatility. \(^1\) The measure of investors’ behaviour expressed in percentage term is based on the option prices traded in real-time. To measure the investor’s fear and nervousness in the commodity market, CBOE has licensed the VIX methodology to apply on the most active six exchange-traded funds (ETF) specific to the commodities market. \(^2\) Why investors prefer options over the other hedge funds? – the reason is that options create options during the market ambiguity. It mitigates risks in a dwindling market and produces income in a flat market. Hence, options act like mini insurance policies, and with varied options strategy, investors can avail such protection against further falling market amid Covid-19.

The historic decline in the demand for Crude oil happened due to slower economic activity, international travel ban, lockdown, and geopolitics of crude oil among Saudi Arabia and Russia and OPEC’s role in Crude’s supply. The oil prices (Brent and WTI) in the first quarter of 2021 first time went under $20, and further US Shale producers were struggling to turn profitable (Ramkumar and Hodari, 2020). More recently, the market has experienced backwardation and contagion effects. Formerly, the commodities market (SPXGSCI) outperformed the equity market (SPX500), but still, commodities are facing contagion and effects. Formerly, the commodities market (SPXGSCI) outperformed the equity market (SPX500), but still, commodities are facing contagion and backwardation (Wallace, 2020). The WTI’s price to be delivered in May 2020 stood negative (-$5.33) a barrel on April 21, 2020; the clearing price also reaches -$37.63, which indicates that sellers must reward buyers for taking barrels off their hands. \(^3\) Unlike the equity and Crude oil market, Gold prices remain less volatile following the tail events. During the crisis and uncertainty period, Gold serves as the best hedge, a safe-haven with high liquidity and risk-adjusted best returns. WCG (2020) reports that Gold has performed much healthier as a tail hedge over the past 2 to 3 decades. There is a general wisdom that precious metals, such as Gold, deliver a reliable, effective hedge over the market uncertainties. In particular, Gold is a better performer during the risk-on environments while poor in risk-off environments. WCG (2020) further analyses that Gold and Silver are the real assets, unlike the financial assets and linked with the current inflationary environment and yield better returns during the crisis period—the plausible reason may be no credit risk and counterparty failure.

On the other hand, Silver inclines to be much more associated with the economy’s outlook than Gold, predominantly to the downside-market. The recent extraordinary rise of volatility (GVZ) in the -Gold market has been obsessed with massive closings across all assets and Covid-19 induced demand in the emerging markets. Gold’s future performance depends on the contagious effects of Covid-19, which may sleep into another global recession and existing business ecosystem –travel prohibitions, the shutdown of many industries, and equity market volatility. Investors’ choice as a safe-haven, Gold has proved that it’s a good source of liquidity and collateral for portfolio rebalancing. Gold, a precious metal, has been an attraction of the worlds’ major central banks to have excessive buying in the last two years. Gold is preferred over other asset classes—low opportunity cost, high return during an economic expansion, and resilient to risk and uncertainty.

The infectious disease outbreak event is one of the disappointing news for the investing community, past pandemic disease outbreak (e.g., 1918–20 influenza, HIV/AIDS, SARS, Ebola, Swine Flu) has not much impacted financial market as Covid-19. Markets are efficient (e.g., Fama et al., 1969; Malkiel and Fama, 1970; Fama, 1991), and asset prices

\(^1\) Refer ‘white paper on VIX’ https://www.cboe.com/micro/vix/vixwhite.pdf.

\(^2\) Refer ‘CBOE Extends Its Volatility Franchise: Applies VIX Methodology to Six Active ETFs’ http://ir.cboe.com/press-releases/2011-16-mar-2011b.aspx.

\(^3\) Caitlin Ostroff and Frances Yoon (2020) “U.S. Stocks Drop as Oil Market Shudders Dow falls more than 400 points; Brent crude drops to lowest level in 18 years” https://www.wsj.com/articles/global-stock-markets-dow-update-04-21-2020-11587443040.
The textual investigation shows that recent equity market volatility has exceeded the realized return volatility level of 1987, a global financial crisis in 2008–09, and the period of prodigious depression 1929–30. The authors have presented excellent work on infectious disease outbreaks such as Covid-19 consequences, and Covid-19 encouraged uncertainty. Recently, Al-Awadhi et al. (2020) also examine the effects of Covid-19 for the Chines equity market and show that growth in contagious disease outbreaks impacts the Chines equity market. Hence, our motivation for the work is to demonstrate the commodities market’s behaviour on the pandemic disease outbreak and Covid-19 induced uncertainty and its impact on the market participants in the commodities trading.

Section 1 discusses the introduction, theoretical background, and literature evidence, and Section 2 explains the data description and a preliminary assessment. Section 3 builds an empirical model and hypothesis. Section 4 presents results and discussion. Section 5 further extends the robustness check of the results, and Section 6 ends with a conclusion and practical implications.

2. Data sources and preliminary analysis

Commodities’ markets reaction to the pandemic disease outbreak Covid-19 has been studied concerning investors’ sentiment. Global commodities such as Crude oil, Gold, and Silver are traded in a large volume based on variants of futures, options, and exchange-traded funds. There have been many ETFs available across various asset classes; Gold and Silver are precious metals and remain the main attraction for portfolio planning investors. The study aims to measure investors’ behaviour expressed in terms of volatility index across various commodities traded globally. Hence, in our empirical analysis, we consider daily closing prices of the implied volatility index, i.e., OXV-Oil, GVZ-Gold, Silver-VXXSLV, and Energy-VXXLE and Mining as well (for more detail, see Appendix A). Our study is concerned about the effects of Covid-19 on the commodities market. We consider the daily growth of Covid-19 in the USA and China; these two countries share a large part of their trading, investments, and economic development. Covid-19 was declared an infectious pandemic disease and health emergency globally by the WHO on January 30, 2020. Our source for daily commodities prices is Bloomberg terminal, and Covid-19 data are available from the European Centre for Disease Prevention and Control. We set our estimation process for the sample period from April 2018 to April 2020 (Ichev and Marin 2018), in which Disease Outbreak News (DONs, Covid-19) event associated from December 31, 2019, to April 30, 2020. We also consider some uncertainty and control variables such as economic policy uncertainty (EPU), equity market uncertainty (EMU), SPXVIX and US T-bill, SPGSCI, WTI, and Brent prices.

Table 1 summarizes descriptive statistics in relation to our sample period across various asset classes of commodities. First, we look at the Crude and the Energy sector. The mean level of the United States Oil Fund (USO) appears to be 95.29 with an adverse annualized return of minuses 4.91% and an average level of market volatility of 42.10%. In line with the USO, the Energy sector also exhibited a similar pattern. Seeing the maximum record of the USO(XLE) prices, it seems 128.64 (78.91) with a peaked level of market volatility OXV(VXXLE) 325.15% (130.61%). More impressive when we compare with the equity market, SPX yield 0.21% annualized returns with a maximum VIX level of 82.29%. This tail event materialized first time in history after GFC. One of the crucial observations from the summary statistic is that the Gold market has remained less affected due to such pandemic disease outbreak news. In a comparison of the various asset classes, Gold and Gold miner stock has reported annualized positive returns with 0.70% and 1.13%, respectively. The extreme level of investors fear and panic in the commodity — Gold, it appears 49.97% (GVZ) and Gold miner (GDXUS) 26.49% (GDXUS) acts as safe-haven. Another most actively traded global commodity, Silver, also exhibited unique variation in price (14.93) and yield (~0.30%). The maximum level of investors concerns about Silver market volatility measured 100.66%, which is the highest historically. Now looking at the commodities market instability, Crude oil is seen with Std. Dev. = 34.70, and the second-highest found for the Energy sector 17.99, Gold, and Silver appear to be less volatile, among other commodities.

Table 2 exhibits summary statistics about the uncertainty index and growth indicators of Covid-19. The mean level of macroeconomic outlook (EPU) and equity market uncertainty (EMU) appeared respectively 125.04 and 86.72, but the maximum level reported highest for the equity market (944.58) with EPU (738.05). Moreover, we also consider a daily index of EMV tracked for the pandemic disease outbreak (IDMV). The average reading was found to be 3.81 with a maximum level (68.54) of media coverage in real-time; zero indicates no news reporting of infectious disease relevant to the financial market. The next panel of the table shows the pandemic development during the period December 30, 2019, to April 30, 2020, in terms of new confirmed cases of Covid-19 and new daily deaths. The average daily new cases in the US (8215.55) exceed China (727.81), along with the mean daily death in the US (507.27) and China (41.55). The maximum level of reporting of daily Covid-19 infections appears 37,289 for the US and 15,141 in China; it seems the rate is double in the US, and it also true for the number of mortality cases. Fig. 1 exhibits the temporal occurrence of contagious disease outbreaks in the US and China. Further, it shows the infectious disease (IDs) market volatility (MV) tracker appears with several spikes starting from December 30, 2019, and ends the first quarter of 2020. This phenomenon has been documented through

### Table 1

| Crude oil       | Energy sector | Equity market |
|-----------------|---------------|---------------|
| USOUS           | XLEUS         | SPX           |
| RUSOUS          | RLLEUS        | RSPX          |
| OXV             | VXXLE         | VIX           |
| Mean            | 95.2872       | 62.7259       | 2866.6870 |
| Maximum         | 128.6400      | 78.9100       | 3386.1500 |
| Minimum         | 17.0400       | 23.5700       | 2237.4000 |
| Std. Dev.       | 19.8470       | 11.2156       | 203.9297  |
| Observations    | 542           | 542           | 542       |
| Gold            | Gold miner    | Silver        |
| GLDUS           | GDXUS         | SLVUS         |
| RGLDUS          | RGDXUS        | RSLVUS        |
| GZV             | VXGDX         | VXSLV         |
| Mean            | 129.8819      | 23.8604       | 14.9349   |
| Maximum         | 163.3400      | 34.0300       | 18.3400   |
| Minimum         | 111.1000      | 17.7500       | 11.2100   |
| Std. Dev.       | 13.1497       | 5.8415        | 1.2022    |
| Observations    | 542           | 542           | 542       |

* - indicate an annualized return in percentage.
Table 3 present the correlation matrix between Covid-19 induced uncertainty and the commodities market. By conventions, it seems that greater uncertainty lowers the market performance measured in terms of benchmark stock and commodities indices. Hence, uncertainty and asset prices are adversely associated, and it is quite apparent from Table 3, the degree of association appears negative and statistically significant.

Further, we can see that the precious metal Gold and Gold miners stock exhibited a positive association during the market uncertainty. It also confirms that Gold acts as a safe-haven during crisis and market boom as well. Table 4 demonstrates the correlation between the most popular commodities’ volatility index and uncertainty indicators. By conventions, the higher the uncertainty greater is the market volatility. It is clearly visible that most of the volatility index yields a positive and
VOLINDX = index of volatility for various commodities

\[ \text{VOLINDX} = \alpha_0 + \alpha_1 \text{Index} + \alpha_2 COVID_{US-1} + \alpha_3 COVID_{CH-1} + \alpha_4 COVID_{EU-1} + \alpha_5 COVID_{US-1} + \alpha_6 COVID_{CH-1} + \alpha_7 COVID_{EU-1} + \epsilon \]

where \( \text{Index} \) represents the index of various commodities, \( \text{COVID}_{US-1} \) is the number of confirmed cases in China, \( \text{COVID}_{CH-1} \) is the number of confirmed cases in China, and \( \text{COVID}_{EU-1} \) is the number of confirmed cases in Europe.

**Table 3**

| USD | XLE | GLD | GDX | SLV | SPX | SPGSCI | WTI | Brent |
|-----|-----|-----|-----|-----|-----|---------|-----|-------|
| EPU | -0.805 * | -0.749 * | 0.516 * | 0.292 * | -0.218 * | -0.273 * | -0.802 | -0.793 * | -0.789 * |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| EMU | -0.716 * | -0.746 * | 0.465 * | 0.225 * | -0.174 * | -0.258 * | -0.739 | -0.698 * | -0.730 * |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| VIX | -0.775 * | -0.797 * | 0.421 * | 0.112 b | -0.317 * | -0.443 * | -0.789 | -0.761 * | -0.783 * |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| IDs | -0.768 * | -0.797 * | 0.534 * | 0.242 * | -0.221 * | -0.230 * | -0.784 | -0.755 * | -0.782 * |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Covid-19 | -0.749 * | -0.464 * | 0.764 * | 0.508 * | -0.416 * | -0.329 * | -0.673 | -0.721 * | -0.665 * |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Table 4:

| OVX | VXXLE | GVZ | VXGDX | VXSLL |
|-----|-------|-----|-------|-------|
| EPU | 0.872 * | 0.814 * | 0.811 * | 0.818 * | 0.806 * |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| EMU | 0.704 * | 0.804 * | 0.766 * | 0.771 * | 0.725 * |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| VIX | 0.824 * | 0.979 * | 0.898 * | 0.920 * | 0.859 * |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| IDs | 0.845 * | 0.931 * | 0.900 * | 0.888 * | 0.853 * |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Covid-19 | 0.665 * | 0.310 b | 0.345 * | 0.359 * | 0.360 * |
| p-value | 0.000 | 0.003 | 0.001 | 0.001 | 0.001 |

Significant at *1%, **5%, ***10% level.

3. Methodology and hypothesis framework

Fear of the infectious disease Covid-19 has shocked the world’s commodity markets and raised great concern over economic uncertainty and recession globally. This empirical work examines investors’ unprecedented overreaction in the commodities market across the Crude oil, Gold, Gold Mining, Silver, and Energy sector in the USA. There are many prominent studies (e.g., Chen et al., 2007; Chen et al., 2009; and Wang et al., 2013) dig into the likely impact of infectious diseases on the commodity market volatility tracker (MV) calculated by Baker et al. (2019a,b,c). One can see that ISMV was proliferating post-February 2020 and reached its peak level during April 2020.

4. Results and discussions

Table 5 shows the Crude oil market’s regression outcome amid Covid-19 —expressed in terms of investors’ sentiment index OVX. The oil volatility index is calculated in real-time based on the USO ETF options. OVX is the most important measure of oil price volatility. It shows investors’ fear and worries specific to trade in the variety of crude oil. The global Crude oil prices traded between $20 to $150 from 1999 to 2016. Still, recently Crude was hovering between $40-$60 and further in near-term futures contract traded below zero, the reason lack of liquidity, high transaction costs, and constrained storage. For the first time in history during 2007–2008, Crude traded more than $150, but recent pandemic drawdown the Crude at its low level. The Crude demand is subject to oil and petroleum products and the geological and uncontained nature of economic outlook; it should appear positive and significant. **Underlying = returns calculated corresponding to each underlying asset on which options are written, the associated coefficient should appear negative and statistically significant, by underling convention assets and commodities’ volatility are inversely related. COVID_{US-1} = number of confirmed cases of Covid-19 in the US, it’s expressed as an index and one-period lag, the index is calculated by taking a log of (1+ new confirmed cases) (e.g., Eckstein and Tsiddon, 2004; Persitz, 2006), similarly it’s calculated for other indicators of Covid-19. COVID_{CH-1} = number of confirmed cases in China, the main epicenter of the virus outbreak is the Wuhan city of China, encompassing Covid-19 because investors regard the news related to the pandemic, and China is one of the strategic trading partners of the US. U_t = is the vector of variables indicating outlook of macroeconomy of the US, its economic policy uncertainty (EPU), equity market policy uncertainty (EMU), SPVXIX, here we take the log of the EPU and other uncertainty variables with one-period lag. The coefficient on the U_t should increase investors’ fear and panic in the commodities market; hence it should be positive and statistically significant. X_{t-1} = is the vector of other control variables that influence the trading into the commodities market, e.g., S&P GSCI, WTI Crude oil, Brent Crude oil, US T-bill. D_t = is the dummy variable created to measure the DONs period, and to know what was the response of various commodity market-specific during the infectious disease outbreak, e.g., it assumes 1 for January 2020 otherwise zero. Here, \epsilon_t, \epsilon', and \epsilon'' are the classical white noise process and meets the requirement of OLS estimation.

\[ (1) \] uncover effects of the growth of the Covid-19 outbreak on the various classes of commodities measured in terms of implied volatility index. \[ (2) \] is an augmented regression model expressed in terms of interaction dummy variables; this specification measures the likely impact of Covid-19 during the DONs period, i.e., through January, February, March, and April 2020. Further, \[ (3) \] modified from eq. (2) to analyze effects of Covid-19 induced uncertainty in the commodities markets. In particular, our empirical hypothesis is that ‘there is an adverse impact of Covid-19 induced uncertainty in the commodities markets’.
geopolitical conditions among the major oil producer countries. Crude price volatility depends on future demand and supply of the Crude, and hardly short-run dynamics affect crude demand and supply, but the first time in history due to pandemic outbreak, Crude trade low in the near term. The recent disease outbreak news has triggered Crude price fluctuation among the top five Crude traded globally. Due to Covid-19 economic activity and the consumption of petroleum products has decayed significantly. Consequently, there has been a decline of about 24% in Crude refining activity in the first quarter of 2020.

EIA (US Energy Information Administration) (2020) presents some insights into Crude oil prices’ major driver. Geopolitical and economic events have played the main role in driving crude prices globally. For
example, Crude traded between $20-$76 from 1970 to 1985 following US spare capacity, Arab Oil-price Embargo, the Iranian revolution, Iran-Iraq War, and Saudis abandon. And from 1985 to 2015, Crude appeared around $20-$125 with many geopolitical events like the Asian crisis, 9/11 terrorist attacks, GFC, and more recently, Crude hovered from $40-$68 after 2015 due to the OPEC production quota. For the first time in history, Covid-19 induced uncertainty has disrupted the Crude's entire supply chain, and global Crude has traded at its lower level during
Table 5
Crude oil market volatility and Covid-19.

| Panel A: OVX and Covid-19 |
|---------------------------|
| Regressor                  | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
| Intercept                 | 3.7865   | 42.59a | 3.7736   | 44.46a | 3.6743   | 9.68a  | 2.9642   | 12.14a | 5.2528   | 11.84a |
| RUSO                       | -5.1250  | -1.96a | -4.8507  | -1.93a | -5.5874  | -2.08b | -5.2872  | -1.96b | -4.6737  | -2.05b |
| COVIDUS                   | 0.1966   | 3.22a  |          |        |          |        |          |        |          |        |
| COVIDCH                   | 3.35E-05 | 6.38a  |          |        |          |        |          |        |          |        |
| EPU                       | 0.0339   | 0.30   |          |        |          |        |          |        |          |        |
| EMU                       | 0.2290   | 3.51a  |          |        |          |        |          |        |          |        |
| USTBILL                   | 1.1213   | -7.00a |          |        |          |        |          |        |          |        |
| SPREAD                    | 0.1762   | 5.19a  |          |        |          |        |          |        |          |        |
| Panel B: OVX and DONs period |
| Regressor                  | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
| Intercept                 | 3.7893   | 42.46a | 3.7979   | 42.21a | 39.4218  | 14.98b | 36.6937  | 17.60a | 3.7884   | 42.50a |
| RUSO                       | -4.9638  | -1.92a | -5.05    | -1.92a | -3.0567  | -1.80b | -2.4381  | -1.77a | -4.8574  | -1.88c |
| COVIDUS*DJAN20             | 0.9484   | 6.01a  | 0.14     | 3.22a  | 0.8364   | 4.99a  | 0.4121   | 7.16a  | 0.1677   | 2.48b  |
| COVIDUS*DFEB20             |          |        |          |        |          |        |          |        |          |        |
| COVIDUS*DAPR20             |          |        |          |        |          |        |          |        |          |        |
| COVIDUS*DQ120              |          |        |          |        |          |        |          |        |          |        |
| SPREAD                    | 0.1777   | 5.25   |          |        |          |        |          |        |          |        |
| Panel C: OVX and economic policy uncertainty |
| Regressor                  | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
| Intercept                 | 3.7904   | 42.40a | 3.7906   | 42.26a | 39.5939  | 14.90b | 36.6162  | 17.53a | 3.7877   | 42.47a |
| RUSO                       | -5.5607  | -2.08a | -5.1689  | -1.97a | -3.1180  | -1.85b | -2.5085  | -3.35a | -5.1335  | -1.96c |
| COVIDUS*DJAN20*EPU         | 0.2941   | 10.48a | 0.0345   | 4.40a  | 0.0153   | 5.47a  | 0.0672   | 7.07a  | 0.0378   | 3.48a  |
| COVIDUS*DFEB20*EPU         |          |        |          |        |          |        |          |        |          |        |
| COVIDUS*DAPR20*EPU         |          |        |          |        |          |        |          |        |          |        |
| COVIDUS*DQ120*EPU          |          |        |          |        |          |        |          |        |          |        |
| SPREAD                    | 0.1864   | 5.48a  |          |        |          |        |          |        |          |        |
| Panel D: OVX and equity market uncertainty |
| Regressor                  | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
| Intercept                 | 3.7920   | 42.32a | 3.7906   | 42.17a | 39.5001  | 14.93b | 36.5781  | 17.57a | 3.7888   | 42.37b |
| RUSO                       | -5.6837  | -2.07a | -5.1839  | -1.97b | -3.0917  | -1.82b | -2.6037  | -3.68a | -5.1668  | -1.97b |
| COVIDUS*DJAN20*EMU         | 0.1966   | 9.41a  | 0.0277   | 5.14a  | 0.0164   | 5.47a  | 0.0750   | 6.88a  | 0.0305   | 3.76a  |
| COVIDUS*DFEB20*EMU         |          |        |          |        |          |        |          |        |          |        |
| COVIDUS*DAPR20*EMU         |          |        |          |        |          |        |          |        |          |        |
| COVIDUS*DQ120*EMU          |          |        |          |        |          |        |          |        |          |        |
| USTBILL                    |          |        |          |        |          |        |          |        |          |        |
| SPREAD                    | 0.1863   | 5.48a  |          |        |          |        |          |        |          |        |

The table shows the regression results of eqs. (1)–(3) concerning Covid-19 induced uncertainty in the Crude oil market, regression estimates are consisting of autocorrelation and heteroskedasticity (HAC- Newey-West), Significant at *1%, **5%, ***10% level).

Pandemic development. Further, the demand for petroleum products, slower economic growth, non-OPEC production, and Saudi Arabia oil production remained the main determinant of the global crude prices.

Table 5 exhibits investors’ sentiment in the crude oil market amid the Covid-19 outbreak and uncertainty induced by pandemic development. First, looking at the slope of the COVIDUS, it appears positive and statistically significant at a 1% level. The coefficient linked to COVIDCH was also found to be positive and significant. It implies that the growth of the Covid-19 cases in the US and China does impact future oil market volatility. In order to hedge oil market uncertainty, investors, buy options, and put-options act as insurance against a large fall of oil prices. An excess demand for put-option leads to a rise of premiums. Higher the premium resulting implied volatility of OVX will be higher, and one can see the maximum level of OVX found to be about 325%. The unprecedented rise of the OVX signifies the overreaction of the market participants concerning the commodities prices. Now referring to the slope of uncertainty factors associated with the macroeconomy and equity market, the respective estimates for EPU and EMU found to be positive. Still, only equity market uncertainty contributes to a significant rise in the level of OVX. The future level of oil market volatility is directly associated with the underlying’s performance, i.e., prices of USO fund and short-term interest rates. One can see that yield associated with USO and USTBILL appears to be negative and statistically significant. It indicates that volatility and returns are negatively associated; a negative return or yield causes a rise in the volatility; this phenomenon is further supported by the volatility feedback and leverage effects hypothesis. In our regression specification, we also add one of the control variables, ‘spread,’ it’s a difference between two benchmarks of the Crude oil traded globally, i.e., WTI and Brent. We can see that across all panels of Table 5, it appears positive and statistically significant, indicate that the higher the degree of spread, the higher the level of future OVX. Panel B depicts the investors’ fear and panic during the disease outbreak news (DONs) period; we set dummy variables for the first four calendar months and jointly for the first quarter of 2020. One can see that the spread of Covid-19 infection in the US through January–April 2020 has impacted the Crude oil market adversely. The significant positive estimate indicates that there has been an unparalleled rise in oil price volatility during the first quarter of 2020. Panel C and D shows the augmented regression results of the Covid-19 induced EPU and EMU. We can see that all estimates appear positive and statistically significant. It implies that the macroeconomy and equity market’s contagious pandemic-related uncertainty does explain the sentiment in the
commodities market (e.g., (Baker et al., 2019a,b,c; Baker et al., 2020b; Shaikh, 2020). It is also due to the volatility feedback effects; the decline in the stock price eventually results in a rise in market volatility.

Table 6 shows the behaviour of the investors’ sentiment who trade into the Energy sector; XLE trails a market-cap-weighted index of US Energy firms in the SPX500. XLE provides absolutely liquid exposure to a basket of US energy firms. CBOE writes options on the XLE fund in order to provide Energy sector insurance to investors trading in the Energy market. VXXLE is the overall indicator of investor fear and nervousness in the energy sector; March 16, 2020, it appeared with the highest about 169% level, indicating extreme concern of the market participants about the energy stocks. Panel A clearly shows that the energy sector has an impact due to Covid-19 growth in the US and China. XLE provides absolutely liquid exposure to a basket of US energy firms. CBOE writes options on the XLE fund in order to provide Energy sector insurance to investors trading in the Energy market. VXXLE is the overall indicator of investor fear and nervousness in the energy sector; on March 16, 2020, it appeared with the highest about 169% level, indicating extreme concern of the market participants about the energy stocks. Panel A clearly shows that the energy sector has an impact due to Covid-19 growth in the US and China.

Energy market. VXXLE is the overall indicator of investor fear and nervousness in the energy sector; on March 16, 2020, it appeared with the highest about 169% level, indicating extreme concern of the market participants about the energy stocks. Panel A clearly shows that the energy sector has an impact due to Covid-19 growth in the US and China.

Table 6
Energy sector market volatility and Covid-19.

Panel A: VXXLE and Covid-19

| Regressor | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
|-----------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|
| Intercept | 3.9060   | 106.69 | 3.0428   | 155.14 | 1.2384   | 3.74   | 2.3101   | 17.30  | 3.8777   | 19.93  | 2.1421   | 9.88   |
| RXLE      | -3.6139  | -2.67  | -1.0674  | -1.67  | -2.4786  | -2.16  | -1.5628  | -1.23  | -1.7598  | -1.41  | -1.5956  | -2.31  |
| COVIDUS   | 4.84E-05 | 10.75  | 1.36E-05 | 7.98   | 0.4190   | 5.58   | 0.2222   | 5.46   | 0.0000   | 0.05   | 0.0925   | 0.85   |
| COVIDCH   |         |        |          |        |          |        |          |        |          |        |          |        |
| EPU       |         |        |          |        |          |        |          |        |          |        |          |        |
| USTBILL   |         |        |          |        |          |        |          |        |          |        |          |        |
| RSPGSCI   |         |        |          |        |          |        |          |        |          |        |          |        |

Panel B: VXXLE and DONs period

| Regressor | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
|-----------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|
| Intercept | 3.1612   | 74.54  | 3.1552   | 74.03  | 3.1441   | 83.29  | 3.1200   | 87.76  | 3.1441   | 83.29  | 3.7966   | 20.15  |
| RXLE      | -2.0770  | -1.11  | -1.9291  | -1.00  | -2.4743  | -1.48  | -2.9753  | -1.79  | -2.4740  | -1.48  | -2.0640  | -1.81  |
| COVIDUS*DJAN20 | -0.0333 | -2.47 | - | 1.71E-05 | 3.69 | | 1.62E-06 | 5.65 | 1.71E-05 | 3.69 | 1.14E-05 | 2.90 |
| EPU       |         |        |          |        |          |        |          |        |          |        |          |        |
| USTBILL   |         |        |          |        |          |        |          |        |          |        |          |        |
| RSPGSCI   |         |        |          |        |          |        |          |        |          |        |          |        |

Panel C: VXXLE and economic policy uncertainty

| Regressor | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
|-----------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|
| Intercept | 3.1611   | 74.56  | 3.1552   | 74.07  | 3.1438   | 83.44  | 3.1201   | 87.77  | 3.1438   | 83.44  | 3.7944   | 20.14  |
| RXLE      | -2.0795  | -1.11  | -1.9284  | -1.00  | -2.4755  | -1.48  | -2.9799  | -1.79  | -2.4753  | -1.48  | -2.0662  | -1.82  |
| COVIDUS*DJAN20*EPU | -0.0075 | -2.25 | 2.84E-06 | 3.85 | 2.59E-07 | 5.65 | 1.89E-06 | 3.00 | 0.2835 | -3.87 | -3.2479 | -2.31 |
| COVIDUS*DJAN20*EPU | 0.0148 | 1.92 | 2.84E-06 | 3.85 | 2.59E-07 | 5.65 | 1.89E-06 | 3.00 | 0.2835 | -3.87 | -3.2479 | -2.31 |
| RSPGSCI   |         |        |          |        |          |        |          |        |          |        |          |        |

Panel D: VXXLE and equity market uncertainty

| Regressor | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
|-----------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|
| Intercept | 3.1610   | 74.56  | 3.1552   | 74.24  | 3.1430   | 83.82  | 3.1203   | 87.82  | 3.0430   | 63.32  | 3.7990   | 20.01  |
| RXLE      | -2.0765  | -1.10  | -1.9199  | -1.00  | -2.4642  | -1.48  | -3.0157  | -1.82  | -2.2639  | -2.38  | -2.4823  | -1.85  |
| COVIDUS*DJAN20*EMU | -0.0066 | -2.61 | 3.12E-06 | 4.03 | 2.86E-07 | 5.19 | 3.12E-06 | 5.03 | 2.30E-06 | 3.32 | -0.2846 | -3.84 |
| COVIDUS*DJAN20*EMU | 0.0013 | 2.35 | 3.12E-06 | 4.03 | 2.86E-07 | 5.19 | 3.12E-06 | 5.03 | 2.30E-06 | 3.32 | -0.2846 | -3.84 |

The table shows the regression results of eqs. (1)-(3) concerning Covid-19 induced uncertainty in the Energy sector, regression estimates are consisting of autocorrelation and heteroskedasticity (HAC- Newey-West), Significant at *1%, **5%, ***10% level).
often a negotiation among the exciting protection and cost. Gold returns tend to outperform during the great recession, sovereign debt crises i&I, a pullback of 2018, but first time in history, Gold yield negative returns in the short-run amid the Covid-19 crisis. Gold has been a precious metal as a safe-haven and can optimize the portfolio. Hiller et al. (2006) analyze the relationship between the equity market and precious metals investment like Gold, Platinum, and Silver. The authors report a low relationship and statistically not significant. Further, Conover et al. (2009) experiment with the investment in precious metals that enhances the portfolio hedge and improved returns. The authors argue that moving for a 5%-25% allocation of the investment in precious metals results in a noticeable portfolio performance improvement. Further they deliberate that ETFs and ETNs in the commodities market provide enhanced distribution of equity investment. GVZ gold volatility index is based on the GLD ETF funds and represents the investors’ worries about the future uncertainty in gold trading. Panel A of Table 7 clearly exhibits that Covid-19 induced uncertainty impacted the investors’ sentiment. Further, one can see returns of SPGSCI, a broad commodities index, do not explain gold volatility significantly. Albeit, the short-term interest rate entirely responsible for the increased level of volatility in the gold market. Panel B uncovers that February, March, and April 2020 remain more volatile for the gold prices amid of Covid-19 outbreak in China and the USA. There has been a decrease of around 40% in demand for bullion. It is for the emerging markets, including China and India (WCG, 2020), during the first quarter of 2020. Panel C and D clearly show that economic uncertainty and equity market uncertainty matter for the increased level of volatility in the gold market significantly.

Table 7 discusses investors’ sentiment within the outbreak of pandemic Covid-19 in the Gold miners’ companies traded in the GDX ETF funds. Gold Miners ETF pursues to imitate the inclusive

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### Table 7

**Gold market volatility and Covid-19.**

#### Panel A: GVZ and Covid-19

| Regressor | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
|-----------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|
| Intercept |          |        |          |        |          |        |          |        |          |        |
| RGLD      | 2.5152   | 102.51 | 2.4724   | 140.66 | 1.1712   | 5.10   | 1.9759   | 19.81  | 3.0388   | 60.52  |
| COVIDUS   | 1.2251   | 0.38   | 1.9787   | 1.49   | 0.7146   | 0.31   | 1.5124   | 0.63   | 1.8491   | 1.30   |
| COVIDUS6-5 | 3.31E-05| 10.69  | 9.80E-06 | 8.47   | -2.6E-07 | -0.05 | 4.03E-06 | 2.28   | 0.0352   | 5.77   |
| EPU       |          |        |          |        |          |        |          |        | 0.1521   | 4.99   |
| EMU       |          |        |          |        |          |        |          |        | 0.0162   | 1.41   |
| USTBILL   |          |        |          |        |          |        |          |        | -0.6306  | -11.81 |
| RSPGSCI   |          |        |          |        |          |        |          |        | -0.8586  | -1.38  |

#### Panel B: GVZ and DONs period

| Regressor | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
|-----------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|
| Intercept |          |        |          |        |          |        |          |        |          |        |
| RGLD      | 2.8274   | 0.80   | 2.9497   | 0.83   | 3.0692   | 0.92   | 1.3231   | 0.38   | 3.0697   | 0.92   |
| COVIDUS   | 0.0201   | 3.00   |          |        |          |        |          |        | 1.9895   | 1.40   |
| COVIDUS6-5 | 8.07E-05| 4.52   |          |        |          |        |          |        | 2.95E-05 | 17.62  |
| COVIDUS6-5 |          |        |          |        |          |        |          |        | 8.07E-05 | 4.52   |
| COVIDUS6-5 |          |        |          |        |          |        |          |        | 3.21E-05 | 2.61   |
| COVIDUS   |          |        |          |        |          |        |          |        | -0.5961  | -12.34 |
| COVIDUS   |          |        |          |        |          |        |          |        | -0.8043  | -1.29  |

#### Panel C: GVZ and economic policy uncertainty

| Regressor | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
|-----------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|
| Intercept |          |        |          |        |          |        |          |        |          |        |
| RGLD      | 2.5573   | 80.91  | 2.5558   | 80.96  | 2.5435   | 89.49  | 2.5247   | 92.60  | 2.5435   | 89.49  |
| COVIDUS   | 2.8253   | 0.80   | 2.9406   | 0.83   | 2.9805   | 0.90   | 1.3062   | 0.37   | 2.9808   | 0.90   |
| COVIDUS6-5 | -0.0110 | -1.60  |          |        |          |        |          |        | 1.9553   | 1.38   |
| COVIDUS   | 0.0040   | 3.06   |          |        |          |        |          |        | 1.9553   | 1.38   |
| COVIDUS   | 1.30E-05 | 4.70   |          |        |          |        |          |        | 1.30E-05 | 4.70   |
| COVIDUS   | 4.71E-06 | 18.32  |          |        |          |        |          |        | 5.19E-06 | 2.69   |
| COVIDUS   |          |        |          |        |          |        |          |        | -0.9599  | -12.33 |
| COVIDUS   |          |        |          |        |          |        |          |        | -0.8061  | -1.29  |

#### Panel D: GVZ and equity market uncertainty

| Regressor | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
|-----------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|
| Intercept |          |        |          |        |          |        |          |        |          |        |
| RGLD      | 2.5572   | 80.94  | 2.5559   | 81.01  | 2.5431   | 89.82  | 2.5247   | 92.60  | 1.4431   | 69.82  |
| COVIDUS   | 2.8310   | 0.80   | 2.9351   | 0.83   | 2.8206   | 0.86   | 1.2866   | 0.37   | 3.8661   | 0.76   |
| COVIDUS   | -0.0057  | -1.43  |          |        |          |        |          |        | 1.7101   | 1.19   |
| COVIDUS   | 0.0034   | 3.16   |          |        |          |        |          |        | 1.7101   | 1.19   |
| COVIDUS   | 1.39E-05 | 4.76   |          |        |          |        |          |        | 2.23E-05 | 5.56   |
| COVIDUS   | 5.25E-06 | 18.64  |          |        |          |        |          |        | 5.87E-06 | 2.84   |
| COVIDUS   |          |        |          |        |          |        |          |        | -0.5966  | -12.22 |
| COVIDUS   |          |        |          |        |          |        |          |        | -0.7776  | -1.42  |

The table shows the regression results of eqs. (1)-(3) concerning Covid-19 induced uncertainty in the Gold market, regression estimates are consisting of autocorrelation and heteroskedasticity (HAC- Newey-West), Significant at *, **, *** level.
Gold miners market volatility and Covid-19.

| Panel A: VXGDX and Covid-19 | [1] | [2] | [3] | [4] | [5] | [6] |
|-----------------------------|-----|-----|-----|-----|-----|-----|
| Regression                  | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
| Intercept                   | 3.7570 | 38.25* | 3.7278 | 40.32* | 4.5098 | 6.69* | 3.0228 | 10.04* | 4.9692 | 12.61* | 5.7245 | 7.72* |
| RGDX                        | 0.2023 | 0.07 | 0.7871 | 0.28 | 1.1663 | 0.39 | 0.4272 | 0.15 | 0.6377 | 0.24 | 1.1965 | 0.46 |
| COVIDUS                     | 1.61E-01 | 6.53* | -1.93E-02 | -0.81 | 2.73E-05 | 4.25* | -0.4428 | -3.08* | 0.1649 | 2.36* | -0.7510 | -1.87* |
| COVIDUS/DJAN20              | 0.1840 | 2.98* | 0.1365 | 15.01* | 0.0206 | 2.49* | -0.3382 | -0.76 | -1.2449 | -0.31 |                      |     |
| COVIDUS/DMAR20              |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| COVIDUS/DAPR20              |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| COVIDUS/DQ120               |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| Panel B: VXGDX and DONs period | [1] | [2] | [3] | [4] | [5] | [6] |
| Regression                  | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
| Intercept                   | 3.7728 | 37.59* | 3.7672 | 38.13* | 3.7799 | 37.46* | 29.0448 | 24.77* | 3.7570 | 38.25* | 4.8249 | 12.19* |
| RGDX                        | 1.3222 | 0.44 | 1.5742 | 0.53 | -0.3425 | -0.11 | -10.7167 | -0.26 | 0.2023 | 0.07 | 0.2737 | 0.10 |
| COVIDUS/DSFEB20             | 0.0830 | 4.98* |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| COVIDUS/DQ20*EMU            | 0.1840 | 2.98* | 0.1365 | 15.01* | 0.0013 | 19.15* | 0.1610 | 6.53* | 0.1031 | 3.98* | -1.2423 | -2.78* |
| Panel C: VXGDX and economic policy uncertainty | [1] | [2] | [3] | [4] | [5] | [6] |
| Regression                  | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
| Intercept                   | 3.7720 | 37.60* | 3.7678 | 38.09* | 3.7799 | 37.46* | 29.0452 | 24.76* | 3.7581 | 38.18* | 4.8315 | 12.18* |
| RGDX                        | 1.3376 | 0.45 | 1.5228 | 0.52 | -0.3487 | -0.11 | -12.1687 | -0.29 | 0.1379 | 0.05 | 0.2348 | 0.09 |
| COVIDUS/DQAN20/EPU          | 0.2704 | 5.30* |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| COVIDUS/DFEB20/EPU          | 0.0363 | 3.04 |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| COVIDUS/DMAR20*20*EMU       | 0.0274 | 14.90* |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| COVIDUS/DAPR20*20*EMU       |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| COVIDUS/DQ120*20*EMU        |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| Panel D: VXGDX and equity market uncertainty | [1] | [2] | [3] | [4] | [5] | [6] |
| Regression                  | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat | Estimate | t-stat |
| Intercept                   | 3.7739 | 37.58* | 3.7691 | 37.98* | 3.7708 | 37.46* | 29.0488 | 24.76* | 3.7589 | 38.10* | 4.8422 | 12.18* |
| RGDX                        | 1.2836 | 0.43 | 1.4476 | 0.49 | -0.5321 | -0.11 | -12.5544 | -0.30 | 0.2267 | 0.08 | 0.3728 | 0.14 |
| COVIDUS/DQAN20*EMU          | 0.1699 | 6.08* |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| COVIDUS/DFEB20*EMU          | 0.0288 | 3.37* |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| COVIDUS/DMAR20*EMU          | 0.0250 | 14.94* |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| COVIDUS/DAPR20*EMU          |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| COVIDUS/DQ120*EMU           |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| USST BILL                   |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| RSPGSCI                     |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |

The table shows the regression results of eqs. (1)-(3) concerning Covid-19 induced uncertainty in the Gold miners’ stock, regression estimates are consisting of autocorrelation and heteroskedasticity (HAC- Newey-West), Significant at [1]*%, [5]*%, [10]*% level.

The performance of firms tangled with the gold mining business as strictly as possible. CBOE allowed to introduced options on the GDX fund to provide market safeguarded against the gold mining business’s uncertainty. VXGDX is the GDX options based real-time gold miner’s volatility index that expresses investors’ anxiety and fear in the near term. Foster (2020), a portfolio manager, deliberate on the gold mining stocks’ investment that helps in risk-off-positioning, panic increased market momentum, and liquidity for meeting margin calls. Gold has performed as a hedge against both the turmoil and the inflation that might ultimately come from Federal policies and buying and selling treasuries and mortgage-backed securities. The unprecedented rise of the premium in the options market leads to an increase of the Gold mining volatility VXGDX; Gold mining has come across a fringe effect so far from the pandemic. Still, for the first time in history, the investors’ panic peak was found to be about 190% on March 19, 2020. Panel A of Table 8 exhibits that pandemic Covid-19 growth in the US and China impact the gold mining business. Nonetheless, one can see that uncertainty of the Fed’s policy actions during the pandemic period does not explain investors’ sentiment trading in the gold market. But equity market uncertainty significantly impacts the future level of the gold miner stock volatility. The investors’ response about short-term interest rates was adverse and significant, while gold miners’ stock volatility remains unresponsive to the other commodities’ trading (RSPGSCI). Panel B depicts the effects of Covid-19 growth during the first quarter on the gold miners’ stocks, and it’s apparent that there has been a pronounced effect of pandemic outbreak on the gold mining stock volatility. Panel C and D also exhibits that the economy’s economic outlook in the short run and equity market uncertainty matter for the gold miners. One of the important observations is that gold miners’ stock and equity market returns have weak associations; gold mining stocks are independent of...
equity market performance. Naeem et al. (2020) report no interdependence between BRICS equity markets and commodities like Gold and oil with a short horizon. Considering the global financial crisis, but asymmetric interdependence exists in the long run. Similarly, Morema and Bonga-Bonga (2020) examine volatility spillover between commodity and South African equity markets and find significant spillover among Oil(Gold) and stock markets. Hence, empirical evidence presented here provides important insight into portfolio optimization; a risk-averse investor can minimize and avoid the equity markets’ uncertainty by investing in gold miners’ stocks.

Table 9 displays the measurement of investors’ fear and panic in one of the precious metal Silver during pandemic development. SLV is an iShares Silver Trust that tracks the Silver spot price, after adjusting for the expenses and liabilities, utilizing silver bullion held in London. SLV has remained the main attraction for bullion investment because it provides exposure to meet daily fluctuation in the price of Silver, cost-effective, and convenient, and acts as the best hedge against inflation. CBOE introduces SLV ETF options to provide protections to the market player to meet bullion market uncertainty in the short-run. VXSLV is the real-time Silver market volatility index measures the future market volatility of trading into Silver. Khazza (2020) reports the ‘Fear—COVID-19’ on the bullion market, stock market crash, and the global credit crunch lead to investors and fund managers to settle their market holdings, together with bullion, in order to encounter margin calls and uphold their positions. The author deliberate there is a fear of stagflation in the market in the long run amid Covid-19 and the Fed’s recent actions’ ambiguity. There has been a first time in history a peak of investors fears in the Silver market found to be about 114% on March 18, 2020. Besides, Sappor et al. (2020) and Rodwell (2020) explain the impacts of COVID-19 on Metals Prices and Volatility and further report that Silver prices reach the lowest in 11 years due to lack of inter-industry demand and negative yields on the government bonds. To combat such market uncertainty bullion traders, buy put-options. The higher the demand, the higher the premium will be and which results in higher implied volatility. Recent pandemic development holds a severe impact on the future production of precious metals and mining

### Table 9
Silver market volatility and Covid-19.

#### Panel A: VXSLV and Covid-19

| Regressor | [1] Intercept | t-stat | Estimate | t-stat | [2] Intercept | t-stat | Estimate | t-stat | [3] Intercept | t-stat | Estimate | t-stat | [4] Intercept | t-stat | Estimate | t-stat | [5] Intercept | t-stat | Estimate | t-stat | [6] Intercept | t-stat | Estimate | t-stat |
|-----------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|
| RSLSV     | -2.9596      | -0.47  | 0.6226   | 0.47   | -1.1121      | -0.59  | -0.4169  | -0.20  | -0.0020      | -0.13  | 5.13E-06   | 0.77   | 3.96E-06   | 1.57   | 0.0505   | 1.37   | 0.1445      | 0.17   | 4.54     | 0.0157 | 0.52         |
| RSLSV     | 3.52E-05     | 11.12  | 9.60E-06 | 6.69E-01| 0.3000       | 5.11E-01| 0.1470   | 4.54E-01| 0.0157       | 1.52   | 0.3265    | 4.26E-01| 0.3440    | 0.52   |

#### Panel B: VXSLV and DONs period

| Regressor | [1] Intercept | t-stat | Estimate | t-stat | [2] Intercept | t-stat | Estimate | t-stat | [3] Intercept | t-stat | Estimate | t-stat | [4] Intercept | t-stat | Estimate | t-stat | [5] Intercept | t-stat | Estimate | t-stat | [6] Intercept | t-stat | Estimate | t-stat |
|-----------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|
| RSLSV     | -2.9596      | -0.47  | 0.6226   | 0.47   | -1.1121      | -0.59  | -0.4169  | -0.20  | -0.0020      | -0.13  | 5.13E-06   | 0.77   | 3.96E-06   | 1.57   | 0.0505   | 1.37   | 0.1445      | 0.17   | 4.54     | 0.0157 | 0.52         |
| RSLSV     | 3.52E-05     | 11.12  | 9.60E-06 | 6.69E-01| 0.3000       | 5.11E-01| 0.1470   | 4.54E-01| 0.0157       | 1.52   | 0.3265    | 4.26E-01| 0.3440    | 0.52   |

#### Panel C: VXSLV and economic policy uncertainty

| Regressor | [1] Intercept | t-stat | Estimate | t-stat | [2] Intercept | t-stat | Estimate | t-stat | [3] Intercept | t-stat | Estimate | t-stat | [4] Intercept | t-stat | Estimate | t-stat | [5] Intercept | t-stat | Estimate | t-stat | [6] Intercept | t-stat | Estimate | t-stat |
|-----------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|
| RSLSV     | -2.9596      | -0.47  | 0.6226   | 0.47   | -1.1121      | -0.59  | -0.4169  | -0.20  | -0.0020      | -0.13  | 5.13E-06   | 0.77   | 3.96E-06   | 1.57   | 0.0505   | 1.37   | 0.1445      | 0.17   | 4.54     | 0.0157 | 0.52         |
| RSLSV     | 3.52E-05     | 11.12  | 9.60E-06 | 6.69E-01| 0.3000       | 5.11E-01| 0.1470   | 4.54E-01| 0.0157       | 1.52   | 0.3265    | 4.26E-01| 0.3440    | 0.52   |

#### Panel D: VXSLV and equity market uncertainty

| Regressor | [1] Intercept | t-stat | Estimate | t-stat | [2] Intercept | t-stat | Estimate | t-stat | [3] Intercept | t-stat | Estimate | t-stat | [4] Intercept | t-stat | Estimate | t-stat | [5] Intercept | t-stat | Estimate | t-stat | [6] Intercept | t-stat | Estimate | t-stat |
|-----------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|--------------|--------|----------|--------|
| RSLSV     | -2.9596      | -0.47  | 0.6226   | 0.47   | -1.1121      | -0.59  | -0.4169  | -0.20  | -0.0020      | -0.13  | 5.13E-06   | 0.77   | 3.96E-06   | 1.57   | 0.0505   | 1.37   | 0.1445      | 0.17   | 4.54     | 0.0157 | 0.52         |
| RSLSV     | 3.52E-05     | 11.12  | 9.60E-06 | 6.69E-01| 0.3000       | 5.11E-01| 0.1470   | 4.54E-01| 0.0157       | 1.52   | 0.3265    | 4.26E-01| 0.3440    | 0.52   |

The table shows the regression results of eqs. (1)-(3) concerning Covid-19 induced uncertainty in the Silver market, regression estimates are consisting of autocorrelation and heteroskedasticity (HAC- Newey-West), Significant at **1%**, *5%*, **10%** level. |
operations. It is expected that the mining budget will be cut by about 29% this fiscal, which will have a substantial impact on the mining activity. Panel A of Table 9 also reports the result in line with previous commodities market behaviour. The Covid-19 pandemic development in the US and China has disrupted the investors’ apprehension in bullion trading. The slower economic activity and drawdown of the equity market adversely impacted investors’ sentiment. Further, the decline in the short-term bond yield has increased Silver market volatility. The association of the Silver market volatility between other commodities and the equity market remains low responsive. Hence one can say that precious metals like Silver act as an archetypal safe-haven asset. Panel B also signifies that due to decreased consumption of precious metals in other industries, the first quarter of 2020 has raised investors’ anxiety. Panel C and D also exhibits that policy uncertainty and equity market uncertainty affect the bullion market and metals mining.

5. Robustness check

In this section, we present the robustness check of the results reported in the previous sections. Baker et al. (2019a,b) deliberate on the stock market volatility and jumps based on the equity market volatility tracker (EMV). The tracker is based on the newspaper-text keyword counts related to the uncertainty. Further, they extend the same mechanism to track pandemic disease outbreaks in their EMV tracker and have a separate reading named ‘Daily Infectious Disease Equity Market Volatility Tracker (IDsMV)’. Our study employs the IDsMV tracker to uncover the effects of such news related to pandemic diseases on the commodities markets gauged in terms of implied volatility index. We set our specification as follows,

$$VOLINDX_{t}^{Commodity} = \alpha_{0} + \alpha_{1} R_{t}^{Indexing} + \alpha_{2} IDS_{t} MV_{t-1} + \alpha_{3} U_{t-1} + \alpha_{4} X_{t-1} + u_{t}$$

(4)

$$VOLINDX_{t}^{Commodity} = \alpha_{0} + \alpha_{1} R_{t}^{Indexing} + D_{t}(\mu_{0} + \mu_{2} IDS_{t} MV_{t-1}) + \alpha_{3} U_{t-1} + \alpha_{4} X_{t-1} + u_{t}$$

(5)

In our regression specification IDs_{t} MV_{t-1} is one period lag with log-transformation of (1 + IDS_{t} MV_{t}). Our empirical hypothesis is that ‘media coverage of pandemic disease outbreak (e.g., Covid-19) does impact the investor sentiment in the commodities market’.

Table 10 shows the relationship between commodities market volatility and infectious disease outbreak news. The options market is efficient, and the premium investors pay to avail hedge against the market uncertainty reflects the arrival of new information in the market on a real-time basis. Hence options’ implied volatility gauges the investors’ fear and estimates the future market volatility. Our study employs five major commodities’ market volatility indexes that reflect the investors’ anxiety and panic due to uncertainty of the future economic and political event, natural pandemic event as well. Panel A of Table 10 explains that the pandemic news outbreak has disrupted the investors’ sentiment. The positive slopes across all classes of the commodities show that recent pandemic growth has impacted the commodities market with major sell-off to meet their margin requirement and rebalancing the portfolio. One of the interesting outcomes observed that short-term interest rates affect the future level of commodities market volatility adversely. The spread of WTI and Brent raises the market participant’s concern in trading and investing in the Crude oil market. Also, Panel B explains that market volatility was approaching a normal level during January, but once WHO announced Covid-19 as an international emergency in February, and suddenly market overreacted and adjusted the future uncertainty, which is reflected in terms of investors’ sentiment index (VIX). The first quarter of 2020 has been the period drawdown of the equity and commodities market, yet the market cannot adjust to the uncontained future effects of the Covid-19 outbreak.

6. Conclusion and policy implications

This article presented the commodities market’s investors’ sentiment in terms of the implied volatility index of various commodity specifics. We demonstrated the pandemic development of Covid-19 and its effects on the Crude oil, Energy sector, Gold, and Silver markets. Results are more pronounced during March 2020, tranquil Covid-19 induced uncertainty is disorderly to explain the bullion and precious metals market. In the short run, the Covid-19 disease outbreak event has increased to strong apprehensions about the impending commodity investment and consumption. Yet, the effects of the virus remain uncontained and vague for many industries and markets.

Overall, empirical results uncover that the Covid-19 cases in the US and China impact the ex-ante market volatility of the commodities market. In order to hedge market uncertainty, investors buy options and put-options act as insurance against a large fall of commodities prices. The unprecedented rise of the OVX signifies the overreaction of the market participants concerning the commodities prices. The future level of commodities’ market volatility is directly connected with the underlying’s performance (ETF fund) and short-term interest rates; empirical outcome shows that yield associated with the fund and UST-BILL appears negative and statistically significant. In our regression specification, we also add one of the control variables, ‘spread,’ it’s a difference between two benchmarks of the crude oil traded globally, i.e., WTI and Brent, higher the degree of spread higher is the level of OVX.

One can see that the range of Covid-19 infection in the US through January–April 2020 has impacted the furthest of the commodities market adversely. The significant positive estimate indicates that there has been a remarkable upsurge of volatility during the first quarter of 2020. Moreover, contagious pandemic related uncertainty of the macroeconomy and equity market does explain the commodities market’s sentiment.

Empirical findings presented here yield some policy implications: (i) in order to hedge against the tail events like Covid-19, investors should invest in the volatility product, for example, VIX futures and other put options linked with the underlying index. (ii) Volatility trading —for example, Futures and Options on VIX and F&O related strategies provide the strongest leveraged and best protection during the drawdown events. (iii) The study’s most important findings reveal that crude oil and energy markets exhibit an extreme volatility level; it indicates investors do have limited access to other hedge instruments to protect market adversity except for options. Hence there is a need for more derivatives instruments and volatility products to meet risk aversion in the energy market. Our current study is limited to the number of Covid-19 infection cases and commodity markets. For example, Oxford or other countries’ first vaccination news has a specific impact on stock and commodity markets in the west and emerging markets. Exploring the effects of vaccination news on the equity and commodity market can add more to market efficiency literature.

CRediT authorship contribution statement

Imlak Shaikh: Conceptualization, Methodology, Validation, Investigation, Formal analysis, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.
Table 10: Robustness Check: On the relationship between commodities markets and infectious disease news.

| Regressor | Crude oil | Energy | Gold | Gold miner | Silver |
|-----------|-----------|--------|------|------------|--------|
| Intercept | 1.5642 | 41.86 | 0.79 | 1.2130 | 34.26 |
| Return    | -0.5317 | -2.15 | -0.37 | 0.8573 | 1.84  |
| ID_MV     | 0.2840 | 7.27  | 0.3358 | 0.1664 | 6.36  |
| USTBILL   | -0.0637 | -4.03 | 0.0136 | -0.0636 | -5.08 |
| Spread/RSPGSCI | 0.0093 | 2.83 | -0.6982 | -2.27 | -0.2169 | -1.03 |

Appendix A: Commodities index and allied volatility index (Commodity-ETFs linked Options).

| Commodity /industry | Underlying ETF/Futures | Volatility index | Description |
|---------------------|------------------------|-----------------|-------------|
| Crude oil           | United States Oil Fund, LP (Ticker - USO) | O VX | Oil ETF Volatility Index |
| Energy sector       | XLE Energy Select Sector SPDR Fund | VXXE | Energy Sector ETF Volatility Index, US energy firms (SPX500) |
| Gold                | The SPDR Gold Trust | GVZ | Gold ETF Volatility Index |
| Silver              | iShares Silver Trust (SLV) | VAXSLV | Silver ETF Volatility Index |
| Gold miners         | GDX ETF | VXGDX | Gold Miners ETF Volatility Index |
| Commodity-based index: | S&P GSCI | SPX5GSCI | |
| WTI crude oil       | WTI Futures | |
| Brent crude oil     | Brent Futures | |
| Uncertainty and other variables: | EPU | Equity market uncertainty |
| VIX index           | VIX | |
| Infectious Diseases EMV index | IDsmV | |
| S&P index           | SPX500 | |
| US treasury rates   | USTBILL | |

The table shows the regression results of eqs. (4) and (5) concerning Infectious Disease Market Volatility uncertainty in the commodities markets, regression estimates are consisting of autocorrelation and heteroskedasticity (HAC- Newey-West), Significant at *1%, **5%, ***10% level].

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