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Can gold and bitcoin hedge against the COVID-19 related news sentiment risk? New evidence from a NARDL approach

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\textbf{ABSTRACT}

The COVID-19 pandemic has led to extensive news coverage, causing investor sentiment to swing, which has further increased financial market price volatility. There is an increasing need to find a hedge against sentiment risk. This paper examines the hedge capabilities of gold and Bitcoin against COVID-19-related news sentiment (CNS) risk under a nonlinear autoregressive distributed lag (NARDL) model. Our empirical results reveal that there is an obvious asymmetric effect from the CNS on gold prices in the short run and that the decrease in the COVID-19-related news index would have a greater impact on gold prices than when it increases. The impact of CNS on Bitcoin prices is asymmetric in the long and short term, especially in the long term. In addition, we conclude that gold is a hedge against CNS risk in the long term, and the hedging effect of Bitcoin is mainly reflected in the short-term.

1. Introduction

Until now, over 100 million people have been infected, and more than 2.5 million deaths have been claimed worldwide due to the outbreak of COVID-19. According to the forecast of the International Monetary Fund (2020), the global economy will contract by about 4.9 percent in 2020. This economic shock is expected to be much larger than during the global financial crisis (GFC). At the same time, the financial market experienced huge fluctuations during the pandemic. In the early days of the COVID-19 pandemic, asset prices, such as stock and crude oil, suffered unprecedented shocks (Amar et al., 2021; Gil-alana and Monge, 2020), and many investors suffered heavy losses. Due to the huge losses in this period, finding hedging assets is a timely and important solution for practitioners and researchers.

In view of its enormous societal and economic impact, the ongoing pandemic has been widely reported and explosively disseminated by media outlets worldwide. Emergency events, such as the current pandemic, receive more media coverage and more attention than other general events (Mairal, 2011). The constant flow of pandemic-related news to investors can raise anxiety and panic, affecting investor sentiment and thus their decision-making behaviours (Klibanoff et al., 1998; Shaikh, 2021). Such sentiment shocks have a great impact on financial market transactions (Kaplanski and Levy, 2010; Tetlock, 2007; Umar et al., 2021a) and cause dramatic market volatility (Audrino et al., 2020; Ho et al., 2015; Su et al., 2017). In the current era of information explosion, financial market participants may not be able to quickly and accurately assess the impact of major emergency news on financial markets, especially in the context of wide spread fake news. Hedge fund managers who hedge against sentiment risk outperform those who do not hedge (Zheng et al., 2018). Therefore, objective analysis of news information to obtain higher returns is of great significance to financial market participants.

Generally speaking, gold (Baur and ThomasMcdermott, 2016; Ciner et al., 2013) and Bitcoin (Bouri et al., 2017; González et al., 2021; Urquhart and Zhang, 2019) are hedging investments during times of financial crisis. However, in this current unprecedented crisis, are the hedging functions of gold and Bitcoin still effective? Who will win this hedging race? These questions are worthy of further research and discussion. Numerous studies have conducted relevant research on whether gold and Bitcoin can be classified as hedge or safe-haven assets during the pandemic. For stocks, some studies argue that gold, as in previous crises, acts as a hedge or safe haven under the current health crisis, while the role of Bitcoin is not clear, which proves that, for most of the time during the COVID-19, gold investments are evinced to be more...
beneficial than Bitcoin to hedge against stock markets’ downturn risk (Chemkha et al., 2021; Ji et al., 2020; Shehzad et al., 2021). Another view is just the opposite. The results of some studies show that during a pandemic, Bitcoin typically has a negative correlation with stock returns, suggesting that it qualifies as a better hedge or safe haven than gold (Będowska-Sjöka and Kliber, 2021; Chikili et al., 2021). In the research on hedging oil price risk, Dutta et al. (2020) obtain the time-varying correlation results which show that gold is a safe-haven asset for the global crude oil market; on the other hand, Bitcoin only plays a role in the diversification of crude oil. Salsu et al. (2021) split the data into two parts to represent the time period before and during the pandemic and found that gold is an important safe haven against oil price risks. Meanwhile, some research on other hedging targets has been conducted; for example, economic policy uncertainty and equity market volatility indexes (Baker et al., 2016) are used by Jiang et al. (2021) to test whether cryptocurrencies are good hedges. These studies were all conducted in the context of the COVID-19 outbreak. At the moment, the dissemination of COVID-19-related news has had a significant impact on the volatility of asset prices. A large portion of asset price volatility risk is directly attributable to COVID-19-related news sentiment (CNS). A direct study of the ability of traditional hedging assets to hedge CNS, which has a more intuitive and obvious meaning, could be a good reflection of the former’s ability to hedge assets, such as stocks, during a pandemic. However, until now, no paper has explored the link between the CNS and traditional safe haven assets, like gold and Bitcoin, which are likely to be the best investment options for investors during the COVID-19 period. Our study fills this gap. In this article, we selected three news sentiment indicators to investigate the effects of COVID-19 on gold and Bitcoin from the perspective of behavioral finance to determine whether gold and Bitcoin have the ability to hedge sentiment risk on COVID-19. This research provides an important reference for potential investors in gold and Bitcoin by analyzing the news implications of major shock events.

In addition, this research considers the impact of exchange rates and crude oil prices on the prices of gold and Bitcoin. First, much of the literature considers the relationship between gold, Bitcoin, and currency; the effect of the exchange rate (the real value of the dollar) has been taken into account to reflect the financial function of gold (He et al., 2020; Pukthuanthong and Roll, 2011) and Bitcoin (Hui et al., 2020; Janson and Karoubi, 2021). Second, due to the strong substitution as a hedging asset between gold and crude oil, numerous papers include crude oil prices in studies about gold hedges (Adekoya and Oliyide, 2020; Umar et al., 2021b; Salsu et al., 2021). Additionally, the relationship between Bitcoin and crude oil is receiving increasing attention (Das et al., 2020; Selmi et al., 2018).

At present, the main methods of research on hedging are generalized autoregressive conditional heteroskedasticity (GARCH) series models (Dutta et al., 2021; Jin et al., 2020), copula approach (Nga et al., 2020; Sukcharoen and Leatham, 2017), wavelet approach (Celeste et al., 2020; Zaremba et al., 2019), and so on. For example, Akkoc and Civcir (2019) use different versions of the structural vector autoregression-dynamic conditional correlation (DCC)-GARCH framework to examine the movement of the international gold prices index to explore the hedging effect of gold on stocks. In a wavelet-based multivariate GARCH framework, Belhassine and Karamti (2021) explore the correlation and hedging effectiveness of oil and equity markets over different investment horizons. Five copula models are used by Garcia-jerecno and Beninel (2020) to explore the relationship of Bitcoin as a hedging asset for market stock indexes. However, through these methods, it is difficult to distinguish the difference in a nonlinear case, and they do not reflect the trend of hedging ability in the short and long term. Although some articles have investigated the nonlinear impacts on gold and Bitcoin markets using nonlinear methods; for example, the quantile method is used to analyze the hedging properties in extreme cases (Shahzad et al., 2019), in which little attention is paid to the asymmetry in the hedging abilities of a hedge against the up and down changes in the price or uncertainty of hedge underlying and the differences in long- and short-term hedging abilities. In this paper, we explore the asymmetric relationship of the CNS with the prices of Bitcoin and gold for the first time. We use a multivariate NARDL framework to study the asymmetric impacts in short- and long-run horizons. It is helpful for investors to understand the difference in the impact of positive and negative shocks on gold and Bitcoin returns by testing asymmetric effects. As a result, they can target the use of sound strategies to reduce the risk associated with sentiment shock.

To the existing literature, the contribution of this article is mainly in three aspects. Above all, we study the hedging capabilities of gold and Bitcoin against COVID-19 based on the perspective of behavioral finance. This paper provides a new perspective for studying the hedging capabilities of assets. Second, the asymmetric effects, in the long and short run, between COVID-19-related news and prices of gold and Bitcoin are explored in this paper, which is a highlight compared to previous studies. Using the NARDL method to master asymmetric and nonlinear results, investors can develop appropriate strategies to reduce losses. Third, we compare the different market performances of gold and Bitcoin in the COVID-19 period. The study finds that their reactions to COVID-19-related news are significantly different, and interesting conclusions are drawn: gold is a COVID-19 risk hedge in the long term, while Bitcoin is a COVID-19 risk hedge in the short term.

The remainder of the project is structured as follows: Literature and theory are presented in Section 2, Section 3 details the data and reviews the methodology framework which used in this paper, the empirical results and discussions are reported in the fourth section, and finally, Section 5 concludes.

2. Literature review and theory

2.1. Hedging performance of gold and bitcoin

Traditionally, gold has been regarded as a good hedging tool and safe haven asset, and it is considered to have intrinsic value due to common cultural beliefs (Starr and Tran, 2008). At the same time, gold has historically been considered a substitute for currency (Batten et al., 2010; Jain and Ghosh, 2013). Gold has been well documented in the literature as a hedge tool (Niu et al., 2022; O’Connor et al., 2015). However, in many cases, gold has no obvious hedging function. Choudhry et al. (2015) explored the link between gold returns and the stock market in several developed countries during the GFC. The results suggest that gold may not be a safe haven for equity markets. Hood and Malik (2013) argued that there is no negative correlation between gold and the US stock market during periods of extreme volatility, which indicates that gold is not a good hedging tool for the equity market. In China, gold plays an important role as a safe-haven asset in times of market turbulence, but this function is not constant and changes with market volatility (Peng, 2020). In Malaysia, gold does not serve as a safe haven when the stock market plummets (Ghazi et al., 2015).

Bitcoin, the first cryptocurrency, was born in early 2009 and was introduced by Nakamoto (2008) as a decentralized digital currency. Such virtual currency is independent of any central bank or specific government because of its special nature. Bitcoin is easily available for trading on numerous specialized platforms, which makes it an investment asset. Bitcoin has attracted more and more attention from practitioners all around the world, which has inspired much research on its hedging properties. Some scholars argue that Bitcoin has some hedging abilities similar to gold, so it can apparently act as a hedge against equities and the US dollar, similar to gold (Dyhrberg, 2016a, 2016b). Urquhart and Zhang (2019) studied the correlation between Bitcoin and currencies using an asymmetric-DCC model. They found evidence that Bitcoin can be classified as an intraday hedge for several currencies, including the Swiss franc and British pound sterling. Guesmi et al. (2019) employed a multivariate GARCH model to support the assumption that Bitcoin can offer diversification and hedging benefits to
investors. Bouri et al. (2020) found that cryptocurrencies perform attractively as hedges during equity decline, particularly against Japanese and Asian Pacific equities. This property is revealed in both normal and crisis times. However, another viewpoint on the role of Bitcoin suggests the opposite. Some research points out that Bitcoin has a very weak relationship with other financial assets (Baur et al., 2018; Corbet et al., 2018) because the determinants of Bitcoin prices are different from other financial assets (Kristoufek, 2015). Regarding the relationship between global uncertainty and Bitcoin, Bouri et al. (2017) found a positive correlation using the DCC model. This shows that the role of Bitcoin as a hedging asset for uncertainty is not obvious.

In the existing research, there are many differences or even opposite conclusions about the hedging properties of gold and Bitcoin. This property may change depending on the fundamental characteristics of a major emergency. For example, we expect that the hedging abilities of gold and Bitcoin against COVID-19 pandemic risk are different from those of geopolitical events. Using different methodologies may also have different results. Overall, the hedging capabilities of gold and Bitcoin in many situations are controversial. Even with traditional and ancient safe-haven assets such as gold, the hedging function may not work in different situations. Therefore, for the current health crisis, it is necessary to study the roles of gold and Bitcoin as hedging assets.

2.2. Theoretical framework of the major emergencies influencing asset prices under media coverage

Major public health emergencies have a significant impact on society and the economy through public sentiment pathways (Esparrica et al., 2022; Haroon and Rizvi, 2020). A consistent influx of real-time information on the pandemic makes the public more anxious about the future, leading to panic buying or hoarding products (Naeem, 2021). During the SARS outbreak, there are only a few hundred confirmed cases and 38 deaths in the United States and Canada, but public fears sentiment led to an overestimation of the probability of infection, resulting in a total loss of $1 billion in Canada (Blendon et al., 2004). In fact, although SARS did not cause serious health effects, economic losses were enormous (Smith, 2006). The World Bank (2010) emphasized that the casualties and economic losses caused by major disasters, such as disease epidemics and natural disasters, to human society cannot be ignored. With the significant increase in the frequency and extent of major epidemics, the impact of public health emergencies is gradually spreading from personal injury and the real economic sector to the financial sector. A growing number of research studies have begun to focus on the sentiment effect of major public health emergencies on financial markets (Ichov and Marin, 2018; Smith, 2006). SARS and Ebola outbreaks have been found to cause changes in individual sentiments and psychology, generating price fluctuations in financial markets (Chen et al., 2007). The above-mentioned mechanism is similar to other major emergencies, such as earthquakes (Shan and Gong, 2012), geopolitical events (Brandt and Gao, 2019), and terrorist attacks (Papakyriakou et al., 2019), which cause asset price volatility by influencing investor sentiment. We define the huge uncertainty brought by the news sentiment of major events to the financial market as news sentiment risk. In this paper, the market risk arising from the news sentiment volatility of COVID-19 is referred to as CNS risk. Therefore, there is a basis for studying the effect of the pandemic on financial markets from the perspective of sentiment.

Major events, such as the COVID-19 pandemic, are mainly disseminated through public media to interfere with investors’ decisions. When infectious diseases are rampant, news related to infectious diseases can interfere with investor judgment through public media, such as the news, and affect the financial markets (Donadelli et al., 2017). Nowadays, with wide media coverage, media sentiment, media attention, media authority, and the information dissemination ability of the media have a huge impact on investor concerns and affect investor sentiment. Specifically, there are two opposite investor sentiments: optimistic and pessimistic. When there is good news on the treatment plan, vaccine development has effectively progressed, or there is a decline in confirmed and death cases, investors become optimistic, and their investment strategies become more aggressive, thus resulting in purchases of higher-yielding assets to cater to investor sentiment. When there is no progress in the treatment plan and vaccine development, the infectious disease is getting worse, or the government takes restrictive policies to prevent the disease, such as lockdowns, people gain a sense of fear and pressure similar to that of facing the threat of terrorism (Huberman and Regev, 2001). This pessimistic sentiment induces investors’ investment strategies to become more conservative; thus, they invest in hedge assets to deal with uncertainties. The aggregate effects of positive and negative investor sentiment affect asset prices. We establish a theoretical transmission mechanism framework of the major emergencies affecting asset prices through investor sentiment in Fig. 1, as follows:

Many scholars have used news indicators to represent investor sentiment and to study the impact of sentiment on financial markets. Barberis et al. (1998) proposed a parsimonious model of investor sentiment and found evidence that stock prices overreacted to a series of good or bad news. Rognone et al. (2020) argued that both positive and negative news have a positive impact on Bitcoin prices. This indicates that changes in news sentiment do not affect investors’ trading strategies for Bitcoin. Smales (2014b) suggested that negative news sentiment has a greater impact on gold futures returns than positive news sentiment. Most of these studies divide news into positive and negative and study the impact of different news sentiments on financial markets, while there is a lack of relevant studies on positive and negative sentiment shocks. The NARDL model used in this paper can better identify the differences in such shocks.

3. Data and methodology

3.1. Data

To study the effect of COVID-19-related news on gold and Bitcoin, we used daily data covering 603 working days (from January 2, 2020, to June 3, 2022). Our paper considers the prices of gold and Bitcoin as dependent variables. The daily gold price data are from Bloomberg Terminal, and Bitcoin prices are obtained from the Coindesk website. We selected the oil price from the US Energy Information Administration, which provides the spot price of Cushing West Texas Intermediate crude oil. Real effective exchange rate (RER) is the index of the real (broad) effective exchange rate of the United States (2010 = 100), and the data are provided by the Bank for International Settlements.

Niu et al. (2021) used lasso and elastic net methods to screen different COVID-19 sentiment indicators that have the greatest impact on commodity markets. The results show that the fake news index (FNI), panic index (PI), and worldwide sentiment index (SI) have the greatest influence on the commodity market. Therefore, we adopted three major COVID-19 news index indicators to measure the CNS–FNI, PI and SI—which Ravenpack compiled. This platform provides real-time media analytics and explores announcements describing key issues related to the Coronavirus pandemic. It curates and accumulates real-time news from more than 19,000 global news sources. Its sources include the Dow Jones News Agency, Wall Street Journal, and StockTwits (Blitz et al., 2020). These platforms have received widespread attention from a large number of investors. News data from these platforms can well reflect investor sentiment. There are a great deal of papers using these news data as news sentiment indicators (Cepoi, 2020; Shi and Ho, 2020; Smales, 2014a). The indicators used in this paper and their calculation instructions are shown in Table 1.

3.2. Methodology

In order to investigate the impact of CNS on the gold and Bitcoin markets, we adopt the Nonlinear Autoregressive Distributed Lag
The price impact model of Bitcoin is the same framework. In order to study the asymmetric effects in long- and short-term simultaneously, we follow Shin et al. (2014), Eq. (1) for the NARDL model can be rewritten as such:

$$\Delta \ln GP_t = \rho \ln GP_{t-1} + a_{0+} \ln OP^+_{t-1} + a_{0-} \ln OP^-_{t-1} + a_{\Delta RER} \ln RER^+_{t-1} + a_{\Delta RER} \ln RER^-_{t-1} + \sum_{i=1}^{d} \alpha_i \Delta \ln OP_{t-i} + \sum_{i=1}^{d} \left( \omega_i^+ \Delta \ln OP^+_{t-i} + \omega_i^- \Delta \ln OP^-_{t-i} \right) + \sum_{i=1}^{d} \left( \alpha_i^+ \Delta \ln RER^+_{t-i} + \alpha_i^- \Delta \ln RER^-_{t-i} \right) + \sum_{i=1}^{n} \left( \omega_i^+ \Delta \ln FNI^+_{t-i} + \omega_i^- \Delta \ln FNI^-_{t-i} \right) + \sum_{i=1}^{n} \left( \alpha_i^+ \Delta \ln PI^+_{t-i} + \alpha_i^- \Delta \ln PI^-_{t-i} \right) + \sum_{i=1}^{k} \left( \omega_i^+ \Delta \ln SI^+_{t-i} + \omega_i^- \Delta \ln SI^-_{t-i} \right) + \varepsilon_t, \quad (3)$$

where variables GP, RER, OP, FNI, PI, SI represent the gold price, the real effective exchange rate (REER) in the U.S. dollar, the oil price, fake news index, panic index, and sentiment index, respectively.

The partial sums of positive and negative changes of variables can be represented by the positive and negative signs, respectively. Taking oil price (OP) as an example, as shown below:

$$OP^+_t = \sum_{i=1}^{t} \Delta OP^+_i = \sum_{i=1}^{t} \max(\Delta OP_i, 0),$$

$$OP^-_t = \sum_{i=1}^{t} \Delta OP^-_i = \sum_{i=1}^{t} \min(\Delta OP_i, 0). \quad (2)$$

We utilize the Fpss statistic to test the joint null of $\rho = a^+_X = a^-_X = 0$. Rejection proves the existence of a long-term cointegration relationship. Then, the Wald test is used to test the asymmetric effects in long run ($H_0: a^+_X = a^-_X$) and short run ($H_0: \sum_{i=1}^{p} \omega^+_i = \sum_{i=1}^{p} \omega^-_i$).

4. Results and discussion

Before the empirical estimation, a unit root test was performed on the data according to the preconditions of an autoregressive distributed lag model. As can be seen from the results of the unit root test in Table 2, all sequences are I(0) or I(1), which indicates that the characteristics of all sequences meet the requirements of the NARDL model for data stationarity.

| Variables       | Description and source                                                                 |
|-----------------|----------------------------------------------------------------------------------------|
| Fake news index (FNI) | It measures the level of media chatter about the novel virus that makes reference to misinformation or fake news alongside COVID-19. Values range between 0 and 100. Where a value of 2.00 indicates that 2 percent of all news globally is talking about fake news and COVID-19. |
| Panic index (PI)  | It measures the level of news chatter that makes reference to panic or hysteria and coronavirus. Values range between 0 and 100. The higher the index value, the more references to panic found in the media. |
| Worldwide sentiment index (SI) | It measures the level of sentiment across all entities mentioned in the news alongside the coronavirus. The index ranges between -100 (most negative) and 100 (most positive) sentiment while 0 is neutral. |
### Table 2
Results of the unit root tests.

| variables     | ADF      |          | PP       |          | KPSS     |          |
|---------------|----------|----------|----------|----------|----------|----------|
|               | level    | 1st diff.| level    | 1st diff.|          | level    | 1st diff.|
| Oil Price     | -0.698   | -28.997***| -0.627   | -29.497***| 2.700*** | 0.171    |
| Gold Price    | -2.980** | -23.047***| -2.918** | -23.170***| 0.935*** | 0.151    |
| Bitcoin Price | -0.453   | -24.384***| -1.646   | -24.420***| 2.617*** | 0.365*   |
| Panic Index   | -2.588*  | -13.284***| -6.988***| -49.638***| 1.576*** | 0.113    |
| Fake News Index| -4.580***| -19.657***| -15.130***| -73.914***| 0.951*** | 0.098    |
| Sentiment Index| -4.999***| -17.917***| -4.609***| 35.267*** | 0.697*** | 0.106    |
| RER           | -1.274   | -24.525***| -1.438   | -24.638***| 0.928*** | 0.149    |

Notes: ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively. ADF, PP and KPSS are Augmented Dickey-Fuller, Phillips-Perron, and Kwiatkowski-Phillips-Schmidt-Shin tests, respectively (All samples).

**Fig. 2.** Time-series plots of data samples from January 2, 2020 to June 3, 2022 (All samples).
At the same time, Fig. 2 depicts the time series of data samples from January 2, 2020, to June 3, 2022. We provide a detailed explanation of the relationship between index changes and sentiment. Intuitively, when the indexes of PI and FNI rise (the positive changes occur)—panic news and fake news related to COVID-19 increase—public sentiment will change negatively. The worldwide sentiment index, on the other hand, is a direct indicator of sentiment, with sentiment becoming positive when the index rises and negative when it falls.

The correlation coefficient matrices of the variables are calculated and shown in Fig. 3. The results show that the correlation of all variables is between $-0.16$ and $0.22$, indicating that there is no obvious correlation between all variables.

### 4.1. Is gold a hedge against CNS risk?

In this section, we explore the impact of the CNS on gold prices. In Table 3, we find that the influence coefficients of the positive and negative CNS fluctuations on the gold prices are significantly different, indicating that the influence of the CNS on gold prices is significantly asymmetric in both the long and short terms. This paper observes a

### Table 3

Multivariate NARDL-estimation results for the gold price (All samples).

| Variable | Coefficient | Std. Error | Coefficient | Std. Error |
|----------|-------------|------------|-------------|------------|
| lnGPt-1  | -0.043204***| 0.012125   | 0.036912**  | 0.015235   |
| FNIy     | -0.000173   | 0.001814   | 0.036572**  | 0.014143   |
| FNIy-1   | -0.000940   | 0.001745   | 0.054683*** | 0.017261   |
| PIy     | 0.002154**  | 0.0009092  | -0.995732***| 0.198681   |
| PIy-1    | 0.002286**  | 0.000891   | 0.320143*** | 0.089120   |
| SIy     | 8.80E-05**  | 4.05E-05   | C           | 0.00004004 |
| SIGP     | 5.61E-05   | 3.77E-05   | LFNI1       | 0.021757   |
| lnOPy    | -0.009190*  | 0.005413   | LFNI        | 0.049856   |
| lnOPy-4  | 0.008031    | 0.005097   | LPI+        | 0.052912   |
| lnRECy   | 0.014425    | 0.005145   | LPI        | 0.002037   |
| SIGP     | 0.0038230  | 0.059035   | LS1+        | 0.001298   |
| SIGP     | 0.004185*   | 0.002307   | LS1        | 0.185886   |
| SIGP     | -0.008147** | 0.001048   | LOP+       | 0.333881   |
| SIGP     | -0.003341***| 0.001288   | LOP        | -0.884872  |
| SIGP     | -0.002377** | 0.001145   | LRER+      | 0.185886   |
| SIGP     | -0.000182*  | 0.000106   | LRER        |             |
| Observations | 603        |             |             |             |
| R-squared | 0.132334   |             |             |             |

Notes: First differences are denoted by the $\Delta$ operator. $\Delta X = \alpha_{X}/\rho$ indicates the long run effect of a specific regressor ($X$) on gold price (GP). $***$, $**$, and $*$ denote statistical significance at the 1%, 5% and 10% level, respectively.
positive response of gold prices (a rise in price) to positive changes in negative FNI in the long run. The estimated long-run coefficients LFNI1+ and LFNI1- are determined as $-0.004004$ and $0.021757$, respectively. When the media spreads and discusses fake news about COVID-19—in other words, when the FNI rises—investors will panic and feel pessimistic about the future and prefer to buy gold to hedge risk. In the short term, when $\Delta$FNI + t-3 rises, the price of gold rises. In this case, gold offers hedging properties for fake news sentiment risk in the short run.

We find that the positive and negative impacts of the PI on gold prices are significant in the long run, while the positive and negative impacts of the PI on gold prices are significant in the short term. Panic sentiment rose rapidly in the early stages of the COVID-19 outbreak, especially in the middle and late March, triggering extreme panic and financial market chaos. Gold has been an eminent asset for safe investment (Gaur and Lucey, 2010). Nevertheless, the safe haven phenomenon of gold occurs only at moderate levels of risk since at higher or extreme levels of volatility, the market moves with the stock market (Baur and McDermott, 2010). The stock price did not rise during this turbulent period, so the price of gold did not rise either. As the COVID-19 pandemic has continued to spread, people have gradually adapted to this living environment, their panic mood has relieved, and their investment awareness has gradually become rational. However, as the COVID-19 pandemic does not end in the short term, investors are pessimistic about the future economy. Consequently, an upward spike in the need and demand for gold, which holds a hedging ability, has increased (Shahzad et al., 2020). The increase in demand has caused gold prices to soar.

As for the relationship between worldwide sentiment and gold prices, the results show that gold prices are more vulnerable to the positive impact of worldwide SI, while gold prices’ response to the negative impact of SI is not significant in the long run. The estimated long-run coefficients LS11+ and LS11- are $0.002037$ and $-0.001298$, respectively. This shows that the impact of positive changes on the price of gold is almost two times larger than that of negative changes in SI. Positive sentiment shocks have a much greater impact on gold prices than positive sentiment shocks. The short-term situation is the exact opposite of the long-term situation. This indicates that investors are willing to buy gold as the COVID-19 pandemic worsens. The short-run impact is negative and significant at lag 3 ($-0.000182$). This coefficient relationship is significant only at the 10% level. This suggests that gold is a good hedge against worldwide sentiment risk in the short and long term. To obtain higher returns and reduce sentiment risks, investors can pay special attention to the price fluctuations of gold caused by negative worldwide sentiment shocks.

Additionally, the oil price and the RER have little impact on gold prices in the long term, while they have a significant impact on gold prices in the short term. Additionally, the results in Table 3 show that the behaviour of oil price changes is asymmetric in the short term, and the results are consistent with those of Bildirici and Turkmen (2015). The positive shock of oil price in the previous period has a positive significance on gold prices, and the positive shock of oil price in the previous period is more obvious than the negative shock. These results are similar to those of Kumar (2017). The main positive influence of oil prices on gold prices can be explained by the following two reasons. First, the rise in oil prices has increased the production costs of goods and services in oil importing economies, thus exacerbating inflation. Many studies have shown that gold is an inflation hedging tool (Kampinis and Panagiotidis, 2015; Van Hoang et al., 2016), which has led to an increase in demand. Second, the rise in oil prices has a negative impact on economic growth, leading to a decline in asset prices. Therefore, investors prefer to invest in gold as a substitute for storing the value of certain assets (Kumar, 2017; Rebrodo, 2013). In summary, the rise in oil prices will lead to an increase in demand for gold, which will drive up the price.

4.2. Is bitcoin a hedge against CNS risk?

In this section, we explore the impact of the CNS on Bitcoin prices. The empirical results are displayed in Table 4. We find that the influence coefficients of the positive and negative CNS fluctuations on the Bitcoin prices are significantly different, indicating that the impact of the CNS on the Bitcoin prices is significantly asymmetric in both the long and short terms. The long-term response of the Bitcoin prices to the change in FNI is statistically significant for whatever direction FNI changes, and its coefficient significance is exactly the opposite of gold. The estimated long-run coefficients LFNI2+ and LFNI2- are $0.958914313$ and $0.697145751$, respectively. The short-run effects of fake news sentiment on Bitcoin prices are highly positive, especially in lag periods 1 and 5, suggesting that there is a process of positive impact to negative impact.

Panic sentiment has a significant short-term negative impact on Bitcoin prices and is asymmetric. For positive change, lags of 1 and 5 are significantly negative, and for negative change of PI, the coefficients of lags of 0, 2, and 4 are also significantly negative. For positive variation, the lag is 1 and 5. Obviously, the negative variation in panic sentiment has a far greater impact on Bitcoin than does the positive variation. According to Table 5, there is asymmetry in the long run. In the short and long terms, panic sentiment increases and Bitcoin prices decrease. The above results prove that Bitcoin is not a good hedging tool for panic sentiment risk in the short and long run.

In addition, we observe a negative response of Bitcoin prices to the positive variations in the SI and a positive response of Bitcoin prices to the negative variations in the SI in the long run. The estimated long-run coefficients LS2+ and LS2- are determined as $-0.007746395$ and $0.003366702$, respectively. This shows that the impact of positive changes on the price of gold is two times larger than that of negative changes in SI. It is interesting that SI has the opposite effect on Bitcoin in the short run. Worldwide sentiment has a positive effect on Bitcoin prices in the short term. This shows that the deterioration of the COVID-19 pandemic has a positive impact on Bitcoin returns in the short term. In the short and long run, Bitcoin, like gold, has the effect of resisting worldwide sentiment risks brought about by the COVID-19 pandemic.

In addition, unlike the impact on gold prices, oil price and RER have significant long-term impacts on Bitcoin prices. The short-term impacts of oil prices on Bitcoin prices are significant. For positive variation, the lag is 1, 2, 4, and 5. The coefficient is significantly positive. For negative changes in oil prices, the coefficients of lag 0, 1, 3, and 5 are also significant. Oil prices have a significant impact on the price of Bitcoin in the short term, and these results are consistent with those of Ciaian and Rajcaniova (2018). We find that crude oil prices have long-run symmetry and short-run asymmetry with Bitcoin prices, which is the opposite of the results of Lin and An (2021). Crude oil prices have a significant short-term lag, meaning that spot Brent crude oil prices have a lasting short-term impact on Bitcoin prices, and these results are contrary to those of Lin and An (2021). For the positive change in RER, only the lag 0 and 3 coefficients have significant statistical significance. The RER has a statistically significant impact on the price of special currency, and the results are consistent with those of Ciaian et al. (2016).

Based on the above results, it is obvious that the impact of the CNS on the price of gold has an obvious asymmetric effect in the long run, and its impact mainly focuses on the negative change in the COVID-19-related news index. A decrease in the COVID-19-related news index would have a greater impact on gold prices than when it increases, except for SI. Gold can hedge the risk of panic news in the long term, while it can hedge fake news and sentiment news in the short term. Bitcoin can hedge the risk of panic news in the short and long terms and hedge sentiment news in the short term. In the short term, with the spread of COVID-19 news, Bitcoin prices rose, indicating that Bitcoin can hedge risks in the short term. Above all, these results suggest that gold and Bitcoin can serve as good hedges against the risks brought by COVID-19.
8

It is very interesting to analyze the time period after vaccination to explore the behavioral differences observed compared with the whole sample period and to accurately guide investors’ decisions. Considering that the vaccination plan of COVID-19 in the United States was launched on December 14, 2020, this paper takes the period between December 14, 2020, and June 3, 2022, as a sample for vaccination. Tables 6–8 show the multivariate NARDL estimates of gold and Bitcoin prices in the post-vaccination period. Similar to the results in Sections 4.1 and 4.2, we find that the influence coefficients of positive and negative fluctuations of CNS on gold and Bitcoin prices are significantly different, indicating that the influence of CNS on gold and Bitcoin prices is significantly asymmetrical in the long and short terms. However, compared with the results during the COVID-19 pandemic, the results after vaccination show that the specific effects of CNS, oil, and RER on the price of gold (Bitcoin) are different. Compared with the results in Table 3 during the COVID-19 pandemic, we find that the results after vaccination in Table 6 show that the influence of fake news on the price of gold changes from positive to negative in the short and long terms. In addition, the impact of sentiment on gold prices has become more pronounced in the short and long terms. More importantly, the impact of oil and RER on gold prices has changed from insignificant to significant in the long term, and the impact on gold prices has become more significant in the short term than the results of the whole sample period in Table 3.

Compared with the results in Table 4 during the COVID-19 pandemic, the results in Table 7 show that the impact of fake news on Bitcoin prices is significantly reduced. In addition, the impact of panic on Bitcoin prices has changed from a negative impact to a positive impact in the long term. The effects of oil and RER on Bitcoin prices will become more significant in the long run, but oil prices seem to diminish in the short run. From Tables 5 and 8, it can be concluded that the results after vaccination are significantly different from those during the entire COVID-19 pandemic. Unlike the results in Table 5, Table 8 shows that most variables have obvious asymmetry with gold prices in the short and long terms. FNI and RER have obvious asymmetry with the price of Bitcoin in the long term, while oil prices have obvious asymmetry with the price of Bitcoin in the short term.

4.4. Further discussion

Faced with different news risks, investors can adopt different investment strategies. For example, when the market is flooded with fake news about COVID-19, we can adopt gold as a long-term hedge asset, and Bitcoin as a short-term hedge asset. In the globalized financial market, the influence of online fake news is increasing. Research from nonfinancial markets suggests that fake news will attract more attention than legitimate news articles (Chopra et al., 2019; Golman et al., 2017). The volume of abnormal stock trading increases due to the release of fake news (Clarke et al., 2016). Our results suggest that fake news also exerts a great impact on the gold and Bitcoin markets.

In the long term, it is not unexpected to find that a rise in panic sentiment drives a price increase in hedging assets such as gold, while it is interesting that a drop also causes positive price jumps in the gold market. Since negative changes in panic sentiment have more positive effects on gold prices than positive changes, investors can focus on the investment opportunities brought about by the decline in panic in the...
momentary change in sentiment, gold is a good hedge for both the long and negative information about COVID-19 floods the market. For the in the short term. In the face of the global COVID-19 pandemic, positive investments in physical gold and invest their money in higher-returning
tionship between gold and oil is partly due to inflation (the rise in oil - long term. Bitcoin can be chosen as an asset to hedge against panic risk and short terms. In the minds of global investors, gold is a better asset to
Black Swan “ we find a negative response of gold prices to the negative change in oil prices in the long run, according to Table 3. The results indicate that a 1% drop in oil prices leads to a 0.186% drop in gold prices. The rela-
long term. Bitcoin can be chosen as an asset to hedge against panic risk in the short term. In the face of the global COVID-19 pandemic, positive and negative information about COVID-19 floods the market. For the momentary change in sentiment, gold is a good hedge for both the long and short terms. In the minds of global investors, gold is a better asset to hedge COVID-19 risk than Bitcoin.
Due to oil taking a major hit during the pandemic, studying the relationship between oil and gold and between oil and Bitcoin helps corroborate the resilience of gold and Bitcoin as a hedge during the “Black Swan” event of COVID-19. Regarding the gold–oil relationship, we find a negative response of gold prices to the negative change in oil prices in the long run, according to Table 3. The results indicate that a 1% drop in oil prices leads to a 0.186% drop in gold prices. The relationship between gold and oil is partly due to inflation (the rise in oil prices is a proxy for inflation) (Batten et al., 2010, 2014). In fact, as the fall in oil prices would ease inflation, investors would reduce their investment in physical gold and invest their money in higher-returning assets. It can be seen that gold does not have the attributes of a safe haven for crude oil, and many studies have reached similar conclusions (Rehman, 2018; Sadorsky, 2014; Salisu and Amediran, 2020; Sephton and Mann, 2018). As for Bitcoin, the long-run response of its prices to oil price variation is statistically significant regardless of whether the oil prices change in a positive or negative direction, and there is no obvious asymmetric effect. The results suggest that there is a negative response of Bitcoin prices to positive variations in oil prices and a positive response of Bitcoin prices to negative variations in oil prices. This finding confirms that Bitcoin is an efficient hedge against oil in the long run. On the contrary, in the short term, the impact of soaring oil prices on the price of Bitcoin is positive, which is consistent with the recent research results of Das et al. (2020). They pointed out that Bitcoin is not an attractive asset to hedge against oil-related uncertainties in the short term.
In addition, in the empirical model, we also consider the framework. The FNI, PI, and world SI are selected as COVID-19-related explanatory variables on the price of gold and Bitcoin. We use the Wald statistic to investigate, Software, Writing & editing, Supervision.

Table 8

|                | Long-run asymmetry test | Short-run asymmetry test |
|----------------|-------------------------|--------------------------|
|                | F-Stat | P-value | F-Stat | P-value |
| gold           | 2.410  | 0.122   | 3.104  | 0.079   |
| FNI            | 3.628  | 0.058   | 0.000  | 0.987   |
| PI             | 0.168  | 0.682   | 0.360  | 0.549   |
| SI             | 1.007  | 0.316   | 0.118  | 0.731   |
| GP             | 0.617  | 0.433   | 3.144  | 0.077   |
| RER            | 5.601  | 0.019   | 1.276  | 0.259   |

Notes: The table reports the results of the symmetry tests of the effect of each explanatory variable on the price of gold and Bitcoin. We use the Wald statistic which tests the null hypothesis of $\alpha = 0$ for each explanatory variable in Equation.

5. Conclusion

In this paper, to explore whether gold and Bitcoin have the ability to hedge the risk of the COVID-19 pandemic, we analyze the impact of COVID-19-related news on the prices of gold and Bitcoin under a NARDL framework. The FNI, PI, and world SI are selected as COVID-19-related news indicators. In addition, in the empirical model, we also consider the impact of the RER of the US dollar and the prices of oil on the prices of gold and Bitcoin.

When considering the role of news relating to the COVID-19 pandemic, our results suggest that in the long run, the impact of COVID-19-related news on the price of gold mainly focuses on the negative change of the COVID-19-related news index, and the impact of negative changes on the price of gold is far greater than that of the positive changes in the news sentiment index. Gold can well hedge the risks brought by the news sentiment of the COVID-19 pandemic in the long run. Previous studies have shown that gold can hedge the risks of geopolitical events (Baur and Smales, 2020; Triki and Ben Maatoug, 2020). Furthermore, we indicate that gold can also hedge against the huge risks of COVID-19 pandemic, a once-in-a-century public health event. As for Bitcoin, our results suggest that in the long run, the impact of COVID-19-related news on the price of Bitcoin has an obvious asymmetric effect, and it can effectively hedge the risk of COVID-19 fake news sentiment.

In summary, gold is a hedge against the COVID-19 pandemic in the short term, while Bitcoin is a relatively good asset against COVID-19 risk in the long term. When encountering a major emergency, such as COVID-19, investors can consider Bitcoin and gold as assets in their portfolios to diversify their risks, reduce their losses, and maintain their returns.

There are still some potential extensions to our analysis in the future. For instance, the difference in the transmission mechanism of different news sentiments on the financial market can be further studied. In this way, different sentiment risks can be better differentiated and avoided. In addition, this paper only studies the impact on the return of gold and Bitcoin, and the impact on their volatility can also be discussed for future research.

CRediT authorship contribution statement

Xuehong Zhu: Conceptualization, Formal analysis, Software, Writing – review & editing. Zibo Niu: Methodology, Investigation, Software, Writing – review & editing. Hongwei Zhang: Methodology, Investigation, Software, Writing – review & editing, Visualization, Data curation. Jiaxin Huang: Methodology, Writing – original draft, Writing – review & editing, Formal analysis. Xuguang Zuo: Resources, Writing – review & editing, Supervision.

Data availability

Data will be made available on request.

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