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# Research in International Business and Finance

journal homepage: [www.elsevier.com/locate/ribaf](http://www.elsevier.com/locate/ribaf)

Full length Article

## Did COVID-19 change spillover patterns between Fintech and other asset classes?

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### ARTICLE INFO

#### Keywords:

Fintech  
KFTX  
Bitcoin  
Global equity index  
Oil  
Forex  
COVID-19

### ABSTRACT

This study examines the spillover effect between financial technology (Fintech) stocks and other financial assets (gold, Bitcoin, a global equity index, crude oil, and the US Dollar) during the COVID-19 crisis. Employing daily data from June 2019 to August 2020, our empirical analysis shows that the outbreak of COVID-19 exacerbated volatility transmission across asset classes, while subsequent decreases in new confirmed cases globally reduced the intensity of these spillovers. The evidence for the USD and gold supports their safe haven properties during catastrophic events, while innovative technology products as represented by a financial technology index (KFTX) and Bitcoin were highly susceptible to external shocks. These results show that when push comes to shove, the buck stops with the USD and gold and that the exorbitant privilege enjoyed by the USD prevailed during the COVID-19 pandemic.

### 1. Introduction

The rapid adoption of financial technology (Fintech) within the financial services industry is evident in the multifaceted interconnections between Fintech and other asset classes.<sup>1</sup> These connections and their effects can be explained in the context of similarities between key market segments and Fintech (for example, see [Dorflleitner et al., 2017](#); [Kommel et al., 2018](#); [Yao et al., 2018](#)) and increased investment into Fintech firms from traditional financial institutions ([Lee and Shin, 2017](#)). In this study, we explore the relationship between innovative and traditional financial markets during the COVID-19 pandemic. Although the Fintech ecosystem has proven to be transformative for the financial sector, the demand for Fintech services is dependent on economic activities across the globe, which have been enormously affected by COVID-19. Therefore, it is critical to understand the changes in the pattern of information transmission between Fintech and traditional financial markets to inform policymakers and practitioners about how these markets respond to unprecedented events, such as the COVID-19 pandemic.

The COVID-19 pandemic has had crucial implications for the global financial sector and is shaping research in finance ([Goodell, 2020](#)). For example, some studies have analyzed the implications of COVID-19 for financial markets and portfolio diversification (e.g.,

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<sup>1</sup> Financial technology, or Fintech, a term that refers to innovation in the field of financial services arising from the digital revolution, has gained popularity in recent years. For example, the popularity of smartphones and the internet have enabled Fintech firms to develop ways for financial market participants to conduct transactions more efficiently than in the past.

<https://doi.org/10.1016/j.ribaf.2021.101441>

Received 24 August 2020; Received in revised form 16 April 2021; Accepted 17 April 2021

Available online 28 May 2021

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Corbet et al., 2020a and 2020b; Goodell and Goutte, 2020a; Yarovaya et al., 2021a). The COVID-19 crisis created a set of new issues that amplified the ongoing challenges of globalization, such as increased market interconnectedness and financial contagion (Nasir and Du, 2018; Baker et al., 2020; Ghabri et al., 2020). Lucey et al. (2021) introduced a Cryptocurrency Uncertainty Index (UCRY) that showed that the COVID-19 pandemic increased both price and policy uncertainty in cryptocurrency markets, which may have affected the growing safe haven and hedging properties of the assets. In this study, we aim to answer a broad research question that is important for financial markets participants: to what extent have various financial assets acted as safe havens during the pandemic? The debate about what is and what is not a safe haven is not new and although there is some consensus regarding the diversification benefits of certain asset classes, this question remained unsettled even in the pre-COVID world.

Current debates are specifically focused on the hedging and safe haven properties of gold and cryptocurrencies. For instance, Ciner et al. (2013), Lucey and Li (2015), Beckmann et al. (2015), and Henriksen (2018) reported on the effectiveness of gold as a hedge against the stock. Similarly, studies by Luther and Salter (2017); Stensås et al. (2019), and Urquhart and Zhang (2019) focused on cryptocurrencies and found them to be an alternative safe haven asset class. Some studies considered cryptocurrencies and gold within the same empirical investigation (see Klein, 2017; Lucey and Li, 2015) and found that cryptocurrencies are not stable over time (Klein et al., 2018; Corbet et al., 2020b). A recent study by Thampanya et al. (2020) raised concerns about the hedging ability of both gold and cryptocurrencies with respect to the stock market, whereas, in a contemporaneous study, Huynh et al. (2020) argued that although the fourth industrial revolution has created new investment opportunities in the form of technology indexes and cryptocurrencies, the significance of traditional assets such as gold has not been diminished. Given that the debates regarding hedge effectiveness and the safe haven characteristics of various asset classes are still unsettled, the COVID-19 pandemic has given it a new context. Within that context, this study explores the spillover effect between Fintech and other financial assets during the COVID-19 crisis.

Considering its significance and socio-economic and financial implications, a number of studies have focused on the COVID-19 pandemic and financial markets. One of the earliest contributions was made by Goodell (2020), who argues that COVID-19 will have crucial implications for and shape future research in finance. Specifically, Conlon and McGee (2020) focused on the US markets, while Corbet et al. (2020b) examined the Chinese stock market and both reported that during the pandemic, Bitcoin was shown to be a weak hedge and did not act as a safe haven. In contrast, Goodell and Goutte (2020a and 2020b) have shown that Bitcoin did increase in value during the pandemic. Furthermore, focusing on industry level data, Goodell and Huynh (2020) reported abnormal returns by the legislator in the US stock market that were due to COVID-19 and trading ahead of the market. With respect to gold, Cheema and Szulczuk (2020) reported that gold as an asset lost its safe haven properties during the global pandemic. In the context of COVID-19, Corbet et al. (2020a) reported a significant spillover effect between oil and renewable energy firms' stock that could have implications for portfolio diversification. Given that these early studies on the subject have reported contrasting results, there is clearly more to be done to understand the impact of the COVID-19 pandemic on financial markets.<sup>2</sup>

Despite Fintech's popularity, the implications of COVID-19 for the sector are relatively underexplored (Yarovaya et al., 2021b). To the best of our knowledge, this is the first study that considers whether the impact of a pandemic that is integral to a Fintech index could spill over to other traditional financial assets and vice versa and whether an index of Fintech companies acts as a recipient or source of such volatility spillovers. Specifically, we focus on three research questions: (i) did volatility spillovers change under the COVID-19 pandemic; (ii) are Fintech firms immune to external shocks transmitted from traditional financial markets; and (iii) were traditional (stock, foreign exchange, oil, and gold) or innovative (cryptocurrencies and Fintech) assets better hedges during the COVID-19 crisis? Providing answers to these questions is also an important contribution of this study.

To answer these questions, we constructed measures of connectedness from variance decompositions, following the approach in Francis and Kamil (2014). This allows our study to make additional contributions as follows. First, by doing so, we contribute to the literature on market interconnectedness by providing new empirical evidence on spillover effects between innovative and traditional financial asset returns and volatilities before and after the outbreak of the COVID-19 pandemic. To reiterate, this is the first study to analyze the spillover effect between financial technology companies and other assets in the context of the pandemic. Specifically, we use a generalized vector autoregressive framework to characterize daily volatility spillovers between the KBW NASDAQ financial technology index (KFTX),<sup>3</sup> the cryptocurrency market, and traditional asset classes such as gold, oil, foreign exchange markets, and a global developed market equity index. Our key findings suggest that the pandemic amplified volatility spillovers between these markets. Second, this study contributes to the literature on safe haven assets and hedging by including Fintech and cryptocurrencies. Our findings show that the USD and gold acted as safe havens during the pandemic, while innovative technology-related assets such as the KFTX and Bitcoin were recipients of volatility shocks, similar to other traditional products (the Morgan Stanley Capital International (MSCI) World Index and oil). These key findings shed light on how market participants differentiate between Fintech and traditional asset classes, providing useful insights for practitioners and policymakers.

The remainder of the paper is organized as follows. Section 2 presents our methodology and descriptive statistics for the data used in the study. Section 3 reports our empirical findings and offers a brief discussion of results. Section 4 concludes this short study and suggests policy implications.

<sup>2</sup> Please see Yarovaya et al. (2020) for comprehensive review of the COVID-19 literature.

<sup>3</sup> The KBW Nasdaq financial technology index is designed to track the performance of financial technology companies that are publicly traded in the U.S.

## 2. Data and methodology

### 2.1. Data

Our study uses daily financial market data from June 5, 2019 to August 20, 2020. The number of global COVID-19 cases was reported beginning January 23, 2020 and was obtained from the Worldometer website. Data on the KFTX was obtained from Bloomberg. Data on the MSCI World Index (MSCI), which tracks equity markets in developed countries globally, gold (gold bullion from the LBMA, in USD), the price of crude oil (WTI Spot Cushing, in USD), and Bitcoin (BIT) were obtained from Thomson Reuters' (now Refinitive) DataStream.

Fig. 1 shows the market dynamics for these financial assets as well as the increase in confirmed cases of COVID-19. The major recovery likely happened to both innovative and traditional financial assets especially when the COVID-19 cases started to drop.

Descriptive statistics for our dataset are presented in Table 1.

Data for financial assets includes open, close, high, and low prices over the period from June 5, 2019 to August 20, 2020. Following Diebold and Yilmaz (2012), the daily variance for asset  $i$  at time  $t$  is estimated using the high and low prices:

$$\sigma_{it}^2 = 0.361 \left[ \ln \left( P_{i,t}^{max} \right) - \ln \left( P_{i,t-1}^{min} \right) \right]^2. \tag{1}$$

To compute asset volatility, the low price is observed at  $t-1$ . As high, low, open, and close prices on any given day are all the same for the assets represented by indexes in this study, returns and volatilities would be zero if we had used high and low prices recorded on the same day. As price volatilities are often skewed, we used log-volatilities, which closely approximate a normal distribution. However, to control for cases when volatility is zero,  $\sinh^{-1}$  is used instead of the natural logarithm ( $\sinh^{-1}(x) = \log(2x)$ ):

$$\sigma_{i,t} = \sinh^{-1} \left( \sqrt{252 * \sigma_{it}^2} \right) \tag{2}$$

Figs. 2 and 3 show the daily volatilities of the various asset classes for periods before and during the COVID-19 pandemic. Oil, BIT, and the MSCI equity index display the highest level of volatility, while gold and KFTX are less volatile. Among these financial assets, the US dollar (DOLLAR) is the most stable over the entire period. To examine the volatilities of these asset classes more closely, we separated the period into before and during the COVID-19 pandemic (see Fig. 3 below and Fig. 4). This shows that oil and Bitcoin experienced the highest volatility during both the periods, while the US Dollar was the most stable of the assets studied.

### 2.2. Methodology

To measure volatility transmission during the COVID-19 pandemic, we divided the data sample into two sub-periods, before COVID-19, that is, from June 5, 2019 to January 10, 2020, covering 159 trading days before the outbreak and during the outbreak (during COVID-19), that is, from January 13, 2020 to August 20, 2020. According to the vector autoregression (VAR) model employed, a forecast of stock price returns or volatility involves two components—systematic and idiosyncratic—presented here as a regression:

$$\sigma_{it} = \beta \sigma_{M,t-1} + \varepsilon_{i,t}. \tag{3}$$

where  $\sigma_{it}$  is the volatility of asset  $i$  at time  $t$ ,  $\sigma_M$  is market volatility,  $\beta$  is the systematic portion of an asset's volatility or the measure of its relationship to the broader market, and  $\varepsilon$  is the idiosyncratic portion that relates to asset  $i$ . The crucial questions are (1) how

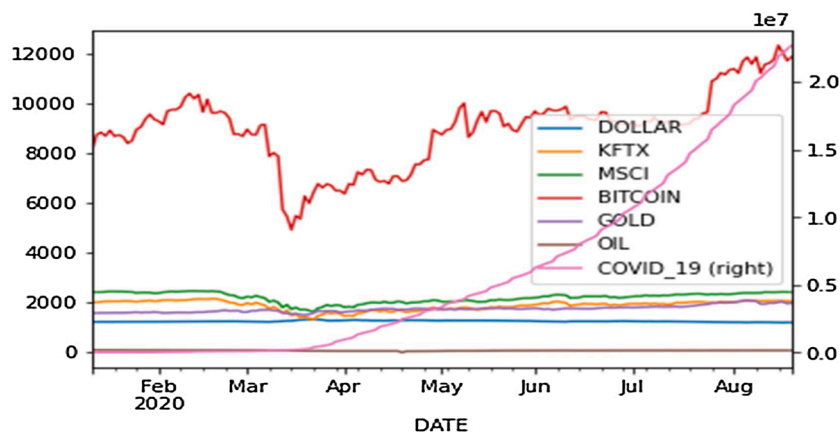


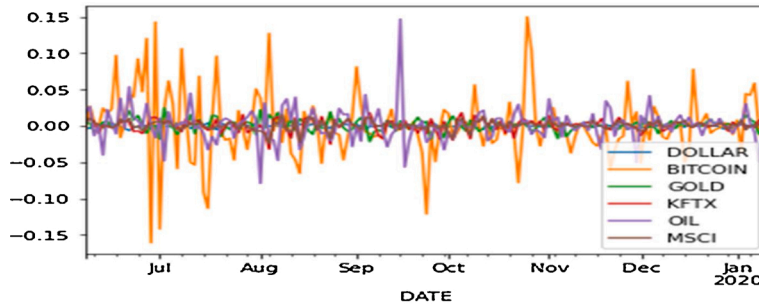
Fig. 1. Dynamics of financial assets and COVID-19 cases.

Source: Authors calculations. Notes: We normalized FINTECH (KFTX) and financial assets at 100 at the start date. The LHS and RHS Y-axes depict financial assets' price movements and reported cases of COVID-19.

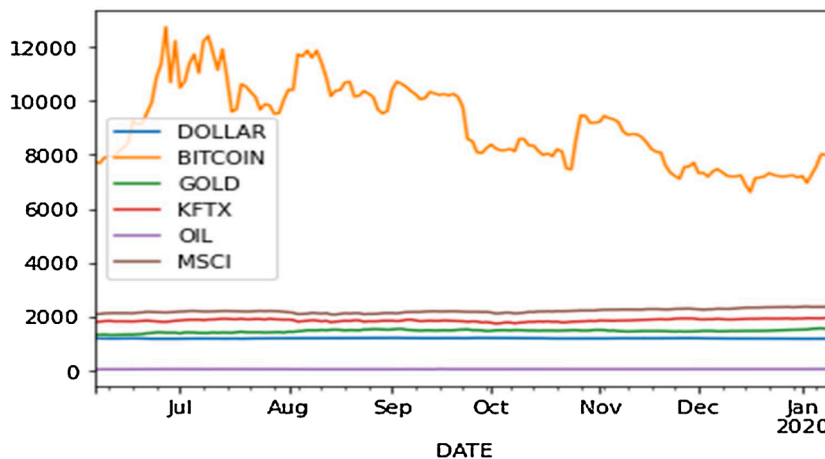
**Table 1**  
Descriptive Statistics.

Index	Mean	Std. Dev.	Skewness	Kurtosis	JB
BIT	0.0024	0.0429	-0.9407	10.5846	906.0205***
DOLLAR	0.0002	0.0046	0.4426	4.1828	97.4003***
Gold	0.0009	0.0132	0.6938	7.4045	287.7144***
KFTX	0.0004	0.0245	-0.4846	2.5789	42.1220***
MSCI	0.0001	0.0232	-0.7540	5.6194	193.3275***
Oil	-0.0273	0.3088	-7.6640	69.5776	27326.3534***

Notes: The number of observations is 316 trading days. \*, \*\*, and \*\*\* denote significance at the 90 %, 95 %, and 99 % levels, respectively. JB denotes the Jarque–Bera normality test.



(a) Asset Returns Before COVID-19



(b) Asset Prices Before COVID-19

Fig. 2. (a) Asset Returns Before COVID-19. (b) Asset Prices Before COVID-19.

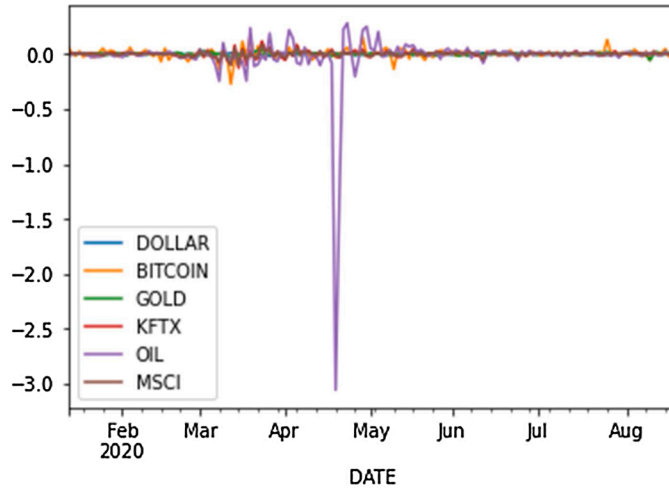
responsive is future volatility  $\sigma_{i,t+1}$  at time  $t + 1$  to a shock to  $\varepsilon_{i,t}$  and (2) in a system with various volatilities, how does a shock to the idiosyncratic term,  $\varepsilon_{j,t}$ , for variable  $j$  at time  $t$  affect  $\sigma_{i,t+1}$  for variable  $i$  at time  $t + 1$ ? Stated differently, when and how does the idiosyncratic risk of one asset's volatility affect the future volatilities of other assets? These effects are the spillovers we wish to analyze.

A VAR with  $P$  lags for a set of  $N$  variables with  $\sigma_i$  for  $i = 1, \dots, N$  variables will replace  $\sigma_M$ :

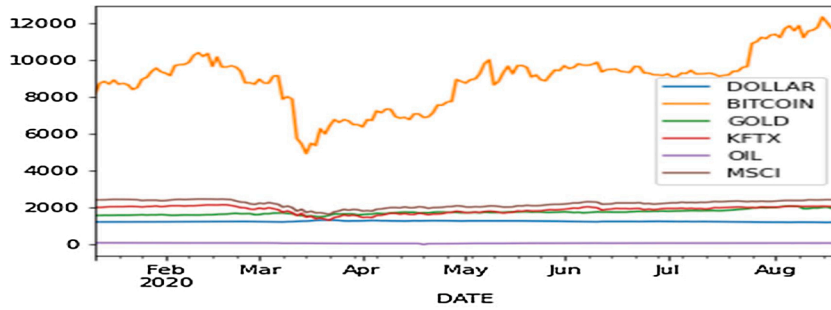
$$\sigma_t = \sum_{i=1}^P \beta_{t-1} \sigma_{t-1} + \varepsilon_t \tag{4}$$

where  $\sigma_t$  and  $\sigma_{t-1}$  are vectors of length  $N$ , each  $\beta_{t-1}$  is an  $N \times N$  coefficient matrix, and  $\varepsilon_t$  is a vector of error terms with a distribution  $N(0, \sigma^2)$ .

Next, we convert VAR into a moving average representation of order  $Q$ (MA(Q)):



(a) Assets Returns Before COVID-19



(b) Assets Prices Before COVID-19

Fig. 3. (a) Assets Returns Before COVID-19. (b) Assets Prices Before COVID-19.

$$\sigma_i = \sum_{l=0}^Q \varnothing_{t-l} \varepsilon_{t-l} \tag{5}$$

where each  $\varnothing$  is a matrix of coefficients that measure the magnitudes of each impulse. Here, an impulse is defined as a unitary shock to  $\varepsilon_{t-1}$ . The next step is to derive the impulse response function (IRF) for each variable using the MA(Q) for each variable  $j$  on variable  $i$ .

$$\sum_{l=0}^Q (e_i' A_l P e_j)^2 \tag{6}$$

where  $e_i$  and  $e_j$  are basic vectors with utility at  $i$  and  $j$ , respectively, and  $A$  is a matrix of  $\varnothing$  coefficients. The impulse response is the cumulative error of the forecast of a shock to variable  $i$  from variable  $j$  at time  $t-l$ .

Finally, using the IRF, we calculated the forecast error variance decomposition matrix for the entire set of variables.

$$\theta_{ij}^0 = \frac{\sum_{l=0}^n (e_i' A_l P e_j)^2}{\sum_{l=0}^n e_i' A_l \Sigma A_l' e_i} \tag{7}$$

The numerator is the impulse response, the denominator is the total forecast error in a system of variables, and  $\Sigma$  is the error covariance matrix. The forecast error variance of variable  $i$  attributable to variable  $j$  is the impulse response of  $j$  on  $i$ , divided by the total forecast error of  $i$ .

### 3. Empirical findings

#### 3.1. Spillover effects between financial assets before and during COVID-19

The results of our analysis of whether volatility is transmitted between the innovative assets (KFTX, Bitcoin) and traditional

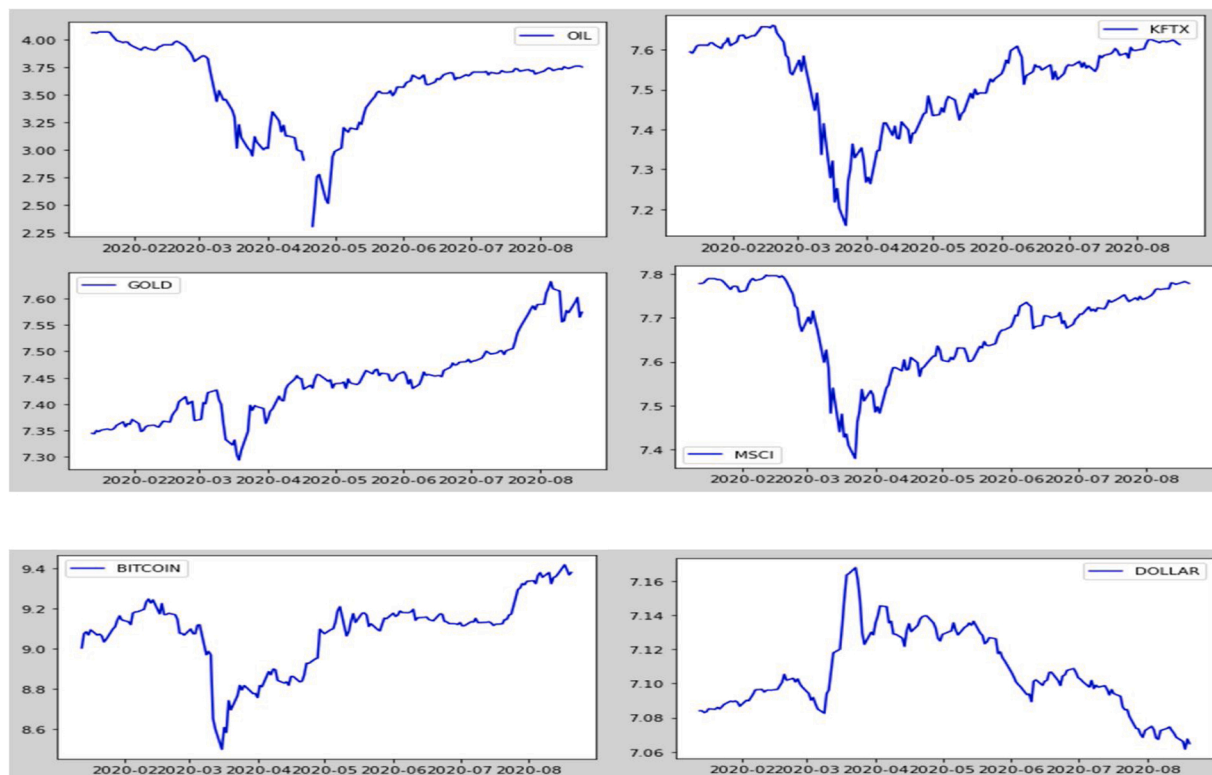


Fig. 4. Asset Returns during COVID-19.

financial assets are presented in Tables 2 and 3 for the periods before and subsequent to the outbreak of the COVID-19 pandemic.

The results from Table 2 show that before the outbreak of COVID-19, the DOLLAR index received the highest level of volatility from the overall system, followed by KFTX, while MSCI, gold, and oil contributed the highest levels of volatility to the overall system, and DOLLAR and KFTX contributed lower levels of volatility at 5.86, and 14.41, respectively. The results in Table 3 tell an interesting story compared to Table 1. The outbreak of COVID-19 moved the highest and lowest level of volatilities of different assets to a more balanced state; each financial asset received volatility in the other assets in the range of 11–12, and DOLLAR, BITCOIN, and oil have caused the highest volatility from the other assets, approximately at 21.18, 14.45, and 13.86, respectively.

The World Health Organization declared COVID-19 a Public Health Emergency of International Concern (PHEIC) on January 30, 2020 after cases of coronavirus were reported in China in November 2019. It is not surprising that the volatilities of the financial assets in our study are larger for the period after the outbreak of COVID-19. In contrast, the period after COVID-19 was identified as a PHEIC, which started on January 23, 2020, produced less volatility spillover effects between the financial assets. In summary, these spillover tables provide an input-output decomposition of the Spillover Index. As shown in Table 2, the total volatility spillovers from USD to other assets (i.e., DOLLAR's contributions to others) are much larger before the COVID-19 outbreak (54.17) than after (21.18). Total volatility spillovers from other assets to DOLLAR are 24 before and 4 after the outbreak of the COVID-19 pandemic (DOLLAR contributions from others).

From the results of the analysis of volatility spillovers, we can estimate the net pairwise spillover by subtracting two spillovers. For example, during two periods, the Fintech (KFTX) volatility transmission to gold is 17.02 and 9.58, while the volatility transmission from gold to Fintech (KFTX) is 0.73 and 10.19 and hence, the net pairwise spillover from Fintech (KFTX) to gold is 16.29 before the

Table 2

Volatility spillover of Assets before COVID-19.

Before COVID-19							
	DOLLAR	KFTX	MSCI	BITCOIN	Gold	Oil	FROM
DOLLAR	64.87	17.85	1.05	12.01	0.93	3.28	5.86
KFTX	67.16	16.98	0.96	10.99	0.73	3.19	13.84
MSCI	66.90	17.03	1.05	10.98	0.86	3.18	16.49
BITCOIN	61.11	19.80	1.27	13.53	1.03	3.26	14.41
Gold	67.11	17.02	0.87	10.92	0.79	3.28	16.53
Oil	62.72	18.48	1.74	12.38	1.26	3.41	16.10
TO	54.17	15.03	0.98	9.55	0.80	2.70	83.23

**Table 3**  
Volatility spillover of Assets during COVID-19.

	DOLLAR	KFTX	MSCI	BITCOIN	Gold	Oil COVID-19	FROM
DOLLAR	24.55	9.97	10.19	16.95	10.53	15.95	10.78
KFTX	25.09	9.64	9.90	16.77	10.19	16.34	12.91
MSCI	25.05	9.68	9.95	16.71	10.24	16.30	12.86
BITCOIN	24.06	9.95	10.09	17.27	10.50	15.98	11.82
Gold	24.73	9.58	9.76	16.98	10.12	16.44	12.84
Oil	24.76	9.92	10.14	16.92	10.41	16.02	12.00
COVID-19							<b>12.63</b>
TO	21.18	8.45	8.63	14.45	8.93	13.86	<b>10.34</b> 85.84

Note: The row totals of the spillovers measure how much volatility asset  $i$  receives from the system. The column totals measure how much volatility each asset contributes to the overall system. Hence, each cell in the table is a measure of how much volatility from column  $i$  is given to row  $j$ .

COVID-19 outbreak and from gold to Fintech is 0.61 after the COVID-19 outbreak. The net pairwise spillover provides another way to examine volatility spillover effects between different asset types in the markets. Overall, KFTX had similar spillover effects to other financial assets in the study during both periods before and after the COVID-19 outbreak. The spillover effects for KFTX have implications for investors who are interested in observing asset classes that have high levels of volatility transmission to the Fintech market. This provides evidence that traditional markets such as DOLLAR did not help to hedge volatile events, while the innovative markets Fintech, and gold were safe havens during the catastrophic pandemic.

### 3.2. Robustness testing

The higher volatility of the financial assets during the COVID-19 outbreak may raise the question of whether this increased volatility is due to the pandemic or due to a different external factor, such as the non-stationarity of the sampled data. Fig. 4 shows that the data lack any consistent trends across the asset classes. Many showed a positive trend that then reversed dramatically when COVID-19 lockdowns were initiated in March 2020, followed by a significant jump; however, gold and BITCOIN declined more gradually and DOLLAR followed a different path, declining to a low at the end of August 2020. Therefore, we conducted robustness tests by examining the stationarity of the data after the COVID-19 outbreak to remove any seasonality effect by using a rolling mean and standard deviation.

The graphs in Fig. 5 indicate that volatility (rolling standard deviation) increased significantly at the outbreak of COVID-19 across all financial assets.

## 4. Conclusion & implications

This study analyses the impact of the COVID-19 pandemic on the dynamics of volatility spillovers in financial markets, focusing on innovative assets, such as a Fintech index and Bitcoin, and traditional assets, such as gold, oil, global equities, and the USD. Employing data for periods before and during the COVID-19 pandemic, our results show that bursts of volatility spillovers between the Fintech index, Bitcoin, and traditional assets are associated with the outbreak of this global pandemic. The USD and gold appear to have been the pillars of stability during the COVID-19 crisis; hence, we can confirm their role as safe haven assets. In contrast, innovative assets represented by Bitcoin and the Fintech index are shown to be the largest recipients of volatility spillovers during the COVID-19 pandemic and, therefore, should not be considered as safe havens. We acknowledge that there is still considerable uncertainty regarding the spillover effect of the epidemic and its long-term impact on the global economy. The study contributes to the ongoing debate regarding the impacts of COVID-19 on financial markets and diversification opportunities that have been available during this crisis by focusing on the volatility spillover effects of both high-tech financial and traditional asset classes. The results offer important implications with respect to designing an effective diversification strategy. The USD maintained its unique role in the global economy and the so-called exorbitant privilege (*privilege exorbitant*) it enjoys. When push comes to shove, the buck stops with the USD and gold, as was the case in the pre-Fintech and Cryptocurrency era.

### Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

### CRedit authorship contribution statement

**Lan-TN Le:** Methodology, Software, Formal analysis, Data curation. **Larisa Yarovaya:** Conceptualization, Resources, Writing - review & editing. **Muhammad Ali Nasir:** Conceptualization, Writing - original draft, Project administration.

### Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.ribaf.2021>.



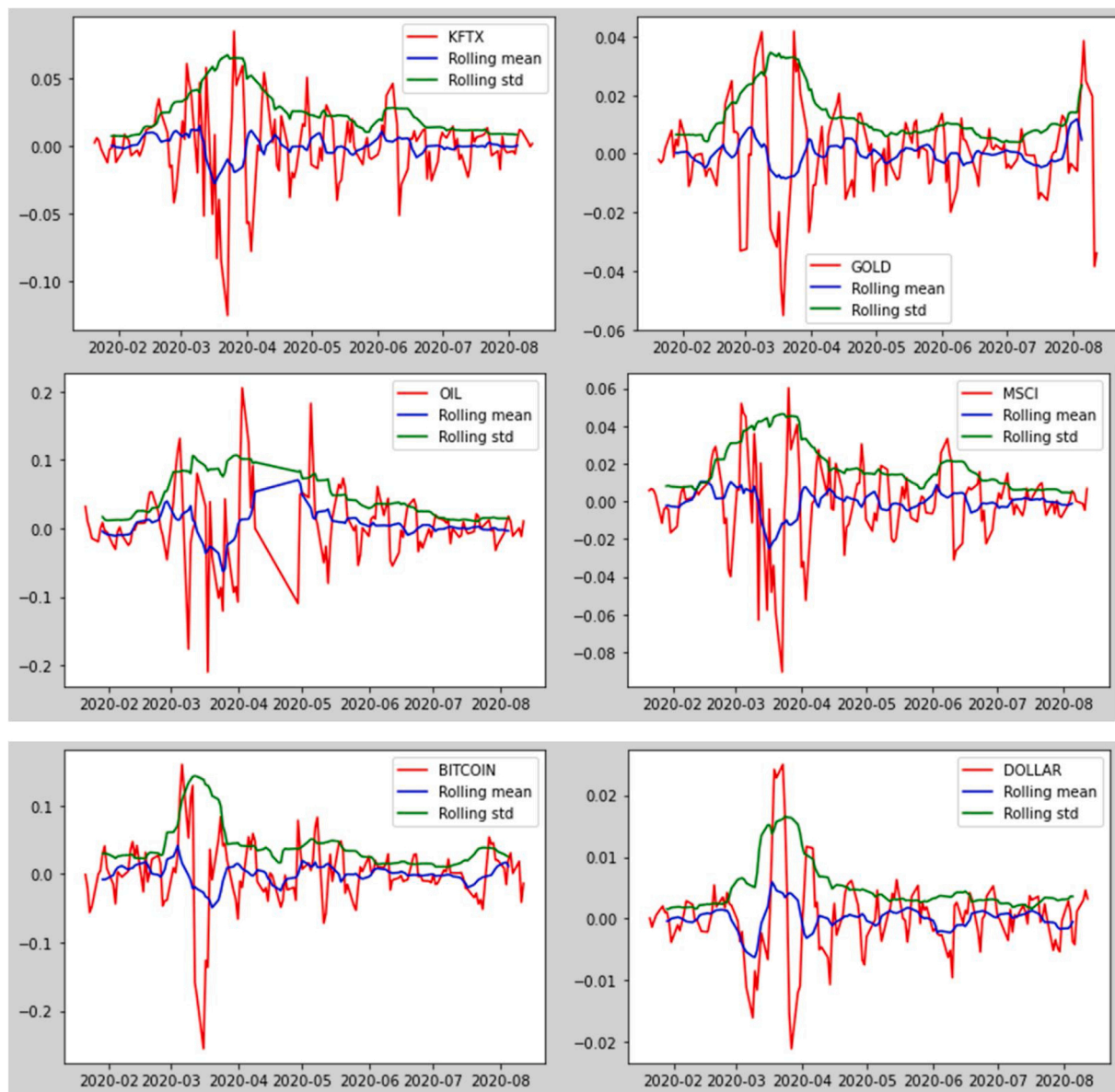


Fig. 5. Log Volatility of Financial Assets after COVID-19.

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