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# Cryptocurrencies and COVID-19: What have we learned?

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## Abstract

We highlight the considerable recent research that investigates how cryptocurrencies have been impacted by COVID-19. We highlight common threads of investigation and consider common findings and conclusions. We also provide suggestions for future research. Additionally, we provide an overview of a recent paper in which we report on a study that applies wavelet methods to daily data of COVID-19 world deaths and daily Bitcoin prices,

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## 1 Introduction

As 2020 is coming to a close, the COVID-19 pandemic is still ongoing, with in many regions of the globe, unprecedented levels of cases and deaths. While the eventual scale of the disaster is not yet determined, the initial deployment of vaccinations suggests the possibility of the 'end of the beginning.' We are all now tragically familiar with the ongoing enormous costs in lives of this pandemic. However, we are also concerned about the eventual economic impact of this crisis, including the impact on financial markets. In response to this, a number of researchers, have investigated the association of COVID-19 with the movement of cryptocurrencies.

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We include ourselves in these efforts. In a recent article (CITE FRL), we apply wavelet methodology (Grinsted et al., 2004; Kang et al., 2019) to daily data of COVID-19 world deaths and daily Bitcoin prices from 31th December 2019 to 29th April 2020, finding that levels of COVID-19 caused a rise in Bitcoin prices. This effect is especially strong for the portion of our period post April 5. Our results, as well as others, are particularly meaningful when considering that COVID-19 catalyzes greater concern for future economic costs, and likely greater economic uncertainty. As noted by Goodell (2020), the ongoing COVID-19 crisis will have enormous ongoing economic costs. Prior to the current crisis, for instance, Bloom, Cadarette, and Sevilla (2018) point out the economic vulnerability posed by potential pandemics, both in terms of costs to the health system, as well as costs of social distancing: loss to employment productivity, loss to consumer demand, an impact on tourism and other particular industries, and an impact on foreign direct investment<sup>1</sup>. This concern is echoed by Fan, Jamison, and Summers (2018). They note very recently “an unmet need for greater investment in preparedness against major epidemics and pandemics.” They estimate the expected annual losses from pandemic risk to be annually approximately 500 billion US dollars, or 0.6% of global income. Considering the costs of COVID-19, this seemingly large sum now seems greatly underestimated. Other works highlighting the need for economic risk management vis-à-vis the potential likelihood of future pandemics include Bloom and Canning (2004); Cavallo et al. (2013); Lewis (2001); Madhav et al. (2017); Tam, Khan, and Legido-Quigley (2016); Yach, Stuckler, and Brownell (2006) and many others. Lagoarde-Segot and Leoni (2013) model the stress to the banking industries of developing countries as a result of large pandemics.

As noted by Goodell (2020), COVID-19 engender a long-term increase in costs of equity. Lee and McKibbin (2004), for instance, find a 200-basis point increase in the country risk premium for China and Hong Kong following SARS. However, China and Hong Kong were particular risk areas for SARS, while COVID-19 is global. Consequently, a large increase in perceived equity risk is reasonably expected.

As gold is often considered to move with economic policy uncertainty (Raza, Shah, and Shahbaz, 2018), it is natural to extend this inquiry to cryptocurrencies. Certainly, there are numerous studies investigating the co-movement of Bitcoin and similar currencies with movement in global economic uncertainty. Again, this area is not settled. For instance, Wu et al. (2019) and Wang et al. (2019) find a negligible relationship, while Bouri et al. (2018) and Demir et al. (2018) find a stronger relationship.

It is also reasonable to consider further the movement of Bitcoin with other assets, particularly in the context of changes in economic apprehension. After all, economic conditions manifest to financial markets through changes in asset prices. While Bouri et al. (2017b), Klein et al. (2018) and Smales (2018) do not find consistent evidence that Bitcoin serves as a safe haven for global assets, Selmi et al. (2018) show that Bitcoin, like gold, serves as a hedge, safe haven, and

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<sup>1</sup>See also Goodell and Huynh (2020) for impact of COVID-19 on US industries

diversifier for oil price movements. However, this property seems to be sensitive to the Bitcoin's and gold's different (bear, normal or bull) market conditions and to whether the oil price is in a downside, normal or upside regime. Kurka (2019) find that the relationship between Bitcoin and other assets depends on whether there are shocks occurring. Further, Matkovskyy and Jalan (2019) find that, during crisis periods, risk-averse investors tend to move away from Bitcoin, with a view that it is riskier than financial markets. The reader can have a look on Goutte et al (2020) to have a complete survey of Cryptofinance and Mechanisms of Exchange.

A further question is how the role of Bitcoin in hedging other assets has changed during the period of the COVID-19 crisis. Understandably there are few studies yet on such recent events. An exception is Conlon and McGee (2020), who show that Bitcoin has indeed been a poor hedge against the SP500 during the COVID-19 crisis.

Overall, our study of how Bitcoin prices co-move with the intensity of the COVID 19 crisis contributes, alongside other new investigations, to our understanding both of how COVID-19 is impacting financial systems; as well as how Bitcoin might act as a hedge, diversifier, or safe haven during extreme, global, crises.

While Goodell and Goutte, 2020 evidence Bitcoin as acting as a safe haven similar to gold. However, others, (Chen, Liu and Zhao, 2020; Conlon, Corbet and McGee, 2020; Conlon and McGee, 2020) find that fear has an adverse effect on Bitcoin returns, nullifying the role of Bitcoin and Ethereum as a safe haven asset. Additionally, others find that cryptocurrencies do not act as a hedge or safe haven during extreme financial and economic downturns (Conlon and McGee, 2020; Corbet, Larkin, et al., 2020).

## 2 Data and econometric framework

This study applies the wavelet method of Grinsted et al. (2004) to daily data of COVID-19 world deaths and Bitcoin prices from 31th December 2019 to 29th April 2020. We employ the methodology stated in Goodell and Goutte (2020). We compute the daily returns by finding the difference between two consecutive prices:  $ri, t = P_{i,t} - P_{i,t-1}$  with  $i$  is for COVID-19 deaths and Bitcoin.

Figure 2 shows the dynamics of the return series and illustrates the stylized factors (e.g., volatility clustering) for the Bitcoin return series.

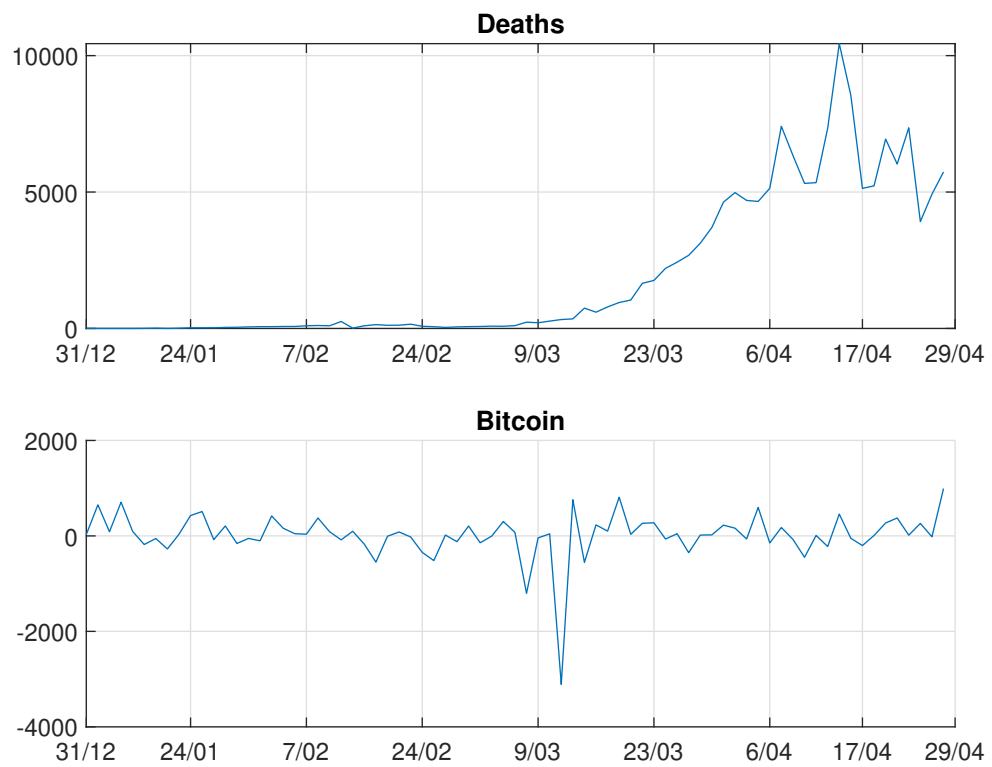


Figure 1: Evolution dynamics of the return series

We see on Figure 2, that the dynamic of the COVID-19 pandemic is a two-phase process: an exponential increasing of the death's number until middle of April then a quite linear decreasing.

Table 1 presents descriptive statistics of the return series. booktabs

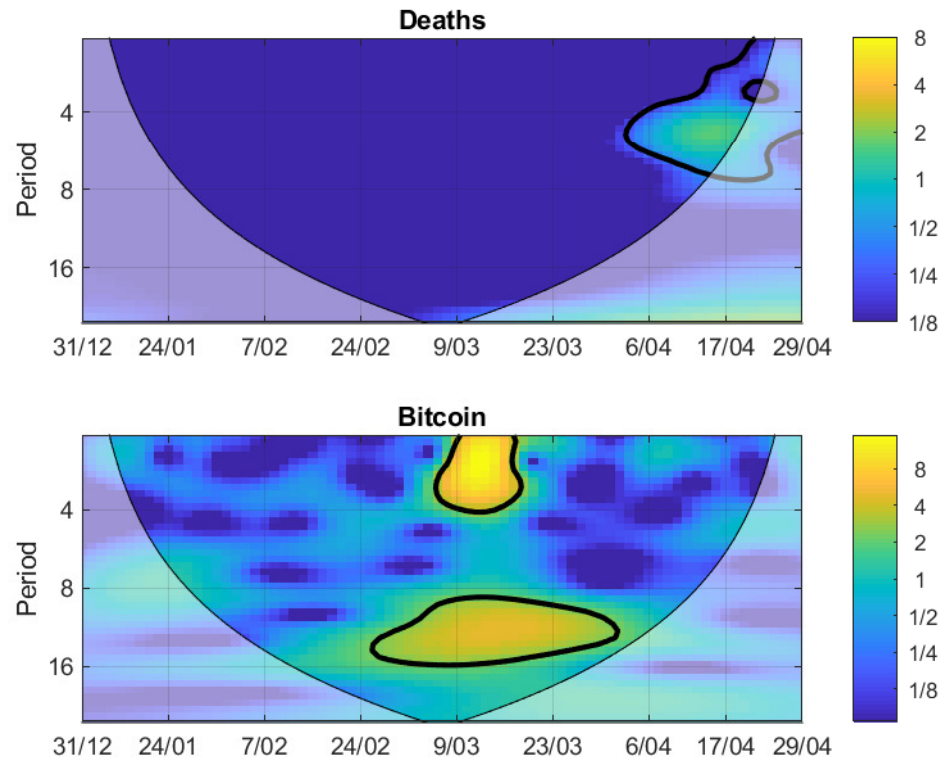
Table 1: Descriptive Statistics

	Covid Deaths	Bitcoin
Mean	1889.519	20.602
Std. Deviation	2678.431	488.075
Skewness	1.272	-3.507
Std. Error of Skewness	0.274	0.274
Kurtosis	0.491	22.184
Std. Error of Kurtosis	0.541	0.541
Shapiro-Wilk	0.730	0.704
P-value of Shapiro-Wilk	< .001	< .001

As shown in Table 1, Bitcoin exhibits skewing, as well as excess kurtosis. These findings and the Shapiro-Wilk statistics demonstrate that the distributions of this series is asymmetric and leptokurtic, rejecting the normality property. As the series are asymmetric and leptokurtic, we consider that wavelet analysis is the appropriate tool. Wavelet analysis, rather than assessing an average statistical relationship, investigates co-movement with time, as well as frequency.

## 2.1 Wavelet coherence

We apply continuous wavelet power spectrum and coherence methodologies between COVID-19 deaths and Bitcoin return prices. This is illustrated in Figures 2.1 and 2.1. The wavelet power spectrum is defined as the absolute value of the square of the wavelet transform. It gives us a measure of the time series variance for each time and for each scale (frequency). The horizontal axis displays the time component, while the vertical axis shows the frequency component. This ranges from scale 1 (a day) up to scale 16 (more than 16 days). The black contours in the plot indicate regions with significance at the five-percent level. This is estimated by Monte Carlo simulation with phase-randomized surrogate series. The solid curved line shows the cone of influence, or the zone affected by edge effects.



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Figure 2: Continuous wavelet transform of COVID-19 deaths and Bitcoin returns. The horizontal axis shows time, while the vertical axis refers to the period in days..

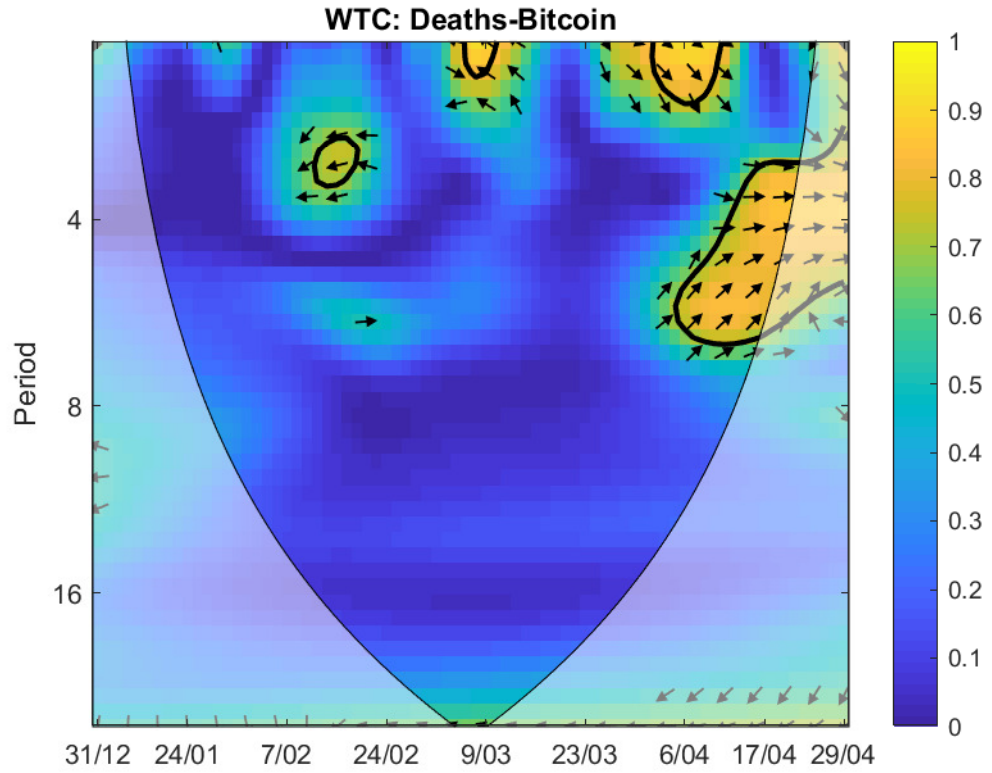


Figure 3: Wavelet coherency (WTC) between COVID-19 deaths and Bitcoin. The level of correlation is indicated by the color on the right side of the charts; the hotter the color (moving from cool (blue) to hot (yellow)) the higher the absolute correlation value with respect to  $R^2(u, s)$ .



## Two new periods:

1- One month lag between beginning of April to middle of May

2- One week lag between 10 June to 10 July

Figure 2.1 illustrates the wavelet coherence and phase difference between COVID-19 deaths and Bitcoin return prices. The coherency ranges from yellow (high coherency) to blue (low coherency) to designate the amount of co-movement. Therefore, a yellow color represents strong co-movement; whereas a blue color indicates weak co-movements. We can identify four significant high-degree co-movements between COVID-19 deaths and Bitcoin.

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- For the 10th February to 20th February period across the 2-4 day frequency band.

- A two-day frequency cycle observed during the period 8th March to 10th March and another one during the period 5th April to 10th April. 10th April to 30 april
- A particularly meaningful and significant coherence for 3-7 day frequency cycles observed during the period 5th April to 29th April. 5 to 8 days

Middle of April to Middle May

These coherences evidence the contagion effect during the implementation of containment in the majority of the countries of the world (i.e. after middle of March). The increasing of COVID-19 deaths was associated with a reduced value of Bitcoin for short and mid terms during this period. Perhaps these periods roughly match 1) the beginning of the pandemic (i.e., a global threat outside of China; 2) the beginning of large-scale enforced social distancing in many Western countries; and 3) the full global manifestation of COVID-19.

Additionally, we discern causality and phase differences between COVID-19 deaths and Bitcoin returns. Arrows indicate the phase differences between COVID-19 deaths and Bitcoin returns. For example,  $\rightarrow$  and  $\leftarrow$  indicate that both COVID-19 deaths and Bitcoin returns are in phase and out of phase. Being in phase (out of phase) indicates a positive (negative) correlation between COVID-19 deaths and Bitcoin returns. Moreover,  $\nearrow$  and  $\swarrow$  indicate that COVID-19 deaths are leading Bitcoin return prices, while  $\searrow$  and  $\nwarrow$  indicate COVID-19 deaths values are lagging those of Bitcoin return prices.

Thus as shown in Figure 2.1, we can identify causality and phase differences between COVID-19 deaths and Bitcoin return prices. We observe that since 5th April, the main and most significant period of coherence and co-movements in both 1-2 days and 3-7 day bands, that arrows are in majority  $\nearrow$  and  $\rightarrow$ , signifying an in-phase relationship and a positive correlation between COVID-19 deaths and Bitcoin returns. Moreover, these arrows also indicate that COVID-19 deaths led Bitcoin returns in the short and medium terms, over this period of full world containment.

In summary, we find predominantly a strong negative co-movement of Bitcoin prices and COVID-19. However, levels of the intensity of this co-movement do vary over our overall period of study, with some brief intervals even exhibiting a positive association. It is interesting to compare our results with Demir et al. (2018). Demir et al. (2018) find a negative association of economic policy uncertainty with Bitcoin only for extreme values of this uncertainty. Certainly COVID-19 is an extreme event, with likely an extreme impact on peoples' perception of uncertainty. Our results may result in more questions than answers for future research. For instance, how does the co-movement of Bitcoin

with COVID-19 compare with the co-movements of national financial markets with the pandemic? Why were there strong but brief periods of negative co-movement of Bitcoin with COVID-19 as early as February 10? Could Bitcoin have a signaling value? Many of these questions are outside the bounds of this paper.

### 3 Conclusions

As the COVID-19 pandemic continues, with the eventual scale of the disaster not yet determined, we are all painfully aware of the continuing cost in lives of this pandemic. However, there is also concern about the eventual economic impact of this crisis, including the effect on financial markets. Additionally, academic finance has also had, in the last few years, considerable interest in the hedging, diversifying and safe-haven qualities of Bitcoin. In response to this, we investigate the co-movement of Bitcoin with levels of COVID-19 related fatalities. We consider that while national equity markets reflect economic concerns at country levels, the evolving COVID-19 crisis affords a measure of a developing global economic threat. We apply wavelet methods to daily data of COVID-19 world deaths and daily Bitcoin prices from 31th December 2019 to 29th April 2020, evidencing that levels of COVID-19 cause a rise in Bitcoin prices. This effect is especially strong for the portion of our period post April 5. We consider that our study contributes both to the fast-growing body of work on the financial impacts of COVID-19; as well as to an ongoing focus in the literature regarding whether Bitcoin is a safe haven investment.

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