The Impact of Covid-19 on the Cryptocurrency Market and the Return of Ethereum

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Abstract: In this work, we carry out an investigation into the relationship of the cryptocurrency- Ethereum and the event of COVID-19. We examine the impact of COVID-19 on the cryptocurrency stock market using a 2-sample T-test. Moreover, we conducted an event study to analyze how COVID-19 has affected the individual stock-Ethereum. The results from the T-test indicate that COVID has not affected the overall cryptocurrency stock market. However, the results from the event study demonstrate that the return of Ethereum has been affected. The significance of this research is to inspect whether cryptocurrency is favored by the public and economy during the pandemic as a form of currency instead of traditional money.

1 INTRODUCTION

Ethereum is known as the second most popular cryptocurrency, the most popular one is Bitcoin. Both Ethereum and Bitcoin are based on the blockchain network. Literally, blockchain is a chain of "block", "block" is used to record transactions across computers ("Blockchain", Wikipedia). These "blocks" are decentralized which means that the network of blocks isn't owned by any entity— a company or a government. Instead, the blockchain is managed by all of the ledger holders. You can view blockchain as a platform, Ethereum and Bitcoin use blockchain technology to record transactions.

There are two important news about Ethereum this month. Ethereum's "London hard fork" started on August 5 (Camomile Shumba, businessinsider.com) The term "hard fork" means an improvement of protocols. After the "London hard fork", Ethereum increases its scalability, thus increase the speed and efficiency of transaction.

Another important news released on August 16. In the white paper published by Microsoft, the firm is planning to use the Ethereum blockchain to combat digital piracy (Isabelle Lee, businessinsider.com). As in the Ethereum blockchain, each transaction is recorded and Microsoft can backtrack the source of the pirated content.

Although Ethereum and Bitcoin both are based on blockchain, there are many differences between them, such as transaction speed, scripting language (Nathan Reiff, Investopedia.com). Ethereum's transaction speed is about 4 transactions per second, while it's 15 transactions per second for Bitcoin. Scripting language for Ethereum is more complicated than Bitcoin because Ethereum needs to support more complex logic, and this leads to the fact that there are more wide range of bugs in code. Other differences include the consensus algorithms that they run on (Ethereum uses ethash while Bitcoin uses SHA-256), the network upgrades they choose (Ethereum uses hard forks, while Bitcoin uses soft forks) (Coinsider, Youtube.com).

More importantly, the Bitcoin and Ethereum networks are different in their overall aims. Bitcoin was created as an alternative to national currencies, Elon Musk even said Tesla accepts bitcoin as payment. However, Ethereum was intended as a platform aiming to allow different applications working on it. I think this is the advantage of Ethereum because it is not only used as digital currency, but also as a platform. On this platform, many decentralized apps can be used such as DeFi (decentralized finance) and gaming. There are about 100 Ethereum apps you can use now including Musci, pooling and investments, etc ("100+ Ethereum Apps You Can Use Right Now", consensys.net).

There is another thing interesting about

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Ethereum. As we need to make sure that everyone agrees on the order of transactions, miners can help this happen by solving computationally difficult puzzles in order to produce blocks, which can secure the network from attacks. Basically, the first miner solves the problem and after he finish the problem and the second miner can do the double check for him and both of them can get the cryptocurrencies in return as a bonus. Miners use graphic cards to mine, and different graphics cards have different computing power. Because mining consumes a lot of electricity, some people steal electricity from the government or universities to mine it. They also need a lot of graphics cards, so the miners have affected the market by raising the price of graphics cards. The Chinese government doesn't want the economy to flow out of the country, which is why mining and cryptocurrencies are banned in China. (1Point3Arces, 2020) The purpose of this paper is to examine the effect of COVID-19 on the cryptocurrencies market and the individual stock Ethereum.

2 LITERATURE REVIEW

2.1 Brief Review

COVID-19 outbreak in 2019, has rapidly spread all over the world, affecting almost everyone on the planet and causing thousands of deaths. The COVID-19 epidemic not only has a huge impact on the overall economy, but also has a huge impact on cryptocurrency, such as Bitcoin and Ethereum.

This review tries to answer the following questions. Does the COVID-19 pandemic that surrounds everyone also affects the price of Bitcoin and Ethereum? What is the relationship between COVID-19 pandemic Bitcoin and Ethereum? Can investors increase the adoption of cryptocurrencies such as Bitcoin and Ethereum? Some academic studies have shown that the price of Bitcoin is affected by political and economic uncertainty. In a period of uncertainty around the world, many investors hope to use Bitcoin and Ethereum to store some of their assets, making it possible to use them as financial assets.

2.2 How COVID-19 Pandemic Affects Cryptocurrencies?

Studies of the impact of the COVID-19 pandemic on cryptocurrencies have emerged rapidly. Demir's study indicates that at first Bitcoin value and number of reported COVID-19 cases and deaths shows a negative relationship, however, as the pandemic lasts, the relationship becomes positive (Demir, et al, 2020). This shows that cryptocurrencies start to become a hedge as the deepening of the COVID-19 effect. The reason behind this may be the fact that as the number of reported COVID-19 cases and deaths rise, governments around the world take additional restrictions and this may increase the demand for cryptocurrencies. Bitcoin and Ethereum can mitigate some of the issues that the pandemic brought (Fang, et al, 2019). Reminding that Bitcoin and Ethereum can be used as a payment and money transfer instrument between different countries, researchers also found that demand for cryptocurrencies during the pandemic increases (Hadar and Sarel, Columbia.edu) As a result, cryptocurrencies become more attractive compared to other alternatives such as the stock and gold. Furthermore, investors fear that COVID-19 will push central banks or governments to interfere with the market. This emotion may cause investors to switch their investments into the crypto market which is decentralized. As cryptocurrencies are not managed by a central entity, they can help investors to avoid some of the political risk. Hence, investors should consider taking cryptocurrencies as part of their assets depending on the cycle of COVID-19. For market researchers, they should continue to focus on the fluctuations in these cryptocurrencies because as the number of observations increases, it will provide new insights for the behavior of cryptocurrencies in the market.

2.3 Bitcoin and Ethereum Can Serve as a Short Term Safe-haven Asset

Before the invention of cryptocurrency, many studies analyzed the properties of safe-haven assets. For example, Baur and Lucey (Baur, Lucey, 2010) proposed that an asset is safe if it is not correlated with stocks during a market crash. Thus, gold is considered as a safe-haven during the past economic crisis. The cryptocurrencies market increased significantly since the inception. Bitcoin has increased its value from nearly $0 to more than $7000 in April 2020. Can Bitcoin serve as a safe-haven for assets? Before the COVID-19, the answer is positive, although many people pointed the potential bubble in. However, as the pandemic of COVID-19 lasts longer, Bitcoin's price moves closely with S&P500 which shows that it is not a good safe-haven for stocks. Ethereum is also investigated. The result shows that both Bitcoin and Ethereum are suitable for

short-term safe-havens, but Ethereum is possible a better safe-haven than Bitcoin as the pandemic lasts (Mariana, et al, 2021) On the other hand, researcher also found that before and during the COVID-19, Ethereum shows the highest daily return volatility, followed by Bitcoin, S&P500, and gold.

2.4 Cryptocurrencies Can Drive a Covid-19 Recovery in Emerging Markets

Due to the pandemic of Covid-19, people have been restrained to shop online and have moved away from physical cash, obviously this will benefit cryptocurrency. On the other hand, the rise of price of Bitcoin and Ethereum is also attractive to investors looking to hedge against inflation. The statistics firm-Statista- confirmed that Nigeria was the leading country for adopting Bitcoin and cryptocurrency (Oxfordbusinessgroup.com). Tomiwa Lasebikan is the co-founder of Buycoins Africa which is a company that facilitates cryptocurrency trade. He said that cryptocurrency trade was enabling Nigerian expatriates to avoid the country's extreme high exchange rate. Importantly, cryptocurrencies can be used for buying many products such as mobile devices. Statista firm also noted that the existing popularity of peer-to-peer payments prompt many Nigerians to explore cryptocurrencies. Emerging markets usually has an instable political or economic environment, Bitcoin and Ethereum is a more reliable option than traditional currency by enhancing investors' confidence.

2.5 Summary

COVID-19 shows a strong impact on the global market. However, Bitcoin and Ethereum show an advantage being comparing to traditional assets and play an increasing import role in emerging market, making it a better alternative for asset allocation.

3 PROCEDURE

3.1 Event Definition

Our group decides to look at two different periods of time and investigate the returns of the cryptocurrency market and Ethereum. To do this, we take the estimation window from 2019/1/1 to 2019/12/31, which is approximately 1 year. The reason that we do this is because we want to compare the data before the pandemic with the data after the first state of lockdown in the United States which is on 2020/03/18. And also, the more data we have for estimation, the more accurate and more reliable it is. We gathered the event data from two days before the first lockdown to see the influence of pandemic to the market of cryptocurrency and created a 8-sample size window for the event window (2020/3/9-2020/3/18).

3.2 Selecting Criteria

We obtain the data of Ethereum' s price from Yahoo finance (Andrew, 2021), which is a reliable and obtainable source for sole traders. It is one of the biggest websites for traders to get the newest stock price and data, provides financial news, data and commentary including stock quotes, press releases, financial reports, and original content. It also offers some online tools for personal finance management. In addition to posting partner content from other web sites, it posts original stories by its team of staff journalists. It is ranked 15th by similarWeb on the list of largest news and media websites. We process the data using Excel. The cryptocurrency market index we are going to use later is the S&P Cryptocurrency Broad Digital Market Index, which is an index that indicates the performance of the broader digital asset market (IndexS&P Dow Jones, 2021). The index comes from Lukka Inc, who is an enterprise crypto asset software and data provider. The Company builds middle and back-office software and data services on infrastructure made for the complexities of blockchain data to businesses that interact with crypto assets as part of normal business processes. We have chosen this index because it reflects the performance of cryptocurrency market and it suits in the market model we are building, hence it is appropriate for our research and attainable (Jake Benson, Lukka introduction, 2021).

3.3 Calculating Normal and Abnormal Return

Our data analysis begins by calculating the normal and abnormal returns, as we are going to analysis its change later.

The normal return is calculated using natural logarithm return, which subtracts the logarithm price yesterday from the logarithm price today. The property of logarithm transforms the equation to the natural logarithm: price today divided by price yesterday, as the figure below shows.

$$Normal\ return_t = ln\ ln\ P_t\ - ln\ ln\ P_{t-1}\ =$$

$$ln\ ln\ \frac{P_t}{P_{t-1}} \quad (1)$$

We decided to use the natural logarithm return because of two reasons: the additivity property of it and its trait of following log normal distribution. Log return can be added for time-series perspectives, unlike the percentage return. Also, stock return is assumed to follow a Log normal distribution. Therefore, log return is used for this statistical evaluation.

To calculate abnormal return, we used the model of risk-adjusted return. This is equal to the actual return minus expected return.

$$Abnormal\ return = actual\ return - expected\ return$$

We constructed a market linear regression model that relates individual stock ETH return and the synchronous cryptocurrency market return. R_t stands for the normal return at time t. The parameter α represents the 'idiosyncratic return of the individual stock'. This is typically related to the company's performance or in other terms, the return coming from the investment's own interest that cannot be explained by common factors, the parameter ß is the systematic risk level of the stock, the parameter σ measures the variance of α.

$$R_t = \alpha + \beta R_{market,t} + \varepsilon_t$$
$$var(\varepsilon_t) = \sigma^2 \quad (2)$$

We can obtain the value of α and ß from the past data in the estimation window. Hence, we can predict the returns during the event window based on the return of market using this model.

$$R_t = \alpha + \beta R_{market} \quad (3)$$

Then we can compute the difference between this estimated return and the actual return. This will give us the equation for abnormal return.

$$AR = R_{t\backsim Actual} - (\alpha + \beta R_{market,t\backsim Expected}) \quad (4)$$

3.4 Estimation Procedure

Table 1 In this procedure, the first thing we need to do is to obtain the values for normal stock return and market return, using Equation 1.

Table 1: Formulae calculating normal return.

Date	ETH Price	Cryptocurrency Index		
01/01/2019	140.819412	344	Stock Return	Market Return
02/01/2019	155.047684	361.43	=LN(B6/B5)	=LN(C6/C5)
03/01/2019	149.13501	351.42	=LN(B7/B6)	=LN(C7/C6)
04/01/2019	154.58194	352.93	=LN(B8/B7)	=LN(C8/C7)
07/01/2019	151.699219	368.34	=LN(B9/B8)	=LN(C9/C8)
…	…	…	…	…
31/12/2019	129.610855	507.17	=LN(B265/B264)	=LN(C265/C264)

After this we have to compute the values of Alpha, Beta and Standard error using the data of normal return we have in the estimation window, which is approximately 1 year. These values are essential to our calculation later in the market model. It serves the purpose of calculating abnormal return. To calculate α, we use the INTERCEPT function in EXCEL, which calculates the point at which a regression line will intersect the y-axis, to calculate ß, we use the SLOPE function that returns the slope of the linear regression through the given data points, and to calculate the standard error of XY, we use the STEYX function that returns the standard error of the predicted y-value for each x in a regression.

Table 2: Formulae shown in Excel.

Mean	=AVERAGE(Stock_Return)
Standard deviation	=STDEV(Stock_Return)
Number of days (Size)	=COUNT(Stock_Return)

Moreover, the mean model used later requires the value of mean, standard deviation and sample size for stock return. These values can be found using the following equations.

Table 3: Formulae shown in Excel.

Alpha	=INTERCEPT(Stock_Return,Market_Return)
Beta	=SLOPE(Stock_Return,Market_Return)
standard error of XY	=STEYX(Stock_Return,Market_Return)

Now we have all the data and values we need:

Table 4: A section of values from estimation window.

Estimation Window (2019/1/1 - 2019/12/31)						
Date	ETH Price	Cryptocurrency Index			Mean	-0.000319007
01/01/2019	140.8	344	Stock Return	Market Return	Standard deviation	0.046961462
02/01/2019	155	361.43	0.096254405	0.049426728	Number of days (Size)	260
03/01/2019	149.1	351.42	-0.038880705	-0.028086296		
04/01/2019	154.6	352.93	0.035872309	0.004287648	Alpha	-0.001530066
07/01/2019	151.7	368.34	-0.018824574	0.042736688	Beta	0.81110673
08/01/2019	150.4	368.36	-0.008869753	5.42962E-05	standard error of XY	0.029758636

3.5 Testing Procedure

Before we start testing our null hypothesis, we need the value of mean, standard deviation and sample size for stock return in the event window as well. They can be calculated using the similar equations as above. Also we calculated the normal return too.

Table 5: Formulae shown in Excel.

Mean	=AVERAGE(Stock_Return_Event)
Standard deviation	=STDEV(Stock_Return_Event)
Size	=COUNT(Stock_Return_Event)

Table 6: All Values from event window.

Event Window (2020/3/9 - 2020/3/18)						
Date	ETH Price	Cryptocurrency Index	Stock Return	Market Return		
09/03/2020	201.986328	584.02	-0.187020823	-0.168233538	Mean	-0.093957652
10/03/2020	200.767242	593.9	-0.006053775	0.016775726	Standard deviation	0.218134168
11/03/2020	**194.86853**	**581.37**	**-0.029821111**	**-0.021323568**	Size	8
12/03/2020	112.347122	441.12	-0.550731744	-0.27607044		
13/03/2020	133.201813	398.15	0.170271987	-0.102488129		
16/03/2020	110.605873	367.26	-0.18589218	-0.080758775		
17/03/2020	113.942749	392.35	0.029722932	0.066084254		
18/03/2020	114.84227	390.7	0.007863501	-0.004214297		

With all of these values available, we can use our 2-sample mean model now. The mean model is to test whether the mean of 2 sample is the same or not. Our null hypothesis is the following:

$H_0 = COVID - 19\ has\ no\ effect\ on\ the\ return\ of\ Ethereum$

Therefore, we can obtain the following equation:

$$\underline{x}_{est} = \underline{x}_{event}$$
$$\rightarrow \underline{x}_{est} - \underline{x}_{event} = 0 \quad (5)$$

Now, we can carry out the test for the mean model, using the formula below:

$$t = \frac{\underline{x}_{est} - \underline{x}_{event}}{\sqrt{\frac{s_{est}^2}{n_{est}} + \frac{s_{event}^2}{n_{event}}}} \quad (6)$$

As we already obtained the values in the estimation window and event window that we needed, all we have to do now is just plug in all the values into this formula.

Table 7: Mean model.

t-value	=ABS((P5-G4)/SQRT((P6^2)/P7) + ((G5^2)/G6))
Mean	-0.000319007
Standard deviation	0.046961462
Number of days (Size)	260
Mean	-0.093957652
Standard deviation	0.218134168
Size	8

Table 8: Critical values from the estimation window.

Mean	-0.000319007
Standard deviation	0.046961462
Number of days (Size)	260

Table 9: Critical values from the event window.

Mean	-0.093957652
Standard deviation	0.218134168
Size	8

If the absolute value of t is greater than 1.96, we have 95% of confidence to reject our null hypothesis.

Table 10: Testing significance of t-value in Excel.

Significant?	=IF(Y5>1.96,"Yes","No")

After examining the effect of the event on the market, we will now consider its impact on the individual stock ETH using the event study method.

For event study, we do the following steps:

Find the abnormal return using:

$$AR = R_{t\_Actual} - (\alpha + \beta R_{market,t\_Expected})$$

Table 11: *Calculation* of Abnormal Return.

Abnormal Return
Risk Adjusted Return
=M5-($G$8+$G$9*N5)
=M6-($G$8+$G$9*N6)
=M7-($G$8+$G$9*N7)
=M8-($G$8+$G$9*N8)
=M9-($G$8+$G$9*N9)
=M10-($G$8+$G$9*N10)
=M11-($G$8+$G$9*N11)
=M12-($G$8+$G$9*N12)

Table 12: Values of G8 and G9.

	F	G
8	Alpha	-0.001530066
9	Beta	0.81110673

Table 13: Values of M5-M12 and N5-N12.

	M	N
	Stock Return	Market Return
5	-0.187020823	-0.168233538
6	-0.006053775	0.016775726
7	**-0.029821111**	**-0.021323568**
8	-0.550731744	-0.27607044

9	0.170271987	-0.102488129
10	-0.18589218	-0.080758775
11	0.029722932	0.066084254
12	0.007863501	-0.004214297

Table 14: Values of abnormal return.

	S
	Abnormal Return
	Risk Adjusted Return
5	-0.049035402
6	-0.018130613
7	-0.010995356
8	-0.325279087
9	0.254930864
10	-0.118858129
11	-0.022348386
12	0.012811811

Do a t-test to test the significance of the abnormal return

$$If \left|\frac{Abnormal\ Return}{standard\ error}\right| > 1.96, then\ AR\ is\ significant \quad (7)$$

Table 15: T-test and significance.

	T	U
	t-test	Significant?
5	=S5/$G$10	=IF(ABS(T5)>1.96,"Yes","No")
6	=S6/$G$10	=IF(ABS(T6)>1.96,"Yes","No")
7	**=S7/$G$10**	**=IF(ABS(T7)>1.96,"Yes","No")**
8	=S8/$G$10	=IF(ABS(T8)>1.96,"Yes","No")
9	=S9/$G$10	=IF(ABS(T9)>1.96,"Yes","No")
10	=S10/$G$10	=IF(ABS(T10)>1.96,"Yes","No")
11	=S11/$G$10	=IF(ABS(T11)>1.96,"Yes","No")
12	=S12/$G$10	=IF(ABS(T12)>1.96,"Yes","No")

Table 16: Value of standard error of XY.

		G
10	standard error of XY	0.029758636

Calculate the cumulative abnormal return inside event window.

Table 17: Formula of CAR shown in Excel.

CAR(-2,5)
=SUM(S5:S12)

$$CAR(N) = \sum_{t=-N}^{N} \quad AR \sim N(0, 2N\sigma^2) \quad (8)$$

Compute the confidence interval for CAR.

$$(-1.96 \times \sqrt{2N\sigma^2}\,, 1.96 \times \sqrt{2N\sigma^2}) \quad (9)$$

Table 18: Confidence interval.

Confidence interval (-2,5)
=1.96*SQRT(2*$P$7*$G$10^2)
=-1.96*SQRT(2*$P$7*$G$10^2)

Compare CAR and its confidence interval and see whether if it exceeds it. Based on this comparison, state whether we can reject the null hypothesis. (If it exceeds, we have 95% confidence to reject the hypothesis)

Table 19: CAR and its confidence interval.

CAR (-2,5)	Confidence interval	Comparison
-0.27690	(-0.23331, 0.23331)	|-0.27690|> 0.2331

3.6 Empirical Results

Using the mean model, we can cannot reject our hypothesis that COVID-19 has no effect on the market of cryptocurrency.

Table 20: Calculation from the Mean Model.

Mean model	
t-value	1.214152901
t-critical	1.96
Comparison	1.214< 1.96
Significant?	No
Conclusion	Cannot reject the null hypothesis

However, from the event study, we can reject our hypothesis that COVID-19 has no effect on the individual stock return of ETH.

Table 21: Significance of CAR.

CAR (-2,5)	Confidence interval	Comparison	Significant?	Conclusion
-0.27690	(-0.23331, 0.23331)	|-0.27690|> 0.2331	Yes	Reject the null hypothesis

4 CONCLUSIONS & INTERPRETATIONS

In a nutshell, the event of COVID-19 does not have a significant impact on the performance of cryptocurrency market, however, COVID-19 has affected the abnormal return of Ethereum.

The cryptocurrency market is composed mainly by the largest bitcoin. A possible explanation to the question above may be that bitcoin has not been affected as hard, so the overall cryptocurrency market isn't affected as much. But the individual performance of Ethereum is influenced. Though, when reflecting on the logic behind this, we should consider the difference between bitcoin and Etheruem. The reality is, however, apart from the existence of smart contracts (Ethereum allows users to create smart contracts- computer code stored on a blockchain that automatically execute when beforehand conditions are reached) and some functional differences (e.g. the block time of Ethereum is only 12-15 seconds whereas the block time of bitcoin is 10 minutes), there aren't any major differences ("Difference Bitcoin and Ethereum", 2020). In terms of evaluation, we may only imply that after periods of consideration, investors and the majority of the public believe that Ethereum, due to its advantages on technology, is a better investment and perhaps, more likely to take over the status of fiat money. As the generations of our epoch encounter

the approach of a new form of money, scientists and experts have to think carefully in order to decide whether to accept it or not. The answer to this question, indeed, needs further investigations and researches.

AUTHOR CONTRIBUTION

Franky, Wen Hao, is responsible for doing data analysis, including calculating abnormal returns, estimation & testing procedure, and empirical results, plus inspection and modification of this paper. Stefan, Cheng Xin Peng, is responsible for doing background information and event definition Eric, Lu Zheng Jun, is responsible for doing selecting criteria and conclusion & interpretations Maisie, Zhao Rui Yao, is responsible for doing literature review and background information

REFERENCES

"100+ Ethereum Apps You Can Use Right Now", Consensys.net, March 17, 2020. https://consensys.net/blog/news/90-ethereum-apps-you-can-use-right-now/

1Point3Arces, 2020, "Global COVID-19 Tracker & Interactive Charts", available at https://coronavirus.1point3acres.com/

Andrew Serwer (2021) Yahoo Finance https://finance.yahoo.com/quote/ETH-USD/chart?p=ETH-USD#eyJpbnRlcnZhbCI6ImRheSIsInBlcmlvZGljaXR5IjoxLCJ0aW1lVW5pdCI6bnVsbCwiY2FuZGxlV2lkdGgiOjEuNDI4MzkwMzY3NTUzODY1NiwiZmxpcHBlZCI6ZmFsc2UsInZvbHVtZVVuZGVybGF5Ijp0cnVlLCJhZGoiOnRydWUsImNyb3NzaGFpciI6dHJ1ZSwiY2hhcnRUeXBlIjoibGluZSIsImV4dGVuZGVkIjpmYWxzZSwibWFya2V0U2Vzc2lvbnMiOnt9LCJhZ2dyZWdhdGlvblR5cGUiOiJvaGxjIiwiY2hhcnRTY2FsZSI6ImxpbmVhciIsInBhbmVscyI6eyJjaGFydCI6eyJwZXJjZW50IjoxLCJkaXNwbGF5IjoiRVRILVVTRCIsImNoYXJ0TmFtZSI6ImNoYXJ0IiwiaW5kZXgiOjAsInlBeGlzIjp7Im5hbWUiOiJjaGFydCIsInBvc2l0aW9uIjpudWxsfSwieWF4aXNMSFMiOltdLCJ5YXhpc1JIUyI6WyJjaGFydCIsIuKAjHZvbCB1bmRy4oCMIl19fSwic2V0U3BhbiI6bnVsbCwibGluZVdpZHRoIjoyLCJzdHJpcGVkQmFja2dyb3VuZCI6dHJ1ZSwiZXZlbnRzIjp0cnVlLCJjb2xvciI6IiMwMDgxZjIiLCJzdHJpcGVkQmFja2dyb3VkIjp0cnVlLCJyYW5nZSI6bnVsbCwiZXZlbnRNYXAiOnsiY

Baur D.G., Lucey B.M. Is gold a hedge or a safe haven? An analysis of stocks, bonds and gold. Financ. Rev. 2010,45(2):217–229.

"Bitcoin vs. Ethereum - Everything you need to know!", YouTube, May 29, 2019. <https://www.youtube.com/watch?v=bDiVMhLN2e0>

Camomile Shumba. "Ethereum's London hard fork upgrade has been burning ether at a rate of around $8,900 a minute, data shows." Insider. Aug 6, 2021. https://markets.businessinsider.com/news/currencies/ethereum-london-hard-fork-ether-burn-blockchain-demand-crypto-2021-8

Can cryptocurrencies drive a Covid-19 recovery in emerging markets?, Oxfordbusinessgroup.com, Feb 21 2021. Available at https://oxfordbusinessgroup.com/news/can-cryptocurrencies-drive-covid-19-recovery-emerging-markets

Demir, E., Bilgin, M.H., Karabulut, G. et al. (2020) The relationship between cryptocurrencies and COVID-19 pandemic. Eurasian Econ Rev 10, 349–360

"Difference Bitcoin and Ethereum",2020. GeeksforGeeks, available at https://www.geeksforgeeks.org/difference-bitcoin-and-ethereum/#:~:text=Difference%20between%20Bitcoin%20and%20Ethereum%3A%20%20%20,written%20%20...%20%205%20more%20rows%20

Fang, L., Bouri, E., Gupta, R., & Roubaud, D. (2019). Does global economic uncertainty matter for the volatility and hedging effectiveness of Bitcoin? International Review of Financial Analysis, 61, 29–36.

Hadar and Sarel. "How the Covid-19 Pandemic Affected the Cryptocurrency Market", Columbia.edu, March 26, 2021. Available at <https://clsbluesky.law.columbia.edu/2021/03/26/how-the-covid-19-pandemic-affected-the-cryptocurrency-market/>

IndexS&P Dow Jones (2021): https://www.spglobal.com/spdji/en/indices/digital-assets/sp-cryptocurrency-broad-digital-market-index/#overview

Isabelle Lee. "Microsoft is looking to use the ethereum blockchain to prevent piracy." Insider. Aug 16, 2021. Available at https://markets.businessinsider.com/news/currencies/microsoft-msft-ethereum-blockchain-fight-piracy-digital-tech-public-ledger-2021-8

Jake Benson, Lukka introduction, Bloomberg: https://www.bloomberg.com/profile/company/1084005D:US (2021)

Mariana C D, Ekaputra I A, Husodo Z A. Are Bitcoin and Ethereum safe-havens for stocks during the COVID-19 pandemic?[J]. Finance research letters, 2021, 38: 101798.

Nathan Reiff. "Bitcoin vs. Ethereum: What's the Difference?" Investopedia. Jun 16, 2020. <https://www.investopedia.com/articles/investing/031416/bitcoin-vs-ethereum-driven-different-purposes.asp>