



Weak Form Efficiency of Cryptocurrency and Precious Metal Market in the Midst of Covid-19 Pandemic

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Abstrak

Logam mulia dan cryptocurrency merupakan salah satu instrumen investasi yang banyak dipilih pada masa pandemi Covid-19. Terdapat tiga jenis efisiensi pasar yaitu efisiensi bentuk lemah, semi-kuat, dan kuat, hal ini diungkapkan dalam hipotesis pasar efisien yang dikemukakan oleh Fama dalam beberapa karyanya. Efisien atau tidaknya sebuah pasar dapat diketahui dari return yang didapatkan oleh para pelaku pasar, pelaku pasar akan mendapatkan return yang wajar apabila berada di dalam pasar yang efisien. Penelitian ini bertujuan untuk mengetahui apakah pasar logam mulia dan cryptocurrency efisien pada bentuk lemah. Uji run test dan Augmented Dickey-Fuller digunakan untuk mengetahui keacakan pergerakan harga (random walk). Semakin acak (random) harga maka akan semakin efisien dalam bentuk lemah. Periode yang digunakan dalam penelitian ini adalah 1 Januari 2019 sampai dengan 30 Juni 2021. Hasil dari penelitian ini adalah, harga logam mulia berjalan secara acak selama pandemi Covid-19 yang dapat diartikan pasar logam mulia efisien dalam bentuk lemah. Sedangkan hasil uji return cryptocurrency menunjukkan bahwa pasar cryptocurrency tidak efisien dalam bentuk lemah di masa pandemi Covid-19. Investor dapat memilih emas sebagai instrumen investasi di masa pandemi karena nilainya yang stabil dan dinilai lebih aman daripada cryptocurrency.

Kata kunci: mata uang kripto, efisiensi bentuk lemah, random walk

Abstract

Precious metals and cryptocurrencies are one of the most preferred investment instruments during the Covid-19 pandemic. There are three types of market efficiency, weak form efficiency, semi-strong, and strong form efficiency; this is disclosed in the efficient market hypothesis proposed by Fama in several of his works. Efficient or inefficient market can be seen from the returns obtained by the market participants, market participants will get a reasonable return if they are in an efficient market. This study aims to determine whether the precious metals and cryptocurrency markets are efficient in the weak form. Run test and Augmented Dickey-Fuller test are used to determine the randomness of price movements (random walk). The more random the price, the more efficient it will be in the weak form. The period used in this study is January 1, 2019 to June 30, 2021. The results of this study are the price of precious metals runs randomly during the Covid-19 pandemic, which means that the precious metal market is efficient in a weak form. Meanwhile, the results of the cryptocurrency return test show that the

cryptocurrency market is inefficient in the weak form during the Covid-19 pandemic. Gold can be chosen by investors as investment instrument during pandemic because its stable value and considered safer than cryptocurrencies.

Keywords: *cryptocurrency, weak-form efficiency, random walk*

1. INTRODUCTION

The capital market is a medium of allocating capital and other economic resources in an effective and efficient way [35]. The capital market makes a significant contribution to the progress of the country's economy, hence the efficiency of the capital market is important to know. According to Fama [14], capital market efficiency is the suitability of stock prices in the capital market based on all available information about the company. The development of research on capital market efficiency is based on research conducted by Fama [12] which contains an explanation of theoretical market efficiency analysis. Along with the times, the theory of market efficiency analysis that has been stated previously needs to be continuously studied and developed in accordance with current conditions. Fama's [13] research followed by Fama [14] revealed that there are three segments of market efficiency based on the level of absorption of information, namely the efficiency of the weak form, the efficiency of the semi-strong form, and the strong form.

The development of technology provides many conveniences for the public to access all the information they want to know, including the emergence of a digital-based financial system. Along with the development of technology and digital finance, cryptocurrencies have been created whose functions are the same as traditional money as commonly used today [18]. The existence of the financial crisis in 2007-2008 became a gap for cryptocurrencies to be used by the public. This cryptocurrency adopts a decentralized financial system that is different from the traditional financial system that is still valid today [1]. Cryptocurrency is considered more effective and efficient even though it still has many limitations on its implementation. Bitcoin is one of the biggest cryptocurrencies that once got rejected to be used in several countries [18].

The increasing requests and popularity of cryptocurrencies has led to an increment of cryptocurrency's price over the last five years [33]. Despite the erratic fluctuations, cryptocurrency liquidity continues to increase [33]. However, the efficiency of the cryptocurrency market experienced a decline after the June 2016 [33]. So that Tran & Leirvik [33] says that most of the cryptocurrency market is considered to be inefficient, this increase was occurred in 2017 to 2019. Hence, cryptocurrency is not the only investment instrument that investors choose. Stock investment is still considered more convincing because there is more information about stock instruments than cryptocurrencies.

In the midst of economic uncertainty, especially with extraordinary events such as the current pandemic, some investors are afraid to invest their capital in the capital market. This investor's fear became the basis for selling shares on a large scale which caused the stock prices of several issuers to plummet. Most investors who withdraw their funds in the capital market will allocate funds to buy gold because this metal belongs to a strong and safe investment asset class [21][37]. Not only gold, there are several other metals that have investment values such as silver, platinum, and palladium [27]. The increase in transaction activity during the Covid-19 pandemic did not only occur in precious metals, but also occurred in activity of the cryptocurrency. This happens because cryptocurrency is considered as a safe haven asset that is able to provide higher and faster profits than gold or other precious metals. As a result, the price of one of the most popular cryptocurrencies, Bitcoin, has increased by 8 times [2]. However, gold, which is one of the precious metals that is in great demand by the public, has also experienced a significant price increase during

the Covid-19 pandemic. In 2019 gold experienced a fairly rapid price increase of around 50% from the original Rp. 600,000-, to around Rp. 900,000-, in mid-2020 [16].

Most of the research only aims to determine the efficiency of the capital market, so it is necessary to carry out further studies by adding several commodities as research objects. So that this research can provide an overview of market efficiency that is broader than previous research, such as the research of Pulungan [25] which examines the market efficiency of palm oil commodities. The existence of this research is also to complement the results of Chang [5] and Charles [6] research which discusses the market efficiency of the weak form of precious metals. This study uses daily price data for gold, silver, platinum and palladium, as well as the five cryptocurrencies with the largest market capitalization values in 2021 such as Bitcoin, Ethereum, Tether, Binance Coin, and Cardano. This research needs to be done because investing in cryptocurrencies starts to be in great demand by investors and is considered very promising. Therefore, with this research, investors can reconsider their decisions before deciding to invest, whether existing data and information can reflect future prices.

Gold is one of the precious metal commodities which is one of the objects in this research. Chang [5] finds that gold is inefficient in every country and period. Research on the efficiency of the weak form of gold was conducted in 3 countries with developing gold market conditions, namely Russia, India, and China. The results show that the gold market in Russia is efficient in weak form over the entire study period. Different results occur in China and India where market conditions are not always efficient in weak form. Harper [17] also states that silver is an efficient commodity in weak form in the 2008 to 2012 study period. Precious metals have an efficient value in weak form and are feasible to be used as investments, but gold is the most efficient precious metal [6]. This research needs to be done to find out whether the weak form efficiency of the metal market and *cryptocurrency* is still relevant during the Covid-19 pandemic.

2. LITERATURE REVIEW

2.1

Weak Form Market

Weak form efficiency is one of the three types of market efficiency described by Fama [14]. According to Zaman [38], weak form efficiency is best applied in less developed markets because this type of market has limited information. Market efficiency can be determined from the availability of information presented in the market. This is evidenced by a study presented by Yadirichukwu [36] in a study aimed at examining the causes of economic instability in Romania. The results of this study indicate that one of the causes of this instability is the lack of information about market conditions.

2.2

Efficient Market Hypothesis

The concept of market efficiency was introduced by Fama [11] in a study that discussed price behavior in the stock market. The stock market can be said to be efficient if the information available is in accordance with the prevailing stock prices at that time [4]. Market efficiency can be known through the presence or absence of market participants who get returns, because in an efficient market, the perpetrators will get a reasonable return. The intrinsic value of shares is one of the determinants of stock prices whose value always changes according to current economic conditions, which can be known through company information available on the stock exchange. There are three types of market efficiency, that is weak, semi-strong, and strong forms of efficiency [34]. Weak form efficiency indicates that all past information is reflected by the current stock price. In semi-strong efficiency, the price will be a reflection of all information about the company and can change according to current conditions. Meanwhile, in the strong form of market efficiency, prices can change at any time and are a reflection of all company conditions to the hidden conditions.

The Efficient Market Hypothesis (EMH) states that the price of securities is a reflection of all conditions and information about the company [4]. This hypothesis states that market conditions are always efficient, but in practice there is a contradiction between EMH and events that actually occur [15]. Determining market efficiency is not something easy, this happens

because there will always be other hypotheses that refute this hypothesis [15]. The Efficient Market Hypothesis (EMH) is the result of the development of the original concept of market efficiency which led to a theory, namely the Random Walk Theory [15].

2.3 Random Walk Theory

Random Walk Theory introduced by Fama was described in two articles published in 1965 and 1970 [11] [13]. Efficiency is related to the pattern of changes in stock prices on the stock exchange, based on this explanation, Fama developed a theory, namely the Random Walk Theory [10]. Broadly speaking, this theory reveals that actually stock prices cannot be predicted through fundamental reports alone. This is evidenced by the fall in several company stock prices with good fundamentals as a result of the Covid-19 pandemic. So that the efficient market hypothesis cannot reflect the actual market conditions very accurately [11].

2.4 Cryptocurrency Weak Form Efficiency

The Covid-19 virus, which began to spread at the end of 2019, had a considerable impact on economies around the world. This is the cause of the decline in share prices in most issuers in the capital market. This negative stock price change is inversely proportional to what happens to the prices of several cryptocurrencies, especially Bitcoin [22]. This is the basis for Dyhrberg [9] to say that Bitcoin is capable of being a hedging asset. Bitcoin has several things in common with gold, such as a limited amount and no government regulation specifically aimed at the circulation of *cryptocurrency*.

In contrast to Dyhrberg [8], Bouri [3] proves that *cryptocurrency* can only be a hedge under certain conditions. Bouri [3] states that cryptocurrencies, especially Bitcoin are only feasible for asset diversification. Dyhrberg [8] revealed that the liquidity of Bitcoin still cannot outperform the liquidity of metal commodities such as gold. Meanwhile, Susilo's research [32] revealed that cryptocurrencies such as Bitcoin and Ethereum are money systems which mechanisms do not require a physical form and use a peer-to-peer system. Over the past few years, many media outlets have labeled Bitcoin as New Gold as a result of its high and fast returns [19]. In a previous study by [29] which discussed the market efficiency of the weak form of cryptocurrencies, it was found that cryptocurrencies do not run randomly. This shows that fundamental analysis is not enough to be used as a basis for making investment decisions. Investors also need to perform technical analysis in predicting future prices. Cryptocurrency can be said to be efficient if there is no certain pattern in returns. This is in contrast to the findings [28] in a journal that discusses whether or not there is a day-of-the-week and a month-of-the-year effect where price increases usually occur on Monday, Wednesday, Thursday, and the end of February. So the hypothesis developed in this study is as follows:

H_1 : the *cryptocurrency* does not run randomly

2.5 Precious Metal Weak Form Efficiency

Metal commodity is one of the raw materials that is quite crucial in several production processes so it is important to study [30]. In this study, several metal commodities such as gold, silver, platinum, and palladium were used. As the most famous precious metal, gold is widely chosen as an investment instrument because its value tends to be stable, and increases during a crisis. This makes gold widely used as asset diversification by investors [23]. Not only gold, there are other metals that are classified as precious metals, namely silver. Not only serves as a raw material for production, silver can also be a hedging investment instrument that is quite safe because its value is quite stable. Platinum and palladium are also investors' choices because they are still classified as precious metals in the market. While platinum can be used as a medium of exchange because of its purity. Platinum and palladium have more roles than gold in financial markets [6]. The metal commodity market can be said to be efficient in its weak form if the price of the related stock moves randomly and is unpredictable. However, it turns out that stock prices in the commodity market have a certain pattern which is usually called a seasonal pattern or calendar anomalies [26]. So, the hypothesis developed in this study is as follows:

H_2 : the metal market does not run randomly

3. RESEARCH METHODS

3.1

Data Types and Sources

This study uses secondary data, which comes from the daily prices of five cryptocurrencies with the largest market capitalization values in 2021, that is Bitcoin, Ethereum, Tether, Binance Coin, and Cardano for the period January 1, 2019 to June 30, 2021. The daily price data for *cryptocurrencies* obtained from <https://investing.com/> while daily metal price data is obtained from <https://www.kitco.com/>.

Sampling was carried out using a purposive sampling method, where cryptocurrency was the one with the largest number of market capitalizations. The metal samples that will be used in this study are four types of metals that belong to the category of precious metals. In Table 1. we can see the five cryptocurrencies with the largest market capitalization values in 2021. The precious metals studied in this study are gold, silver, platinum, and palladium.

Table 1. Biggest Cryptocurrency Capitalization 2021

Cryptocurrency	Market Cap December 31, 2019 (US\$)	Market Cap June 30, 2021 (US\$)
Bitcoin	130,446,112,598.42	656,852,513,237.53
Ethereum	12,139,765,786.44	265,001,225,920.82
Tether	4,106,723,975.41	62,468,888,600.38
Binance Coin	2,443,242,001.68	46,535,565,043.08
Cardano	851,576,356.87	44,196,834,747.32

Source: <https://coinmarketcap.com/historical/20210630/>, accessed on March 6, 2022, 15:32

The period before the pandemic was divided from January 1, 2019 to December 31, 2019, while the period of the Covid-19 pandemic was divided from January 1, 2020 to June 30, 2021. This distribution was carried out based on the reality that occurred at that time. There were 7,736 people infected with Covid-19 in China on January 30, 2020, while the first case in Indonesia was found on March 2, 2020. The first spike in Covid-19 cases in Indonesia occurred on March 31, 2020 with 1,528 people infected with this virus. Indonesia also has the highest mortality rate due to the Covid-19 virus, which is 8.9% [31].

3.2

Analysis Technique

The data obtained from these sources will be processed using a run test. Runs tests are used to find out the truth of the Random Walk or the randomness of daily returns of cryptocurrencies and precious metals [24]. This is done to assess the effectiveness of the cryptocurrency and precious metals market. The more random or unpredictable, the better the conditions for weak form market efficiency [27]. After that, an additional test was carried out, the stationarity test through the Augmented Dickey-Fuller (ADF) to ensure the acceptance of the hypothesis. The tests to be carried out can provide results as to whether the cryptocurrency and precious metals markets are efficient in a weak form market. Data can be said to be efficient in weak form if unit root test exists Augmented Dickey-Fuller. H_0 is rejected if the ADF is less than the ADF Critical Value 0.05 or the ADF less than the output residual value. The data can be said to be stationary or there is no unit root if H_0 is rejected.

4. RESULT AND DISCUSSION

4.1

Descriptive Statistic

The descriptive statistical value of the research sample in the form of 5 *cryptocurrencies* with the largest capitalization, and 4 precious metals gold, silver, platinum, and palladium can be seen in Table 2. and Table 3. below.

Table 2. Descriptive Statistics of Cryptocurrency and Precious Metal Returns Before Covid-19

No	Cryptocurrency	N	Min	Max	Average	Standard Deviation
1	Bitcoin	365	-0.009	-0.006	-0.007	0.002
2	Ethereum	365	-0.020	0.058	0.019	0.055
3	Tether	365	0.003	0.007	0.005	0.002
4	Binance	365	-0.020	-0.012	-0.016	0.005
5	Cardano	365	-0.018	0.037	0.010	0.038
6	Emas	250	0.002	0.003	0.003	0.000
7	Perak	250	-0.002	0.000	-0.001	0.001
8	Platinum	250	-0.014	0.006	-0.004	0.014
9	Palladium	250	-0.002	0.002	0.000	0.003

Note: N = total observation days

Source: Secondary data, processed.

Based on the descriptive statistical data in Table 2. it was found that the highest average price of the cryptocurrency before the pandemic was the price of Ethereum with a *return* 0.019 and the lowest average price was Binance Coin with a return -0.016. The highest average price of precious metal is gold with a return 0.003 and the lowest average is Platinum with a return -0.004.

Table 3. Descriptive Statistics of Cryptocurrency and Precious Metal Returns During Covid-19

No	Cryptocurrency	N	Min	Max	Average	Standard Deviation
1	Bitcoin	547	-0.023	0.000	-0.011	0.016
2	Ethereum	547	0.012	0.053	0.033	0.029
3	Tether	547	0.000	0.007	0.004	0.005
4	Binance	547	-0.002	0.011	0.005	0.009
5	Cardano	547	0.009	0.021	0.015	0.008
6	Emas	375	0.004	0.008	0.006	0.002
7	Perak	375	-0.007	0.006	-0.001	0.009
8	Platinum	375	-0.010	0.037	0.013	0.033
9	Palladium	375	0.013	0.022	0.017	0.006

Source: Secondary data, processed.

Based on descriptive statistical data on the prices of cryptocurrencies and precious metals during the pandemic in Table 3. the highest average cryptocurrency is Ethereum with a return 0.033 and the lowest average price is Bitcoin with a return -0.011. The highest average price of precious metal is palladium with a return 0.017. To find out the probability of cryptocurrency and precious metal price data, it is necessary to do a run test to be able to find out whether the cryptocurrency and precious metal price data runs randomly or not.

4.2 Run Test Result

Cryptocurrency run test results can be seen in the table below. The run test was carried out using the mean and median to get more accurate results.

Table 4. Cryptocurrency Run Test Results (Median)

	Bitcoin	Binance	Cardano	Ethereum	Tether
Test Value ^a	0.001	0.002	0.003	0.002	0.000
Cases < Test Value	456	456	456	456	447
Cases >= Test Value	456	456	456	456	465
Total Cases	912	912	912	912	912
Number of Runs	519	494	491	497	529
Z	4.108	2.452	2.253	2.651	4.785
Asymp. Sig. (2-tailed)	0.000	0.014	0.024	0.008	0.000

Source: Secondary data, processed.

The results of the run test using the median show that all the probability values of the cryptocurrencies used in this study are significant at a significance level of 0.05. Where sequentially the probability value of Bitcoin, Binance Coin, Cardano, Ethereum, and Tether is 0.000; 0.014; 0.024; 0.008; 0.000. The values of the five cryptocurrencies indicate that H_1 accepted, so the run test using the median shows that the cryptocurrency does not run randomly (random walk). This means that the cryptocurrency is inefficient in its weak form based on calculations using run tests with the median.

Table 5. Cryptocurrency Run Test Results (Mean)

	Bitcoin	Binance	Cardano	Ethereum	Tether
<i>Test Value^a</i>	0.003	0.006	0.005	0.004	0.000
<i>Cases < Test Value</i>	482	498	475	488	488
<i>Cases >= Test Value</i>	430	414	437	424	424
<i>Total Cases</i>	912	912	912	912	912
<i>Number of Runs</i>	505	480	483	495	527
<i>Z</i>	3.290	1.796	1.778	2.680	4.811
<i>Asymp. Sig. (2-tailed)</i>	0.001	0.073	0.075	0.007	0.000

Source: Secondary data, processed.

Based on the results of the run test using the mean, it shows that Bitcoin and Tether are significant at the 0.01 and 0.05 significance levels. Binance Coin and Cardano are significant even at the 0.01 significance level, while Ethereum is significant at the 0.05 significance level. These results can be interpreted that there is acceptance of H_1 which means the prices of Bitcoin, Binance Coin, Cardano, Ethereum, and Tether do not run randomly. So based on the results of the run test using the mean, the cryptocurrency is inefficient in its weak form. Weak form market efficiency can be achieved if market prices run randomly [28]. It is the same with Robiyanto [29] where the price of cryptocurrencies does not run randomly so the cryptocurrency market is inefficient in its weak form. This phenomenon occurs because cryptocurrencies are unreliable in times of crisis and pandemic. The presentation of run test precious metals of gold, silver, platinum, and palladium can be seen in the table below. Calculation of run test for precious metals is carried out using mean and median so that the resulting data is more detailed.

Table 6. Precious Metal Run Test Results (Median)

	Gold	Platinum	Silver	Palladium
<i>Test Value^a</i>	0.000	0.001	0.000	0.001
<i>Cases < Test Value</i>	312	312	312	312
<i>Cases >= Test Value</i>	313	313	313	313
<i>Total Cases</i>	625	625	625	625
<i>Number of Runs</i>	309	301	329	328
<i>Z</i>	-0.360	-1.001	1.241	1.161
<i>Asymp. Sig. (2-tailed)</i>	0.719	0.317	0.215	0.246

Source: Secondary data, processed.

Table 7. Precious Metal Run Test Results (Mean)

	Gold	Platinum	Silver	Palladium
<i>Test Value^a</i>	0.000	0.000	0.001	0.001
<i>Cases < Test Value</i>	306	301	329	313
<i>Cases >= Test Value</i>	319	324	296	312
<i>Total Cases</i>	625	625	625	625
<i>Number of Runs</i>	311	307	319	330

Z	-0.189	-0.487	0.512	1.321
Asymp. Sig. (2-tailed)	0.850	0.626	0.609	0.186

Source: Secondary data, processed.

The results of the run test using the mean show similar results to the run test using the median. The results which can be seen in Table 7. show that all precious metals, namely gold, platinum, silver, and palladium are not significant at the 1%, 5%, and 10% significance levels. The data shows that the second H_0 is accepted, which means the market price of the precious metal using the mean runs randomly. The Covid-19 pandemic has caused a lot of losses in almost all markets in the world. This is a moment for precious metals to be chosen to serve as safe haven assets. This phenomenon causes an increase in demand which has a direct impact on the price of precious metals, where most of the metals experienced a significant price increase. So, this study get the result that precious metals are efficient in the weak form market.

4.3 Augmented Dickey-Fuller Result

To confirm the results, the Augmented Dickey-Fuller test was carried out, this test was carried out to determine the stationarity of the data. There is a unit root in the data if the probability is greater than the 5% significance level.

Table 8. Cryptocurrency Augmented Dickey-Fuller Results

	Prob. Bitcoin	Prob. Binance	Prob. Cardano	Prob. Ethereum	Prob. Tether
Level	0.000	0.000	0.000	0.000	0.000

Source: Secondary data, processed.

Table 9. Precious Metal Augmented Dickey-Fuller Results

	Prob. Gold	Prob. Silver	Prob. Platinum	Prob. Palladium
Level	0.517	0.693	0.411	0.553

Source: Secondary data, processed.

Augmented Dickey-Fuller test results on cryptocurrencies show similar results on each other. The probability value of Binance Coin, Bitcoin, Cardano, Ethereum, and Tether shows the same number of 0.000. The figure shows that the cryptocurrency is significant even at the 1% significance level which means there is no unit root on cryptocurrency data return. This proves that cryptocurrency is inefficient. The probability value of the Augmented Dickey-Fuller shows that all the precious metals used in this study have varying amounts, all of which are greater than the 5% significance level. This probability value indicates that there is a unit root in the precious metal price data, so the precious metal market can be said to be efficient in a weak form during the Covid-19 pandemic. Augmented Dickey-Fuller tests show consistent results on the market efficiency of the weak form of cryptocurrencies and precious metals during the Covid-19 pandemic. The results of the Augmented Dickey-Fuller test also show results that support the calculations with the run tests that have been carried out previously. In this Augmented Dickey-Fuller test, a market is said to be efficient if its value is greater than its significance level. So, from this test the same results are obtained, the cryptocurrency market is inefficient, and precious metals are efficient in weak form.

5. CONCLUSION

The results of this study showed consistent results both from the run test using mean and median as well as the Augmented Dickey-Fuller. Based on the run test on cryptocurrencies using the mean, the same interpretation is obtained with the results of the run test using the median. The results of the run test on cryptocurrencies show that the overall data is significant at a significance level of 5% which means the cryptocurrency does not run randomly. So, it can be said that the cryptocurrency was inefficient in its weak form during the Covid-19 pandemic.

This result is reinforced by the results of the Augmented Dickey-Fuller which shows that there is no unit root on return cryptocurrency data which means the cryptocurrency does not run randomly. Gold price data also shows consistent results from the run test to the Augmented Dickey-Fuller showing that the precious metal market is efficient in a weak form during the Covid-19 pandemic. The results of the run test show an insignificant probability value at the 5% significance level which means that the price of precious metal runs randomly. Augmented Dickey-Fuller tests also show that there is a unit root in the precious metal price data. So, it is evident that the metal market was efficient in a weak form during the Covid-19 pandemic.

REFERENCES

- [1] Apopo, N., & Phiri, A. (2021). On The (in)Efficiency of Cryptocurrencies: Have They Taken Daily or Weekly Random Walks? *Heliyon*, 7(4), 1–10. <https://doi.org/10.1016/j.heliyon.2021.e06685>
- [2] BI. (2021, May 29). Masa Pandemi, Investasi Kripto Kian Diminati Anak Muda. *BeritaSatu.Com*. <https://www.beritasatu.com/digital/74947/masa-pandemi-investasi-kripto-kian-diminati-anak-muda>
- [3] Bouri, E., Molnár, P., Azzi, G., Roubaud, D., & Hagfors, L. I. (2017). On The Hedge and Safe Haven Properties of Bitcoin: Is It Really More Than a Diversifier? *Finance Research Letters*, 20(1), 192–198. <https://doi.org/10.1016/j.frl.2016.09.025>
- [4] Brown, S. J., & Brown, S. J. (2020). The Efficient Market Hypothesis , and The Professional Status of Investment Management. *Financial Analysts Journal*, 76(2), 5–14. <https://doi.org/10.1080/0015198X.2020.1734375>
- [5] Chang, B. H., Ahmed, P., Ghumro, N., & Rehman, M. U. (2018). Are gold markets weak form efficient? Evidence from China, India and Russia. *Sukkur IBA Journal of Management and Business*, 5(1), 52–65. <https://doi.org/10.30537/sijmb.v5i1.189>
- [6] Charles, Amélie, Darné, O., & Kim, J. H. (2015). Precious Metals Shine? A Market Efficiency Perspective. *International Review of Financial Analysis*, 41(5), 284–291. <https://doi.org/https://doi.org/10.1016/j.irfa.2015.01.018>
- [7] Charles, Amelie, Darnn, O., & Kim, J. H. (2015). Will Precious Metals Shine? A Market Efficiency Perspective. *International Review of Financial Analysis*, 41, 284–291. <https://doi.org/https://doi.org/10.1016/j.irfa.2015.01.018>.
- [8] Dyhrberg, A. H. (2016a). Bitcoin, Gold and The Dollar - A GARCH Volatility Analysis. *Finance Research Letters*, 16(1), 85–92. <https://doi.org/10.1016/j.frl.2015.10.008>
- [9] Dyhrberg, A. H. (2016b). Hedging Capabilities of Bitcoin. Is It The Virtual Gold? *Finance Research Letters*, 16(1), 139–144. <https://doi.org/https://doi.org/10.1016/j.frl.2015.10.025>
- [10] Fama, E. F. (1965a). Random Walks In Stock-Market Prices. *Financial Analysts Journal*, 21(5), 55–59. www.jstor.org/stable/4469865
- [11] Fama, E. F. (1965b). The Behaviour of Stock Market Prices. *Journal of Business*, 38(1), 34–105. <http://jstor.ac.uk/>
- [12] Fama, E. F. (1970a). American Finance Association Efficient Capital Markets : A Review of Theory and Empirical Work. *The Journal of Finance*, 25(2), 383–417. <https://doi.org/https://doi.org/10.2307/2325486>
- [13] Fama, E. F. (1970b). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance*, 25(2), 383–417. <http://www.jstor.org/stable/2325486>

- [14] Fama, E. F. (1991). Efficient Capital Markets: II. *The Journal of Finance*, 46(5), 1575–1617. <https://doi.org/10.2307/2328565>
- [15] Gabriela, A. (2015). The Efficient Market Hypothesis : Review of Specialized Literature and Empirical Research. *Procedia Economics and Finance*, 32(15), 442–449. [https://doi.org/10.1016/S2212-5671\(15\)01416-1](https://doi.org/10.1016/S2212-5671(15)01416-1)
- [16] Ginanjar, D. (2021, June 21). Prospek Emas saat Pandemi Covid-19 Tak Kunjung Berakhir. *JawaPos.Com*. <https://www.jawapos.com/ekonomi/finance/21/06/2021/prospek-emas-saat-pandemi-covid-19-tak-kunjung-berakhir/?page=3>
- [17] Harper, A., Jin, Z., & Sokunle, R. (2015). Examining Market Efficiency : A View From the Silver Futures Market. *Journal of Finance and Accountancy*, 20, 1–6. <https://www.aabri.com/manuscripts/152181.pdf>
- [18] Hawaldar, I. T., Rajesha, T. M., & Lolita, J. D. S. (2019). Testing The Weak Form of Efficiency of Cryptocurrencies: A Case Study of Bitcoin and Litecoin. *International Journal of Scientific and Technology Research*, 8(9), 2301–2305. <https://www.ijstr.org/paper-references.php?ref=IJSTR-0819-20908>
- [19] Klein, T., Pham Thu, H., & Walther, T. (2018). Bitcoin Is Not The New Gold – A Comparison of Volatility, Correlation, and Portfolio Performance. *International Review of Financial Analysis*, 59(5), 105–116. <https://doi.org/10.1016/j.irfa.2018.07.010>
- [20] Leirvik, T. (2021). Cryptocurrency Returns and The Volatility of Liquidity. *Finance Research Letters*, 41(1), 1–8. <https://doi.org/10.1016/j.frl.2021.102031>
- [21] Mittal, S. K. (2018). Testing Weak Form of Efficient Market Hypothesis: Empirical Evidence for Bullions and Base Metal Segment of Indian Commodity Market. *Economic Affairs*, 63(2), 575–581. <https://doi.org/10.30954/0424-2513.2.2018.37>
- [22] Mnif, E., & Jarboui, A. (2021). COVID-19, Bitcoin Market Efficiency, Herd Behaviour. *Review of Behavioral Finance*, 13(1), 69–84. <https://doi.org/10.1108/RBF-09-2020-0233>
- [23] Nargunam, R., & Anuradha, N. (2017). Market Efficiency of Gold Exchange-Traded Funds In India. *Financial Innovation*, 3(1), 1–18. <https://doi.org/10.1186/s40854-017-0064-y>
- [24] Palamalai, S., Kumar, K. K., & Maity, B. (2020). Testing the random walk hypothesis for leading cryptocurrencies. *Borsa Istanbul Review*, 20(4), 1–13. <https://doi.org/10.1016/j.bir.2020.10.006>
- [25] Pulungan, D. P., Wahyudi, S., & Suharnomo, S. (2018). Does the Crude Palm Oil Market Walk Randomly? *Jurnal Keuangan Dan Perbankan*, 22(2), 211–218. <https://doi.org/https://doi.org/10.26905/jkdp.v22i2.2023>
- [26] Robiyanto. (2015). Month of the Year Effect Pada Beberapa Pasar Komoditas di Indonesia. *Jurnal Ekonomi Dan Bisnis*, 18(2), 53–64. <https://doi.org/10.24914/jeb.v18i2.260>
- [27] Robiyanto, R. (2016). Month of the Year Effect Pada Beberapa Pasar Modal di Asia Tenggara dan Pasar Komoditas. *Jurnal Ekonomi Dan Bisnis*, 18(2), 53–64. <https://doi.org/10.24914/jeb.v18i2.260>
- [28] Robiyanto, R., & Djari, Y. R. (2021). Day of the Week Effect dan Volatilitas Cryptocurrency Pada Masa Pandemi Covid-19. *AFRE (Accounting and Financial Review)*, 4(1), 1–17. <https://doi.org/10.26905/afr.v4i1.5713>

- [29] Robiyanto, R., & Pangestuti, I. R. D. (2018). Weak Form Market Efficiency Analysis In the Cryptocurrency Market. *2nd International Conference on Management & Entrepreneurship (2nd i-CoME)*, 2(13), 124–128. <http://i-come.petra.ac.id/wp-content/uploads/2018/11/PROCEEDING-OF-i-CoME-2018.pdf>
- [30] Sierra, L. P., Gir, L. E., Osorio, C., & Osorio, C. (2017). Has Financialization In Commodity Markets Affected The Predictability In Metal Markets? The Efficient Markets Hypotheses for Metal Returns. *International Journal of Economics and Financial Issues*, 7(4), 15–22. <https://www.econjournals.com>
- [31] Susilo, A., Rumende, C. M., Pitoyo, C. W., Santoso, W. D., Yulianti, M., Herikurniawan, H., Sinto, R., Singh, G., Nainggolan, L., Nelwan, E. J., Chen, L. K., Widhani, A., Wijaya, E., Wicaksana, B., Maksum, M., Annisa, F., Jasirwan, C. O. M., & Yunihastuti, E. (2020). Coronavirus Disease 2019: Tinjauan Literatur Terkini. *Jurnal Penyakit Dalam Indonesia*, 7(1), 45. <https://doi.org/10.7454/jpdi.v7i1.415>
- [32] Susilo, D., Wahyudi, S., Pangestuti, I. R. D., Nugroho, B. A., & Robiyanto, R. (2020). Cryptocurrencies: Hedging Opportunities From Domestic Perspectives in Southeast Asia Emerging Markets. *SAGE Open*, 10(4), 1–14. <https://doi.org/10.1177/2158244020971609>
- [33] Tran, V. Le, & Leirvik, T. (2020). Efficiency In The Markets of Cryptocurrencies. *Finance Research Letters*, 35(1), 1–8. <https://doi.org/10.1016/j.frl.2019.101382>
- [34] Tuyon, J., & Ahmad, Z. (2016). Borsa _ Istanbul Review Behavioural Finance Perspectives on Malaysian Stock Market Efficiency. *Borsa Istanbul Review*, 16(1), 43–61. <https://doi.org/10.1016/j.bir.2016.01.001>
- [35] Widhiastuti, W., & Utami, I. (2017). Market Reaction to Cabinet Reshuffle: The Indonesian Evidence. *International Journal of Economics and Financial Issues*, 7(5), 183–188. <https://ideas.repec.org/a/eco/journ1/2017-05-22.html>
- [36] Yadirichukwu, E., & Ogochukwu, O. J. (2014). Evaluation of The Weak Form of Efficient Market Hypothesis: Empirical Evidence From Nigeria. *International Journal of Development and Sustainability*, 3(5), 1199–1244. www.isdsnet.com/ijds
- [37] Yousef, I., & Shehadeh, E. (2020). The Impact of COVID-19 on Gold Price Volatility. *International Journal of Economics and Business Administration*, VIII(Issue 4), 353–364. <https://doi.org/10.35808/ijeba/592>
- [38] Zaman, S. (2019). Weak Form Market Efficiency Test of Bangladesh Stock Exchange: An Empirical Evidence From Dhaka Stock Exchange and Chittagong Stock Exchange. *Journal of Economics, Business & Accountancy Ventura*, 21(3), 285–291. <https://doi.org/10.14414/jebav.v21i3.1615>