

# The Impact of Volatility, Liquidity, and Crude Oil Price Index on Cryptocurrency Returns (Testing the Weak-Form Market Efficiency) Period January 2019 - June 2021

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## ABSTRACT

Since it was first founded by Satoshi Nakamoto in 2008, cryptocurrencies have attracted the attention of investors significantly. Until now, many investors have invested their money in cryptocurrencies. This study aims to prove and analyze the effect of volatility, liquidity and world oil price indices on cryptocurrency returns. It also examines whether the occurrence of market efficiency is weak or not. This study aims to prove and analyze weak efficiency market and the impact of liquidity, volatility and the world oil price index on the return of the cryptocurrency market. This study uses quantitative methods and secondary data, so that the number of samples taken are 3 types of cryptocurrencies (Bitcoin, Ethereum and Binance Coin) which are listed on [coinmarketcap.com](http://coinmarketcap.com) and [investing.com](http://investing.com), as well as the oil price index taken from [investing.com](http://investing.com). The analytical methods used in this study are series correlation test and runs test as well as multiple linear regression analysis. The results of this study indicate that volatility and liquidity affect the efficiency of the cryptocurrency market while the oil price index has no effect. The results of autocorrelation test on return itself prove that these coins have weak form efficiency.

**Keywords:** Market Efficiency, Cryptocurrency, Liquidity, Oil Price Index, Volatility

## INTRODUCTION

The rapid development of science and technology has been able to increase economic growth in the fields of investment, finance and trade. The global economic crisis in 2008 which began with the economic crisis in the United States, which spread to other countries around the world, was one of the triggers for the birth of cryptocurrencies or what are known as cryptocurrencies. proposed by several studies (Shahzad et al., 2019; Urquhart and Zhang, 2019; Mnif et al., 2020), that all financial assets in general seem to be losing value, and many investors are watching the behavior of this cryptocurrency because of the large return value that given. Internet technology has made significant changes to financial activities with the emergence of cryptocurrencies as a means of payment.

Since the emergence of Bitcoin (BTC) in 2008, the cryptocurrency ecosystem has experienced a market capitalization surge that crossed one trillion United States Dollars at its highest point in February 2021 ([coinmarketcap.com](http://coinmarketcap.com), 2021). In addition, many investors were attracted by asset diversification, and saw the opportunity for more than four hundred cryptocurrencies to be launched over the past three years, causing cryptocurrencies that started as peer-to-peer payment systems to emerge as important asset classes. Chaim and Laurini

2019; Corbet et al., 2019). Cryptocurrencies are based on blockchain technology which enables electronic transactions to depend on cryptography rather than trust in a verifying third party (Nakamoto, 2008). The drastic growth in the price of Bitcoin viralized bubble behavior and general market skepticism (Hafner, 2018; Cheung et al., 2015), exposing the need for a deeper understanding of the underlying processes driving cryptocurrency valuation. The introduction of Bitcoin futures by CME and the Chicago Board Options Exchange (CBOE) on December 18, 2017 solidified the cryptocurrency's position as a new asset class. Interest in investing in cryptocurrencies is increasingly evident, with positive growth from investors.

The high interest in investing in cryptocurrencies has led to research on cryptocurrencies' returns and market efficiency being one of the research topics debated in the academic world over the past few years. The study of market efficiency has important implications for market participants and policy makers due to the emergence of cryptocurrencies as an alternative to fiat or government-backed currencies and as a new digital investment option. Since the last decade, the cryptocurrency market has shown rapid growth in value and volume, creating many investment opportunities. Apart from Bitcoin, alternative cryptocurrencies such as Ethereum or Binance Coin have developed into the cryptocurrencies with the largest market capitalization (Yahoo Finance, 2020; coinmarketcap.com, 2020). A study by Selmi et al. (2018) show that crypto assets are also important for risk management and anticipating frequent market shocks, making them an additional option for risk-averse investors (Dyhrberg, 2016a, 2016b). Thus, the efficient market hypothesis (EMH) of the cryptocurrency market is very important for the valuation of crypto portfolios, especially with the occurrence of financial crises, global pandemics and other risks.

Research conducted on the return and efficiency of the cryptocurrency market so

far has built several arguments. First, previous studies have considered the largest crypto asset, Bitcoin, and provided mixed conclusions about whether Bitcoin behaves in overall inefficiency or temporary efficiency. Second, the largest altcoins, such as Ethereum, Ripple, and Litecoin, show less evidence of efficiency behavior. However, some studies show that some of the biggest cryptocurrencies will experience efficiencies over time. For example, Drozd et al. (2020) show that the Bitcoin market, and perhaps other cryptocurrencies, carry real potential to become a regular market soon. Third, the efficiency of the cryptocurrency market appears to be unstable and affected by the impact of various events.

Illiquid cryptocurrencies also incur greater costs for investors and speculators to buy and sell due to higher spreads and higher transaction costs. Wei (2018) found evidence that there is a strong relationship between liquidity and cryptocurrency returns. Wei (2018) argues that if cryptocurrency market participants have limited risk-bearing capacity and issue inventory, this will lead to significant price deviations even in periods where there is no fundamental change in cryptocurrency news. Active traders who detect these large deviations can place 'arbitrage trades' for price convergence back to 'fundamental values' in the absence of news. However, these efforts will be hampered if the underlying liquidity is low. In the highly illiquid cryptocurrency market, the lack of active traders also means it will take longer for market participants to act on new information, resulting in market inefficiencies. Brauneis and Mestel (2018), found evidence that liquidity has a positive effect on the efficiency of the Bitcoin market, whereas according to Al Yahyee et al. (2020) that the cryptocurrency market is inefficient in terms of its volatility and liquidity.

On the other hand, oil prices can also have an impact on cryptocurrencies because oil is one of the important energy resources

needed to mine cryptocurrencies. Jareno et al. researched the relationship between oil prices and cryptocurrencies and found that the two influence each other positively, especially during the economic turbulence during the covid-19 period. The study by Das and Dutta (2019) discusses the scale of power consumption for companies running bitcoin aggregated software estimated at 22 Terawatts/hour (TWh), which is close to the annual energy demand of Ireland. As such, rising oil prices are expected to increase the production costs of cryptocurrencies and hence could affect the base price. Bouri et al., (2017b), van Wijk, (2013) and Ciaian et al., (2016) argue that potential changes in oil prices signal shifts in the general price level, which can appreciate (or depreciate) the value of cryptocurrencies. Then inflationary pressures led by rising oil prices can also depreciate fiat currencies. Thus, currencies separate from the real economy, such as cryptocurrencies, can be used to settle cross-border payments. As a result, the price of crypto assets may increase according to demand.

Follow-up studies state that an increase in oil prices due to demand or supply has different economic implications (Kilian, 2009). An increase in oil prices due to higher demand for oil is referred to as a demand shock. Whereas, the supply side shows scarcity of oil availability or increase in the price of oil extraction which leads to higher oil prices differently and significantly impacts traditional assets such as stocks, precious metals, and fiat currencies (Atems et al., 2015; Clements et al., 2019; Uddin et al., 2018). The decline in world oil prices also affected the large number of crypto coin sales. Cryptocurrency markets tumbled after a slump in oil prices and a sell-off in stocks. The market cap or the entire value of cryptocurrencies has fallen dramatically from the previous day, according to data from coinmarketcap.com. The sell-off in cryptocurrency markets came after the international oil benchmark plunged sparked by Saudi Arabia slashing

its official selling price for oil after OPEC failed to agree a production cut deal.

The results of research on various phenomena that occur give rise to research gaps or gaps so that it is interesting to re-examine using various variants of cryptocurrencies into an analysis. This study aims to prove whether the cryptocurrency market is efficient and to analyze the extent to which liquidity, volatility and world oil prices influence the return of cryptocurrencies.

## LITERATURE REVIEW

### Efficient Market Hypothesis (EMH)

According to Tandelin (2016), the market is said to be efficient, one of which is if the price of equity reflects all of the information available on the market. Overall information must be available to investors, to know everything about the equity and its fundamental value. The concept of the Efficient Market Hypothesis (EMH) was first put forward by Fama (1970) in Rahman and Ervina (2017) which essentially states that in an efficient market, securities in the form of convertible bonds will always be traded at fair value so that no one also able to obtain returns that are not normal (abnormal return), after adjusting for risk, by using existing trading strategies. In other words, the price formed in the market is the result of a reflection of all available information.

### Cryptocurrencies

Literally, cryptocurrency might be parsed from the words cryptography and currency. Cryptocurrency is a decentralized ecosystem that can be defined as an economic system based on supply and demand. As a currency, cryptocurrencies offer several advantages over government-issued and backed currencies. Most notable is that no entity has sovereignty over it, and being an unregulated currency affords almost complete anonymity (Amanzholova & Teslya, 2018). As part of the core of the specification, digital currencies are immutable and decentralized which paves

the way for market participants to enhance risk management and portfolio analysis. Investors are reported to use cryptocurrency investments as a speculative asset rather than a means of payment which might explain their volatility behavior (Cheah and Fry, 2015; Cheung et al., 2015).

### **Market Efficiency and Return**

According to Fama (1995) in Latif and Mohd (2017), an efficient market is a market consisting of a large number of rational market participants who actively compete with each other to maximize profits and predict future market values obtained from financial instruments using important up-to-date information available to market participants. There are 3 (three) forms of market efficiency. (1) Weak form of market efficiency, (2) Semi-strong form of market efficiency (3) Strong form of market efficiency. Among the three forms of EMH, the most commonly used is the weak form EMH, which represents the inability of interested investors to utilize past information of investable assets to envision the future value of these assets. If the market is not efficient, then this will make investors switch to other, cheaper assets to improve their portfolio performance (Narayan et al., 2016).

In investing in an asset, the hope that investors want is to get a return. According to Jogianto (2010: 205) return is the result obtained from investment. Return can be used as one of the factors that motivates investors to invest and is also a reward for the courage of investors to take risks on the investments made (Eduardus Tendelilin, 2010). Therefore, returns are very important as one of the attractions for investors to invest their funds in the financial market. Analysis used by investors for valuation of a company's shares by using technical analysis. Technical analysis bases itself on asset price movement patterns over time such as price and volume information. Technical information is an attempt to estimate the price of an asset in the future

by observing changes in the price of that asset in the past.

### **Volatility**

According to Firmansyah (2006), volatility is a statistical measurement for fluctuations in the price of an asset during a certain period. Volatility can be interpreted as a statistical measure, related to financial market instruments in the fluctuation of an asset's price and recorded as a range of price changes in the difference between the maximum and minimum prices in a certain period in trading sessions, daily trading, monthly, and others. Volatility is also referred to as "market mood" to see whether an asset price is experiencing sharp spikes or weakening (range of fluctuations) which means it is experiencing high volatility. Volatility is different from risk, in this case volatility can be used to measure a risk opportunity, but the measure This cannot be used as a benchmark as a source of risk in transactions.

Reporting from Cointelegraph (2020), volatility is the level of variation in trading prices within a certain period of time and is one of the special elements of crypto assets that does not have a centralized authority. In a securities market, volatility is often associated with changes in both directions. For example, when a crypto asset rises and falls by more than one percent over a period of time, this is known as an "unstable" market. Instability is a major factor when pricing options contracts. Volatility often refers to the amount of uncertainty associated with the size of a security's change in value. High volatility means that a security's value has the potential to spread over a larger range of values. That is, the price of a security can change dramatically over a short period of time in either direction.

### **Liquidity**

According to Greene and McDowall (2018), liquidity is the probability of an asset that can be converted into the expected amount of value in the expected amount of time.

Any token that defines itself as 'money' must be highly liquid. When the price falls, it will result in more sellers. In an efficient market, the market must be large and highly liquid. Chordia, Roll, and Subrahmanyam (2008) state that if market participants are unable to absorb the impact of price pressures from an imbalance in buy and sell orders, then price deviations will emerge which encourage predictability of returns and create potential arbitrage profits. Higher liquidity facilitates arbitrage trading which leads to lower return predictability and higher market efficiency. In addition, if market participants can fully absorb price pressures from imbalances in buy and sell orders and utilize all available information in order flows, it can be concluded that there is no relationship between liquidity and the predictability of returns from order flows.

### **World Oil Price Index**

World crude oil is one of the mining products that drives the world economy. Industries around the world still rely on fuel oil which is a refined product of crude oil as a raw material for production factors because refined crude oil is a source of energy. Crude oil is mainly classified according to various types of sulfur content and oil density. This standard is set by the American Petroleum Institute (API). According to the API, the unit called gravity indicates the degree of density of petroleum. Oils with a gravity of more than 40 degrees are considered light oils, while oils with a gravity of less than 20 degrees are considered heavy oils. Oils that have a gravity between 20-40 degrees are considered moderate oil.

### **MATERIALS & METHODS**

The purpose of this study is to look for interdependence relationships between

variables in order to be able to describe the dimensions or factors that drive why Bitcoin returns generally soar, even as the biggest crypto. The things that will be researched, analyzed and interpreted are all things related to the efficiency of the cryptocurrency market which is affected by volatility, liquidity and the world oil price index. The population in this study is specifically three (3) crypto currencies namely Bitcoin, Ethereum and Binance Coin. According to Sugiyono (2011) the sample is part of the number and characteristics possessed by the population. Sampling measurements are carried out through statistics or based on research estimates to determine the size of the sample taken in carrying out research on an object. Taking this sample size must be done in such a way as to obtain a sample that can describe the actual state of the population. The samples taken are based on data from the cryptocurrency market, specifically on Bitcoin, Ethereum, and Binance Coin, and from world oil price indices, specifically the WTI index. The data analysis technique used to test the hypothesis in this study is descriptive analysis and Multiple Linear Regression analysis.

### **RESULT**

#### **Descriptive Statistical Analysis**

This analysis is used to describe a data seen from the maximum value, minimum value, value (mean), and standard deviation value. In this study the variables used in the calculation of descriptive statistics are independent variables, namely: BTC, ETH and BNB. Based on the descriptive statistical analysis in the following table, the sample description is obtained as follows:

Table 1 Descriptive Statistics

Descriptive	Return BTC	Return ETH	Return BNB	Volatility BTC	Volatility ETH	Volatility BNB	Liquidity BTC	Liquidity ETH	Liquidity BNB	Indeks WTI
Mean	0.00243	0.00305	0.00610	0.04004	0.05157	0.005697	0.00893	0.00814	0.09138	51.00707
Median	0.00154	0.00254	0.00191	0.03966	0.05101	0.05117	0.00410	0.002340	0.00200	54.16500
Maximum	0.17182	0.23070	0.69765	0.08318	0.10782	0.41543	2.77220	32.30600	39.88830	74.05000
Minimum	-0.46473	-0.55071	-0.41889	0.03958	0.05086	0.04905	-3.49220	-33.63820	-46.29200	-37.63000
Std Dev	0.04025	0.05190	0.06103	0.00170	0.00242	0.02025	0.29430	3.27621	3.46362	12.36294
Skewness	-1.57351	-26.8261	-1.62692	18.71798	15.59986	9.10733	-0.45689	-0.25934	-2.23638	-1.17910
Kurtosis	24.49603	21942	26.82161	461.73350	335.88520	128.98740	50.69742	41.59402	80.28246	5.951298
Jarque-Bera	17916	11381	21942	8041014	4243208	615099	86389	56549	227469	542.3403
Probability	0.0000	0.00000	0.00000	0.00000	0.00000	0.00000	0.0000	0.00000	0.00000	0.00000
Sum	2.21014	2.78206	5.5784	36.47703	46.98003	51.89929	8.13080	7.41220	83.24280	46518.45
Sum Sq Dev	1.47438	2.45092	3.38982	0.00262	0.00531	0.37323	78.81592	9767.5130	10916.930	139239.3

## Data Analysis Results

### Determination of the Multiple Linear Regression Estimation Data Model

Table 2 The results of the multiple linear regression model

Variable	BTC			ETH			BNB		
	Coefficient	t-Statistic	Prob.	Coefficient	t-Statistic	Prob.	Coefficient	t-Statistic	Prob.
VOLATILITY	2.1561	3.1981	0.0014**	1.9884	3.3700	0.0008**	0.3279	2.4749	0.0133**
LIQUIDITY	0.0693	17.8291	0.0000**	0.0087	20.1092	0.0000**	0.0059	21.5669	0.0000**
WTI	-0.0001	-1.0018	0.3167	0.0000	-0.3007	0.7637	0.0000	-0.2821	0.7778
C	-0.0798	-2.9053	0.0038**	-0.0978	-3.1468	0.0017**	-0.0100	-0.9346	0.3500
R-squared	0.2682			0.3180			0.0843		
Adjusted R-squared	0.2658			0.3157			0.0813		
S.E. of regression	0.0345			0.0429			0.0585		
Sum squared resid	1.0790			1.6716			3.1040		
Log likelihood	1776.752			1577.3380			1350.5060		
F-statistic	110.796			140.9457			29.3297		
Prob(F-statistic)	0.0000			0.0000			0.0000		
Durbin-Watson stat	2.1710			2.1272			2.2166		

## DISCUSSION

### Cryptocurrency Market Efficiency

Based on the test run, in the 5 semester period from 2019 to 2021, where the cryptocurrencies used as samples, namely BTC, ETH and BNB, the research was all random or random, meaning that the relationship between crypto asset prices for the current period is independent of the previous period and not influenced by the previous period. This finding is also reinforced by the serial correlation autocorrelation test which shows

that there is no significant autocorrelation coefficient at lag-2 and lag-3, although there is one at lag-1. Based on the run-test and serial correlation tests on good efficiency in the 5-semester period for the three crypto currency samples, it proves that the market is efficient in a weak form, this is shown by a random pattern. The results of the study show that in general BTC, ETH and BNB support weak form market efficiency for the period from January 2019 to June 2021. Therefore investors cannot use past period

prices to predict current prices, because past information has already been absorbed into the market. cryptocurrency prices in the past period as well. Weak return predictability is one of the characteristics of efficiency. Under these circumstances an investor cannot obtain a higher profit level than normal circumstances by using trading rules that are based on past price information.

Theoretically investors act rationally by considering the level of profit and the level of risk that may occur. Investors take into account various information that is developing in the cryptocurrency market to get higher profit levels with lower risks. Information is the key to making a profit, but keep in mind that not all information is relevant to consider. This research has proven that the cryptocurrency market is efficient in the weak form. Research results showing weak market efficiency are in line with research by Zheng Nan (2020), Hawaldar and Tim (2020) and contrary to research by Nadarajah and Chu (2016), Urquhart (2016), and Warsito (2020) mentioning the cryptocurrency market not efficient.

#### **T-test The Effect of Volatility on Return**

The effect of X1 (Volatility) shows a prob value smaller than alpha 5%, meaning that volatility has a significant effect on returns. When comparing the effect of X1 on the efficiency of the three models, it shows that the biggest effect of volatility is on BTC, BNB and the lowest is on ETH. This is in line with the research by Burggraf and Rudolf (2021), Al-Yahyaee et al. (2020) which states that volatility weakens market efficiency. This is also in line with research by Fakhfekh, M., & Jeribi, A. (2019), Cheikh, Zaied, & Chevallier (2019) which states that there is a positive relationship between volatility and returns. This research is not in line with the results of research by Dyhrberg (2015) who conducted volatility analysis research on Bitcoin, gold, and dollars, where it was stated that cryptocurrency (Bitcoin) has a random walk so it is proven to have weak efficiency so that

investors cannot get high returns. and is influenced by past prices and public information.

#### **T-test The Effect of Liquidity on Return**

The effect of X2 (liquidity) shows a significant positive effect on returns. When compared to the effect of X2 on the efficiency of the three models, it shows that the biggest influence of liquidity is on BTC, BNB and the lowest is on ETH. This result is in line with the research of Thomas Leirvik (2022), Al-Yahyaee, et al. (2020), Purwati (2019), which states that high liquidity causes cryptocurrencies to become increasingly inefficient and earn abnormal returns. This is contrary to research by Leirvik (2022), Brauneis and Mestel (2018), Wei (2018) which states that efficiency in the cryptocurrency market is supported by cryptocurrency liquidity. Wei (2018) stated that the cryptocurrency market has a strong level of efficiency in a liquid market. So that the more liquid, the abnormal return is not easy to obtain.

#### **T-test The Effect of the WTI Index on Return**

The third hypothesis is the effect of the WTI Index (X3) showing a prob value greater than alpha 5%, which means that the world oil price index has no significant effect on the efficiency of cryptocurrencies. This result contradicts the results of research by Symitsi and Chalvatzis (2019), Okorie and Lin (2020), Jareno et al. (2021) which states that world oil prices have a significant effect on cryptocurrencies. However, this study is in line with Yin et al. (2021), Canh, Binh and Tanh (2019), and Smales (2019) who argue that there is no significant correlation between Bitcoin and the world oil price index.

#### **Test - F The joint effect of Volatility, Liquidity and WTI Index (X1, X2 and X3) on Return**

The F test is used to determine the magnitude of the influence of all independent variables together on the

dependent variable. If the prob F value <5% significance level, it can be concluded that the independent variables together have a significant effect on the dependent variable. The results of the F test show that the calculated F value is 31.0333 and prob (0.000), the prob value (0.000) is smaller than alpha 5%, so reject H<sub>0</sub>, meaning that together X<sub>1</sub>, X<sub>2</sub>, and X<sub>3</sub> have a significant effect on Y.

## CONCLUSION

The purpose of this study is to determine liquidity, volatility and the world oil price index and to analyze the factors that influence the efficiency of the cryptocurrency market. From data analysis, hypothesis testing and research discussion, several conclusions can be drawn, as follows:

1. Market efficiency tests show results for Bitcoin, Ethereum and Binance Coin experiencing market efficiency in a weak form.
2. Volatility has a positive and significant effect on Bitcoin returns
3. Liquidity has a positive and significant effect on Bitcoin returns
4. The world oil price index (WTI) has no significant effect on Bitcoin returns.
5. Volatility, liquidity and the world oil price index simultaneously have a significant positive effect on Bitcoin returns.
6. Volatility has a positive and significant effect on Ethereum returns
7. Liquidity has a positive and significant effect on Ethereum returns
8. The world oil price index (WTI) has no significant effect on Ethereum returns.
9. Volatility, liquidity and the world oil price index simultaneously have a significant positive effect on Ethereum returns
10. Volatility has a positive and significant effect on Binance Coin returns
11. Liquidity has a positive and significant effect on Binance Coin returns
12. The world oil price index (WTI) has no significant effect on Binance Coin returns.
13. Volatility, liquidity and the world oil price index simultaneously have a significant positive effect on Binance Coin returns

## Declaration by Authors

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