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To Assess the Association between Exchange Rate, Commodity Prices and Cryptocurrency in Indonesia

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ABSTRACT: *The paper aimed to assess the association among exchange rate, commodity prices and crypto currency in Indonesia. This study is quantitative in which the data has been gathered from the Investing.com from 2016 to 2020. The variables which were considered in the study include exchange rate, gold prices, cotton prices, oil prices, Bitcoin and Ethereum. In terms of the analysis, the vector autoregression and granger causality test has been adopted.The results of this study identified that there is no effect of exchange rate, oil price, cotton price and gold price on Bitcoin. On the other hand, there is only significant effect of gold prices on Ethereum. The results of this study are restricted to Indonesian context and the data has been considered from 2016 to 2019 due to the lack of data on crypto currency.*

Key words: *Exchange rate, Oil price, Gold price, Cotton price, Bitcoin, Ethereum, Indonesia.*

1. Introduction

In light of the study conducted by Erdas and Caglar (2018) it was found that money cannot be considered as means of exchange but now it also refers to store of value, standard of deferred payment and an commodity. Money is influenced by various factors such as technological advances and internet data. With the advancement of technology and rapid globalisation, electronic currencies are commonly used and many market transactions are carried out through virtual currencies. One of the popular virtual currency that has gripped the market is Bitcoin that helps in instant electronic payments. It consist of block chain technology and unlike the conventional note systems, Bitcoin does not have any physical form nor does the Government Issue it.

Despite of the prevailing criticism over its legal, technical and safety issues, Bitcoin has gained increased interest and attention from the internet users (Murphy, Murphy, & Seitzinger, 2015). The previous studies that are conducted in similar domain have not yet analysed relationship or the causality testing with commodity prices and exchange rate. Therefore, this study explores and investigates the association between exchange rate, commodity prices and cryptocurrency in case of Indonesia.

Many researchers investigated whether Bitcoin is a currency or asset but it was found that it is considered as a financial asset only and is not suitable or effective for purchasing goods and services (Glaser, Zimmermann, Haferkorn, Weber, & Siering, 2014). In addition to this, the researchers also reached to this conclusion that the volatility of Bitcoin is higher than other currencies. Yermack (2013) found that virtually there is no association in daily exchange rate of Bitcoin with dollar's exchange rate. Another study conducted by Chen, Pandey, and Dba (2014) revealed that Bitcoin cannot be used as medium of exchange but it is more suitable as an investment asset and can play a vital role in improving investor's portfolio.

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2. Literature Review

There is a growing interest of academicians and researchers on Bitcoin given its rapid rise in popularity amongst economists and analysts. In light of the basic functions of money that are: store of value, unit of exchange, and unit of account, the research carried out by Yermack (2013) have evaluated that whether Bitcoin can be regarded as money or not. The analysis of Yermack's findings show that as compared to the widely used currencies, the volatility of Bitcoin is much higher, this characteristic tends to undermine the usefulness of Bitcoin as unit of account and medium of exchange. The findings have further postulated that dollar exchange rate and the daily exchange rate of Bitcoin have no correlation.

There are other researches that have shed light upon the relationship between Bitcoin, stock prices, and commodity prices, Glaser et al. (2014) analysed the perception of user for Bitcoin as a currency or as an asset. The results of this research concluded that Bitcoin is a currency which is not used for buying commodities or assets, it is rather used for financial speculation. Similarly, another study was carried out by Chen et al. (2014) for determining the purpose of Bitcoin. The results of the research indicated that it might not be a suitable currency used for exchange however, it can play a considerable role in improving the efficiency of investor's portfolio. Baek and Elbeck (2015) made comparison of stock market index and Bitcoin volatility through their research. The results of this research precisely showed that Bitcoin is 23 times more volatile as compared to S&P 500.

As per the research of Narayan, Falianty, and Tobing (2019) Indonesia Digital Asset Exchange ("Indodax") is one of the largest Indonesian cryptocurrency exchange. On average, the daily transaction of D10million US dollar is being performed with this exchange within Indonesia. Furthermore, Kusumastuty, Wulandari, Narmaditya, and Kamaludin (2019) in his research has defined that there is zero correlation determined between cryptocurrency and daily exchange rate within Indonesia as compared to the exchange rate of other economies, which mainly includes British pound, US dollar, Gold, Yen and much more. On the other hand, Pati (2019) in his research has evaluated the influence of exchange rate and cryptocurrency on the Indonesian Stock market. It has been analysed that a noticeable impact of the exchange rate and cryptocurrency has been observed, and it produces a vital impact on the value of cryptocurrency.

Furthermore, Bufala (2019) in his research has examined the influence of bitcoin on the gold prices. It has been evaluated that bitcoins are sufficient for gold prices, and it provides vital results within the investment processes. The high fluctuations in the exchange rate of bitcoins, which is considered safe in which the investment can be done, and the desired results can be obtained. A noticeable influence of the bitcoin prices has been observed in association with gold and it has been categorised as a speculative asset having a positive impact on the economic factors and long-term results can be obtained.

H3: There is a relationship between gold prices and bitcoin.

Furthermore, Andrean (2019) in his research has examined the influence of exchange rate and cryptocurrency on the oil prices. It has been evaluated that a significant impact of oil prices is present on the value of cryptocurrency in terms to have long-term results. In contrast to this, Makarov and Schoar (2020), in his research has evaluated that either cryptocurrency should be considered as currency or asset. After evaluating various aspects, it has been deduced that cryptocurrency is considered as a speculative financial asset. This can be used as an investment asset. On the contrary, it has been evaluated that cryptocurrency is not suitable to be considered as an exchange currency, however, it can be used to enhance the efficiency of the investor portfolio. This can be used to invest in different categories in which oil is the most highlighted. However, it has been described-above that an essential impact of the exchange rate and cryptocurrency is observed on the oil prices, which can also be used to perform various investments within the respective field.

H4: There is a relationship between oil prices and bitcoin.

There was another study conducted by Atik, Kose, Yılmaz, and Saglam (2015) where the relationship between exchange rate and Bitcoin as determined in the context of Turkey. A number of trading currencies were analysed in this study. The final results of this research indicated that thee was existence of one-way relationship between Japanese yen and Bitcoin. Dwyer (2015) conducted a research aimed towards comparing variance of Bitcoin returns with foreign exchange and gold. The results depicted that the variance of returns in the case of Bitcoin are relatively higher than gold and foreign exchange. Bouoiyour and Refk (2015) conducted a research where the relationship between returns of Bitcoin and gold and silver was assessed.

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Optimal-GARCH method was used for the purpose of testing their relationship. The results of this research indicate that in the short-run Bitcoin is a rather weak hedge relative to the long-run.

Time-series analysis was conducted in order to find out the relationship between different economic indicators and the Bitcoin (Georgoula, Pournarakis, Bilanakos, Sotiropoulos, & Giaglis, 2015). From the results of this research it was analysed that Bitcoin value has an inverse relationship with exchange rate of EUR and USD. Furthermore, the findings of this research suggested that there is a negative relationship of Bitcoin and S&P 500. Icellioglu and Ozturk (2017) carried out a research where both short run and long run relationship of Bitcoin with different exchange was studied. Granger causality test and Johansen cointegration tests were applied in this research, however, both long and short run relationship were found to be statistically insignificant.

Dirican and Canoz (2017) carried out a research on Bitcoin have influence over the investor's decision with the help of Autoregressive Distributed Lag Model. There were different indices considered in this research, among which US stock market indices and Chinese stock market indices appeared to have relationship with Bitcoin prices. From this perspective it can be stated that the investors that invest in these indexes can be influenced by the price of Bitcoin. However, there were other indices for which no significant influence was found such as FTSE100 and BIST100. Poyser (2017) has conducted a research to determine the nexus between price of Bitcoin and different micro and macroeconomic variables via a Bayesian Approach. The result for the pair of Yuan and USD showed negative association of Bitcoin price with gold price and investor and attention. On the other hand, the result for the pair of Euro and USD showed positive association of Bitcoin price with gold price and investor and attention.

Based on the hypothesis formed in the above section, following is the conceptual model which was followed to analyse the relationship between exchange rate, commodity prices, and Bitcoin price in Indonesia:

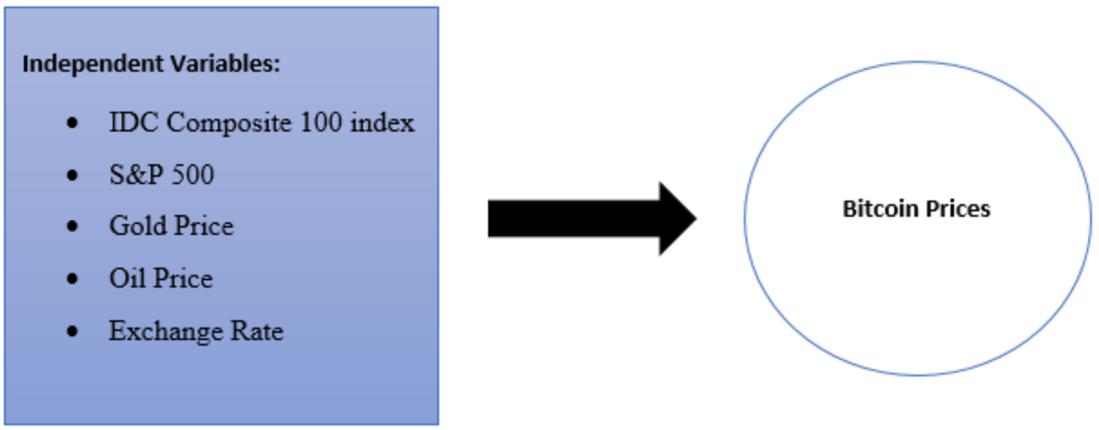


Figure-1. Conceptual model.

As shown in the above conceptual diagram, there are different factors that comprise of independent variable. Fundamentally, exchange rate and commodity prices are the independent variables. As this study is based on Indonesia hence the stock index selected for this research is IDC composite 100 index. Moreover, S&P 500 has also been selected as the predictor in the conceptual model which shows the market capitalisation-weighted index of 500 largest US companies traded on the stock market based on their market value. The two commodities which tends to impact the stock price and the overall capital market are mainly gold and oil, hence the other two predictors in the conceptual model are gold prices and oil prices. The last factor of the independent variable is the exchange rate where Rupiah is measured against the value of American Dollar. All the aforementioned variables tend to influence Bitcoin prices, the dependent variable as per the research topic is cryptocurrency is the criterion variable. Bitcoin is selected in this regard because it is considered as the pioneer among other kinds of cryptocurrencies.

Narayan et al. (2019) in his research has examined the typical theory of fiat money. It has been evaluated that it is analysed that the principle that bitcoin, which is the commodity money without gold. This theory

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further defines that fiat money without any state and the credit money without any debt defines that bitcoin is not any gold, debt banking or state. Pati (2019) in his research has further stated the relationship between the bitcoin pricing and selected exchange rate based on the GARCH models. However, it has been determined that the GARCH model highlights the influence of conditional variance present in between the US dollar and bitcoins and other stable currencies. This theory further defines the volatility, efficiency and liquidity of the bitcoin markets traded by different firms. This defines that is not considered as a reliable instrument despite the high yield. Furthermore, it has been identified that the bitcoin market is considered vulnerable because of the numerous risks and speculations identified within the respective market. On the other hand, Erdas and Caglar (2018), in his research has studied the short and long-run relationship between the selected exchange and bitcoin. This theory is significant because it provides essential information regarding the casualty relation regarding selected exchange and bitcoin. After analysing this theory, it has been identified that there is no such association present between other exchanges and bitcoin.

It has been further evaluated from the research of Erdas and Caglar (2018) which define that there is no such relation determined among the traditional assets and bitcoin that is being traded specifically in countries like Indonesia. There is a small ratio but essential correlations are determined between bitcoin and various Indonesian assets, which mainly includes oil and gold. Moreover, it has been identified that bitcoin can be used as a diversification tool because of the low correlation value in comparison with the traditional instruments. This allows vital measures to be used within the investment portfolio. Bitcoins are used mostly as a speculative investment and it does not use as an alternative currency or any medium of exchange. Moreover, noticeable domination of the bitcoin prices has been observed over the exchange currencies, which defines the bitcoin can be used as a secure medium to perform an investment, which can play a significant role in any uncertain situation. This defines that the bitcoin can be used to have a long-term impact, and various positive measures can be obtained accordingly.

3. Method

The researcher has used quantitative method alongside secondary data for statistical testing. The data will be collected from existing databases that can be accessed for obtaining commodity prices, exchange rates and bitcoin prices. The data will be collected from 2016 to 2019 (as per availability) on daily basis of prices.

Firstly, descriptive statistics for the variables were calculated in order to assess the statistical characteristics of the variables in the model. As the data was of time-series nature hence unit-root testing was carried out. Existence of unit root means that parametric tests can be applied and if there is no existence of unit root then parametric tests cannot be applied. The following equation shows the t-statistic of γ_2 coefficient:

$$\Delta p_t = \gamma_0 + \gamma_1 t + \gamma_2 p_{t-1} + \sum_{i=1}^{n} n_i \Delta p_{t-1} + \varepsilon_t$$

It is assumed that 's_t' is the stochastic time-series with k-dimensions, and is further influenced by an exogenous variable which is also time-dependent 'x_t' possessing d-dimensions then, the VAR model can be formulated below:

$$s_t = A_1 s_{t-1} + A_2 s_{t-2} + \cdots + A_n s_{t-n} + \varepsilon_t$$

After the transformation of equation which was formed by cointegration of relationship, the following equation was formed:

$$\Delta s_t = \alpha \beta' s_{t-1} + \sum_{j=1}^{n-1} \Gamma_i \Delta s_{t-1} + \varepsilon_t$$

$$\Pi = \sum_{j=1}^{n} \cap_i - I$$

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$$\cap_j = -\sum_{k=j+1}^{n} A_k$$

Further, as cointegrating vector is present, that is why we are moving towards the following equation where $\cap s_{t-1} \sim I(0)$

$$\Delta s_t = \alpha\beta' s_{t-1} + \sum_{k=1}^{n-1} \cap_j \Delta s_{t-1} + \varepsilon_t$$

Error correction in the above equation is represented by $\beta' s_{t-1}$, hence it can be stated as ec_{t-1} which shows the relationship between variables in the long-run. The equation can be re-written as:

$$\Delta s_t = \alpha ec_{t-1} + \sum_{k=1}^{n-1} \cap_j \Delta s_{t-1} + \varepsilon_t$$

Another test that has been applied on the dataset that is Vector Auto-Regression (VAR) for the purpose of testing causality between variables. The following equation indicates the equation for the VAR testing carried out:

'ec_{t-1}' in the above equation represents the long-term relationship between the variables that are included in the research model. In alignment to this equation, the following equation specifically shows the variables that are incorporated:

$$\widehat{LBP_t} = \alpha_1 + \beta_1 IDC_t + \beta_2 LSP_t + \beta_3 LGP_t + \beta_4 OP_t + \beta_5 ER_t + \epsilon_t$$

Where,
BP = Bitcoin prices
IDC = IDX composite 100
SP = S&P 500
GP = Gold price
OP = Oil price
ER = Exchange Rate

4. Results and Analysis

4.1. Descriptive Statistics

The Table 1 depicts the descriptive Statistics of the variables which have been adopted in this study. In this manner, it is evident from the Table 1 that mean value for exchange rate is determined to be 0.00012 which shows that the average mean value for exchange rate of Indonesia against USD is 0.00012 Rp. Additionally, the standard deviation for the exchange rate is computed to be 0.003 which posits that the exchange rate of Indonesian rupiah against USD will deviate from 0.003 Rp. In addition to this, the mean value for the oil prices is determined to be -0.0001 which depicts that the average oil prices over the years was USD -0.0001. Meanwhile, the standard deviation for oil prices was computed to be 0.033 which depicts that the oil prices will deviate from USD 0.033. On the other hand, the mean value for the gold prices was determined to be 0.0002 which depicts that the average gold price against the Indonesian Rupiah is USD 0.0002. In this manner, the standard deviation for gold prices was computed to be 0.008 which posits that gold prices will deviate from USD 0.008. With respect to the cotton prices, it has been determined that the mean value for cotton prices is 0.00 which shows that the average cotton prices against the USD were 0.00. In this manner, the standard deviation for the cotton price was computed to be 0.014 which posits that the cotton prices will deviate from USD 0.014. The mean value for the gasoline prices was obtained to be 0.00 which shows that the average gasoline price was USD 0.00 while the standard deviation for the gasoline prices was computed to be 0.024 which shows that the gasoline prices will deviate from USD 0.024. Moreover, the mean value for Bitcoin was determined to be 0.002 which depicts that the average price for Bitcoin was USD 0.002 with respect to Indonesian Rupiah while the standard deviation was computed to be 0.042 which shows that the Bitcoin will deviate from USD 0.042. Furthermore, the mean value for Ethereum was determined to be

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0.002 which depicts that the average price for Ethereum was USD 0.002. Additionally, the standard deviation for Ethereum was computed to be 0.059 which posits that the Ethereum will deviate from USD 0.059.

Table-1. Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
ER (Rp)	948	0.00012	0.003	-0.027	0.044
OP (USD)	946	-0.0001	0.033	-0.282	0.319
GP (USD)	948	0.0002	0.008	-0.047	0.055
CP (USD)	948	0.00	0.014	-0.078	0.059
GOP (USD)	948	0.00	0.024	-0.329	0.139
BTC (USD)	948	0.002	0.042	-0.186	0.227
ETH (USD)	948	0.002	0.059	-0.266	0.258

4.2. Augmented Dickey-Fuller (ADF)

The unit root testing is significant on the basis of the previous patterns in order to forecast the values. According to Paparoditis and Politis (2018) historical values makes it challenging to assess the future values while using the conventional inferential statistics. Therefore, the Augmented Dickey-Fuller (ADF) has been used for the purpose of detecting the unit root.

Table-2. Augmented dickey-fuller (ADF).

Augmented Dickey-Fuller test statistic	t-Statistic	Prob.*
Exchange Rate	-24.050	0.000
Gold Price	-25.175	0.000
Cotton Price	-28.922	0.000
Gasoline Price	-33.385	0.000
Bitcoin	-30.245	0.000
Ethereum	-28.151	0.000

From the above Table 2, the results for Augmented Dickey-Fuller (ADF) can be determined in which null hypothesis is grounded on the fact that there is presence of unit root in the data. In this manner, it can be identified from the above table that there is no presence of unit root in exchange rate, gold price, cotton price, gasoline price Bitcoin and Ethereum as the p-values of all the variables were below the threshold of 0.05.

4.3. Vector Autoregression

The Table 3 depicts the relationship among all the variables with respect to the equations of each variable. In this manner, it can be determined that there is no relationship among the variables with respect to the equation of Bitcoin as p-value is 0.206 which is above the threshold of 0.05. In addition to this, there is significant relationship among the variables with respect to the equation of gasoline prices as p-value is 0.015 which is below the threshold of 0.05. Moreover, the relationship is also significant among the variables with respect to the equation of gold prices as p-value is 0.025 which is also below the threshold of 0.05. On the other hand, there is also a significant relationship among the variables with respect to the equation of oil prices as p-value is 0.00. Furthermore, the relationship of variables with respect to the exchange rate is also significant as p-value is 0.00.

Table-3. Vector autoregression equations.

Equation	Parms	RMSE	R-sq	chi2	P>chi2
BTC	15	0.040	0.031	18.009	0.206
ETH	15	0.060	0.023	13.328	0.500
GOP	15	0.020	0.047	27.816	0.015
CP	15	0.014	0.025	14.816	0.390
GP	15	0.008	0.044	26.087	0.025
OP	15	0.029	0.078	47.873	0
ER	15	0.004	0.068	41.146	0.000

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Moreover, the below Table 4 depicts the vector autoregression with respect to Bitcoin. In this manner, it can be determined that there is significant effect of Ethereum on the Bitcoin as the Ethereum is dependent on the first lag as B= -0.071 [p= 0.043< 0.05].

Table-4. Vector Autoregression (Bitcoi).

	Coef.	Std. Err.	z	P>|z|
BTC				
BTC				
L1.	-0.015	0.054	-0.28	0.782
L2.	0.041	0.049	0.84	0.4
ETH				
L1.	-0.071**	0.035	-2.02	0.043
L2.	0.012	0.035	0.35	0.726
GOP				
L1.	0.080	0.074	1.08	0.279
L2.	-0.034	0.065	-0.53	0.599
CP				
L1.	-0.001	0.118	-0.01	0.991
L2.	-0.083	0.119	-0.7	0.483
GP				
L1.	-0.365	0.196	-1.87	0.062
L2.	-0.092	0.209	-0.44	0.661
OP				
L1.	0.056	0.064	0.87	0.382
L2.	0.041	0.059	0.7	0.482
ER				
L1.	0.419	0.500	0.84	0.403
L2.	0.283	0.585	0.48	0.628
_cons	0.005	0.002	2.61	0.009

Table-5. Vector Autoregression (Ethereum).

	Coef.	Std. Err.	z	P>|z|
ETH				
BTC				
L1.	-0.056	0.080	-0.71	0.479
L2.	-0.067	0.073	-0.92	0.36
ETH				
L1.	-0.044	0.052	-0.85	0.397
L2.	0.049	0.052	0.93	0.352
GOP				
L1.	0.079	0.109	0.72	0.47
L2.	-0.059	0.097	-0.61	0.539
CP				
L1.	0.081	0.175	0.46	0.644
L2.	0.024	0.177	0.13	0.893
GP				
L1.	-0.607**	0.291	-2.09	0.037
L2.	0.012	0.311	0.04	0.97
OP				
L1.	0.007	0.095	0.07	0.94
L2.	0.085	0.087	0.97	0.333
ER				
L1.	0.624	0.743	0.84	0.401
L2.	-0.904	0.869	-1.04	0.298
_cons	0.007	0.003	2.64	0.008

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On the other hand, the Table 5 depicts the vector autoregression with respect to Ethereum. In this manner, it can be determined from the below Table 5 that there is significant effect of gold price on Ethereum which is dependent on its first lag as B= -0.607 [p= 0.037< 0.05].

With respect to the vector autoregression of gasoline prices, it can be determined from Table 6 that there is an effect of gold prices on the gasoline prices as the gold price is dependent on it second lag as B= -0.301 [p= 0.003< 0.05]. Moreover, there is also significant effect of exchange rate on the gasoline prices as exchange rate is dependent on its first lag B= -0.531 [p= 0.031< 0.05]

Table-6. Vector Autoregression (Gasoline Prices).

	Coef.	Std. Err.	z	P>|z|
GOP				
BTC				
L1.	-0.014	0.026	-0.54	0.591
L2.	0.011	0.024	0.47	0.64
ETH				
L1.	0.014	0.017	0.8	0.424
L2.	-0.023	0.017	-1.34	0.179
GOP				
L1.	-0.066	0.036	-1.84	0.066
L2.	0.071**	0.032	2.23	0.026
CP				
L1.	-0.005	0.058	-0.08	0.934
L2.	0.061	0.058	1.05	0.293
GP				
L1.	0.048	0.096	0.5	0.614
L2.	-0.301**	0.103	-2.93	0.003
OP				
L1.	-0.002	0.032	-0.07	0.947
L2.	-0.010	0.029	-0.33	0.739
ER				
L1.	-0.531**	0.246	-2.16	0.031
L2.	0.131	0.287	0.46	0.648
_cons	0.000	0.001	0.47	0.635

Table-7. Vector Autoregression (Cotton Price).

	Coef.	Std. Err.	z	P>|z|
CP				
BTC				
L1.	-0.013	0.019	-0.69	0.49
L2.	-0.012	0.017	-0.68	0.495
ETH				
L1.	0.011	0.012	0.9	0.367
L2.	0.002	0.012	0.2	0.842
GOP				
L1.	-0.003	0.025	-0.13	0.898
L2.	0.018	0.023	0.82	0.415
CP				
L1.	-0.059	0.041	-1.43	0.152
L2.	0.030	0.041	0.72	0.469
GP				
L1.	0.090	0.068	1.33	0.184
L2.	0.106	0.073	1.45	0.146
OP				
L1.	0.002	0.022	0.1	0.924
L2.	0.003	0.020	0.16	0.872
ER				
L1.	-0.212	0.173	-1.22	0.222
L2.	0.446**	0.203	2.2	0.028
_cons	0.001	0.001	1.23	0.22

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The Table 7 depicts the Vector Autoregression with respect to the cotton prices. In this manner, it can be determined from the below table that there is significant effect of exchange rate on the cotton prices as the exchange rate is dependent on its second lag as B= 0.446 [p= 0.028< 0.05].

The Table 8 depicts the vector autoregression with respect to the gold price. On the basis of the below table 8, it is evident that there is an effect of gasoline prices on gold prices as the gasoline price is dependent on its second lag as B= -0.031 [p= 0.023< 0.05]. Moreover, the effect of exchange rate is also significant on the gold prices as the exchange rate is dependent on its first lag as B= -0.282 [p= 0.008< 0.05].

Table-8. Vector Autoregression (Gold Price).

	Coef.	Std. Err.	z	P>|z|
GP				
BTC				
L1.	0.005	0.011	0.4	0.686
L2.	-0.009	0.010	-0.86	0.389
ETH				
L1.	0.007	0.008	0.94	0.348
L2.	0.004	0.007	0.59	0.552
GOP				
L1.	0.013	0.016	0.85	0.394
L2.	-0.031**	0.014	-2.27	0.023
CP				
L1.	-0.007	0.025	-0.27	0.789
L2.	-0.013	0.025	-0.52	0.606
GP				
L1.	0.106**	0.042	2.53	0.011
L2.	0.060	0.045	1.34	0.179
OP				
L1.	-0.013	0.014	-0.93	0.35
L2.	0.003	0.013	0.22	0.824
ER				
L1.	-0.282**	0.107	-2.64	0.008
L2.	-0.012	0.125	-0.09	0.926
_cons	0.000	0.000	0.69	0.488

Table-9. Vector Autoregression (Oil Prices).

	Coef.	Std. Err.	z	P>|z|
OP				
BTC				
L1.	-0.033	0.039	-0.85	0.394
L2.	-0.049	0.035	-1.38	0.168
ETH				
L1.	0.019	0.025	0.75	0.454
L2.	-0.015	0.025	-0.59	0.555
GOP				
L1.	-0.045	0.053	-0.84	0.398
L2.	-0.013	0.047	-0.27	0.784
CP				
L1.	0.162	0.085	1.9	0.057
L2.	-0.151	0.085	-1.77	0.077
GP				
L1.	-0.123	0.141	-0.87	0.383
L2.	0.002	0.151	0.01	0.99
OP				
L1.	0.249**	0.046	5.39	0.00
L2.	-0.080	0.042	-1.9	0.058
ER				
L1.	-0.127	0.360	-0.35	0.723
L2.	-0.516	0.421	-1.23	0.22
_cons	-0.001	0.001	-0.93	0.354

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The Table 9 depicts the vector autoregression with respect to the oil prices. In this manner, it has been determined that there is no significant effect of variables on the oil prices.

The Table 10 shows the vector autoregression with respect to the exchange rate. In this manner, it can be determined on the basis of the below Table 10 that there is significant effect of oil prices on the exchange rate as oil price is dependent on its second lag as B= 0.015 [p= 0.009< 0.05].

Table-10. Vector Autoregression (Exchange Rate).

	Coef.	Std. Err.	z	P>|z|
ER				
BTC				
L1.	-0.005	0.005	-1.02	0.309
L2.	-0.001	0.005	-0.19	0.848
ETH				
L1.	-0.001	0.003	-0.15	0.88
L2.	0.002	0.003	0.58	0.559
GOP				
L1.	0.001	0.007	0.08	0.933
L2.	0.010	0.006	1.54	0.125
CP				
L1.	0.015	0.012	1.28	0.201
L2.	0.003	0.012	0.28	0.782
GP				
L1.	0.017	0.019	0.88	0.377
L2.	-0.004	0.020	-0.18	0.856
OP				
L1.	-0.008	0.006	-1.28	0.201
L2.	0.015**	0.006	2.59	0.009
ER				
L1.	0.168**	0.049	3.44	0.001
L2.	0.190**	0.057	3.33	0.001
_cons	0.000	0.000	-0.49	0.626

4.4. Granger Causality Test

The below Table 11 depicts the results obtained from Granger Causality test. In this manner, it can be determined that the equation of gasoline prices determined to have significant short term effect excluding the gold prices as B= 8.816 [p= 0.012< 0.05]. This depicts that gold price do not granger gasoline prices. In addition to this, the equation of gold prices was also determined to have significant short term effect while excluding the gasoline prices and exchange rate as the p-value for both the variables was below the threshold of 0.05. This posits that the gasoline prices and exchange rate do not granger gold prices. Moreover, the significant short term effect of oil price equation was also determined while excluding the cotton price as p-value is determined to be below the threshold of 0.05. Therefore, the cotton prices do not granger oil price. Furthermore, the equation of exchange rate is also determined to have significant effect while excluding the oil prices as the p-value < 0.05. In this manner, the oil prices do not granger exchange rate.

The Table 12 depicts the summary of hypothesis and on the basis of this table, it is evident that there is no influence of exchange rate, oil price, cotton price and gold price on Bitcoin. In this manner, the results of this study align with the findings of Glaser et al. (2014) that Bitcoin is a currency which is not used for buying commodities or assets, it is rather used for financial speculation. On the other hand, it has also been determined that there is no influence of exchange rate, oil price and cotton price on the Ethereum. However, the significant influence of gold price on Ethereum was determined. Ti contradicts with the study of Poyser (2017) that there is negative association of cryptocurrency price with gold price and investor and attention.

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Table-11. Granger Causality.

Equation	Excluded	chi2	df	Prob > Chi2
BTC				
BTC	ETH	4.172	2	0.124
BTC	GOP	1.728	2	0.421
BTC	CP	0.492	2	0.782
BTC	GP	3.673	2	0.159
BTC	OP	1.436	2	0.488
BTC	ER	1.028	2	0.598
BTC	ALL	12.91	12	0.375
ETH				
ETH	BTC	1.296	2	0.523
ETH	GOP	1.107	2	0.575
ETH	CP	0.225	2	0.893
ETH	GP	4.355	2	0.113
ETH	OP	0.974	2	0.614
ETH	ER	1.625	2	0.444
ETH	ALL	10.164	12	0.602
GOP				
GOP	BTC	0.524	2	0.769
GOP	ETH	2.372	2	0.305
GOP	CP	1.126	2	0.569
GOP	GP	8.816**	2	0.012
GOP	OP	0.122	2	0.941
GOP	ER	4.735	2	0.094
GOP	ALL	17.766	12	0.123
CP				
CP	BTC	0.913	2	0.633
CP	ETH	0.866	2	0.648
CP	GOP	0.748	2	0.688
CP	GP	3.882	2	0.144
CP	OP	0.039	2	0.98
CP	ER	5.842	2	0.054
CP	ALL	12.141	12	0.434
GP				
GP	BTC	0.929	2	0.628
GP	ETH	1.274	2	0.529
GP	GOP	6.845**	2	0.033
GP	CP	0.324	2	0.85
GP	OP	0.883	2	0.643
GP	ER	7.119**	2	0.028
GP	ALL	19.286	12	0.082
OP				
OP	BTC	2.550	2	0.279
OP	ETH	0.878	2	0.645

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OP	GOP	0.726	2	0.695
OP	CP	7.126**	2	0.028
OP	GP	0.760	2	0.684
OP	ER	1.737	2	0.42
OP	ALL	15.982	12	0.192
ER				
ER	BTC	1.058	2	0.589
ER	ETH	0.357	2	0.836
ER	GOP	2.404	2	0.301
ER	CP	1.680	2	0.432
ER	GP	0.813	2	0.666
ER	OP	7.655**	2	0.022
ER	ALL	14.883	12	0.248

5. Discussion and Summary of Hypothesis

Table-12. Summary of Hypothesis

Hypotheses	Proposition	Results
H_1	There is a significant influence of exchange rate on Bitcoin.	Rejected
H_2	There is a significant influence of oil price on Bitcoin.	Rejected
H_3	There is a significant influence of cotton price on Bitcoin.	Rejected
H_4	There is a significant influence of gold price on Bitcoin.	Rejected
H_5	There is a significant influence of exchange rate on Ethereum.	Rejected
H_6	There is a significant influence of oil price on Ethereum.	Rejected
H_7	There is a significant influence of cotton price on Ethereum.	Rejected
H_8	There is a significant influence of gold price on Ethereum.	Accepted

6. Conclusion and Recommendations

With the advancement of technology, it has been realised by researchers and policy makers that money cannot be considered as means of exchange but now it also refers to store of value, standard of deferred payment and an commodity. In this manner, this study has been conducted for the purpose of assessing the association among exchange rate and commodity prices and crypto currency in Indonesia. In this manner, the data has been gathered from Investing.com while the variables considered for commodity include gold, cotton and oil. The data has been analysed using the vector autoregression and granger causality. The results of this study identified that there is no effect of exchange rate, oil price, cotton price and gold price on Bitcoin. On the other hand, there is only significant effect of gold prices on Ethereum. In this manner, it is suggested for the policy makers to increase the emphasis over gold prices for the purpose of ensuring sustainability in the prices of crypto currency.

7. Limitations and Future Implications

The results of this study are restricted to Indonesian context therefore, it is suggested for the future researchers to focus on other countries as well with respect to determining the effect of exchange rate on crypto currency. On the other hand, the data has been considered from 2016 to 2019 due to the lack of data on crypto currency. In this manner, it is suggested to future researchers to increase the sample size for the purpose of presenting significant findings.

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