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Analysis of Return and Risk of Cryptocurrency Bitcoin Asset as Investment Instrument

Sunita Dasman

Abstract

This study aims to explore the potential use of the cryptocurrency bitcoin as an investment instrument in Indonesia. The return obtained from bitcoin cryptocurrency is compared to other investment instruments, namely stock returns, gold and the rupiah exchange rate. The research period was carried out based on research data from 2011 to 2020. This study employee compares means test (t test) and analysis of variance (F test) on rate of return of bitcoin investment. The bitcoin return compare to the rate of return form the others investments instruments namely exchange rate, gold and stock. The study collected 120 data of each investments instruments: bitcoin, exchange rate, gold and stock from various of sources during 2011–2020. Then, we calculate the return and risk of individual investment instruments. The results showed that the bitcoin currency had the highest rate of return 18% with a standard deviation of 61% compared to exchange rate, gold and stock returns. While the rate of return for the others investment instruments showed less than 0.5% with standard deviation less than 5%. The rate of return bitcoin has significance difference compare to the rate of return of exchange rate, gold and stock. The study contribute for the investors who would like to invest on bitcoin. The investors should understand the characteristic of bitcoin in term of rate of returns and also the risk. This study also contributes to government of Indonesia on crypto currency development. The Indonesia government should adopt and regulate on crypto currency in the future to secure the investor and economic growth.

Keywords: Cryptocurrency, bitcoin, stocks, gold, exchange rate

1. Introduction

As cryptocurrencies become popular and market places for cryptocurrencies are growing rapidly. Understanding the rate of return can support cryptocurrency world is and how design choices affect investors. One threat to cryptocurrencies is high fluctuations in traders' willingness to buy or sell [1]. The adoption of crypto assets has been a great concern for policy makers ever since Facebook announced its cryptocurrency, Libra, in June 2019 [2].

The technology behind these cryptocurrencies, a decentralized and open-source system named "blockchain" is often presented as one of the most innovative technology offering several many disruptive innovations in the next years [3–6]. The crypto-currencies trading volume also has a granger-causality to energy

consumption [7]. A crypto asset is an intangible digital asset whose issuance, sale or transfer are secured by cryptographic technology and shared electronically via a distributed ledger [8].

The era of digitalization of technology has given birth to the cryptocurrency Bitcoin (BTC) as a new exciting currency for the world community, including Indonesia. BTC is an alternative to complement the needs of global financial transactions that want convenience, efficiency and security. Use of the digital computing tools to process scientific, economic, and social information has changed the human capacity, considerably. Virtual space is being activated year over year being the result of efficient application of information resources [9].

The development of BTC is very rapid in Indonesia. Indonesia, which has a total population of 271,349 889 people in 2020 (BPS, 2021). The population of Indonesia is very potential for the growth of the investment climate for BTC.

Almost all countries in the world experienced a decline in economic growth in 2020 due to the 19 virus pandemic. However, BTC price growth showed a very significant increase in 2020. BTC prices recorded the best performance since 2013 amounting to 260 USD / BTC. The price of BTC is USD 12,310 in 2020 or an increase of 68.04% compared to 2019 amounting to USD 7,326 / BTC (investing, 2021). **Table 1** shows the development of the value of BTC (USD / BTC) in 2010–2020.

Variable	Indicator	Measurement	Type of data	Source
Stock	Indonesia Composite Index	Average Stock Price/ Baseline*	Ratio	www.investing.com
Exchange Rate	Convert from USD to IDR currency	IDR/USD	Ratio	www.investing.com
Gold	Gold price in USD per 1 Troy Ounce	USD/Troy Ounce	Ratio	www.harga-emas.org
Bitcoin	Bitcoin price in USD per Bitcoin	USD/BTC	Ratio	www.investing.com

Source: various sources, 2021. *The baseline used to calculate the composite stock price index is the average price of the shares on August 10, 1982.

Table 1.
Operational variable.

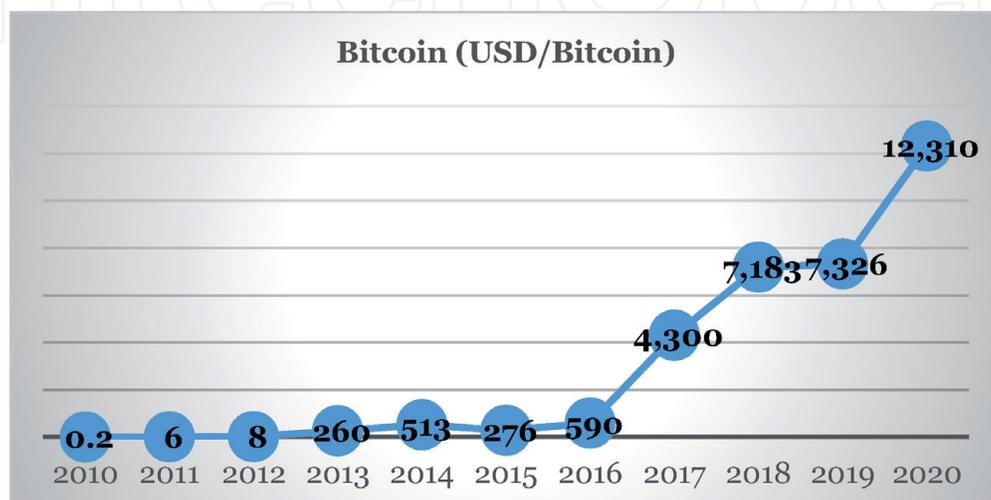


Figure 1.
Bitcoin cryptocurrency graph 2010–2020 (USD/BTC). Source: www.investing.com, 2021.

Indonesians who start investing in bitcoin currency can change the existing financial asset structure. The development of bitcoin currency in Indonesia can disturb the stability of the rupiah as the only valid currency for domestic transactions. Therefore, Bank Indonesia as the determinant of monetary policy has not or has not legalized bitcoin currency as a virtual currency in Indonesia.

This research aims to examine bitcoin cryptocurrency as an investment instrument opportunity compared to other investment instruments, namely stocks, gold and the rupiah exchange rate. For the government as policy makers, this research is expected to be an input for the development of digital currency in the era of information technology. In addition, for investors, this research is expected to illustrate the returns and risks faced when investing in bitcoin (**Figure 1**).

2. Literature review and hypothesis development

The study and analysis of the cryptocurrency market is a relatively new area. A few works published in recent years have had the potential interest in this topic. Many scientists have been studying Bitcoin from different angles ever since it appeared. Cryptocurrency is a digital currency, whose creation and control is based on cryptographic methods. Some researchers claim that Bitcoin is just a bubble. The fundamental value of Bitcoin is difficult to reveal, and history shows that innovative assets are indeed more prone to bubbles [10].

Bitcoin is the first decentralized peer-to-peer payment network that is fully controlled by its users without any central authority or intermediary. Bitcoin is a digital currency residing in an open source P2P (peer-to-peer) payment network. P2P is a computer network model that consists of two or more computers, where each computer in the network environment can share. This network makes it easy for users to transact directly without the need for services from third parties.

The elements of Bitcoin are the existence of a peer-to-peer network, blocks, blockchain, and miners. The peer-to-peer network in Bitcoin allows users to transfer a certain amount of Bitcoin value, these transactions are stored in files called blocks, these blocks are intertwined with each other to form a block chain called the blockchain, and miners solve complex mathematical formulas. to prove ownership of Bitcoin.

Bank Indonesia responds to the existence of Bitcoin if it can be used, traded, or stored as an asset or a form of digital commodity by the people of Indonesia, but it cannot be used as a means of payment because only the Rupiah currency is the only legal means of payment in Indonesia.

Bitcoin is the first implementation of the concept of cryptocurrency, which was first described by Wei Dai in 1998. The proposes of cryptocurrency is a new form of money that uses cryptography to control creation and transactions rather than using a centralized authority.

Cryptocurrency is a digital asset designed to function as a medium of exchange that uses strong cryptography to secure financial transactions, control the creation of additional units, and verify asset transfers.¹⁹ Cryptocurrency is a type of alternative currency and digital currency. Cryptocurrencies use decentralized controls compared to centralized digital currencies and central banking systems.

Cryptocurrency is a virtual currency that circulates without being regulated by a particular central bank, is not “backed up” with gold as currency, and is not protected by any particular country. Distribution and use through the internet network media. With this crypto many benefits are obtained without exchanging it for real money, the value of crypto prices has international standards so that the value is the same everywhere, the transfer time is very fast, and crypto is not owned

by a particular company. Crypto is a digital asset where transactions are carried out using an online network. Crypto assets are virtual so if one wants to see what the physical form of this currency is, then the answer is no. The form is not like a physical currency issued by a bank and also not the currency of a country.

Investors can maximize asset allocation through a combination of risky assets to reduce high risk. Investors who have an aversion to risk tend to reject investments that are more likely to have speculative content. Investors who do not like risk consider risk-free investments or speculate on investments that have a positive premium.

Research related to virtual currency, especially bitcoin cryptocurrency, is still rarely done in Indonesia. However, the development of bitcoin cryptocurrency has recently begun so that further studies are needed to provide an overview to the public and policy makers regarding bitcoin cryptocurrency investment. Some of the research results that have been carried out both domestically and globally can be summarized as follows:

Voskobojnikov et al. [11] identified and qualitatively analyzed 6,859 reviews pertaining to the user experience with top five mobile cryptocurrency wallets. They suggested that both new and experienced users struggle with general and domain-specific user experience issues that, aside from frustration and disengagement, might lead to dangerous errors and irreversible monetary losses. They reveal shortcomings of current wallet user experience as well as users' misconceptions, some of which can be traced back to a reliance on their understanding of conventional payment systems. Based on their findings, they provide recommendations on how to design cryptocurrency wallets that both alleviate the identified issues and counteract some of the misconceptions in order to better support newcomers.

Hachicha and Hachicha [12] proved the efficiency of Markov Chain for our sample and the convergence and stability for all parameters to a certain level. On the whole, it seems that permanent shocks have an effect on the volatility of the price of the bitcoin and also on the other stock market. Our results will help investors better diversify their portfolio by adding this cryptocurrency.

Mikhaylov, A. [10] conclude that the cryptocurrency market has entered a new stage of development, which means a reduced possibility to have excess profits when investing in the most liquid cryptocurrencies in the future. However, buying new high-risk tools provides opportunities for speculative income.

Igoni et al. [13] concluded that market capitalization and volume of digital currency did not constitute the significant variables of policy to influence the monetary policies in the South African economy, hence they operate independently. A decision to adopt and regulate digital currency operation or not in Nigeria does not affect. They recommend the Nigerian to embrace the digital environment in terms of regulations for tax advantage.

Le Tran and Leirvik [14] shown that the level of market-efficiency in the five largest cryptocurrencies is highly time-varying. Specifically, before 2017, cryptocurrency-markets are mostly inefficient. This corroborates recent results on the matter. However, the cryptocurrency-markets become more efficient over time in the period 2017–2019. This contradicts other, more recent, results on the matter. The reason is that they apply a longer sample than previous studies. Another important reason is that they apply a robust measure of efficiency, being directly able to determine if the efficiency is significant or not. On average, Litecoin is the most efficient cryptocurrency, and Ripple being the least efficient cryptocurrency.

Agosto and Cafferata [15] found that extremely rapid price accelerations, often referred to as explosive behaviors, followed by drastic drops pose high risks to investors. From a risk management perspective, testing the explosiveness of individual cryptocurrency time series is not the only crucial issue.

Rabbani et al. [16] identified that the sharia compliance related to the cryptocurrency/Blockchain is the biggest challenge which Islamic Financial Technology organizations are facing. During our review we also find that Islamic Financial Technology organizations are to be considered as partners by the Islamic Financial Institutions (IFI's) than the competitors. If Islamic Financial institutions want to increase efficiency, transparency and customer satisfaction they have to adopt Financial Technology and become partners with the Financial Tech companies.

Hairudin et al. [17] indicated that public embrace of cryptocurrencies continues to lag as the masses currently show reluctance in embracing cryptocurrencies as a complement, let alone a substitute to fiat counterparts. Governments have also successfully defended their sovereignty in preserving legal tender status, structural seignior age and exclusivity. Market-based studies hint at consistent inefficiencies across the spectrum. The most promising areas of research for crypto-financial intelligentsia would be delving into establishing trial runs for central bank-backed cryptocurrencies.

Grobys et al. [18] indicated that a variable moving average strategy is successful when using the 20 days moving average trading strategy. Specifically, excluding Bitcoin the technical trading rule generates an excess return of 8.76% p.a. after controlling for the average market return. The results suggest that cryptocurrency markets are inefficient.

Amsyar et al. [19] concluded that cryptocurrency has the disadvantage of not having the authority responsible for dealing with all problems that occur in all transactions, and money laundering crimes also often occur, this is a challenge for how to utilize cryptocurrency and blockchain technology in the current era of globalization.

Vaz de Melo and Fluminense [20] indicated that indicate that the strength of dependence among the crypto-currencies has increased over the recent years in the cointegrated crypto-market. The conclusions reached will help investors to manage risk while identifying opportunities for alternative diversified and profitable investments.

Tu et al. [21] detected two sudden jumps in the standard deviation, in the second quarter of 2017 and at the beginning of 2018, which could have served as the early warning signals of two major price collapses that have happened in the following periods. They propose a mean-field phenomenological model for the price of cryptocurrency to show how the use of the standard deviation of the residuals is a better leading indicator of the collapse in price than the time-series' autocorrelation. Their findings represent a first step towards a better diagnostic of the risk of critical transition in the price and/or volume of crypto-currencies.

Fang et al. [22] summarized the existing research papers and results on cryptocurrency trading, including available trading platforms, trading signals, trading strategy research and risk management. This paper provides a comprehensive survey of cryptocurrency trading research, by covering 126 research papers on various aspects of cryptocurrency trading (e.g., cryptocurrency trading systems, bubble and extreme condition, prediction of volatility and return, crypto-assets portfolio construction and crypto-assets, technical trading and others). This paper also analyses datasets, research trends and distribution among research objects (contents/properties) and technologies, concluding with some promising opportunities that remain open in cryptocurrency trading.

Drożdż et al. [23] found that A particularly significant result is that the measures applied for detecting cross-correlations between the dynamics of the BTC/ETH and EUR/USD exchange rates do not show any noticeable relationships. This could be taken as an indication that the cryptocurrency market has begun decoupling itself from the Forex.

Panagiotidis et al. [24] found that a significant interaction between bitcoin and traditional stock market. The increased impact of Asian markets on Bitcoin compared to other geographically-defined markets. Two years after the Chinese regulatory interventions and the sudden construction of CNY's share in bitcoin trading volume.

Aysan et al. [25] found that bitcoin can be considered as a hedging tool against global geopolitical risk.

Krafft et al. [1] found that individual "buy" actions led to short-term increases in subsequent buy-side activity hundreds of times the size of our interventions. From a design perspective, we note that the design choices of the exchange we study may have promoted this and other peer influence effects, which highlights the potential social and economic impact of HCI in the design of digital institutions.

Panagiotidis et al. [26] found that search intensity and gold returns emerge as the most important variables for bitcoin returns.

Koutmos [27] found that the contribution of return shocks to transaction activity is quantitatively larger in magnitude.

Demir et al. [28] found that bitcoin can serve as a hedging tools again uncertainty.

Balcilar et al. [29] found that non-linear relationship between bitcoin returns and trading volume. The trading volume cannot help to predict the volatility of returns at any point of the conditional distribution.

Urquhart [30] found that bitcoin return significantly inefficient but in the process of moving towards an efficient market.

Based on the research objectives, the researcher wants to compare the returns obtained from bitcoin currency and others investment instrument, namely stocks, exchange rates and gold to see how rate of return behavior on bitcoin currency. Besides measure rate of return on bitcoin currency, the researcher also measures the risk of bitcoin currency investment. Standard deviation of bitcoin currency employee to measure the risk of the investment. Thus, the statistical hypotheses and research hypotheses used in this study are as follows:

Ho1: $\mu_1 = \mu_2$.

Ha1: $\mu_1 \neq \mu_2$.

Ho2: $\mu_1 = \mu_3$.

Ha2: $\mu_1 \neq \mu_3$.

Ho3: $\mu_1 = \mu_4$.

Ha3: $\mu_1 \neq \mu_4$.

Ho4: $\mu_1 = \mu_2 = \mu_3 = \mu_4$.

Ha4: At least one of the average returns are not equal.

where:

μ_1 = average bitcoin returns.

μ_2 = average exchange rate returns.

μ_3 = average gold returns.

μ_4 = average stock returns.

While the research hypothesis developed in this study is as follows:

H01: There is no difference between the bitcoin returns and the exchange rate returns.

Ha1: There is a difference between the bitcoin returns and the exchange rate returns.

H02: There is no difference between the bitcoin returns stock and the gold returns gold.

Ha2: There is a difference between the bitcoin returns and the gold returns.

H03: There is no difference between the bitcoin returns and the stock returns.

Ha3: There is a difference between the bitcoin returns and the stock returns.

H04: There is no difference between the bitcoin returns and the others investment instrument.

Ha4: There is a difference between the bitcoin returns and the others investment instrument.

3. Methodology

This study compares the return and risk of bitcoin, stocks, gold and the rupiah exchange rate. This research is a type of quantitative research using secondary data. Secondary data used in the study were obtained from www.investing.com [31]; for bitcoin and share prices. Gold prices were obtained from www.harga-emas.org [32]; Rupiah exchange rate is obtained from www.bi.go.id [33]. The research period from 2010 to 2020 used monthly data or 132 observed data.

The return calculation uses the formula for the difference from the current value to the previous value divided by the value in the previous period. In general, the return formula can be written as follows:

$$\text{Return} = \frac{R_t - R_{t-1}}{R_{t-1}} \quad (1)$$

where:

R_t = the return at period t .

R_{t-1} = the return at period $t-1$.

In this study also measure risk of each investment instruments. Standard deviation is employed to measure the risk of investments. Standard deviation to measure how far the deviation from the average of each investment instruments. The higher standard deviation value means the higher risk of the investment. Here the formula to measure standard deviation (σ):

$$\sigma = \sqrt{\frac{1}{n-1} \sum_{s=1}^n [r(s) - r]^2} \quad (2)$$

where:

σ = standard deviation of investment.

n = number of observation.

$r(s)$ = return of investment.

r = average of investment.

Table 1 shows the operational variables used in this study include investment instruments, namely bitcoin, exchange rates, gold and stock.

4. Research Results

Statistical descriptions include the average, minimum value, maximum value and standard deviation of each investment instrument, namely bitcoin, exchange rate returns, gold returns and stock returns during the study period 2011–2020. Bitcoin's return has the largest average of 18% compared with returns from other investment instruments. In addition, the standard deviation of bitcoin returns has

Instrument	N	Min	Max	Mean	Std. dev.
Bitcoin (μ_1)	120	-0.3887	4.7088	0.1800	0.6108
Exchange Rate (μ_2)	120	-0.0905	0.1367	0.0040	0.0258
Gold (μ_3)	120	-0.1212	0.1363	0.0035	0.0472
Stock (μ_4)	120	-0.1676	0.0944	0.0049	0.0415

Source: data processing, 2021.

Table 2.
Descriptive statistic.

Instrument	Stock	Exchange Rate	Gold	Bitcoin
Stock	1			
Exchange Rate	-0.602	1		
Gold	0.218	-0.258	1	
Bitcoin	0.042	0.023	-0.018	1

Source: data processing, 2021.

Table 3.
Correlation matrix.

the largest value of 61.08% compared to other investment instruments. The range of bitcoin returns between -38.87% till 470.88%. **Table 2** shows the descriptive statistics of the investment instruments studied.

The correlation matrix between investment instruments can be found in **Table 3**. The highest correlation is obtained from the return stock and return exchange rate (-0.602). The more the stock return increases, the lower the return exchange rate will be. In other words, the stronger the rupiah exchange rate, the more the composite stock price index will increase. The strengthening of the rupiah exchange rate had an impact on increasing domestic economic growth so that investors invested heavily in stocks. Therefore, stock returns also increase when there is an increase in the rupiah exchange rate. Meanwhile, bitcoin does not show a correlation with other investment instruments which is indicated by a correlation matrix value below 5%. This figure shows that the bitcoin returns are not affected by the others instruments investments returns namely exchange rate, gold and stock returns.

An overview of the return fluctuations obtained from each investment instrument of stock return, exchange rate return, gold return and bitcoin return can be seen in **Figures 2–5**. Each investment instrument shows different return fluctuations. The lowest standard deviation is the exchange rate 2.58%, while the highest standard deviation is Bitcoin 61.08%. In other words, investment in bitcoin have the highest risk compared to the alternative investment instruments. The others investment instruments have low risk between 2.6% till 4.7%. Investment in foreign exchange rate has the lowest risk compared to the others alternative investments. Investment on gold and stock have similar risks around 4.2% to 4.7%.

The range of the largest fluctuation was obtained from the return on bitcoin investment, especially in the period 2012 to 2014. In 2013, bitcoin returns reached the highest point where returns increased from 10–70%. However, the return drastically decreased to (-5%) entering 2014. It means the investment in bitcoin get the highest return and also the highest risk compared to the others instrument of investment.



Figure 2.
 The return stock 2011–2020. Source: data processing, 2021.

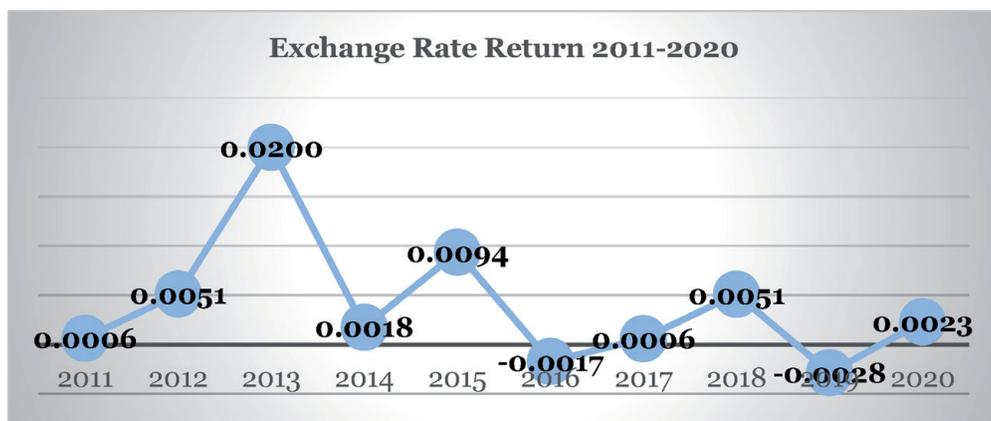


Figure 3.
 The return exchange rate 2011–2020. Source: data processing, 2021.



Figure 4.
 The return gold 2011–2020. Source: data processing, 2021.

The next test was to compare the returns between each investment instrument through paired sample tests, namely stock-exchange rate, stock-gold, stock-bitcoin, exchange rate-gold, exchange rate-bitcoin and gold bitcoin. **Table 4** shows the results of the paired sample test of each investment instrument.

The results of the paired samples test of returns between investment instruments can be seen in **Table 4**. The results of the paired sample test between bitcoin and the others investment instruments shows significant level less than 0.01. It

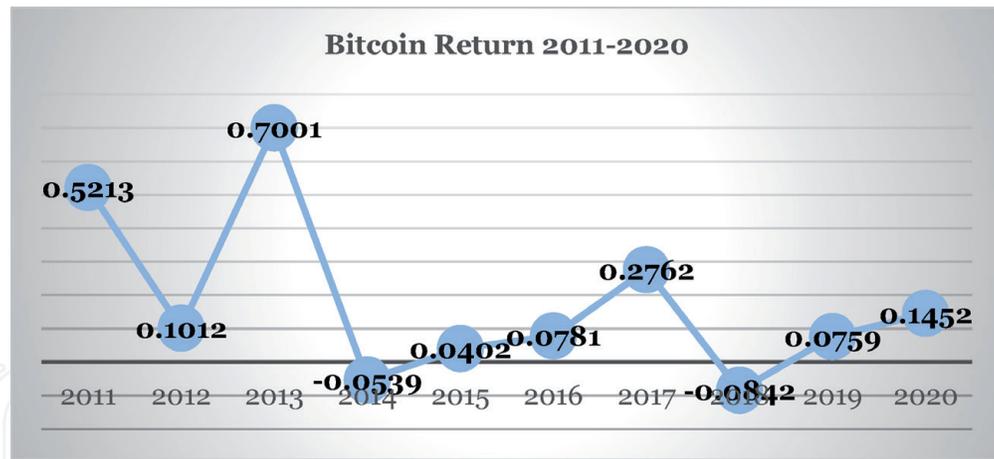


Figure 5.
Bitcoin return 2011–2020. Source: data processing, 2021.

Instrument	Mean	Std. dev.	Std. error mean	t	df	Sig.
Bitcoin - Ex. Rate	-0.1760	0.6108	0.0558	-3.156	119	0.002
Bitcoin - Gold	-0.1765	0.6135	0.0560	-3.151	119	0.002
Bitcoin - Stock	-0.1751	0.6105	0.0557	-3.143	119	0.002

Source: data processing, 2021.

Table 4.
Paired samples test.

means that is difference of return between bitcoin and the others investment instruments. The average means difference of bitcoin and the others investment instruments around -17.6% . Standard deviations show around 61% of investment on bitcoin. It means that the highest risk of bitcoin investments.

Based on the results of testing paired samples test return on investment between investment instruments and the explanation above, it can be concluded that the research hypothesis is as follows:

Ha1: There is a difference between the bitcoin and the exchange rate return (accepted at significance level 0.01).

Ha2: There is a difference between the bitcoin and the gold return (accepted at significance level 0.01).

Ha3: There is a difference between the bitcoin and the stock return (accepted at significance level 0.01).

One sample test is conducted to prove whether or not there are differences between the investment instruments used in this study. The one sample test results show that bitcoin returns provide a very significant difference ($\alpha < 0.01$) compared to other investment instruments: exchange rate, gold and stock. The average return of stock, exchange and gold investment instruments.

Table 5 shows analysis of variance single factor for each investment instruments. The variance of bitcoin the highest (0.37) if compared to stock, exchange rate and gold returns (0.001–0.002). It means there us a big different between bitcoin returns and the others investment instruments.

Table 6 shows analysis of variance to test hypothesis 4 whether there is significant level of the return. The result indicates that F calculation (0.9826) is higher than F critical value (2,624). It means there is significant different between bitcoin and the others investment instruments.

Groups	Count	Sum	Average	Variance
Stock return	120	0.585183	0.004877	0.001723
Ex-Rate return	120	0.483912	0.004033	0.000663
Gold Return	120	0.422361	0.00352	0.002228
Bitcoin return	120	21.60168	0.180014	0.373122

Source: data processing, 2021.

Table 5.
Anova single factor summary.

Source of variation	SS	df	MS	F	P-value	F crit
Between Groups	2.783868	3	0.927956	9.826513	0.00000	2.623637
Within Groups	44.95054	476	0.094434			
Total	47.73441	479				

Source: data processing, 2021.

Table 6.
Anova single factor test.

Based on the results of the analysis of variance single factor test shows that there is a difference between the average return of all investment instruments. Thus, the statistical hypothesis and research hypothesis (Ha4) is accepted at significant level 0.01 or can be written down as follows:

Ha4: There is a difference between the investment instruments (accepted at significance level 0.01).

Based on the average test between the research instruments used, bitcoin has a very significant difference in return compared to other investment instruments. Meanwhile, stock investment instruments, exchange rate and gold have the same average return.

5. Conclusions

Based on the research results discussed in the previous chapter indicate that the investment in bitcoin still promising. The price of bitcoin rapidly increase during the study 2011–2020. The rate of return of bitcoin investment is the highest compared to the other investment instruments: stock, exchange rate and gold. Meanwhile, the bitcoin investment also has the highest risk compared the others investment instruments.

It can be concluded that bitcoin investment provides the highest return (18%) compared to other investment instrument returns. However, the very high return on bitcoin comes with high risk investment. The risk of investing in bitcoin is indicated by a standard deviation of 61%, while the standard deviation of other instruments: stock, exchange rate and gold less than 5%.

Based on the results of the paired sample test, it shows that the average return on bitcoin shows a very significant difference compared to the others instrument. Meanwhile, the return on the others instrument: stock, exchange rate and gold show the same return.

For the investors who love risk, then the investment in bitcoin could be an alternative for an investment. The investment on bitcoin promise higher return compare

to the other investment instruments. For the investors who are risk aversion, an investment on bitcoin doesn't fit since this investment have the highest risk.

This research has practical implication for the investors who require high return. In the same time, the investors also have to understand the risk along the investment on bitcoin.

The other implication for government of Indonesia as policy maker on crypto currency. The crypto currency quite develops rapidly in this crypto world era. The role and regulation on crypto currency are needed to secure investors and economic growth.

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