

WEAK FORM MARKET EFFICIENCY ANALYSIS IN THE CRYPTOCURRENCY MARKET

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ABSTRACT

Research on the efficiency of financial markets is mostly done in the context of the capital market, though the financial market has grown so rapidly. One of the fast-growing results of financial innovation is the virtual currency/cryptocurrency pioneered by Bitcoin. Bitcoin market is growing rapidly even exceeds the capital market capitalization of a country, currently. This study, therefore, examines the efficiency of the Bitcoin market. The data in this study is the daily closing data of Bitcoin. This data is obtained from Yahoo Finance, while the research period used is the period July 17, 2010, to February 7, 2018, so as many as 2762 days of observation. Data analysis is done by Run Test. The results of this study indicate that Bitcoin markets do not run randomly, so it is inefficient in weak form. These findings suggest that technical analysis can be used in the Bitcoin market.

Keywords: Virtual currency, cryptocurrency, bitcoin, market efficiency, run test.

INTRODUCTION

Research on market efficiency (which began in the capital market) began to rise after the introduction of the Efficient Market Hypothesis. There are three forms of market efficiency, namely: the weak form efficiency, the semi-strong form efficiency, and the strong form efficiency (Pulungan, Wahyudi, & Suharnomo, 2018). Each of these efficiencies is closely related to information that may affect the price of a securities/financial instruments. The weak forms efficiency is only related to historical prices; semi-strong form efficiency associated with published information; while the strong form efficiency associated with all information both published and unpublished (Khajar, 2010; Robiyanto, 2015; Robiyanto, Hersugondo, & Puryandani, 2015).

Several studies related to weak forms capital market efficiency have been done by Jain, Vyas, and Roy (2013); Robiyanto *et al.* (2015); Robiyanto and Puryandani (2015); Utomo and Fuad (2008). Most of these studies conducted studies on seasonal patterns and random walk testing. Semi-strong market efficiency testing has been done by Haryanto (2011); Herdinata (2012); Khajar (2010); Luhur (2010); Makaryanawati (2012); Sunarjanto and Adisastra (2008). These studies mostly use a variety of events that are deemed to affect stock price movements such as issuers' corporate action information. While research about the testing of the strong form efficiency been done by Khan and Ikram (2011) by using mutual funds and investment managers performance. While research on the efficiency of markets in other financial markets been done by Pulungan *et al.* (2018) in the commodity market; and Robiyanto (2017a) in the bond market.

By 2010 there was a financial instrument called virtual currency that was originally used for peer-to-peer payments among online video gamers (ICBA, 2015) and online gamblers via Satoshi Dice (Badev & Chen, 2014). The instrument was created by a programmer (Turpin, 2014) and was named Bitcoin by Satoshi Nakamoto, the inventor (Nakamoto, 2008; Seetharaman, Saravanan, Patwa, & Mehta, 2017). Bitcoin as the first cryptocurrency in the world, until 2017 has a market capitalization of USD 5.9 billion and is still growing (Seetharaman *et al.*, 2017). Bitcoin, in 2010 only worth USD 0.04, but never reached a record high of USD 19345.49 in December 2017. Bitcoin market even threaten other major currencies in the world. Bitcoin has been considered a legal payment tool in some countries such as the United States, Canada, Australia and the European Union. Although there are still many countries that reject the legality of Bitcoin payment instruments such as Iceland, Indonesia, and many other countries. However, with an online trading system, Bitcoin trading can be easily done both in both the real Bitcoin market and the Bitcoin futures market in any country.

Unfortunately, this study of cryptocurrency is still rare (Farell, 2015), even the study of market efficiency, especially on the weak form in the cryptocurrency market has never been found. And by knowing the market efficiency of this weak form, it can be seen whether the cryptocurrency market is random walk or not. Therefore, this study conducts a study about market efficiency in weak form in the cryptocurrencies market namely Bitcoin. The purpose of this research is to scrutinize whether Bitcoin market is a random walk market (efficient in weak form) so that it cannot

be predicted, or does not walk randomly, so the technical analysis can be used to predict price movement in the future.

LITERATURE REVIEW AND HYPOTHESIS

Cryptocurrency Market

Cryptocurrency was created by programming experts, whose original purpose was to determine the exchange rate that could be stimulated with limited resources (Turpin, 2014). Its value is determined by the trust of its users and is protected by its nature and cryptography to identify and maintain its authenticity. Cryptocurrency market begins with the introduction of Bitcoin by Satoshi Nakamoto (Nakamoto, 2008). In general, Bitcoin is a scheme created to facilitate the transfer of value on both sides (Badev & Chen, 2014). Under the Bitcoin protocol, all transactions at a given time are collected into blocks. This block is then disseminated at all points connected to the Bitcoin network (Farell, 2015). Bitcoin uses the Hashcash PoW mechanism. In its journey, the number of cryptocurrency is increasing to more than 550 cryptocurrency (Farell, 2015).

Efficient Market Hypothesis, Weak Form Market Efficiency, and Hypothesis Development

The concept of market efficiency originally appeared in the capital market, so it is not surprising that this concept is often known as capital market efficiency. The concept of capital market efficiency suggests that the market price of traded securities on a regular basis can reflect all existing information and quickly make full adjustments to new information (Emery, Finnerty, & Stowe, 2008; Supramono, Widhiastuti, & Utami, 2017). The embryo of the concept of capital market efficiency is related to random-walk securities prices in the capital market (Jain *et al.*, 2013). There are three forms of capital market efficiency based on the three forms of information (past information, published information and private information (unpublished), i.e., weak form efficiency, semi-strong form efficiency, and strong form efficiency (Onwukwe & Ali, 2018; Robiyanto, 2015, 2017a; Taungke & Supramono, 2015).

About the weak form efficiency, Khajar (2010) argues that the weak form efficiency has the meaning that the price of securities is fully reflect the past information. This weak form capital market efficiency is closely related to random walk theory. Within the framework of weak form capital market efficiency, the price of a security reflects all past price information, thus implying that the price of a security cannot predicted by using the past information (Khajar, 2010; Robiyanto, 2017a). In reality, the price of securities can be analyzed using technical analysis that heavily relies on past information. The existence of patterns in the capital market also shows that securities in the capital market can be predicted using the past information. These patterns have also been documented in various studies such as Hersugondo, Robiyanto, Wahyudi, and Rini (2016); Robiyanto (2017a). The same can also happen in cryptocurrency markets (in this study is Bitcoin). Cryptocurrency market, as well as capital markets, tend not to walk randomly so it can be predicted. Based on the above, the hypothesis is formulated as follows:

H₁: The cryptocurrency market (Bitcoin) does not run randomly

RESEARCH METHODS

The data used in this research is daily closing data of Bitcoin trade. The period used in this study is the period July 17, 2010, until February 7, 2018, so as many as 2762 days of observation. This data is obtained from Yahoo Finance site. Meanwhile, the analytical tool used for testing the cryptocurrency market efficiency in this research is Run Test. Hypothesis 1 in this study will be accepted if the resulting *Z statistic* has a significance level below 5%.

FINDINGS

Descriptive Statistics of Cryptocurrency Market

Descriptive statistics of Bitcoin's price and return can be seen in Table 1. The maximum price of Bitcoin during the research period is USD 19345.490 which occurred on Dec 16, 2017. Bitcoin minimum price is USD 0.049 occurred on July 16, 2010. While the average value and standard deviation for Bitcoin price is USD 900.537 and USD 2363.428. Regarding return, Bitcoin's highest return was 3,368 or 3368%, which occurred on Feb 26, 2014, while the largest decrease of Bitcoin was 0.572 which occurred on Feb 20, 2014. The average value of Bitcoin return and standard deviation return of Bitcoin during the research period was 0.007 and 0.093. This shows that during the research period Bitcoin price tends to increase and every day able to generate return of 0.007. Unfortunately, the risk of Bitcoin is very large as indicated by standard deviation of 0.093.

Table 1
Descriptive Statistics of Bitcoin Price and Return

	Bitcoin Price (USD)	Bitcoin Return
Minimum	0.049	-0.572
Maximum	19345.490	3.368
Standard Deviation	2364.428	0.093
Average	900.537	0.007

Source: Yahoo Finance, processed.

Run Test Result

Based on the results of the analysis by using Run Test, the results obtained as can be seen in Table 2.

Table 2
Run Test

	Bitcoin
Test Value	.0072
Cases < Test Value	1634
Cases \geq Test Value	1128
Total Cases	2762
Number of Runs	1252
Z	-3.295
Asymp. Sig. (2-tailed)	.001

Source: Yahoo Finance, processed.

Run Test results yield *Z value* of -3.295 which is significant at 5% significance level. Based on this the H_1 stating that the cryptocurrency market (Bitcoin) does not run randomly, is accepted.

DISCUSSION

Based on the results of the analysis, the conclusion is that the cryptocurrency market does not run randomly. This is similar to studies in other financial markets such as capital markets, bond markets, currency markets and even derivative markets that have been done by Hersugondo *et al.* (2016); Jain *et al.* (2013); Robiyanto (2017a, 2017b); Robiyanto and Puryandani (2015). This suggests that technical analysis that prioritizes past information can be applied to the cryptocurrency market. Cryptocurrency is less likely to have an underlying asset, the price of cryptocurrency is entirely determined by the confidence of investors affecting demand and supply (Turpin, 2014).

Because of this nature, cryptocurrency is seen as a speculative instrument and a tools of speculation by traders (Bolt & van Oordt, 2016), so that short-term oriented analytical techniques play a significant role in cryptocurrency trading. This is also supported by the very large findings of standard deviation cryptocurrency values which indicate that the risks are very high, especially since the cryptocurrency market does not have a price restriction mechanism as it applies in the capital market supported by the time of cryptocurrency market trading that runs 24 hours a day and seven days per week.

The current rise of the cryptocurrency market needs to be addressed with caution given the absence of the underlying intrinsic value. This can be a financial bubble that is even worse than the Tulipmania that occurred in the seventeenth century.

CONCLUSION

The results of this study indicate that the cryptocurrency market (Bitcoin) does not walk randomly so it can be concluded that the Bitcoin market is inefficient in weak form. Since this cryptocurrency market does not walk randomly, then the use of technical analysis to predict the price of Bitcoin can be done. Therefore investors or speculators in the Bitcoin market can use technical analysis in their trading activities to gain short-term gains.

The findings in this study also indicate that the risks in the cryptocurrency market studied (Bitcoin) are so high that investors should be cautious in trading, especially since cryptocurrency has no intrinsic value like Tulip that spurred Tulipmania which is a financial bubble in Europe in the seventeenth century. Since this research focuses on Bitcoin products which are the instruments with the largest capitalization. Future research on cryptocurrency markets can be done using other cryptocurrency products and involves cryptocurrency futures markets.

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