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CAN BITCOIN'S PRICE BE A PREDICTOR OF STOCK PRICES?

Yutaka Kurihara[1*], Akio Fukushima[2], Shinichiro Maeda[3]

[1*]Faculty of Economics, Aichi University, Japan
[2]Institute for Economic Studies, Seijo University, Japan
[3]Faculty of Economics, Kyushu University, Japan

ABSTRACT: Bitcoin has become widely used, and it can be expected that the price would have impacts on stock prices. Along with interest rates, some economic variables have been focused as deterministic elements of stock prices. This study examines whether or not Bitcoin's price can be a predictor of stock prices. Empirical results show that interest rates and stock prices are deterministic elements of stock prices. Also, among economic variables, Bitcoin's price is not a predictor of stock prices. Instead, interest rates and stock prices are suitable for predictors of stock prices.

Keywords: Bitcoin, Interest Rate, Stock, Predictor.

1. INTRODUCTION

This paper examines the relationship between U.S. and Japanese stock prices and Bitcoin's price and examines whether or not Bitcoin's price can be a predictor of these stock prices. Bitcoin started with a tremendous impact. Thought transaction volume largely fluctuates, and a large amount of money has been poured into the transaction. Bitcoin was first outlined in Nakamoto (2009). Bitcoin is not a legal currency but a private monetary system that manages itself and does not depend on central banks or governments (Dowd and Hutchinson, 2015). Since its creation, Bitcoin has attracted a lot of attention and has been traded frequently. Some serious accidents have occurred, but Bitcoin seems to have overcome these situations.

Bitcoin is a different from any other currencies used around the world. Some central banks in the world have begun discussing central bank digital cash, however, Bitcoin is not a digital cash. One of the large differences is that Bitcoin can be inflated or deflated at its will; the supply of Bitcoin is limited, and more cannot be created easily. No one manages the Bitcoin under a monopoly. Participants manage the system using blockchain. Of course, we can send or receive any amount of Bitcoin to anyone cheaply compared to other financial instruments. Bitcoin confers much freedom and demands user responsibility, but the rewards are well worth the user's time (Bitcoin homepage, retrieved on March 22, 2020). Most people believe that Bitcoin contains high risk for transactions. In reality, the prices have fluctuated hugely, and Bitcoin has been accepted by many market participants.

This study focuses on Bitcoin's price. Dwyer (2014) showed that Bitcoin's price volatility is higher than that of gold or some foreign currencies. Gronwald (2014) found that Bitcoin prices fluctuate as largely such as some currencies in newly emerging markets. Cheung *et al.* (2015) and Carrick (2016) indicated that Bitcoin's price has large deviations from normal price levels. Kurihara and Fukushima (2017) examined the anomaly of Bitcoin's price and found that Bitcoin's transactions are becoming more efficient. Ma and Tanizaki (2019) showed that day-of-the-week effects are different among different sample periods.

Price stability of Bitcoin is one key point for its spreading usage. People make every decision about spending or investing by using legal currencies or Bitcoin. If Bitcoin prices change drastically or lose value, people will avoid using it, and this can sometimes damage efficient allocation of resources. Under such situations, Bitcoin users should take measures to reduce systemic risk. A sound payment system is necessary to maintain and boost the market economy. Examining Bitcoin's price is necessary, however, few studies have tackled this problem.

The purpose of this paper is to examine deterministic factors of the stock prices and the role of Bitcoin's price. There are many papers that focus on the deterministic elements of stock prices, however, there are few studies that examine the relationship between stock prices and Bitcoin's price. Whether or not Bitcoin's price is suitable for predicting stock prices has not been examined. Following this section, section 2 reviews related existing studies with this study. Section 3 analyzes the relationship between stock prices and other variables that would impact stock prices. Based on the analyses of section 3, empirical analyses are performed, and a presentation of the results is section 4. Finally, a brief summary of this study is performed.

2. RELATED EXISTING STUDIES

In the 1980s and 1990s, many studies were presented about the relationship between stock prices and interest rates. For recent ones, Shubita and Al-Sharkas (2010) found thatinterest rates are negatively related with stock prices. Jareno *et al.* (2016) confirmed that the stock market has a sensitivity element to changes in interest rates. Stoica *et al.* (2014) confirmed a noticeable effect of the international interest rate on stock market indexes in the cases of the Czech Republic, Hungary, Poland, and Romania. No monetary policy autonomy exists in Bulgaria, Latvia, and Lithuania. Also, studies have indicated that interest rates have some predicting effects on stock pricing (Campbell, 1987; Campbell and Shiller, 1991; Fama, 1984; Hodrick, 1992; Keim and Stambaugh, 1986) Also, short-term interest rates have been found to affect stock prices (Campbell and Ammer, 1993; Fang and Bessler, 2017; Zafeiropoulos, 2008) found that including interest rates in the model fits the model to examine forecasts of stock returns. However, interest rates in Japan have been quite low since the 2000s, so it should be noted that unprecedented phenomena have been ongoing.

Little research has been conducted on the relationship between stock prices and exchange rates. However, many studies have been provided recently. Kurihara (2006) suggested that interest rates have not impacted on Japanese stock prices but exchange rates and U.S. stock prices have. Ismail and Bin (2009) showed that the exchange rates depreciate as the stock price index falls and the exchange rates appreciate when the stock price index rises. Michelis and Ning (2010) showed a significant relationship between the real stock returns and the real exchange rates. Lee *et al.* (2011) showed that there are significant price spillovers from the stock market to the foreign exchange market for Indonesia, Korea, Malaysia, Thailand, and Taiwan. Kollias *et al.* (2016) showed that an exchange rate has a causal effect on stock markets for Norway and the U.K. Raji *et al.* (2017) found that the negative relationship between stock prices and exchange rates is found when exchange rates are low or high. Bahmani-Oskooee and Saba (2018) found that the effects of exchange rate changes on stock prices are asymmetric. Manasseh *et al.* (2019) found a spillover effect from stock markets to foreign exchange markets. Ekpeno and Godwin (2019) found that exchange rate changes on stock prices are asymmetric for the short- and long-run. Huang and Lee (2019) showed that the response of exchange rate and interest rate to stock market is immediate, but the response of stock market to exchange rate and interest rate appears later. Andriansyah and Messinis (2019) found that stock prices have impacts on exchange rates through a portfolio in Indonesia. Kaya and Soybilgen (2019) found that there exist long-run and short-run asymmetric relationships between macroeconomic variables and stock prices in Turkey. In general, many studies accept that there is a relationship between exchange rates and stock prices, but there are a lot of cases for countries, periods, currencies, and so on.

Finally, the relationship between Bitcoin's price and stock prices has not been analyzed. Poyser (2019) found that the Bitcoin's price is negatively associated with the price of gold as well as the exchange rate between the Chinese Yuan and the U.S. Dollar while positively correlated to stock market index. Kumar *et al.* (2019) explored how the leverage effect is not significant for cryptocurrencies. Muglia *et al.* (2019) showed that Bitcoin does not show any impacts on the Standard & Poor's 500 using the sample period of 11 August 2015 to 19 July 2018. However, the relationship between Bitcoin and stock prices has started to be examined and there is little study for examining predictability of Bitcoin's price on stock prices.

3. DETERMINISTIC ELEMENTS OF STOCK PRICES AND BITCOIN'S PRICE

As mentioned in the previous section, little study has been performed on the relationship between Bitcoin price and stock prices, so there is no consensus about this relationship. The Bitcoin's price being a predictor of stock prices has not been discussed a lot.

The most important point is the relationship between Bitcoin and stocks. Bitcoin's price has not been stable, and the volatility is much larger than the process of stocks. According to this thought, stocks are treated as safe assets compared to Bitcoin. In this case, Bitcoin's price can be a predictor of stock prices. However, the link between Bitcoin and stocks cannot be found theoretically. Table 1 shows the correlation between stock prices and variables used in this study including Bitcoin's price.

Table 1(a). S&P 500

Bitcoin	Euro-dollar	Yen-dollar	FF	call	Dow Jones	Nikkei
0.666	0.717	0.745	0.835	0.840	0.993	0.954

Note. Call is a Japanese short-term interest rate and Nikkei is Japanese stock market index

Table 1(b). Dow Jones

Bitcoin	Euro-dollar	Yen-dollar	FF	call	S&P 500	Nikkei
0.624	0.675	0.686	0.882	0.849	0.993	0.939

Note. Call is a Japanese short-term interest rate and Nikkei is Japanese stock market index

Table 1(c). Nikkei

Bitcoin	Euro-dollar	Yen-dollar	FF	call	S&P 500	Dow Jones
0.659	0.753	0.882	0.725	0.765	0.954	0.939

Note. Call is a Japanese short-term interest rate and Nikkei is Japanese stock market index

The correlations seem clear. Compared to other economic variables, the values of Bitcoin are small. The link between Bitcoin's price and stock prices is small compared to interest rates and stock prices.

4. EMPIRICAL ANALYSIS

4.1 Unit Root Test

Unit root tests of each macroeconomic variable related to stock prices are performed. All of the data are daily, and the sample period is from 2000 to 15 March 2020. Bitcoins' data are from Bitcoinaverage (https://bitcoinaverage.com/en/data-store/historical-bitcoin-exchange-rates). Other data are from Nikkei Telecom (database).

Table 2. Unit Root Tests

variable	**t-statistic**	**prob**
Bitcoin's price (Bitcoin)	-1.360	0.602
One lagged difference of Bitcoin's price (dBitcoin)	-12.156	0.000
Japanese stock market index; Nikkei (stockpriceJPN)	-1.425	0.571
One lagged difference of Japanese stock market index; Nikkei (dstockpriceJPN)	-47.703	0.000
US stock market index; Dow Jones Industrial index (stockpriceUSDJ)	-1.460	0.553
One lagged difference of US stock market index; Dow Jones Industrial index (dstockpriceUSDJ)	-47.274	0.000
US stock market index; S&P index (stockpriceUSSP)	-1.441	0.563
One lagged difference of US stock market index; S&P index (dstockpriceUSSP)	-47.103	0.000
Japanese short-term interest rate; call (callJPN)	-1.922	0.322
One lagged difference of Japanese short-term interest rate; call (dcallJPN)	-22.000	0.000
Japanese long-term interest rate; 10- year government bond (10bondJPN)	-1.306	0.629
One lagged difference of Japanese long-term interest rate; 10- year government bond (d10bondJPN)	-49.128	0.000
US short-term interest rate; FF (FFUS)	-0.683	0.848
One lagged difference of US short-term interest rate; FF (dFFUS)	-38.974	0.000
US long-term interest rate; 10- year government bond (10bondUS)	-1.074	0.282
One lagged difference of US long-term interest rate; 10- year government bond (d10bondUS)	-50.315	0.000
Yen/dollar exchange rate (exchangeYEN)	-1.308	0.627
One lagged difference of Yen/dollar exchange rate (dexchangeYEN)	-50.277	0.000
Euro/dollar exchange rate (exchangeEURO)	-1.394	0.586
One lagged difference of EURO/dollar exchange rate (dexchangeEURO)	-48.722	0.000

Note. Parentheses are abbreviation in this study and are also used for Table 3.

All of the one day changes for each variable (level) is statistically significant, so they are used for estimations in section 4.2.

4.2. Regression Analyses

Regression analyses are performed. The estimated equation is Equation (1). This study estimates an equation of one time and two time lag of the explanation variables (X in the equation). As stock prices, three kinds of stock prices in the United States and Japan are used for estimations. For explanation variables, Bitcoin's price, interest rates of the United States and Japan, two exchange rates, and three stock prices of the United States and Japan.

$$\text{Stock prices} = C + X(-1) + X(-2) + \varepsilon \qquad (1)$$

The forecasted data are estimated from the regression of equation (1). The sample period is from 2000 to the end of 2019 as the coronavirus (infectious disease) hit stock markets, and stock prices have been fluctuating from the beginning of February 2020. The estimated values are compared to the actual values. The difference arises when forecasting further. Dynamic forecast will take previously forecasted values while static forecast" will take actual values to make the next forecast. The results are shown in Tables 3a, 3b, and 3c. The first line in each table displays explanation variables, and the meaning of these variables is given in Table 2.

Table 3(a). Regression results of Japanese stock market index; Nikkei

	dBitcoin	**dcallJPN**	**d10bond JPN**	**dexchange YEN**	**dstockprice JPN**	**dStockprice USDJ**	**dStockprice USSP**
C	4.160 (0.956)	4.016 (0.911)	5.579 (1.300)	7.311 (0.274)	4.264 (0.968)	0.695 (0.178)	0.241 (0.062)
One-lag	0.009 (0.037)	-1214.079* (-1.754)	466.320** (2.027)	-0.043 (-0.169)	-0.007 (-0.345)	0.543*** (25.331)	5.013*** (26.279)
Two-lag	0.665*** (2.641)	-1001.379 (0.140)	-263.210 (-1.143)	-8.503 (0.147)	-0.003 (-0.156)	0.044** (2.021)	0.333* (1.727)
Adj.R2	0.035	0.000	0.052	0.307	-0.0008	0.220	0.233
F-statistic	3.682	1.653	42.587	335.371	0.071	320.837	345.304
Prob (F-statistic)	0.011	0.174	0.000	0.000	0.931	0.000	0.000
D.W.	2.002	2.006	1.999	2.129	1.991	2.300	2.304
Dynamic							
Root mean Square error	3387.408	3396.726	3641.390	1740.048	3368.947	2551.492	2585.303
Mean absolute error	16.834	2891.705	3172.878	1272.227	2874.667	2175.682	2205.259
Theil Inequality coef.	0.108	0.108	0.117	0.052	0.108	0.079	0.080
Static							
Root mean Square error	208.633	208.913	203.461	173.925	209.136	184.548	183.009
Mean absolute error	144.645	144.446	141.072	122.961	144.643	126.443	125.313
Theil Inequality coef.	0.006	0.006	0.000	0.005	0.006	0.005	0.005

Note. ***, **, and * denote significant at 1, 5, and 10%. Parentheses are t-statistics.

Table 3(b). Regression results of US stock market index; Dow Jones Industrial index

	dBitcoin	**dFFUS**	**d10bondUS**	**dexchangeEURO**	**dstockprice USDJ**	**dstockprice USSP**
C	4.821 (1.217)	4.794 (1.214)	-16.518 (-0.963)	5.080 (1.290)	0.5999 (1.358)	6.168* (1.699)
One-lag	0.035 (0.156)	28.179 (0.191)	9.851 (1.356)	243.859 (0.437)	-0.023 (-1.079)	-39.355 (-0.564)
Two-lag	0.119 (0.525)	390.989*** (2.701)	42.206 (0.605)	464.129 (0.834)	0.039* (1.776)	45.872 (0.658)
Adj.R2	-0.0008	0.005	0.161	0.010	0.001	0.159
F-statistic	0.339	4.927	144.705	9.254	2.299	144.100
Prob (F-statistic)	0.797	0.002	0.000	0.000	0.100	0.000
D.W.	1.986	1.994	1.930	1.985	1.928	1.928
Dynamic						
Root mean Square error	3280.114	3264.995	2176.024	3271.952	326.160	2346.877
Mean absolute error	2462.434	2416.277	1616.835	2417.924	258.619	1828.546
Theil Inequality coefficient	0.093	0.093	0.060	0.093	0.082	0.065
Static						

Root mean Square error	188.074	187.503	172.270	186.969	20.944	172.328
Mean absolute error	115.298	0.642	108.006	113.832	12.989	108.001
Theil Inequality coefficient	0.004	0004	0.004	0.004	0.004	0.004

Note. ***, **, and * denote significant at 1, 5, and 10%. Parentheses are t-statistics.

Table 3(c). Regression results of US stock market index; S&P index

	dBitcoin	**dFFUS**	**d10bondUS**	**dexchange EURO**	**dstockpriceUS DJ**	**dstockpriceUS SP**
C	1.065* (1.773)	0.676 (1.175)	-1.390 (-0.728)	-1.452 (-0.304)	0.607 (1.377)	0.599 (1.358)
One-lag	-0.002 (-1.109)	-0.105 (-0.182)	0.934 (1.155)	1.711 (0.441)	-0.003 (-1.456)	-0.023 (-1.079)
Two-lag	0.028 (1.113)	53.680*** (3.390)	0.570 (0.073)	39.291 (0.633)	0.004* (1.656)	0.039* (1.766)
Adj.R2	0.0002	0.006	0.160	0.011	0.001	0.001
F-statistic	1.150	6.022	145.205	9.663	2.636	2.299
Prob (F-statistic)	0.327	0.0004	0.000	0.000	0.071	0.100
D.W.	1.979	1.989	1.922	1.976	1.912	1.928
Dynamic						
Root mean Square error	258.350	282.468	280.598	273.230	323.111	326.160
Mean absolute error	211.310	215.214	200.147	194.011	110.792	258.619
Theil Inequality coefficient	0.061	0.070	0.068	0.067	0.081	0.082
Static						
Root mean Square error	20.949	20.882	19.194	20.832	20.941	20.944
Mean absolute error	12.993	13.003	12.249	12.818	12.984	12.988
Theil Inequality coefficient	0.004	0.004	0.004	0.004	0.004	0.004

Note. ***, **, and * denote significant at 1, 5, and 10%. Parentheses are t-statistics.

The results are not necessarily strong, but there are some clear points where the empirical results are useful. First, Bitcoin's price is not correlated strongly with stock prices. Also, Bitcoin's price cannot be a predictor of stock prices. Secondly, Japanese stock prices are influenced by U.S. stock prices and interest rates.

5. CONCLUSION

This study examined whether or not Bitcoin's price can be a predictor of stock price. Empirical results show that it is not, but the reason why Bitcoin's price cannot be a predictor of stock prices seems to be difficult to understand. It is clear that market participants do not treat Bitcoin as a substitute of stocks. Instead, they transact Bitcoin as an independent financial commodity of stocks. Bitcoin does not have a long history, and the situation will constantly change in the future. There definitely exists room for more research on this subject.

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