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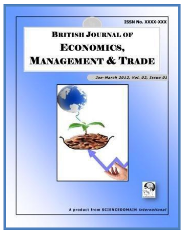

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Bitcoin: Exchange Rate Parity, Risk Premium, and Arbitrage Stickiness

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Authors' contributions

This work was carried out in collaboration between both authors. Author HD designed the study and performed the statistical analysis. Author WD provided the computer science development background and wrote the first draft of the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Bitcoin has two major roles: as currency and as financial asset. This paper attempts to address these roles: whether Bitcoin is a real currency, and what its financial features are. Using daily data of the exchange rates quoted from the world major Bitcoin dealer since the inception of Bitcoin and the spot market exchange rates, we calculate the triangle arbitrage asset price to decompose the features of this currency. The results suggest significant liquidity discount of Bitcoin and risk premium as a financial asset in terms of British Pound Sterling (2.46%) and Chinese Yuan (0.3%). There is idiosyncratic risk component associated with Bitcoin implied by the Granger causality tests. Bitcoin, as investment objectives instead of currency unit, is associated with excess risk and low returns. Such poor performance discourages investors to spend Bitcoin as currency and to pursue the arbitrage profit. Investors store and hold Bitcoin as fixed asset. In addition, both arbitrage stickiness and low Treynor ratio are persistent over time.

Keywords: Bitcoin; exchange rate; risk premium; arbitrage; currency.

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1. INTRODUCTION

Bitcoin is a world-wide peer-to-peer payment system, and its digital currency, bitcoin, was developed in 2009. Bitcoin can refer to the protocol and transaction network, or to the currency itself [1]. Different from the cash tokens or conventional currencies, Bitcoin does not have defined or long-term equilibrium exchange rates with certain financial assets, e.g., U.S. Dollar, or gold. Its issuance is not centralized and its intrinsic value is not affected by any regulative policy. In fact, Bitcoin supply is supported by the computation capacity provided by its miners. The miners who offer their computer processing capacity to support Bitcoin transaction are rewarded bitcoin as an exchange. Therefore the Bitcoin regime is decentralized in contrast to the traditional currencies which are issued by central banks. These special characters enable the utilization of Bitcoin to grow in a rapid speed: the market value of it increases from 50 to 7.2 Billion, both in U.S. Dollar, from 2009 to 2013.

This paper attempts to address, at a holistic manner, the currency feature and financial characters of Bitcoin both as asset and as a currency. The meanings of this study go beyond pursuing the free arbitrage opportunities of Bitcoin and merely regard it as another financial asset in the portfolio. In other words, the major implication of this paper is not for the profit pursuit by the practitioners, though it can be utilized for such purpose. Among the numerous qualitative articles describing Bitcoin, this paper attempts to empirically address the role of Bitcoin in the investment process context. We start from examining the fundamental functions of modern currency, and then extend the discussion to arbitrage profit.

Previous studies on Bitcoin fall into three major groups. The first group covers the general introduction of the generation, circulation, and potentials of bitcoin, for example, [2,3,4]. The second cluster focuses on the risk, regulation, and legal concerns of bitcoin, for instance, [5,6,7,8]. The third group, which is the largest, discussed the technical details related to computer science rather than the economics and financial characters of bitcoin, such as [9].

We use the functions of fiat currency as the determinants of the identification of Bitcoin. The functions of currency are widely recognized as the unit of account, the transaction medium, and the vehicle of store of value. Some previous literatures, for example, [10,11], sub-categorize these three functions in detail by addressing two other functions: standard of deferred payment and measure of value. However, such subcategory is embedded in the functions of unit of account and store of value. We therefore adopt the consensus three-function classification.

To be widely-accepted as a real currency, Bitcoin should at the minimum meet, among others, the following criteria: being a stable unit of account, carrying high liquidity, and maintain steady intrinsic value. The first criterion consolidates the acceptance of this new currency from the capital market by reducing the menu cost of its users. To be an effective transaction medium, Bitcoin must maintain high transaction volume and liquidity. Liquidity is usually measured by the willingness of accepting a payment upon certain discount [12]. The higher the discount is, the less liquid the asset is. The last criterion refers to the fundamental financial asset feature of the currency. In other words, the currency should generate appreciation potential when it is associated with risk. If the currency unilaterally depreciates persistently, its volatility can fundamentally reduce its popularity, though it carries fiat money judicial identity.

The nature of Bitcoin determines that it is a stable unit of account. The number of Bitcoins generated is set to decrease geometrically, with a 50% reduction every 4 years. From the year of 2020, Bitcoin money supply increase rate, similar to the measure of M1, is approximately 7%, and at the year of 2032, its money supply increase rate is only at 0.8%. In fact, the number of Bitcoins in existence never exceeds 21 million. Such self-discipline in terms of money issuance is stricter than almost all the central banks in the world and will guarantee the stability of the unit of Bitcoin. More importantly, the transparent mechanism and rule of issuance velocity foster consistent market expectation and confidence, which is widely absent for some less disciplined or predictable currencies in terms of their issuance. For example, the M2 of Japanese Yen increased reaches an all time high of 875918.40 JPY Billion in July of 2014 from 8404 JPY Billion in February of 1960. The annually compounded growth rate is as high as 9%.

The second criterion requires Bitcoin to be an effective transaction medium. The effectiveness can be detected and measured top-down or bottom-up. The top-down method, which is from the macro-perspective, starts from looking into the legislative approvals of using Bitcoin and focuses on the number of transactions with Bitcoin. This method has two drawbacks: first, the legal status of Bitcoin does not guarantee the willingness of using the currency; second, the ratio of the number of transaction fulfilled with Bitcoin and conventional fiat currency is unknown. The bottom-up method, which is from the micro-perspective, overcomes both of those problems. We adopt the second way to measure the effectiveness by investigating the price discount of Bitcoin in transactions with high volumes, in comparison to the spot currency market exchange rate. The discount of Bitcoin parity exchange rate from the spot market rate is a good indicator of investor willingness of accepting Bitcoin payments and its liquidity.

The third standard of Bitcoin as real currency is whether Bitcoin as a financial asset can be a reasonable store of value. In other words, if the benchmark-adjusted risk of holding Bitcoin is positive, Bitcoin should appreciate relative to the benchmark exchange risk. Any negatively sloped capital market line of Bitcoin is an unfavorable feature. This paper thus develops an algorithm to reveal such risk-adjusted return. The algorithm is similar to Treynor ratio and presents the excess return per unit of relative risk.

To fully test the possible liquidity discount in Bitcoin transactions and the risk premium of it as a financial asset, this paper first performs unit root tests to ensure the validity of linear regressions. After the linear regressions, we employ Granger causality tests to detect the existence of idiosyncratic risk carries by Bitcoin. In addition, this paper specifies the premium of the risk for each individual major currency. The results confirm the liquidity discount of Bitcoin, and relative risk premium in the case of British Pound Sterling and Chinese Yuan. The regression outputs also imply the risk discount in terms of Canadian Dollar, Australian Dollar, Euro, and Japanese Yen. Bitcoin as currency is immature, as it does not fulfill the requirement of transaction medium, and Bitcoin as financial asset is only appropriate for British Pound and Chinese Yuan investments.

The second section describes the data source and preparation; the third section discusses the thoughts and logics of the regression, as well as the reasons of excluding some models adopted in parallel studies; the fourth section presents the linear regression results, the causality regression outputs, and the pseudo-Treynor ratio values; section five concludes and leaves out unrealized thoughts.

2. DATA

The exchange rates quoted in the spot currency markets are from the FRED database supported by the Federal Reserve Bank of St. Louis. The exchange rates quoted are Euro, British Pound Sterling, Australian Dollar, Chinese Yuan, Canadian Dollar, and Japanese Yen. The quotations follow market practices: EUR/USD, GBP/USD, AUD/USD, CNY/USD, USD/CAD, and USD/JPY. The daily rates are from June 8, 2011 to December 30, 2013, to be consistent with the data history of Bitcoin. This study ignores the bid-ask spread and the interbank-dealer spread, as we aim to identify fundamental asset value deviation, rather than the marginal arbitrage opportunity. The date span covers the whole history of Bitcoin at the maximum. Using daily data not only can increase the regression capacity but also can investigate the feasibility of arbitrage from the microstructure perspective of the market.

The exchange rates among the Bitcoin and other “fiat money” currencies are obtained from Bitcoincharts database. The size of the time series variables is summarized in Table 1. From each dealer, the close prices and the implied prices are calculated for the regressions in the next step. The implied price is based on the dealer’s report of the trading volume denoted by currency and Bitcoin. As all the dealers use direct quote, the implied price is computed with the following Equation (1):

$$\text{implied price} = \frac{\text{Dealer Report Bitcoin Volume}_t}{\text{Dealer Report Fiat Curreny Volume}_t} \quad \text{Eq. (1)}$$

For some exchange rates among the Bitcoin and fiat currencies, multiple dealers quote at different levels at a point of time when the market operates. This is due to the various exchange procedures and processing costs, which do not necessarily imply arbitrage opportunities. For U.S. Dollar, Euro, and Canadian Dollar that are operated by more than one dealer, the average quotes are calculated as the weighted price. In the following regressions, variables with _C stands for the close price of exchange rates, _W denotes the weighted average price, and _I is the implied price obtained from the volume.

The preparation for the following regressions also involves the transformation of exchange rates among Bitcoin to exchange rates among fiat currencies. We use the triangle arbitrage to realize the Bitcoin parity currency exchange rates.

For example, the Bitcoin parity exchange rate of U.S. Dollar per Euro is computed with U.S. Dollar per Bitcoin and Euro per Bitcoin.

3. METHODOLOGY

To proceed with the linear regression, we first perform the Augmented Dickey-Fuller unit root test. According to the classical assumption of linear regression, the independent variables and the dependent variable should be stationary, except for there are integrated at the same level and are cointegrated. To verify the status of the time series variables, we employ the following standard procedure:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \cdots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t \quad \text{Eq. (2)}$$

The null hypothesis is $\gamma = 0$, i.e., the series has a unit root. The alternative hypothesis is $\gamma < 0$, or the series is stationary. We report the results in Table 2. The lag length selection is based on Schwarz Information Criteria (SIC), and the maximum lag considered is 20. The regression is based on [13].

The results reject the null hypothesis that unit roots exist and thus suggest that the series are stationary. We proceed to the Granger causality test, which is adopted to measure the mutual impact between Bitcoin parity exchange rate and the spot market exchange rate. For a bivariate linear autoregressive model with pairwise variables $X_1$and X_2, the test regression is:

$$X_1(t) = \sum_{j=1}^{P} A_{11,j} X_1(t-j) + \sum_{j=1}^{P} A_{12,j} X_2(t-j) + E_1(t) \quad \text{Eq. (3)}$$

$$X_2(t) = \sum_{j=1}^{P} A_{21,j} X_1(t-j) + \sum_{j=1}^{P} A_{22,j} X_2(t-j) + E_2(t) \quad \text{Eq. (4)}$$

P in the regression equations is the maximum number of lags included, and the matrix A is the plain vanilla VAR coefficients. $E_.(t)$ is the regression residual. If the variance of $E_.(t)$ is improved by adding X_1or X_2, it implies that X_1 or X_2 Granger causes X_2 or X_1. The way to detect such improvement is by testing whether, for example, the coefficients carried by A_{12} are jointly different from zero. If the null hypothesis of $A_{12} = 0$is rejected significantly by the F test, X_2 Granger causes X_1 . We use the Bayesian Information Criterion (BIC) to determine the number of lags. The results are presented in Table 4.

Some previous studies adopt band-pass filter or Hodrick-Prescott filter to separate the cyclical patterns in the asset price time series to study the interaction of the residuals of price and return variables, for example, [14]. The band-pass filter passes the cyclical patterns with given frequencies within a range, yet in this paper, the frequency of the potential cyclical trend is not pre-determined. The Hodrick-Prescott filter has the similar function to the band-pass filter. It can separate the long-term sensitive trend from the original variable by controlling the parameter λ in the following optimization problem:

$$\min_{\tau}\left(\sum_{t=1}^{T}(y_t - \tau_t)^2 \quad + \lambda \sum_{t=2}^{T-1}[(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2\right)$$

Time series y_t is comprised of the trend component τ and the cyclical component c_t . Unfortunately, the filter generates shifts in the trend that do not actually exist when one-time permanent shocks andvarious growth rates occur. This is highly likely in the case of Bitcoin exchange rate series, as the government or regulation recognition and ban insert structural breaks frequently. Hence, this study does not incorporate the Hodrick-Prescott filter. In addition, while Johansen cointegration test is another potential measure of the interaction of the exchange rate variables, it is not appropriate for the dataset in this study, which contains only short-term time series. The commercialized history of Bitcoin is merely two years, yet cointegration procedure is usually adopted for long-term relations [15].

4. RESULTS AND DISCUSSIONS

The core results that this paper attempts to reveal is whether the Bitcoin parity exchange rates equal the spot market exchange rate. If the implied parity exchange rate is significantly different from the spot market rate considering the transaction cost, the parity computation can in fact guide the route of arbitrage. The meanings of such results are not merely the exploration of arbitrage opportunities, but to price the functions that fiat money carry and Bitcoin lacks. The purpose of the preliminary is to compare whether the Bitcoin Parity exchange rates equal the spot market exchange rates. Simply calculating the correlation coefficients of the two rates cannot serve as a substitute of this step, though the numerical values of the correlation coefficients and the coefficients of the univariate linear regressions are the same. Correlation coefficient equaling one is only the necessary but insufficient condition of two variables being the same.

Table 1. Bitcoinexchange rate variables from bitcoin exchange dealers

Bitcoin exchange dealer	Currency	Data start	Data end	Bitcoin exchange dealer	Currency	Data start	Data end
Bitstamp	U.S. Dollar	20110913	20131230	Rock	Euro	20111109	20131229
Btce	U.S. Dollar	20110821	20131210	Btcn	Chinese Yuan	20110613	20131230
Cbx	U.S. Dollar	20110705	20131230	Mtgox	Australian Dollar	20110902	20131230
Mtgox	U.S. Dollar	20100717	20131230	Mtgox	Canadian Dollar	20110927	20131230
Btcde	Euro	20110826	20131230	Virtex	Canadian Dollar	20110608	20131230
Btce	Euro	20121102	20131230	Mtgox	Sterling	20110906	20131230
Mtgox	Euro	20110827	20131230	Mtgox	Japenese Yen	20110827	20131230

Table 2. Unit root tests of bitcoin parity exchange rate

Variable	Lag length	t-statistic	*P* value	Variable	Lag length	t-statistic	*P* value
BTEUR/USD_I	4	-4.38	0.00	BTUSD/CAD_I	4	-28.32	0.00
BTAUD/USD_I	15	-3.98	0.00	BTCNY/USD_I	3	-8.24	0.00
BTGBP/USD_I	3	-12.38	0.00	BTCNY/USD_W	4	-3.91	0.00
BTUSD/JPY_I	0	-28.42	0.00	BTCNY/USD_C	15	-3.84	0.00

In Table 3, all the dependent variables are the Bitcoin parity exchange rates, and the independent variables are the spot market exchange rates. The variables are calculated with the implied rates (_I), the close level rates (_C) and the weighted rates (_W). The results suggest that the Bitcoin parity rates are fundamentally different from the spot market rates. In other words, the triangle arbitrage condition does not hold in the real transactions. In a simplified example, if the observed rates in the Bitcoin dealer is quoted at 2 Euros exchange for 1 Bitcoin and 3 U.S. Dollars for 1 Bitcoin, the Bitcoin parity should lead to the exchange rate of 1.5 U.S. Dollar per Euro in the spot market. However, Table 3 implies that the coefficients of independent variables are significantly different from 1.

Such result implies two major conclusions: first, Bitcoin is treated by investors not only as a general currency but also a financial asset. As an investment object, rather than a general transaction benchmark, the value of Bitcoin fluctuates with the change of demand driven by market sentiment. While all dollars are created equal, no Bitcoin is created and exchanged equally. Second, the fixed effects represented by the intercept term needs to be further confirmed. Most of the intercept terms are negative, showing the liquidity discount in Bitcoin trading. Users of this new currency have to accept lower revenue when realizing the fiat money value of Bitcoin. At 5% significance level, such discount is persistent in the case of Euro and Pound. As the rest of the intercepts are insignificant statistically, we adopt the Granger causality tests to further identify the existence of the idiosyncratic risk.

The Granger causality procedure is described by Equation (3) and (4)in the previous section. The left columns in Table 4 report the causality from the Bitcoin parity exchange rate to the spot market rate. The null hypothesis is no casual relations exist. None of the results reject the null hypothesis, implying the fact that the value of Bitcoin and Bitcoin arbitrage fail to affect the spot market transaction. Bitcoin value is not one of the determinants of equilibrium spot market exchange rates. A plausible explanation is the relatively low trading volume of Bitcoin and its short history.

The right columns in Table 4 indicate that the spot market rates of Australian Dollar and Japanese Yen significantly affect the exchange rates of these two currencies with Bitcoin. However, other Bitcoin exchange rates are independent from the impact of spot currency market. This conclusion is consistent with the non-zero intercepts in Table 3 regressions, which imply that idiosyncratic risk premium determines largely the value of Bitcoin. The essential difference of the two exchange rates is persistent over time in the linear model and causality model. Apparently, with a sufficiently long period of operating of Bitcoin from 2011 to 2014, investors should have realized such value difference and the corresponding arbitrage opportunity, yet it is not eliminated. Hence this study concludes the arbitrage stickiness phenomenon exists in Bitcoin market. The reluctance of arbitrage can only be explained by the financial asset character of Bitcoin. When the risk-adjusted return of investing in Bitcoin is higher than the arbitrage profit, investors treat Bitcoin as financial asset instead of currency. They adopt the buy-and-hold strategy, regardless of the arbitrage opportunity if they immediately realize the value difference of Bitcoin through a triangle arbitrage.

The regressions above confirm the financial asset feature of Bitcoin, the existence of idiosyncratic risk premium of Bitcoin, and the arbitrage stickiness in the currency trading. As investors hold Bitcoin as an investment vehicle, the next reasonable question is to measure the performance of Bitcoin with its key economic features. The fundamental requirement of any financial asset is the positive slope of capital market line, i.e., excess return must be associated with extra risk relative to the benchmark. The classical method to realize this general rule is to compute and race the Sharpe ratio. However, there is no risk-free asset in currency market, and all risks of currencies are relative to the mutual currency pair. Therefore we develop the following pseudo-Treynor ratio to exhibit the risk-return characters of Bitcoin, similar to the Treynor ratio adopted in equity analysis.

$$\text{pseudo} - \text{Treynor ratio} = \left(\frac{q_t^{BT,currency} - q_{t-1}^{BT,currency}}{q_{t-1}^{BT,currency}} - \frac{q_t^{BT,USD} - q_{t-1}^{BT,USD}}{q_{t-1}^{BT,currency}}\right) \Big/ \frac{\text{covariance}(q^{BT,currency}, q^{BT,USD})}{\text{variance}(q^{BT,USD})}$$

$$= \frac{\left(r_t^{BT,currency} - r_t^{BT,USD}\right)}{\beta^{BT,currency}}$$

where q is the qouted exchange rate, and r is the currency holding period return. Eq. (5)

Table 3. Unit root adjusted linear regressions of bitcoin parity exchange rates and spot market exchange rates

Dependent Variable: BTEURUSD_I				Dependent Variable: BTGBPUSD_I			
Independent variables:	**Coefficient**	**t-statistic**	***P* value**	**Independent variables:**	**Coefficient**	**t-statistic**	***P* value**
EURUSD_C	15.4785	3.11	0.00	GBPUSD_C	0.6604	4.60	0.00
C	-10.0096	-2.66	0.00	C	0.4757	2.11	0.04
Dependent Variable: BTAUDUSD_I				**Dependent Variable: BTCNYUSD_C**			
Independent variables:	**Coefficient**	**t-statistic**	***P* value**	**Independent variables:**	**Coefficient**	**t-statistic**	***P* value**
AUDUSD_C	1.3375	4.61	0.00	CNYUSD_C	36.5675	2.28	0.02
C	-0.3448	-1.18	0.24	C	0.2559	0.10	0.92
Dependent Variable: BTUSDJPY_I				**Dependent Variable: BTGBPUSD_C**			
Independent variables:	**Coefficient**	**t-statistic**	***P* value**	**Independent variables:**	**Coefficient**	**t-statistic**	***P* value**
USDJPY_C	7.5047	2.24	0.0254	GBPUSD_C	1.1396	3.96	0.00
C	-546.5651	-1.87	0.06	C	-0.0845	-0.46	0.64
Dependent Variable: BTCNYUSD_I				**Dependent Variable: BTCNYUSD_W**			
Independent variables:	**Coefficient**	**t-statistic**	***P* value**	**Independent variables:**	**Coefficient**	**t-statistic**	***P* value**
CNYUSD_C	0.9025	3.94	0.00	CNYUSD_C	31.9152	1.97	0.05
C	0.0137	0.37	0.71	C	1.0292	0.40	0.69
Dependent Variable: BTUSDCAD_I				**Dependent Variable: BTGBPUSD_W**			
Independent variables:	**Coefficient**	**t-statistic**	***P* value**	**Independent variables:**	**Coefficient**	**t-statistic**	***P* value**
USDCAD_C	21.9571	1.62	0.10	GBPUSD_C	1.0925	3.80	0.00
C	-21.0154	-1.53	0.13	C	-0.0537	-0.29	0.77

Table 4. Causality regressions of bitcoin parity exchange rates and spot market exchange rates

From:	**To:**			**From:**	**To:**		
Bitcoin parity exchange rate	**Spot market exchange rate**	**F test statistic**	***P* value**	**Spot market exchange rate**	**Bitcoin parity exchange rate**	**F test statistic**	***P* value**
BTEUR/USD_I	EUR/USD_C	1.41	0.25	EUR/USD_C	BTEUR/USD_I	0.47	0.76
BTAUD/USD_I	AUD/USD_C	1.53	0.20	AUD/USD_C	BTAUD/USD_I	6.29	0.00
BTGBP/USD_I	GBP/USD_C	1.14	0.34	GBP/USD_C	BTGBP/USD_I	2.93	0.02
BTGBP/USD_W	GBP/USD_C	2.40	0.05	GBP/USD_C	BTGBP/USD_W	0.34	0.85
BTGBP/USD_C	GBP/USD_C	2.32	0.06	GBP/USD_C	BTGBP/USD_C	0.39	0.82
BTUSD/JPY_I	USD/JPY_C	0.58	0.68	USD/JPY_C	BTUSD/JPY_I	4.64	0.00
BTUSD/CAD_I	USD/CAD_C	0.30	0.88	USD/CAD_C	BTUSD/CAD_I	0.40	0.81
BTCNY/USD_I	CNY/USD_C	0.69	0.60	CNY/USD_C	BTCNY/USD_I	0.98	0.42
BTCNY/USD_W	CNY/USD_C	0.83	0.51	CNY/USD_C	BTCNY/USD_W	0.81	0.52
BTCNY/USD_C	CNY/USD_C	1.41	0.24	CNY/USD_C	BTCNY/USD_C	0.85	0.50

Table 5. Investmentcharacters of bitcoin as financial assets

	BTAUD_C	BTCAD_C	BTCNY_C	BTEUR_C	BTGBP_C	BTJPY_C
Pseudo-treynor ratio	-0.0067	-0.0532	0.0030	-0.0484	0.0246	-0.0007
Ratio skewness	-1.1910	-2.4467	6.8792	-2.9327	5.5987	-2.4485
Ratio kurtosis	24.2339	8.8623	48.9343	9.5839	49.6508	5.7130
	BTAUD_I	**BTCAD_I**	**BTCNY_I**	**BTEUR_I**	**BTGBP_I**	**BTJPY_I**
Pseudo-treynor ratio	-0.0860	0.0231	-1.1649	-1.0655	-0.1124	16.7578
Ratio skewness	-27.9204	-21.3538	-28.6023	-19.6221	-28.5862	4.0396
Ratio kurtosis	793.2913	601.4262	818.7233	391.5195	818.1120	17.7393
	BTAUD_W	**BTCAD_W**	**BTCNY_W**	**BTEUR_W**	**BTGBP_W**	**BTJPY_W**
Pseudo-treynor ratio	-0.0060	-0.0526	0.0030	-0.0475	0.0259	-0.0007
Ratio skewness	-0.7698	-2.3138	6.9198	-2.7558	5.9939	-2.3121
Ratio kurtosis	24.2177	8.8471	48.2313	9.9839	49.7150	5.9180

Above Table 5 presents the return and relative risk comparisons of all the major Bitcoin exchange rates. The benchmark of return is the holding period return of Bitcoin presented with U.S. Dollar. The benchmark of risk is the relative risk in terms of the volatility of the Bitcoin amount presented with U.S. Dollar. Table 5 also adds the third and fourth moment to further explore the capital appreciation pattern. The results show that other than the Chinese Yuan and British Pound Sterling, most of the investments on Bitcoin with other currencies are not as favorable as investing Bitcoin with U.S. Dollar. Excess returns are in general negatively skewed and distributed in fat tails.

5. CONCLUDING REMARKS

This paper suggests that Bitcoin has two roles: as currency and as investment objectives. Using daily data of Bitcoin exchange rates from major dealers and spot currency markets, the regressions imply that bitcoin, as a type currency, is much less mature than the conventional currencies. There is significant liquidity discount of Bitcoin, and the idiosyncratic risk premium dominates its value. We also find that Bitcoin, as investment objectives, as associated with excess risk and low returns. However, the poor investment performance does not discourage investors from recognizing and utilizing Bitcoin as a financial asset. In fact, investors continue to ignore the currency feature of Bitcoin and the arbitrage profit brought by its currency character. The arbitrage stickiness is persistent over time.

The groups of conclusions suggest a paradox. Bitcoin has two roles: as a currency in the goods and services market, and as an asset in the financial market. The results indicate that there is triangle arbitrage profit by spending Bitcoin as a currency. In contrast, the investment performance of Bitcoin is poor by storing Bitcoin as an asset. Yet investors do not pursue the arbitrage profit and would stick to the low return associated with higher risk.

The next steps of this study are to identify the possible reasons of this paradox. Though it seems that investors give up risk free profit and run after low and risky returns, simply summarizing this as an indicator of investor irrationality is not satisfying. There might be other benefit factors that induce investors to store Bitcoin as financial asset, for example, the risk feature of Bitcoin might be counter-cyclical and thus provides ideal diversification in the portfolio. Equivalently, this paradox does not necessarily challenge the Efficient Market Hypothesis (EMH). Further study needs to investigate the transaction cost of arbitrage actions and the component of idiosyncratic risk to address this paradox.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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