Application of Error Correction model with monetary function factors in the return of bitcoin

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Abstract. Bitcoin is a kind of virtual currency based on block chain technology. In many scenarios, it shows the function of currency to a certain extent. However, many believe that the value of Bitcoin is hollow, speculative and unable to undertake monetary functions, which prevents it to circulate as a real currency. This paper assumes that Bitcoin can undertake monetary functions, which can verify the relationship between monetary functions and Bitcoin earnings. According to the availability of the data and the previous research results, the monthly value of the indexes to measure the monetary function from 2010 to 2020 are selected to form a regression equation with the monthly return data of Bitcoin in the corresponding period. ADF test shows that the explained variable is a first-order simple integer, and the explanatory variables have both first-order simple integer and stationary sequence, and there is a cointegration relationship between them. The result of error correction model shows that the relationship between Bitcoin rate of return and the relevant indicators to measure monetary function is not significant, which rejects the original assumption that Bitcoin can assume monetary function, indicating that Bitcoin does not have the ability and potential to assume monetary function. This may be due to the speculative nature of Bitcoin and the lack of powerful credit support. Therefore, investment in Bitcoin needs to be cautiously thought, but the blockchain technology used in Bitcoin needs to be vigorously developed, which could lead to a technological revolution; in addition, it is momentous for countries to develop digital currencies of central bank to meet the challenge.

1. Introduction
In 2008, Satoshi Nakamoto firstly put forward the concepts of block chain and Bitcoin. Bitcoin has been the most influential and largest unlicensed chain virtual currency until now [1]. In 2009, Bitcoin was officially launched, and block chains, as the key technology of Bitcoin, gradually attracted attention and were considered to be used in the digital currencies of central bank. In July 2019, the Bank for International Settlements publicly expressed its support for the issuance of digital money by central banks and the International Monetary Fund began to actively explore the issuance of global digital currency IMF Coin. Since then, a relatively authoritative analytical framework on digital currencies has been provided, which is called the theory of "money flower and the money tree". Besides, in August 2020, China began pilot work on digital RMB in Beijing, Tianjin, Hebei, Yangtze River Delta, Guangdong-Hong Kong-Macau Greater Bay Area and parts of the central and western regions [2].

This paper mainly searches for the differences between digital currency of the central bank and Bitcoin and empirically analyzes whether Bitcoin can play a monetary role. The arrangements of the
rest of this paper are as follows: the second part is theoretical analysis, the third part is empirical research, while the fourth part gives the conclusions and prospects.

2. Theoretical analysis

Block chain technology is a vital basic technology of financial technology, Zhenliang Dong et al. (2020) [3] pointing out the advantages of the extensive application of financial technology, he believed that in the future development of financial technology, it is necessary to carry out research on business activities, the order of industry organization, supervision and the interdisciplinary study of financial technology. Sansan Wang (2021) [4] believed that financial technology has developed to 3.0 era, and the ultimate goal of financial technology is to realize the innovation of finance. With the development of financial technology, the systemic risk of financial activities are increased and more and more financial activities have been separated from supervision which need to pay attention to.

As the basic technology of financial technology, block chain technology has a wide range of applications. Bitcoin dominates the development direction of encryption currency, which adopts the distributed account book technology to ensure that the node data can not be easily changed and successfully constructs the trust foundation and that’s why digital currency can learn from Bitcoin. Xiaonan Ji et al. (2021) [2] summed up the specific structure of Chinese, Digital Currency Electronic Payment (DC/EP), and described its distribution and circulation mechanism, the account system and the payment mechanism. It was pointed out that digital currency could make payment more convenient and realize double offline payment through digital money wallet. Besides, it could also realize point-to-point currency delivery through digital currency smart contract, so as to avoid the problem of interception, misappropriation and false claim in the process of payment.

Shiqin Zeng et al. (2020) [1] summarized the general hierarchical technical structure, basic principle and research progress of block chain, and introduced the contents of block chain network layer, data layer, common recognition layer, control layer and application layer in detail. The data layer is the core of the block chain, and the key technology of the data layer ensures the impossible modification and anonymity of the data. The technology of common recognition layer is committed to realizing the consensus of the whole network and the unity of the whole network in the untrusted environment. What’s more, Digital money will be used as a new generation of financial infrastructure.

It is generally believed that currency generally has the functions of trading medium, accounting unit and value storage. Digital money, especially the central bank digital currency, also has these functions, which can promote economic efficiency and optimize the allocation of resources. The use of block chain technology in digital currency can also achieve traceability of transactions, which can make national governance more intelligent and effective. When block chain technology is standardized, digital money can better adapt to the market, achieving the linkage effect of value before different products and services, and better solving the phenomenon of unreasonable pricing. Because of the technical and morphological advantages of digital money, the liquidity of digital money will be better than that of legal paper money. In addition, the issuing mechanism of digital money can solve the problem of inflation to some extent, so it has more advantages as a means of value storage than traditional currency. However, Bitcoin, as a virtual currency that has attracted much attention in recent years, has been controversial about its value.

Having considered the above theories and the existing data, this paper puts forward the following assumption:

H1: the "monetary functions" have a significant impact on the return of Bitcoin, which means that bitcoin can undertake monetary functions,

H2: There is a unit root in the residual sequence of cointegration regression.

The paper employs the returns of Bitcoin as the explained variable and the indexes to measure the monetary functions as the explanatory variables to study whether Bitcoin has the potential to perform monetary functions.
3. Model

3.1. Sample selection and data sources
Considering the availability and properness of sample data, this paper selects relevant variable data from September 2010 to November 2020, which obtains 738 monthly valid data for reference and calculation of the variables and the ultimate model data is 492. For a small number of missing data in statistical materials in the https://cn.investing.com/crypto and EPS database, the paper uses 0 to take place.

3.2. Variable definition and research model

3.2.1. Explained variables. Considering the availability of the whole data, this paper selects the monthly closing price of Bitcoin (denominated in dollars) from September 2000 to November 2020 as the initial data and written as $x_t$. And the time sequence diagram is shown in figure 1. This paper refers to the method of data processing of Jinwang Wu et al. (2020) [5], which used logarithmic result of the closing price to obtain the corresponding rate of return. The logarithmic rate of return in this paper is calculated as follows:

$$\log - \text{return}_t = (\log(x_t) - \log(x_{t-1})) \times 100$$

![Figure 1. Monthly price trend of Bitcoin (denominated in dollars).](https://cn.investing.com/crypto)

3.2.2. Explanatory variables. In order to measure the three functions of currency, his paper refers to the research of Tang Ying (2019) [6] to select relevant measurement indicators of trading media, value storage and accounting units. In this paper, the real effective exchange rate called $Reer_t$ from September 2010 to November 2020 is selected, which is based on the average cycle value of CPI whose basic period is 2010 (= 100). The data comes from the EPS database. Select the total retail sales of goods in China from September 2010 to November 2020 (denominated in hundreds of millions of yuan), called $CR_t$ and retail price index of commodities for the same period based on August 2010 (= 100) (based on last month’s data processing), called $RPI_t$. The data comes from the EPS database. Calculate the standardized total retail sales and record them as $Crdirpi_t$.

$$Crdirpi_t = CR_t/RPI_t$$

Select the cumulative value of Chinese residents' savings deposits (denominated in hundreds of millions of yuan) from September 2010 to November 2020, recorded as $SA_t$ and consumer price index
for the same period based on August 2010 (= 100), recorded as \( C_{RRR} \). (According to the data processing based on last month.) The data comes from the EPS database. First, the value of the current period is calculated by subtraction of the next period, and then the price index is used to standardize them. The variables are recorded as \( M_{sa} \):

\[
M_{sa} = (S_{A_t} - S_{A_{t-1}})/C_{PI_t}
\]

3.2.3. Research model. The related model constructed in this paper is as follows, which reflects the influence of some monetary function variables on the return of Bitcoin. According to the views of some economists, the current situation of Bitcoin development, the availability of selected indicators and other factors, this paper expects that the impact of variables may not be significant.

\[
Log - return_t = \alpha + \beta_1 Reer + \beta_2 Crdirpi_t + \beta_3 M_{sa} + \epsilon
\]

3.3. Stability test and error correction model of time series

3.3.1. Variable stationarity test. In order to avoid the phenomenon of "false regression", this paper carries out augment Dickey-Fuller test on the time series data in the model variables, and the test results are as follows in Table 1.

| Variables          | T value | P value | ADF model | Order number |
|--------------------|---------|---------|-----------|--------------|
| \( Log - return_t \) | -8.5539 | 0.0000  | 2         | 0            |
| \( Reer_t \)       | -7.1567 | 0.0000  | 1         | 1            |
| \( Crdirpi_t \)    | -6.6638 | 0.0000  | 3         | 0            |
| \( M_{sa} \)       | -12.4925| 0.0000  | 1         | 1            |

The results of ADF test showed that at the significant level of 5%, the variables \( Log - return_t \) and \( M_{sa} \) were first-order simple integer, variables \( Reer_t \) and \( Crdirpi_t \) are stationary sequence and the number of the highest order variables are more than one, so there is the possibility of cointegration.

3.3.2. Cointegration regression and error correction model. The cointegration regression equation is constructed as follows:

\[
Log - return_t = \hat{\alpha} + \beta_1 Reer + \beta_2 Crdirpi_t + \beta_3 M_{sa} + \epsilon
\]

\[
e_t = Log - return_t - Log - return_{t-1}
\]

The results of the integration test of residual sequence \( e_t \) shows that the T value is -8.9440, which is less than the critical value of cointegration test -4.1887 at the significant level of 5%. Therefore, the zero hypothesis of having unit root is rejected, that is, the residual sequence is a stable sequence, recorded as \( I(0) \). It is considered that there is a cointegration relationship between variables. According to Granger representation theorem, it is considered that the short-term disequilibrium relationship between variables can be represented by an error correction model (ECM). And according to the results of ECM, the T value result of the variable is not significant, which confirms the previous conjecture, and the ability of the explanatory variable to interpret the explained variable is not enough, which confirm that Bitcoin can’t be used as currency. In addition, the results of error correction model are tested by LM test, White test and VIF test. The test results show that there is no autocorrelation, heteroscedasticity and multiple collinearity in the model.

4. Conclusion and prospect

The origin and technical characteristics of blockchain technology determine that it plays an important role in digital currency. The quaternion model \( DF = f(T, A, P, L) \) of digital currency evolution reveals the necessity of technical characteristics for the development of digital currency. As one of many
kinds of fundamental technology digital currency, block chain technology has some unique advantages. Only the mature block chain technology can give birth to the mature central bank digital currency, under the competition for digital seigniorage, the countries with advanced block chain technology can turn the crisis into prosperity. But Bitcoin, as a virtual currency using blockchain technology, is totally different from the central bank's digital currency.

Based on the fluctuation data of Bitcoin’s price from September 2010 to November 2020, this paper selects variables from the point of view of measuring monetary function, and proves that Bitcoin does not have the characteristics of assuming monetary functions as the digital currency of central bank.

At present, the research and development of digital RMB continues to advance, the scope of pilot and application scenarios are gradually expanded. Under the background of the increasing development of digital economy, data, as the "oil" of digital economy, is regarded as one of the seven major factors of production, with the others being labor force, technology, capital and so on.[7] The data has increasingly reflected the "asset" feature of value creation, which indicates that the combination of data and real assets has become an irresistible trend. With the price of Bitcoin rising this year, the focus on decentralized finance will not be cool, but Bitcoin will never become a currency with monetary functions. In the future, block chain technology will further strengthen its combination with 5G and artificial intelligence. In the face of the challenges of itself, block chain will pay attention to cross-chain technology research and development, scalability and performance under wireless networks. In data management, block chain will attach importance to the privacy protection technology of data, interlink transaction processing optimization technology, smart contract oriented transaction processing optimization technology. At the same time, the central bank digital money work is also steadily carried out, I believe that China can seize the opportunity and leave a heavy ink for history in the digital currency construction and make the full use of the functions of currency.

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