

Feasibility Analysis of Digital Currency Market

—Taking Bitcoin as an Example

Ning Zhu ^a, Meiqi Yan

School of Economics and Management Shandong Agricultural University, Taian, China 271001, China.

^a759201300@qq.com

Abstract. With the increasing acceptance of Bitcoin based on block chain technology, Digital Currency has attracted more and more attention. Many people think that traditional banks may be out of date, while digital currency is more convenient. Therefore, we design a mature digital money system that can replace the traditional bank based on the research of once popular bitcoin. However, some governments argue that these currencies are unregulated and have a high risk of anonymity because they are easily used for illegal transactions, such as tax avoidance and the purchase of illegal goods. Which factors are hindering the steady development of digital money prices. Is there an model to make the digital money market keep on developing? In this paper, through logical analysis, the influence factors of several kinds of digital currency prices are determined. Then we try to build a digital currency model based on Bitcoin, and analyze the price fluctuation of bitcoin price from 2013 to 2018. We find that during the development of Bitcoin, the price changes show obvious stages: the rising stage of healthy development and the stage of pathological sharp decline. In the process of analyzing the stage of its price morbid development, we find that there are some contradictions in considering the objective factors. Therefore we introduce the subjective factors that affect bitcoin price, and analyze it by analytic hierarchy process (AHP). Finally, we construct a differential equation model to analyze the influence of subjective and objective factors. The model in the end has some reference significance for the authorities trying to accept digital currency, and a warning can also be given before the prices go up to that point.

Keywords: Digital Currency Market Bitcoin price fluctuation regression model differential equation analytic hierarchy process (AHP) critical point.

1. Background

Digital money can be used to buy and sell goods just like traditional money and without physical substance. They enable their users to instantly exchange money via email addresses or fingerprints. Instant payment systems from companies like PayPal, Stripe, Venmo, Zelle, Apple Pay, Square Cash, and Google Pay allow the virtual money to go anywhere of the world in seconds without a bank or currency verification transaction.

However, some governments argue that these currencies are lack of regulation and their anonymity is risky because they can easily be used for illegal transactions, such as tax avoidance and the purchase of illegal goods. Therefore, we will build a digital financial market that is universally applicable and feasible, and can promote local and even global economic growth in the long run, due to existing problems and combining different policy demands cooperation willingness of each country, and the composition of solutions to possible problems. In the end, our model will be gradually promoted all over the world, so as to promote global economic development.

2. Summarization of Model

2.1 Variable Settings

Based on a certain theoretical basis, we believe that objective economic factors, such as inflation rate and exchange rate, may have some impact on the price of digital currency through reasoning analysis. Therefore, after a full investigation, we decided to set the following variables as our main analysis factors:

Z — Average Price Of Bitcoin
 X_1 — CPI
 X_2 — DINIW
 X_3 — GDP
 X_4 — Interest Rate
 X_5 — Inflation Rate

2.2 Time-ordered Factors

To make the study more convenient, we take the monthly average of the objective factors in the United States as samples and analyze the time series of the factors as follows, so that we can observe their trends. It should be noted that objective economic factors are always similar in any country, so the analysis of these objective factors can also be used in other countries.

3. Analysis of the Price of Bitcoin

3.1 What is Bitcoin?

Bitcoin is a peer-to-peer, global cryptocurrency digital payment system in common use. It does not rely on specific institutions to issue, generated by computer algorithms, peer-to-peer transmission of digital currency, can be through the Internet global transactions. The concept was first proposed in 2008 in an article titled "bitcoin: a peer-to-peer electronic cash system" published on an advanced cryptography forum.

3.2 How Bitcoin Works

Bitcoin has formed a system that covers the distribution of distribution, circulation and derivatives of derivatives, which is the main reason for the long term of the vast majority of the digital cryptocurrency market.

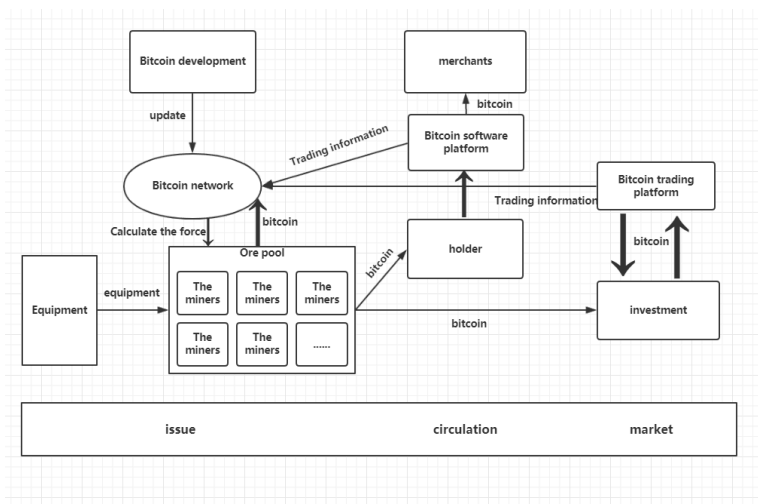


Figure 1. The Bitcoin distribution system diagram

3.3 The Rising Stage of Healthy Development

Firstly, we chose the data from 2013 to 2017 and do Multiple Regression Analysis by EViews. The results are as follows.

Table 1. The data from 2013 to 2017 Analysis results

Dependent Variable: Z
Method: Least Squares
Date: 01/28/19 Time: 20:23
Sample: 2013Q2 2017Q4
Included observations: 19

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-172821.5	145221.0	-1.190058	0.2553
X1	852.0292	908.0714	0.938284	0.3652
X2	-230.7403	163.1791	-1.414031	0.1809
X3	44.63896	438.4924	0.101801	0.9205
X4	-227.5578	244.0629	-0.932374	0.3681
X5	-136.4984	120.1911	-1.135678	0.2766
R-squared	0.694017	Mean dependent var	1388.735	
Adjusted R-squared	0.576332	S.D. dependent var	2774.522	
S.E. of regression	1805.931	Akaike info criterion	18.08763	
Sum squared resid	42398049	Schwarz criterion	18.38587	
Log likelihood	-165.8325	Hannan-Quinn criter.	18.13810	
F-statistic	5.897213	Durbin-Watson stat	1.182837	
Prob(F-statistic)	0.004639			

Regression results show that the value of correlation coefficient R is 0.69. It can be concluded that there is a strong correlation between these objective factors and the price of Bitcoin, which is very celebrated. Next, we can make further analysis. Then we make a further regression analysis between the quarterly average price of Bitcoin and the square of explanatory variables X_1, X_2, X_3, X_4, X_5 . The results are as follows:

We assume that there are only objective factors work and structure a model as below:

$$Z = -67581.17 + 1.32X_1^2 - 1.228X_2^2 + 0.398X_3^2 - 2.119X_4^2 - 4.627X_5^2 \quad (1)$$

In order to analyze the relationship between price variation and explanatory variables, we derive the upper formula and obtain the following Differential Equation Model

$$\frac{dZ}{dt} = 2.64X_1 \frac{dX_1}{dt} - 2.456X_2 \frac{dX_2}{dt} + 0.769X_3 \frac{dX_3}{dt} - 4.238X_4 \frac{dX_4}{dt} - 9.254X_5 \frac{dX_5}{dt} \quad (2)$$

Based on this model, we draw a conclusion that X_2, X_4, X_5 play a negative role, Therefore, we make a further analysis of the decline process of Bitcoin prices in 2018.

3.4 The Stage of Pathological Sharp Decline

Bitcoin price is selected as dependent variable, and the dollar index, interest rate and inflation rate are selected as dependent variables for regression analysis. The results are as follows. (Since there are fewer data after 2017, in order to increase the scientific results, we select monthly data for analysis):

Table 2. Monthly data analysis

Dependent Variable: Y
Method: Least Squares
Date: 01/28/19 Time: 18:20
Sample: 2017M11 2018M12
Included observations: 14

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	19519.77	16196.55	1.205180	0.2559
X2^2	2.116193	2.255636	0.938180	0.3703
X4^2	-6.554639	1.956736	-3.349782	0.0074
X5^2	0.375804	4.776985	0.078670	0.9388
R-squared	0.621694	Mean dependent var	7898.077	
Adjusted R-squared	0.508202	S.D. dependent var	3224.097	
S.E. of regression	2261.004	Akaike info criterion	18.51996	
Sum squared resid	51121375	Schwarz criterion	18.70255	
Log likelihood	-125.6397	Hannan-Quinn criter.	18.50306	
F-statistic	5.477879	Durbin-Watson stat	0.840271	
Prob(F-statistic)	0.017344			

The results show that the price of Bitcoin has the following relationship with the dollar index, interest rate and inflation rate in the course of its decline:

$$\bar{Z} = 19519.77 + 2.116X_2^2 - 6.555X_4^2 + 0.376X_5^2 \quad (3)$$

Analyzing the results of this regression, we find that interest rates still play a negative role in the decline of Bitcoin prices, and this explanation is very strong. After speculating and analyzing, we believe that subjective factors play a decisive role in this process, and each subjective factor plays a role in different weights, but what is the weight?

Therefore, we use analytic hierarchy process to analyze the influence of subjective factors on Bitcoin. Based on the previous theoretical analysis, the analytic hierarchy process (AHP) is divided into three layers: target layer, criterion layer and index layer. The target layer is the factor affecting the price of Bitcoin, and the criterion layer is the specific sub-goal of the target layer, namely, market manipulation, personal preferences and government policies. The structure of the analytic hierarchy process is shown in the figure.

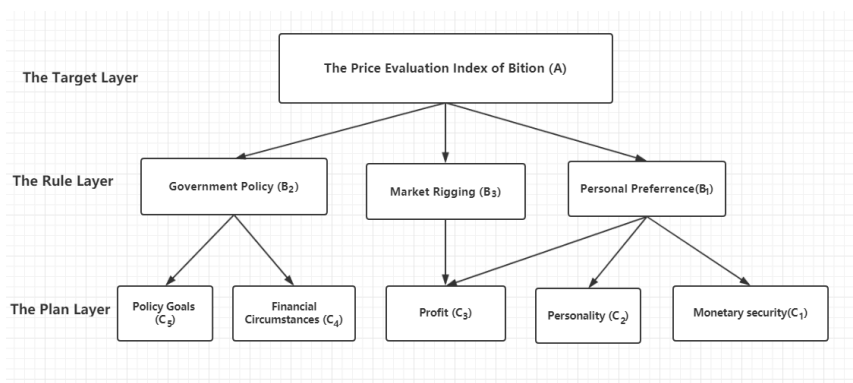


Figure 2. The structure of the analytic hierarchy process

The importance of sub-goals in the target layer is different, and Market Rigging should be the most important. Individuals will be affected by various factors when making currency choices, especially the need to consider the issue of monetary security, which will also affect the price of Bitcoin to a certain extent, so we take this as a secondary factor. Government policy factors are relatively a secondary factor. According to the experts' opinions, the importance ratio of the three sub-goals is about 7:3:1.

Therefore, according to the index system, using the above-mentioned scaling method, the importance of the index is scored, and then the scoring results are discussed and summarized internally. The discriminant matrix is as follows:

Table 3. The discriminant matrix

The Price Evaluation Index of Bitcoin (A)	Market Rigging(B3)	Personal Preference (B1)	Government Policy (B2)
Market Rigging (B3)	1	3	7
Personal Preference (B1)	1/3	1	3
Government Policy (B2)	1/7	1/3	1

Excel was used to calculate the maximum characteristic root of the judgment matrix. Lambda Max =3.007 is the consistency test of the judgment matrix, and the consistency index needs to be calculated by equation (4), which result is 0.0035.

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (4)$$

Then the mean random consistency index is calculated. Stochastic consistency ratio is $0.0068 < 0.1$ calculated by equation (5).

$$CR = \frac{CI}{RI} \quad (5)$$

Therefore, it is considered that the result of AHP has a satisfactory consistency, that is, the allocation of weight coefficient is very reasonable. The weight of each impact factors as follows:

Table 4. The weight of each impact factors

The Price Evaluation Index of Bitcoin (A)	Weight(Wi)
Market Rigging (B3)	0.6694169
Personal Preference (B1)	0.2426369
Government Policy (B2)	0.0879462

Therefore, we can determine the proportion of subjective factors in this process. The specific quantitative model is as follows:

$$\frac{d\tilde{Z}}{dt} = 8.776Y_1 \frac{dY_1}{dt} + 3.18Y_2 \frac{dY_2}{dt} + 1.1152Y_3 \frac{dY_3}{dt} \quad (6)$$

where Y_1 is Market behavior, Y_2 is Personal preference, Y_3 is Government intervention factor

3.5 Final Model

Based on the above analysis, we conclude that the model consistent with the development of bitcoin is summarized as follows:

$$\begin{aligned} \frac{dZ}{dt} = & 2.64X_1 \frac{dX_1}{dt} + 4.232X_2 \frac{dX_2}{dt} + 0.769X_3 \frac{dX_3}{dt} + 0.752X_5 \frac{dX_5}{dt} \\ & - 13.11X_4 \frac{dX_4}{dt} - 8.776Y_1 \frac{dY_1}{dt} - 3.18Y_2 \frac{dY_2}{dt} - 1.1152Y_3 \frac{dY_3}{dt} \end{aligned} \quad (7)$$

3.6 Critical Point

Through the above comprehensive analysis, we find that the price of Bitcoin can remain stable under certain conditions, which is the critical point we will discuss next. According to the above model, the critical point of Bitcoin price can be calculated by this equation.

$$2.64X_1 + 4.232X_2 + 0.769X_3 + 0.752X_5 = 13.11X_4 + 8.776Y_1 + 3.18Y_2 + 1.1152Y_3 \quad (8)$$

Only when the price of Bitcoin reaches a critical point can we control it so as to maintain the smooth and healthy development of Bitcoin. Similarly, the model can also be used as a reference model for measuring the price of other digital currencies.

4. Construction of Digital Currency Model and Perturbation Analysis

4.1 Construction of Digital Currency Model

We try to build a model which is apply to general situation based on the analysis of Bitcoin.

According to the above analysis ,we find that both subjective factors and objective factors are the influence of the price of currency .So we build the following model:

$$Z = \alpha_0 + \sum_{i=1}^n \alpha_i X_i + \sum_{j=1}^m \beta_j Y_j + \mu \quad (9)$$

And if you want to know the relationship between the explanatory variables and the variation of price, you can follow this model:

$$Z = \alpha_0 + \sum_{i=1}^n \alpha_i X_i^2 + \sum_{j=1}^m \beta_j Y_j^2 \quad (10)$$

By deriving the model, we can get the differential equation model which describe the relationship between the change of digital money price and its influencing factors.

$$\frac{dZ}{dt} = 2 \sum_{i=1}^n \alpha_i X_i \frac{dX_i}{dt} + 2 \sum_{j=1}^m \beta_j Y_j \frac{dY_j}{dt} \quad (11)$$

4.2 Analysis Stability

There may be autocorrelation and multi-collinearity between dependent explanatory variables and explanatory variables. At the same time, explanatory variables may be affected by other factors. To further verify the scientificity and rationality of the model, we analyze the stability of the model. Assuming that the coefficients of variables in the model are slightly changed by some factors. Can the model still reflect the changing trend of digital money? We might as well establish the following models for analysis:

$$\frac{dZ}{dt} = 2 \sum_{i=1}^n (\alpha_i + \hat{\alpha}_i) X_i \frac{dX_i}{dt} + 2 \sum_{j=1}^m (\beta_j + \hat{\beta}_j) Y_j \frac{dY_j}{dt} \quad (12)$$

Using the formulas mentioned above, we may give the variable coefficients a real light microwave dynamic value, and fit the image of the model before and after the data changes through Eviews, and get the results as shown in the figure.

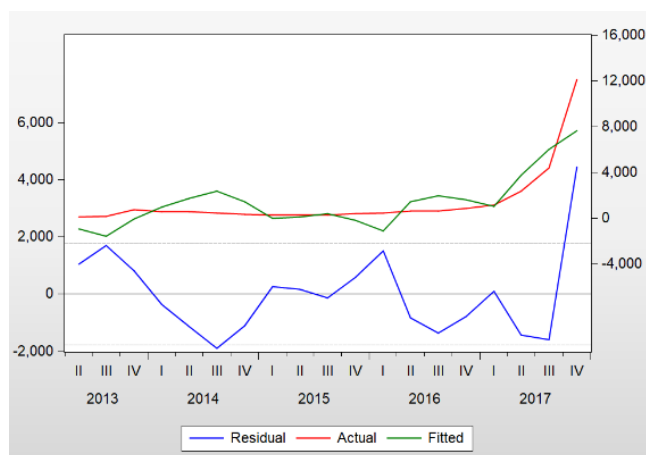


Figure 3. the results

Therefore, we can conclude that when the interaction between some factors has a small impact on the coefficients in our model, local oscillation may occur for the whole model, but the overall trend of the model can still reflect the actual characteristics, so the model is stable.

5. The Advantages and Disadvantages

5.1 Strengths

- Improvement of research methods. By Analytic Hierarchy Process (AHP) we give weight to subjective factors, determine the weight of each factor, and reflect fuzzy variables into the model qualitatively and quantitatively.
- Improvement of research angle. Previous research is to discuss a influence on digital

currency, we discussed the DINIW, the index of GDP, CPI, inflation rate and other factors, and observed from the digital currency trading volume, months average trading, and quarterly trading volume effect. The differential equation model in the mathematical model combining with the economic problems becomes interdisciplinary issue. Then we analyzed it.

- Improvement of research data. The influencing factors we studied are more comprehensive, involving multiple data such as US dollar index, GDP, CPI and inflation rate, and observing multiple data changes of digital currency. Moreover, the data involved are data of the past 6 years, which covers a wide range of data.

5.2 Weaknesses

- Sample is not large enough, there may be contingency. And there will still be inconsiderate factors.
- The requirement of system construction is high, the technical implementation barriers.
- Low public acceptance makes it difficult to promote and use digital currency in the future.
- Because the formation time of current digital currency is too short, and its price history is even shorter, this paper has no way to conduct a comprehensive exploration of it in a very long time. So the final conclusion still has some deficiencies.

6. Conclusion

Digital currency is the product of the evolution of currency form in the era of digital economy. Existing form of legal tender has gradually cannot meet the needs of the current social and economic development, mainly is the encrypted space requirements of the economic activity and the demand of the future digital society issued digital currency is the national sovereignty in the virtual space or encrypted space is outspread, the central bank issued digital currency is a necessity of history, is also a productivity development puts forward new requirements to the productive relations, there is no denying the fact that central Banks need to issue its own digital currency.

Non-fiat digital currencies, such as bitcoin, are not real money at the moment and cannot be the reserve currency of central Banks. It will take time to find a suitable position for non-fiat digital currencies. Despite the rapid development, mixed and speculative, a new type of asset is likely to emerge after the bubble has dissipated. This is a problem that all central Banks should face. Generally speaking, the conditions for the central bank to issue digital currency are gradually maturing, but there is still a lot of work to be done for large-scale issuance. Next we will give the authorities our recommendations for containing market crashes.

First, attach importance to publicity and education, and guide the public to realize the advantages and convenience of digital currency. We will provide professional training to the branches of the people's bank of China and commercial Banks, open channels for handling consumer complaints, protect the legitimate rights and interests of consumers, and eliminate worries about the use of digital currencies.

Secondly, it is suggested that the state formulate policies to support the use and promotion of legal digital currency. Provide services for the public and enterprises and institutions, such as paying fines for violation of regulations, university project fund allocation, etc.; Tax incentives will be given to companies that use digital currencies.

Finally, the pilot mode is adopted to continuously accumulate experience in the observation effect and gradually expand the application types and participation areas of digital currency.

Digital currency is the trend of The Times. Only when digital currency market, gold market, securities market and other traditional currency markets go hand in hand and develop together, and the two complement each other, can we achieve "win-win" and steady economic growth of the country. I believe that in the near future we can see that each country has launched sovereign digital currency, mainstream digital currency will also flourish!

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