

Bitcoin, Not Disappointing: The Self-fulfilling Expectations of Bitcoin Prices

Jiang Jiantao¹, He Ao², Dongwoo Yoo^{3*}

¹Guangdong Baiyun University, Guangzhou, China

²University of Ulsan, Ulsan, South Korea

³University of Ulsan, Ulsan, South Korea

*Corresponding author

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Abstract: Since the outbreak of COVID-19, the price of Bitcoin has been rising, and its yield has surpassed most financial assets. More and more investors have poured into the virtual currency trading market. This paper selects the supply and demand factors, expectations of price, the number of buyers, and the degree of simple purchase that affect the Bitcoin price as research variables and uses the implicit function theory to analyze the self-fulfilling expectations of the Bitcoin price. The results show that the rising Bitcoin price has pushed up investors' expectations of its future price, and at the same time, the reasonable expectations of Bitcoin's price increase have driven Bitcoin price to new highs.

1. Introduction

In the past two decades, the digital cryptocurrency based on blockchain has developed rapidly, which is known as the "fourth" industrial revolution. The technical characteristics of "decentralization" have brought subversion to the existing financial industry innovation but also promoted a revolutionary leap in the global economy. And as of November 1, 2021, Bitcoin has soared to \$61,000, with a market value of \$1.15 trillion, accounting for 45% of the circulating market value of all cryptocurrencies[1].

Bitcoin is a decentralized peer digital currency issued by specific algorithms and does not rely on any central authority or middleman. The Bitcoin network shares a public ledger called "Blockchain." Bitcoin has the characteristics of "distributed bookkeeping, tamper-free, traceability, and decentralized point-to-point transactions." However, Bitcoin has also been criticized by many scholars and government agencies for its volatile price, its inability to meet economic growth demand, as well as its transaction delays, and high energy consumption. With the surge in Bitcoin prices and the influx of money into the Bitcoin market, different governments have different regulatory attitudes towards virtual currencies. In September 2021, the Chinese government stipulated that virtual currency-related business activities were illegal financial activities. At the same time, in Korea, on March 5, 2020, the parliament passed an amendment to the Specific Financial Transaction Information Reporting and Utilization Act (Special Financial Law), allowing cryptocurrencies to obtain legal "identity." And the Korean government is also the first country to impose a corporate tax on digital currency exchanges, currently imposing 22% and 2.2% local income tax on digital currency asset exchanges. At present, most countries and regions of the world are open to Bitcoin[2-3].

In the research, this paper collects articles on Bitcoin price changes and organizes relevant opinions. After reviewing some literature, we make the theoretical and practical analysis of the price of Bitcoin and select the direct variables to analyze the self-fulfilled expectation of Bitcoin price under the implicit function theory. Finally, we explain the results and conclude the interesting phenomenon.

2. Variable selection and assumptions

2.1 Variable selection

Based on the development of previous literature, this paper continues the research by analyzing the influencing factors of Bitcoin price. According to previous research, the supply and demand factors, socio-economic factors, technology market factors, and investors' psychological expectations will have different impacts on the price of Bitcoin. This paper selects the direct and apparent variables from these factors to analyze the self-fulfilled expectation, which are the price of Bitcoin (P), supply of Bitcoin (S), demand for Bitcoin (D), the expectation of Bitcoin's price (P^e), number of buyers (B), degree of simple purchase (SP) and the equilibrium quantity (Q). According to our analysis in this chapter, the paper summarizes the variables studied in Table 1.

Table 1 Summary of variables

Variable	Abbreviation	Explanation
Price of Bitcoin	P	The price of Bitcoin has been rising since its birth.
Supply of Bitcoin	S	The supply of Bitcoin is fixed due to its design mechanism. (3.1)
Demand for Bitcoin	D	The demand for Bitcoin is increasing. (3.2)
The expectation of Bitcoin's price	P^e	Investors have been looking forward to the price of Bitcoin. (3.3)
Number of buyers	B	Bitcoin buyers and holders are expanding. (3.4)
Degree of simple purchase	SP	Investors are becoming more and more accessible to Bitcoin. (3.4)
Equilibrium quantity	Q	The market reaches the equilibrium of supply and demand.

Note. P^e means the expectation of Bitcoin's price; SP is an acronym for "simple purchase."

2.2 Assumptions

This article uses the implicit function theory for derivation and here makes some reasonable assumptions about the relationship between related variables.

(1) Assumption 1.

When the expectation of Bitcoin's price (P^e), the number of buyers (B), and the degree of simple purchase (SP) increase, the demand quantity of Bitcoin (D) will also increase.

(2) Assumption 2.

When the price of Bitcoin (P) goes up, the demand quantity of Bitcoin (D) goes down.

(3) Assumption 3.

Since the total amount of Bitcoin is fixed, we simply assume that the supply of Bitcoin (S) is constant and is not affected by other factors, including Bitcoin's price (P), the expectation of Bitcoin's price (P^e), number of buyers (B), and degree of simple purchase (SP).

(4) Assumption 4.

Furthermore, this article also assumes that when investors' expectations of Bitcoin's price increase, the number of buyers and degree of simple purchase would also rise.

These assumptions, rewritten in terms of derivatives and partial derivatives, are summarized as follows in Table 2.

Table 2 Summary of derivative expressions of assumptions

Assumptions	Derivative expressions
(1)	$\frac{\partial D}{\partial P^e} > 0$ $\frac{\partial D}{\partial B} > 0$ $\frac{\partial D}{\partial SP} > 0$
(2)	$\frac{\partial D}{\partial P} < 0$
(3)	$\frac{\partial S}{\partial P} = 0$ $\frac{\partial S}{\partial P^e} = 0$ $\frac{\partial S}{\partial B} = 0$ $\frac{\partial S}{\partial SP} = 0$
(4)	$\frac{dB}{dP^e} > 0$ $\frac{dSP}{dP^e} > 0$

3. Theoretical analyses

This paper attempts to study and analyze the phenomenon of self-fulfilled expectations about the rising Bitcoin price from its birth. As for the price (P) of Bitcoin and the expectation of Bitcoin's price (P^e), the influence of these two variables on each other is theoretically studied under the implicit function theory [4-5].

According to the theory of supply and demand, at the point of market equilibrium, the demand and supply are equal to the equilibrium quantity (Q), and according to the content of implicit function theory, this paper can get functions(1) and (2) as follows.

$$F^1(P, Q, Pe, B, SP) = D(P, Pe, B, SP) - Q = 0 \quad (1)$$

$$F^2(P, Q, Pe, B, SP) = S(P) - Q = 0 \quad (2)$$

3.1 Analysis from price expectation(P^e) to price increase(P)

Check the conditions for the existence of the implicit functions.

① Differentiability

$$\frac{\partial F^1}{\partial P} \frac{\partial F^1}{\partial Q} \frac{\partial F^1}{\partial Pe} \frac{\partial F^1}{\partial B} \frac{\partial F^1}{\partial SP} \frac{\partial F^2}{\partial P} \frac{\partial F^2}{\partial Q} \frac{\partial F^2}{\partial Pe} \frac{\partial F^2}{\partial B} \frac{\partial F^2}{\partial SP} \text{ Are differentiable.}$$

② Jacobian

$$[Jacobian] = \begin{bmatrix} \frac{\partial F^1}{\partial P} & \frac{\partial F^1}{\partial Q} \\ \frac{\partial F^2}{\partial P} & \frac{\partial F^2}{\partial Q} \end{bmatrix} = \begin{bmatrix} \frac{\partial D}{\partial P} & -1 \\ \frac{\partial S}{\partial P} & -1 \end{bmatrix} = \begin{bmatrix} \frac{\partial D}{\partial P} & -1 \\ 0 & -1 \end{bmatrix} \neq 0$$

At the equilibrium, from the total differential of Equation (1), we can get.

$$\frac{\partial F^1}{\partial P} \cdot dP + \frac{\partial F^1}{\partial Q} \cdot dQ + \frac{\partial F^1}{\partial Pe} \cdot dPe + \frac{\partial F^1}{\partial B} \cdot dB + \frac{\partial F^1}{\partial SP} \cdot dSP = 0 \quad (3)$$

$$\frac{\partial D}{\partial P} \cdot \frac{dP}{dPe} + \frac{\partial D}{\partial Q} \cdot \frac{dQ}{dPe} + \frac{\partial D}{\partial Pe} \cdot \frac{dPe}{dPe} + \frac{\partial D}{\partial B} \cdot \frac{dB}{dPe} + \frac{\partial D}{\partial SP} \cdot \frac{dSP}{dPe} = 0 \quad (4)$$

$$\frac{\partial D}{\partial P} \cdot \frac{dP}{dPe} + (-1) \cdot \frac{dQ}{dPe} = -\frac{\partial D}{\partial Pe} - \frac{\partial D}{\partial B} \cdot \frac{dB}{dPe} - \frac{\partial D}{\partial SP} \cdot \frac{dSP}{dPe} \quad (5)$$

At the equilibrium, from the total differential of Equation (2), we can get.

$$\frac{\partial F^2}{\partial P} \cdot dP + \frac{\partial F^2}{\partial Q} \cdot dQ + \frac{\partial F^2}{\partial Pe} \cdot dPe + \frac{\partial F^2}{\partial B} \cdot dB + \frac{\partial F^2}{\partial SP} \cdot dSP = 0 \quad (6)$$

$$\frac{\partial S}{\partial P} \cdot \frac{dP}{dPe} + \frac{\partial S}{\partial Q} \cdot \frac{dQ}{dPe} + \frac{\partial S}{\partial Pe} \cdot \frac{dPe}{dPe} + \frac{\partial S}{\partial B} \cdot \frac{dB}{dPe} + \frac{\partial S}{\partial SP} \cdot \frac{dSP}{dPe} = 0 \quad (7)$$

$$\frac{\partial S}{\partial P} \cdot \frac{dP}{dPe} + (-1) \cdot \frac{dQ}{dPe} = 0 \quad (8)$$

From Equations (5) and (8) in matrix form, we can get.

$$\begin{bmatrix} \frac{\partial D}{\partial P} & -1 \\ \frac{\partial S}{\partial P} & -1 \end{bmatrix} \begin{bmatrix} \frac{dP}{dPe} \\ \frac{dQ}{dPe} \end{bmatrix} = \begin{bmatrix} -\frac{\partial D}{\partial Pe} - \frac{\partial D}{\partial B} \cdot \frac{dB}{dPe} - \frac{\partial D}{\partial SP} \cdot \frac{dSP}{dPe} \\ 0 \end{bmatrix} \quad (9)$$

$$\begin{bmatrix} \frac{dP}{dPe} \\ \frac{dQ}{dPe} \end{bmatrix} = \begin{bmatrix} \frac{\partial D}{\partial Pe} + \frac{\partial D}{\partial B} \cdot \frac{dB}{dPe} + \frac{\partial D}{\partial SP} \cdot \frac{dSP}{dPe} \\ -\frac{\partial D}{\partial P} + \frac{\partial S}{\partial P} \\ 0 \end{bmatrix} \quad (10)$$

According to the assumptions in Table 2, $\frac{dP}{dPe} > 0$. It means that when people's expectations of price increase, the price of Bitcoin will increase.

3.2 Analysis from price increase (P) to price expectation (P^e)

Based on the previous analysis, we focus on the impact of price on the expectation in the backward. Check the conditions for the existence of the implicit functions.

① Differentiability

$$\frac{\partial F^1}{\partial P} \quad \frac{\partial F^1}{\partial Q} \quad \frac{\partial F^1}{\partial Pe} \quad \frac{\partial F^1}{\partial B} \quad \frac{\partial F^1}{\partial SP} \quad \frac{\partial F^2}{\partial P} \quad \frac{\partial F^2}{\partial Q} \quad \frac{\partial F^2}{\partial Pe} \quad \frac{\partial F^2}{\partial B} \quad \frac{\partial F^2}{\partial SP} \quad \text{are differentiable}$$

② Jacobian

$$[Jacobian] = \begin{bmatrix} \frac{\partial F^1}{\partial P} & \frac{\partial F^1}{\partial Q} \\ \frac{\partial F^2}{\partial P} & \frac{\partial F^2}{\partial Q} \end{bmatrix} = \begin{bmatrix} \frac{\partial D}{\partial P} & -1 \\ \frac{\partial S}{\partial P} & -1 \end{bmatrix} = \begin{bmatrix} \frac{\partial D}{\partial P} & -1 \\ 0 & -1 \end{bmatrix} \neq 0$$

So implicit functions exist. At equilibrium, Equations (1) and (2) also hold.

According to the same assumptions, similarly, we can get $\frac{dPe}{dP} > 0$. It means that when the price of Bitcoin increases, people's expectations of the price will increase as well.

4. Conclusions

People's expectation and the price of Bitcoin has a mutually positive relationship. When investors see the price of Bitcoin increase, they expect the price of Bitcoin to continue to rise, and indeed, the price of Bitcoin will hit a new high. In the backward, when the price of Bitcoin hits a new high, investors expect the price of Bitcoin to go up, and indeed, investors' expectations have been fulfilled again. In other words, the fulfillment of self-expectations and the fact that the price of Bitcoin has risen from a positive cycle led to a continuous increase in the price of Bitcoin.

Finally, this article has certain flaws in the premises and assumptions. Considering the changes in supply, the endless price of Bitcoin, irrational growth, and the emergence of alternative currencies, perhaps the price system of Bitcoin will collapse one day, although there are still no such signs. However, this would be our follow-up research direction.

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