

Microeconomic Analysis of Bitcoin Pricing and Establishing Theoretical Conditions for the Possibility of a Bubble or a Crash

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Abstract

Crypto currencies are becoming popular on the digital platform as a medium of exchange and more as a store of value, specifically to satisfy the speculative motive. Bitcoin is one such and the trendiest crypto currency which is in news due to considerable volatility observed in its price in recent times. This paper began by examining the history of bitcoin and questioning whether the volatility in its price is yet another bubble in the making. After distinguishing bitcoin from traditional currencies, this paper examined the process of bitcoin price determination from a pure microeconomic point of view using the popular demand and supply cross diagram as a tool and deduction as a methodology and established theoretical conditions that can lead to a bitcoin price bubble or a crash. Here, the concept of price elasticity of demand and supply is brought into play to understand stable and unstable equilibrium. The paper also debated about the possibility of valuation of bitcoin and warned the governments and investors about the damaging potential of this currency in upsetting their goals with reference to regulation and investment returns, respectively.

Keywords : Bitcoin, bubble, crash, price determination, stable & unstable equilibrium

JEL Classification : D01, D03, D50

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The Bitcoin system is believed to have been created by the mysterious Japanese programmer Satoshi Nakamoto in 2008, whose identity is still to be verified. No one has come forward to stake a claim as its inventor. Bitcoin network is a system of cross-border value transfer for untrusted parties without a centralized authority ; whereas, bitcoin is the unit of account of that system. In this paper, bitcoin has been discussed as a currency rather than a system as a whole. Bitcoin is a crypto currency and like all other crypto currencies, bitcoin is a peer-to-peer programmable digital currency based on an electronic medium. The present volatility in the price of bitcoin has caught the attention of one and all on a global scale. It has gained the status of a celebrity among all financial investment avenues.

Volatility in Price of Bitcoin – Yet Another Bubble in the Making ?

A lot of volatility in the price of bitcoin was observed during the period of October to December 2017. The price of bitcoin skyrocketed from about ₹ 50,000 a year ago to close to ₹ 10,00,000 now (Singh, 2017). Bitcoin gained nearly 1400% since the start of the year (Datta, 2017). The volatility is so large that one is forced to doubt about this upward rally as a bubble. Many experts across the globe have labelled the bitcoin rally as a bubble (Barbora & Vishwanathan, 2017). This volatility reminds one of the famous episodes of Tulip Mania in the seventeenth

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century Netherlands, or dot com bubble of late 1990s in the U.S., or subprime asset mania in the U.S. during the mid 2000s. Alan Greenspan compared bitcoin to confederate money printed by the American South that went defunct at the end of the American Civil War (Pai, 2017). Bitcoin bubble could be the twenty first century Tulip bubble in the making before our eyes.

Bitcoin Versus Traditional Currencies

Bitcoin differs from traditional currencies in the following respects :

- (1)** Bitcoin does not have any physical or material existence as traditional currencies.
- (2)** Bitcoin is a currency without an intrinsic value ; whereas, traditional currencies are fiat currencies with some intrinsic value.
- (3)** Bitcoin is not controlled by either the government or the central bank as is the case with traditional currencies. Only a few countries have given bitcoin a legal regulation as a currency. It is yet to become a national or a global currency in true sense of the term.
- (4)** Supply of bitcoin is limited by the very nature of its software programme from which it can be mined ; whereas, the supply of traditional currencies is unlimited depending upon the discretion of the central bank which issues it.
- (5)** Traditional currencies carry risk of loss in value basically due to inflation. Bitcoin, on the other hand, entails multiple risks in loss of its value. It is prone to attacks from hackers as it is digital in nature. Moreover, price fluctuations in bitcoin can be attributed to unanticipated real and psychological factors at play and lack of regulation.
- (6)** Presently, bitcoin is being used more as a speculative asset than as a medium of exchange. Except for some major global currencies which are used for speculation, the rest are confined to performing the most important functions of money, namely medium of exchange, store of value, and unit of account within the well defined geographical territory.

What Determines the Price of Bitcoin?

According to the previous studies (Buchholz, Delaney, & Warren, 2012 ; Kristoufek, 2013; van Wijk, 2013), bitcoin price is determined by three key factors : (a) supply demand interactions of bitcoin, (b) bitcoin's attractiveness for investors, and (c) global macroeconomic and financial developments. This paper attempts at explaining bitcoin price formation from a pure microeconomic view point using the basic textbook demand and supply framework and fill the gap in this area of research.

- (1)** Traditional microeconomic theory postulates that price of any commodity is determined by the interaction of demand and supply forces. Demand curve is derived from utility preferences of a consumer for that commodity (on the basis of the law of diminishing marginal utility), and supply curve is derived from cost conditions of producing that commodity (specifically marginal cost). This principle cannot be applied to bitcoin on a one-to-one basis because of the following two reasons :
- (2)** On the demand side, in the pure sense of the term, there cannot be any utility schedule as this crypto currency does not have any intrinsic characteristics and ,therefore, intrinsic value. Bitcoin does not have an underlying

value derived from consumption or its use in production processes such as gold. Moreover, being in the nature of a speculative good, it is in all probability likely that buyers will exhibit irrational behavior based on various behavioral biases, acute information asymmetry, limitation of information processing power, and prone to emotions like greed and fear. So, law of demand will get violated for the market as a whole.

(3) On the supply side, it cannot be subjected to either the law of diminishing returns or to the law of returns to scale as bitcoin is not a typical commodity which can be manufactured by converting inputs into output. The supply of bitcoin is restricted. It is based on mathematical algorithms. A lot of power or energy is consumed to mine bitcoins and also to verify each transaction as many high powered computers have to be run to make the required calculations (Datta, 2017). This is what is called mining. Bitcoin's basic supply depends on mining the fixed quantity available. The total number of bitcoins was fixed at 21 million by its creator (Pai, 2017). Secondary supply can be ensured from trading it on various online exchanges. Here, law of supply does work as at an increasing price, higher supply will come forth. Many investors waiting to dislodge their stock of bitcoins will be able to do so at increasing prices, thereby making them earn capital gain.

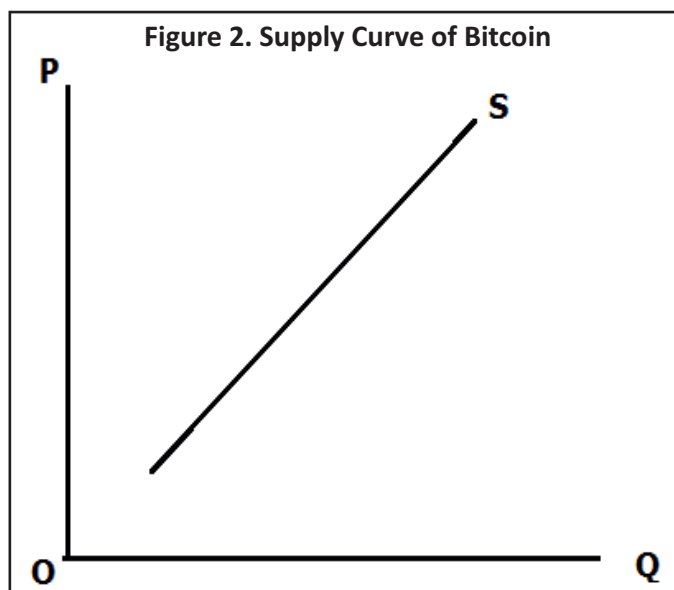
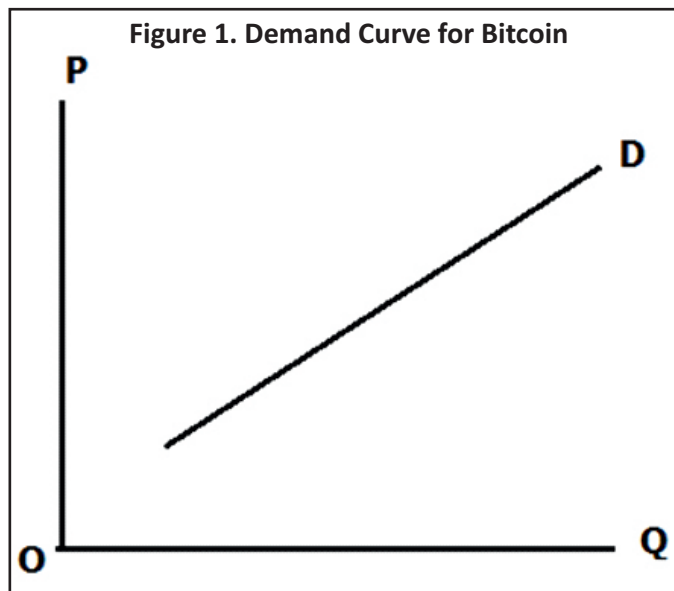
The above discussion makes it amply clear that one has to look for an alternate model for explaining its price determination. It is here that one can peep in behavioral economics to gain some insights that prove helpful to understand the price determination phenomenon in case of not only bitcoins, but all such speculative assets having no intrinsic value.

In case of such commodities, demand-side factors pre-dominate the price determination process. It is basically the preferences of buyers, favorable or unfavorable, that drive the prices up or down. And these preferences are in turn based on various behavioral biases like herding, loss aversion, self-control, overconfidence, confirmation, etc. Moreover, buyers' preferences are also driven by human emotions like fear and greed. Psychology plays a bigger role in driving one's choice of buying or selling such assets.

Nature of Market Demand and Supply Curve of Bitcoin

As discussed in the previous section, it will not be possible to derive the demand curve for bitcoin from utility or any other theory of demand as bitcoin is not a normal commodity. Here, I make a strong assumption that a majority of people in the market for bitcoins exhibit irrational behavior in case of all such assets having no intrinsic value. So, the law of demand will get violated. Due to a number of behavioral biases (like herding, overconfidence, confirmation, etc.) at play along with the greed to become wealthy with the least possible efforts in the fastest possible time, at an increasing price, more of it is demanded in the expectation of further rise in price so as to book profit by selling it at a price higher than the purchase price. On the other hand, when price starts decreasing, biases like herding (in the downward direction) become dominant, and that gets supplemented by emotions like fear. Therefore, less of bitcoins are demanded at decreasing prices in the expectation of further fall in price so as to avoid losses by selling it at a price less than the purchase price. So, a demand curve for bitcoin will be upward sloping as depicted in the Figure 1 (quantity demanded is taken on X axis and price on Y axis; symbols D , S , and P indicate demand, supply, and price, respectively in this and subsequent diagrams in this paper). Irrationality manifested in a number of ways alone is to be attributed for this case of exception to the law of demand.

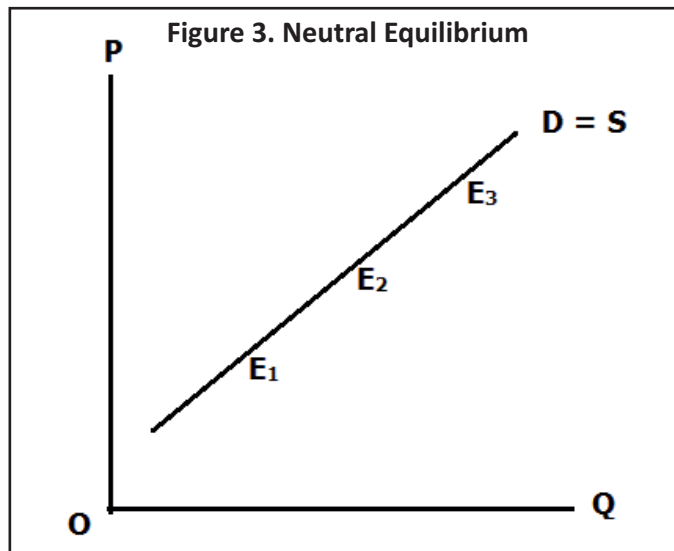
So far, as the supply curve is concerned, it will be upward sloping as at an increasing price, more of it will be supplied by those investors who were waiting for a particular high price level which was their targeted price at which they are willing to offload their stock, full or partial. On the other side, at a decreasing price, less of it will be supplied by those investors basically suffering from loss aversion bias. They will hold on to their stock or offload only very slowly in the expectation of price reversal sometime in the future. This gives us upward sloping supply curve as depicted in the Figure 2.



Deriving Conditions for Stable or Unstable Equilibrium

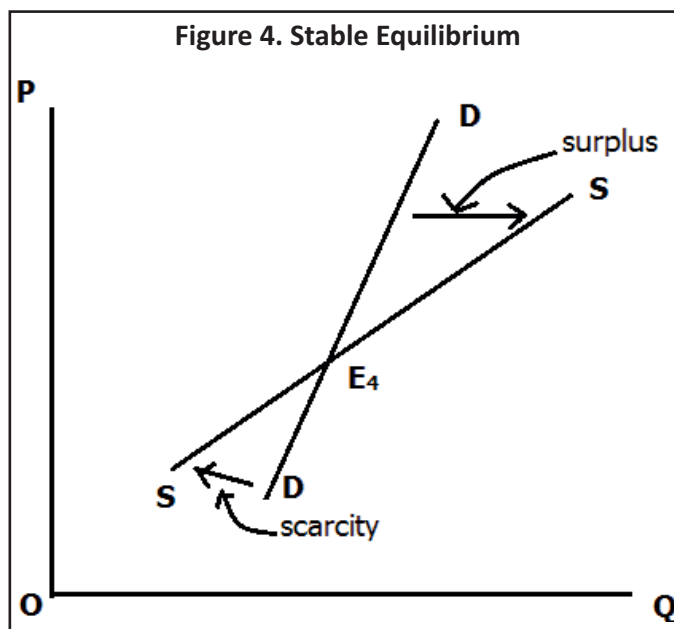
I have used microeconomic framework of price determination to derive conditions for stable or unstable equilibrium. Price of bitcoin will be jointly determined by demand and supply forces. So, we bring together Figure 1 and Figure 2. In this context, three possibilities can arise :

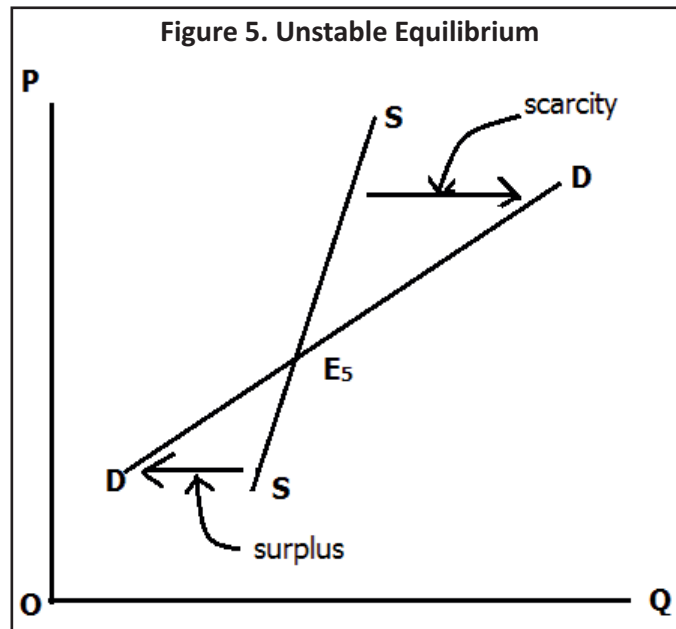
(1) If demand and supply curve coincide, we have neutral equilibrium at each and every point (such as at E_1 , E_2 , and E_3 as depicted in the Figure 3) and the price could go either way. This case is more of a theoretical possibility. As seen in the Figure 3, the slopes of demand and supply curves are equal. That is, price elasticity of demand equals price elasticity of supply. Hence, it can be concluded that whenever the proportionate change in response of buyers to a change in bitcoin's price equals the proportionate response of sellers to such a change in price, we



can arrive at a neutral equilibrium generating uncertainty as to the direction of price movement. It will be very difficult to predict a bubble type scenario or a crash like situation.

(2) If slope of supply curve is less than the slope of demand curve (or, price elasticity of supply is greater than price elasticity of demand), which means that sellers are proportionately more responsive to bitcoin price changes in comparison to buyers, the equilibrium will be stable. There will be a tendency for the market to revert to the initial equilibrium. Any movement away from this equilibrium price therefore cannot lead to a bubble or crash. This is shown in Figure 4. A movement on the upper side of equilibrium point E_4 will lead to a surplus situation (as supply will be greater than demand), thereby initiating a competition among sellers and pushing down the price back to the original equilibrium. If the movement away from equilibrium E_4 is in downward direction, it will initiate competition among the buyers, thereby pushing up the price back to the original equilibrium.





(3) If slope of the demand curve is less than the slope of the supply curve (or, price elasticity of demand is greater than price elasticity of supply), which means that buyers are proportionately more responsive to bitcoin price changes in comparison to sellers, we get an unstable equilibrium. There is a possibility of bubble if price were to increase from the given equilibrium and a crash if price were to decrease from the given equilibrium. Any movement of price above the equilibrium E_5 (Figure 5) will aggravate scarcity ; hence, price is likely to further rise to any extent. Also, the possibility of bubble becomes more pronounced as the price is increasing without the support of fundamentals and improvement in quality of the asset. On the other hand, any movement of price below the equilibrium E_5 will result in surplus, which further drives down the price, the lowest possible price being zero. Such an unstable equilibrium is depicted in the Figure 5.

Does Bitcoin Have Value?

All investments have an underlying asset that has some value e.g. physical property, a useable commodity, or stocks of listed companies. Singh (2017) argued that crypto currencies can have value because, in principle, they are similar to gold and fiat money, which derive their value from factors like status as legal tender, convention, and confidence. I contend that bitcoin may have a price but not value because value of bitcoin is not drawn from anything that is concrete or material. It has no legal backing. The use of bitcoin as a medium of exchange is also very much limited among a small community. Moreover, it has still to gain confidence of many as a stable currency. Datta (2017) asserted that fundamental analysis cannot be deployed to ascertain the extent of overvaluation or undervaluation in bitcoin and other crypto currencies, which are backed by nothing and not linked to any macroeconomic parameter like GDP growth, fiscal deficit, etc. As bitcoin does not have inherent characteristics, it would not be possible to calculate financial parameters such as its net present value using discounting technique as is done in case of business entities.

So, the question of fundamental analysis becomes irrelevant to bitcoin. Technical analysis too cannot be of much help in predicting price movements when there is too much of volatility. Consequently, it would be safe to conclude that it would never be possible to know the true value of any such kind of crypto currency whose use as a medium of exchange is very much limited, and it is basically being demanded to satisfy a speculative motive.

Research Implications

On the basis of the study of the nature of bitcoin as a digital currency, its comparison with traditional currencies and on the basis of the results derived using deduction in this paper regarding the conditions igniting volatility in bitcoin prices, the following can be penned as a warning to different stakeholders of bitcoin:

- (1)** Governments across the globe will have to formulate a policy regulating the bitcoin trading market on the lines of regulating stock exchanges. Theoretical arguments advanced in the paper point to a possibility of crash which can harm many small scale investors, thereby eroding their wealth.
- (2)** Investment in bitcoin can become a haven for the hoarders of black money. Therefore, governments should track all such transactions taking place in bitcoin exchange markets.
- (3)** Investors willing to invest in such type of speculative assets should educate themselves with the theoretical aspects of the characteristics of such markets and monitor the numerical changes in various statistical parameters related to it. As of today, looking at its price volatility, it seems to be a very attractive investment instrument generating very high returns, but the risks are equally high as there is a possibility of crash that can be triggered by any factor.
- (4)** Being a digital currency, it is more vulnerable to cyber attacks, which can easily destabilize the whole Bitcoin system and thus cause more volatile price responses. It needs to be noted here that while bitcoin transactions themselves are protected by blockchain technology, the wallets in which bitcoins are held are prone to attack by the hackers. Moore and Christin (2013) examined 40 Bitcoin exchanges and found that 18 of them had closed down due to cyber attacks. Buyers, sellers, governments, and all other stakeholders should be informed about this fact. Hence, the governments, apart from regulating bitcoin systems, need to ensure setting up of a cyber attack free information technology infrastructure for crypto currencies and related laws punishing the culprits.

Conclusion

The price of bitcoin is basically determined by interaction of demand and supply forces like any other commodity. The only difference being the nature of demand curve, which is upward sloping, is based on the assumption of irrational behavior of buyers. On the demand side, psychological factors like behavioral biases and human emotions play an important role in determining buyers' preferences. Bubble or crash in bitcoin market can very much happen if buyers are proportionately more responsive to changes in price compared to that of sellers. Multiple known and unknown factors can push this market upside to infinite price only to fall later or on the lower side to zero price.

Bitcoin looks like presenting a very lucrative earning opportunity as a speculative asset. It may seem to be giving returns much higher than that promised by stock markets or investment in real estate or gold. However, things are not that rosy as they look at the first sight. Higher return is coupled with equally high risk and uncertainty. Going by the nature of this digital currency, which is not backed by anything whose fundamentals can be measured, without being controlled by a centralized agency and prone to attack by hackers, there are a lot of lessons in store for all stakeholders, most importantly, for governments and investors.

Limitations of the Study and Scope for Further Research

First and foremost, the study focuses only on the role of demand and supply in explaining bitcoin price

determination. Other factors that may influence this phenomenon have been neglected here. A very strong assumption of human beings behaving irrationally has been made in order to derive upward sloping demand curve and thereby explain bubble or crash possibilities. If a majority of human beings in such markets behave rationally, then the theoretical conditions derived explaining upside and downside volatility may not hold good. Researchers in the area of behavioral economics can pick up from here, and on the basis of empirics, prove or disprove human rationality in case of all such speculative assets and also test for the existence of various behavioral biases mentioned in this paper. There is ample of scope for behavioral economists to further elucidate on this theme.

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