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Bitcoin: something seems to be 'fundamentally' wrong

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Abstract

In the present paper we remark that the absence of an intrinsic or fundamental value represents a problem for the stability of the bitcoin's price as an asset. In addition, we consider some financial stability concerns that derive from the hypothesis that the bitcoin will survive as an asset subject to high speculation.

Keywords: bitcoin; fundamental value; financial stability.
JEL Classification: E42, G12, G23

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1 Introduction

Bitcoin is a virtual currency scheme[1] designed by a person or a group of people whose pseudonym is Satoshi Nakamoto. It is a decentralized system (there is no central authority issuing the bitcoin or supervising bitcoin payments) which allows for anonymous transactions by internet. Its protocol, implemented in 2009, is explained in Nakamoto (2008).

Although it has gained some popularity since 2013, several economists have cast doubts on the ability of the bitcoin to fulfill the functions of money and, instead, consider that it resembles more a highly speculative investment (see, for instance, Yermack, 2014).

[1] A detailed analysis of virtual currency schemes can be found in ECB (2012).

The bitcoin can be considered, inter alia, as a medium of exchange or as an asset. As a medium of exchange, the bitcoin has not been supported by any government or monetary authority which weakens its ability to compete with the legal tenders of each country. When the government declares a currency legal tender, although people may want to use other currencies to make transactions, it is easy that the one supported by the government becomes valuable and consolidates as a medium of exchange because the fact that public wages, taxes and public goods and services have to be paid in such currency creates a huge network around it that makes it worthwhile to use.

The lack of support from any goverment reinforces a vicious circle in which the bitcoin is mainly demanded as an asset for speculative purposes rather than as a medium of exchange, thereby generating high volatility in its value, which in turn dissuades people from using the bitcoin as a medium of exchange.[2] Similar to hyperinflation episodes, it is difficult to persuade people to make transactions with a currency that has a significant probability of losing 1 or 2% of its value overnight (of course it can also gain such value and that is why it can be very attractive for speculative reasons).[3] Furthermore, as it has been previously shown (Ron and Shamir, 2013) most bitcoins have been hoarded rather than used for transactions confirming the dominant use of the bitcoin for speculation.

The value of the bitcoin is market-determined. As a medium of exchange, the supply of bitcoins is stable and will be constant approximately from 2030 on. This feature, which has been promoted as a good characteristic of the bitcoin, plays against its role as a medium of exchange since it rules out the possibility of responding to demand shocks with supply movements that help to stabilize the bitcoin's value.

As an asset, the bitcoin supply depends on the willingness of its holders to sell bitcoins at the market price and its demand depends on the willingness of people to buy it at such price.

The present paper sets up a model which points out some particular features of the bitcoin that are relevant for understanding the problem of its value as an asset. In short, we remark that a small or nil intrinsic or fundamental value represents a problem for the stability of the bitcoin's price (as an asset). Although this would not threaten the future of the bitcoin if it were able to gain enough acceptance as a medium of exchange,

[2] Similar views have been previously stated. See for instance The Economist, March 15th 2014 and Ito, 2014

[3] For instance, in 42 of the last 100 days (from 01-Mar to 08-Jun-2014), the bitcoin's price has shown a variation greater than 2% with respect to the previous day.

this situation seems to be highly improbable due to the reasons explained above.

In addition, we consider some financial stability concerns that derive from the hypothesis that the bitcoin will survive as an asset subject to high speculation.

2 A simple model to analyze the bitcoin as an asset

Let us think of a demand-supply model for any asset in the following way. We divide the demand of an asset X (consider that, for instance, X represents famous paintings) into three components. First, an 'autonomous' component, which is independent of the price. This component intends to capture the fact that, no matter the price (at least within a wide range), some people simply want/need to have/use X. Second, a component related to the fact that X provides utility to its holder. Third, a component related to speculative purposes, i.e. the attempt to profit from the fluctuations of the market value of X (for simplicity we assume that the opportunity cost of such investment is zero). The demand equation is as follows:

$$X_t^d = a_{0,t} - a_{1,t}p_t + a_{2,t}\left(E_t^d p_{t+1} - p_t\right) \tag{1}$$

where p_t is the price in period t and $E_t^d p_{t+1}$ corresponds to the expected value in t of p_{t+1} by those who are willing to demand/buy X.

The supply of X has three analogous components: an autonomous component (people who simply need to sell X, no matter the price), a non-speculative component related to the fact that producers of X are encouraged by a higher price and the speculative component.

$$X_t^s = c_{0,t} + c_{1,t}p_t - c_{2,t}\left(E_t^s p_{t+1} - p_t\right) \tag{2}$$

For the speculative component, there is a continuum (of measure one) of agents who extract noisy signals from the market and form their expectations. Each period t a proportion $c_{2,t}$ receives signals from the market such that each of them is willing to sell a unit of X, and the rest of agents ($a_{2,t} = 1 - c_{2,t}$) receive signals that make each of them willing to buy a unit of X.

The market equilibrium ($X_t^d = X_t^s$) yields:

$$p_t = \frac{a_{0,t} - c_{0,t} + c_{2,t}E_t^s p_{t+1} + (1 - c_{2,t})\,E_t^d p_{t+1}}{1 + a_{1,t} + c_{1,t}} \tag{3}$$

which can be written as

$$p_t = \beta_t \left[\alpha_t + c_{2,t} E_t^s p_{t+1} + (1 - c_{2,t}) E_t^d p_{t+1}\right] \tag{4}$$

where $\beta_t \equiv (1 + a_{1,t} + c_{1,t})^{-1}$, $\alpha_t \equiv a_{0,t} - c_{0,t}$. We assume the autonomous factor α_t follows a random walk:

$$\alpha_t = \alpha_{t-1} + \varepsilon_t \tag{5}$$

Each agent i receives a signal $y_{i,t+1}$ on the shock ε_{t+1} (the noise in each signal is assumed to be independent from the others) and constructs a forecast of the shock, that is, $\widehat{\varepsilon}_{i,t+1} \equiv E\left[\varepsilon_{t+1} \mid y_{i,t+1}\right]$. A relatively high (low) value of $\widehat{\varepsilon}_{i,t+1}$ implies that the signal from the market is indicating that the future price may be high (low) with respect to the current one, and therefore such signal makes its receiver willing to buy (sell) X. The signal $y_{i,t+1}$ is independently distributed with mean ε_{t+1}. Consequently, although in a large sample such signal should be unbiased, for a particular period and for the average of agents it can be biased: $\int_0^1 \widehat{\varepsilon}_{i,t+1} di = \overline{\varepsilon}_{t+1}$.

Without loss of generality we can order the forecasts from the lowest to the highest. The lowest will be $\widehat{\varepsilon}_{0,t+1}$ and the highest $\widehat{\varepsilon}_{1,t+1}$. The average forecast that is constructed by those who demand X is denoted by $\widehat{\varepsilon}_{t+1}^d \equiv \frac{1}{1-c_{2,t}} \int_{c_{2,t}}^1 \widehat{\varepsilon}_{i,t+1} di$, and, analogously, for the supply side we use $\widehat{\varepsilon}_{t+1}^s \equiv \frac{1}{c_{2,t}} \int_0^{c_{2,t}} \widehat{\varepsilon}_{i,t+1} di$. For simplicity, we also assume that parameters $a_{1,t}$ and $c_{1,t}$ do not vary over time, and hence $\beta_t = \beta$.

To obtain a solution for the price of X we postulate the following form:

$$p_t = A_\alpha \alpha_t + A_\varepsilon \widetilde{\varepsilon}_{t+1} \tag{6}$$

where A_α and A_ε are constants to be determined. This implies that the agent i's price expectations are

$$E_{i,t} p_{t+1} = A_\alpha \left(\alpha_t + \widehat{\varepsilon}_{i,t+1}\right) \tag{7}$$

and the average expectations for the demand and the supply sides are

$$E_t^d p_{t+1} = \frac{1}{1 - c_{2,t}} \int_{c_{2,t}}^1 E_{i,t} p_{t+1} di \tag{8}$$

and

$$E_t^s p_{t+1} = \frac{1}{c_{2,t}} \int_0^{c_{2,t}} E_{i,t} p_{t+1} di \tag{9}$$

respectively. Then substituting (7), (8) and (9) into (4), we obtain

$$p_t = \beta \left[\left(1 + A_\alpha \right) \alpha_t + A_\alpha \widetilde{\varepsilon}_{t+1} \right]$$

Therefore our postulated form is consistent as long as $A_\alpha = \beta / \left(1 - \beta \right)$ and $A_\varepsilon = \beta^2 / \left(1 - \beta \right)$ and the solution for the price of X is[4]

$$p_t = \frac{\beta}{1 - \beta} \left(\alpha_t + \beta \overline{\varepsilon}_{t+1} \right) \tag{10}$$

Equation (10) allows us to point out two features of the bitcoin that are relevant for understanding the problem of its value as an asset.

1. The existence of a fundamental value ($a_1, c_1 > 0$) serves as an anchor to make Equation (10) to converge to a real solution (i.e. $\beta < 1$). In the absence of these factors, $a_1, c_1 = 0$ and $\beta = 1$, there is no convergence of the equation and one would expect frequent emergence of bubbles as remarked by several economists, including the Nobel Prize winner Robert Shiller.[5] Even if the fundamental value is not zero, if it is positive but small enough a similar result holds. If $a_{1,t} + c_{1,t}$ is close to zero β is close to one and any change in the autonomous factor or in the average market signal will have a huge impact on the asset's price.

   While paintings may give some utility to their holders (or shares give dividends to stockholders), it is not clear what is the utility or the non-speculative profit derived from holding bitcoins. The situation is different if we consider the bitcoin as a medium of exchange but, as explained above, it still seems to be difficult that the bitcoin gets support to be regarded as a convenient medium of exchange.

2. In situations in which the average market signal is negative, i.e.

   $$\overline{\varepsilon}_{t+1} < 0$$

   the size of the autonomous demand factor relative to the autonomous supply factor becomes crucial to avoid that the price may go down to zero. $a_{0,t} > c_{0,t} \rightarrow \alpha_t > 0$. In the case of the bitcoin, the autonomous demand seems to be mainly related to a very undesirable situation: some people use it for illegal purposes

[4] Based on the model's results it can also be verified that, for any agent i in the demand side $\widehat{\varepsilon}_{i,t+1} \geq \overline{\varepsilon}_{t+1}$ and, for any agent k in the supply side $\widehat{\varepsilon}_{k,t+1} < \overline{\varepsilon}_{t+1}$.

[5] See, for instance, http://www.businessinsider.com/robert-shiller-bitcoin-2014-1

because transactions are completely anonymous and they are not subjected to the regulation of any authority, and therefore using the bitcoin (no matter the price) becomes a good way to avoid the law.

As an additional point, notice that Equation (10) shows that a significant part of an asset price volatility can be related to the volatility of noise in the signals. Investors extract signals from information related to the fundamental value of an asset, i.e. the company's balance sheet, the outlook for the sector's production... in the case of the bitcoin it is expected that the noise volatility may be much higher since it is not clear what is the reference information related to the fundamental value.

3 Some Financial Stability Considerations Regarding the Bitcoin

As we mentioned above, there are reasons for not being very optimistic about the consolidation of a decentralized virtual currency such as the bitcoin. However, it results interesting to analyze some of the consequences that an eventual positioning of the bitcoin may bring for financial stability.

For that purpose, let's suppose that the bitcoin (or any other virtual coin) obtains enough public acceptance either as a medium of exchange or as a less liquid asset used for speculative purposes in an economy. In other words, let's assume that a significant number of transactions are done with virtual money or that a significant number of individuals buy bitcoins hoping they can exchange them for more dollars in the future in order to have capital gains.

Let's think about two different situations: one in which there is no bitcoin-denominated debt, and another one in which some debts are denominated in bitcoins.

Under the first scenario, financial stability concerns are less meaningful than under the second one. In both cases, households, firms and banks handle virtual wallets and use bitcoins either for transactions or for speculative purposes. Assuming full convertibility between the dollar and the bitcoin, then they use the dollar (legal tender) to obtain bitcoins (either to make transactions or to speculate), but since there's no bitcoin-denominated debt, banks don't have deposits denominated in such currency. Banks only handle bitcoins for buying goods and services that are paid with this virtual coin, or hold them in their balances as an investment.

In this scenario, macroeconomic stability concerns appear when there are considerable oscillations in the dollar/bitcoin exchange rate. Devaluations of the dollar with respect to the bitcoin, or expectations of devaluation, may induce agents to prefer to accept bitcoins instead of dollars generating additional exchange rate pressures and, eventually, speculative attacks. This concern worsens when we think that expected appreciations of the bitcoin are probably followed by a larger demand for it. Substantial exchange rate movements may affect the willingness of individuals to accept dollar payments, reproducing a situation similar to a hyperinflation.

The main challenge related with financial stability under this first scenario deals with the willingness that agents may have of leveraging their bitcoin holdings. Agents can issue dollar-denominated debt for buying bitcoins if, for instance, they expect an appreciation of this asset. Whenever their expectations result invalid in the future, both their incentives and capacity for repaying such debts decrease, reproducing a situation in which agents appear to be over-indebted. A high enough degree of over-indebtedness may result in a debt-deflationary process which may lead to serious problems related with financial instability. However, as in this first scenario all debts are denominated in dollars, the Fed, the FDIC and other regulatory institutions can respond to situations in where there is an accelerated increase in agents leverage using several policy tools (ex-ante measures such as imposing maximum debt to income ratios, capital surcharges, etc.; and ex post measures such as lender of last resort actions).

Probably the most challenging scenario for financial stability is the second one, relating to an economy in which bitcoin denominated debt is allowed. Let's suppose that one agent borrows a bitcoin from another with the promise of repaying the principal and an interest rate in bitcoins. Let us first assume that credit is not intermediated by formal banks, but through bilateral relationships established between individuals. It would be extremely difficult to impose any regulation over those debts. They would operate as informal credit somehow similar to supplier credit, but denominated in foreign currency. Large exchange rate movements can cause difficulties for repaying bitcoin denominated debts. If the debtor needs to buy bitcoins for repaying his debt, abrupt changes in the price of bitcoins will significantly affect his paying capacity.

Now, let us assume there are formal banks for issuing bitcoin-denominated debt. These banks could be those that are actually established or may also be individuals or coalitions of individuals engaged in borrowing and buying bitcoins as their main economic activity. They accept deposits of small denominations in order to lend to borrowers requiring loans in higher denominations. Regulating and supervising these

banks may be extremely hard for governmental agencies, because these banks may easily be established as shadow banking.

In the absence of a lender of last resort in bitcoins, a generalized fear from depositors could easily lead to bank runs. Sufficiently large bank runs could lead to bankruptcies of several virtual banks. Even in the case in which no traditional banks are involved in bitcoin lending, these banks may result affected from virtual banks' bankruptcies whenever virtual banks use dollar-funding provided by the traditional ones.

4 Conclusion

This paper points out that a small or nil intrinsic or fundamental value represents a problem for the stability of the bitcoin's price as an asset. In the absence of fundamental factors a rational expectations equilibrium for price is not guaranteed. If such factors are small enough any small change in the market's conditions will have a huge impact on the bitcoin's price and one would expect frequent emergence of bubbles as remarked by several economists, including the Nobel Prize winner Robert Shiller.

Some financial stability concerns derived from the hypothesis that the bitcoin will survive as an asset subject to high speculation are also highlighted. In particular in a scenario in which a bitcoin-denominated debt market develops, a generalized fear from depositors could easily lead to bank runs due to the absence of a lender of last resort in bitcoins.

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