

DEPARTMENT OF IMPRESA AND MANAGEMENT
Master thesis in Global Economic Challenges

Bitcoin: A rival to fiat money or a speculative financial asset?

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The Bitcoin system has been capturing a growing interest since its creation in 2009. The virtual currency was initially analyzed in a cryptographic perspective, underling the technical features of this peer to peer electronic cash system. However, the cryptocurrency is nowadays studied as a potential substitute for fiat currency and as a powerful tool to exploit arbitrage opportunities.

Following these phenomena, the thesis covers all the phases that have characterized the Bitcoin history, focusing the research field on the arbitrage opportunities that spread across the exchange platforms.

In chapter one was introduced the concept of virtual currency, contextualizing it into the history of money, in order to demonstrate the evolution in the monetary system caused by the born of new schemes. These are analyzed following the description gave by the European Central bank, focusing on the virtual currency schemes with bidirectional flow. Those are systems that have a direct connection to the real world because, firstly, to hold them it is needed to exchange the cryptocurrencies versus fiat currency. Secondly, it is possible to exchange them back from the virtual world to the real one. Subsequently it's been discussed the ecosystem into which this money operates, trying to delineate some differences with legal money. The preliminaries differences arisen are related to a centralized or decentralized monetary system and to the anonymity of the owner of digital versus fiat currency. In order to give a more specific overview, some virtual currencies have been proposed, of them the most adopted are Bitcoin and Litecoin. Finally it is possible to find an international overview of the legal framework relative to this issue. In fact, many authors stressed how the lack of regulation has attracted fraudulent actors in this market, sometimes engaging Ponzi schemes. It is given a more deep analysis based on the US regulation and to the declaration of the Internal Revenue Service of the US Government that on March 2014 released a guidance on Bitcoin and similar currencies. In their point of view rather than considering those as a form of money, they should be considered as a property, and for that scope taxed as income on the basis of fair market value as of the date of the specific activity.

In chapter two it is given an overview of Bitcoin and on the reason why it is an interesting topic to study. The first element that draws the attention is the meaning of Bitcoin. It is a decentralized peer to peer network, Bitcoin with the capitol "B", but also a unit of that system, with the little "b". To acquire bitcoin the clients can mine it or exchange it for other currencies on various platforms.

In order to perform the transaction in bitcoins, there a two components to look at, one is the Blockchain and the other is the keypairs. The protocol so designed has some advantages, as described in the third paragraph. It is not needed a central institution clearing the transactions so, in the original form, there are not middleman. Therefore the transaction fees are very low and the clients can perform deals anytime anywhere, consequently no cost of transportation or storage and

security are reported. Another point of strength is the anonymity of the transaction, which is, however, verifiable in the blockchain. Moreover in the merchants standpoint the transaction are not reversible. A strong point is also the possibility to fight against inflation, being a finale cap on the total amount of bitcoin that can be issued (21 million until 2140).

Certainly the system has also some disadvantages stressed in the second paragraph of chapter two. One is its the price volatility, being the market illiquid and being affected by network effect it is possible to see sharp fluctuations from one they to the other. Another point studied by Moore and Christin (2013) is the security risks, which led to the shutting down of the exchanges for insolvency. More technical are the delayed confirmation time and the double spending problem, that, however, the community is trying to fix. Mentioned as an advantage the finite supply, for some authors, can create, on the contrary, a likely deflationary spiral, but the adoption of the currency is not yet so expand to test this hypothesis. A limit in the use of Bitcoin as a financial asset is the absence of a derivative market and so the possibility to hedge investor's position against bitcoin rises and falls. Nevertheless in the market have appeared futures contracts for the purpose aforementioned.

To better understand how it is possible to classify Bitcoin the chapter holds on studying its uses as medium of exchange and store of value, citing the report of Bank of America Merrill Lynch. It is evident that bitcoin is getting the mainstream as means of payment for the aforementioned advantages in its usage. While it is not easy to assess whether it is also a store of value. The Nobel prize Paul Krugman (2013) underlined how the instability in the Bitcoin price and so its uncertain value destroy the store of wealth function. The conclusion is that for now it cannot be considered for that application. But this led the discussion toward the identification of this form of currency as money or not. In an Austrian school perspective, Bitcoin can be considered as money, and many authors see in the monetary theory of Friedrich von Hayek (1976) the inspirer of the system. Anyway it lacks in stability and durability of value. At the end it is defined as a transactional currency. Many are the differences between Bitcoin and money, for how it was created and developed, for how it is spendable and for how it is manage in a monetary policy point of view. So Bitcoin has to be considered an asset rather than money.

The research study of the thesis is centered around the different price of Bitcoin in the exchanges and so to the arbitrage opportunities that investors seek on the currency platforms. Especially the model presented tries to delineate the reasons of this spread scrutinizing different variables. At this aim the third chapter reports firstly the arbitrage opportunities that can be exploited in the market, as the statistical, interest rate and currency arbitrage to then focalize the work on the specific virtual currency conditions.

Moreover, the study is presented. It begins by collecting historical data on the Bitcoin exchange rates maintained by the website bitcoincharts.com. This includes the daily trade volumes and weighted daily price for 49 Bitcoin exchanges converting into 22 currencies for six months until April 1, 2014, when the data collection was made. It has to be noticed that Mt.Gox exchange is not part of the database due to its closure on February 2014.

All the different currencies were converted into dollars, at daily exchange rates, because the USD market is more liquid than the other markets and for this reason there is more space for arbitrage opportunities. Another reason behind the choice of the dollar is that the benchmark platform (Bitstamp.net), that will be used to calculate the spread among the websites, trades especially in dollars. Where the data were not available, because the websites suffered an attack, in those days both the daily volume and the average weighted price were calculated as the mean of the day before and after the hacker attack. Concerning the average daily transaction volume, made in bitcoin, bigger exchanges are more homogeneous in the price traded for each bitcoin. Thus an increment in the volume traded by the smaller exchanges makes that possibility of scalping lower. Therefore the alignment in the daily volume traded in the exchanges, implies a similar alignment of the prices between those actors.

The other independent variable analyzed for the study is the exchange rate at which each currency related to a platform, and so exchanged versus Bitcoin in the first place, is traded versus dollars. Regarding the percentage variation of each most traded currency (FC. foreign currency) in each platform versus US dollars, the formula used for the calculation is $\Delta E_{\$/FC} = [(E_{\$/FC\ t+1} + E_{\$/FC\ t}) / E_{\$/FC\ t}]$.

Furthermore the analysis is built in order to assess whether the inflation rate of the country, which issues the most traded currency of the platform, is linked to the discrepancies in the Bitcoin price.

Say that Mercado Bitcoin is an exchange, which trades bitcoins (BTC) versus Brazil Real (BRL). Firstly, given the fact that the data about this platform are not in dollar it is used the daily exchange rate of the BRL/USD to have all the values in the same unit of account. Therefore it was calculated the variation of the BRL during the period considered to identify eventual relations between the Bitcoin price in this venues and in Bitstamp.net. If there are connections this may mean that Bitcoin is used in a triangular arbitrage.

Regarding the inflation rate variable in the case of Mercado Bitcoin was analyzed the inflation rate of the Brazil, all the data relative to the inflation rate are of the last quarter of 2013. If the most traded currency in the exchange is not linked to the physical place where the platform is incorporated, then the inflation rate has been linked to the country that issues it, not to the place where the platform is based. For instance Bitfinex.com is incorporated in the British Virgin Island

but on the website it is possible to exchange bitcoins for dollars. In this case the inflation rate used was the one of the United States; the same happened for TheRockTrading.com, which is a Cypriot company but trades mostly in dollars.

Other independent variables have been subject of the analysis, nevertheless those variables were not correlated to the spread and for the same reason are not included in the final result. Those were the transaction fees of the exchange, the number of breaches suffered by the platform and the extent to which the exchange's jurisdiction has implemented "Anti-Money Laundering and Combating the Financing of Terrorism" (AML) international standards. The data related to the transactions fees were collected on each platform and each time the platform guarantees a different fees on the basis of the volume traded, the resulting transaction fees for the model was calculated as the mean of the highest and the lower one. The reason why this variable is not significant for arbitrage aim could be that fees are low and almost the same in all the trading venues analyzed so under this circumstance this cannot be considered an explanatory variable of the spread. But it was likewise important as result because if the transaction costs are low, identical items should be traded at almost the same prices. Instead the law of one price does not hold every time in this market, so there must be something else. With regard to the security breaches the scrutiny was based on the bitcoincharts.com and then confirmed by the Bitcoin community and forums. In this case it was expected that more security breaches the exchange suffered, less attractive this could be for investors and so the owner should guarantee more profit due to the lower safety measures. But also this variable is not considered significant because in the Bitcoin market the target of the hackers are mostly the bigger exchanges, while the smaller, when suffered such attacks, are forced to close because they do not have the liquidity to repay the wallet stolen. So the hacker attacks generate a different phenomenon but not the one of the different prices in different exchanges.

Finally, to assess regulatory impact, the study attempted to identify the country where each exchange is based. Then it is used an index (ranging between 0 and 49) computed by World Bank economists to identify each country's compliance with "Anti-Money- Laundering and Combating the Financing of Terrorism" (AML-CFT) regulations. The AML index has not able to suggest the reasons of platforms differences, probably because it is linked to the physical place where the exchange is incorporated and so it is not interesting for the scope aforementioned.

Then the main part deals with the construction of the regression model to the extent to describe the hidden drivers of the bitcoin prices differentials across platforms:

$$\text{Spread} = \alpha + \beta \text{Log}(\text{Daily vol.}) + \beta \Delta\% \text{ exchange rate} + \beta \text{inflation rate} + \varepsilon$$

It is hypothesized that trading volumes, inflation rate and exchange rate are related to the price for which a bitcoin is sold in different exchanges. The model has the following null hypothesis:

- 1) In the population there is no relationship between the volume and the spread controlling for exchange rate variation and inflation rate.
- 2) In the population there is no relationship between the exchange rate variation and the spread controlling for volume and inflation.
- 3) In the population there is no relationship between inflation rate and spread controlling for volume and exchange rate variation.

The multiple regression yields the following results:

Spread	Coef.	Std.Err.	t	P>t
Log.(Volume)	-9.380**	4.705	-1.99	0.049
$\Delta\%$ E\$/FC	-5.891***	1.231	-4.78	0.000
Inflation rate	452.397**	236.526	1.91	0.050
_Cons	25.040**	10.733	2.33	0.024

N.of obs.	F(3,44)	Prob>F	R-squared	Adj. R-squared	Root MSE
48	22.29	0.0000	0.6032	0.5761	33.106

The results of the model show how it is possible to reject the null hypothesis for all the three explanatory variables.

The t-test shows relative low p-values for the independent variables volume, exchange rate and inflation rate. Moreover the coefficients explain the way to which those variables affected the responses variable spread.

The daily volume has a negative coefficient meaning that as the volume traded by a platform increases, the spread between the platforms decreases. That happened for two different reasons. One is that an increase in the daily volumes can be generated by a network effect so individuals after a positive or a negative news act on big platforms, leaving the small platforms reacting on price movements slowly. But another reason is that to exploit a successful arbitrage strategy, the investor will buy where the price are low to sell the same currency on platforms where the price are high. The movements in supply and demand in the long-term generate a balance between bid and ask price on the platforms used to trade, flattening the price differentials.

Vis-à-vis the variation in the exchange rate, it is noticed that when it increases the spread decreases, because the coefficient is negative. Definitely when the variation increased this means that there is a depreciation of the foreign currency (FC). The foreign currency is the one traded in a different value than dollars. Thus the value of the bitcoin has strengthened, because investors will buy Bitcoin to exchange the foreign currency into dollars to purchase goods in the latter currency rather than in the depreciated currency. In this context Bitcoin is used as both a means of payment and a financial asset.

Therefore the difference between the benchmark exchange, which trades in USD, and the one of the depreciated currency will be lower, because the price of bitcoin in the depreciated foreign currency will approach the price in the benchmark platform in dollars.

Finally the coefficient of the inflation rate is positive. This is the most important evidence of the study because highlights the possible use of the currency as a store of value in country that fight against hyperinflation. The relationship is the follow as the inflation rate increases the spread increases as well, amplifying the distance between the price quoted by a platform which trades a currency of a country with high inflation and the one that trades currencies of stable countries.

The analysis has of course some point of weaknesses. Firstly the time series is of only six months (4 October 2013- 4 April 2014). The choice of this period was determined by the limited amount of the same exchange platforms in longer periods, for the high turnover in the exchanges. A lot of exchanges are opened only for few months while other shut off after a long activity, as Mt.Gox. But if the bitcoin market will continue to stabilizing, then an analysis of more periods will be feasible, thanks to more actors that will be able to remain in the market.

Furthermore the analysis can have a bias because are analyzed both intra-platforms and inter-platforms prices. Nevertheless the former are connected to the website Localbitcoins.com, that shows the exchanges for the major currencies in circulation.

For further analysis could be also interesting to analyze more in detail the relationship between the inflation rate and the bitcoin prices movements to stabilize the store of value role of this currency, in order to scrutinize whether in the future it develops as money.

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