UNDERGRADUATE RESEARCH

Do Major Currency Trading Volumes Explain the Rise of Bitcoin's Price?

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Abstract

We examine the determinants of the Bitcoin price over the period from September 2012 to September 2017. Unlike conventional currency demand models, trading volume is negatively related to the Bitcoin price and the frequency of Internet searches for the term Bitcoin is positively associated with the price. We find strong and significant time trends in the Bitcoin price. These results suggest that the rise in Bitcoin's price during our observation period was driven largely by speculation.

JEL codes: A22, E42, F33, F65, G41

Key words: Bitcoin, cryptocurrency, speculation

Introduction

Near the end of 2017, Bitcoin's exchange rate to the United States Dollar was 1BTC = $4,255USD. In the previous year, the price of 1BTC was $623.19USD, approximately a 583% increase. Subsequently, the Bitcoin price soared to around $20,000 on December 16, 2017, then precipitously declined to about $7,000 on February 5, 2018, when trading volume peaked. The extreme magnitude of these investment gains motivated us to investigate the factors underlying the Bitcoin phenomenon.

In 2009, one or more programmers using the alias of Satoshi Nakamoto created Bitcoin, a digital fiat currency that can be exchanged peer to peer without the need for a financial intermediary. Individuals all over the world invested in Bitcoin even as many analysts claimed that it was entirely speculative, inhabiting a bubble analogous to the Dutch Tulip Mania. Others claim Bitcoin may become the global currency of the future due to its decentralized nature, anonymity, protection from local currency instability, and low transactions cost.

Some attribute the rise in Bitcoin's price level to scarcity as a fundamental element of Bitcoin's code. The total supply of Bitcoin is limited to 21 million coins and the software imposes the restriction that over time a decreasing quantity of coins can be mined until the 21 million

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capacity has been reached.[2] The implementation of scarcity mimics the economic behavior of traditional commodities like gold.

We examine monthly Bitcoin prices from September 2012 to September 2017. We find that the price is negatively related to U.S. trading volumes and positively related to Internet searches for the term Bitcoin. There is also a strong nonlinear time trend in prices over this period. We conclude that the results are consistent with a speculative motive for movements in Bitcoin prices.

The following section reviews the empirical literature on Bitcoin prices. Then, we lay out our estimation strategy. Next we discuss the data, followed by the results. The final section offers a conclusion.

Literature Review

Due to the recent inception of Bitcoin, and its even more recent mainstream adoption, econometric analysis of its determinants is somewhat sparse. The bulk of discussion revolves around determining Bitcoin's status under traditional definitions of currency. Kubat (2015) examined volatility rates among Bitcoin, gold, the Euro, and Apple stock, attributing excessive volatility to Bitcoin and concluding it does not meet the criteria as a store of value against traditional assets. Similarly, Yermack (2013) found that Bitcoin is much more volatile than fiat currencies and uncorrelated with them. Dyhrberg (2016), however, found that Bitcoin volatility is similar to that of gold and the U.S. dollar, suggesting possible hedging capabilities and advantages as a medium of exchange.

Beyond the issue of volatility, the academic literature finds that traditional macroeconomic variables may correlate with Bitcoin's price. Puri (2016), for example, examined country specific inflation rates, unemployment rates, industrial production, and money supply as determinants of Bitcoin prices, concluding that inflation alone was statistically significant. This is consistent with using Bitcoin to hedge against risk in other currencies. Increases in inflation should correspond to more demand for Bitcoin and therefore a higher price.

Zhu, Dickinson, and Li (2017) found that the CPI, the Federal Funds Rate, and a USD Index negatively influenced Bitcoin over the long run. The negative correlation of the USD Index and the Federal Funds Rate to the Bitcoin price is consistent with economic theory. If the dollar has been gaining strength, investors want to hold dollars when Bitcoin is stagnant or going through a price correction due to over valuation. Even though these variables may negatively affect the Bitcoin price, Bitcoin's value has skyrocketed against the dollar. Observing a negative relationship between CPI and Bitcoin, as Zhu, et al. (2017) do, seems contrary to logic, but they grouped the data for CPI, Federal Funds Rate, and USD Index together since their trend-lines move in the same direction, thus eliminating the confusion.

Even though the literature points to macroeconomic variables as factors in the price of Bitcoin, the influence of speculative factors outweighs them. Bianchi (2018) finds that returns on cryptocurrencies (of which Bitcoin is one) are significantly correlated with returns on commodities such as gold and energy, but that macroeconomic factors do not significantly drive trading activity.

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[2] The limit is set by the technical details that established bitcoins. Every new block that is "mined" initially releases 50 new coins, but this quantity halves every 210,000 blocks. The limit of the resulting geometric series is 21 million. The founders apparently wished to limit the number to prevent a situation of an issuer, such as a central bank, debasing the cryptocurrency by issuing more of it for its own profit.

Kristoufek (2015) found a link between internet interest (searches for the term "Bitcoin") and Bitcoin's price. During bubble formation, internet interest boosted the Bitcoin price further, while during the bursting of a bubble, it pushed Bitcoin prices lower. Puri (2016) also examined global internet searches and downloads of Bitcoin Client (necessary to hold and trade coins without an exchange) discovering that they are significantly positively related to the Bitcoin price, although the effect fades over time.

From the literature, we hypothesize that Bitcoin's price should be positively correlated with variables such as Google search trends, Wikipedia search, Bitcoin Client downloads, and blog posts, because society has not fully adopted Bitcoin, leading to an extremely volatile demand. As the average number of individuals holding Bitcoin rises, the long run demand for Bitcoin should stabilize. The increasing holdings of Bitcoin by the general public may reflect the experience of the 2008 financial crisis, Greek economic instability, and global conflicts. Avoiding currency failures by holding Bitcoins should be attractive for individuals who suspect that another such incident is imminent, similar to an increase in the demand for gold following a financial crisis or an economic recession.

Estimation Strategy:

We utilize a log-linear regression equation to determine the significance of several variables in explaining Bitcoin's price, as shown in the following equation.

$$\text{Ln(Bitcoin Price)} = b_1 + b_2\,\text{Ln(USTV)} + b_3\,\text{Ln(JPTV)} + b_4\text{Ln(CHTV)} + b_5\text{Ln(BTR)} + b_6\text{DMG} + b_7\text{T} + b_8\text{TS}$$

USTV, JPTV, and CHTV represent the monthly trading volume on Bitcoin exchanges in U.S. Dollars, Japanese Yen, and Chinese Yuan. Increased activity in certain exchanges could imply arbitrage similar to the global currency exchange. Which coefficients show the most significance will indicate which currencies' exchanges contribute most to Bitcoin's price.

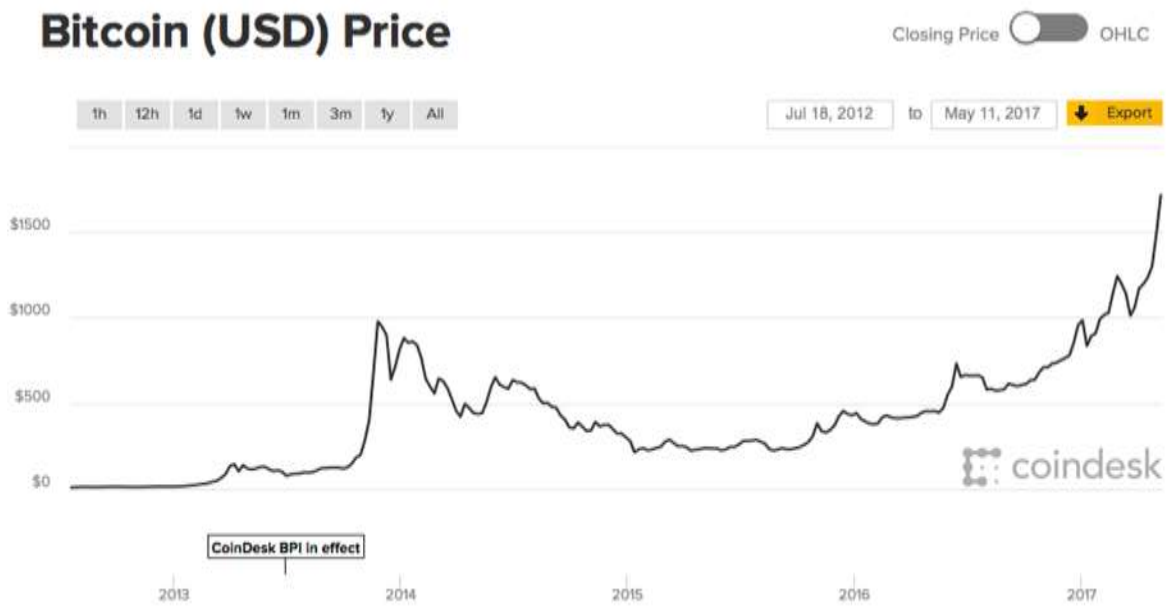
BTR is an index for Google searches for the term Bitcoin. Values are from 0-100 with zero being the fewest searches and 100 representing the highest. Bitcoin was obscure from 2009-2013, just on the periphery of most Americans' perception. From 2013 onward, especially in 2016 and 2017, Bitcoin moved to the mainstream as casual investors took notice. If more individuals are researching Bitcoin, there is a high probability they are also purchasing it, leading to higher demand and price. We expect that an increase in searches for Bitcoin leads to a higher Bitcoin price.

DMG is a dummy variable representing the time period after an incident in which the largest Bitcoin exchange at the time, Mt. Gox, mishandled customers' Bitcoin accounts. Although negative, this event was one of the first times Bitcoin received coverage by mass media. We suspect that this actually increased interest in the asset as the media coverage exposed ordinary citizens to Bitcoin. Despite the negative coverage, an immediate sell off created an opportunity to get cheap Bitcoin.

T is a time trend variable. As time moves forward, more individuals are open to the concept of Bitcoin, perhaps increasing its price. Any trends caused by left-out variables also are captured here. Despite the big dip in price from the Mt. Gox incident, Bitcoin's price has consistently risen as time has moved forward.

TS is the time trend squared. This will capture any nonlinear changes over time caused by left-out variables. Bitcoin's price exhibits growth that appears to be non-linear. Bitcoin's price has

not risen gradually over time, but by huge increases in short amounts of time not seen by other investments, as shown below.



Data

The data are a time series beginning in September of 2012 and continuing monthly until September 2017 for a total of 61 observations. The data sources are shown in the following table.

Variable	Source
BTCP	https://data.bitcoinity.org/markets/price/30d/USD?r=day&t=l
USTV	https://data.bitcoinity.org/markets/volume/30d/USD?t=b
JPTV	https://data.bitcoinity.org/markets/volume/all/JPY?r=month&t=b
CHTV	https://data.bitcoinity.org/markets/volume/all/CNY?r=month&t=b
BTR	https://trends.google.com/trends/explore?date=all&q=bitcoin

The following table shows descriptive statistics for all variables. Note that the Bitcoin price is in thousands of U.S. dollars. Subsequent to our data period, the Bitcoin price rose to $20,000 on

December 16, 2017, then precipitously declined to about $7,000 on February 5, 2018, even though trading volume simultaneously peaked.

Variable	Mean	Min	Max	SD
BTCP	5.765	2.424	8.328	1.346977634
USTV	14.49	13.31	15.66	0.488549776
JPTV	10.89	2.427	13.714	2.107027793
CHTV	14.941	9.719	18.969	2.518556708
BTR	2.7729	.6931	4.6052	0.81312459
DMG	.7049	0	1	0.459864556
T	31	1	61	17.75293403
TS	1271	1	3721	1135.60511

Results

All statistical analyses were performed using the R statistical package. The initial regression in log linear form yielded the following results:

Coefficients	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	7.8694318	0.9759560	8.063	8.87e-11
USTV	-0.4846286	0.0671618	-7.216	2.03e-09
JPTV	0.0192558	0.0247529	0.778	0.440075
CHTV	-0.0203009	0.0261812	-0.775	0.441551
BTR	1.2570245	0.0544192	23.099	< 2e-16
DMG	0.3607715	0.1967867	1.833	0.072375
T	0.0789097	0.0193844	4.071	0.000157
TS	-0.0009246	0.0002296	-4.028	0.000181

R-squared: 0.9752, Adjusted R-squared: 0.9719, F: 297.3 p-value: < 2.2e-16

The Breush-Godfrey test for autocorrelation produced a p-value of .3584, such that the null hypothesis of no autocorrelation could not be rejected. Consequently, no correction for autocorrelation was made.

Coefficients	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	7.8931097	0.9145548	8.631	8.28e-12
USTV	-0.4853586	0.0665816	-7.290	1.26e-09
BTR	1.2458930	0.0500234	24.906	< 2e-16
DMG	0.2968465	0.1532821	1.937	0.0579
T	0.0734610	0.0122340	6.005	1.58e-07
TS	-0.0008159	0.0001493	-5.464	1.16e-06

R-squared: 0.9747, Adjusted R-squared: 0.9724, F: 423.2 p-value: < 2.2e-16

The variables CHTV and JPTV were dropped for lack of significance and a restricted regression was run on the remaining variables as shown above. A Restricted Least Squares F-test gave a p-value of 0.5872 that was insufficient to reject the null hypothesis that the R-squares of the two regressions were equal. By Ockham's razor, we prefer the restricted regression. All coefficients are significant at the 1% level, except for the dummy, DMG, significant at 10%.

The dependent variable and the explanatory variables USTV and BTR were run in log form such that these coefficients represent relative percentage changes $\%\Delta Y/\%\Delta X$. The rest of the explanatory variables (DMG, T, and TS) were run as integers, so these coefficients represent an average rate of change.

The USTV coefficient shows that for a 1% change in U.S. Dollar trade volume the Bitcoin price drops by about .48%. This is consistent with economic theory, because if speculative factors are causing the price of Bitcoin to rise, then U.S. investors may hold, but not buy, Bitcoin at high prices, then cash out as the price falls. U.S. buying does not begin again until the price has fallen. This behavior would generate an inverse relationship between trading volume and price. The shortcoming to this variable is that trade volume and Bitcoin price are only represented by transactions on exchanges; peer to peer transactions are not counted.

The coefficient for BTR, Bitcoin search trend data, is significant at less than 1% and shows that for a 1% increase in Google searches for the keyword Bitcoin, the Bitcoin price rises by about 1.25%. This result indicates that the Bitcoin market is driven by mere interest, rather than more substantial factors. The results for USTV are consistent with this, because if the price was driven by U.S. demand, then USTV should have a positive coefficient.

The coefficient for DMG, the dummy variable for the period after the mishandling of Bitcoin by Mt.Gox, is significant at 10%, but very close to the 5% level. The coefficient indicates that after the incident, there is a one-time increase of about 30% in the Bitcoin price. This result is compatible with the view that the incident boosted the popularity of Bitcoin by exposing everyday citizens to it, even though it was bad press on the largest exchange at the time.

The time trend (T) and its square (TS) were significant at less than 1% and their signs indicate that the Bitcoin price is increasing at a decreasing rate, other things equal. This complies with economic theory, because when the price of Bitcoin is low, more people will buy, and this will drive the price up over time. As the price continues to rise, buying slows as investors begin to fear that its price may tumble. To the extent this price rise over time is independent of real economic factors, it may indicate speculative behavior.

Conclusion

The results indicate that the rise of Bitcoin's price is highly speculative. Upon starting this study, we expected the trade volume for major currencies to be significantly related to Bitcoin's price, but the results indicate that social forces play more of a role. When this study began on September 19, 2017, the price of one Bitcoin was $4,255. Upon completion of the study on December 7, 2017, the Bitcoin price stood at $16,260. Given this magnitude of return to investment in Bitcoin, the academic economic community should focus on thoroughly analyzing the potential determinants of Bitcoin's price.

The main issue with the validity of Bitcoin as a currency is that many people do not use it to purchase goods, but simply hold it in the expectation that it will become more valuable. Since the value has been increasing, many people have decided it must be a sound investment, even though they may not know what they are purchasing and do not use it as a medium of exchange.

This econometric study does not account for all the possible determinants of Bitcoin's dramatic price increase. In the future, it would be worthwhile to examine the trade volumes across all currencies as well as the number of Bitcoins in circulation to confirm that traditional indicators of demand are affecting the Bitcoin price. It would also be interesting to gather daily data so as to have more observations.

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