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Article

What Drives Bitcoins? A Comparative Study of Bitcoin Prices and Financial Asset Classes

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Florian Bartholomae and Pierre Rafih

What Drives Bitcoins? A Comparative Study of Bitcoin Prices and Financial Asset Classes

Eleven years after its introduction, Bitcoin is still around. While its future remains uncertain, the digital token trades at a value of about EUR 8,000, unsecured by any asset, unbacked by any institution. In so far as there is no fundamental driver of the value of Bitcoin and after many scandals and criticisms related to technical, financial, behavioral and even ecological issues, it remains remarkably resilient in a digital age of transparency and readily available information, where tweets and rumors may have enormous effects on the financial markets. The announcement of Libra (Libra Association Members 2019), a corporate digital currency to be introduced in early 2020 by a large consortium of international companies under the leadership of Facebook, including other leading corporate global players, has been followed by a surprisingly sustainable price rally in Bitcoin, when some expectations are that Libra could eventually spell Bitcoin's end.

The discussion about the nature of Bitcoin remains open. It is currently not possible to classify Bitcoin in an existing category of instruments. While it is decidedly a cryptocurrency, this category itself encompasses a broad range of instruments who, by design and intended purposes, range from near-equity participative tokens, over so-called smart contract platforms to digital currencies and quasi-currencies. We also agree with many authors that, while being called cryptocurrency, it does not necessarily display the range of attributes and characteristics that traditional national or supranational currencies – commonly referred to as money – display (Lo and Wang 2014). A recent study conducted between July 2010 and June 2015 concludes that Bitcoin does not display characteristics of “a traditional asset class including currencies” (Baur et al. 2017, 187). Within this paper, we will not address the discussion about the nature of Bitcoin. Nevertheless, we concur with the observation of usage patterns of Baur et al. (2017)'s, which is reflected in the judgement of international monetary institutions such as the IMF or the ECB, who, at this time, do not see any neces-

sity to regulate Bitcoin as they do not consider it to be a currency. While Bitcoin does not fit in any ‘traditional asset class’, it can at least be said that it is a form of financial asset.

The purpose of this paper is to address Bitcoin purely as a financial asset, not a currency, and to contribute to answering the question of what factors drive Bitcoin prices. We want to compare and correlate the historical relative price volatilities of Bitcoin with those of a small selection of representative global financial market indicators for different asset classes, to try and assert whether similarities in patterns are recognizable that can help take a step in the direction of understanding the nature of Bitcoin as a financial asset, inspired by previous work. This approach differs from other recent studies who address Bitcoin volatility using GARCH models (Katsiampa 2017) or analyze the price volatility attributable to speculative trading (Blau 2018) or trading volumes (Balcilar et al. 2017). To complement the study, we include a comparison of Bitcoin and the financial indicators with a non-financial sentiment index and a public interest indicator. Thus, the structure of the paper is as follows. After a description of the considered variables, the results of the analysis are presented. Finally, the last section concludes and refers to future research opportunities.

DESCRIPTION AND SELECTION OF VARIABLES

This paper focuses purely on an empirical study of 79-months long time series beginning in January 2013 and ranging to July 2019. While the last dataset was determined by the availability of information for all included variables, we chose to start no earlier than January 2013, despite information being available for all figures up to Bitcoin's introduction in January 2009, for several reasons. The first is that prior to 2013, Bitcoin was largely an unknown to the financial community and the broad public. The resulting very low trading volumes and illiquidity make a comparison with highly traded and liquid financial assets inappropriate. In 2013, Bitcoin was first introduced in popular acclaimed media such as TED.com (Kemp-Roberston 2013) and public interest, as measured by internet search queries of the term as computed by Google trends, also rises significantly by a factor of 7 to 12 over the course of that year (Google Trends 2019). That same year saw the first announcement of a hedge fund starting to invest in Bitcoin (Matonis 2019). The year 2013 also saw the biggest year-to-year price jump in percentage terms, nearly three times as high in relative terms, as the highly media-covered price rally over the course and to the end of 2017.

Figure 1 shows the study period within the dotted-line rectangle. Using a concept made popular by Gladwell (2002), it would seem that, in many respects, 2013 constitutes a tipping point for Bitcoin.

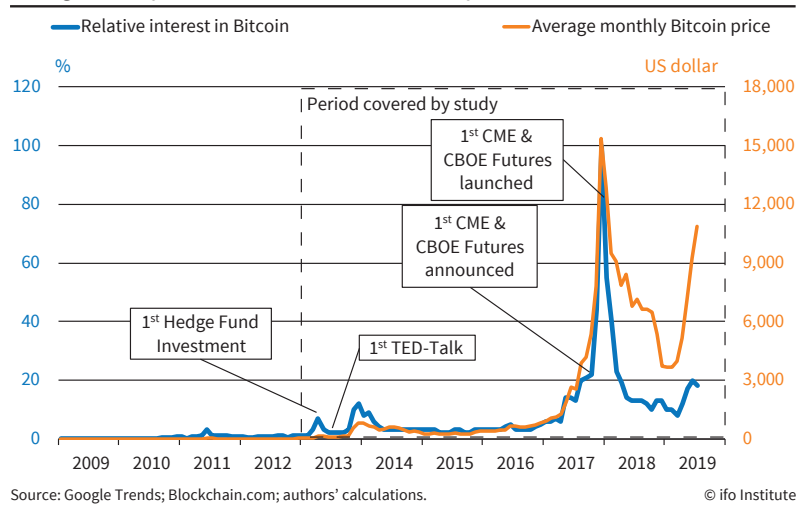


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Figure 1
Average Monthly Bitcoin Price and Relative Monthly Interest in Bitcoin



We chose to use monthly averages of the Bitcoin price for several reasons. On the data side, this allows for better comparison with some of our independent variables. However, more importantly, using monthly averages rather than monthly or daily closing prices for the financial variables reduces the effect of the endemic wash trades that are characteristic in the Bitcoin market (Scheider 2019) and would create a bias in valuation through artificially driven short-term price volatility. Since the independent variables are all traded on strongly regulated and monitored markets, which essentially preclude wash trading, diffusing such effects is a legitimate foundation for comparative studies of any kind. Monthly averages also reduce the impact of known turn-of-the-month (Kunkel 2003), window-dressing and other seasonal effects (Cadsby 1992) that are common and documented occurrences in classical financial asset trading.

Besides the development of Bitcoin prices, Figure 1 also depicts the development of the relative interest in Bitcoin over time, an indicator of public interest computed by Google using search queries in the internet. The Media Buzz value is based on the interest in Bitcoin as computed by Google Trends. It represents the relative interest in Bitcoin over time, the monthly value derived from search queries of the term in the internet. This value is always between 0 and 100 for any number of observations. It is here computed on a monthly basis, where the value 0 represents months in which there are either no or only very few research queries. The value of 100 represents the month in which the term 'Bitcoin' was researched most over time. This indicator is thus a relative value.

To account for the global distribution of the Bitcoin phenomenon and limit the impact of country-specific effects, we selected three financial indices with a global scope that aim at representing a similar distribution of assets. The first independent

variable is the S&P Global 1200, a global equity index that captures approximately 70 percent of global market capitalization in stocks and is a composite of several major regional indices (S&P 2019a). The index is weighted by float-adjusted market capitalization of each component. The constituents include the S&P 500 (US), S&P Europe 350, S&P TOPIX 150 (Japan), S&P/TSX 60 (Canada), S&P/ASX All Australian 50, S&P Asia 50 and S&P Latin America 40 (S&P 2019a). It thus adequately covers the markets in which Bitcoin is also most actively

traded and thus represents the global regulated stock markets.

The second independent variable, representing the global bond markets, is the S&P Global Developed Aggregate Ex-Collateralized Bond Index. It measures the performance of investment grade debt issued by "sovereign, quasi-sovereign, government and corporate entities" (S&P 2019b, 2) in the native currencies of the developed countries. This index excludes collateralized bonds. We chose this index excluding collateralized bonds to exclude valuation effects induced by underlying collaterals. This exclusion makes a comparison with Bitcoin, which is not collateralized or secured by any asset or institution, more adequate.

The third independent variable is the gold price. A number of papers have drawn a comparison between Bitcoin and gold at one level or the other (Nakamoto 2008; Dyhrberg 2016; Baur et al. 2017), both in behavioral and financial analyzes. The inclusion of gold prices, as the archetypical safe haven, thus appears highly warranted. For the computation of the gold price, we use the daily closing spot prices for an ounce of gold. For spot prices, data from different sources are sufficiently close to warrant a selection of any of these sources as valid.

The sentiment variable is the OECD's Consumer Confidence Index (CCI) for 35 countries, which is published by the OECD on a monthly basis. The CCI provides an indication of future developments of households' consumption and saving, based upon answers regarding their expected financial situation, their sentiment about the general economic situation, unemployment and capability of savings (OECD 2019). For the CCI, which has a base value of 100, deviations from this base value measure the level of positive or negative sentiment at any given time. At values over 100, consumers are rather optimistic about their own future economic situation and thus more inclined to consume rather than save. Values

Table 1

Descriptive Statistics of Considered Variables, Based on Monthly Averages

Variable	N	Min	Max	Mean	Std. dev.
BTC in USD	79	15.15	14,818.23	2,535.39	3,482.71
Bitcoin Media Buzz	79	1.00	100.00	9.85	14.04
OECD CCI 35	79	98.97	100.91	100.21	0.48
Gold price	79	1,068.32	1,671.89	1273.67	103.30
S&P Global Bond Index	79	188.92	215.63	201.31	6.33
S&P Global Stock Index	79	1,375.57	1,787.50	1,588.27	117.04

Source: Authors' own calculation.

under 100 indicate a potentially higher propensity of consumers to postpone purchases and increase savings. Table 1 summarizes some descriptive statistics of the considered variables.

The observed period with monthly averages includes the all-time high of the Bitcoin price to date, which was above USD 19,000 in the middle of December 2017 (see also Figure 1). From the minimum value of just under USD 15 observed in 2013, Bitcoin's valuation has evolved significantly by a factor of a thousand, much more than any other indicator. Data from CCI indicate that instances of both rather negative (values below 100) and a positive sentiment values occurred during the period under review. Although the average mood was rather positive, the standard deviation shows that sufficient instances of negative mood were present during the period, so that the data set covers the full spectrum. The three representatives of the financial asset classes considered, the stock and bond indices and the gold spot price also show significant levels of change over the study period.

RESULTS OF ANALYSIS

In a first step, we analyze whether there is a correlation between the considered variables. Therefore, we calculate the rank correlation coefficients according to Spearman to determine general monotonous correlations without assuming a particular linear correlation. Table 2 summarizes the results. With the exception of the gold price, the Bitcoin price shows a significantly high correlation with the selected variables. The strongest positive correlation can be observed with the public interest/media buzz. Depending on the assumed causality, this means that either Bitcoin is mentioned particularly frequently when the Bitcoin price increases or the

Bitcoin price is strongly influenced by public interest/media – i.e., the interest generated in the media pushes the demand for Bitcoin. A closer look at Figure 1 shows this correlation between Bitcoin price and public interest as well. Even after the December 2017 hype – which was mainly triggered by the introduction of Bitcoin futures on the two largest global commodity exchanges, CBOE and CME – it appears that public interest, while still higher than in any year prior to 2017, is correlated with Bitcoin prices.

A high correlation can also be observed with the stock index, which confirms our assumption that Bitcoin is more of a speculative investment that strives in periods of positive economic sentiment and/or growth. The next strongest positive correlation is with the OECD Consumer Confidence Index (CCI), followed by S&P Global Bond Index. The correlation with the gold price is weakly positive, but not significant. This correlation structure suggests that the price for Bitcoin is driven by emotional rather than factual motivations; i.e., Bitcoin has probably not been considered by risk diversifying investors as an additional form of investment during this period.

The only, but also highly significant, correlation for the gold price is with S&P Global Bond Index, which in turn points to an institutional correlation. This can be rationalized by the fact that both gold and bonds are conservative low-risk investments favored during weakening economic cycles. This result gives a measure of confidence on the quality and validity of the dataset. It comes as no surprise that there is a negative, but not significant, correlation between the gold price and the CCI. This confirms the well-documented assumption of gold as a classical safe haven, or refuge value, for investment purposes. Interestingly, there is also a highly significant correlation between the S&P Stock Index and the Media Buzz. A likely explanation could reside in

Table 2

Spearman Correlation Matrix

Variable	BTC\$	Media	CCI	Gold	Bonds	Stocks
BTC in USD	1					
Bitcoin Media Buzz	.909**	1				
OECD CCI 35	.807**	.731**	1			
Gold price	.090	.152	-.172	1		
S&P Global Bond Index	.691**	.619**	.400**	.635**	1	
S&P Global Stock Index	.854**	.726**	.894**	-.088	.527**	1

Note: Significance levels (two-sided): **p<0.01; *p<0.05.

Source: Authors' own calculation.

Table 3

Pearson Correlation Matrix

Variable	BTC\$	Media	CCI	Gold	Bonds	Stocks
BTC in USD	1					
Bitcoin Media Buzz	.818**	1				
OECD CCI 35	.671**	.494**	1			
Gold price	.100	.067	-.445**	1		
S&P Global Bond Index	.639**	.439**	.287*	.491**	1	
S&P Global Stock Index	.712**	.424**	.897**	-.278*	.471**	1

Note: Significance levels (two-sided): **p<0.01; *p<0.05.

Source: Authors' own calculation.

the fact that the introduction and rise of Bitcoin coincides completely with the sustained low interest policy supported by all major economies since the financial crisis. This resulted in substantial assets shifts in the long-term investment strategies of even conservative investors away from fixed-income securities and traditional low-yield conservative investments such as savings accounts and life insurances to stocks. Another marginal explanation could be the halo effect resulting from positive Bitcoin media coverage in conjunction with its sustained and extensive price increase of this most speculative asset, which might have drawn attention away from conservative investments as gold or bonds to more speculative investments such as equity.

In the second step, we check for a linear relationship between the variables in order to find support for an OLS regression. The results are displayed in Table 3. The direction and ranking of the correlations remain unchanged and continue to be highly significant. The highest correlation of the Bitcoin price is still with the Public Interest/Media Buzz, followed by the CCI and the stock index. However, the correlation with the Media Buzz is somewhat less strong, which suggests that there is rather a non-linear correlation. The negative correlation between the gold price and CCI is now highly significant; however, there is still no significant correlation of gold with the other variables.

Encouraged by these results, we then conduct a simple ordinary least squares (OLS) regression, assuming the Bitcoin price as the variable to be

explained and gradually adding the other variables as explanatory variables. In total, we derive five model specifications, whose results are summarized in Table 4.

All model specifications have highly significant parameters and also the general explanatory content is high. As the results from Tables 2 and 3 have already suggested, there is no significant correlation between the Bitcoin price and the gold price, which also does not lead to a significant explanation in the regression analysis, which is why we do not report these results here. This low correlation differs from a previous study conducted by (Dyhrberg 2016), but could be explained by the choice of the period considered and the use of monthly averages. If we relate this to the results of previous studies (Baur et al. 2017), which find that about one third of investors buy and hold Bitcoins in a way investors would buy and hold gold as a refuge value, it would also suggest that these investors do not significantly influence the character of Bitcoin as an asset or its price.

While specification 1, in which the Media Buzz is the single explanatory variable, only has a moderate explanatory content (recognizable by R^2), the explanatory content increases by adding the other variables. The high significance remains and also the additional variables are highly significant. Specification 3 and 5 provide the highest plausible explanatory power at which each variable provides real added value (as indicated by the increase in R^2_{adj}) and all effects are highly significant. Specification 4 yields some interesting results. The inclusion of the stock

Table 4

Regression Results of Different Model Specifications

BTC in USD	1	2	3	4	5
(Constant)	538.14 (277.823)	-254,017.84** (46,130.122)	-267,521.705** (37,668.652)	124,230.192 (74,415.091)	-40,323.011** (5,211.552)
Bitcoin Media Buzz	202.806** (16.267)	159.465** (15.909)	128.424** (13.881)	163.274** (13.23)	140.349** (12.212)
OECD CCI 35		2,544.368** (461.079)	2,329.768** (377.443)	-1,523.945 (785.778)	
S&P Global Bond Index			175.425** (27.965)		119.326** (27.820)
S&P Global Stock Index				18.523** (3.124)	10.989** (1.493)
R^2	.669	.763	.845	.839	.864
R^2_{adj}	.664	.757	.839	.833	.859

Note: Significance levels: **p<0.01; *p<0.05.

Source: Authors' own calculation.

index instead of the bond index leads to a reversal of the influence of the CCI into the negative, but this effect loses significance (the according p-value is given by .056). As Tables 2 and 3 show the S&P Global Stock Index and the CCI are almost perfectly related with each other, and furthermore the increase in the standard deviation of CCI points to the problem of multicollinearity in this situation. Thus, specification 5 considers all variables except for CCI and yields again plausible results. In all specifications, the effect of the Media Buzz remains positive and significant which clearly highlights the robustness of this indicator as an explanatory variable and confirms the assumptions made based on Figure 1.

CONCLUSIONS

We can conclude that the price of Bitcoin is driven by public interest/media coverage, consumer confidence, and, among the selected financial assets, stock prices, which also correlates highly with consumer confidence. These results thus make a plausible case for the price behavior of Bitcoin being similar to cyclical assets with higher risk-return relationships. The analysis shows the great importance of mood and media interest for the Bitcoin price, which is why these must be strongly considered when making potential forecasts about the future development of the price of Bitcoin. Whether such effects will be as prevalent in the long run remains to be seen. As suggested in the beginning of this paper, it would appear that the level of correlation between Bitcoin prices and public interest/media coverage might be receding since the bubble at the end of 2017. This could be interpreted as Bitcoin losing some of its glamour as a novel phenomenon. In turn, this could mean that similar studies in the future could be conducted without a public-interest bias.

Nevertheless, we want to stress that the reported results must be taken with caution as a snapshot. While Bitcoin can definitely be considered as the flagship and best representative of cryptocurrencies, this asset class still represents a very recent and heterogeneous addition to the investment markets and must be considered as still being in an 'unfinished' state. Simultaneously, this very state – which, aside from investor behavior, includes aspects such as the 'mining' mechanics and industry as well as regulations – constitutes a unique case that justifies research interest.

There is still little knowledge and much speculation about this asset class, especially how valuations will develop in the future. It remains to be seen whether the very heterogeneous cluster of currently more than 2,500 traded cryptocurrencies will be recognized in the long run as an investment class of their own, co-existing with classical ones. The heterogeneity of cryptocurrencies should, in the process of institutionalization, at the very least result in

a selective 'weeding out' and segmentation within the category.

The announcement of the second generation of cryptocurrencies, so-called stable coins such as Libra (Taskinsoy 2019), which were developed incorporating the lessons learned from Bitcoin and other first-generation cryptocurrencies, may usher in a new stage, forcing the 'old' cryptocurrencies into new niches.

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