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Study and Research on the Six-Year Process of Bitcoin Price and Return

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ABSTRACT

The purpose of this study, is create a challenge and discussion concerning the existence of information about the Bitcoin price and return, which suggests the relationship of information and the strong performance it. The information trends are available at different time periods and the summary data related to the statistical descriptions for the price and return index are also discussed. In this paper we show a significant correlation between the price trend and return in the Bitcoin that has been confirmed by various statistical methodology. Using statistical tests and reviewing trends and relationships between the variables, planning can be done to invest in it and its performance or inefficiency can be tested. The results of this research shows a significant and positive relationship between the price and return of Bitcoin.

1 Introduction

Bitcoin is a peer-to-peer cryptographic digital currency. A cryptocurrency is a digital asset designed to work as a medium of exchange using cryptography to secure the transactions, to control the creation of additional units, and to verify the transfer of assets, cryptocurrencies are classified as a subset of digital currencies and are also classified as a subset of alternative currencies and virtual currencies [1]. Bitcoin is unregulated and hence comes with benefits (and potentially a lot of issues) such as transactions can be done in a frictionless manner and anonymously. It can be purchased through exchanges or can be 'mined' by computing/solving complex mathematical/cryptographic puzzles [2]. Bitcoin offers the promise of lower transaction fees than traditional online payment mechanisms and is operated by a decentralized authority, unlike government issued currencies [3]. With such online payment mechanisms, it makes sense to think of it as a proper financial instrument as part of any reasonable quantitative trading strategy [9]. Bitcoin has been introduced by Nakamoto [23] and is type of cryptocurrency instead of traditional methods of payment [6]. Several authors have modelled Bitcoin data in recent years [16]. Garsia et al. [13] studied the links between social signals and Bitcoin price through

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a social feedback cycle. Moore and Chrishtin [21] provided an empirical analysis of Bitcoin Exchange risk. Henecic and Gourieroux [15] modelled and predicted the Bitcoin /USD exchange rate through the application of a non-causal autoregressive model. Cheunge et al. [8] investigated the existence of bubbles in Bitcoin markel. Kristoufek [17] by wavelet coherence analysis examined Bitcoin price information and main drivers of price. Urquhart [29] was the first researcher to test weakness of Bitcoin data. He used five different tests and concluded that Bitcoin returns are market inefficient. Fama [11] presented the performance of capital markets, the theory and models. The topic under discussion is the ineffectiveness of Bitcoin with a dynamic approach by Aurelio and, on the other hand, the speculative and dynamic approach in Bitcoin deals has been investigated by Blue [4]. The fluctuations in the Bitcoin return prediction and some of the facts on the Bitcoin market have been written by Barviera et al. [3]. The relationship between the returns and risks of Bitcoin and existing fluctuations, as well as the reduction of the risk in it, has been mentioned by Bouri et al. [5]. Donier and Bouchaud [9] has investigated the cause of the collapse of the markets and the unsurpassed nature of the Bitcoin market. Nadarajah and Chu [15] tested the same hypothesis not on Bitcoin Returns but an odd integer power of Bitcoin returns that are actually market inefficient. In this paper, we follow up the Nadarajah and Chu [22] work. We show that, unlike recent papers, Bitcoin data is trendy and will undermine the existence of a process of assumption of inefficiency. In this regard, we use the annual data from 2012 to 2017. Using data on daily Bitcoin prices and in six groups of 2012, 2013 to 2017 will provide us with a very important approach. The contents of this paper are organized as fallows. Literature review are presented in second section and Bitcoin data is used and has been analysed in section three. In the fourth section, statistical analyses are presented based on trends in the annual and general data, and in the last section some results will be presented.

2 Literature Review

Bitcoin is a decentralized digital currency, which works peer-to-peer without a centralized repository, and is accepted as a form of payment all around the world. The “public ledger”, which registers transactions, is known as the block chain [18]. A conventional ledger records bills and notes which are used by an organization, but in the case of Bitcoin these are simply data “entries” in the block chain sequence [19]. As introduced and first documented by Nakamoto [23], Bitcoin is a form of cryptocurrency an ‘‘electronic payment system based on cryptographic proof’’ [20], instead of traditional trust [28]. His major innovation was to achieve consensus without a central authority. Cryptocurrencies are a part of this solution the part that made the solution thrilling, fascinating and helped it to roll over the world [24]. Several authors have modelled Bitcoin data in recent years [25]. In recent year, Symitsia [27] assessed the out-of-sample performance of Bitcoin within portfolios of various asset classes and a well-diversified portfolio under four strategies and estimate the economic gains net of transaction costs and find statistically significant diversification benefits from the inclusion of Bitcoin which are more pronounced for commodities[26]. George et al. [14] proposes a computational intelligence technique that uses a hybrid Neuro-Fuzzy controller, namely PATSOS, to forecast the direction in the change of the daily price of Bitcoin. The proposed methodology outperforms two other computational intelligence models, the first being developed with a simpler neuro-fuzzy approach, and the second being developed with artificial neural networks.

Faruk et al. [12] investigates the predictive power of global geopolitical risks (GPR) index on daily returns and price volatility of Bitcoin over the period July 18, 2010–May 31, 2018. Considering Bayesian Graphical Structural Vector Autoregressive (BSGVAR) technique. Dyhberg et al. [10] examine the invisibility of Bitcoin by exploring the trading dynamics and market microstructure of Bitcoin on three US cryptocurrency exchanges using high frequency intraday data of individual trades and quotes. Kristoufek [17] provides a novel measure of liquidity uncertainty for Bitcoin using bid–ask spread data from Bitfinex one of the largest and most liquid Bitcoin exchanges. This measure can be used to analyse liquidity developments in Bitcoin exchanges or to gauge the immediacy associated with buying or selling Bitcoin. Chaim and Laurini [7] narrative of a Bitcoin is a bubble is very common. We employ statistical techniques to empirically evaluate such claim. A branch of literature links the existence of a bubble in some financial asset's price to strict local martingales a finitely lived asset has a bubble if, and only if, it is a strict local martingale under the equivalent risk-neutral measure. A diffusion process is a strict local martingale if its volatility increases faster than linearly as its level grows.

3 Data Set

The data are in Unquhart's paper [29] that is daily closing prices for Bitcoin in USD from the 1st of August 2010 to 31st of July 2016. The data are in Nadarajah and Chu's study [22] regarding three subsample periods from the 1st of August 2010 to 31st of July 2013 and 1st of August 2013 to 31st of July 2016 and full period from the 1st of August 2010 to 31st of July 2016.

In this paper, we considered data from Six periods; with the full period from 2nd February 2012 to 10th November 2017; the subsample period from the 2nd February 2012 to 31st December 2012; the subsample period from the 1st January 2013 to 29st December 2013; the subsample period from the 1st January 2014 to 29th December 2014; the subsample period from the 1st January 2015 to 29th December 2015; the subsample period from the 1st January 2016 to 17th December 2016; the subsample period from the 1st January 2017 to 10th November 2017. In order to evaluate the performance and observance of Bitcoin data in the price index as well as the yield index, we first give a brief descriptive statistics of the index of price and returns. According to the article of Nadarajah and Chu we calculate Bitcoin returns using the following formula that changes the time on a daily basis.

$$R_t = 100\ln(\frac{P_t}{P_{t-1}})$$

Data are selected from time intervals of 2nd February 2012 to 11th November 2017 and are summarized in the Table 1 with some summary of statistics:

Table1: Some summary of statistics for price and return.

Variable	Count	Mean	StDev	CoefVar	Range	Median
Price	2093	662.7	1081.4	163.18	7442.4	370.0
return	2092	0.3330	4.5535	1367.53	68.0989	0.2587

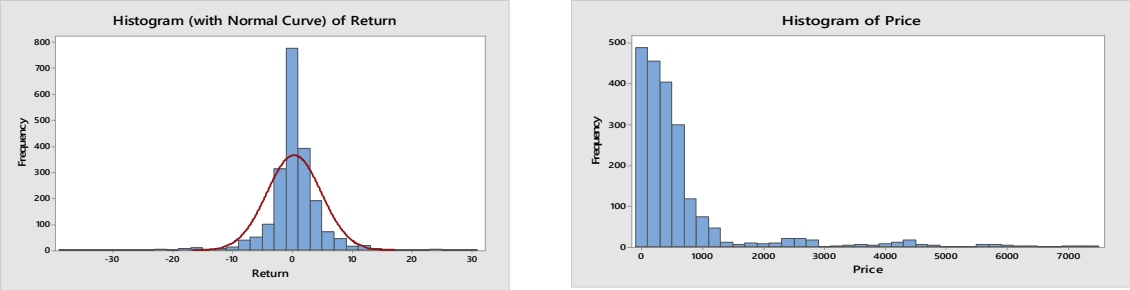

Fig. 1: Histogram of price data (right) and returns with normal curves (left).

Understandable concept can be understood from the above diagrams that is the existence of a positive distribution, such as Chi-square, in price data and a normal distribution with high kurtosis to return data. This is the first signal in the existence of information related to the trend in Bitcoin data.
In the study of Nadarajah and Chu the mean and median of the Bitcoin return was close to zero, which according to the data obtained from the site "www.investing.com" and in accordance with Table 1, will be a challenging issue [22]. We will discuss more about it later and come up with some other statistical tests.

4 Research and Methodology

In this section, first we summarize the descriptive statistics of the six data groups in accordance with Table 2 and use it in order to carry out future analyses.

Table 2: Some statistics describe Bitcoin price and return according to different time periods

	N	Range	Minimum	Maximum	Mean	Std. Devotion	Skewness	Kurtosis
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
Price 2012	334.00	9.48	4.22	13.70	8.50	3.28	0.14	(1.67)
Price 2013	364.00	1,131.72	13.28	1,145.00	187.71	243.88	2.32	4.38
Price 2014	364.00	626.29	308.26	934.55	523.83	144.32	0.53	(0.42)
Price 2015	364.00	283.49	183.01	466.50	272.77	59.53	1.67	2.11
Price 2016	352.00	981.70	283.01	81.70	556.67	151.50	(0.08)	1.02
Price 2017	315.00	6,663.82	778.58	7,442.40	2,634.61	1,685.11	0.95	0.03

Table 2: Continue

	N	Range	Minimum	Maximum	Mean	Std. Devotion	Skewness	Kurto-sis
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
Return 2012	334.00	60.55	(37.24)	23.31	0.24	3.72	(2.69)	36.81
Return 2013	364.00	64.07	(33.21)	30.86	1.10	6.98	(0.53)	5.32
Return 2014	364.00	33.91	(17.89)	16.02	(0.23)	3.91	(0.03)	4.41
Return 2015	364.00	55.74	(34.53)	21.21	0.09	4.10	(1.81)	19.09
Return 2016	352.00	28.93	(17.91)	11.02	0.23	2.56	(0.66)	10.54
Return 2017	315.00	41.02	(17.30)	23.72	0.59	4.59	(0.15)	3.21

As can be seen from the general overview in Table 2, the annual trend seems to be evident with respect to the average price and returns. On the other hand, some malicious and political propaganda can be considered as the main reason for the decline in Bitcoin's negative price and returns in 2014, which is an unexpected repetition. Because the emotional trend will increase the price of Bitcoin, despite government's opposition and its international requirements.

Table 3: Run test for Bitcoin price to different time periods

Runs Test (Median)							
	Price 2012	Price 2013	Price 2014	Price 2015	Price 2016	Price 2017	Price all
Asymp. Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Runs Test (Mean)							
	Price 2012	Price 2013	Price 2014	Price 2015	Price 2016	Price 2017	Price all
Asymp. Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Runs Test (Mode)							
	Price 2012	Price 2013	Price 2014	Price 2015	Price 2016	Price 2017	Price all
Asymp. Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000

There are several ways to define runs in this literature, however, in all cases the formulation must produce a dichotomous sequence of values. We will code values above the median as positive and values below the median as negative. A run is defined as a series of consecutive positive (or negative) values. The runs test is defined as:

H0: the sequence was produced in a random manner

Ha: the sequence was not produced in a random manner

The test statistic is

$$Z = \frac{R - \bar{R}}{S_R}$$

where R is the observed number of runs, $\bar{R}$ is the expected number of runs, and S_R is the standard deviation of the number of runs. The values of $\bar{R}$ and S_R are computed as follows:

$$\bar{R} = \frac{2n_1n_2 + 1}{n_1 + n_2}$$

$$S_{\bar{R}}^2 = \frac{2n_1n_2(2n_1n_2 - n_1 - n_2)}{(n_1 + n_2)^2(n_1 + n_2 - 1)}$$

with n_1 and n_2 denoting the number of positive and negative values in the series.

The runs test rejects the null hypothesis if $|Z| > Z_{1-\alpha}$ with significant level α.We have performed Run test for price data in the above periods, and in all periods of time, the zero assumption is rejected. In no way we can say that the Bitcoin price trend in the annual interval is a random process, and this will lead us to more important results. In the last column of Table 3, we have tested the above test on all data that is evidence of the original claim. In the following, we will draw up a series of time series' charts in order to guide further and identify trends in data-based data.

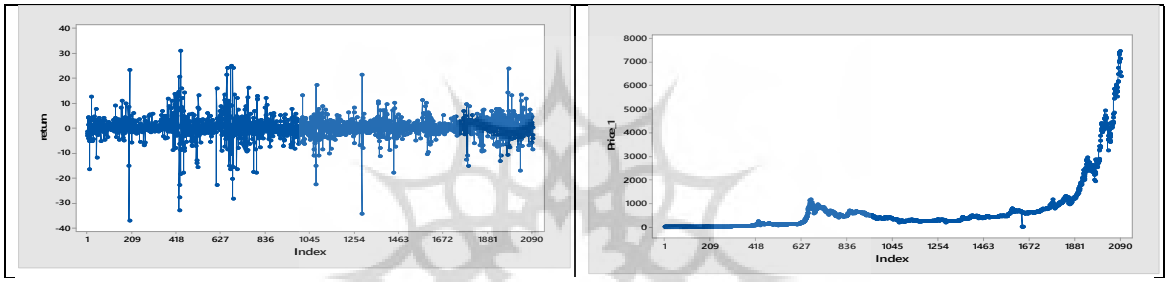

Fig .2: Time series' plot for price (right) and time series' plot for return (left)

Table 4: Correlations between price variables

		price 2012	price 2013	price 2014	price 2015	price 2016	price 2017
Price 2012	Pearson Correlation	1	.505	-.548	.484	.771	.882
	Sig. (2-tailed)		.000	.000	.000	.000	.000
	N	334	334	334	334	334	315
Price 2013	Pearson Correlation	.505	1	-.581	.799	.642	.746
	Sig. (2-tailed)	.000		.000	.000	.000	.000
	N	334	364	364	364	352	315
Price 2014	Pearson Correlation	-.548	-.581	1	-.466	-.528	-.656
	Sig. (2-tailed)	.000	.000		.000	.000	.000
	N	334	364	364	364	352	315
Price 2015	Pearson Correlation	.484	.799	-.466	1	.628	.428
	Sig. (2-tailed)	.000	.000	.000		.000	.000
	N	334	364	364	364	352	315
Price 2016	Pearson Correlation	.771	.642	-.528	.628	1	.689
	Sig. (2-tailed)	.000	.000	.000	.000		.000
	N	334	352	352	352	352	315
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	315	315	315	315	315	315

**. Correlation is significant at the 0.01 level (2-tailed).

The graph of Bitcoin Time Series is a demonstration exponential model, and this graph for return data

depicts a static with an almost identical variance time series (Serinaldi, [26]). Performing time series analysis consistent with Bitcoin data can lead to quantitative and qualitative analysis, contrary to previous researches, which we will further discuss in more detail. In order to do more analysis, we obtain Pearson's' correlation of the price variables and first we set the number of data in equal daily intervals and for different years their correlation and significance will be in accordance with Table 4.

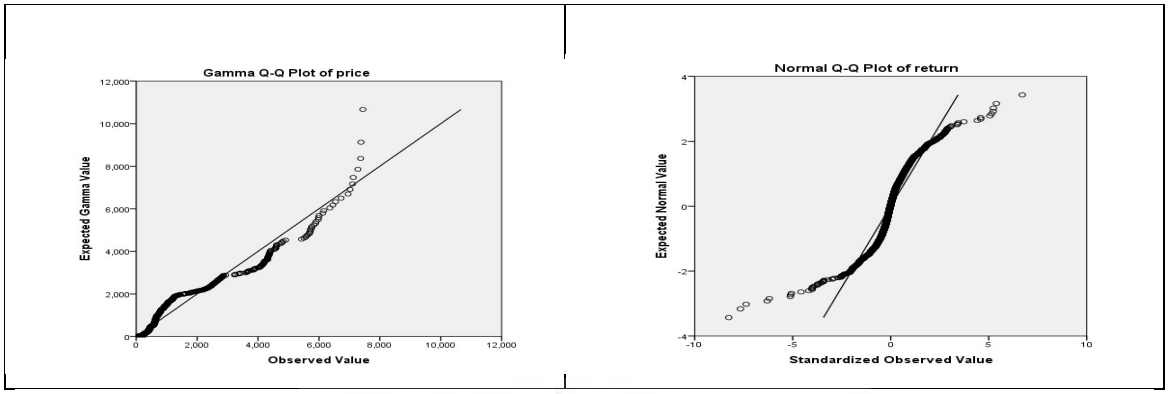

Fig. 3: Q-Q plot of data price and return

As illustrated in Table 4, the Bitcoin data correlation is strong and meaningful in many years except the year 2014. What is shown in Figure 4 is the adaptation of Bitcoin price data distribution by exponential Gamma distribution as well as compliance with the normal distribution of Bitcoin price returns .All these analyses are presented to explain the performance of Bitcoin data.

5 Discussion and Conclusions

What matters in this study is the importance of examining the trend and information in the data on the price of Bitcoin, which, in spite of previous papers such as; Nadarajah and Chu [22] and Unquhart [29] model and information performance can be a major challenge. It is very important to evaluate the efficiency or inefficiency of Bitcoin trading on the basis of probability, chance or to use analytical models by using a technical analysis model. In many cases, it is recommended to use a quantitative analysis and modelling and massive statistical communication for a specific process or model with information. For example, it's not possible to model a particular type of Crypto currency, except for speculative purposes and supply and demand systems, and have no specific analysis, but after historical studies, they will be developed in the long run. In the future, Bitcoin models will be able to analyse cash flow and free cash flow analysis, which will be discussed in future papers and studies.

In this article we used the data from site "https://www.investing.com" and may have been one of the main challenges of the topic. In any case, the data is available and will validate the results. There seems to be a gap between the face of Bitcoin and its deals, and its efficiency and inefficiency, which can be an important motive for further analysis. We will also provide supplemental modelling and detailed examinations of models with statistical patterns by Bayesian approach, simulation and fuzzy analysis for Bitcoin data in future studies. Bitcoin studies can be focused on modelling and designing

appropriate returns based on technical analysis. On the other hand, after modelling, it is possible to make optimal decisions on investing in this currency. Also, due to the importance of relevant data, other analyses can be made and results can be generalized to other outputs. Any behaviour of investors in data analysis and sales, as well as statistical analysis of data can be very decisive and influential. In this regard, the technical analysis available in this paper can be generalized to simple calculations to other markets, such as gold and currency. Analysing and studding the relationship between returns and prices is one of the methods of technical analysis based on historical observations. The use of partial correlation and modern models of time series in the future and in subsequent researches along with business models is suggested.

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