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Correction

Correction: Different GARCH models analysis of returns and volatility in Bitcoin

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A correction on

Different GARCH models analysis of returns and volatility in Bitcoin
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The author would like to submit the following corrections to recently published paper (Wang, 2021). The author also modified some expressions for readers to read more fluency.

The dollar and $ was replaced with USD, Bitcoin was replaced with BTC, U.S. was replaced with USA.

The title and abstract have been updated.

Title: Different GARCH model analysis on returns and volatility in Bitcoin

Abstract: The aim of this study was to examine the returns and volatility of Bitcoin. The study uses the daily closing price of Bitcoin from October 1, 2013 to July 31, 2020 as the sample data, which include 2496 observations. About the methodology, the paper describes the utilisation of GARCH models to analyse Bitcoin's returns and volatility. First, the data were tested by using the augmented Dickey-Fuller test to verify the stability and diagram tests sequence. After that, the lag order and determination results of the mean value equation show that the Lag 4 period is the best. Additionally, the paper describes an autocorrelation test of the residual series, which revealed that

there is no significant autocorrelation in the residual term for the Bitcoin returns, but that the residual squared has significant autocorrelation. In addition, a linear graph of squared residuals was formulated and the ARCH-LM test was used to find the data that are suitable for modelling with GARCH models since the data have a strong ARCH effect. As result, a GARCH (1,1) model was used; the findings indicated that the returns and volatility of Bitcoin have clustering characteristics, and that the returns and volatility of Bitcoin constitute a persistent process although the effects gradually reduce over time. Because of the limitations of the GARCH (1,1) model and researching asymmetry of the returns and volatility of Bitcoin, TARCH and EGARCH models were adopted; the findings indicated that the returns and volatility of Bitcoin are without a "leverage effect". To further explain this special phenomenon, safe-property is quoted in this research. In the end, this paper demonstrates that Bitcoin, as a safe-haven property, can hedge financial risks in times of economic depression. Besides, Bitcoin has a revised asymmetric effect between positive and negative shocks that makes it a viable asset to add to the portfolios of investors.

First, the first half of the second and sixth paragraphs in Section 1 (Introduction) have been updated.

Since the publication of Bitcoin (BTC) in October 2008, the digital and decentralised currency has attracted the attention of many researchers. BTC is one of the most famous and important cryptocurrencies, and it is based on blockchain technology with cryptology. Its transaction assumes the peer-to-peer (P2P) method. Notably, mining BTC is the most important way to get more coins, and owing to the calculations of a special algorithm, BTC does not depend on any currency institutions for issuance. Instead, it uses a decentralised transaction system and distributed ledger, which combines with many nodes in the BTC internet to record each trade information unit for every node. Besides, it uses cryptology to protect the safety of the decentralised system during BTC transactions. In addition, there are only about 21 million bitcoins that can be mined on the BTC internet. However, owing to the calculation speed now, the BTC system currently releases some BTC to miners every 10 minutes once. Nonetheless, in the future, more precisely by 2140, the number of mining bitcoins will be maximum.

To study BTC, it is important to understand blockchain technology, which is the core technology of BTC. The technology involves recording a series of trade information units, also called a block, and sending them from one account to another. Besides, every block is encrypted by cryptography, which can effectively protect the transaction information of every block during the process of transmission. As a new method of application of computer technology, blockchain technology includes aspects such as the storage of distributed data, P2P transmission, an encryption algorithm and a consensus mechanism. In addition, blockchains, an essential technology of BTC, has a lot of new advantages in different aspects. For example, a blockchain is a decentralised system, which makes it different from traditional currencies' transaction systems. In a normal system, there is a centre to control and collect all information and data from all transactions. As a result, this characteristic of blockchains can effectively improve the safety of a system since there is no centre in this system and all nodes act as the centre for the whole system. Besides, this aspect enhances the security of the system since every node takes part in recording transaction information and every node can use the distributed ledger to monitor the safety of the decentralised system and avoid tampering by hackers.

There is vast academic literature on the returns and volatility of BTC, but asymmetric research is still insufficient. Precisely, there is scarce research on the use of different generalised autoregressive conditional heteroskedasticity (GARCH) models to further analyse BTC's returns and volatility. In this respect, different GARCH models were used in this study to analyse sample times that are longer than other studies; the characteristics of BTC were found and the safe-haven property and revised asymmetry were quoted. The aim was to explain why the returns and volatility of BTC do not have a "leverage effect", which is rare in this area of study. It is also expected that the findings of this study will be of great help to investors who want to make strategic investment decisions on how to hedge financial risks.

A new reference is added in Section 2.2(Valuation of Bitcoin).

Baur et al. (2015) found that the returns attributes of BTC are unlike those of traditional assets, as they afford significant diversification of investments. Through an analysis of the BTC public ledger, researchers found that a third of all bitcoins are held by investors (Baur et al., 2015).

Furthermore, owing to the global dispersion of BTC and its independence from any central bank or supranational institution, regulation will be difficult and challengeable (Baur et al., 2015).

The first half of Section 2.4 (Applications of different GARCH models to the returns and volatility of BTC) has been updated.

After predicting the returns and volatility of BTC, researchers started to use different models to find the returns and volatility of BTC. The volatility of the price was investigated in financial markets early, but the reports on the volatility of the price of BTC are not sufficient. Because BTC prices rapidly change, now more researchers are gradually focusing on this area. Therefore, the excessive volatility of BTC and how to correctly judge it have not been studied enough, leaving a wide research gap. However, BTC price volatility remains a major concern among investors, as numerous studies have shown. For instance, Jamal and Refk (2015) conducted a study that was aimed at providing a discussion of BTC's price fluctuations by using several extensions of the optimal GARCH model. In this case, the results of their study suggested extreme volatility in the price of BTC. Precisely, their findings indicated that conditional variances followed a long memory process between December of 2010 and June of 2015.

Section 5.1.4 (ARCH-LM test for the residual (9th-order lag)) has been updated.

ARCH-LM testing, the standard test to detect autoregressive conditional heteroscedasticity, was first be presented by Engle in 1982. ARCH-LM testing was performed on the residuals of serial linear regression, and the object of the F test was the joint significance of the squared residuals of all of the lags. The Obs*R statistic is the LM test statistic, which is the number of observations multiplied by the test regression R. Given the significance level $\alpha = 0.05$ and a degree of freedom of 9, the value of LM was 284.1393, which is greater than the critical value of 16.9190, and the concomitant probability P was 0.0000, which is less than 0.05. The null hypothesis was rejected. This shows that there was obvious heteroscedasticity in the return sequence, and that the residual had

a strong ARCH effect. Therefore, it is reasonable that the GARCH model was selected to simulate the data for BTC's returns rate.

The first paragraph of Section 6 (Conclusions) has been updated.

To sum up, the GARCH (1,1) model results show that the returns and volatility of BTC have clustering characteristics. Figures 7 and 8 show that the BTC returns and volatility sharply increased from 2013 to 2014, 2017 to 2018 and 2019 to 2020. The ESDC happened in 2013–2014, a trade war between China and the USA started in 2017–2018 and the COVID-19 pandemic arose in 2019–2020, all amounting to famous financial crises. Interestingly, financial market returns declined during the financial crash, but the returns of BTC rose. This phenomenon can be explained by a reduction in interest rates and monetary excessing. Because the central banks of countries across the world issued more of their currency to hedge risks of economic depression with a low interest rate, people had more money. However, they wanted to minimise inflation, so investments were helpful. Due to the issuance of more currencies, BTC can be a low valuation asset for investment; thus, it is a concern of capital for every country. This is why BTC returns and volatility exhibited a clustering feature during several periods. Besides, the findings associated with the GARCH (1,1) model indicate that the shocks affecting conditional variance are a part of a long-term process, so this finding can be used to predict the returns and volatility of BTC in the future. However, because conditional variance is limited to influencing the future returns and volatility of BTC, its effect gradually decreases; this can effectively explain why BTC's returns and volatility decrease after financial crises and crashes.

A new reference (Baur et al., 2015) is added in References.

The changes have no material impact on the conclusion of this article. The original manuscript (Wang, 2021) will be updated. The author apologizes for any inconvenience caused to our readers by this change.

Conflict of interest

The author declares no conflicts of interest in this study.

References

Baur DG, Lee AD, Hong K (2015) Bitcoin: currency or investment? *SSRN Electron J.* https://doi.org/10.2139/ssrn.2561183

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