An Analysis of the Correlation between Cryptocurrencies and Hang Seng Index

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Abstract: With the development of credit carriers and advanced technologies, cryptocurrencies have flourished as a class of decentralised assets designed on blockchain architecture. In this paper, the daily closing price of Bitcoin and the closing price of Hang Seng Index between March 2022 and March 2024 are selected for empirical study based on the Vector autoregressive model. The results of the study show that there is a unidirectional Granger cause between the growth volume of daily price of Bitcoin market and the price of Hang Seng Index, and the price of Bitcoin is the Granger cause of the fluctuation of the price of Hang Seng Index, which leads to the conclusion that there is a certain lagged effect and influence between cryptocurrency market and Hang Seng Index in terms of the price performance, which provides a reference for the risk management and investment decision-making.

Keywords: Cryptocurrency; Vector Autoregressive Model; Stock Market; Market Performance

1. Introduction

The Hang Seng Index occupies a central position in China's and the world's financial system. It is a key link in China's capital market and plays an indispensable role in consolidating Chinese position as an international financial centre. The Hang Seng Index not only helps enterprises raise capital and achieve rapid development through diversified financing channels, but also provides investors with diversified investment choices, enabling them to deeply participate in and share the fruits of China's economic prosperity. The stability and prosperity of the Hang Seng Index is of vital importance to the stability and development of the global economy. As a mature financial market, price fluctuations in the Chinese stock market are affected by a number of complex factors, including changes in macroeconomic data, the strengths and weaknesses of company performance, and the evolution of political factors.

Meanwhile, with the booming development of digital technology, cryptocurrencies, an emerging financial product, have gradually come into prominence, and their influence and market value have become increasingly apparent. The cryptocurrency market, with its unique volatility and riskiness, has attracted widespread attention in the financial market. Its price performance are not only affected by market supply and demand, but also by multiple factors such as the macroeconomic environment and regulatory policies.

In recent years, the link between cryptocurrencies and the Chinese stock market has attracted increasing attention. This correlation is not only reflected in the linkage of price fluctuations, but also at various levels such as capital flows, investor behaviour and market regulation. An in-depth study of the correlation between cryptocurrencies and the Chinese stock market not only helps us to understand the operation mechanism of the global financial market in a more comprehensive manner, but also has important theoretical and practical value, which can provide investors with a more accurate basis for decision-making, and policy makers with more scientific policy recommendations.

2. Literature Review

Cryptocurrency [1] is a medium of exchange that uses cryptographic principles to secure transactions and control the creation of transaction units, based on a decentralised consensus mechanism, as opposed to a banking and financial system that relies on a centralised regulatory system. Cryptocurrency

as a virtual asset, its price is entirely determined by market supply and demand, and the market is still relatively young and immature, so from its emergence to the present day, there have been a number of scholars who have carried out relevant research on the impact of its volatility. For example, Fan Yingfei [2] et al. first applied the mixed distribution model to cryptocurrency classification, and supplemented the research on the impact of market sentiment on cryptocurrency price volatility by analysing the sentiment indices of various categories using the linkage degree method, which is of great significance. Bouri [3] et al. demonstrated a right-tailed correlation between the Global Financial Stress Index and Bitcoin returns based on Copula's correlation results. Xiaoli Gong [4] et al. then measure the risk spillover index based on a complex network perspective using a quantile time-frequency volatility spillover model, thus capturing the tail risk spillover effects of cryptocurrencies and the global stock market in the time-frequency domain with different shock sizes.

The Hang Seng Index (HSI) is one of the earliest stock market indices in China. Since its launch on 24 November 1969, it has been widely quoted as an important indicator of SAR 's stock market performance and is often used to represent the overall performance of SAR 's stock market, with the constituents of the Hang Seng Index being what we call blue chips [5]. The HSI constituents are also what we call blue chips. In the research on the impact of volatility in the Chinese stock market, Han Xue [6] used a VAR model to model the returns of the two markets under the new situation and verify the mean spillover effect. It is concluded that there is a two-way mean spillover effect and a negative correlation between the Special Administrative Region's stock and exchange markets. Li Zhuo [7] Li Zhuo, on the other hand, develops an EGARCH model for the daily return series of the Hang Seng Index, and concludes that there exists significant volatility aggregation, conditional heteroskedasticity, and leverage effect in the daily return of the Hang Seng Index. While Ma Dongdong [8] et al. used the GSADF methodology to conduct a bubble test based on the five major stock indices such as the Dow Jones Industrial Index and the Hang Seng Index, which are representative of the global stock market, to measure the specific period of the existence of stock market bubbles.

For an analytical study of the relationship between the virtual currency market and the domestic financial market, Jiahong Li [9] et al. apply GARCH-t and other models with exogenous variables in the mean equation to analyse the correlation between Bitcoin and major assets in the Chinese financial market. Zhou Weihua [10] et al. conclude that both bitcoin yield and yield volatility are predictive of NASDAQ market risk based on a GARCH model regression of the GED distribution.

Based on the analysis of existing literature, it is found that there are fewer studies on the volatility relationship between virtual currencies and the domestic stock market, therefore, this paper is here to conduct an empirical study on the correlation between the two based on the Bitcoin closing price data as well as the Hang Seng Index closing price data.

3. Model Introduction

The VAR model is an autoregressive way of describing a weakly smooth process that represents multiple variables over the same sample period as linear combinations of their past values. Its expression is given below:

$$Y_t=\phi_0+\phi_1 Y_{t-1}+\cdots+\phi_p Y_{t-p}+BX_t+\varepsilon_t \quad (1)$$

$$, t=1,2\cdots, T$$

Y_t denotes the k-dimensional column vector of endogenous variables; $Y_{t-i}, i=1,2,\cdots,p$ for lagged endogenous variables;X_t denotes a d-dimensional column vector of exogenous variables; p represents the lag order; T denotes the number of samples.

4. Descriptive Analysis

This article uses daily data of Bitcoin's closing price and Hang Seng Index's closing price, representing the cryptocurrency market's and Hang Seng Index's respectively, for the time period of 28 February 2022 - 1 March 2024, and the data are taken from the official website of Invesco.

As can be seen from the daily data charts in Figure 1, the closing price of the Hang Seng Index during the period under review exhibited a volatile trend, initially declining, followed by a brief rise, and then another decline. The Bitcoin closing price, on the other hand,

showed an overall V-shaped volatility trend of falling and then rising, and continued to rise overall after reaching its lowest in early 2023. On a staged basis, before February 2023, the Hang Seng Index moved in the same direction as Bitcoin, and the closing price of the Hang Seng Index moved ahead of the closing price of the cryptocurrency Bitcoin, and after February 2023, the two markets moved in opposite directions, with the Hang Seng Index trending down and the closing price of Bitcoin continuing to rise.

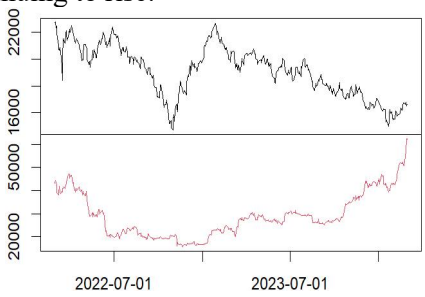


Figure 1. Time Series Plot of the Hang Seng Index and Bitcoin Closing Prices in the Hang Seng Index

Table 1. Results of Descriptive Statistics

Statistics	HSI	BTB	dHSI	dBTB
nbr.val	495	495	494	494
min	14687.02	15776.20	-1116.58	-6635.30
max	22761.71	62467.60	1672.42	5411.40
range	8074.69	46691.40	2789.00	12046.70
median	19380.34	27262.20	-28.80	-12.00
mean	19059.42	29040.51	-12.40	38.89
std.dev	1855.62	9354.24	332.36	1082.07
skewness	-0.22	0.83	0.60	-0.10
kurtosis	-0.85	0.14	2.30	6.75

As can be seen from Table 1, the extreme and standard deviations of the cryptocurrency index and the Hang Seng Index are both larger, indicating that both are more volatile and that the cryptocurrency market is more volatile than the OTC market.

5. Empirical Analysis

5.1 Stability Test and Determination of Lag Order

In order to avoid the pseudo-regression phenomenon when using the VAR model, we first need to carry out the smoothness test on the cryptocurrency data and the Hang Seng Index data. In this study, we primarily selected the ADF test as our tool for analyzing the smoothness of the series. The outcomes of this test are presented in Table 2.

Table 2. Stability Test Results

variable name	HSI	BTB	dHSI	dBTB
ADF test	-2.2631	-0.6369	-8.2506	-7.6866
	(0.4669)	(0.9756)	(0.0100)	(0.0100)
reach a verdict	non-stationary	non-stationary	smoothly	smoothly

According to the test results, both dHSI and dBTB have unit root characteristics and show non-smooth series characteristics. However, after the first-order difference treatment, both data dHSI and dBTB no longer have unit root and show smoothness. Therefore, for the data of the closing price of cryptocurrency Bitcoin and the closing price of Hang Seng Index, we firstly perform the first-order difference treatment before building the model. Regarding the determination of the lag order, this paper evaluates by applying the AIC, HQ, SC, and FPE criteria, and finds that the test results all point to the 1st order as the optimal lag order. Based on the above analysis, the VAR model used in this paper will set the lag order to be 1st order.

5.2 Modelling

Four models were developed based on the presence or absence of a constant term and a trend term, Model1, Model2, Model3 and Model4 model regression results are shown below:

As can be seen from Table 3, the four models have the same level of significance, and at this point, combined with the completeness of the estimated VAR model, it is concluded that Model1 is the optimal VAR model and the parameter estimation of the independent variable dHSI on the dependent variable dBTB is more significant, and the estimation results are as follows:

$$dBTB_t = -0.1759dHSI_{t-1} + 0.0141dHSI_{t-1} - 262.7671 + 1.1956*weekno \quad (2)$$

Table 3. Output of Regression Results

	VAR							
	Model1		Model2		Model3		Model 4	
dHSI.l1	0.0173	-0.1759	0.01731	-0.17887	0.01754	-0.16971	0.01903	-0.18303
	(0.0452)	(0.1459)	(0.04516)	(0.14759)	(0.04517)	(0.14685)	(0.04512)	(0.14738)
dBTB.l1	0.0353*	0.0141	0.03507*	0.038	0.03586*	0.02784	0.03459*	0.03917
	(0.0141)	(0.0454)	(0.01389)	(0.04539)	(0.01396)	(0.0454)	(0.01388)	(0.04533)
const	-11.0794	-262.7671**	-13.58136	32.82933	-	-	-	-
	(30.1	(97.45	(14.93	(48.79				

	905)	35)	179)	559)				
trend	-0.0101	1.1956***	-	-	-0.04395	0.39329*	-	-
	(0.1061)	(0.3425)			(0.05248)	(0.17063)		
R-Squared	0.01378	0.02821	0.01376	0.003989	0.01491	0.01488	0.0135	0.004202
F-statistic	2.278	4.732	3.419	0.9812	2.472	2.468	3.359	1.036

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

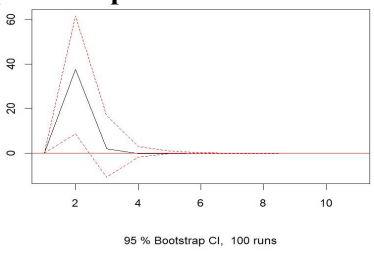
5.3 Granger Causality Test

Table 4. Results of Granger Causality Test

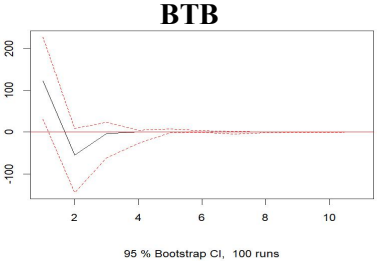
original hypothesis	hysteresis order (math.)	F-Test	p	reach averdict
Granger reasons why dHSI is not dBTB	1	1.5	0.2	acceptance
Granger reasons why dBTB is not a dHSI	1	6.4	0.004	rejection

As can be seen in Table 4, in the original hypothesis that dHSI is not the Granger cause of dBTB, the p-value of the test result 0.2 is greater than 0.05, so the original hypothesis can't be rejected at the 5% level, i.e. dHSI is not the Granger cause of dBTB. In the original hypothesis that dBTB is not the Granger cause of dHSI, the p-value of the test result 0.004 is less than 0.05, so the original hypothesis can be rejected at the 5% level and the alternative hypothesis is accepted, i.e. dBTB is the Granger cause of dHSI.

5.4 Impulse Response



(a) Orthogonal Impulse Response from BTB



(b) Orthogonal Impulse Response from HSI

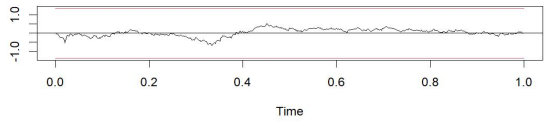
Figure 2. Impulse Response Plot Between dBTB and dHSI

As can be seen from Figure 2, the perturbation of Bitcoin's closing price on the Hang Seng Index reaches its maximum in the second period, and then gradually converges, levelling off around the third period, and converging to zero in the fourth period; the perturbation of the Hang Seng Index market on the Bitcoin market reaches its maximum in the first period, and then generates a negative shock, gradually converging to zero around the third period.

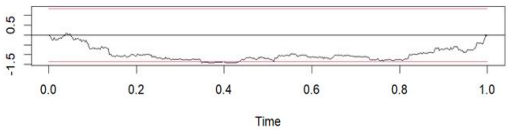
5.5 Smoothness Test and Prediction

Assuming that there is a cross-correlation between the closing price of Bitcoin and the Hang Seng Index, the stability of the model is determined by employing the OLS-CUSUM test, the results of which are shown in Figure 3:

As can be concluded from Figure 3, the trend of Bitcoin closing price within 0.5% is relatively smooth, with no major fluctuations or deviations from the mean, indicating that the model is stable. On the other hand, the closing price of the Hang Seng Index is within 1.5%, with some outliers deviating from the mean, and the model is less stable and predictive.

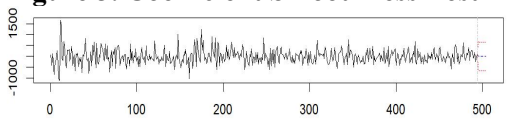


(a) OLS-CUSUM of Equation HSI

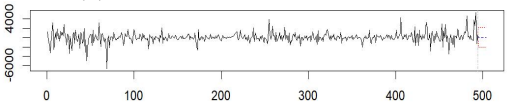


(b) OLS-CUSUM of Equation BTB

Figure 3. Coefficient Smoothness Test



(a) Forecastr of Serier HSI



(b) Forecastr of Serier BTB

Figure 4. Projections

Based on the above analysis, the VAR model can better reflect the relationship between the Bitcoin market and the Hang Seng Index. In view of the strong forecasting ability of the predictive time series model, this paper carries out the relevant forecasts, as shown in Figure 4.

6. Conclusion

This study begins with an in-depth descriptive analysis of the closing price of Bitcoin and the closing price of Hang Seng Index, which successfully removes the unit root problem through the first-order difference treatment. After the smoothness test and model estimation, it is concluded that the two variables exhibit smoothness characteristics after the treatment. Subsequently, the relationship between the two is explored using the Granger causality test, which disproves the original hypothesis that there is no significant relationship between the closing price of Bitcoin and the volatility of the Hang Seng Index. It clearly shows that there is a significant Granger causality relationship between the closing price of Bitcoin and the volatility of the closing price of the Hang Seng Index.

On this basis, the VAR model was further constructed and estimated, and the optimised model structure was obtained. Compared with the single time series model, the VAR model significantly improves the reliability and accuracy of forecasting results by introducing multivariate time series analysis. This finding reaffirms the close connection between cryptocurrencies (represented by Bitcoin) and the Special Administrative Region's stock market (represented by the Hang Seng Index) in terms of price volatility. The two markets do not exist in isolation, but influence and interact with each other.

From the analysis of the time series charts, it can be seen that although the closing price of Bitcoin and the closing price of the Hang Seng Index are not identical in terms of volatility trends, there does exist a certain degree of similarity between the two. This correlation is especially evident when the market is experiencing greater volatility. Through the analysis of the VAR model, it is observed that the amount of growth in the daily closing price of the Bitcoin market is a Granger cause of the volatility of the closing price of the Hang Seng Index, but the reverse is not true. This unidirectional Granger causality suggests that the price performance of the Bitcoin market can drive the price performance of the Hang Seng Index market to a certain extent, further projecting the existence of lagged effects and interactions between the cryptocurrency market and the Special Administrative Region's stock market in terms of price performance. This correlation may be due to the fact that both markets are affected by a variety of factors such as the macroeconomic environment, investor sentiment, and regulatory policies.

In summary, this study not only delves into the close correlation between Bitcoin and the Special Administrative Region's stock market, but also meticulously explores the specific manifestations and potential operating mechanisms of this correlation through the VAR model. These research findings hold significant theoretical and practical value for deepening the understanding of the interactive relationship between the cryptocurrency market and traditional financial markets, as well as for formulating targeted investment strategies and risk management measures. For investors, it is crucial to fully recognize the correlation between Bitcoin and the Special Administrative Region's stock market, avoid blindly following trends or investing solely in one asset, and comprehensively consider the dynamic changes in both markets to effectively control risks and maximize returns. At the same time, regulatory agencies should strengthen their supervision of the cryptocurrency market, guard against potential market risks, and closely monitor the interaction between the two markets to ensure market stability and healthy development. Furthermore, academia and industry should continue to deepen their research on the correlation mechanisms between cryptocurrencies and the Special Administrative Region's stock market, revealing the underlying economic principles and market laws, providing investors and regulatory agencies with more scientific and practical decision-making support and policy recommendations, and jointly promoting the healthy development of the market.

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