Research on the relationship between Cryptocurrency and OTC market based on VAR model

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Abstract. Based on the VAR model, this paper uses weekly data of cryptocurrency indices and weekly closing prices of OTC markets from March 2018 to July 2022 to conduct empirical research. The results show that the weekly closing price increase of the OTC market is the Granger cause of the weekly increase of the cryptocurrency index, but the weekly increase of the cryptocurrency index is not the Granger cause of the weekly closing price increase of the OTC market, that is, the long-term fluctuation of the OTC market price will affect the fluctuation of the cryptocurrency market price, but the fluctuation of the cryptocurrency market price will not affect the fluctuation of the OTC market price. At the same time, according to the analysis of the pulse response chart, when the OTC market is impacted by one unit, the cryptocurrency index fluctuates to the highest point in the second period, and the fluctuation in the fifth period approaches zero. On the basis of these empirical research results, this paper will put forward targeted suggestions.

Keywords: cryptocurrency, OTC market, VAR model, risk assets

1 Introduction

Cryptocurrency is often used as a risk hedging tool to reduce the impact of inflation on people, so it has received increasing attention. However, due to the serious excessive speculation in the market and the absence of financial regulation system, the risk of the cryptocurrency market is also high. In recent years, the number of stocks traded on the OTC market in the United States has accounted for two-thirds of the United States. However, since OTC transactions take place outside the centralized market and are not strictly listed, prices are volatile and risks are high. Both types of markets belong to high-risk markets and are highly concerned, so it is of practical significance to study whether there is a correlation between them.

Scholars have done a lot of research on the relationship between the cryptocurrency market and the capital market. Among them, Du Linfeng [2] (2017) used the time-varying parameter vector autoregressive model (tvp-var) to dynamically identify the time-varying relationship among bitcoin market, RMB exchange rate and stock mar-

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ket. The empirical results show that the impact of Bitcoin market on exchange rate market and stock market presents the characteristics of alienation. Li Jiahong [1] (2021) used three GARCH family models and found that there was a leverage effect between bitcoin and China's financial market; Luo Mei [4] (2020) used bitcoin yield and Dow Jones index yield to conduct empirical research, proving that the digital currency market and the stock market have significant linkage. Based on Granger causality test and GARCH model in the short and long window period, Zhou Weihua [3] (2021) proposed that bitcoin return rate is significantly positively correlated with NASDAQ composite index return rate, and bitcoin market risk can be transmitted to the stock market. Li yinglu [5] (2019) established a prediction model of cryptocurrency index CCi30 index using BP neural network, and predicted the closing price of cryptocurrency index cci30 index by constructing a three-layer BP neural network. According to the review of the existing literature, it is found that there are few studies on the correlation between the cryptocurrency market and the OTC market. Therefore, this paper will use the data of the cryptocurrency index and the closing price of the OTC market to conduct an empirical study on the correlation between the two.

2 Model introduction

The basic form of VAR model is the autoregressive expression of weakly stationary process, which describes several variables in the same sample period as linear functions of their past values. The expression is as follows:

$$Y_t = \phi_0 + \phi_1 Y_{t-1} + \cdots + \phi_p Y_{t-p} + BX_t + \varepsilon_t, t = 1,2 \cdots, T \quad (1)$$

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

3 Data description

The data in this paper are the weekly data from March 19, 2018 to July 31, 2022, in which the BDM index representing the cryptocurrency market is obtained from the official website of S&P Dow Jones Index, and the OTCQX Composite data representing the OTC market is obtained from the official website of UK Financial Situation.

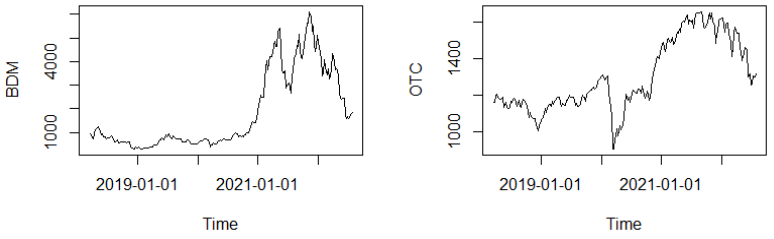

Fig. 1. BDM index and weekly closing price of OTC market (Photo credit: Original)

Fig. 1 is the weekly data trend chart of the two markets. In general, both the cryptocurrency and the OTC market showed an overall trend of rising first and then declining. In stages, in early 2020, the outbreak of COVID-19 sent all markets into a panic, with both OTC and cryptocurrency market data trending lower. Shortly after the outbreak of the pandemic, the Federal Reserve cut the federal funds rate to essentially zero, which turned the BDM index and the OTC market into an upward trend after a brief decline. Subsequently, due to the pandemic lockdowns and supply chain shocks, severe inflation occurred in May 2021. Inflation caused the BDM index to start to decline, while the OTC market closing price also peaked in May and has been in a downward trend since then.

Table 1. descriptive statistical results (Photo credit: Original)

statistic	Cryptocurrency index	OTC market data	First-order difference of Cryptocurrency index	First-order difference of OTC market data
Sample size	227	227	226	226
min	290.27	905.35	-863.24	-184.84
max	6111.93	1656.71	759.79	105.75
mean	1796.51	1299.64	3.88	0.69
median	840.88	1222.10	7.13	4.99
sd	1627.22	195.19	241.86	33.65
skew	0.99	0.42	-0.63	-1.33
kurtosis	-0.51	-1.10	3.48	5.55

As can be seen from Table 1, the range and standard deviation of the cryptocurrency index and OTC market data are both large, indicating that the volatility of the cryptocurrency market is more intense than that of the OTC market.

4 Empirical research

4.1 Stationarity test and determination of lag order

Generally, only stationary series can be used for VAR model estimation; otherwise, spurious regression phenomenon will occur. Therefore, before establishing the model, the stationarity test of BDM and OTC market data should be carried out first. In this study, ADF test, PP test and KPSS test were selected to analyze the stationarity of the series, and the test results are shown in the following table:

Table 2. test results of stationarity (Photo credit: Original)

Variable	ADF Inspection	PP Inspection	KPSS test (LEVEL)	KPSS test (TREND)	Conclusions
BDM	-2.1697 (0.5047)	-6.0008 (0.7729)	3.0595 (0.01)	0.4605 (0.01)	Unstable
OTC	-1.6581	-8.3511	3.1647	0.3734	Unstable

	(0.7195)	(0.6402)	(0.01)	(0.01)	
dBDM	-5.0868 (0.01)	-179.51 (0.01)	0.1404 (0.1)	0.1401 (0.0609)	stable
dOTC	-5.403 (0.01)	-193.95 (0.01)	0.1047 (0.1)	0.0991 (0.1)	stable

The test results show that both BDM and OTC have unit roots and exhibit non-stationary sequence characteristics. However, the data after the first-order difference do not have unit roots, so the data after the first-order difference is stable. To sum up, the cryptocurrency index and the data of the OTC market can be modeled after first-order difference. In terms of determining the lag order, this paper uses AIC, HQ, SC and FPE criteria to determine the optimal lag order, and the test results are all of order 1. Therefore, this paper locates the lag order of this VAR model at order 1.

4.2 VAR model Parameter Estimation

Four models are established according to the presence or absence of constant term and trend term, namely Model1, Model2, Model3 and Model4, and the regression results are shown in the following table:

Table 3. regression result output (Photo credit: Original)

VAR								
Explained variable / Explanatory variable	Model1		Model2		Model3		Model4	
	dOTC	dBDM	dOTC	dBDM	dOTC	dBDM	dOTC	dBDM
dOTC. l1	0.1186 (1.771)	2.4182*** (5.379)	0.1193 (1.787)	2.4211*** (5.399)	0.1196 (1.791)	2.4222*** (5.402)	0.1196 (1.795)	2.4223*** (5.414)
dBDM. l1	-0.0084 (-0.903)	0.1431* (2.289)	-0.0083 (-0.896)	0.1434* (2.300)	-0.0083 (-0.892)	0.1435* (2.302)	-0.0083 (-0.894)	0.1435* (2.307)
const	2.1402 (0.472)	8.1536 (0.268)	0.6396 (0.286)	2.1359 (0.142)	---	---	---	---
trend	-0.0132 (-0.381)	-0.0528 (-0.227)	---	---	0.0010 (0.060)	0.0012 (0.011)	---	---
R-Squared	0.0173	0.1418	0.0167	0.1416	0.0167	0.1417	0.0167	0.1417
F-statistic	1.299	12.17	1.884	18.3	1.26	12.22	1.897	18.41

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

It can be seen from table 3 that the significance levels of the four models are the same. At this time, combined with the integrity of the estimated VAR model, it is concluded that model 1 is the optimal VAR model, and the independent variable dndx has a more significant effect on the parameter estimation of the dependent variable DBDM. The estimation results are as follows:

$$dBDM_t = 2.41816dOTC_{t-1} + 0.14307dBDM_{t-1} + 8.15360 - 0.05276 * weekno \quad (2)$$

4.3 Granger causality test

The Granger causality test is conducted for the weekly increase of closing prices in the cryptocurrency market and OTC market. The test results are shown in the following table:

Table 4. Granger causality test results (Photo credit: Original)

Original hypothesis	Lag order	F-Test	p	conclusion
dBDM is not the Granger reason of dOTC	1	0.8029	0.438	accept
dOTC is not the Granger reason for dBDM	1	29.151	0.002	refuse

As can be seen from Table 4, in the null hypothesis that dBDM is not the Granger cause of dOTC, the P value of test result 0.438 is greater than 0.05, so the null hypothesis cannot be rejected at the 5% level, that is, dBDM is not the Granger cause of dOTC. At the same time, in the null hypothesis that dOTC is not the Granger cause of dBDM, the P-value of test result 0.002 is less than 0.05, so the null hypothesis can be rejected at the 5% level and the alternative hypothesis can be accepted, that is, dOTC is the Granger cause of dBDM.

4.4 Impulse response analysis

Because dBDM is not the Granger cause of dOTC, only the disturbance of dOTC to dBDM and the disturbance of dBDM to itself are considered. The impulse response analysis results are as follows:

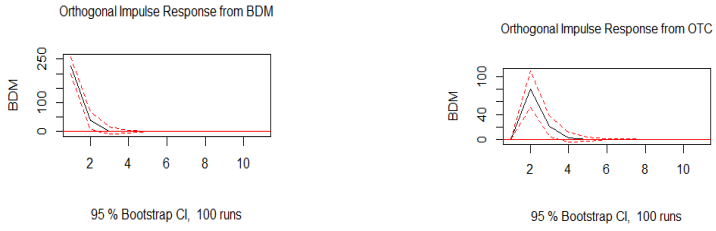

Fig. 2. Impulse response result chart (Photo credit: Original)

As can be seen from Figure 2, the disturbance of the cryptocurrency index to itself reaches the maximum in the first period, then gradually converges, and converges to 0 in the third period. The disturbance of the OTC market to the cryptocurrency market reaches the maximum in the second period, and then gradually converges to 0 around the fourth period.

4.5 Coefficient stationarity test

CUSUM test of recursive least square method is used to determine the stability of the model. The test results are shown in the figure:

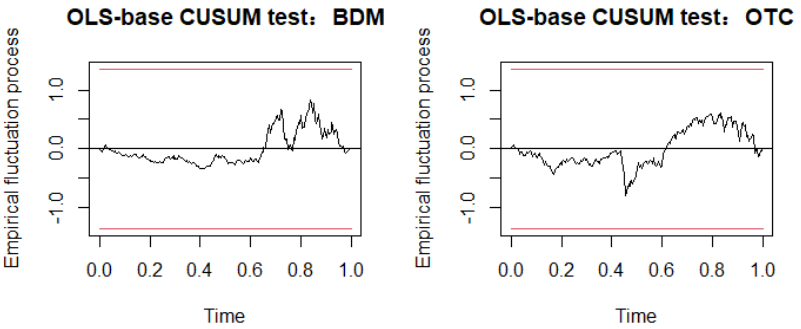

Fig. 3. coefficient stationarity test (Photo credit: Original)

It can be seen from Figure 3 above that the cumulative residual sum of cryptocurrency index and OTC market data is within the critical line, and the coefficient of the current model can be considered to be in a stable state.

5 Conclusions

The empirical analysis results show that the weekly closing price growth of the OTC market is the Granger cause of the weekly growth of the cryptocurrency index, but the weekly growth of the cryptocurrency index is not the Granger cause of the weekly closing price growth of the OTC market. There is a one-way Granger cause between the two. Generally speaking, the change of the OTC market price can promote the change of the cryptocurrency market price.

The reason for this phenomenon may be that the OTC market has a higher trading volume and influence than the cryptocurrency market. In recent years, OTC markets have become more regulated and more suitable for investors. Many start-ups or multinational groups choose to list their shares on the OTC market before listing on the US capital markets. According to statistical data, the proportion of over-the-counter trading in the total stock trading volume of the United States has risen from less than 25% in 2009 to two thirds of the total stock trading volume, and the financing amount has shown a trend of increasing. Compared with bitcoin, which was born in 2008, and the cryptocurrency market composed of more virtual currencies, the OTC market has a higher trading volume and influence. While cryptocurrencies and stocks are viewed as different kinds of assets, the relationship between the two is increasingly close. On the one hand, many countries have developed digital asset management policies similar to stock market regulation, a move that brings cryptocurrencies closer to traditional financial institutions. On the other hand, the OTC market for Bitcoin is at least two to three times larger than the trading market, and most cryptocurrency transactions actually take place over the OTC counter, so the operation and rise and fall of crypto-

currency prices are also closely linked to the OTC market. To sum up, this article discusses the encryption currency index and the correlation between the OTC market, through the establishment of the VAR model, empirical analysis, the results showed that OTC market price changes may affect encryption monetary market price changes, therefore, dynamic encryption currency investors can focus on OTC market, judge encryption price fluctuation in the currency market, Choose the right cryptocurrency.

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