Macro Regulation and Fluctuation of Cryptocurrency Market: Evidence from China

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ABSTRACT

As a new developing financial market, cryptocurrency market is deeply concerned by investors and governments all over the world. However, due to its price instability, encryption and decentralization, the supervision of cryptocurrency has become a difficulty in the development of today's financial market. Different countries adopt different regulatory policies for cryptocurrency, and the regulatory attitude of various countries also affects the development of cryptocurrency market to a certain extent. Among them, China has a decisive influence in the cryptocurrency market with its huge number of cryptocurrency investors. In order to explore whether China's macro regulatory policies will have a significant impact on the cryptocurrency market, this paper studies the impact of China's macro regulatory policies on the volatility of the cryptocurrency market based on ARMA-GRACH model. Eventually, the results show that China's macro regulatory policies have a significant impact on the price fluctuation of cryptocurrency in the short term, but this impact disappears in the long term. Governments are supposed to formulate relevant policies carefully to prevent systemic financial risks, and investors also need to take a correct attitude towards the fluctuation of cryptocurrency.

Keywords ：*GRACH models, cryptocurrency, Marco regulation,*

1. INTRODUCTION

Cryptocurrency is a medium of transaction which based on block chain technology and using cryptography principles to ensure transaction security and control the creation of transaction units. In 2009, Nakamoto has designed the world's first cryptocurrency - bitcoin, which is also the most rapidly developing digital currency at present. Since then, cryptocurrency has come into people's view.

Different from legal tender, cryptocurrency has the characteristics of virtualization, decentralization, anonymity, transparency, encryption, price instability, and so on. It is precisely because of these characteristics that they bring great challenges and opportunities to the global financial market. Without a doubt that cryptocurrency is a breakthrough and innovation of science and technology in the financial field. According to the theory presented by Li Mengqing in 2021, cryptocurrency will break the original international trade transaction mode, and the pricing mode of production raw materials and bulk commodities in international trade will also be changed [1].

In recent time, with the development of society and the rapid growth of the digital economy, cryptocurrency has attracted the attention of the public. However, high returns to cryptocurrency correspond to high risks. While enjoying the benefits, investors also undertake a gigantic risk - the strong fluctuation of cryptocurrency prices. What's worse, the popularity of block chain technology has also led to the chaos of cryptocurrency ICO (initial coin offering) and has exacerbated the threats to the traditional monetary system. Once cryptocurrency breaks away from the existing regulatory system, it will bring great risks to the existing financial system. Therefore, cryptocurrency should be intensively regulated and be correctly guided to avoid enormous economic loss and monetary disturbances. For the good development of cryptocurrency and the maintenance of financial order, China has issued many policies to supervise cryptocurrency.

Different countries hold different opinions and take various actions to cryptocurrency. Even in different periods, identical countries could adopt different attitudes to cryptocurrency, such as China. At the birth of cryptocurrency, China adopted a relatively loose

regulatory policy. In 2013, the Central Bank issued the notice on preventing bitcoin risks with various regulatory authorities. In the next years, the transaction of cryptocurrency in China was very popular, accounting for 70% of the transaction share in the world.

Until 2017, China has implemented strict and conservative regulatory policies to strictly limit the savage growth of cryptocurrency and prevent financial risk. In 2017, the central bank with other regulatory departments issued the announcement of preventing the financing risk of issuing to substitute currency, which explicitly prohibited ICO. In 2019, China Internet Finance Development Association also released the risk tips on preventing ICO and "virtual currency" trading activities in the name of the block chain. In May 2021, the financial commission on the State Council emphasized cracking down on bitcoin mining and trading. The issue of various policies shows the strong regulatory attitude to the Chinese government.

Many scholars have done a lot of research on cryptocurrency fluctuations and government regulation. Some scholars believe that bitcoin may have policy risks [1]. Some research showed that government attitude and regulatory policies have a great impact on the development trend of bitcoin [2,3]. Further research especially emphasized the importance of China, claiming that China's cryptocurrency regulations will propel similar regulations globally [4]. Also, the regulatory policy of bitcoin in China has exacerbated the price fluctuation and market risk level of bitcoin market [5]. According to the theory presented by Kristoufek and Han Yuguang, because bitcoin has a super national sovereign issuance mechanism and trading mechanism, the monetary and fiscal policies of various countries have no significant impact on the price fluctuation of bitcoin, while regulatory policies, transaction demand, exchange rate and other factors have a significant impact [6]. Recent research showed that bitcoin is similar to stocks, is greatly affected by policies, and there is speculative arbitrage in the market [7]. Therefore, it is necessary for the state to strengthen the supervision of virtual currency.

However, their studies only focus on bitcoin while neglecting the whole cryptocurrency market, which is not representative. In addition, little existing literature makes use of ARMA-GRACH models to study the fluctuation of cryptocurrency market.

Up till this point, the latest existing research only stays in 2018 and mostly concentrates on developed country, whether it is research data or research events. There are enormous vacancies in developing countries and in nowadays.

Excluding the impact of Sino-US trade war and COVID-19 on the encrypted currency, this article will focus on the impact of China's macro policy on the cryptocurrency market in 2021.Based on previous studies,

this research will explore the fluctuation of cryptocurrency when facing the macro supervision of the Chinese government by constructing multi-dimensional models. On the one hand, this research hope to enhance the government's understanding of cryptocurrency market, to make regulatory policies play a bigger role in the future and guide the healthy growth of cryptocurrency. Besides, it's meaningful to the legal cryptocurrency regulation in the future. On the other hand, this research also expects investors to raise risk awareness and treat cryptocurrency fluctuation wisely and correctly.

In this paper, we use ARMA-GARCH models with explanatory variables in the variance equation to study the effect of macro regulatory policies on the volatility of cryptocurrency market.

2. METHODS

2.1. data used in this study

Data on this research derived from the investing website from China. On May 18, 2021, China Internet Finance Association, China Banking Association and China payment and clearing Association jointly issued an announcement on preventing the risk of speculation in virtual currency transactions. Then, on May 21, the financial commission of the State Council stressed the crackdown on bitcoin mining and trading, which can be regarded as a rigorous macro regulatory policy. In addition, it is important to avoid the short time series will have an adverse impact on the experimental results. So, in this section, we chose Bitcoin and Cardano as representatives to study the volatility of the cryptocurrency market and collected the closing prices of the two cryptocurrencies from February 16, 2021 to September 16, 2021. Including holidays and weekends, there are 200 groups of valid ,accurate data and what statistical software we use is Stata. The price data are often unstable, while the ARMA process requires that the data should be stable. Therefore, the log difference is made for the daily transaction price to stabilize the yield. The logarithmic rate of return is calculated as following.

$$r_t = ln p_t - ln p_{t-1} \qquad (1)$$

Among this, r_t represents the daily logarithmic rate of return,p_t represents the closing price of the index at time t,p_{t-1} represents the closing price of the index at time t-1.

2.2. the build of ARMA-GRACH models

Introduction to the experiment: According to the goal of this article, we will use the ARMA-GRACH models to estimate our results. What's more, dummy variables are introduced to simulate the volatility of the market in different time periods.

2.2.1. ARMA models

Autoregressive moving average (ARMA) models is a high-precision time series models proposed by statisticians Box and Jenkins in the 1970s. The formula of ARMA models is:

$$x_t = \varphi_0 + \sum_{i=1}^{p} \varphi_i \, x_{t-i} + \alpha_t - \sum_{i-1}^{q} \theta_i \, \alpha_{t-i} \quad (2)$$

$\{\alpha_t\}$ Parameter estimation can only be carried out after ARMA (P, q) is ordered. The common methods of order determination are PACF order determination and information criterion method, and in this study, we adopt PACF criterion to determine the order.

2.2.2. GRACH models

There are many uncertainties in the cryptocurrency market, and its volatility (risk) fluctuates with time. Engle(1982) put forward to the models based on volatility for the first time-autoregressive Conditional Heteroscedasticity(ARCH), which can be are used to explain some time series models with special heteroscedasticity. Bollerslev(1986) improved ARCH and proposed the GRACH models, which reduced the parameters and made the measurement results more accurate. The formula of GRACH models is:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \cdots + \alpha_q \varepsilon_{t-q}^2 + \gamma_1 \sigma_{t-1}^2 + \cdots + \gamma_p \sigma_{t-p}^2 \quad (3)$$

$\{ \ \sigma_t^2 \ \}$ represents the Variance equation, $\{\varepsilon_{t-1}^2\}$ represent the random disturbance,

$\alpha_1, \ \gamma_1$ represent the parameters to be estimated for ARCH and GRACH, respectively.

The simplest GRACH models is GRACH (1,1):

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma_1 \sigma_{t-1}^2 \quad (4)$$

3. EMPIRICAL RESEARCH AND RESULTS

In this research, we chose bitcoin, which occupies the largest proportion in the cryptocurrency market, as the research object to carry out ARMA-GRACH models experiment on the data, and after obtaining the corresponding results, we use the Carnado, which accounts for the second largest market value, to carry out the robustness experiment to test the effectiveness of the experimental results and stability of the empirical results.

3.1. Descriptive Statistics

Descriptive statistics are made based on the logarithmic daily yield series after pretreatment. The statistical results are shown in Table 1:

Table 1. Descriptive statistics of Bicton log yield

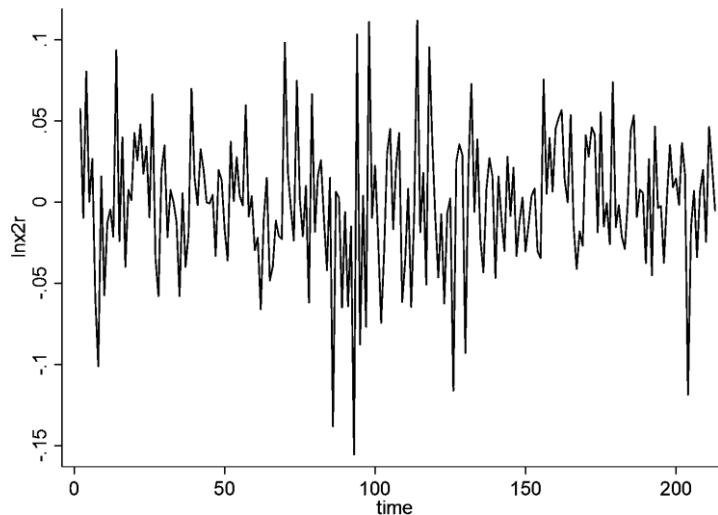| Variable	obs	Mean	Std.Dev.	Min	Max
lnxr	212	0.0033194	0.0590676	-0.3292	0.2307725

Figure 1 Timing chart of bitcoin daily logarithmic yield

From Figure 1, we can see that daily log return fluctuates around 0 and there is a parent characteristic: large fluctuations are accompanied by large fluctuations, and small fluctuations are accompanied by small fluctuations.

3.2. Research Procedure and Results

Firstly, before using the ARMA-GRACH models, we need to carry out stationary test, ARCH test and order determination of ARMA (p, q). Through the Augmented Dickey-Fuller test (ADF), we can see that the probability

value (p) of Bicton corresponding to the t-test is approximately equal to zero which means rejecting the original hypothesis and logarithmic price yield time series is stable（See Table 2 for inspection results）. Then, under the condition of selecting the 12th stage of the lag order, we use information criterion to decide the order determination of AR and draw the graph of autocorrelation coefficient to confirm the order determination of MA.

Table 2 Unit root test

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-9.942	-4.003	-3.435	-3.135

Table 3. ADF test with time trend term in lag period 12

| lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	350.199				0.001782	-3.49199	-3.48532	-3.4755*
1	352.356	4.3144	1	0.038	0.001762*	-3.50356	-3.49021	-3.47058
2	352.764	0.81466	1	0.038	0.001772	-3.49764	-3.47761	-3.44816
3	352.775	0.02306	1	0.879	0.00179	-3.48775	-3.46106	-3.42178
4	353.806	2.0618	1	0.151	0.001789	-3.48806	-3.45469	-3.4056
5	354.308	1.0051	1	0.316	0.001798	-3.48308	-3.44304	-3.38414
6	354.425	0.23355	1	0.629	0.001814	-3.47425	-3.42754	-3.35881
7	354.609	0.36802	1	0.544	0.001829	-3.46609	-3.42181	-3.33345
8	357.187	5.1563	1	0.023	0.001801	-3.48187	-3.42181	-3.33345
9	357.453	0.53017	1	0.467	0.001814	-3.47453	-3.40779	-3.30961
10	359.543	4.1815	1	0.041	0.001794	-3.48543	-3.41202	-3.30403
11	359.844	0.60051	1	0.438	0.001807	-3.47844	-3.39835	-3.28054
12	362.565	5.4424*	1	0.020	0.001776	-3.49565	-3.40889	-3.28126
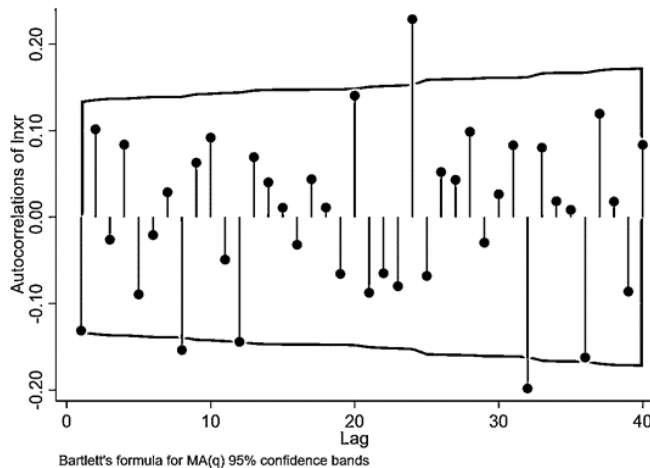
Figure 2 ACF of logarithmic price yield

From the table 3 and figure 2, we ascertain the coefficients of ARMA models and construct ARMA (1,1). After establishing the ARMA models, we calculate the residual errors and test the residual errors with white noise test to judge whether the residual errors are independent or not. According to the results, at the significance level of 10%, the original hypothesis is not rejected, which means there is no sequence correlation in the standardized residual sequence and it proves that the models are adequate.

Normally, when performing GARCH estimation based on ARMA (p, q) models. GARCH (1,1) models describe heteroscedasticity concisely and have good fitting effect. Therefore, in the research on the volatility

of cryptocurrency market, we considered that GRACH (1,1) can well capture the characteristics of time series volatility.

In order to consider whether the volatility of cryptocurrency market increases after China's implementation of regulatory policies, we introduce dummy variables: dummy 1 was introduced to study the changes of market volatility within one week after the promulgation of the policy: within one week of policy publishing, the value of dummy1 is 1, otherwise it is 0. In the same way, dummy 2 was introduced to study the changes of market volatility within two weeks, dummy 3

was introduced to study the changes of market volatility within one month, and X4 was introduced to study the changes since the promulgation of the policy (May 18,2021).

After determining the order for ARMA models and GRACH models, we basically completed the establishment of the models. According to the models we built, we brought bitcoin data on and introduce dummy variables. The model estimation results are shown in the tables.

3.3 Results

Table 4 Variance Equation of Bitcoin

Variables	Bitcoin			
	(1)	(2)	(3)	(4)
Within 1 week=1	1.74**			
	(0.88)			
Within 2 weeks=1		1.31***		
		(0.40)		
Within 3 weeks=1			1.06***	
			(0.23)	
Time point and later=1				0.14
				(0.17)
ARCH	-0.10	-0.10	-0.09	0.005
	(0.02)	(0.05)	(0.04)	(0.034)
GARCH	-0.10	0.17	0.19	0.09
	(0.02)	(0.60)	(0.58)	(5.8)
Constant term	-6.29	-6.56	-6.66	-6.53
	(0.41)	(0.67)	(0.67)	(6.47)

Note: *** most significant at the 0.01 level

** highly significant at the 0.05 level

* Significant at the 0.1 level

From the estimated coefficient value of the variance equation, we can know that Bicton's price fluctuated distinctly due to the issuance of regulatory policy. Under the 95% confidence level, the dummy variable value is 1.74 in dummy1, which is highly significant. Then, under the 99% confidence level, the variable value is 1.31 and 1.06 respectively in dummy2 and dummy3, which are the most significant while the value of dummy4 is not significant. Within one week of the policy release, this fluctuation is the most obvious and strongest. Even after a month, the fluctuation was continuous and significant. However, in the dummy4, the fluctuation is not

significant anymore, which means that the impact of policy release on the Bicton market has basically disappeared.

3.4 Robustness Check

In order to ensure the accuracy and universality of the experimental conclusions, we introduce Cardano (the second largest cryptocurrency in market value), and then use ARMA-GRACH models to study the changes in Cardano volatility before and after the policy release. The experimental results are shown in the Table 5.

Table 5 Variance equation of Carnado

Variables	Carnado			
	(1)	(2)	(3)	(4)
Within 1 week=1	2.47***			
	(0.67)			
Within 2 weeks=1		1.81***		
		(0.47)		
Within 3 weeks=1			-0.03	
			(0.95)	
Time point and later=1				-0.43
				(0.29)
ARCH	0.11*	0.12**	0.15***	0.14***
	(0.06)	(0.06)	(0.06)	(0.06)
GARCH	0.65***	0.59***	0.76***	0.75***
	(0.17)	(0.20)	(0.09)	(0.11)
Constant term	-7.11***	-6.88***	-7.79***	-7.46***
	(0.62)	(0.60)	(0.54)	(0.68)

Note: *** most significant at the 0.01 level

** highly significant at the 0.05 level

* Significant at the 0.1 level

From the estimated coefficient value of the variance equation, we can see that at the 1% confidence level, the variable value is 2.47 and 1.81 in dummy1 and dummy2, which is the most significant. In addition, it indicates that the fluctuation of the Cardano is even more violent than that of the bitcoin and this also shows to a certain extent that bitcoin can better resist the impact of external factors compared with other encryption currency. Then, like Bicton, the wave of the Cardano gradually has disappeared in the long time. So, basically, the conclusion we obtained from bitcoin has been confirmed in Cardano.

The above statistic and empirical research fully verify our assumption: after the introduction of macro regulatory policies, there are obvious fluctuations in the cryptocurrency market, but this exogenous variable is short term and will not affect the price of cryptocurrency in the long run.

4. CONCLUSION

This paper studies the impact of China's macro regulatory policies on the volatility of cryptocurrency market by using ARMA-GRACH models. We can find that:

(1) The price fluctuations of bitcoin and Carnado have volatility aggregation: fluctuations tend to be concentrated and last for a period of time

(2) Strict regulatory policies have an adverse effect on the cryptocurrency market, which will cause a sharp drop in the price of cryptocurrency in a short term. Different cryptocurrencies have different volatility in the face of policy impact, which mainly depends on the stability and maturity of the currency. But this drop and uncertainty will vanish in a long run.

(3) As an emerging investment market, the development of cryptocurrency market is still imperfect and the stability of the market is weak, which makes it much vulnerable to the impact of all parties. What's worse, cryptocurrencies are likely to form a bubble in the boom and fall.

For one thing, the conclusions of this paper supplement the existing literature with empirical evidence on the impact of macro regulatory policies on the volatility of cryptocurrency market; for another thing, it provides suggestions for investors to avoid large economic losses and reminds the state to formulate relevant policies on cautious:

For short-term investors, they can short to sell cryptocurrencies after the promulgation of macro regulatory policies and buy them after the market is stable, so as to make profits and avoid losses; for value investors, the policy release will not affect the value of cryptocurrency; for the country, it is very necessary to

strengthen the supervision of cryptocurrency currency to prevent persistent financial risks caused by the issue of polices.

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