

The Fluctuation of the Digital Currency Share Price under the Expansion of the e-CNY Ecosystem

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Abstract. As our country's legal digital currency, e-CNY will have a fundamental impact on social payment and lifestyle. We construct a Seasonal Autoregressive Integrated Moving Average model by using the closing price of digital currency index from August 5th, 2021 to April 6th, 2022. We show that e-CNY ecosystem expansion events notably improve market confidence in digital currencies, which reflect large deviations from actual value as the predicted value after three ecosystem expansion events. This paper provides a reference for promoting the consensus of legal digital currencies from the perspective of the monetary demand side.

Keywords: e-CNY; Expansion of Ecosystem; Share Prices.

1. Introduction

With the development of blockchain technology, the expansion of e-CNY ecosystem is possible. Over the past decades, e-CNY has had a period of vigorous development. In 2022, e-CNY was admitted by wechat payment and this year, e-CNY was used in Beijing Winter Olympics successfully. At the beginning of 2022, influenced by the epidemic and weak global economy, China's major sector index fell constantly, but after wechat payment system announced to admit e-CNY, digital currency index remained the growth trend for more than a month. Thus, ecosystem expansion events can have great positive impact on digital currency-related stock price. Under the special stock market participant structure dominated by retail investors in China, those investors will be users of e-CNY in the future. As a result, by analyzing the fluctuations of digital currency which can also be reflected in the potential users' confidence on e-CNY, we can find how to effectively promote e-CNY in the whole society.

In the development path of digital currency, China is different from other countries. Qiqi Gao (2020) summarizes the path of China and the United States. He points out that the United States tends to develop and integrate private block chain technology with companies. However, China tends to take the monetary authorities as the main body to promote the sovereign block chain products.

As the representation of private block chain products, Bitcoin faces weak trust problem. Thus feasibility, pricing and trend prediction of private rights digital currencies become research hotspots. Léo Malherbe, Matthieu Montalban, Nicolas Bédu and Caroline Granier (2019) find it is difficult to form a long-term and stable credit for Bitcoins lacking of consensus basis and having self-deflation characteristics. Luca Fantacci (2019) shows that private digital currencies had no unlimited legal compensation, thus such private currencies are not eligible for Hayek currency competition. Basing on rational expectations, BIAIS BRUNO, BISIÈRE CHRISTOPHE, BOUVARD MATTHIEU, CASAMATTA CATHERINE and MENKVELD ALBERT J. (2023) constructs generation overlap model to price Bitcoin and finds that factors outside the fundamentals has also had an impulse on the price of bitcoin. In the digital currencies trend forecast, Jing-Zhi Huang, William Huang and Jun Ni (2019) and Jaquart Patrick, Dann David and Weinhardt Christof (2021) forecast the short-term price trend of bitcoin based on high-dimensional technical analysis and machine learning, respectively.

However, under the digital currency implementation model dominated by Chinese government, e-CNY is expected to have strong credit. As a result, researchers in China focus on top-level design of digital currency, such as legal principles and information technology foundation. Yanchao Yang (2020) make necessary legislative institutional arrangements for the currency attribute, civil rules and regulatory system of digital currency. Qian Yao and Yingwei Tang (2017) summarize smart contract

vulnerabilities in block chain, which may bring uncontrollable consequence when legal digital currency is used. At the level of information technology support, Qian Yao (2018) proposes the AI model design of currency issuance.

According to the existing literature, under strong credit assumption, supply side has already been profoundly analyzed. However, Qian Yao (2018) points that the essence of currency is a social consensus. Thus, the implementation of e-CNY can't overlook demand-side recognition. In the United States demand-side recognition can be observed from the transaction price with the dollar as the value scale. Instead, Dong Yang and Zheli Chen (2020) point that e-CNY is digitized cash. Xiangguang Chen and Zeqing Huang (2018) show that e-CNY could not take itself as the measure of value. Thus, methods to measure Bitcoins value may not be used to measure e-CNY value, which means that it is hard to estimate attitude on e-CNY from demand-side. This paper tries to analyze enterprises that provide technical support for the e-CNY by using their share prices-digital currency index. As retail private investors, the major participants in Chinese stock markets will also be future users of e-CNY. So, by using share fluctuation information, we can analyze people's attitude to e-CNY. Frankly, private electronic payment has already occupied market. As a result, e-CNY might have an effect on third-party private electronic payment system alternatives which is pointed by Dian Liu (2021). Therefore, with the specific e-CNY ecosystem expansion event as an impulse, especially considering the event of wechat as a widely used payment system in society announcing to support e-CNY, we can directly measure people's expectations on e-CNY and provide convenient suggestions on correctly solving relationship between third-part payment system and e-CNY and find useful on booming development of e-CNY.

2. Data and the Study Design

2.1 Study Design

This paper aims to examine market investors' reaction to expansion of e-CNY ecosystem. Therefore, the impact of exogenous variable impact on stock price is the research emphasis. To be able to quantify the impact of this shock, we use machine learning to construct the simulated value and the true value in the absence of exogenous impact and compare them. Due to the seasonal fluctuations of stock prices and the characteristics of the time series, we choose Seasonal Autoregressive Integrated Moving Average (SARIMA) as research model.

Seasonal Autoregressive Integrated Moving Average is one of the time-series prediction methods. As the expansion of ARMA model, SARIMA model contains differential order terms and seasonal factors that can better predict the trend of real data. The basic model is SARIMA(p,d,q)(P,D,Q,T).

To precisely examine the influence on stock price brought by e-CNY ecosystem expansion event, we try to get rid of the influence of market index sharp fluctuations. Thus, we use the five months difference sequences between the closing price of the digital currency index and the closing price of the Shenzhen Composite Index before ecosystem expansion to construct SARIMA model. Then we can retro predict the digital currency sequences after the expansion of the e-CNY ecosystem. The predicted value of the SARIMA model is taken as the theoretical value of the price of the digital currency plate without the expansion time of e-CNY ecosystem. And the difference between the predicted value and the actual value is the value affected by the expansion of e-CNY ecosystem. Using these data, we confirm the influence degree brought by such kinds of events.

2.2 Data Sources and Description Statistics

The expansion of the broad e-CNY ecosystem refers to the expansion of the application scenarios of e-CNY, including the process of e-CNY development from theory to practice, such as e-CNY is used for shopping, e-CNY is admitted by electronic payment systems and the government system uses e-CNY to carry out tax settlement. One of the e-CNY ecosystem expansion focal points is in January 2022. On January 4th, 2022, e-CNY APP (pilot version) successfully upgrades and the major Android app stores are open for download. On January 6th, 2022, WeChat platform which belongs

to Tencent begins to provide e-CNY service. In a short period, plenty of ecosystem expansion events have had a great influence on digital currency index. Therefore, we choose January 6th, 2022 as a time node and use daily closing prices data of digital currency index from August 5th, 2021 to April 6th, 2022 (except on weekends and holidays), A total of 160 sets of data to construct model. All closing prices come from the Flush APP.

In order to include the impact caused by market index, we choose Shenzhen Composite Index as market index, for digital currency index containing shares of 71 listed companies of which have 59 shares (83%) belongs to the main board of the Shenzhen Stock Exchange. Therefore, Shenzhen Composite Index might have direct influence on digital currency index.

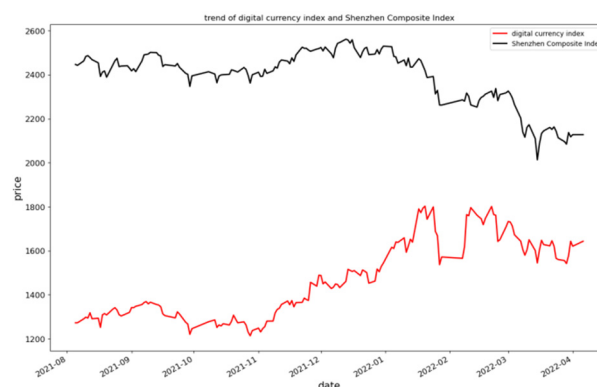


Fig 1. Trend of digital currency and Shenzhen Composite Index

Prices of the digital currency index are shown in Figure 1. It shows that digital currency index maintains growth trend from 2021 August to 2022 April, which reflects that market participants own positive expectations on development of e-CNY. At the same time, there is a long and prolonged decline on Shenzhen Composite Index. Although investors' pessimism is highly contagious during this term, prices of digital currency index still growth at the beginning of January and quickly recover from depression of Shenzhen Composite Index. Those facts strongly prove that expansion of e-CNY ecosystem can effectively enlarge society confidence on future of e-CNY and make obvious positive influences on digital currency index.

3. Modeling Process and the Empirical Results

3.1 Stability Testing

To prevent pseudo-regression, an ADF stationarity test is performed on a differential sequence between digital currency index and the Shenzhen Composite Index (the test results were shown in Table 1). The difference sequence is non-stationery and P-value is 0. 5325. However, their P-value of first order difference is 0. 000 so the first-order difference sequence is stable. As a result, the differential sequence between digital currency index and the Shenzhen Composite Index is a first order single whole sequence, and d in SARIMA model will use 1.

Table 1. Results of ADF Testing

ADF Testing	Variable name	
	<i>Shenzhen Composite Index and digital currency index D-value</i>	<i>Shenzhen Composite Index and digital currency index the first-order difference of the difference value</i>
Test Statistic	-1.5021	-17.4516
P-value	0.5325	0.000

3.2 Model Estimation and Constructing

As can be seen from Figure 2, the time series correlation diagram of the difference between the closing price of the digital currency plate and the closing price of the Shenzhen Composite Index after the first order difference has the characteristics of tail decay, which is suitable for the establishment of SARIMA model.

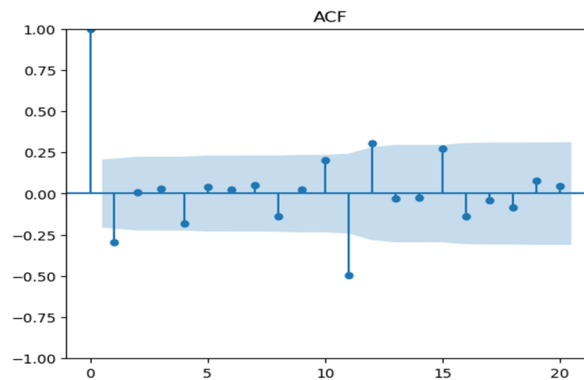


Fig 2. ACF results of first order difference

To determine the order of the SARIMA model, we rely on the AIC information criterion in the maximum likelihood order method and implement the traversal using python. After comparing each value, we choose value of p equals to 5 and value of q equal to 3. The paper constructs the SARIMA (5,1,3) (0,1,1,12) model.

Using Python software, we constructed parameter estimation and SARIMA model, and the regression results of ARIMA (5,1,1,3) (0,1,1,12) model of the price difference of digital currency plate and the price of Shenzhen Composite Index are shown in table 2.

3.3 Model Testing

From the table 2, except coefficient of ar. L3 and ma. L1 have just a few deviations, other lag term coefficients are both within the 15% significant range, which reflects that the model has a great fit.

Table 2. Results of SARIMA Model

variance	Statistical Magnitude		
	<i>Coefficient</i>	<i>Z-value</i>	<i>P-value</i>
ar.L1	-0.6081	-2.974	0.003
ar.L2	-0.9388	-5.566	0.000
ar.L3	-0.2714	-1.112	0.266
ar.L4	-0.3497	-1.932	0.053
ar.L5	-0.2290	-1.430	0.153
ma.L1	-0.5548	-1.137	0.255
ma.L2	0.4423	1.913	0.056
ma.L3	-0.8679	-2.009	0.045
ma.S.L12	-0.7250	-3.905	0.000
sigma2	0.0238	1.899	0.058

In order to further test the validity of the model, LB statistics is used to test for its residuals for the presence of sequence autocorrelation. As a result, Q value is 0.02 and P-value is 0.09. The null hypothesis cannot be rejected which shows that the residual of this regression result is a white noise sequence with pure randomness and the model is feasible.

3.4 Model Prediction Analysis and Comparison

Based on SARIMA model, we gain theoretical values of the first-order difference and restore them as difference closing prices between digital currency index and Shenzhen Composite Index. With actual closing prices of Shenzhen Composite Index between January 6th and April 6th, we calculate the predicted price trend of the digital currency index.

Using SARIMA model to make retroactive prediction after the events of e-CNY ecosystem expansion are announced. And the difference between predicted value and actual value is the part that is affected by news of e-CNY ecosystem expansion. If such d-value is positive number, it will mean that such kind of event make a positive impulse. If such d-value is negative number, it will mean that such kind of event hit down on the confidence of market participants.

3.5 Retroactive Prediction

Using this model to make a dynamic prediction for three months after e-CNY ecosystem expansion, we show that the actual value and the theoretical value are quite different and positive in most of the time which means these events have already made positive impulses on digital currency index. What's more, trend of predicted value is similar to the actual value shows that our model can effectively contain market index influence and measure special events' impulse precisely.

Table 3. Part of Comparison Between Prediction and Fact

date	Statistical Magnitude	
	<i>Difference between prediction and fact</i>	<i>Percentage of difference</i>
1/14	45.23	2.76%
1/17	159.09	8.89%
1/18	149.94	8.46%
1/19	193.09	10.77%
1/20	224.65	12.46%
1/21	197.34	11.32%
.....		
2/9	288.85	16.37%
2/10	297.92	16.94%
2/11	374.92	20.87%
2/14	350.26	19.88%
2/15	311.25	17.75%
2/16	290.52	16.64%
.....		
3/10	283.98	17.71%
3/11	318.52	19.30%
3/14	332.99	20.80%
3/15	372.87	24.14%

From figure 3 and table 3. Early in January, 2022, under the background of e-CNY APP updating and wechat admitting to support e-CNY, market participants keep optimistic attitude for these e-CNY ecosystem expansion events. As a result, the difference showed its first peak in mid-January. After January 17th the interval of the difference soared from (0,60) to (150,250) and deviation between prediction and actual price exceed 13%. Early in February, 2022, along with the Beijing Winter Olympics holding, e-CNY is closed for trial operation in Beijing Winter Olympics venues. Expansion of e-CNY ecosystem is truly accessing to the social value. In the first round of upsurge based obtained superposition, difference keeps positive trend. Around February 11, difference break through 300,

and deviation degree goes to 20%. In March, Russia is kicked out of the SWIFT system, investors shape a cognition that Chinese government shall vigorously develop channels for payment and settlement. And e-CNY may become an important medium for RMB internationalization. With expectation of acceleration of e-CNY using, the index of digital currency faces the third wave of rising peak. The difference rises from around 200 to nearly 372 on a single day on March 15 and deviation secondly exceeds 20%.

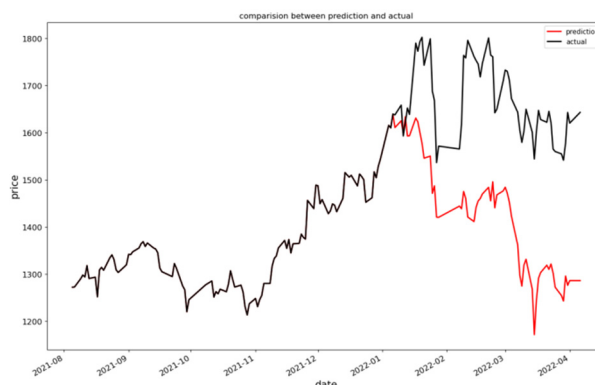


Fig 3. Trend of prediction and fact

4. Conclusion

Under the background of e-CNY ecosystem expansion, we construct SARIMA model using the closing price of digital currency index. The stock price of digital currency plate is retrospective forecast. Comparing the difference between the predicted values and the actual values, we find that there are positive impacts on digital currency index created by e-CNY ecosystem expansion events with a longer influence time. Recently NPC and CPPCC emphasize on promoting development of digital economy. As the financial infrastructure of digital economy, e-CNY certainly will extend to the whole country.

From investors' perspective, this paper proves impacts of market on individual shares for considering the impacts of Shenzhen Composite Index, the trend of forecast results is similar to the trend of real stock prices. What's more, the impact of special events provides certain theoretical basis for investors' investment decisions. Meanwhile, from government's perspective, under conditions of modern credit currency, e-CNY cannot extend without common recognition and confidence. As reflection, price of digital currency index may partly give expression to people's expectations on development of e-CNY. This paper shows that if our governments want to implement and widely use e-CNY for the whole society, they need to build a broader e-CNY ecosystem and expand the corporation with payment platforms and financial enterprises. Such kind of efforts will match payment habits of Chinese residents and create a suitable ecosystem which can effectively promote development of e-CNY.

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