

# The Research on the Money Supply of Central Bank Digital Currency

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**Abstract:** Currently, the only central bank digital currencies (CBDC) in the world is Venezuela's currency—Petro. Nowadays, the IMF, BIS, and major countries have conducted a lot of research on CBDC. It's an urgent issue for the central bank to issue CBDC, determine and formulate the circulation of CBDC and the issuance speed, and supervise it. Therefore, establishing ARMA and VARs by sorting out literature, the paper uses the characteristics of CBDC—cash, and similarities with third-party payment in terms of payment to determine the circulation of CBDC by third-party payment users and currency in circulation. The model calculates and predicts the speed of circulation of digital currency. The issuance of CBDC will accelerate the circulation of money. In this regard, we will explore the impact of money supply on monetary policy and make relevant recommendations.

**Keywords:** Money supply; Central bank digital currency; ARMA model VAR model

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## 1. Introduction

With the emergence of bitcoin a few years ago, digital currency has gradually entered the field of vision.

Bitcoin is a cipher currency generated by block chain technology. People can freely participate in the bitcoin transaction, and the record information generated by each exchange will be broadcast to the whole network and will be collate on the only data chain of the whole network. Therefore, bitcoin has the characteristics of anonymity and security. However, the bitcoin system has a serious defect: firstly, a large amount of energy is consumed to produce bitcoin and secure the safe circulation of bitcoin; secondly, the throughput of the system is very low, and it is difficult to support the daily transactions of the legal money.<sup>[1]</sup>(Qin Bo, 2017, "Bitcoin and Digital Fiat Currency", "Journal of Cryptologic Research"). And there is a great credit risk. Though, it is difficult to be widely used in economic activities.

In this paper, the central bank digital currencies (Hereinafter referred to as "CBDC") is defined as the legal currency issued by the central bank, which represents the

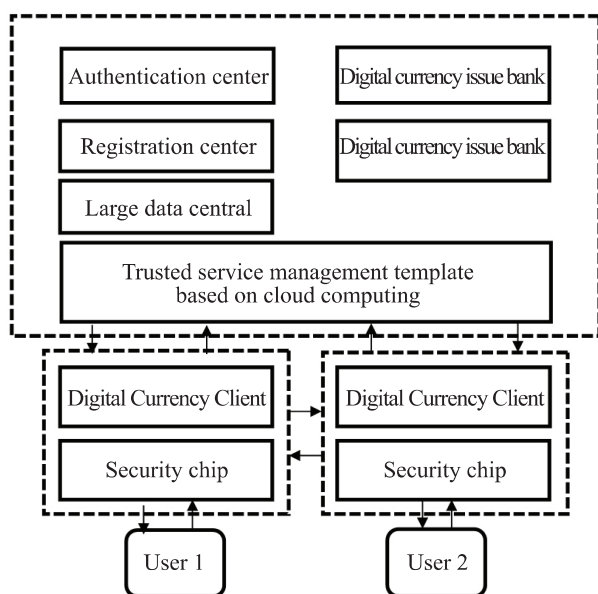
specific amount of value by encrypted numeric string. It is not a physical entity itself, nor a physical entity as a carrier, but a digital information, which is used for network investment, trading and storage, and represents a certain amount of value. (Liu Xiang min, 2016, "The legal issues of issuing digital money by the central bank", "China finance" seventeenth phase, 17 to 19 pages<sup>[2]</sup>).

At present, the only CBDC in the world is the "Petro", introduced by Venezuela, which will be supported by resources such as oil and gold. The Venezuelan government hopes to save money system which is deeply in the face of inflation and collapse. In addition to Venezuela, Russia, Israel and other countries are also planning to issue their own CBDC in order to resist economic sanctions from the West. Sweden, Singapore and other countries also plan to issue CBDC instead of traditional currencies due to the decrease in cash usage.

Taking Venezuela for example, the country's "Petro" uses the ERC20 standard, which is pre mined and issued by the government. And it will be traded on the two-level market at both national and international digital encryption currency exchanges. Although, the Venezuelan gov-

ernment has repeatedly said it is the first digital currency supported by sovereign states and resources such as oil and gold in the world. But its essence is similar to stocks or bonds, which is quite different from the CBDC defined in this paper. The digital currency ecological environment is still in the process of construction and perfection, and its explicit issuance and supervision system can't be known.

According to the results published by the central bank's digital money research project group, the preliminary conception of the CBDC prototype is shown in Figure 1, consists of a template, two libraries, and three centers, which connect the mobile terminal of the user to issue and circulate the digital money. At the same time, this paper will be based on the assumption that the central bank is the only subject of issuing, and the multi- basis of "Central Bank - Commercial Bank" will be discussed.<sup>[3]</sup> (Qiu Xun, 2017, "China Central Bank issues digital money: path, problem and coping strategy", "southwest finance" third issue)



**Figure 1.** Central Bank Digital Currency Prototype Concept

Under this model, the CBDC has both advantages of digital currency while solving its loopholes in regulation and circulation.

At present, the research on CBDC mostly stays in the mechanism of issuing and supervising, but not quantitative research on the supply of legal digital money. In this paper, we assume that the initial issuance of statutory digital currency is 2 trillion and 420 billion 21 million yuan in 2018. Through mathematical modeling, we will further study the determination of the supply of legal digital money.

## 2. Review

For the issuance and circulation of central bank digital currencies(CBDC), academics, central banks and governments are mostly at the theoretical stage.

### 2.1 Status Quo of Central Bank Digital Currencies Research

Domestic and foreign research on CBDC is basically based on macro-impact perspectives. It studies the issue model of CBDC, the implications of CBDC circulation, the risks that CBDC will bring in the market circulation, and how to prevent the risk of CBDC.

Organizations such as G20 and IMF have conducted corresponding research and discussion on the issuance and circulation of CBDC, especially cross-border payment systems. There are three modes for the global cross-border payment path. The first one is led by the International Monetary Fund and all member states are involved. The second is the CBDC cross-border payment form in which the major countries are dominant and other countries participate in voluntary participation. The third kind is a form of payment in which both the IMF and the state participate. Each major country is also learning and storing related knowledge and technology among its own. In the research on the issuance of legal digital currency system in China, there is a central system and a binary system. The one central system is issued by the central bank directly to the masses. The binary system is for the central bank to entrust commercial banks to issue CBDC to the public.

The UK conducted a study on the impact of the issuance of CBDC in 2016 and published a related paper - "Macroeconomics of the Central Bank's Issuing Digital Currency". The study found that the issuance of CBDC could improve GDP for the financial sector. Tax and currency costs have a certain impact, and can significantly increase the central bank's ability to stabilize the economic cycle.<sup>[4]</sup> (John Barrdear and Michael Kumhof, 2016, 7)

The issue of CBDC, scholars carried out relevant research, think that the convenience and benefits brought by it are larger than the paper money, but the risks cannot be ignored. For example, the application of laws and regulations is low, and the regulatory system is not perfect; hardware and software systems of CBDC have high requirements because there are certain distances in technology implementation; financial risks such as money-laundering crimes will be amplified.

Some countries have studied laws and regulations concerning CBDC, and have conducted certain legal supervision on CBDC: Russia is about to enact laws and regulations on digital currency policies; states in the United States have submitted digital currency proposals; Swiss government also had a research on CBDC laws.

Some scholars also put forward corresponding supervision measures on related risks. There are five forms of supervision over digital currencies in various countries: moral advice, market access, improvement of existing laws and regulations, general supervision, and total prohibition. By referring to the supervision of digital currency, some suggestions are made on CBDC: improving the legal system and regulatory framework, promoting technical upgrading, implementing targeted supervision and ensuring the effectiveness of monetary policy.

## 2.2 Status Quo of Central Bank Digital Currencies Supply

This article focuses on the determination of CBDC supply method. Some scholars have made more precise explanations on the definition and circulation of CBDC. Baoshan Chen (2017)<sup>[5]</sup> believes that the principle of issuance of CBDC embodies the essence of currency and believes that its issuance must be under the category of national currency. Wenting Li<sup>[6]</sup> thinks that CBDC itself is cash that can be paid.

Furthermore, by analyzing the currency circulation speed, we can see that the role of CBDC in replacing electronic money is obvious. Priyatama (2010) and Apriansah (2010) studied the currency market in Indonesia and believes that the use of electronic money will greatly speed up the circulation of cash, thus reducing the cash holdings. Domestic scholars also conducted similar research. Xue Yu (2012)<sup>[7]</sup> studied the influence of electronic money on money demand from Friedman's Demand Theory, Keynesian Money Demand Theory, and Fisher's Equation Theory. The conclusions derived from formula derivation are generally consistent with the conclusions and expectations. Guangyou Zhou (2007)<sup>[8]</sup> not only demonstrated the correlation between money demand and currency circulation speed, but also further empirically analyzed the impact of electronic money on the velocity of money circulation at all levels. Yongjun Zhao (2014)<sup>[9]</sup> analyzed monetary policy from the perspective of internet finance, and took third-party payment as an example to analyze and draw the conclusion that the circulation rate of broad money will decline, but no relevant arguments have been made for cash and narrow money.

Since the statutory digital currency has not yet been issued, considering that the effect of CBDC is similar to cash that can be paid and the payment currency is similar to the third party in terms of convenience and so on. Therefore, with the aid of cash supply and the impact of third-party payment on the impact of the money demand model, this paper measures and predicts the impact of CBDC on the impact of the money demand model to determine the supply of legal digital currency.

## 3. Research on the relationship Between the legal digital currency and the circulation of money

In the study, we focus on the money supply of legal digital currency. However, the velocity of circulation is not well researched previously. Luckily, we find that legal digital which combine advantages of cash payment and third-party payment, have the basic function of cash and electronic payment method in the third part. Therefore, the velocity of circulation of legal digital currency could refer to the velocity of third-party payment.

### 3.1 There Are Many Similarities Between the Third-Party Payment and the Legal Digital Currency

For one thing, there is no difference between the two in the aspect of several functions of money. As an electronic form of traditional currency, third-party payment is only a trading medium of traditional currency, which does not affect the function of currency. The legal digital currency, as the legal tender of our country, obviously has the same function. For another thing, both are based on the development of Internet computer technology. In terms of velocity of circulation, third-party payment is not much different from legal digital currency in users' experience. In third-party payment, consumers and merchants complete the transaction through the intermediary of the third-party payment agency. In the use of the legal digital currency, the point-to-point transaction eliminates the third-party payment agency. But the users' experience is almost the same for both consumers and businesses.

### 3.2 The Calculation of the Circulation of Legal Digital Money

The legal digital currency has the basic function of money and is managed by the central bank, which has the credit of the government. So, before the determination of legal digital currency in circulation, this article will refer to the circling velocity of the third party to determine the cash in circulation the number of Internet users use percentage to determine legal digital currency circulation to calculate the initial issue amount of legal digital currency. Set  $y$  as the initial legal digital currency circulation.  $M_0$  in circulation in 2016 is 6830387 billion yuan, and in 2016, the third-party payment of Internet users is 490 million. In 2016, the number of China's population is 1.383 billion. The legal digital currency circulation formula is as follows:

$$y = M_0 * \frac{q}{p}$$

The numerical value is calculated by the formula.

$$y=68303.87*4.9/13.83= \text{¥} 2420.021 \text{ billion}$$

Reasoning after the above formula calculated roughly,

demand for legal digital currency is ¥2.420021 trillion in 2016. Due to the use of third party payment of Internet users accounted for calculating the circulation of legal digital currency, therefore, the legal digital currency circulation that is calculated by the formula assuming the volume of the third party payment of Internet users to be converted into the demand of the legal digital currency. Therefore, the legal digital currency circulation is the maximum of the legal digital money demand according to the formula.

### 3.3 Theory and Model Assumptions

Since the digital currency has not been released yet, there is no data for the time being, so it is not possible to model the time series directly according to the digital money quantity. Consider the similarities between the third-party payment currency and the convenience of the digital currency, therefore this article takes into account the impact on money demand model with third-party payment currency measure and forecast the influence of monetary shocks on money demand model assuming the velocity and impact of shocks are the same between third-party payment and digital currency.

According to Keynes's monetary demand model, monetary demand is related to inflation, interest rates and GDP. This paper ignores the impact of inflation and interest rates on the demand for money in short-term digital currencies, or between 2010 and 2017, when China's inflation and financial asset prices remained stable. The issue of digital currency, as well as third-party payment transactions in currency trading, formed a part of the  $M_0$ ,  $M_1$  and  $M_2$  in currencies into  $M_0$ , and money velocity also changed correspondingly. This paper creatively divides the  $M$  into  $M_0$ ,  $M_1$  and  $M_2$  in the Keynesian monetary demand model, and respectively multiply the contribution coefficient  $a$ ,  $b$ ,  $c$  for the GDP circulation, so that the model can be established as follows:

$$\frac{aM_0 + bM_1 + cM_2}{P} = VY$$

Further, the above can be rewritten as:

$$\frac{aM_0}{P} = V_0Y$$

$$\frac{bM_1}{P} = V_1Y$$

$$\frac{cM_2}{P} = V_2Y$$

In the short term, monetary liquidity increases due to third party payment, If  $M_0$  is not controlled in time, the

money supply will exceed demand in the long term, causing inflation and other phenomena. However, this is only the result of the application of the formula, and it is necessary to further examine whether such influence exists in reality and the direction of this effect.

### 3.4 The Empirical Analysis of the Influence of Third-Party Payment on the Velocity of Money Circulation

#### 3.4.1 A Brief Introduction to the Empirical Analysis

On one hand, map the variables after the removal of seasonal effects, according to the trend term and intercept term, the ADF (Augment dickey-fuller) test was performed. On the other hand, the ARMA (Auto Regression Moving Average) model is established with a stable variable, and the model is used for prediction and analysis. What is more, the model of the Vector Auto Regression model is established, namely, the promotion model of AR, to examine the relationships of the endogenous variables and make a dynamic prediction

#### 3.4.2 Variable Selection and Data Source

Empirical study involved five variables in all, including GDP,  $M_0$ ,  $M_1$ ,  $M_2$ , recycle its work out corresponding variables, namely the money velocity  $V$ , this paper adopts the quotient of GDP and currency. Due to the difference in the monetary level, the corresponding velocity will be different. Therefore, the velocity of money circulation at different levels is interpreted in terms of  $V_0 = \text{GDP}/M_0$ ,  $V_1 = \text{GDP}/M_1$ , and  $V_2 = \text{GDP}/M_2$ , which is derived from the national bureau of statistics. Another variable is the influence factor  $e$  of the third-party payment to the traditional payment, and the total amount of third-party Internet payment is selected from Analysis International. Since Internet payments are ascendent, the data range is from the fourth quarter of 2010 to the third quarter of 2017.

#### 3.4.3 Stationarity Test of Time Series of Each Variable

Before further research on the data, it is necessary to determine the stationarity of the sequence. Since the data selected in this article are quarterly, in order to guarantee the time series stationarity, according to the experience of the existing research,  $v_0$ ,  $v_1$ ,  $v_2$ , MOBPAY respectively take logarithm  $\ln v_0$ ,  $\ln v_1$ ,  $\ln v_2$ ,  $\ln \text{mobpay}$  to enhance stability. Below  $\ln v_0$ ,  $\ln v_1$ ,  $\ln v_2$ ,  $\ln \text{mobpay}$  time series stationarity is studied. First, use Eviews to map each variable to determine whether there is a trend item and intercept term to ensure the accuracy of ADF test. From the graph, each variable has a trend and intercept term. The ADF can be used to test the stationarity test according to the characteristics of each graph, and the changes of each variable are shown in figure 2, figure 3 and figure 4.  $\ln v_0\_sa$  and  $\ln v_1\_sa$  were stable after seasonal adjustment of 10% significance level. After the first order difference  $\ln v_0\_sa$ ,

lnv1\_sa, lnv2\_sa under 5% significance level is smooth.

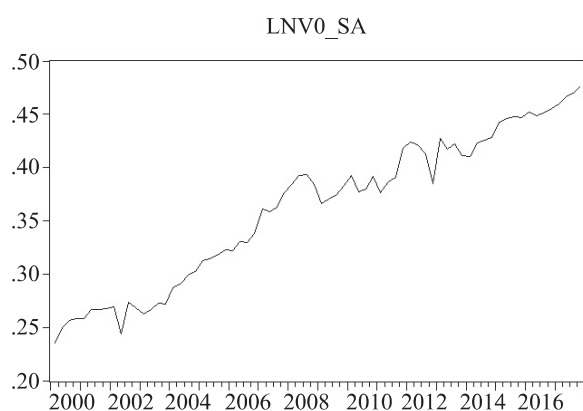


Figure 2.

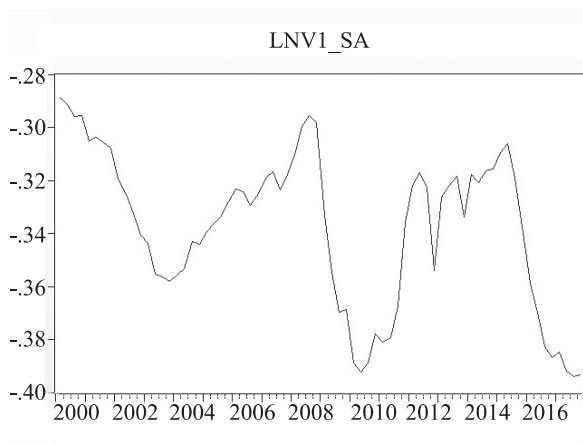


Figure 3.

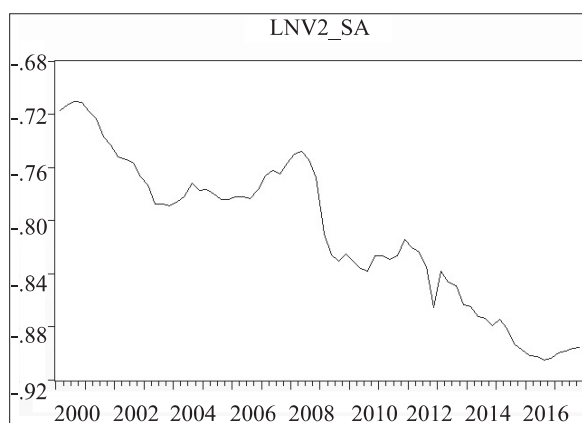


Figure 4.

Because the seasonal adjustments may cause ADF test, use the function in Eviews 9.0 of X12 Seasonal adjustment to realize the seasonal adjustments of data. Judging from Q statistics which is the complicated index of sea-

sonal adjustments, accept or not. If  $Q < 1$ , then accept.

Table 1. The seasonal adjustment test

Variables	Judgments	Q statistics
lnv0_sa	Accept	0.39
lnv1_sa	Accept	0.32
lnv2_sa	Accept	0.30

3.4.4 Build the ARMA model

1) According to the results of ADF test lnv0\_sa, lnv0\_sa can be initially determined to be stable. Therefore, the self-correlation and partial correlation coefficient of the variable is studied, and the results show that the partial correlation exists at the end of the first order. Then the ARMA model of AR(1) is tried, and AR(1) is appropriate according to the minimum principle of AIC and SC information and the stability of the model. The equation is

$$\hat{y}_t = 0.357565 + 0.994565y_{t-1}$$

Where y is lnv0\_sa and the subscript t is the period t, and u is the residual.

Table 2. AF and PAF of lnv0\_sa

Autocorrelation	Partial Correlation	series	AC	PAC	Q-Stat	Prob
. *****	. *****	1	0.945	0.945	66.962	0.000
. *****	. .*	2	0.901	0.084	128.80	0.000
. *****	. . .	3	0.859	0.002	185.84	0.000
. *****	. . .	4	0.821	0.011	238.61	0.000
. . .	. . .	32	-0.151	-0.022	611.56	0.000

Table 3. ARMA(2,1) of lnv0\_sa

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.357565	0.100972	3.541215	0.0007
AR(1)	0.994565	0.021497	46.26590	0.0000
SIGMASQ	0.000129	1.45E-05	8.907370	0.0000
R-squared	0.973336	Mean dependent var		0.361728
Adjusted R-squared	0.972563	S.D. dependent var		0.070020
S.E. of regression	0.011598	Akaike info criterion		-5.972327
Sum squared resid	0.009282	Schwarz criterion		-5.877466
Log likelihood	218.0038	Hannan-Quinn criter.		-5.934563
F-statistic	1259.388	Durbin-Watson stat		2.337515
Prob(F-statistic)	0.000000			
Inverted AR Roots	.99			

From the AF and PAF graph of lnv0\_sa residual, the residual does not appear any AF or PAF. It must be a white-noise series. So, the model is appropriate. The following graph depicts the estimation of lnv0\_sa in 2018.

2) Since the P value of lnv1\_sa is not significant under the ADF test, it cannot reject the unsteady original hypothesis, so the ARMA model is established with a stable first-order difference Dlnv1\_sa. According to the minimum principle of AIC and SC information and the stability of the model, it is appropriate to establish ARMA(1,2) without intercept term.

$$y_t = -0.726897y_{t-1} + 1.094688u_{t-1} + 0.493064u_{t-2}$$

3) Similarly, since the P value of Inv2\_sa is not significant under the ADF test, it cannot reject the unsteady original hypothesis, so the ARMA model is established with a stable first-order Inv2\_sa. It is appropriate to establish ARMA(1,2) according to the minimum principle of AIC and SC information and the stability of the model.

$$y_t = -0.003 - 1.605y_{t-1} - 0.5y_{t-1} + 0.221y_{t-1} + 1.826u_{t-1} + 0.941u_{t-2}$$

(0.001) (0.124) (0.231) (0.127) (0.029) (0.027)

### 3.4.5 Establishing the VAR model

The VAR model and ARMA model are different from the requirements of the assumption of variable stability. Multivariate autoregressive model is the most dependent variable for the early information of independent variables, and the dependent variable is required to pass granger causality test. Because Internet payment appears late, so choose the fourth quarter of 2011 to 2011 in the third quarter of the four indicators Inv0, Inv1, Inv2, Inmobpay quarterly value, using VAR model to measure Inmobpay Inv0, Inv1, Inv2 dynamic effect.

First, we use the VAR function in Eviews to determine the lagged order number. Based on the minimum considerations of AIC, SC and LR, select the most appropriate order. In the table, addind \* represents that the lag order selecting is according to the test criteria, and the second order delay term is selected for the three VAR models.

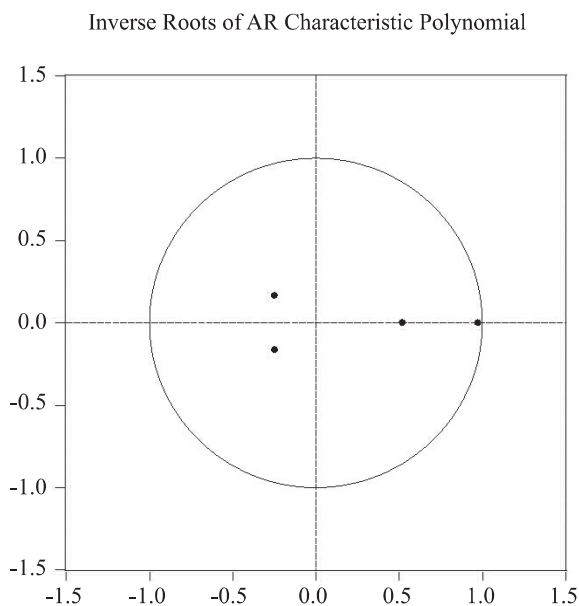


Figure 5. Root test of VAR model of Inv0 and Inmobpay

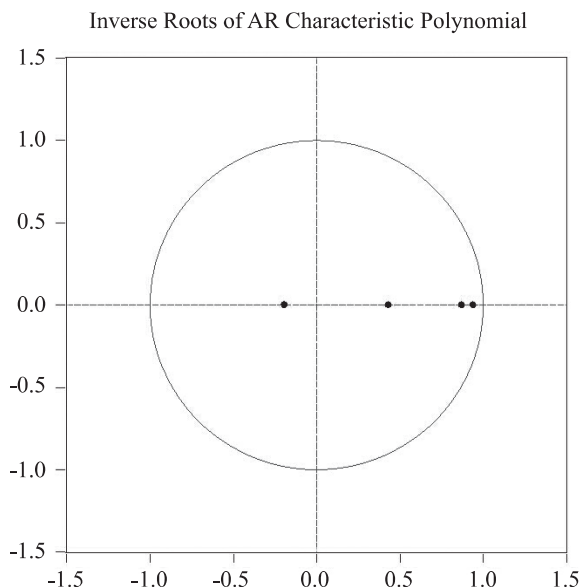


Figure 6. Root test of VAR model of Inv1 and Inmobpay

It can be seen from the graph that the reciprocal absolute value of the characteristic root of AR equation is less than 1, namely, in the unit circle, the model is stable.

Granger Causality Tests to test whether the independent variable has a so-called "causal" relationship to the dependent variable. It is defined as, if the conditional distribution of  $y_t$  determined by the lagged value of  $y_t$  and  $x_t$  is the same as the condition distribution of  $x_t$  determined by the lag value of  $y_t$ , that is:

$$f(y_t|y_{t-1}, \dots, x_{t-1} \dots) = f(y_t|y_{t-1}, \dots)$$

It is said that  $x_{(t-1)}$  has granger causality for  $y_t$ . The original hypothesis of granger causality test is that the independent variable has no granger causality effect on the dependent variable.

It can be seen from the following table that Inmobpay has a significant p value for Inv0 granger causality test, rejecting the original hypothesis and having a "causal" relationship. Inv0 has a p value of over 5% for Inmobpay, and it is difficult to reject the original hypothesis. In the same way, Inmobpay has a significant p value for Inv1 granger causality test. In contrast, Inmobpay does not have a significant p value for Inv1 granger causality test, so VAR model cannot be established.

At last, VAR estimation equation is used to establish the VAR (5) model. List according to the equation of the parameter t test results may not be significant owing to not screening out. Because VAR model does not value individual test results, but the overall effect of the model. Not to analyze the significance of the equations, but to analyze

the analysis, variance, and impulse response.

**Table 4.** Granger Causality Tests

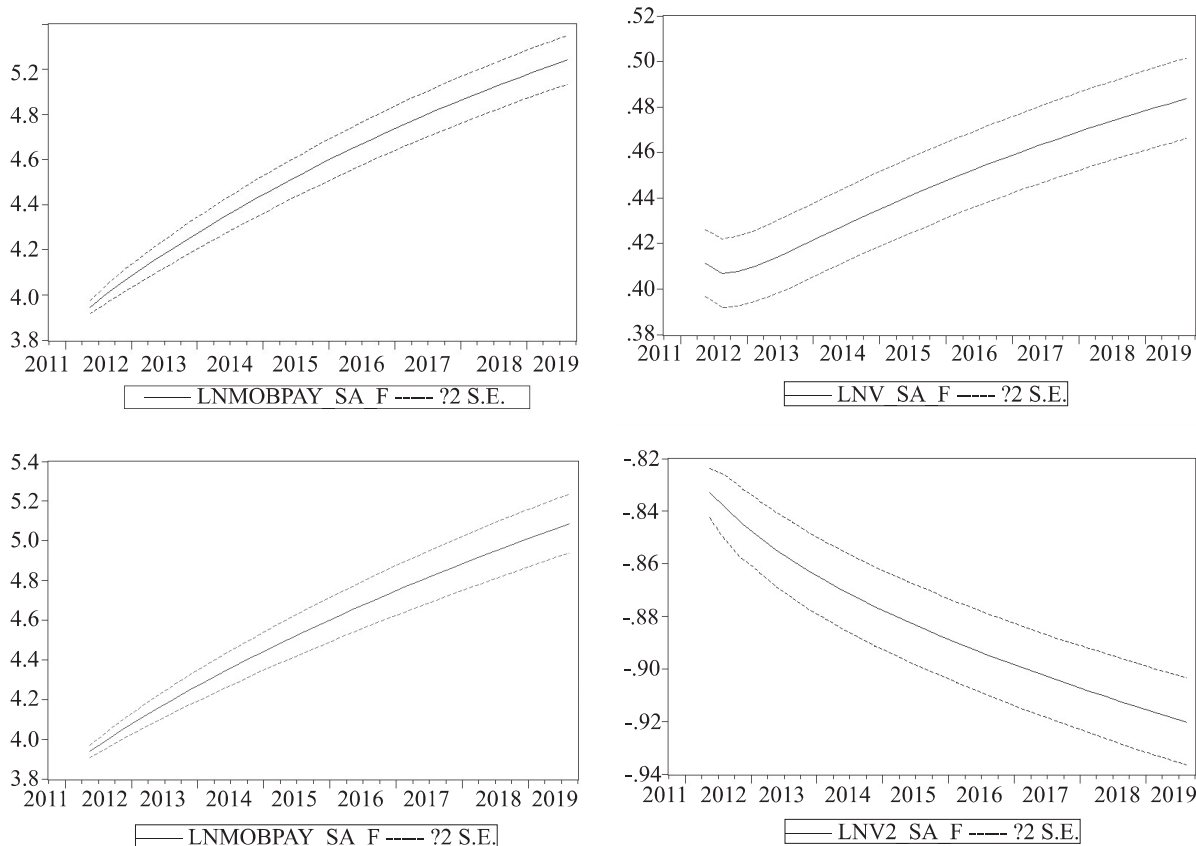
Null Hypothesis:	Obs	F-Statistic	Prob.
LNMObPAY_SA does not Granger Cause LNV0_SA	22	5.09539	0.0185
LNV0_SA does not Granger Cause LNMObPAY_SA		1.97360	0.1695
LNMObPAY_SA does not Granger Cause LNV1_SA		9.65671	0.0016
LNV1_SA does not Granger Cause LNMObPAY_SA		1.27559	0.3047
LNMObPAY_SA does not Granger Cause LNV2_SA		1.72645	0.2077
LNV2_SA does not Granger Cause LNMObPAY_SA		0.71607	0.5028

$$\begin{aligned}
 & \begin{bmatrix} \ln v0_{sa_t} \\ \ln mobpay_t \end{bmatrix} \\
 &= \begin{bmatrix} 0.237022 & -0.015283 \\ 0.950404 & 0.765244 \end{bmatrix} \begin{bmatrix} \ln v0_{sa_{t-1}} \\ \ln mobpay_{t-1} \end{bmatrix} \\
 &+ \begin{bmatrix} 0.186451 & 0.058238 \\ -0.282403 & 0.152194 \end{bmatrix} \begin{bmatrix} \ln v0_{sa_{t-2}} \\ \ln mobpay_{t-2} \end{bmatrix} \\
 &+ \begin{bmatrix} 0.066195 \\ 0.121490 \end{bmatrix}
 \end{aligned}$$

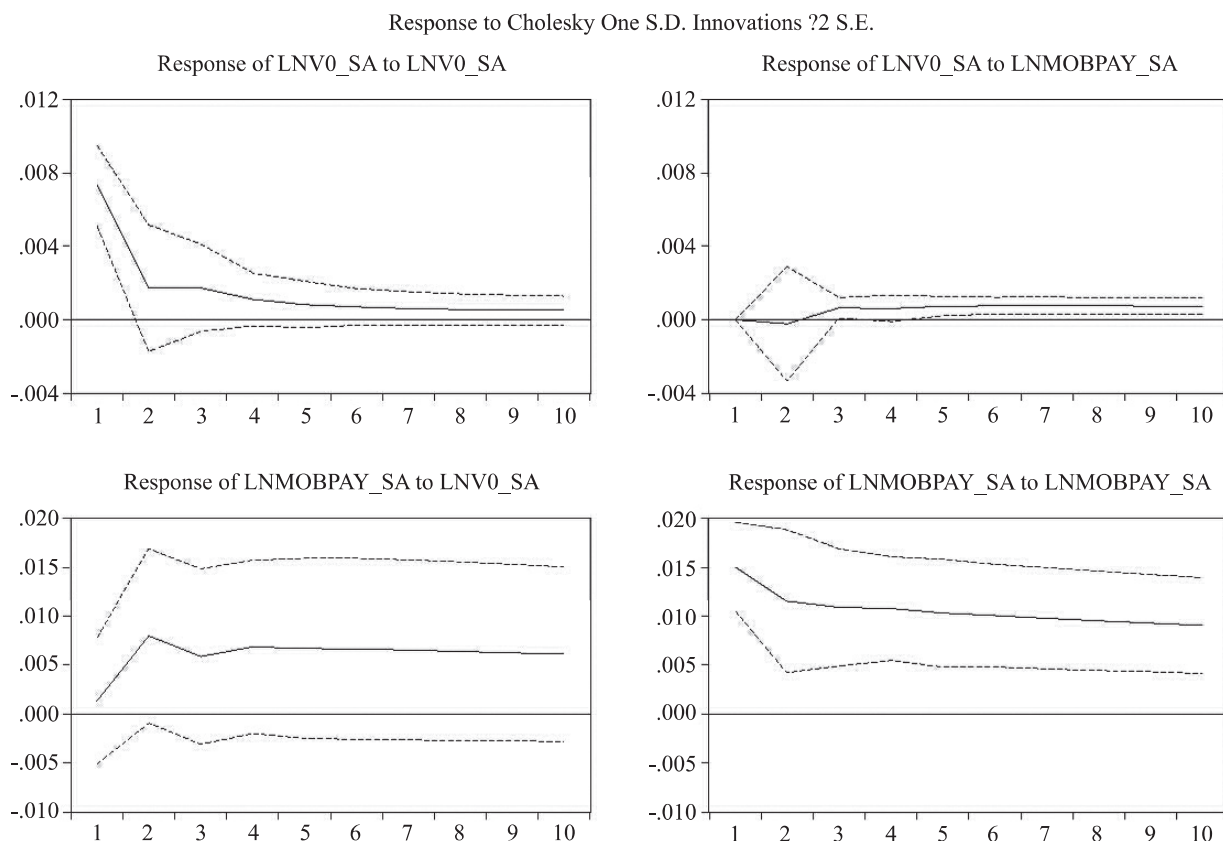
$$\begin{aligned}
 & \begin{bmatrix} \ln v1sa_t \\ \ln mobpay_t \end{bmatrix} \\
 &= \begin{bmatrix} 1.419633 & -0.281947 \\ 0.544389 & 0.631776 \end{bmatrix} \begin{bmatrix} \ln v1sa_{t-1} \\ \ln mobpay_{t-1} \end{bmatrix} \\
 &+ \begin{bmatrix} -0.462099 & 0.261679 \\ -0.344117 & 0.342142 \end{bmatrix} \begin{bmatrix} \ln v1sa_{t-2} \\ \ln mobpay_{t-2} \end{bmatrix} \\
 &+ \begin{bmatrix} 0.084368 \\ 0.240406 \end{bmatrix}
 \end{aligned}$$

Estimation: According to the VAR (2) model, the velocity of M0 and M1 can be predicted steadily. The forecasting method has dynamic prediction and dynamic prediction. The dynamic prediction is to predict with the fitting value of the sample, and the static prediction is to predict with the actual value of the sample. The VAR model is effective in the short term, so to predict the eight quarters after the third quarter of 2017, use the dynamic forecasting method. Result is shown in figure 7, the blue line to predict line, the two red line is the predictive value of standard deviation interval line.

The impulse response function can incorporate all the variables considered into a system to reflect the interplay



**Figure 7.** The prediction



**Figure 8.** Impulse response of lnv0\_sa

of all variables within the system. The impulse response can give the policy effect time delay and time delay interval, and give the degree and direction of the influence. The impulse response function mainly describes the response of an endogenous variable to residual variation. In particular, it is the impact of a standard deviation of random error, having an influence on the endogenous variables and future values. It can be found in the chart that lnv0\_sa impacted lnv0\_sa on lnmobpay\_sa and lnmobpay\_sa after 2 periods. The impact of lnv1\_sa on lnmobpay\_sa and lnmobpay\_sa on lnv0\_sa was stable after 3 periods.

**3.5 Model evaluation**

Compared with the ARMA model, VAR model is more suitable for the impact of digital money issuance or third party payment on the velocity of circulation. ARMA model investigates the equilibrium process, and the VAR impulse response and variance decomposition more research on the dynamic process. Professor Wang Zhenlong of Xi'an Institute of Finance and Economics points out that X - 12 - ARMA seasonally adjusted time series method, the basic process can be divided into three phases, there are modeling, seasonally adjusted, and diagnosis. So can't directly to seasonal data processing and then build model,

comparison is needed before and after adjustment, verify the effect of seasonal adjustment. Therefore, after seasonal adjustment, the seasonal fluctuation of the sequence no longer affects the VAR and ARMA model. Limited by space, the author fails to conduct ARMA modeling directly, and also fails to put more variables into the model to investigate the long-term effects. Summary results of money supply:

**Table 5.** Digital currency supply target-based on VAR model(in billions of yuan)

2018	2019	2020	2021	2022
24200.21	30539.22	39356.82	43870.72	45555.63
2023	2024	2025	2026	2027
50396.71	52772.02	58091.23	73268.90	85556.78

Finally, we further put forward that the initial issue amount of statutory digital currency is 24200.21 billion yuan in 2018. And through the way of mathematical modeling, the supply of legal digital money is given in the table.

**3.6 Summary**

From the ADF test and the time series equation in the ARMA model, namely the logarithmic velocity leveled

Response to Cholesky One S.D. Innovations ?2 S.E.

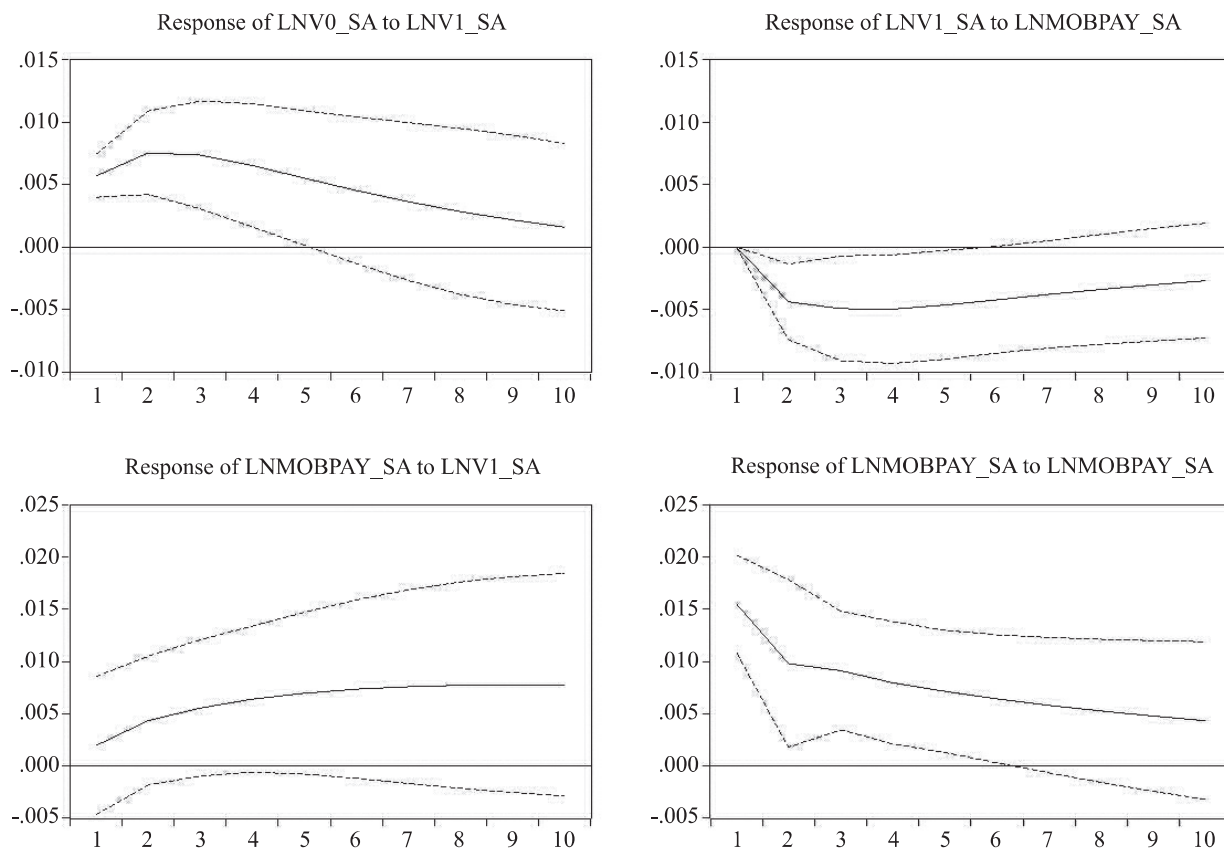


Figure 9. Impulse response of Inv0\_sa

off after the first order difference, it can be thought of that monetary velocity fluctuations in the growth or decline of the long term is in a stable range, and there is a certain relation between fluctuation. Later fluctuation is also associated with early disturbances. Therefore, the regulatory authorities should pay close attention to the macroeconomic indicators such as the velocity of money flow, control the rate of monetary growth and the direction of the disturbance factors.

According to the VAR model, conclusions about the effects of exogenous variables on endogenous variables can be drawn. The circulation of digital currency is likely to speed up the circulation of money. Therefore, it is of great importance to control the velocity of digital currency.

According to the impulse response of the VAR model, the impact of exogenous variables on endogenous variables can be digested and decomposed in two cycles (in this model, the cycle is one month). Therefore, the monetary issuing authorities should respond and correct the normal value of the currency circulation and circulation velocity in time, and control the impact of the issue of the

digital currency on the macro-economy for a certain period of time.

#### 4. Conclusion

On the one hand, the issuance and circulation of central bank digital currency will inevitably affect the speed of money circulation. The change in the speed of currency circulation has reduced the effectiveness of monetary policy. On the other hand, the digital currency has a significant magnification effect on the currency multiplier, which expands the endogenous effects of the currency and thus reduces the stability of the currency; it makes the money supply increase while the base currency remains unchanged.

According to the theory of endogenous money supply, the amount of money supply is determined by the objective demand of economic operation. It is not that the central bank determines the quantity of money supply independently. Therefore, the money supply depends more on the demand for money.<sup>[10]</sup> The central bank whose monetary supply is the intermediary target of monetary policy cannot accurately predict the demand for money

when the currency circulation speed changes, and most of the effects of the implemented monetary policy will be unsatisfactory. The change in the money supply brought about by the currency circulation speed has increased the instability of the monetary system. To address this potential problem and to maintain the stability of the monetary system, we propose the following:

1) Set up a professional central bank digital currency supervisory authority to control the supply of money and reduce the impact on the entire monetary system brought about by the statutory digital currency at the management level in use of the exogenous role of money supply;

2) Determining a reasonable amount of money demand as a basis for money supply: In the past, we blindly focused on the determination of money supply, but the endogenous role of the money supply has become more and more intense, particularly, the money supply's uncertainty is further strengthened after the issuance of digital currency. Therefore, we need switch ideas and refocus on the demand for money to achieve the supply and demand balance in currency market;

3) Accelerate the transformation of the monetary policy framework: Promote the transition of China's monetary policy framework from quantitative to price-based, and give full play to the advantages of the "interest rate corridor".<sup>[11]</sup> Establish a macro-control system with intermediate interest rates as its intermediate goal. The move is to deal with the unpredictability of financial markets caused by the rapid growth of the currency circulation rate. The "interest rate corridor" meets the requirements of this financial environment, which is conducive to exerting a "stabilizer";

To increase the transparency of the policy, for the transparency of monetary policy has the effect of reducing economic fluctuations, and the transparency level of China's monetary policy is relatively low<sup>[12]</sup>. Thus the central bank should take some measures to strengthen contact with the public and communicate with the market. Meanwhile, the improvement of policy transparency is a long-term process, short-term and temporary communication effects cannot play an important role, and only by normalizing

the ditch can policy optimization be really achieved.

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