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2019
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Summary Sheet

Study on the Viability and Effects of Digital Currency

Summary

The transition from traditional currency to digital currency is of particular interest in today's monetary system. In order to quantify the impact of digital currency and study the viability of digital currency, we established several models to solve the problem. The four main results are listed below.

First, the viability study of a global decentralized digital financial market. We studied 13 countries around the world based on their attitudes toward digital currency. Percentage of population using the Internet (PPUI), inflation rate (IR), seigniorage (SE), reserve requirement (RR), deposit interest rate (DIR) and corruption perceptions index (CPI) were selected as six indicators. Relevant data were collected and collated from the official website of the World Bank. Based on these indicators, the countries under study are divided into five categories by cluster analysis method, from which the viability value of digital currency (VV) is calculated. The **Digital Currency Viability (DCV) Model** was obtained through multiple regression modeling.

Second, the modification of current banking and monetary models. We analyzed the operation, the payment, the circulation, the policy, the issuance and the supervision of digital currency. We present a **Digital Currency Issuance (DCI) Model**, which adjusts the circulation according to macroeconomic variables such as output, consumption, investment, unemployment rate and inflation rate. Because the digital currency is difficult to be regulated, we propose a **Double-chain Oversight (DO) Model.** Taking the alliance chain as the core and the public chain as the operating basis, the model ensures the decentralization and the anonymity of the monetary system and offers the possibility of supervision.

Third, the long-term impact of digital currency. We examined the long-term impact of digital currency on the banking industry from the perspective of operation mode and currency utility function (CUF). We conclude that the focus of the banking operation mode will shift to online operation. We establish a **Dynamic Stochastic General Equilibrium (DSGE) Model** covering household, manufacturer and commercial bank, and estimated the long-term economic is of digital currency by analyzing the macroeconomic indicators of the three sectors. We extended the study further by including the impact of illegal trade and morality.

Fourth, a policy recommendation. Based on our research on digital currency, we make a policy recommendation to leaders of countries with different opinions on digital currency. We introduce the influencing factors of the viability of digital currency, as well as the supervision mechanism, circulation mechanism, circulation model and long-term influence of digital currency.

Finally, we comment on the strengths and weaknesses of our models.

Key words: DCV Model, Clustering Analysis, DCI Model, DO Model, DSGE Model

Contents

1 Introduction

1.1 Background

Digital currency can currently be divided into two types: electronically recorded currency balances and electronic currency. The biggest difference between the two types is whether they are issued and guaranteed by the state. There are naming and definitions of online currency in different fields. In this paper, there will be no physical entities, based on blockchain technology, which can be exchanged with traditional currency. Value carriers that can satisfy the value scale and exchange media functions are called digital currency. It is generated based on computer algorithms stored in electronic devices, and implemented through distributed accounting, allowing people to transfer value over computer networks, especially the Internet [1].

The issue of digital currency security has recently arisen as one of the heated topics. Opinions vary when it comes to whether a general digital currency will be a universally accepted. Technological advances made possible by its protocol for computation and communication. Some argue that digital currency can speed up transactions, save on payment processing costs, and that advances in technology make them more secure. On the contrary, Many government warnings issued by note the opportunities that anonymity and lack of oversight create for illegal activities, such as money laundering and terrorism. One of the most stressful and potentially challenges is the security of digital currency because of its anonymity and lack of oversight all over the world.

1.2 Restatement of the Problem

In order to determine the viability of implementing a universal digital currency system in different countries, we are required to answer the following question.

1. Develop reasonable metrics for factors affecting the viability of countries using universal digital currencies. Then consider the different needs of countries and the willingness to cooperate, and establish a model to judge the viability of using countries to use general digital currency.
2. Modify current bank and currency models for different types of countries.
3. Design a mechanism to oversee the general digital currency.
4. Consider the long-term impact of the general digital currency system on current banking, local, regional and world economies, and international relations between nations.
5. Write a one-page policy recommendation for national leaders with different opinions, pointing out the key factors they should consider and our insights.

1.3 Literature Review

David Yermack studied whether digital currency (represented by Bitcoin) has three basic functions of traditional money (transaction medium, accounting unit, value storage) to study whether it is a currency problem [5]. According to statistics, Bitcoin largely does not meet these standards. Most of the bitcoins are not circulating in the market. Its volatility and price uncertainty prevent it from becoming a general equivalent. And because the value of Bitcoin is susceptible to inflexible distribution mechanisms and major media events, its storage value is no longer certain. Bitcoin is considered more like a speculative product than a currency.

William J. Luther explains why cryptocurrencies have failed to gain widespread acceptance based on network effects and switching costs. And he concluded that cryptocurrencies are unlikely to generate widespread acceptance in the absence of either significant monetary instability or government support. [6]

The issue of digital currency security has recently arisen as one of the heated topics. Due to the strong encryption of the blockchain-based digital currency, supervision is difficult. The predecessors proposed a multi-chain model [12] to try to achieve digital currency regulation, but the communication between the chain and the node is more complicated, and because of the establishment of the Superchain, the model has lost the decentralization and transaction privacy for the supervision characteristics.

1.4 Our Work

To further present our solutions, we arrange our paper as follow:

For the first question, we select 6 indicators related to the feasibility of digital currency in the sense of economics. Then we select 13 representative countries for cluster analysis and divide them into 5 categories. Besides we conduct collinearity test on the six indicators, and exclude two of them. Next the feasibility model of multiple linear regression was constructed by using SPSS. We remove the relatively insignificant variables and leave two variables through the $t-test$ of the regression coefficient, and finally conduct the regression analysis again to obtain the regression coefficient.

For the second question, we modify the banking and monetary models from six aspects of digital currency. In addition, we also put forward the issue of digital currency design, also put forward Digital Currency Issuance model based on neural network as the basis for the dynamic operation of the distribution. Then we propose a supervision model based on the double-chain structure, which ensures the decentralization and anonymity of the monetary system and realizes the possibility of supervision.

For the third question, we analyze the long-term impact of digital currency on the banking industry from the perspective of operation mode and the utility function of currency. In order to study the economic effects of digital currency, we establish a Dynamic Stochastic General Equilibrium (DSGE) model. The macroeconomic indicators of the three sectors are analyzed by using aggregate output equal to aggregate demand. We also analyze the influence of digital currency on international relations from the perspective of illegal trade and morality.

Finally, we wrote a one-page policy proposal to the national leaders, and pointed out the key factors they should consider and our opinions.

2 Assumptions and Justifications

- **We assume that the it's not affected by war or religion.** Wars can destabilize countries, and the doctrinal principles of some religions would argue that actual economic activity based on physical assets would affect the circulation and stability of money.
- **We Suppose each country only has its own currency.** In order to facilitate the establishment of the model, we have simplified the monetary system of a country. The following models are all discussed around the legal tender and digital currency of a country.
- **Assume that the monitoring nodes of the system are trusted.** For question 3, the supervision of digital currency in the model we established is mainly conducted by regulators, so the credibility of the supervision node is the basis of the model.
- **This paper adopts decentralized digital currency.** In the case of centralized digital currency, the issuance and settlement of currency are carried out by the central system, which is not too different from the existing server-client mode. Therefore, this paper discusses decentralized digital currency.

3 Symbols

In this paper, we use the symbols to describe our model. Other symbols will be described later.

Table 1 The Definition of Symbol

Symbols	Symbol Description
PPUI	Percentage of Population Using the Internet
IR	Inflation Rate
SE	Seigniorage
RR	Reserve requirement
DIR	Deposit Interest Rate
CPI	Corruption Perceptions Index
VV	The Value of Viability

4 Digital Currency Viability Model

We select l3 countries for representative analysis based on the attitude of different countries towards digital currency. Since the current state attitude is not the only factor to judge the viability of the digital currency system in a country, in order to more accurately explore the viability of the implementation of the digital currency system, we cluster these 13 countries according to the impact factor. First, we collect relevant data from official data sites such as the IMF, and then standardize the data, and use the system clustering method to reclassify 13 countries, the reclassification results are shown in Table 4.

4.1 Preparation of Model

Before setting up the model, we take six indicators that we think are important based on macroeconomics, and then we take 13 countries that are internationally representative and obtained their corresponding data online.

4.1.1 Influential Factor

Herein are the main factors influencing the feasibility of implementing a general digital currency flows we take into consideration in our model.

- **Percentage of Population Using the Internet (*PPUI*)**

  Percentage of Population Using the Internet is the proportion of Internet users in a country.

  The use of digital currency a is web-based, so the PPUI in a country will seriously affect the viability of digital currency.

- **Inflation Rate (*IR*)**

  Inflation Rate, also known as the rate of change in prices, is the ratio of the excess of money to the amount, of money actually needed to reflect the extent of inflation and currency depreciation.

  Inflation is a relatively common economic phenomenon in all countries, and currency substitution is a by-product of high inflation. When the domestic inflation rate increases, it means that the actual purchasing power of the local currency will decrease, which will lead to direct substitution of the currency. Therefore, the level of inflation has an important impact on the viability of digital currency.

- **Seigniorage (*SE*)**

The coinage tax refers to an organization or country that issues currency. After issuing currency and absorbing the wealth of equivalent gold, the currency depreciates, which reduces the wealth of the holder and reduces the economic phenomenon of the issuer's wealth. Seigniorage can be a convenient source of revenue for governments. By providing the government with increased purchasing power at the expense of public purchasing power, it imposes what is metaphorically known as an inflation tax on the public. The coinage tax is a convenient source of income for the government. By providing the government with an increase in purchasing power at the expense of public purchasing power, it imposes a metaphorical inflation tax on the public.

The formula comes as:

$$SE_t = \frac{MS_t - MS_{t-1}}{NGDP_t \cdot ER_t} \tag{1}$$

Where,

SE_t representing the coinage tax for t years;

MS_t means the money supply for t years;

$NGDP_t$ represents Nominal GDP for t years;

ER_t is the exchange rate of the USD.

- **Reserve requirement (*RR*)**

Deposit reserve refers to the financial institution's preparation for guaranteeing customers' withdrawal of deposits and fund liquidation. It is a deposit deposited with the central bank. The ratio of the deposit reserve required by the central bank to its total deposit is the deposit reserve ratio. The reserve ratio is a central bank regulation adopted by most (but not all) central banks in the world, which stipulates the minimum reserve amount that commercial banks must hold. The reserve requirement is a central bank regulation employed by most, but not all, of the world's central banks, that sets the minimum amount of reserves that must be held by a commercial bank.

The, real utility of the deposit reserve ratio, policy is reflected in its ability to expand the credit capacity of commercial banks and adjust the currency multiplier. Therefore, it will indirectly affect the viability of digital currency.

- **Deposit Interest Rate (*DIR*)**

The deposit interest rate is the ratio of the amount of interest to the amount of deposit in a given period of time. It is the standard for calculating interest on deposits.

With low deposit rates, people will be more willing to hold money than deposit in the bank. Then the viability of digital currency will change.

- **Corruption Perceptions Index (*CPI*)**

The Corruption Perceptions Index is a list of the Corruption Perceptions Index established by the world-famous non-governmental organization Transparency International. It reflects the observations and feelings of the world's countries on the corruption of businessmen, scholars and risk analysts.

Banknotes are more susceptible to corruption than digital currencies, so the Corruption Perception Index will reflect a country's preference for digital currency.

4.1.2 Classification and Selection of Countries

Based on the attitudes of countries towards digital currency, we divided countries around the world into five categories [3]:

- **Absolute Ban**

Any activities involving digital currency are prohibited, such as Algeria (DZ), Egypt (EG) and Pakistan (PK).

- **Implicit Ban**

Implicit Ban are imposed by prohibiting domestic financial institutions from facilitating transactions in digital currencies, and their citizens' investment in digital currencies is not prohibited, such as China (CN), Colombia (Co) and Dominican (DO).

- **Generalization supervision**

For example, United States (US) and Brazil (BR). Expanding the scope of the original regulation, so that the regulatory measures of traditional transactions such as anti-money, laundering and anti-terrorism financing are equally applicable to digital currency transactions and their intermediaries.

- **Improve current regulations**

Regulators have revised their tax legislation to apply to digital currency regulation, such as Russia (RU), Argentina (AR), and Iceland (IS)

- **Market access**

Restrictive regulatory measures are established for institutions that operate businesses related to digital currency. Financial intermediaries that provide digital currency services must register with the regulatory authorities; the circulation between digital currency and fiat currency requires authorization. For example, Canada (CA) and Japan (JP).

In the following, the country is represented by **ISO code**

4.1.3 Selection of Data

According to the currency issuance of each country and the nominal GDP, the national Seigniorage is obtained, as shown in appendix table 9.

The value of the Seigniorage for the selected country calculated according to formula (1) is as shown in appendix table 10.

The expected relationship between the data related to the digital currency Viability impact factor and its generation symbol and Viability is as shown in the following Table 2.

Table 2 Viability impact factor related data

Country	PPUI	IR	SE	RR	DIR	CPI
DZ	0.21	0.064	0.029798	0.425	0.0175	34
EG	0.495	0.102	0.149547	0.1	0.07858	34
PK	0.178	0.286	0.077766	0.05	0.04834	32
CN	0.532	0.03	0.211755	0.17	0.015	40
CO	0.575	0.0751	0.023807	0.115	0.06783	37
DO	0.56	0.0161	0.033454	0.2987	0.07181	59
US	0.762	0.0207	0.032753	0.1	0.006	74
BR	0.408	0.0629	-0.04963	0.45	0.12446	40
RU	0.6067	0.0538	-0.00568	0.05	0.06969	29
AR	0.7015	0.4	0.071973	0.195	0.18947	36
IS	0.75	0.017	-0.02884	0.02	0.0575	78
JP	0.9318	-0.0012	0.090629	0.0076	0.001	72
CA	0.8119	0.0131	0.130739462	0	0.003	82

4.2 Classify Countries

In the first place, use the following formula to zero-mean normalize the collection of data in Table 4.

$$x_i^* = \frac{x_i - \mu}{\sigma} \tag{2}$$

Where:

x_i is each impact factor;

μ is the mean of each impact factor;

σ is the standard deviation of each impact factor.

By calculating the Euclidean distance between samples, the number of clusters created by the class-averaging method is shown in Table 3.

Table 3 Agglomeration Schedule

Stage	1	2	3	4	5	6	7	8	9	10	11	12
Cluster	5	12	7	2	7	6	2	1	2	1	1	1
Coefficients	0.061	0.086	0.168	0.242	0.302	0.475	0.55	0.557	0.733	1.01	1.443	1.894

According to the data in Table 3, the following figure is obtained.

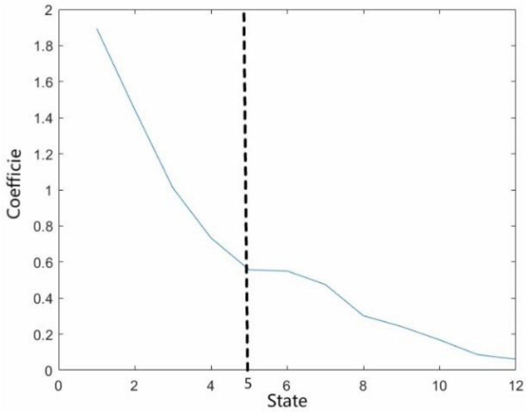

Figure 1 Liner Relation between Cluster and Coefficients

In the above figure, the abscissa is the cluster ordinate for the coefficients, and the image is abrupt when the *cluster* is equal to five. Therefore, the above 13 countries are divided into five categories, and the cluster tree diagram is shown in Figure 2.

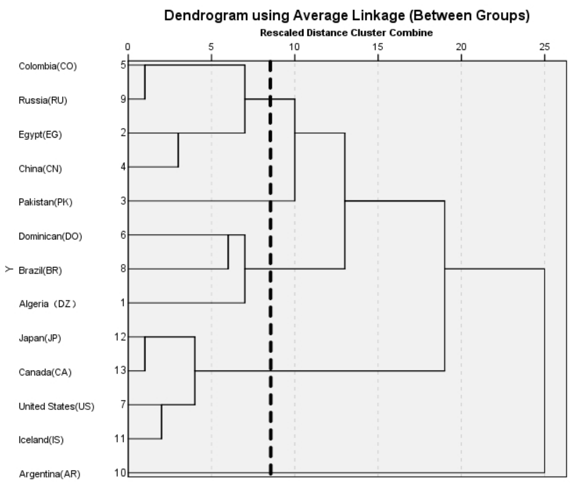

Figure 2 Cluster Tree

Through the analysis of Figure 2, we divided the above 13 countries according to the viability of implementing the digital currency system from low to high into five levels, namely Egypt(EG), China(CN), Colombia(CO) and Russia(RU) is the first level, Pakistan(PK) is the second level, Algeria(DZ), Dominica(DO) and Brazil(BR) are the third level, the United States(US), Iceland(IS), Canada(CA) and Japan(JP) are the fourth level, and Argentina(AR) is last level (see Table 4 for details).

As can be seen from the figure above, we have divided the 13 countries above into 5 categories. Then, we can divide the feasibility of each category of countries corresponding to digital currency into 5 scores, from 1 to 5, step is 1. The economic rules corresponding to the previous economic indicators can be scored with Argentina as 5 points, and the values of each category of countries can be assigned in descending order.

Table 4 National Reclassification Result

Country	DZ	EG	PK	CN	CO	DO	US	BR	RU	AR	IS	JP	CA
Original	1	1	1	2	2	2	3	3	4	4	4	5	5
Final	3	1	2	1	1	3	4	3	1	5	4	4	4

4.3 Digital Currency Viability Model

Digital currency is based on cryptography and communication technology, making full use of the technological advantages of the information age, and has excellent properties of high transaction efficiency and difficult data tampering. In order to study the viability of digital currency, this paper studies what factors affect the demand of digital currency in a country or region, and then examine show these factors affect the degree of feasibility of digital currency, and finally proposes relevant policy recommendations based on the research conclusions.

4.3.1 The Model Construction

According to the introduction in the previous section, the factors affecting the viability of a country's digital currency include Percentage of Population Using the Internet (PPUI), Inflation Rate (IR), Seigniorage (SE), Reserve requirement (RR), Deposit Interest Rate (DIR) and Corruption Perceptions Index (CPI). Therefore, a viability measurement model of the digital currency as shown in equation (2) can be constructed:

$$VV_c = \alpha_0 + \alpha_1 PPUI + \alpha_2 IR + \alpha_3 SE_t + \alpha_4 RR + \alpha_5 DIR + \alpha_6 CPI + \mu$$

Where:

VV_c represents the value of viability of the country;

α_0 is a constant term;

$PPUI$ representing the Percentage of Population Using the Internet;

IR representing the Inflation Rate;

SE representing the Seigniorage;

RR representing the Reserve requirement;

DIR representing the Deposit Interest Rate;

CPI representing the Corruption Perceptions Index;

μ is an error term which obeys normal distribution.

4.3.2 Model Solution and Analysis

Firstly, we use SPSS to test the correlation between independent variables. The test results are shown in Figure3.

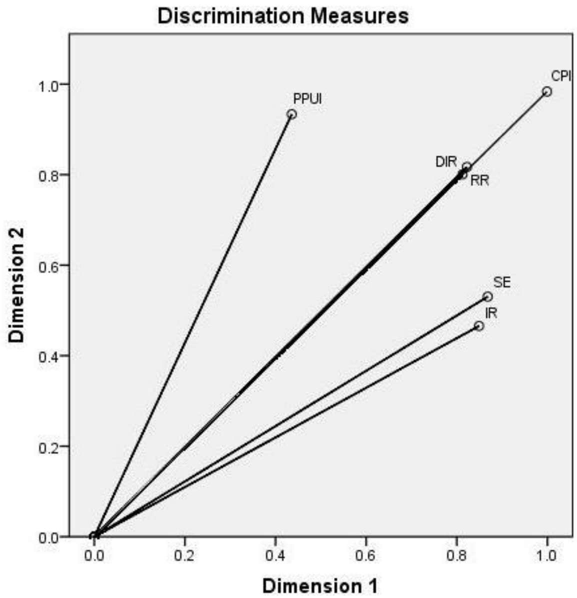

Figure 3 The Result of Testing Correlation

The smaller the angle between the variables, the stronger the correlation. The DIR, RR and CPI in Figure3 are almost coincident, indicating that there is a strong correlation between the three variables. At the same time, you can see that the CPI line segment is longer than the other two variables, and the values in both dimensions are higher, then the model has the strongest explanatory power for the variable. Therefore, we directly delete the two variables DIR and RR. Linear regression analysis is performed on the remaining influencing factors. The dependent variable is the *score* of implementing digital currency. The independent variable is *(Constant), CPI, SE, IR, PPUI.*

Table 5 ANOVA

	Sum of Squares	df	Mean Square	F	Sig
Regression	18.621	4	4.655	6.549	0.012
Residual	5.68	8	0.711		
Total	24.308	12			
R	0.875		Adjusted R Square	0.649	
R Square	0.766		Std. Error of the Estimate	0.84309	

It can be seen from Table 5 that $F = 6.549$ and *Sig* are less than 0.05, so the linear relationship between Dependent Variable and Predictors is significant, and a linear equation can be established. The value of the correlation coefficient R is 0.875. It can be seen that the fitting degree of the equation is very high, and 87.5% of the sample value can be interpreted by the regression equation, so the fitting effect is good.

Table 6 Coefficients

	B	Std. Error	Beta	t	Sig.
(Constant)	-1.054	0.904		-1.166	0.277
PPUI	0.031	1.611	0.005	0.019	0.985
IR	7.897	2.391	0.662	3.303	0.011
SE_t	-4.929	3.339	-0.256	-1.476	0.178
CPI	0.068	0.02	0.96	3.468	0.008

It can be seen from Table 6 that for the predictor *PPUI* and SE_t , the *Sig* value are greater than 0.05. It indicates that the coefficient of these two predictors do not pass the test. Thus, the original variables PPUI and SE_t need to be removed from the model. Repeat the above steps and we get the following results.

Table 7 Coefficients

	B	Std. Error	Beta	t	Sig.
(Constant)	-1.303	0.873		-1.492	0.167
IR	7.647	2.400	0.641	3.187	0.010
CPI	0.068	0.014	0.960	4.768	0.001

It can be seen from Table 7 that for the predictor IR and CPI, the *Sig* value is much less than 0.05. It indicates that the coefficient of these two predictors pass the test and the estimated value is 7.647 and 0.068.

In summary, the resulting regression equation expression is:

$$VV_c = -1.303 + 7.647IR + 0.068CPI + \mu \tag{3}$$

According to the regression equation, we can get the predictor *IR*, *CPI* and the dependent variable *score* VV_c positively correlated. Among these predictors, *IR* has the greatest influence on VV_c .

4.3.3 Model Verification and Analysis

In order to test the reliability of the model, we bring the data from Canada in Table 2 into the mode1 to obtain the viability value of the country: 4.169 belongs to the category 4 countries. Consistent with the previous final classification results (see Table 8 for details). Therefore, the model has high reliability.

Table 8 Model verification results

Country	Score	Judging Result	Clustering results
Canada	4.169	4	4

5 Bank and Currency Model Modification

The biggest feature of the digital currency discussed in this section is decentralization. This section modifies the bank and currency model from three aspects: operation, payment, circulation, policy, issuance and supervision of digital currency.

5.1 Transformation of Operating Mode

Operations moved from offline to online. The physical outlets of commercial banks should be re-arranged, and the number of them should be reasonably reduced on the premise of facilitating customers. More attention should be paid to online transactions, focusing on observing the changes and development of customers' behavioral habits and transaction forms, and making corresponding adjustments to their service models, such as the design of mobile clients and the construction of clearing systems.

5.2 Management of Payment Model

To start with, increase the intensity of supervision and repeat the construction of financial infrastructure. Because the account payment system of each level belongs to different departments and is independent of each other, it is easy to generate data gaps and information islands.

Second, increase the value guarantee for the private sector and reduce moral hazard. Due to the real-time payment settlement of digital currency transactions, fraudulent activities such as fraud are required, so the value guarantee of the private sector needs to be increased [8].

5.3 Distribution Method

The central bank or commercial bank issues substitute currency or bank notes in the form of banknotes and coins. Meanwhile the issuer promises to exchange the equivalent blockchain currency at a fixed rate. For small transactions in daily life, one can use a substitute currency or bank notes to pay. In this way, the transaction confirmation pressure of the blockchain currency system can be reduced, the transaction delay problem of the blockchain currency can be alleviated, and the transaction dilemma when the electronic communication network does not exist can be solved.

The substitute currency or bank note can be issued by the central bank, which is similar to the current banknote issuance system. It is also possible for a number of commercial banks to issue substitute currency or bank vouchers at the same time. Through the mutual competition between the issuing banks and the survival of the fittest, the money market spontaneously determines the issuer of the substitute currency or bank notes; the government and the central bank only stipulate the issuance reserve requirements for the bank vouchers. And in the extreme case provide a certain blockchain currency liquidity support.

5.4 Optimize Policy Effectiveness

The digitization of the currency form plays a key role in improving the effective performance of monetary policy. The “Forward Contingent” design of the currency, namely: “Time Contingent”, “Sector Contingent”, “Loan Rate Contingent”, “Economic State Contingent” design. Solve the dilemma of traditional monetary policy such as poor transmission mechanism, difficulty in counter-cyclical regulation, currency "de-reality" and insufficient policy communication.

5.5 Distribution Design

The issuance design of digital currency is divided into four parts: digital currency issuance, effective, recovery, and circulation model [9]. The following figure shows the digital currency issuance design:

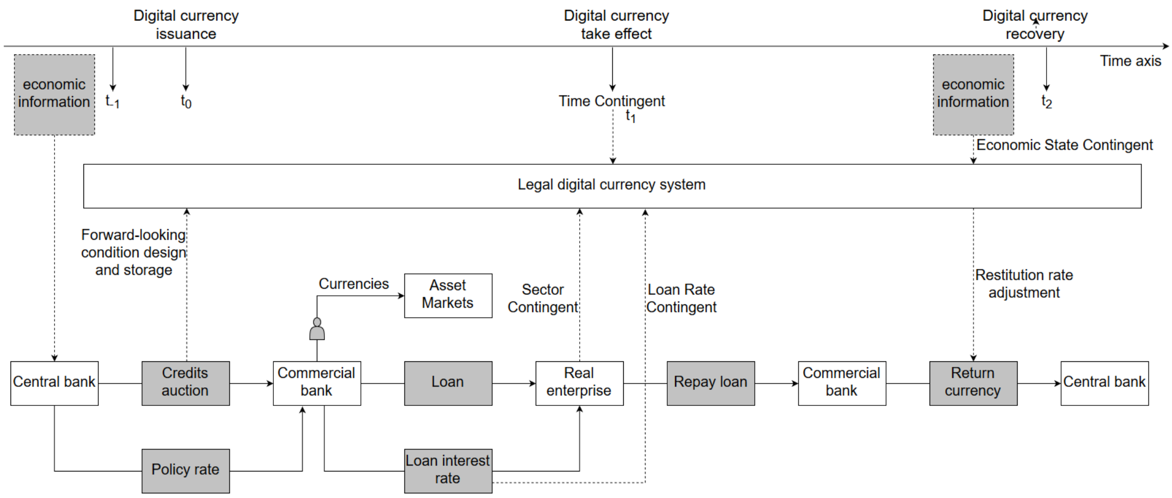

Figure 4 the Digital Currency Issuance Design

5.5.1 Digital Currency Issuance

At the time of digital currency issuance (at time t_0 in Figure 4). the central bank pre-sets four forward-looking conditions: "time-point conditions", "flow-to-department conditions". "credit interest rate conditions", and "economic status conditions". These conditions are set at the time of currency issuance but are triggered after the currency is placed, so they are called forward-looking conditions.

After the central bank designed the forward-looking conditions, it issued a legal digital currency to commercial banks through a credit auction mechanism. The forward-looking conditions set by the central bank, as well as the policy interest rates determined after the auction, the basis of the future commercial bank credit interest rate and the benchmark interest rate, are programmed and stored by the digital currency system.

5.5.2 Digital Currency Takes Effect

After the digital currency was issued, the commercial bank lends outward at t_1.The commercial bank sends the loan information to the legal digital currency system and requests the digital currency to take effect. According to the loan information, the digital currency system judges whether the forward-looking conditions such as "time-point conditions", "flow-through department conditions" and "credit interest rate conditions" are triggered. If triggered, the digital currency will take effect, otherwise it will not take effect.

The specific prospective conditions for the entry into force of the currency are as follows:

- **The time trigger triggers.** When the loan occurs, the digital currency takes effect, otherwise it does not take effect. It can also be pre-set by the central bank at the time of currency issuance. This condition setting can reduce the time lag of monetary policy transmission and avoid currency idling.
- **The flow to the body trigger takes effect.** When the loan flow to the main body meets the requirements of the central bank, the digital currency takes effect, otherwise it does not take effect. This condition setting can achieve accurate money delivery, implement structural regulation, avoid currency idling and falsify.
- **The interest rate trigger takes effect.** When the currency is issued, it is stipulated that the credit rate of the commercial bank to the enterprise must be equal to "the benchmark interest rate at the time of the loan occurrence t_1" plus or minus "the credit basis determined by the auction at the time of currency issuance t_0". When the bank's actual credit rate meets this requirement, the currency takes effect, otherwise the currency does not take effect. Through this condition setting, the benchmark interest rate can be effectively transmitted to the credit interest rate in real time.

5.5.3 Digital Currency Recovery

When the commercial bank recovers the credit (at time t_2 in Figure 4), the legal digital currency is returned to the central bank. There are two situations in which interest rates can be returned to the central bank. One is that the interest rate remains the same, and the policy rate determined by the auction at the time t_0 of the currency issuance. The other is interest rate change. The digital currency system automatically determines whether the "economic status condition" is triggered based on the economic information at time t_2. If triggered, the return interest rate is adjusted. Otherwise, the policy interest rate determined by the auction at the time t_0 is still issued.

5.5.4 Digital Currency Issuance Model

Based on the state space model recurrent neural network, we tentatively give the Digital Currency Issuance model [10].

- State Space Model Recurrent Neural Network

According to Taylor's rules, monetary policy aims to promote economic maximization and sustainable growth while maintaining a low, stable level of inflation. Therefore, the policy rate can be set to the following response function:

$$r_t = r^* + i_t + \alpha(i_t - i^*) + \beta(gdp_t - gdp^*) \tag{4}$$

Where

r_t is the short-term policy rates, the central bank can operate the monetary policy to control the policy interest rate between the interest rate corridors, so the policy interest rate can be expressed as the currency circulation (m_t) The function is $r_t = g(m_t)$.

r^* is the natural interest rate which the actual interest rate level that enables the economy to reach the potential output level;

i_t is the rate of inflation;

i^* is the target inflation rate which is generally set to 2%;

$i_t - i^*$ is the inflation gap;

gdp_t is actual output;

gdp^* is potential-output;

$gdp_t - gdp^*$ is the output gap;

α and β represent the response coefficient of policy interest rate to inflation gap and output gap respectively.

Obviously, when both the inflation gap and the output gap are zero, we can get $r_t = r^* + i_t$. It means the policy rate is equal to the nominal natural rate.

Describe observable economic systems: According to macroeconomics, macroeconomic variables such as output, consumption, investment, unemployment rate, and inflation rate can be described by the Vector Autoregression Model (VAR) system. The general form of the VAR model is:

$$x_t = \mathrm{A}_1 x_{t-1} + \mathrm{A}_2 x_{t-2} + \cdots + \mathrm{A}_p x_{t-p} + \varepsilon_t \tag{5}$$

Where,

x_t represents the *n × 1* vector containing the values of *n* economic variables in period *t*;

$\varepsilon_t \sim i.i.d.N(0,\Omega)$ is an *n × 1* order random error column vector.

Describe the unobservable economic system: equation (4) The variables such as natural interest rate and potential output are unobservable in reality. According to the results of econometrics, state space models can be used to "push back" information from unobservable variables from observable economic variables. The state space model can be represented by:

$$a_t = f(b_t, x_t, \varepsilon_{1t}) \tag{6}$$

$$b_t = h(b_{t-1}, x_t, \varepsilon_{2t}) \tag{7}$$

Where the equation (6) is the observation equation;

a_t is the observable output variable;

b_t is the unobservable state variable;

x_t is the observable input variable;

ε_{1t} is the observation error;

ε_{2t} is the state error;

Equation (7) is an unobservable equation of state.

We can get observation equation:

$$x_t = \begin{bmatrix} 1 & 0 & \cdots & 0 \end{bmatrix} \begin{bmatrix} x_t \\ x_{t-1} \\ \cdots \\ x_{t-p} \end{bmatrix} \tag{8}$$

We also can conclude the state equation:

$$\begin{bmatrix} u_t \\ u_{t-1} \\ \vdots \\ u_{t-p} \end{bmatrix} = \begin{bmatrix} \Phi_1 & \Phi_2 & \cdots & \Phi_{p-1} & \Phi_p \\ 1 & 0 & \cdots & 0 & 0 \\ 0 & 1 & \cdots & 0 & 0 \\ \vdots & \vdots & \cdots & \vdots & \vdots \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} u_{t-1} \\ u_{t-2} \\ \vdots \\ u_{t-p-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_t \\ 0 \\ \vdots \\ 0 \end{bmatrix} \tag{9}$$

Combining the measurement ideas of the state space model with the modeling ideas of the neural network, we use the state space model recursive neural network to establish the digital currency issuance model.

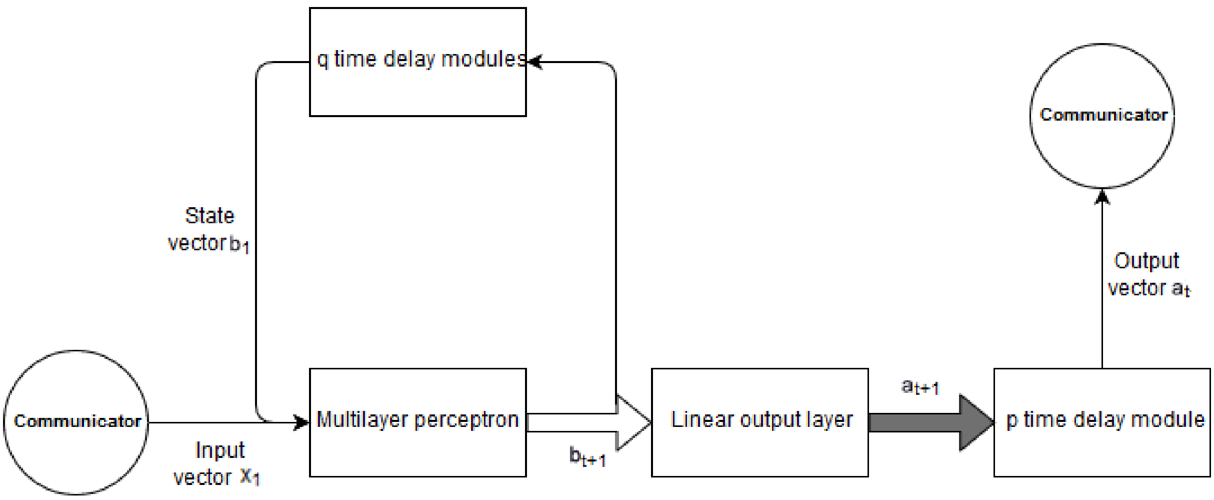

Figure 5 Digital Currency Issuance Process

As shown in the figure, the digital currency issuance model is constructed from three layers: The first layer is the input layer. The feedback node and the source node are included, and the multi-layer perceptron performs "catch", and the multi-layer perceptron can include multiple hidden layers. The source node is connected to the outside and the observable vector x_t is input. The second layer is the hidden layer. Hidden neurons define unobservable states b_t. The output of the hidden layer is fed back to the input through the q unit time delay module. The order of the delay unit that feeds back the hidden layer output back to the input layer determines the order of the model. The third is the output layer. Hidden neurons b_t, through the linear output layer, the network response is given, and then the output vector a_t is obtained by p unit time delay modules.

In economic terms, a_t represents the central bank's currency circulation; x_t represents observable economic variables.

6 Modification of the Oversight Mechanism

Due to the strong encryption of the blockchain-based digital currency, supervision is difficult. The predecessors proposed a multi-chain model [12] to try to achieve digital currency regulation, but the communication between the chain and the node is more complicated, and because of the establishment of the Superchain, the model has lost the decentralization and transaction privacy for the supervision characteristics.

The oversight digital currency model proposed in this paper adopts a double-chain structure, which is divided into Consortium Blockchain and Public Blockchain. The former is the core of the consensus mechanism. It is responsible for collecting, confirming transactions, determining the state of the system, and encrypting storage complete transaction information. However, the latter primarily stores transaction information that has been confused by the alliance chain and uses it as a credential to verify the transaction. Participants in the alliance chain are regulators, while public chain participants are citizens after registration.

The existing double-chain model simply excludes users from the alliance chain, and only builds a clearing platform. Although it is beneficial to supervision, it cannot take advantage of the decentralization of the blockchain. Since the digital currency based on the public chain can grasp the transaction information of all users at each node, if the two sides of the transaction are not well hidden, the existing analysis technology can easily find the connection between the transactions, thereby obtaining the behavior of the user, habits and even real identity [13].

In our model, the alliance chain participants ensure the privacy of the user transaction data through secret sharing, and can also decrypt the transaction content through voting, thereby achieving controllable anonymity, which not only maintains the decentralization and anonymity of the digital currency. The possibility of supervision is also achieved.

The part of the public chain that is added to the oversight digital currency is to increase the credibility of the system, and to store the summary data of each block of the alliance chain in the public chain to anchor, prevent the data from being monitored by the user. Tampering. On the other hand, the encrypted data is stored in the alliance chain. The public chain stores the plaintext of the transaction data of the truncated contact, and provides the basis for verifying the transaction for the nodes in the whole system on the basis of protecting the privacy of the user.

The design criteria of this model: 1. Integrate supervision into the operation of the system, enable the system to monitor and trace the transaction information, and directly manage the account behavior, thereby promoting the acceptance of blockchain technology in all walks of life. 2.on the basis of protecting privacy. 3. Try to let users participate in the system's consensus mechanism to achieve the decentralization of the blockchain.

Most mechanisms do not include traceability, so properly keeping records is one of the requirements for regulatory performance.

6.1 Alliance Chain Structure Design

- **System Initialization**

In the system initialization phase, according to the system security parameters, the elliptic curve key generation basic parameters, the total number of participating nodes of the alliance chain and the secret recovery threshold, the elliptic curve cryptography algorithm is used to obtain the block information encryption key. The secret share will be shared to the n nodes in the system and destroyed; each node then generates an identity authentication signature. The node exchanges the signature key to prevent the impersonation of the membership of the alliance chain from transmitting information, and the key for mutually negotiating the information transmission between the nodes establishes an encrypted channel to prevent leakage of the transaction information. After the parameter initialization is completed, the system establishes the alliance block.

- **Transaction Verification and Forwarding**

The system verifies whether the transaction sent by the user or the transaction format forwarded by other nodes meets the specification through the complete transaction information verification node, and whether the content is correct; whether the transaction sent by the user has been received according to the transaction number. And jointly decide whether to save and forward according to the results of the transaction validity agreement,

- **Consensus Agreement**

This paper uses the CPBFT consensus protocol to verify the correctness of block information using a voting-based mechanism.

- **Transaction Confusion**

An important stage of protecting the privacy of system data and user information. A complete transaction consists of multiple outbound transactions and at least 2 transfer transactions. The alliance chain divides the complete transaction into currencies after confirming that the complete transaction is correct and received. Transferring transactions and currency transfer transactions each transaction consisting of multiple sub-transactions. The number of a sub-transaction can be used as proof of the complete transaction to which it belongs, but it cannot be used to obtain the complete transaction of the sub-transaction. The sub-transaction number is written into the block for tracking together with the complete transaction, and the split transaction loses the currency transfer, Contact with the transfer address to protect the privacy of the user.

- **Transaction Traceability**

The means by which the system achieves the purpose of supervision. The system realizes the purpose of oversight through the traceability of the transaction and the disclosure of the identity of the participants. Here, a security hypothesis is introduced, and. the supervisory nodes in the system are trusted. The oversight node completes the collection of the secret shared share and the recovery of the decryption key. After completing the traceability task, the oversight node will honestly complete the deletion of the relevant information. The result of the transaction traceback does not directly affect the blockchain system, and will not changes to the system status within the system occur, and if the funds are to be recovered or the banned account is completed by a regulatory agency outside the system. When the traceback is initiated, the alliance chain participant initiates a traceback request for a transaction, and all members vote to decide whether to execute. The node that agrees to initiate the traceback sends the saved secret share information to the oversight node in the alliance chain, when the secret recovery threshold is exceeded. The oversight node recovers the key. When the information is revealed, according to the truncated transaction number provided, the matching transaction in the alliance chain is searched, the transaction is restored, and the identity of the trader is obtained. When the completion of a complete transaction is completed. It will get the transfer and transfer transactions related to other complete transactions, so you can reveal all the transaction information through step-by-step progress. After the transaction is traced back, the regulator will destroy the decryption key and other related information. The communication between the internal nodes of the alliance chain uses an encrypted channel.

6.2 Public Chain Structure Design

- **User Identity Authentication Phase.**

The user submits identity information to the identity authentication server. The identity verification server checks the identity of the user, and if there is a problem, rejects the identity application. If the user requests, the private key is used to sign the information provided by the user to generate a certificate, and archived and sent to the user.

- **Transaction Generation Stage**

The transaction payer obtains the newly generated payment address of the payee, and the payer generates a transaction change address. Add the payment and its unlocking key and payment address to the transaction, then count the number of addresses included in the transaction, verify whether the transaction amount is balanced or not, generate a transaction number, and sign the transaction.

- **Public Blockchain Generation Phase**

The public chain node receives the broadcast of the confused transaction sent by the alliance chain, including a large number of payment transactions and collection transactions. The payment transaction corresponds to an existing Unspent Transaction Output(*UTXO)*, including the *UTXO* number and the unlock key. The collection transaction generates a new *UTXO*. After verifying the identity signature and message signature of the message sender, the correctness of the verified payment transaction is determined, and whether the corresponding payment transaction is *UTXO* transaction and whether the payment key provided is correct. Finally, the correct transaction is packaged into the block to generate Merkle(where each leaf node is hashed with the data block, and each non-leaf node is hashed with the encrypted tag of its child node) root and block header.

- **Block Validation Phase**

To receive block determine if compliance is correct, including validation block sender is currently the master node, verify the integrity of the block, validating blocks of data structure, block head the new information is correct, according to the trade mark contrast blocks are stored in each of the transactions the correctness of the ciphertext, finally the correctness of the calculation Merkle tree in each layer. Any step in the validation process that finds a block error or does not meet the requirements directly returns an error.

- **Public Blockchain Consensus Phase**

DPOS consensus protocol is adopted, including witness node election and witness node completion block generation. Because of the large size of the public chain node, the interval time for the selection of the witness node can be set to be longer to reduce the communication cost. Public chain nodes can apply to be witness nodes, but if there is a block delay or even generate an error block, it will be replaced by other nodes in the subsequent election process.

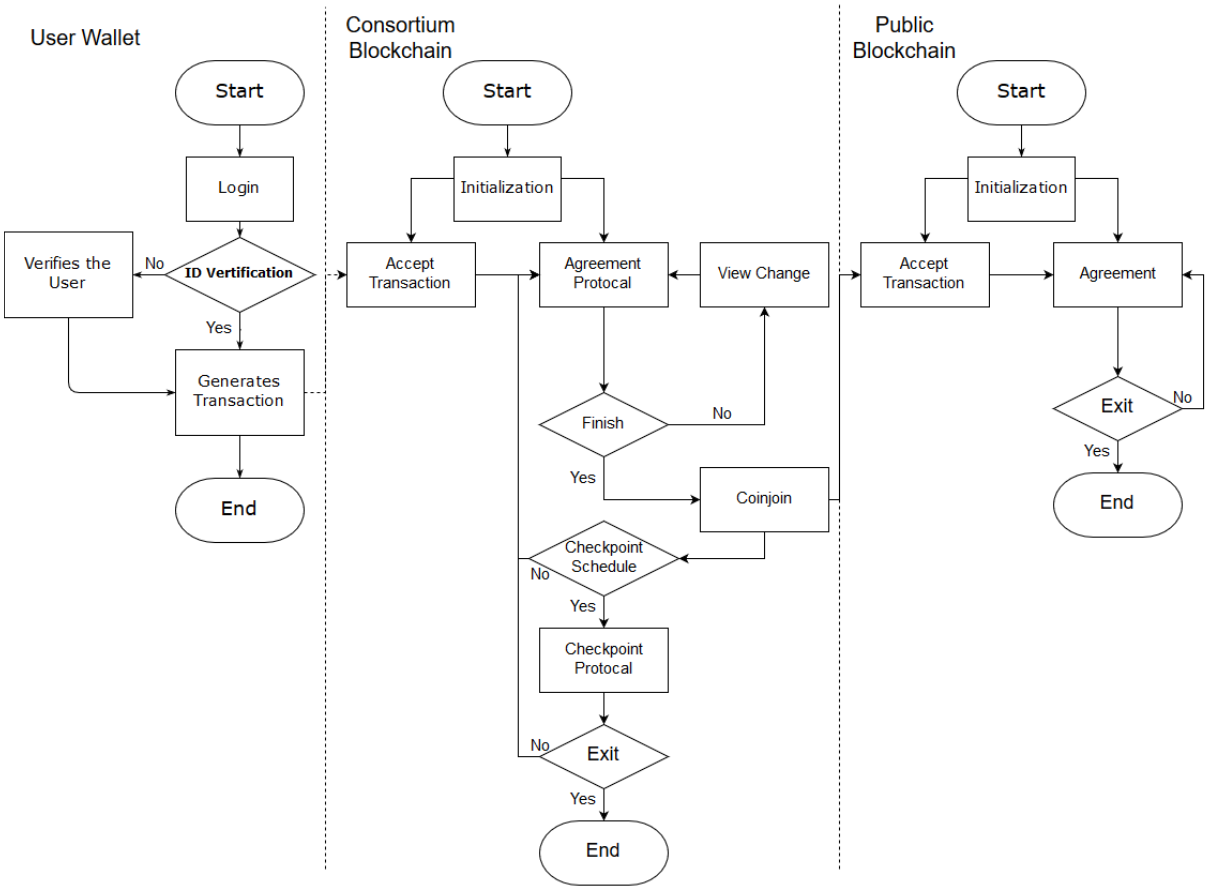

Figure 6 Model design of double chain structure

7 Long-term Impact Analysis

In this section, we expand the scope of our analysis to consider the long-term impact of such a system on current banking, the local, regional and world economy, and international relations between countries.

7.1 Long-term Impact on the Banking Industry

First, the operating model will move from offline to online. The physical outlets of commercial banks will be greatly reduced, and more attention will be placed on online transactions.

Second, the utility function of the original currency is[14]:

$$v(T) = [(c + dn)\int_r^{\infty} e^{-r(t-T)} dt] = \frac{c + dn}{r}$$

The utility function of the new currency is:

$$v'(T) = [(e + fn)\int_r^{\infty} e^{-r(t-T)} dt] - s = \frac{e + fn}{r} - s$$

Where:

N is the number of people using the currency, $n = \ln(N)$;

c, d, e and f are fixed parameters;

r is the discount rate;

T is the point in time of conversion;

s is the convert costs.

When the conversion cost is too high and the new currency is not recognized by the majority, even if the new currency has better characteristics than the old one, people will still choose to use the old currency.

7.2 Long-term Impact on the Economy

We establish a dynamic stochastic general equilibrium (DSGE) model covering three sectors: household, manufacturer, and commercial bank to study the economic effects of digital currency [15].

1. Family

The nominal budget constraints of representative household are

$$P_t c_t + D_t + B_t = W_t n_t + D_{t-1} R_{t-1}^D + B_{t-1} R_{t-1} + G_t \tag{10}$$

Where:

P_t is the nominal commodity price index;

c_t is the Real Consumption of the family;

D_t is the size of the nominal bank deposit held on behalf of the family;

B_t is the family holding Nominal central bank digital currency scale;

W_t is the nominal prices;

n_t is the actual labor supply;

R_{t-1}^D is the bank deposit interest rates;

R_{t-1} is the central bank's digital currency interest rate;

G_t is the nominal profit of a manufacturer.

The economic significance of formula (10) is that we assume that digital currency replaces all physical cash, and households have two asset allocations: bank deposits and digital currency, except for income from. previous investments in bank deposits and digital currencies, household Current income also includes wage income and dividends from manufacturers. The family uses part of the current income for consumption, and the rest saves and invests in bank deposits and digital currency.

Dividing the two sides of the formula (10) by the commodity price index, you can get the actual budget constraints of the family:

$$c_t + d_t + b_t = w_t n_t + d_{t-1} R_{t-1}^D + b_{t-1} R_{t-1} + g_t \tag{11}$$

Where:

d_t is the actual bank deposit size held by the family;

b_t is the actual central bank digital currency size held by the family;

w_t is the actual wage

g_t is the actual manufacturer's profit dividend.

2. The Manufacturer

We assume there are two vendors: the final vendor and the intermediate vendor. In the end, the vendors are completely competitive. They buy the intermediate product yt(z) from the intermediate manufacturer z (z is the manufacturer's continuous label, z [0,1]), and then produce the final product yt. The production function is:

$$y_t = \left(\int_0^1 y_t(z)^{\frac{\mu-1}{\mu}} dz\right)^{\frac{\mu-1}{\mu}} \tag{12}$$

Where: μ is the demand elasticity coefficient of various intermediate products.

The intermediate manufacturers are in a monopolistic competition, assuming that each intermediate manufacturer's production function is a Cobb-Douglas production function:

$$y_t = \mathrm{A}_t k_t^{\gamma}(z) n_t^{1-\gamma}(z) \tag{13}$$

Where: A_t is the total factor productivity, determined by the level of science and technology in the overall economy:

$$\mathrm{A}_t = e^{\chi t + \theta_t} \tag{14}$$

$$\theta_t = \rho_\theta \theta_t + \varepsilon_{\theta_t} \tag{15}$$

Where:

$\chi > 0$ is the Technology that represents the constant development of time;

θ_t is the technical shocks;

k_t is the capital, the corresponding depreciation rate is δ .

Intermediate manufacturer z accumulates capital by investing a in each phase:

$$k_{t+1}(z) = i_t(z) + (1-\delta) k_t(z) \tag{16}$$

This paper assumes that intermediate vendors rely entirely on bank loans to hire workers and capital investments, so the following equation exists:

$$L_t(z) = W_t n_t(z) + P_t i_t(z) \tag{17}$$

Therefore, the cost paid by the corresponding manufacturer is $R_t^L L_t(z)$. The interest rate for the bank loan is R_t^L. In addition, we assume that the manufacturer still has to pay the actual management costs due to price adjustments and capital adjustments:

$$C_P(P_t(z)) = \frac{\phi_p}{2}\left[\frac{P_t(z)}{P_{t-1}(z)} - 1\right]^2 y_t(z) \tag{18}$$

$$C_k(k_t(z)) = \frac{\phi_k}{2}[k_t(z) - k_{t-1}(z)]^2 \tag{19}$$

Therefore, the actual profit of the intermediate manufacturer is:

$$g_t(z) = \frac{P_t(z)}{P_t} y_t(z) - \frac{R_{t-1}^L L_{t-1}(z)}{P_{t-1}} - C_P(P_t(z)) - C_k(k_t(z)) \tag{20}$$

3. Commercial banks

Assuming the existence of interest rate corridor mechanism, commercial Banks have two financing channels: One is to raise money from the public through bank deposits (D_t). The other is through the Standing Lending Facility (SLF) to the central bank loan ($\tilde{B}_t$).After raising funds, commercial Banks lend the funds to enterprises (L_t) or deposit them in the form of deposit reserves at the central bank (M_t).So, $L_t + M_t = D_t + \tilde{B}_t$, in terms of the actual variable

$$l_t + m_t = d_t + b_t \tag{21}$$

Correspondingly, the actual profit of commercial Banks is

$$h_t = \frac{m_{t-1}\breve{R}_{t-1}}{\pi_t} + \frac{l_{t-1}R_{t-1}^L}{\pi_t} - \frac{d_{t-1}R_{t-1}^d}{\pi_t} - \frac{b_{t-1}\hat{R}_{t-1}}{\pi_t} - \sigma l_t - \frac{\omega_t d_t}{m_t} \tag{22}$$

Where:

$\breve{R}_{t-1}$ are the Deposit reserve rate and $\hat{R}_{t-1}$ Standing lending facility rate, they constitute the floor and ceiling of the interest rate corridor respectively

σl_t is the cost that commercial bank pays in developing loan business process

$\frac{d_t}{m_t}$ is the reciprocal of the RRR measures the credit creation ability of commercial Banks, and also represents the balance sheet risks of commercial Banks, such as liquidity risk, maturity mismatch risk, credit risk, etc. The higher the value is, the higher the cost that commercial Banks should pay.

ω_t reflects the risk management ability of commercial Banks. The higher the value is, the lower the risk management ability of commercial Banks will be.

So let's say that ω_t for $\omega_t = (1-\rho_\omega)\omega + \rho_\omega \omega_{t-1} + j_t$.

4. Equilibrium Conditions

The general equilibrium condition is that the total output is equal to the total demand:

$$y_t = c_t + i_t + C_P(P_t(z)) + C_k(k_t(z)) + \sigma l_t + \frac{\omega_t d_t}{m_t} \tag{23}$$

Where:

c_t is the goods consumed for the family sector;

i_t is the Capital investment for manufacturers;

$C_P(P_t(z)) + C_k(k_t(z))$ is the goods that the manufacturer consumes in the production process;

$\sigma l_t + \frac{\omega_t d_t}{m_t}$ is the commodities consumed by commercial banks in the risk management process.

7.3 Long-term Impact on the International Relations

1. Illegal transaction problems

The trading of digital currency does not pass through any financial institution, and no third party can control or block the transaction.

2. Ethical Issues

So far, it is the most difficult concept for participants to define how to use, invest and develop these technologies. Whether the participants are users, developers or investors, they have different ideas and pauses about the ethics of blockchain technology. May cause more ethical issues.

8 Conclusions

8.1 Strengths

1. We have proposed a plan to analyze the viability of a country for digital currency through several existing economic indicators.

2. We have a series of circulation models and Suggestions on the issuance, effectiveness, recovery and circulation of digital currency. In addition, we give mixed circulation Suggestions on the circulation mode of digital currency in the market based on the combination of real currency.

3. In this paper, a two-chain structure regulatory model is proposed, which solves the problem that cryptocurrencies are difficult to be regulated and at the same time ensures the decentralization and anonymity of the monetary system and has strong scalability.

8.2 Weaknesses

1. There are not enough factors to consider the viability: due to the different political and cultural background of each country, there may be more potential factors (such as religion, military) to affect the actual feasibility of each country.

2. We have a series of circulation models and suggestions on the issuance, effective, recovery, and circulation of digital currency. In addition, we give mixed circulation Suggestions on the circulation mode of digital currency in the market based on the combination of real currency.

3. The double chain model is only the theoretical model we put forward. Whether the actual performance can reach the general application is an unknown.

8.3 Model Extension

1. The viability analysis can be specific to each country. Factors that can be considered include citizens' census data on digital currency and the efficiency of bank cash operations.

2. A complete framework can be formed by combining the issuance, recovery and oversight mechanism of currency.

3. We can analyze the work efficiency of the double chain model and improve the internal protocol to improve the efficiency.

A Policy Recommendation for National Leaders

To: National Leaders
Date: January 29,2019
Subject: Digital currency advices

At the request of ICM, our team designed a digital currency viability model. The model takes full account of percentage of population using the Internet (PPUI), inflation rate (IR), seigniorage (SE), reserve requirement (RR), deposit interest rate (DIR) and corruption perceptions index (CPI). At the same time, the current banking and monetary models are modified. We established the circulation model of digital currency based on neural network feedback and proposed a new digital currency supervision mechanism. Finally, we analyzed the long-term effects of digital currency.

Based on our research on digital currency, we give the following six policy recommendations:

Consider mainly the influence of corruption perceptions index and inflation rate on the viability of digital currency. We used SPSS to conduct collinearity test on the six selected influencing factors and we excluded RR and DIR. PPUI and SE were removed according to $t-test$ .We got the digital currency viability model as:

$$VV_c = -1.303 + 7.647 \times IR + 0.068 \times CPI + \mu .$$

Finally, the regression analysis was performed again and we got p=0.002. It shows that the viability of digital currency regression equation is significant. So the viability of digital currency is closely related to the corruption perceptions index and the inflation rate.

Shift the focus to online operations. Pay attention to the changes and development of customers' behavior habits, trading forms and other elements, and make corresponding adjustments to their service modes, such as the design of mobile clients and the construction of the clearing system.

Use the digital currency circulation model based on neural network feedback to predict the circulation. Adjust the circulation according to macroeconomic variables such as output, consumption, investment, unemployment rate and inflation rate.

Digital currency should be issued by the central bank. Exchange the equivalent blockchain currency at a fixed rate. For small transactions in daily life, substitute currency or bank notes can be used instead. Alleviate trade to affirm pressure, alleviate trade delay problem.

Adopt double chain structure supervision mechanism. We proposed a regulatory digital currency model based on blockchain dual chain structure. It is composed of alliance chain and public chain. Taking the alliance chain as the core and the public chain as the operating basis. It not only ensures the decentralization and anonymity of the monetary system, but also realizes the possibility of supervision.

Use the dynamic stochastic general equilibrium (DSGE) model to analyze the economic effects of digital currency. We built the DSGE model covering three sectors: home, manufacturer and commercial bank. The macroeconomic indicators of the three departments are analyzed by using the total output equals to total demand solving model.

From: ICM team 1901692

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Appendix

Table 9 Calculating the data required for the Seigniorage

Name	Exchange rate (%)	2016 Broad money (current LCU)	2015 Broad Money (current LCU)	Nominal GDP (Trillion)
Algeria（DZ）	118.35	2.659	1.906	213518
Egypt (EG)	17.84	2.659	1.906	282242
Pakistan (PK)	102	16.626	14.633	251255
China (CN)	6.6423	155.007	139.228	11218281
Colombia (CO)	3150.49	422.562	394.23	377740
Dominican (DO)	50	1.198	1.091	63969
United States (US)	1	16.815	16.205	18624475
Brazil (BR)	3.7695	6.282	6.618	1795925
Russia (RU)	65.95	50.903	51.37	1246015
Argentina (AR)	17.41	2.33	1.646	545866
Iceland (IS)	119.48	1.6643	1.723	17036
Japan (JP)	109.53	1305	1256	4936211
Canada (CA)	1.32	2.032	1.768	1529760

Table 10 The value of the Seigniorage

Name	Seigniorage	Name	Seigniorage	Name	Seigniorage
Algeria (DZ)	0.029798	Colombia (CO)	0.023807	Russia (RU)	-0.00568
Egypt (EG)	0.149547	Dominican (DO)	0.033454	Argentina (AR)	0.071973
Pakistan (PK)	0.077766	United States (US)	0.032753	Iceland (IS)	-0.02884
China (CN)	0.211755	Brazil (BR)	-0.04963	Japan (JP)	0.090629

Table 11 The value of the Seigniorage

	Sum of Squares	df	Mean Square	F	Sig
Regression	17.048	2	8.524	11.742	0.002
Residual	7.259	10	0.726		
Total	24.308	12			
R	0.837		Adjusted R Square	0.642	
R Square	0.701		Std. Error of the Estimate	0.85202	