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*Original Paper*

# The Impact of Digital Currency on the Financial System: Universal Decentralized Digital Currency, Is It Possible?

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***Abstract***

*With the continuous development of computer and blockchain technology, digital currency has gradually replaced some functions of legal tender. This paper investigated the impact and the feasibility of digital currency on the financial market. Combining the money demand theory of Karl Heinrich Marx and Milton Friedman respectively, we discussed the impact of electronic and cryptocurrencies on the amount of money in circulation. Then, through further empirical analysis, we conclude that in China, digital currency has a substitution effect on current deposits in the long term. Furthermore, the welfare effect level of different countries adopting different policies on digital currency is analyzed by using the local equilibrium model of tariff effect in small countries, and the policy choice of maximizing the total welfare level is discussed based on game theory. Finally, we put forward some suggestions on establishing the global financial supervision system.*

***Keywords***

*Digital currency, Cryptocurrency, Demand for money, Game theory, Currency regulation*

## 1. Introduction

In 2008, the global financial crisis broke out, and countries adopted quantitative and accommodative monetary policies in order to transfer losses. Advocates of non-nationalized private currencies believe that using blockchain technology to create private digital currencies could avert an economic crisis. The biggest feature of private money is decentralization, not relying on central bank credit, and is independent of the “currency” system under the central bank. The latest news shows that Bitcoin’s payment function is further recognized and supported. At present, merchants from more than 200 countries accept bitcoin. There are more than ten well-operated trading platforms worldwide, and daily currency is exchanged for bitcoin. The amount has exceeded 100,000 (in bitcoin), and the number is still growing.

With the development of the digital economy, the emergence of a new type of private digital currency represented by “bitcoin” has replaced some of the functions of traditional currency. Digital currency based on blockchain technology, with its high transaction efficiency, low transaction cost, avoiding inflation to maintain wealth value, and privacy, has triggered the popularity of currency denationalization.

However, the privacy of private digital currency can easily become a means of trading illegal activities, such as tax avoidance and money laundering. Decentralization makes it difficult for the government to regulate it, which in turn hinders it becoming a universal currency.

Commodity and currency theory holds that money is the product of spontaneous market, and the general equivalent of separation in exchange, and is a widely accepted private commodity. Even in the era of credit money, private individuals can become credit providers. From the perspective of the currency issuer, the digital currency can be divided into a private digital currency and a legal digital currency.

Therefore, in this paper, we will analyze the impact of digital currency on the economic system from the perspective of monetary quantity demand.

## 2. Methodology

First of all, we get inspiration from money demand theory of Karl Heinrich Marx and Milton Friedman respectively and build a mathematical model based on people’s money demand motivation. Analyze the impact of electronic currencies and cryptocurrencies on the amount of money in the economy. Then, adopting the method of empirical analysis and using the time series model to analyze the impact of bitcoin and electronic currency on different levels (M0, M1, M2) in China.

Secondly, we use the local equilibrium analysis model of tariff effect in small closed economy countries, and take digital currency as a kind of commodity to analyze the difference of welfare level when the government and the public choose to accept or reject digital currency. Based on the game theory, the choice between the two parties to reach the Nash Equilibrium and maximize the actual welfare effect is analyzed.

Thirdly, by analyzing the supervision of digital currency in the global market, we propose the regulation system of global digital currency financial market from the perspective of the process from the generation of digital currency to the circulation in the market.

## 3. Theoretical Analysis and Empirical Analysis under the Financial System Model

### *3.1 Analysis from the Perspective of Money Demand*

To construct a model that represents the financial system including the digital currency, we first consider the principle of currency circulation, that is: where does it come from and where does it go. Thus we remind the law of the circulation of money created by Karl Heinrich Marx:

$$\mathrm{MV} = PT$$

("M" represents the demand of money; "V" represents the Currency turnover rate within a certain period of time; "P" represents the Total commodity price level ; "T" represents the total volume of the goods and services in the market)

The foundation of this formula is "Labor creates value" (Hao, 2017). In the period of metal currency, gold and silver were regarded as general equivalents and acted as the money. Money has five functions: measures of value, means of circulation, means of payment, means of storage, and world currency. This law of currency circulation points out that the function of the internal means of storage of money can be adjusted spontaneously according to the commodities circulating in the market, so that the money supply can be adapted to the actual demand. Therefore, inflation or deflation will not occur. Now that we are out of the monetary system of the gold standard, the addition of more electronic currency and cryptocurrencies further complicates the changes in currency demand which is exactly what we will discuss in the following paragraphs. Although this law is the circulation of old gold and silver currency, it is also useful in the circulation of symbol currency such as banknotes (Liao, 2012). It can still play an important role in inspiring our model.

Another classic theory about the quantity of money was proposed by the American economist named Milton Friedman modern western economics (Milton & Anna, 1867-1960).

$$\frac{M}{P} = \mathrm{f}(\mathrm{y}, \mathrm{w}, r_b, \mathrm{r}_e, r_m, \frac{1}{p} \times \frac{dp}{dt}, \mu)$$

("M": the demand of money; "P": the total commodity price level; "y": the nominal long-term income; "w": the ratio of non-human wealth to total wealth; "$r_b$": the expected yield of the bond; "$r_e$": expected rate of return on bonds; "$r_m$": expected nominal rate of return on money; "$\frac{1}{p} \times \frac{dp}{dt}$": expected rate of change in price levels; "μ": Other factors affecting money demand)

The digital currency we discussed can be divided into 2 kinds: one is the electronic currency corresponding to the central bank's currency. The other is the virtual currency which is independent of the supply and demand system of currency. Whether it can make the transition to a real currency depends on people's trust in bitcoin and confidence in the whole set of mechanisms (Gu, 2013). As a result, at this stage, cryptocurrencies have a relatively small impact on the amount of money in today's market because of unresolved credit, regulatory, and stakeholder issues. With reference to the optimal money demand theory proposed by Hao (2017), we theoretically derive the impact of these two types of digital currencies on a closed economy.

We assume that in a closed economy there are commodity markets, financial markets, Banks and the public. Money can circulate among these four areas. As shown in Figure 1.

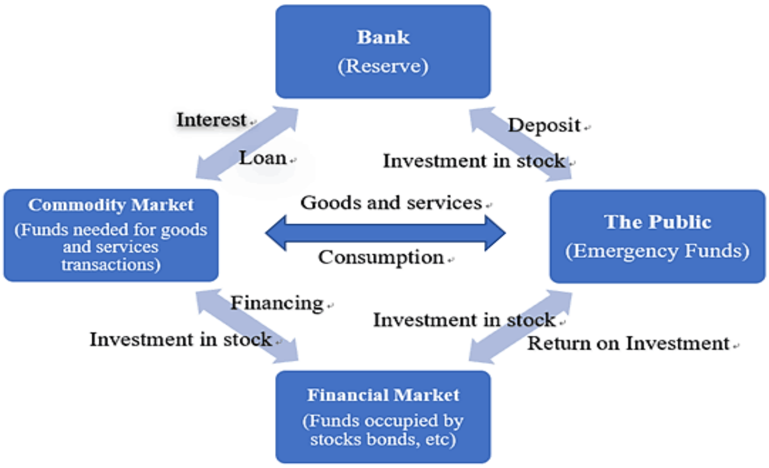


**Figure 1. The Circulation Model of Currency**

The currency in circulation in the commodity and service market includes: the public purchase and pay for goods and services from the manufacturers in the commodity market, at the same time, some of their income is deposited in the bank for interest, and some of the money is invested in the financial market such as stocks and bonds; Manufacturers in the commodity market mortgage part of their assets to Banks for financing, and use part of the funds to invest in stocks, bonds and options in the financial market; And a portion lost in circulation. Funds that can be considered relatively static for a given period of time include money accumulated in financial markets, reserves required by Banks for routine withdrawals, and funds reserved by individuals and firms for emergencies as a part of precautionary demand. Then the monetary demand formula can be expressed as:

$$\mathrm{M} = \frac{PT}{V} + C_1 + C_2 + C_3 + \mu$$

(The definition of M/P/T/V is the same as above; "$C_1$": Precipitating money in financial markets; "$C_2$": Bank reserve; "$C_3$": Funds reserved by individuals for emergency response)

We first talk about the first kind of money. Electronic currency is essentially an innovation of payment method, and its standard currency is still legal tender issued by the central bank.

Electronic money has a major impact on V (the Currency turnover rate within a certain period of time), C1 (Precipitating money in financial markets), C2 (Bank reserve), C3 (Funds reserved by individuals for emergency response) & T (the total volume of the goods and services in the market).

3.1.1 The Influence of Electronic Currency on "V"

Third-party payment platforms such as Paypal (realized point-to-point instant transactions) and electronic payment methods such as bank cards, which were invented before, have undoubtedly accelerated the circulation of money. Services such as electronic wallets and online businesses are enabling people to go outside without having to carry cash. There is the substitution of electronic money for traditional currency. In China, transactions on the third-party payment platform which is built by Alibaba have grown exponentially since 2015. This leads to a reduction in the demand of money.

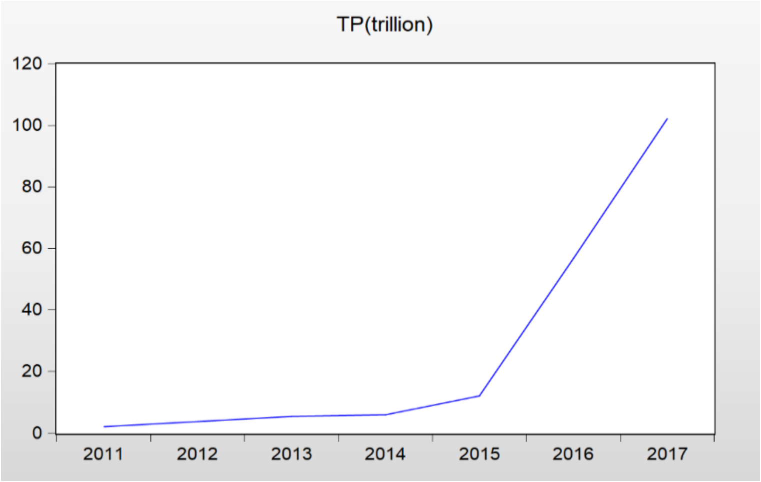


**Figure 2. Third-party Mobile Payment Transaction Volume from 2011 to 2015 in China**

3.1.2 The Influence of Electronic Currency on “C2”, “C3”

Security of electronic currency transaction is higher than that of traditional currency transaction. For one thing, it speeds up the transaction speed and thus reduces the risk of theft and pick pocketing. The second is that money recorded in electronic data greatly reduces the rate of current leakage. This makes banks reduce the amount of cash they need to prepare for daily withdrawals due to the accelerated speed of capital flow. And the demand for funds reserved for the public for emergencies also decreases further, which will lead to the decrease of M.

3.1.3 The Influence of Electronic Currency on “C1”

The development of electronic money is two-sided for financial markets. On the one hand, the development of electronic money accelerates the circulation of funds in the financial market, and the accumulated money in the financial market declines. On the other hand, for example, the conversion service of funds in Alipay (an electronic wallet) and Yu Ebao (an investment and wealth management tool) launched by Alibaba payment platform promotes the velocity of funds entering the financial market, so the impact on M is uncertain.

3.1.4 The Influence of Electronic Currency on “T”

These currency may be used to buy physical goods and services, but may also be restricted to certain communities such as for use inside an online game or a social network (https://www.en.wikipedia.org/wiki/Digital_currency). It’s based on experience that the development of electronic currency has a positive impact on T.

The second digital currency is cryptocurrency. The impact of cryptocurrencies on currency demand is mainly reflected in “C2”. Because both the issuer and the holder of cryptocurrency can be considered as the public, the issuer holding cryptocurrency such as bitcoin will reduce its demand for traditional currency. Buyers of cryptocurrencies will transfer part of their holdings of traditional currency to cryptocurrencies, resulting in a decrease in C2 and a decrease in M. This substitution is particularly evident in the current period of imperfect and incomplete information in the cryptocurrency market. Due to the imperfect market and asymmetric information, there are a lot of arbitrage opportunities in the cryptocurrency market. Most of the motivation for people to hold cryptocurrencies are not to enter the market's circulation system, but to speculate or invest.

*3.2 The Empirical Analysis*

In order to further explore the impact of digital currency on the amount of currencies, we conducted an empirical analysis on the impact of different currency levels based on the data of the transaction volume of China's third-party payment platforms (TP) and the annual transaction volume of bitcoin in China (BT). Due to the rapid development of China's third-party payment platforms since 2015, the change trend of its transaction volume is close to the exponential growth, so the logarithm of BT is taken in the model to reduce the difference in variation (Pang, 2014).

1. Build the time series model

$$\mathbf{M0_t=\beta_1+\beta_2TP_t+\beta_3lnBT_t+\mu_i}$$

$$\mathbf{M1_t=\beta_4+\beta_5TP_t+\beta_6lnBT_t+\mu_i}$$

$$\mathbf{M2_t=\beta_7+\beta_8TP_t+\beta_9lnBT_t+\mu_i}$$

(M0: Cash in circulation (100 million yuan); M1: M0+Demand deposit (100 million yuan); M2: Currency and quasi money supply (including M1, Time deposit, savings deposit and other deposits); TP: Third-party mobile payment transaction volume (trillion); BT: Bitcoin annual circulation (per year))

2. Augmented Dickey-Fuller Test

In order to eliminate the autocorrelation, the Unit Root Test is performed on M0, M1, M2. We used the Augmented Dickey-Fuller test on them.

Null Hypothesis: M0_100_MILLION_YUAN_ has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -75.76739 | 0.0001 |
| Test critical values: | 1% level | -8.235570 | |
| | 5% level | -5.338346 | |
| | 10% level | -4.187634 | |

**Figure 3. ADF Test Results on M0 Detected by Eviews 8**

M0t: in the ADF test of explained variable M0, the results of the three models with minimum AIC, SC and HQ are selected. The results are stable after the test, the null hypothesis that M0t has unit root can be rejected at the significance level of 1%. That is, M0t is the stationary process under the model with intercept term and trend term {M0t}~I(0)

Similarly, the stationarity test is carried out for other variables, and the results are as follow:

**Table 1. The ADF Results of All Variables Detected by Eviews 8**

| Variable | ADF test statistic | Prob | 1% level | 5% level | 10% level | Whether stable |
|---|---|---|---|---|---|---|
| **M0** | -75.76739 | 0.0001 | -8.235570 | -5.338346 | -4.187634 | T |
| **M1** | -0.661652 | 0.9053 | -7.006336 | -4.773194 | -3.877714 | F |
| **D(M1)** | -1.169311 | 0.5931 | -5.604618 | -3.694851 | -2.982813 | F |
| **D(M1,2)** | -1.815919 | 0.0727 | -3.271402 | -2.082319 | -1.599804 | T |
| **M2** | -1.477748 | 0.7366 | -7.006336 | -4.773194 | -3.877714 | F |
| **D(M2)** | -1.662243 | 0.3914 | -5.604618 | -3.694851 | -2.982813 | F |
| **D(M2,2)** | -2.345690 | 0.0348 | -3.271402 | -2.082319 | -1.599804 | T |
| **BT** | 1.943270 | 0.9982 | -8.235570 | -5.338346 | -4.187634 | F |
| **D(BT)** | 1.427378 | 0.9880 | -6.423637 | -3.984991 | -3.120686 | F |
| **D(BT,2)** | 0.786261 | 0.8208 | -3.563915 | -2.157408 | -1.610463 | F |
| **lnBT** | -2.874097 | 0.1120 | -5.604618 | -3.694851 | -2.982813 | T |
| **TP** | -3.331858 | 0.2176 | -8.235570 | -5.338346 | -4.187634 | F |
| **D(TP)** | -3.016093 | 0.1098 | -6.423637 | -3.984991 | -3.120686 | T |

3. Engle-Granger Co-integration Analysis

After the ADF test on variables, the model is further tested by EG co-integration test to see if there is a co-integration relationship between the non-stationary explanatory variables and the explained variables. If there is, the error correction model between them will be established. OLS method was used to estimate the regression equation, and the residual sequence was obtained. ADF test was conducted on the residual sequence, and the results were as follows:

The explained variable M0 conducts co-integration test on the two explanatory variables, and the unit root test of the residual sequence is obtained as follows:

Null Hypothesis: R1 has a unit root
Exogenous: None
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -3.490385 | 0.0060 |
| Test critical values: | 1% level | -3.109582 | |
| | 5% level | -2.043968 | |
| | 10% level | -1.597318 | |

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 5

**Figure 4. The Unit Root Test Results of the Explained Variable M0 on the Two Explained Variables Detected by Eviews 8**

Since N=3, we calculated the result according to the C(α) threshold value and formula in the table of cointegration test thresholds provided by Mackinnon:

$$C(\alpha) = \varphi_\infty + \varphi_1 T^{-1} + \varphi_2 T^{-2}$$

(α: Significance level; T: Sample size; φ∞, φ1, φ2: The corresponding parameters provided in the table)

Select significance level of 0.1 and calculate the critical value C(α):

$$C(\alpha) = -3.4518 - 6.241/7 - 2.79/(7^2) = -4.40031$$

$$t = (-3.490385) > C(\alpha)$$

Therefore, M0 has no co-integration relationship with variables lnBT and TP.

The explained variables M1 and M2 were co-integrated with two explanatory variables, lnBT and TP, respectively. Then we obtained the unit root test results of the residual sequence, which were combined with the above test results as follows.

**Table 2. Unit Root Test Results for All Variables Detected by Eviews 8**

| Explained variables | Explanatory variables | t statistics | C(α) | Confidence level:α | Whether there is a co-integration relationship |
|---|---|---|---|---|---|
| M0 | lnBT，TP | -3.490385 | -4.40031 | 0.1 | F |
| M1 | lnBT，TP | -5.009760 | -4.40031 | 0.1 | T |
| M2 | lnBT，TP | -4.197227 | -4.40031 | 0.1 | F |

Therefore, the second regression model has a co-integration relationship, indicating that there is a long-term equilibrium relationship between explanatory variables and explained variables.

However, in the short term, there may be imbalance in the model. In order to enhance the accuracy of the model, we established an error correction model to connect the changes of short-term factors affecting M1 with long-term changes.

$$\boldsymbol{\triangle M1_t = \beta_4 + \beta_5 \triangle TP_t + \beta_6 \triangle lnBT_t + \gamma ec_{t-1} + \varepsilon_t}$$

(ec stands for residuals in the long-term relationship model)

Dependent Variable: DM1(-1)
Method: Least Squares
Date: 01/27/19 Time: 15:46
Sample (adjusted): 2013 2017
Included observations: 5 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 37089.14 | 10187.38 | 3.640694 | 0.1707 |
| DLNBT | -8729.815 | 4921.916 | -1.773662 | 0.3268 |
| DTP | 612.5625 | 224.9885 | 2.722640 | 0.2241 |
| DR21 | -0.816586 | 0.209948 | -3.889476 | 0.1602 |

| | | | |
|---|---|---|---|
| R-squared | 0.987916 | Mean dependent var | 39341.91 |
| Adjusted R-squared | 0.951664 | S.D. dependent var | 30317.60 |
| S.E. of regression | 6665.456 | Akaike info criterion | 20.43783 |
| Sum squared resid | 44428302 | Schwarz criterion | 20.12538 |
| Log likelihood | -47.09457 | Hannan-Quinn criter. | 19.59924 |
| F-statistic | 27.25139 | Durbin-Watson stat | 3.096059 |
| Prob(F-statistic) | 0.139681 | | |

**Figure 5. Long-term Error Correction Model Detected by Eviews 8**

We can get the following results:

D(M1)= 612.5626D(TP)- 8729.815(lnBT)- 0.816586EC(-1)

t= (2.711640) (-1.773662) (-3.889476)

Adjusted R-squared: 0.951664 Durbin-Watson stat: 3.096059

After debugging, the sequence with the above lagging term (-1) is the short-term relationship regression model in the best form. The results show that BT (Bitcoin annual circulation) has a negative influence on explained variable M1 at the level of confidence about 70%.TP (third-party mobile payment transaction volume) has a positive effect on explained variable M1 at the confidence level of 78%.

The above analysis has proved that there is a long-term equilibrium relationship between the two variables affecting M1: lnBT and TP. On this basis, we use granger causality to further analyze whether there is causality between each explanatory variable and the explained variable and the direction of its influence.

4. Granger causality test

$$Y_t = \sum_{i=1}^{m} \alpha_i X_{t-i} + \sum_{i=1}^{m} \beta_i Y_{t-i} + u_{1t} \qquad (1)$$

$$X_t = \sum_{i=1}^{m} \lambda_i Y_{t-i} + \sum_{i=1}^{m} \delta_i X_{t-i} + u_{2t} \qquad (2)$$

The core thinking of granger causality test is: if a change in X causes a change in Y, then the change in X should occur before the change in Y. The Granger causality test can only test the causal relationship between two or two variables. For the two-variable causality test, the causal relationship is judged by examining whether the α and λ parameters are all zero in the following two formulas.

According to whether the α and λ parameters are all zero, there are four possibilities for the test results, and we mainly considered two of them in this paper:

1) X has a single influence on Y, which is manifested as the parameter α before each lag term of equation (1) X is at least one of which is not zero, while the parameter λ before each lag term of equation (2) is all zero.

2) There is no influence between Y and X, as shown in equation (1) and equation (2), parameter α and λ before each lag term of Y and X are all zero.

A prerequisite for granger causality test is that the time series must be stationary, otherwise false regression may occur. According to the unit root test of the above variables, when the model becomes a two-order difference form, the time series is stable, so granger test is carried out between Y and X one by one. The test results are shown in the Table 3.

**Table 3. Results of Granger Causality Test on the Second Regression Detected by Eviews 8**

| Null hypothesis | Lag period: | 1 |
|---|---|---|
| D(lnBT) does not Granger Cause DM1 | F-Statistic | 0.55379 |
| | Prob. | 0.5927 |
| D(M1) does not Granger Cause D(lnBT) | F-Statistic | 1.98028 |
| | Prob. | 0.3933 |
| D(TP) does not Granger Cause D(M1) | F-Statistic | 0.49655 |
| | Prob. | 0.6092 |
| DM1 does not Granger Cause D(TP) | F-Statistic | 1.75216 |
| | Prob. | 0.4119 |

We can see from the test results that there is no Granger causality for M1, whether it is BT or TP variable.

5. Results analysis

From the above test results, the following conclusions can be drawn: in the long run, the growth of electronic currency and cryptocurrency has an impact on M1, but has no relevant impact on M0 and M2.According to the definition of money level, M1 includes M0 and demand deposits, while M2 includes M1 and time deposits, savings deposits and other deposits. Therefore, we can conclude that cryptocurrencies mainly have a substitution effect on residents' demand deposits.

In the short-term error correction model, the impact of electronic currency and cryptocurrency on M1 is not significant, but this is consistent with China's national conditions. Electronic currency in China began to appear in 2013, and developed rapidly in 2015. By the end of 2017, it had a growth period of only three years. Although it has great potential for development, it has little impact on China's huge monetary aggregates today. On December 5, 2013, the five ministries and commissions such as the People's Bank of China issued a notice to prevent the risk of bitcoin. They supposed that Bitcoin is not issued by the monetary authority, has no legal and mandatory monetary attributes, and therefore is not a real currency, and cannot and should not be used as a currency in the market. As a result, bitcoin and other cryptocurrencies have a small amount of circulation in the real Chinese market, and their influence cannot affect the high level of current volume for the time being. Combined with theoretical analysis, we can see that both electronic currency and decentralized cryptocurrency have a small impact on the demand and supply of money today, and their development has a different impact on currency with different structures. However, in general, both electronic currency and cryptocurrency have a substitution effect on traditional currency. Their impact on the financial system is more obvious in currency and demand deposit due to the public's liquidity preference for currency, so the monetary authorities should pay more attention to the change of this current level.

## 4. The Needs and Willingness of Different Countries to Adopt Digital Currency Financial Systems

### *4.1 Based on The Game Theory, Analyze the Different Choices of Open Small Countries*

#### 4.1.1 Modeling Ideas

According to the local equilibrium model of tariff effect in small countries, for a small country with an open economy, if import tariffs are imposed to manage trade, the net effect of social welfare changes will be negative according to the welfare effect. Based on the analysis of a partial equilibrium of the effects of import tariffs on small countries as world price takers [7], small countries should maximize their own welfare under the free competition market structure, that is, carry out free trade. Using game theory analysis in the digital currency market equilibrium state, whether the government increased restrictions of digital currency which can lead to increasing its market price, and whether people choose to accept the digital currency, 4 circumstances had the impact on welfare levels. Then two different situations are proposed:

1. The government and the public make the best choice for themselves based on the principle of maximizing their own interests, so that the overall welfare level can reach Nash Equilibrium.

2. Both the government and the public make the choice to maximize the overall welfare level, which do not necessarily represent the best choice for them.

#### 4.1.2 Model Hypothesis

1. The objects of analysis are divided into two categories: large countries and small countries (where policy changes by large countries can have an impact on supply and demand in world markets, and small countries do not).

2. The digital currency market is in perfect competition

3. Country H is a small open country under the economic globalization, and its internal demand change will not affect the price of digital currency in the world.

4. Only consider the change of digital currency entering a certain country's market, and carry out local equilibrium analysis.

5. Take bitcoin as the only decentralized digital currency in this condition. Take bitcoin as a commodity and an alternative to money.

#### 4.1.3 Model Establishment

Suppose P is the price of the transaction digital currency and Q is the number of transactions.

P1 represents the equilibrium price under the government's control, and Q4 represents its demand and Q1 represents supply.

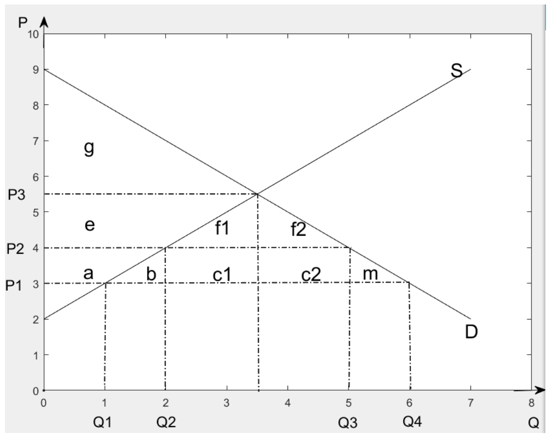


**Figure 6. Welfare Effect Model of Small Countries Adopting Digital Currency**

Assuming that bitcoin enters the currency market of country H, the supply curve and demand curve of domestic bitcoin faced by the market of country H are respectively represented by S and D. P3 is the cost to the domestic public when bitcoin is not used at all. If the domestic public does not accept digital currency, it means the benefits brought by the superiority of digital currency, such as the right of seigniorage and the transaction convenience of decentralized digital currency. And the welfare level of its users is g. Since the producers of bitcoin are not necessarily the domestic public, they need to consider independently: if the government does not control the entry of bitcoin and the public accepts bitcoin, the welfare level at this time is (a+b+c1+c2+m+f1+f2+e+g). If the government controls and the public accept bitcoin, because for the bitcoin producers, while the government controls the entry of bitcoin into the market, the price of bitcoin will rise further due to the continued demand. If the producers of bitcoin are the domestic public, the domestic public can enjoy the increased producer surplus. If the producers of bitcoin are in a foreign market, the producer surplus made up of this part will be enjoyed by foreign producers.

However, it must be pointed out that the welfare level of bitcoin recipients in the second case will not be lower than that in the case where the domestic public does not accept bitcoin. Therefore, we consider the impact of decisions made by the country's subjects on the overall welfare level under the strictest circumstances. This is why the analysis of producer surplus is not included in our game theory model.

When the domestic people use bitcoin and the government does not control it, the cost of bitcoin entering the domestic market is P1. At this time, the cost can be regarded as the cost of bitcoin production. The government loses the rights such as seigniorage, so the government's fiscal revenue is zero. After the government strengthened its control over the entry of bitcoin into the currency market, the benefits of currency purchasers decreased by (a+b+c1+c2+m), while the government revenue increased by (c1+c2); If people do not accept digital currency, their welfare is g and government income is 0.

The government does not strengthen its control over the entry of bitcoin into the currency market, and the government welfare is 0. Currency buyers accept digital currency with the benefits of (a+b+c1+c2+fi+f2+m+e+g). If it is not accepted, the benefit is g.

**Table 4. The Effect Matrix of the Game Theory**

| Government/public | Accept/ | Reject |
|---|---|---|
| **Control** | c1+c2, g+e+f1+f2 | 0, g |
| **No Control** | 0, a+b+c1+c2+f1+f2+m+e+g | 0, g |

According to the Nash Mixed Equilibrium, the probability that the government controls the circulation of digital currency in the country is A, and the probability that the government does not control the circulation of digital currency in the country is (1-A). The probability that people choose to accept digital currency is B, and the probability that people choose not to accept digital currency is (1-B), then the expected payment of the government is:

$$U_g = AB(c1 + c2)$$

$$\frac{\partial U_g}{\partial A} = B(c1 + c2)$$

The public's expected payment is:

$$U_p = B[A(g + e + f1 + f2) + (1 - A)(a + b + c1 + c2 + f1 + f2 + m + e + g)] + (1 - B)[Ag + (1 - A)g]$$

$$\frac{\partial U_p}{\partial B} = (1 - A)(a + b + c1 + c2 + m) + f1 + f2 + e$$

In equilibrium, the mixed strategy is: A=1, B=1. At this time, the mixed strategy will converge to a pure strategic Nash Equilibrium, in which the government chooses to control the circulation of digital currency in the country and the public decides to accept digital currency. This increase in government revenue comes at the expense of a smaller consumer surplus, which ultimately leads to a decline in the country's overall welfare.

Here comes to the conclusion. For a small country with an open economy, the best strategy to maximize the level of social welfare is that the government does not control the circulation of bitcoin, and the resulting social welfare is the largest. This is in line with the principle that small countries should adopt free trade policies in order to maximize their own welfare in a competitive market. Although import tariffs imposed by small countries will increase domestic production fiscal revenue, on the whole they will lead to a net loss of economic welfare and a decline in the welfare level of the country.

*4.2 Further Discussion of Models for Different Types of Countries*

In the model of local equilibrium welfare effect of small countries, the policy changes adopted by small countries on bitcoin cannot change the world terms of trade. However, if large countries adopt control policies for bitcoin, as its demand accounts for a large proportion of the world market demand, the demand for bitcoin will decline in a global scale, thus greatly impeded the liquidity of bitcoin, and its price will further drop to a lower level than the original world market price. At this time, the fiscal revenue obtained by the government under the condition of the control of bitcoin will change from (c1+c2) to (c1+c2+n1+n2). In the case that the producer surplus is still not discussed, the net effect of government tightening restrictions and people's acceptance of bitcoin on social welfare is:

$$(g+e+f1+f2+c1+c2+n1+n2)-(a+b+c1+c2+f1+f2+m+e+g)-a=(n1+n2)-(b+m)$$

Therefore, the choice of big countries and people to maximize their welfare in digital currency depends on the comparison between (n1+n2) and (b+m).

## 5. The Regulatory Regime for Global Digital Financial Markets

### *5.1 Regulatory Background*

Globally, digital currency is growing at a faster pace and cost the least compared to other currencies. At present, there are 259 kinds of digital currency services in 89 countries around the world. In order to ensure the standard development of the digital currency market, all the major countries (regions) in the world have incorporated the digital currency market into the regulatory system. However, digital currency crime still emerges in an endless stream, especially transnational crime, which increases the regulatory difficulty. Brazil, Spain, China and other places have seen digital currency fraud. Money laundering and other criminal ACTS, and even individual digital currency exchanges were attacked by hackers, extortion.

### *5.2 Global Digital Currency Regulatory System*

In view of the unclear legal status of digital currency market, the lack of centralized management institutions, the defects of anonymous transactions, the vulnerability to hacker attacks, transnational circulation and other characteristics, we believe that it is still necessary to establish a unified global digital currency supervision system:

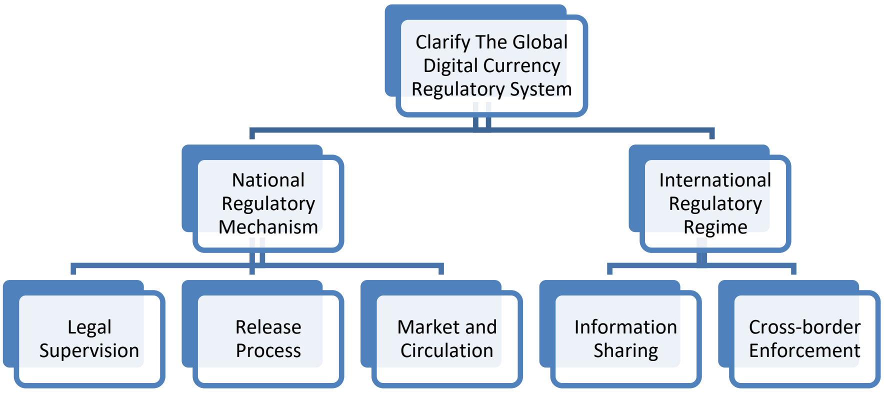


**Figure 7. Digital Currency Supervision System**

**National Supervision:**

1. Legal Supervision:

1) The legal status of digital currencies should be clarified, independent regulatory bodies should be established, relevant rules and regulations should be formulated, and sanctions should be imposed on those who use Internet technologies to destabilize the digital currency market or harm the interests of holders.

2) Establish and improve laws on digital currency actively and crack down on money laundering, tax avoidance and other illegal and criminal activities involving the use of digital currency.

2. Release Process

1) Establish a review mechanism for issuers and set a threshold for entry into the numerical financial market.

2) Referring to the traditional way of money risk management by banks, an electronic money reserve system is established, and legislation is made to make each digital currency issuing entity pay a deposit to the central bank.

3. Market and Circulation

1) Establish digital currency trading institutions and trading information disclosure mechanism.

2) Implement credit rating of the issuing subjects of digital currency and monitor risks of digital currency in real time.

**International Regulation:**

1) Establish a global digital currency transaction information sharing platform, and use extensive data to analyze digital currency transaction information.

2) Strengthen the mechanism for regulatory cooperation and joint enforcement of cross-border crime involving digital currency.

3) Bring bitcoin into the global financial regulatory system.

## 6. Conclusion

Whether the digital currency system can be widely established is always a controversial issue. In this paper, we use different perspectives and methods to discuss the impact of digital currency on the economic system, the different welfare levels generated by different choices of digital currency in different countries, and the establishment of a global digital currency financial market regulation system. First, combining the money demand theory of Karl Heinrich Marx and Milton Friedman respectively, concluded that electronic money would reduce money demand by affecting the total volume of the goods and services in the market, bank reserve, and Funds reserved by individuals for emergency response. Cryptocurrencies mainly affect the decline in money demand through bank reserve. Then, through further empirical analysis, we conclude that in China, digital currency has no influence on the amount of money in the market in the short term, while it has a substitution effect on current deposits in the long term. This change is mainly due to the public’s liquidity preference for money, so the monetary authority can pay more attention to the change of money at this level.

Based on the theory of local equilibrium of import tariff in small countries, this paper establishes a model to analyze the difference in welfare level caused by the choice of adopting digital currency between the government and the public. Based on game theory, we conclude that when the two reach the Nash Equilibrium, the government's restriction on the access of digital currency to the market and people's willingness to use digital currency can't maximize the overall welfare level, which can only be achieved when small countries have no barriers to digital currency. We further discuss the model for different types of countries.

Finally, based on the defects of digital currency, such as the decentralized supervision institution, hacker attack, etc., we established a global digital currency supervision system, including two parts: national supervision and international supervision. Hope to be helpful to the establishment of the supervision system in this respect.

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