The Impact of E-money on China's Money Supply

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Abstract. Electronic money alters the form of currency, reduces the demand for cash, alters the manner in which transactions are settled, and alters the quantity of reserves held by our commercial banks. Electronic money makes the relevant factors acting on the base money supply more complex, which will undoubtedly make it more difficult for the central bank to achieve control over the base money, thereby further weakening the central bank's ability to manipulate the money supply and affecting the effectiveness of the central bank's monetary policy target of the money supply. Therefore, a correct understanding of the impact of electronic money development on the base money supply is crucial for enhancing the effectiveness of monetary policy in China in light of the expanding scale of electronic money in China.

1. Introduction

Since its inception, money has served multiple purposes, playing a crucial role in value storage, payment, and circulation. While the intrinsic properties and fundamental functions of money are typically constant, the external form of money changes as the economy and technology advance. The advancement of information technology has driven continuous financial innovation, and the monetary form has begun a new path of evolution toward digital currency. On the one hand, electronic money is fast, low-cost, easy to carry, easy to preserve, has a high security and allows for long-distance payment[1]. On the other hand, using digital currency also expedites and improves the business processing of banking-style financial institutions, at the same time, banks are expanding emerging online services[2], thereby enhancing the overall efficiency of the financial system. As a result of technological advancements and financial innovations, In addition, in the context of current green finance and sustainable development, electronic money will also become a more environmentally friendly and reliable payment method in the future[3], digital currencies have continued to flourish, altering traditional cash circulation and transaction methods and gradually ushering in China's "cashless era." As this process accelerates, however, the implementation and transmission of the central bank's monetary policy will inevitably be affected.

The evolution of electronic currency is gradually demonstrating an irreversible tendency to replace traditional forms of currency. According to the traditional monetary theory, the money supply is influenced by two major factors: base money and the money multiplier. Base money is an exogenous variable that the central bank can directly manipulate[4]. However, the expansion of electronic currency complicates the factors influencing the base money supply, thereby increasing the endogeneity of base money. E-money alters the monetary form and decreases the demand for cash[5]. Also improve financial and macroeconomic stability by mitigating recurring economic cycles.[6] The birth of electronic money as a new form of money is the second landmark change in the form of money that has occurred since the replacement of fiat money with minted money in the medieval period. In recent years, as a result of the popularity of electronic devices, the growth of the network economy, and the advantages of lower transaction costs and higher security of electronic money compared to traditional money, the proportion of electronic payment transactions has increased rapidly. It is gradually replacing cash payments as the dominant form of personal payment on the market. Data from the People's Bank of China shows that in the second quarter of this year, banks nationwide handled 110.456 billion non-cash payments, amounting to 116.573 trillion yuan, an increase of 6.32% and 7.86%, respectively. The penetration of electronic money in consumer, financial, and personal applications and the full layout of online and offline scenarios have fully covered cash payment functions, substantially reducing the need for cash among individuals.

E-money influences the base money supply through its effect on cash in circulation and commercial bank deposit reserves, thereby diminishing the central bank's ability to regulate monetary policy through the money supply target[7]. As the source of the monetary policy
transmission process, base money, consisting of cash in circulation and commercial bank reserves, plays a key role in the formation of the total money supply and the achievement of the ultimate goal of monetary policy. According to the monetary school, the monetary authority can influence the real economic variables by manipulating the base money and thus controlling the money supply[8]. Central banks must also use reserves in base money as a medium when regulating the economy with monetary policy tools such as open market operations, the legal reserve ratio, and rediscounting.

With the continued growth of communication technology and Internet finance in China, the impact of electronic money on the amount of cash and bank reserves in circulation is intensifying, thereby increasing the complexity of the factors influencing the base money supply. This will undoubtedly make it more challenging for the central bank to achieve control over the base money, thereby diminishing its ability to manipulate the money supply. The result will affect the effectiveness of the central bank's money supply intermediary objective as part of its monetary policy[9].

It is significant to study how e-money affects the supply of base money to enrich the theories related to e-money, base money and monetary policy. The traditional monetary theory states that the central bank regulates the money supply by issuing base money derived from commercial bank deposits. Among the two major factors affecting the money supply, base money is equivalent to an exogenous variable that the central bank can directly manipulate. Nonetheless, the expansion of e-money complicates the factors influencing the supply of base money, thereby increasing the endogeneity of base money and the difficulty for central banks to control base money. Therefore, studying how e-money affects the money supply base is significant for advancing theory.

2. The development and status of electronic money in China

Electronic money in China can be traced back to the BOC card issued in 1985, which was the country's first bank card. In the early days of China's electronic currency, bank cards were primarily used as the storage medium. The domestic bank card business began in 1985 when Zhuhai Credit Card Co. was founded. The company was the earliest to operate a credit card business in China, and the company made the first credit card in China, the Bank of China Card. The government began promoting the Golden Card Project in 1993 to promote the development and use of electronic money in China. In 2002, China UnionPay was formally established in China and basically reached the goal of networking and common use, and China's bank card development took a new step forward. In August 2003, UnionPay issued the "62" BIN UnionPay card[10], the earliest self-branded card for bank cards in China. This event strengthened the cohesiveness of China's bank card industry and the right to develop its own bank cards.

In 2003, Alipay used the Taobao e-commerce platform to enter the traditional financial payment field, changing the channel structure of traditional finance. CaiPay and other Internet businesses and financial institutions launched online third-party payment services sequentially in 2005. Before 2013, Alipay primarily implemented payment services through the PC terminal and had little impact on mobile payments using bank cards. Since 2016, the scale and popularity of third-party mobile payments have expanded significantly. Electronic money is slowly evolving from bank card-based to contemporary electronic payment-based monetary value forms. The monetary form and payment method are complementary, and electronic currency is essentially a form of credit money. Third-party payment manifests this monetary form, essentially the flow of electronic currency. China's third-party payment business has experienced a rapid increase in transaction volume as mobile payments continue to grow. China's third-party payment business has grown from 49.5 trillion yuan in 2015 to 355.5 trillion yuan in 2021 at an average annual compound growth rate of 39.8 percent.

3. The impact of electronic money on the money supply

3.1. The concept of research variables

Form and method of payment are complementary, and the defining characteristic of electronic currency is that it is a form of credit money. This monetary form is represented by third-party payments, which can be viewed as the flow of electronic currency. In recent years, users' payment preferences have shifted to mobile terminals, and mobile payment has become the predominant form of third-party payment. Mobile payments will become more prevalent than PC-based Internet transactions. With the development of society and the need for exchange, combined with the continuous improvement of mobile payment technology, it is anticipated that mobile payment will become a widely accepted method of payment until it completely replaces bank cards, etc., becoming the primary form of electronic currency. Consequently, this paper selects the volume of mobile payment business to measure the level of electronic money development in China, denoted by the abbreviation EM.

The cash held by the public is a crucial component of base money, and electronic money will affect the cash held by the public. In this paper, the ratio of cash in circulation, $\text{M}_0$, to money in circulation, $\text{M}_1$, denoted as $K$, is used to measure the relative proportion of cash in circulation.

The impact of e-money on the legal reserve ratio is neutral according to the theoretical analysis, but it has an effect on the excess reserves of commercial banks, which is transmitted to the base money. In this paper, the excess reserve ratio of financial institutions is utilized to determine the size of commercial banks' excess reserves, denoted as RER.

The impact of electronic money on the base currency is mediated by its effect on cash in circulation and
commercial bank reserves. In this paper, reserve currency stands for base money and is denoted by the MB symbol.

Due to data availability, the time period selected for this study is January 2012 to September 2019, with all indicator data derived from the wind database.

3.2. Data process
First, the e-money and excess reserve ratio indicators are quarterly data series. In this paper, the quarterly e-money and excess reserve ratio data are converted to monthly data using Eviews and quadratic interpolation, while the remaining data series are monthly. Second, because the monthly observations of the time series frequently exhibit monthly cyclical variations, all data have been seasonally adjusted using the Census X-13 method. After removing the seasonal trend, the natural logarithm of the data is calculated to increase the smoothness of the series and reduce the effects of possible multicollinearity and heteroskedasticity in the data. Only the base currency and e-money data are logged in this paper.

3.3. Result analysis
Instead of analyzing how a change in one variable affects another variable, the dynamics of the system are analyzed when an error term changes or the model is subjected to a shock when analyzing VAR models. Impulse response function describes the effect of an endogenous variable on a residual shock, i.e. the effect on the current and future values of the endogenous variable following the application of a shock of a standard deviation size to the random error term. On the basis of the stable VAR (7) model with a lag interval of 40 periods, impulse response function plots for each variable are obtained. When a positive shock is given to electronic money (LNEM) in the current period, there is a strong negative short-term effect on the cash ratio (K) (K). Due to the incomparable benefits of electronic money over paper money, electronic money, as the most recent form in the evolution of money forms, is conceptually more abstract than paper money in terms of the value measure function. In the short term, electronic money will play a significant role in replacing cash in circulation. However, the impulse response indicates that the negative effect of electronic money (LNEM) on the cash ratio (k) in the later period is smaller than in the earlier period, indicating that this substitution is incomplete. Given that the transfer of funds using electronic payment tools must be tightly coupled with traditional bank accounts, the payer's claim to conduct anonymous transactions cannot be fundamentally guaranteed. Especially for remote rural and mountainous areas where network infrastructure is not widely available, the public still prefers to use cash to complete the transaction payment. Therefore, the long-term effect of electronic money replacing cash is limited. In the first five periods following a positive shock to electronic money (LNEM) in the current period, the excess reserve ratio (RER) will increase. This is because when electronic currency first appears, commercial banks have a period of adjustment and need time to accept the new technology. In order to deal with the negative effects of the new thing, they tend to hold more surplus reserves at first. Beginning in period 6, the excess reserve ratio (RER) begins to decline. This indicates that the efficient operation of the electronic payment system reduces the transaction costs of interbank funding over time, allowing commercial banks to maintain fewer excess reserves for daily fund clearing and cash withdrawals. Starting from around period 30, the excess reserve ratio (RER) will change positively. This indicates that as e-money grows in size and the proportion of non-cash settlements rises, the risk for commercial banks increases exponentially. The interbank financing cost reduction attributable to the efficient operation of electronic payment systems is minimal. E-money will positively affect the excess deposit reserves of commercial banks over time. After giving e-money (LNEM) a positive shock during this period, base money (MB) will move positively, and its growth will tend to stabilize. From the previous analysis, it is clear that e-money will reduce cash in circulation and increase commercial bank deposit reserves. And because the extent to which electronic money replaces cash is limited, the increasing scale of electronic money permits the proportion of non-cash settlement to increase, thereby exponentially increasing the risk faced by commercial banks. Long-term, the development of e-money will result in a greater increase in excess reserves held by commercial banks than in the amount of cash in circulation. Thus, e-money will have a positive effect on the base money supply.

4. Discussion
China's monetary policy's current operational and intermediary targets are base money and money supply, respectively. This paper finds through mechanistic analysis and empirical research that e-money, through its influence on cash in circulation and commercial bank deposit reserves in different directions, will eventually cause the base money supply to change in the same direction. This will diminish the money supply's controllability as an intermediary target and the central bank's ability to achieve macroeconomic control objectives by regulating the money supply. The rapid development of electronic money has also hampered the PBOC's ability to measure money. With the increasing degree of electronic money, the drawbacks of the money supply as an intermediary target of monetary policy are becoming more and more prominent. Therefore, it is recommended that the People's Bank of China take into account the impact of electronic money when implementing monetary policy and shift China's monetary policy from quantity regulation to price regulation in a timely and efficient manner. From the previous mechanistic analysis and research findings, it is evident that with the expansion of e-money and the rise of non-cash settlement, the risk commercial banks face will increase exponentially, which will positively affect their excess deposit reserves. This indicates that e-money is increasingly forming an impact posture on commercial banks' payment systems. In addition, the popularity of
Electronic money transactions have greatly saved the cost of supervision, wear and tear, and transportation of paper money, and reduced the possibility of counterfeit fraud, robbery, and other crimes that may arise from cash transactions. The emergence of mobile payment has changed people's payment habits to a great extent, only the need to carry cell phone can complete most of the payment, simplifying the payment behavior. Then once the risk occurs, the networking and invisibility of electronic payment and the possible technical security risks will quickly spread through the network, triggering global and systemic financial risks. Therefore, the People's Bank of China needs to pay great attention to the impact of e-money on the basic money supply and the impact on the commercial banking system, and further promote the healthy and orderly development of e-money to better highlight the driving influence of e-money in the regulation of macroeconomic aspects of monetary policy. From the previous mechanistic analysis and empirical studies, it is clear that e-money will reduce the demand for cash in circulation and increase the number of commercial banks' reserve holdings, which will eventually lead to a homogeneous change in the supply of base money. The impact of e-money on these economic indicators and the financial system represented by commercial banks exposes the drawbacks of instability brought by the development of e-money. Digital money, a more advanced and perfect monetary form than electronic money, is required to serve economic development as society continues to advance. China's current dynamic development of electronic money has laid a solid economic foundation for the generation of digital money, and the transformation and upgrading from the electronification of money to the digitalization of money is an inevitable trend in China's and the world's economic development.

5. conclusion

This study examines the qualitative and quantitative effects of e-money on the money supply base. On the basis of previous research findings, this paper examines the qualitative impact of electronic money on the supply of base money from two perspectives: cash in circulation and commercial bank reserve deposits, which are base money components. At the quantitative level, the VAR model is built by selecting four variables: e-money, cash in circulation, the excess reserve ratio of commercial banks, and base money. The results indicate that electronic currency has a positive effect on the supply of base currency. In particular, e-money reduces the amount of cash in circulation and increases commercial bank reserves. Due to the limited effect of e-substitution money's on cash, the risk for commercial banks will increase exponentially with the growth of e-money and the proportion of non-cash settlement. Long-term, the development of e-money will increase the excess reserves held by commercial banks more than the reduction of cash in circulation; therefore, e-money will have a positive effect on the supply of base money.

Based on the macroeconomic impact of e-money, this paper makes policy recommendations to improve the efficacy of central bank monetary policy and promote the healthy development of e-money, based on the above findings. The first objective is to accelerate the shift of monetary policy from quantity to price regulation; the second objective is to strengthen the supervision of electronic money; the third objective is to accelerate the development of the digital economy; and the fourth objective is to steadily promote the issuance of digital money.

References