

# Electronic Cash for Central Bank's Monetary Policy\*

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## 〈Abstract〉

Electronic cash affects central bank in many areas, in particular regarding the issuance of money, supervision of cashless payments, supervision of the banking system and monetary policy. The effects of electronic cash on central bank policies, the security and integrity of the payment system, and naturally also on single sector such as company engaged in the transport of money and valuables, depend mainly on the extent to which the new payment methods can replace cash.

The possible development of electronic cash merits special attention from central banks for at least three reasons. First, central banks are concerned that the introduction of the new payment instrument should have no adverse effect on public confidence in the payment system and payment media. Second, although the substitution of electronic cash for other forms of money should not theoretically hamper central bank's ability to control the money supply, it might, however, have practical implications, at least in the long run, which need to be carefully examined. Third, because electronic cash may be used for payments of very small value, they have the potential, more than any other cashless instrument, to take over the role of notes and coins in the economy and, therefore, have implications for central bank's activities and revenues.

**Key Words** : Digital Economy, Electronic Cash, Payment System, Central Bank, Monetary Policy

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## I. Introduction

Until now, the financial legal system in most countries has been determined by territorialism basically connected to the physical site of financial institutions. This is inappropriate against a background of rapid globalisation of financial businesses. Territorialism works on the basis of visible goods (visible money) in the traditional finance industry. But we now need a system that recognizes the nature of invisible goods of modern finance<sup>1)</sup>.

Electronic cash will break through territorialism and play an important functional role to bring the world into mega-competition age. Electronic cash goes everywhere in the world instantly through telecommunications networks. Once electronic cash becomes in common use, the financial industry will be free from constraint of dealing in physical goods. All countries will find that their financial regulations have become meaningless. And this also threatens country's occupational rights to issue new participant rights arising from national boundaries. Therefore, existing banks including the central bank in each country require to re-examine their situation

This paper examines first the role of electronic cash in the digital economy and payment system, and analyzes the effects on the monetary policies of the central bank raised by the introduction of the electronic cash.

## II. Electronic Cash in the Digital Economy

In the old economy (paper-based economy), information flow was physical<sup>2)</sup>. In the new eco-

nomy (digital economy), information in all its forms becomes digital—reduced to bits stored in computers and racing at the speed of light across networks. Using this binary code of computers, information and communications become digital ones and zeros. The new world of possibilities thereby created is as significant as the invention of language itself, the old paradigm on which all the physically based interactions occurred<sup>3)</sup>.

Electronic markets ordinarily refer to online trading and auction. The electronic marketplace refers to the emerging market economy where producers, intermediaries and consumers interact electronically or digitally in some way and is a virtual representative of physical markets. The economic activities undertaken by this electronic market place collectively represent the digital economy.

Digital currency (electronic cash) will become dominant when paper-based economy finally turns into the digital economy. In the short term, electronic cash is just a convenient form of existing money since digital money is created against existing money. However, in the long run, electronic cash may be created on its own if users accept it on its face value, which will be determined by how dependable its issuers are.

Why do we need electronic cash? Not because it is the ultimate in anonymous money, but digital currency is very flexible since it can be made to behave like electronic checks or anonymous cash as situation warrants.

Harsh competition is likely in the financial services area after the introduction of electronic cash. Competition will occur in the payment both for small purchases on Internet, and for huge amounts between bankers. In the new cyber-banking, everyone expects that it will require huge to open

1) Varian, 1997, pp.1-3.

2) For example, cash, checks, invoices, bills of lading, reports, face-to-face meetings, analog telephone calls or radio and television transmissions, blueprints, maps, photographs, musical scores, and direct mail advertisements.

3) Tapscott, 1995, pp.6-7.

balances at a legally-acceptable level and to establish a system.

Electronic cash utilizing digital media can be valued in two ways. It could be regarded as the provider-value costed in terms of where and when a service is delivered. Or it could be costed as a receiving value assessed in terms of its worth in the eyes of the ultimate consumer. Either way, any network that combines commercial activities with financial matters should make full use of electronic cash.

Thus, we have a new market for a financial service industry. How far are existing banks going to cope with this situation?

Take Mondex<sup>4)</sup> a development at the earliest stage. It will be followed by a second stage where electronic cash integrates and synthesizes with a digital platform embedded into a network. At this stage, a typical example is Cash developed by DigiCash which allows cash to be transferred electronically. This development is being closely watched as it raises questions about the social role of a bank as a balance-setting agent.

At the third stage, electronic cash will be able to move around the world bypassing the intervention of any banking activity. This opens up the possibility that many current functions of a bank may be superseded at the later stages of the digital revolution. For example, banks may no longer have a part to play in major international capital transfers. And of course money-laundering will be easy and harder to regulate. Thus the new electronic cash age will bring new agenda and problems.

### III. Role of Electronic Cash in the Payment System

Most financial and payment system issues intersect important areas of government policy and regulation—particularly regarding currency flows and customer risk. Electronic commerce<sup>5)</sup> raises many new issues in this respect in that not only does it require new approaches to financial activities that are already regulated and for which policies exist, but it sets up a number of situations for which there is currently no control regime at all unless voluntary. In some cases, industry may prefer to adopt internal controls<sup>6)</sup>

Electronic cash of DigiCash<sup>7)</sup> is the electronic equivalent of real paper cash a secure system or the Internet. Electronic cash is implemented using public-key cryptography, digital signatures, and blind signatures. This system is focused on the anonymity of electronic cash.

The introduction of electronic cash is expected to reduce the share of cash in the small payment market, and there is a high possibility for electronic cash to become a dominant payment instrument in that market. Such an expectation is based on the hypothesis that electronic cash would replace bank notes and coins. Can electronic cash play the same role as a currency does in commercial transactions? To answer these questions, characteristics should first be examined closely.

For a payment instrument to be accepted and used interchangeably like cash in commercial transactions<sup>8)</sup>, it must have following attributes.

4) <http://www.mondex.com/home.htm>,

5) Kalakota, Andrew, 1996.

6) Hynn, Choi, Cha, 1997, pp.859-874

7) <http://www.digicash.nl/publish/ecash-intro/ecash-intro.html> Chaum, 1992.

8) Whinston, Stahl, Choi, 1997

## 1. Wide acceptability

If electronic cash is valued to be usable, i. e., if people use electronic cash widely because of its convenience, electronic cash will likely be accepted as a substitute for cash regardless of its issuers. Of course, as for the risk of the payment system, electronic cash issued by credit institutions may be circulated more widely than one issued by noncredit institutions<sup>9)</sup>.

However, their usage can not be guaranteed like the one issued by the government. In other words, electronic cash issued either by private credit institutions or by private noncredit institutions can not carry government guarantee of usage like legal tender. Does this mean that only the government should be allowed to issue electronic cash? When electronic cash is commonly accepted, and the cashless society is realized, the government may have the exclusive right to issue electronic cash. However, today, when the electronic cash system is in the development stage, it may be undesirable for the government to hold such right. This kind of policy may prevent the electronic cash system from being developed efficiently. Therefore, the role of the central bank related to the circulation of electronic cash should remain to protect the safety and soundness of the payment and settlement system

## 2. Finality

In other words, when a payment instrument is exchanged for goods and services, the transaction is completed at that moment. Therefore, payment instruments without the possibility of dishonor are preferred over checks and drafts. Compared to other payment instruments, the finality of the payment instrument seems to be sufficiently met by electronic cash. In this respect, electronic cash

is better than credit cards, which need the settlements between shops and credit card issuers.

## 3. Anonymity

Anonymity is related to the kinds of technical protocol used by the electronic cash operating systems. As many people have pointed out, unless the usage of electronic cash is anonymous, every transaction can be traced by the third parties, threatening the privacy protection. However, if anonymity is completely guaranteed, electronic cash may easily be used in illegal activities such as money laundering, tax evasion, etc. So far, as seen D. Chaums E-cash, the electronic cash system has been developed to the extent that the digital values are transferred among consumers, but the senders can not be identified. However, it is too early to assume that everybody will prefer the anonymity of electronic cash.

Because electronic cash users may take advantage of the opportunity to use the value-added information which electronic cash carries, some people evaluate that the social cost of the anonymity in the electronic cash system may exceed the social benefit. Therefore, the question is not whether to allow transparency or anonymity, but rather to find a compromising point between the two extremes.

## 4. Comparison with current payment methods

The factors of payment methods are defined as follows. According to these factors, current payment methods are compared. The factors describe clearing time and risks of payment methods, mainly<sup>10)</sup>.

9) Matonis, 1995 ; [http : //inet. nttam. com](http://inet.nttam.com)

10) Sung, 1996 ; [http : //iis. kaist. ac. kr/ - sky/thesis/theis. html](http://iis.kaist.ac.kr/~sky/thesis/theis.html)  
Hynn, Choi, Cha, 1997, p.861.

- Payment due : The time of clearing and updating the payers and the payees accounts after a payer makes a payment.
- Anonymity : Only payment using cash is protecting privacy. The transaction of the method that supports anonymity protected privacy.
- Control on issuing : This factor describes who has the major control power of issuing
- Number of endorsers : Endorsing is the means of certificating authentication of a payer and a payee. In the case of a note, multiple endorsing and circulation is permitted.
- Payers source of authentication : This factor describes what certificates authentication of a payer.
- Guarantee : This factor describes who guarantees payers' non-payment or misprocessed payment
- Risk of payee : This factor describes whether the risk of the payers' non-payment is imposed to the payee. Even though a payee can recover all values to be paid ultimately, the method is risky because that procedure is very complex.
- Circulation : This factor describes whether the payment media is permitted circulation.

〈Table 1〉 Characteristics of Current Payment Methods

Factors	Electronic Cash	Credit Card
Payment due	simultaneously	credit card organization's request
Anonymity	yes	no
Control on issuing	Bank of Korea	Banks
Numbers of endorse	0	only payer
Payer's source of authentication	A/C in wallet	credit
Guarantee	-	credit card organization
Risk of payee	free	free
Circulation	yes	no

#### IV. Effects on Monetary Policies

Because the introduction of electronic cash changes payment patterns and financial behaviors of economic agents, the relationship between the stock of high-powered money and macro variables may be affected, becoming more unstable<sup>11)</sup>. The central bank's monetary policies are also affected. In the following section, the validity of such

assumption and the function of electronic cash in the credit transaction will be examined.

##### 1. Equation of exchange<sup>12)</sup>

The relationship between the average money circulation and the amount transacted in a certain time period can be written called equation of exchange.

11) Whinston, Stahl, Choi, 1997, pp.443-444

12) Hwang, 1984, pp.73-75.

$$MV' = P'T \quad \dots\dots\dots (1)$$

M : stock of money  
 V' : transaction velocity of money  
 P' : average price of transaction  
 T : the number of transaction

Under the assumption that there is a proportional relationship between the amount transaction and the nominal GNP, equation (1) can be stated as :

$$MV = PY \quad \dots\dots\dots (2)$$

M : stock of money  
 V : income velocity of money  
 P : price level  
 Y : real GNP

When Equation (2) is based on the traditional money supply without considering electronic cash, the relationship shown in Equation (2) can be no longer considered to be stable in the electronic cash age. Because electronic cash functions like cash in transactions, it should be included in the stock of money. Then, whether such an inclusion of electronic cash affects the stock of money is closely related to whether electronic cash is issued in exchange either for currencies or for deposits.

## 2. Money multiplier

The money multiplier is the ratio of the money stock to the stock of high-powered money, consisting of currencies and banks deposits at the central bank. Then, the relationship between the stock of money and the stock of high-powered money is shown as :

$$M = mm \times RB = (1/(c+r(1-c))) \times RB$$

RB : the stock of high-powered money  
 mm : the money multiplier  
 c : the currency-deposit ratio  
 r : the reserve-deposit ratio.

If electronic cash is used widely, people are likely to prefer deposits to currencies because currencies are less convenient, more expensive, and risky to hold than electronic cash. Then, as the currency held by the public is replaced by the bank deposits, the stock of high-powered money does not change, but its composition does. The share of the Bank reserves in the stock of high-powered money increases, and that of the currency held by the public decreases. However, the decrease of the currency-deposit ratio results in the increase of the money supply through the money creation process<sup>13)</sup>.

## 3. Effects on the money supply

When electronic cash is issued in exchange for bank deposits, the role of the banks in the payment system may be reduced largely due to the widespread usage of electronic cash in the payment. However, the stock of money supply does not change at all, because demand deposit liability is merely substituted by electronic cash liability.

But, as for the issuances of electronic cash either exchanged for a currency or based on the other assets besides bank deposits, the rise of the money multiplier increases the money supply.

## 4. Foreign transaction

Electronic cash is supposed to be used widely in the foreign transaction due to its lower transaction cost<sup>14)</sup>. For the same reason why there is no single and global currency in the international monetary system, a single and global electronic cash will not exist in the electronic cash system. Subsequently, there will be electronic cash denominated in national currency units, and the digital cash will be exchanged at virtual rates that are based on conventional, real exchange rates.

13) Shin, 1996, pp.7-8., Hong, 1996, pp.83-86.

14) Transaction costs for a transfer are low, ranging from almost nothing to a small fraction of the amount transferred, thus making the technology particularly suitable for low value payments. This does not mean that there are no costs involved—infrastructure costs, primarily the purchase of hardware and software, will need to be incurred, but these costs are fixed and can be amortised against future transactions.

If the use of electronic cash is widespread through the network in foreign transactions, more people are able to rapidly participate in exchange trading, and the risk of exchange speculation becomes larger. Because the speculation for foreign electronic cash is linked to the instability of real exchange rates through the arbitrage condition, the effectiveness of domestic monetary policies will be threatened significantly in the electronic cash system.

### 5. Function of electronic cash in the credit transaction

There are two fundamental functions of money in the monetary transaction. One is as the standard of value and the other is as the means of payment. The latter has been substituted for the credit transaction.

In the credit transaction, the debts function as the means of payment, which arise automatically from the transaction itself. That is to say, the debts don't lead the transaction. But they follow the contract and transfer of goods. Under the complete credit economy system, the credit supply is created on demand for the credit. And the demand for the means of payment is satisfied with the credit supply. In that case the former has been caused by the necessity of credit transaction.

What if the electronic cash would be adopted in the general credit transaction of today? First of all, the role of the central bank money would be reduced to only as the standard of the value. The electronic cash, such as the smart card, would operate as the actual means of payment. Next, the credit creation based on electronic cash would be increased more and more as the necessity of the fractional reserve based on the central bank money would be decreased gradually in proportion to the increase of the quantity of electronic cash<sup>15)</sup>.

From the above investigation, we could find some implications. The electronic cash supply will proliferate the credit transaction. And the credit policy of the central bank will be changed elementally and dramatically.

## V. Implications for Central Bank's Monetary Policies

Electronic cash affects central bank in many areas, in particular regarding the issuance of money, the supervision of cashless payments and the supervision of the banking system and monetary policy.

Electronic cash can in part replace cash and accounting entries, and thus influence the monetary policy of central banks and their position as the sole issuance of bank notes. The circulation of money creates (in addition to the minimum reserve obligation existing with regard to certain book liabilities) a refinancing dependency of banking system on the central bank. This system of refinance is the lever by which the central bank influences market interest rates and thus also indirectly the economy.

In addition, the need for refinancing by banks leads to interest by the central bank. Administered need for refinancing (caused by the substitution effect of electronic cash) would therefore bring reduced profits to the central bank and decreased payments to the government. Thus, the effects of a wide use of electronic cash could become noticeable in the government budget as a decrease in income.

If electronic money were to cause a widespread replacement of cash entries, then central banks would have to react. Thus, the value of electronic units in circulation could be incorporated in the minimum reserve obligation, or could be subject

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15) Jun, 1996, pp.96-97.

to a particular duty of coverage by the central bank. As a last resort, the issuance of electronic units could be monopolized by the central bank, as is presently the case with regard to bank notes. Such a wide-ranging measure would also have to be seriously examined if it should unexpectedly happen that the private sector could not insure the degree of security of individual payment instruments necessary for the flow of payments

In their function as the supervisors of cashless payments, central banks should be probably more concerned in the initial phase with the effects of electronic cash on the security and integrity of non-cash payments than on its monetary and political effects.

The most important factor is the security against forgery of stored electronic units of value. It has already been the case that systems which are generally considered secure can be broken very quickly. Since there is no absolute security, such systems must be designed in such a way that any forgery can be recognized and stopped as soon as possible.

The liability question must also be clarified. In particular, sufficient transparency must be created regarding the scope of liability and the parties liable for damages resulting from system errors, data manipulation, and incorrect data transmissions. In addition, it would be desirable to have a division of risk which took into account the proper interests of the parties and the customers lack of influence on technical measures and did not simply transfer damages to the customer.

As already stated, electronic cash is prepaid cash which the system users have put at the disposal of the issuer in advance. Such cash must be administered securely and competently, and the willingness to pay of the instances which are to exchange electronic cash must constantly be present. This requires that issuers have undoubted credit worthiness and liquidity. The collapse of a significant issuer or massive forgeries in the system could lead to a crisis of confidence which would affect the payment system in general.

Electronic cash offers the possibility of transfe-

ring large sums of cash directly, anonymously and internationally. The Internet knows neither borders nor customs stations at which data and its transmitters must identify themselves. Thus electronic cash could be very attractive for illegal monetary transactions, such as money laundering. The duty to verify identity remains in place for the acceptance of large sums of cash, but afterwards cash converted into electronic cash can be transferred anonymously over national boundaries. Thus, the so-called paper trail of traditional cashless transfers, which allows a further tracking of the money, no longer exists in a system of electronic cash.

If it should happen that electronic cash becomes used to large extent for purposes of money laundering or in the scope of other criminal activities, then the government authority will have to ask whether transactions in electronic cash should not be properly controlled and regulated.

The security and functionality of electronic cash is best guaranteed if its issuance is limited to supervised banks. They have not only significant experience in payments, but also are subject to continual supervision with regard to creditworthiness and liquidity, and maintain a liquidity reserve with the central bank. Bank supervisory authorities could also set requirements for organization of the electronic cash business.

The effects of electronic cash on central bank policies, the security and integrity of the payment system, and naturally also on single sector such as company engaged in the transport of money and valuables, depends mainly on the extent to which the new payment methods can replace cash.

## VI. Conclusion

The possible development of electronic cash merits special attention from central banks for at least three reasons.

First, central banks are concerned that the introduction of the new payment instrument should have no adverse effect on public confidence in the



payment system and payment media. This preoccupation would increase if non-regulated institutions were allowed to issue electronic cash, or if the latter were designed in such a way that counterfeiting would be both easy to achieve and difficult to detect.

Second, although the substitution of electronic cash for other forms of money should not theoretically hamper central banks ability to control the money supply, it might, however, have practical implications, at least in the long run, which need to be carefully examined. This concerns in particular the use of existing monetary policy instruments and the availability of the necessary statistics.

Third, because electronic cash may be used for payments of very small value, they have the potential, more than any other cashless instrument, to take over the role of notes and coins in the economy and, therefore, have implications for central bank's activities and revenues. Moreover, although electronic cash are not, in legal terms, infringing on the banknote monopoly, their general use may reduce the use of legal tender to a fairly large extent.

In conclusion, it is understood that the introduction of electronic cash is technically possible, and has potential to substitute cash in small-amount transactions. Even though the extent to which electronic cash would replace bank notes and coins may depend on the regulations of the regulatory bodies such as the central bank, it is clear that the trend is moving towards that direction. However, because each payment instrument used these days is considered to have its own merits, and electronic cash does not perfectly replace currencies, it is expected that each of cash, deposit money and electronic cash play its role respectively in the small payment market.

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