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# **The evolution of money and the development of the smart card.**

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## **1.0 Introduction**

The purpose of this essay is to present the evolution of the Canadian payments system and explore the possibilities and implications of smart card technology on our current banking environment. While current credit cards and more recent debit cards offer an alternative to cash payment a new smart card technology is being introduced. Smart cards and associated electronic cash are considered to be the next phase in card technology. These concepts are being introduced around the world. The impacts of these new "electronic purses" on our payments system and society are numerous as they may even offer a substitute for our current money system. The emphasis of this essay will be on the opportunities and implications that e-cash and smart cards present to our society.

## **2.0 Concepts**

This chapter introduces the basic concepts used in this essay.

### ***2.1 Conceptual definition of money***

The conceptual definition of money relates to the functions and properties possessed by items qualified as money. These items need to meet certain necessary and sufficient criteria in order to be considered as money. These criteria are:

- Generally accepted as a medium of exchange that is used as a means of financial payment
- Unit of account
- Store of value
- Standard for deferred payments

In other words, money can be said to be anything that is used as a medium of exchange in a society to discharge debt obligations. These four criteria also act as the four main functions of money.

### ***2.2 Concrete definition of money***

The concrete definition of money relates more to the physical attributes and forms that money takes enabling us to identify the specific items used as money. It describes the selection of items and assets that serve monetary functions given the specific social value system, payments habits and the level of technology in a given society. Thus the definition also covers how a given society measures its money supply, i.e. the amount of money circulating in a specifically limited area.

### ***2.3 Electronic money***

Electronic money is a way of storing purchasing power electronically. It can take the form of a card (e.g. a smart card or an electronic purse), or it can be software on a

computer network sometimes referred to as digital cash.<sup>1</sup> Electronic money can take a true digital structure existing as units of value in the form of bytes stored in the memory of personal computers. This electronic money is intended to be used with a variety of transactions and so it can be considered as a substitute for currency.

#### **2.4 Smart cards**

There are two basic kinds of smart cards. The first one is called an intelligent smart card and contains a computer chip that stores and secures information and processes data as required by the cards issuer's specific application needs. These cards offer a larger amount of memory capacity enabling them to process vast amounts of information. For example, monetary value can be added or debited as required.

The second type of card is called a memory card. These cards are primarily information storage cards that contain stored value, which the user can spend in various situations. For example, the current prevalue pay phone cards are memory cards as the value loaded in advance may be used but after this amount is exhausted reloading is impossible.

### **3.0 Evolution of money and the payments system**

In early societies where paper money did not exist barter was the only means of trade. However, barter is an inefficient system as exchange can only take place when there is a double coincidence of wants. This results in troublesome intermediate trades and large transaction costs in the form of search and price information costs. As the amount of commodities and transactions in a society increase these costs also increase forestalling the growth of an economy. Thus as the economy grew new forms for payment were inevitably established.

Almost anything can serve as money given that the item or subject fulfills the following functions relating to the conceptual definition of money (section 2.1):

- (a) Serves as a unit of account
- (b) Serves as a medium of exchange
- (c) Serves as a store of value

By using a common medium for exchange the intermediate trades required to facilitate the transfer of purchasing power can be eliminated. The first type of money was commodity money. This is a monetary system in which the value of the monetary unit is kept equal to the value of a specific quantity of a particular commodity.<sup>2</sup> In early societies various commodities were used as money such as cattle, cloth, axes fishhooks and beads. Later the use of metals gained preference over the commodities, as they possessed certain desirable characteristics and a high intrinsic value.

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<sup>1</sup> Binhammer, Sephton "Money, Banking and the Canadian Payments System." ITP, 1998 pp. 27

<sup>2</sup> Binhammer, Sephton "Money Banking and the Canadian Payments System." International Thomson Publishing, 1998. pp 4

The decisive step in the evolution of money as we know it today was the issuing of paper money. Through trade with merchants people started using written receipts and documents of their command of underlying commodities as a method for payment. During the 17<sup>th</sup> century this sparked the evolution of our current banking fundamentals through the activities of blacksmiths in England. Throughout its evolution money has required one important feature for it to function efficiently as a means of payment. In addition to the mentioned conceptual criteria money must also enjoy the confidence and faith of people. There must be general confidence in its continued acceptance as a standard of payment. This raises several questions about the functionality of electronic money, which will be examined further on.

### **3.1 The current payments system**

Today there exists a variety of instruments to facilitate payments. Cash in the form of coins and notes is one of the most important instruments. Cheques, payment cards, credit cards and debit cards are some of the other tools, even though payment cards are not money - they are only money substitutes (means of transferring money). The monetary standard we use today, called fiat money or an inconvertible paper standard, has by many been thought to be the ultimate form of a payments system. Monetary authorities have the discretionary power to manage a country's money supply and the system allows social control of money, prices and credits. However, a new form of payment called electronic money is evolving with many new possibilities as well as threats. This poses various questions and implications to our central bank system, which will be explored in the following sections.

## **4.0 Smart card technology and potential**

As mentioned (in section 2.4) there are two main types of smart cards: intelligent smart cards and memory cards. There are also examples of multiple application cards with various functions on the same card ranging from identification to banking services and medical records. These cards have a small microchip on them, which enables the storing and processing of data. Thus the card can be defined as a "portable data storage device with intelligent provisions for identity and security".<sup>3</sup> One of the basic uses of these cards is as means of payment where the card is initially loaded with money and units are debited from this pre-loaded amount as the card is used. Other functions include smart cards as access keys, information managers, marketing tools and customized delivery systems.

The advances in technology, deregulation of markets, globalization and telecommunications are some of the driving forces behind the emergence of the smart card. As the smart card is capable of storing data it also implies the development of a new form of money called electronic money. This electronic money could take a digital form existing as units of value in a computer system where it can be downloaded to the users cards. These digital value units (DVUS) can then be used for multiple purposes.<sup>4</sup> E-cash

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<sup>3</sup> Bright R. "Smart Cards: Principles, Practice and Applications." Ellis Horwood Limited, 1988 pp.33

<sup>4</sup> Kobrin J. Stephan article: "Electronic Cash and the End of National Markets"

may be moved through a multiplicity of networks instead of our current bank system and it may be backed by anything that is accepted as a medium of exchange. Thus it can also be created by any autonomous party to serve as a means of payment for their services. This resembles more a commodity monetary system of the past (as mentioned in section 3.0). This is also true due to the fact that the individual issuers of e-money would have to enjoy the confidence of consumers concerning the acceptability of their currency as means of payment. This resembles the era of individual merchants issuing receipts and documents of their command of underlying commodities as money.

#### **4.1 A future scenario**

In a futuristic scenario a typical day in a smart card society might appear like the following. In the morning before you leave for work you slip your smart card into your computer system and download a sufficient amount of DVUS (digital value units). As you head for work and hop on the bus the transportation fare is automatically debited from your card. While walking from the bus stop you quickly buy a newspaper from the local paper stand with a swipe of your card. When entering the office building your card acts as identification and may even store data of e.g. fingerprints and other personal data enabling quick security checks. During the day you borrow DVUS to your college at work by transferring units directly from your card to another card. On the way home you visit your doctor for a regular checkup. Your medical information is stored on the microchip and the correct payment for the service is debited automatically. Finally back at home you may do some Internet shopping and order home entertainment directly by the use of your smart card. In most of these transactions payment is transferred directly from purchaser to provider (possibly without intermediary banks) as final means of payment. Your smart card acts as a deposit account itself requiring only periodic transfers from a banking system, if money as such would be used to facilitate or back the DVUS.

Evidently the imaginary scenario above awakes many questions related to our current banking system. In this new world there would be no immediate need for physical money in small retail consumer transactions. Electronic money would clearly act as a substitute for currency. Comprehensive fund transfers may be executed in seconds and amounts will be debited and credited instantaneously throughout the world. All these facts imply fundamental changes to our financial system. Possible implications will be studied further in chapter 5.0. The following will continue with more prospects of the smart card.

#### **4.2 Advantages**

From a consumer point of view the smart card provides the following functions:

- Make payments                      Card is used to make payments from a deposit or credit account and has a stored value feature.
- Gain rewards                        Card is used to gain points or receive price concessions
- Gain access                         Card is used to gain access to electronic networks and to use equipment or machines
- Store and manage information    Card is used as a portable data file that stores, consolidates and processes information

These functions embedded in smart cards enable the emergence of electronic money as well as allow individuals to process and carry a vast amount of "mobile" information with them offering various advantages. E-cash is more convenient and flexible than our traditional notes and coins. People would presumably prefer to carry a convenient card in their pocket instead of heavy coins and this would also facilitate daily small value retail transactions. They may also replenish their electronic purse at home instead of finding an ATM (without incurring so-called shoe leather costs). It offers individuals a more secure and affordably way of doing business on the Internet than conventional credit cards. Consumers may be able to programme their DVUS to do things that paper money could never do and keep organized records of their transactions. The incidence of error in calculating change from transactions would also be reduced. Transportation is an important area for the implementation of this technology. Electronic ticketing systems installed on buses, metros, taxis and train stations offer greater convenience than discrete systems. The multipurpose smart cards also provide an advantage as they facilitate many every day functions in one card instead of having to carry various individual cards.

In addition to consumers, electronic money could provide even more extensive advantages in other areas of society. Retailers would not have to worry about being robbed and staff pilfering could be controlled as e-cash could be stored digitally in the memory of computer systems and programmed to accept only specific kinds of transactions. It may even pose great potential to developing countries with weak currencies, where foreign currency amounts to a large physical amount of local currency. Since communications systems are often ineffective cash is the only way to trade and carrying large amounts of cash is an uncomfortable necessity. Smart card technology can provide more efficient transactions. Many firms incur increasing costs when handling large amounts of cash which includes expenses related to point-of-sale transactions, theft and safekeeping as well as costs related to the handling of cash between financial institutions and firms. These costs can be avoided on the part of firms as well as financial institutions by the use of electronic cash.

### **4.3 Disadvantages**

Smart card technology also has its disadvantages. Electronic cash may be less secure than traditional money due to technical problems and computer system equipment failure, which might result in a loss of the data and the electronic money itself. The loss of privacy is an issue as consumers fear that their purchasing habits and other possible information on the smart card may be monitored and accessed by financial as well as retail institutions. Losing a card or stolen cards present a problem as reimbursing the lost amount would not clearly fall into anyone's jurisdiction. Without regulation the e-cash business may divert into multiple competing systems that are incompatible with each other and hinders the consumer acceptance of the concept.

From a society's point of view wide acceptance of an electronic money standard would most likely increase the gap between poor and rich as only a privileged sector of society has access to computers and telecommunications. Money laundering and tax evasion also present large potential losses as well as counterfeiting. The danger of other financial

crime and invasion through a globally shared system of telecommunication and computer networks presents a serious challenge to political and social order. The concept of an unregulated financial system would present enormous implications for banking, which will be discussed in the following chapter.

## **5.0 Implications of smart cards and electronic cash**

Various areas of society such as banking, financial institutions and political and economical stability will be effected if electronic money and smart cards emerge as a substitute for our inconvertible money standard (i.e. cash and coins).

To begin with, the question of electronic money qualifying the criteria of money should be addressed. Is e-cash a real substitute for cash or will it stay as a money substitute, i.e. a method of transferring cash from purchaser to provider ? To answer this question the conceptual as well as concrete definitions of money need to be examined.

To be considered as money, electronic cash must fulfill the conceptual definitions of money (section 2.1). It serves as a unit of account as absolute prices between commodities may be measured in e.g. digital value units (DVUS). It is also a store of value as long as its value stays stable and it can be converted easily into purchasing power, i.e. is very liquid. If e-cash gains wide acceptability and enjoys the confidence of individuals as a means of payment it will also qualify as a medium of exchange. Thus, this far, electronic cash seems to have the potential to fill at least the conceptual criteria of money.

The concrete attributes (section 2.2) of e-cash are more complex to determine. First of all e-cash will not exist in a physical form of paper as we know of, but instead in a digital form existing only in "cyberspace". However, it must be generally and easily authenticated as money in order to serve its purpose. Thus some method of reliable digital authentication must be developed to insure that the medium being used is legal and authentic. Concrete criteria also includes the measuring of national money supply. In one opinion e-cash will have to be converted back to traditional money and hence get counted in our current aggregate money measures. In another view the issuing of e-cash will be uncontrollable and central banks will lose control over a significant portion of the money supply. This is probable if no mutual regulations are agreed on and private institutions are allowed to issue their own type of e-currency.

It seems that electronic cash meets most the conceptual definitions of money strengthening its viability as a new medium of exchange. However, on the concrete side similarities are harder to confirm as money not existing in physical form becomes difficult to define and control.

### **5.1 Implications for banking**

Electronic technology is shaping the financial services industry in ways that would not have been comprehensible a few decades ago. An increasing amount of bank services are being conducted electronically with paper-based transactions headed for obsolescence.



For a consumer it means convenience and efficiency as it will be possible to bank from any spot in the world literally at any time we wish. The challenge is to make this environment to work securely and seamlessly.

With the deregulation of financial markets and innovations in telecommunications individuals are able to participate in a global market place where national boundaries are losing their significance. With commerce taking place in virtual cyberspace, with smart cards and electronic cash encouraging this development, it seems a matter of time until some kind of a global currency is adopted. Some of the challenges that our financial system faces are:

- Who will be eligible to issue this new currency and how will banking regulations be formed to insure the soundness and viability of the institutions ? Who will regulate or control financial institutions ?
- Electronic money may provide basis to criminal activities in the form of counterfeiting as well as money laundry activities.
- How should central banks control the money supply ? If private currencies emerge it will be difficult for banks to control the growth money or even measure it in monetary aggregates.
- Will national currencies disappear as cross-country transactions take place in universally accepted dominations of common digital value units (DVUS) that do not need exchanged in foreign currency markets ?
- If e-cash substitutes money and bank deposits the demand for notes and coins will decrease resulting in a change in the fundamentals of banking and the ability to create money.

The relevance of these major changes to our banking system depends on the extent of the development of electronic money as a substitute for the current inconvertible paper money standard. Achieving mutual regulations and enhancing encryption technology may control counterfeiting and other criminal activities. Cooperation on a global basis will also resolve regulatory questions concerning a common domination of electronic cash as well as institutional issues. However, one of the biggest questions is the viability of banking itself in a system where physical cash does not exist and individuals will carry their purchasing power in a digital form on smart cards and computer networks. If e-cash becomes a clear substitute for notes and coins, without being backed by money in the form of bank deposits, this will render banking as we know it useless. Unless banks reserve the right to act as the final intermediary between purchaser and service provider, as when using debit cards today, bank deposits may become obsolete. The smart card itself becomes a mobile deposit account where value may be added and deducted when needed. This implies that the current ability for banks to create money and further economic growth in the form of lending and borrowing money will be hindered. Individuals intertemporal consumption decisions, interest rates as well as the fundamental concepts of lending and borrowing may be transformed by these changes. Nevertheless, these new actors may take over the banks function of creating money by keeping on hand only a fraction of their e-cash deposits and lending out the rest just as commercial banks do.

In a less radical point of view central banks will uphold their monetary control on current cash as well as this new form of electronic money. The total disappearance of notes and coins in the near future is hardly a feasible assumption. In this system banks will still play an important role as financial advisors and service providers, hold individuals e-cash deposits on demand deposit accounts where they can be accessed by remote terminals and act as intermediaries in settling final payments. This would also suggest that e-money will, at present, maintain its convertibility to traditional money. Even though revenue patterns will change, because e.g. transfer payment fees from corporate and individual transactions will decrease, other income sources from mainly electronic services will be introduced. Electronic money will also offer cost reductions to financial institutions and banks in the form of decreased cash handling expenses and clearing procedures for paper based instruments (eliminating float). Banks also have an important advantage: the trust of consumers in depositing money. This plays an important role as a viable monetary standard requires the trust and confidence in the medium of exchange as well as in the institutions providing it.

## **5.2 Implications for society**

The impact of a globally accepted electronic currency would affect many aspects of our current society and economy. The increasing importance of e-cash and digital markets would impose problems for central government control over the economy. A world linked in cyberspace would affect the geographical boundaries of nation-states as clear distinctions between domestic and international areas would decrease when economic transactions can not be located to a geographic area.

Some of the questions governments and society face are:

- Governments will lose monetary control if central banks lose the control of money supply management including control over inflation.
- Collection of taxes may become a problem when large sums of e-cash are easily transferred across borders and tax reporting is difficult to control.
- Government will lose a substantial amount of revenue if electronic cash substitutes bank notes and coins as it eliminates profits from seigniorage.
- Volatility of markets and prices can be a problem as consumers and businesses are able to send their money around the global market effortlessly.
- Electronic commerce will widen that gap between societies wealthy and poor as access to the electronic infrastructure is often limited to progressive nations. Developing countries would have difficulties in providing access to their citizens.

In order to address these implications of a new form of global commerce, electronic money and computer networks cross-national cooperation will be essential. A digital world will demand increasing international cooperation, harmonizing of national regulations and legislation and strengthening the authority of international institutions.<sup>5</sup> It will be necessary to establish international institutions to monitor and measure digital

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<sup>5</sup> Kobrin J. Stephan article: "Electronic Cash and the End of National Markets"

commerce transactions. This should provide a basis for the taxing and controlling of cross-national transactions as well as provide a form of security and legitimacy for participating individuals. The loss of seigniorage for governments may amount to a substantial loss of government revenue, which will further effect the economy and society as a whole. However, it is difficult to estimate the exact impact of electronic money's effect on lost seigniorage as this depends on the rate of which e-cash will substitute money and coins. From a long-term perspective it seems likely that quantitatively significant effects will take a number of years to show.<sup>6</sup>

## 6.0 Conclusion

Smart card technology has introduced the concept of electronic money as a substitute for our current nonconvertible paper money standard in, which purchasing power is transferred through the transaction of government backed tender. Electronic money with the help of smart cards presents a potential substitute for current coins and notes in circulation. This poses multiple implications to our current social and economical institutions.

The impact of the issues discussed depends essentially on the acceptability that e-cash will receive among consumers and retailers. Without confidence in the medium of exchange as a generally accepted means of payment wide approval will be hard to achieve. This also depends on the scale of government and international cooperation in solving the security, authentication, monetary control and other socioeconomic issues as well as rules to govern global digital trade.

The smart card and electronic money themselves present advantageous potential for both consumers and the financial system. Convenience, decreased transfer and handling costs, flexibility and increased application possibilities are some of the main advantages of smart card and e-cash technology. Barriers include start-up costs, security issues, fraud, opposition to new innovations and monetary policy issues. A fundamental question will be in what extent will e-cash move us towards a cashless society and how will banking cope with these changes in money creation and lending ?

It is probable that the near future will see the introduction of applications designed to ease our every day life and provide us with new payment methods. Market forces are racing to be the first in the race towards an increasingly cashless society. Most of these changes are bound to benefit society and considering our natural human nature and the required change in payment habits this development will take place gradually enabling a smooth convergence towards a digital future.

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<sup>6</sup> Stuber Gerald: "The Electronic Purse: An Overview of the Recent Developments and Policy Issues" [Bank of Canada: Technical Report no. 74, Ottawa, January 1996] pp.30

## 7.0 Bibliography

### *Literature:*

Allen, Bara "Smart Cards: Seizing Strategic Business Opportunities." Irwin Professional Publishing, 1997.

Binhammer, Sephton "Money Banking and the Canadian Payments System." International Thomson Publishing, 1998.

Bright R. "Smart Cards: Principles, Practice and Applications." Ellis Horwood Limited 1988.

Canadian Bank Facts 1998/1999 Edition. Canadian Bankers Association, May 1999.

Stuber Gerald: "The Electronic Purse: An Overview of the Recent Developments and Policy Issues" [Bank of Canada: Technical Report no. 74, Ottawa, January 1996].

### *Articles:*

Business Week article: "The Future of Money." June 12, 1995.

Fay Stephan: "The Jingle of E-Money." Management Today, Haymark Publishing, London, Dec 1999.

Kobrin J. Stephan article: "Electronic Cash and the End of National Markets".

Munchetty Naga: "All Cash for Cash in Your Pocket." New Statesman, London, Sep 1999.