
January 1996

THE ELECTRONIC PURSE

***An Overview of Recent Developments
and Policy Issues***

by
Gerald Stuber

The views expressed in this report are solely those of the author.
No responsibility for them should be attributed to the Bank of Canada.



ISSN 0713-7931

ISBN 0-662-23987-3

Printed in Canada on recycled paper

ABSTRACT

Futurists have been speculating about the prospects for a cashless society for many years, and such predictions became more frequent following the introduction of “smart” cards – cards containing a computer chip – in the mid-1970s.

One smart-card application of particular interest to central banks is the electronic purse or wallet, which carries a preloaded monetary value and can be used as a means of payment for multiple small-value purchases. This report provides an overview of current major electronic purse projects and other prepaid card applications around the world and examines selected policy issues.

It is possible that electronic purses will be used to reduce the cost of small-value transactions. Although implementation of the innovation has been slow because of high start-up costs and uncertainty regarding acceptability of the device to the average consumer, a large number of purse trials are under way around the world.

The soundness of both electronic purse products and their issuers could be a matter of interest to central banks and other financial regulatory bodies. Furthermore, national governments may stand to lose a substantial amount of revenue associated with the issuance of coinage and paper currency. The magnitude of such revenue losses would be difficult to estimate, however, both because of limited quantitative understanding of the various current uses of bank notes and because of uncertainty as to the relative attractiveness of electronic purses to consumers and merchants.

While it is doubtful that physical currency will fall into disuse in the foreseeable future, growing familiarity with smart-card technology and the substantial reductions in the unit production costs of smart cards in recent years have nevertheless improved the prospects for a feasible electronic replacement for cash.

The report concludes that over the next few years, the use of smart-card technology for single-purpose prepaid cards and for debit and credit

cards is likely to become more widespread in Canada. Electronic purses may take somewhat longer to come into general use, given that substantial changes will be required both in the payments habits of consumers and in the payments infrastructure of financial institutions and retailers.

RÉSUMÉ

Les futurologues parlent depuis longtemps déjà de l'avènement possible d'une société sans numéraire, et les prédictions à ce sujet se sont multipliées depuis le lancement des cartes à puce (cartes auxquelles est intégrée une puce électronique) au milieu des années 70.

Le porte-monnaie ou portefeuille électronique, qui est approvisionné à l'avance et peut servir au règlement de plusieurs petits achats, est une variante de la carte à puce qui présente un intérêt particulier pour les banques centrales. L'auteur donne un aperçu des principaux projets relatifs aux porte-monnaie électroniques et aux autres cartes prépayées qui ont cours au pays et à l'étranger et examine certaines questions de politique s'y rapportant.

Il se peut que le porte-monnaie électronique soit utilisé à l'avenir pour réduire le coût des petites transactions. Même si la mise en oeuvre de cette innovation est lente du fait que ses coûts de démarrage sont élevés et que l'on ne sait pas si le consommateur moyen est prêt à accepter ce nouveau mode de paiement, il reste qu'elle donne lieu à de nombreuses expériences-pilotes dans différents pays.

La question de la fiabilité des porte-monnaie électroniques et des établissements qui les émettent est susceptible d'intéresser les banques centrales et les autres organismes de réglementation. Il faut également signaler que l'utilisation des porte-monnaie électroniques pourrait faire perdre aux gouvernements nationaux une bonne partie des revenus qu'ils tirent de l'émission des pièces de monnaie et des billets de banque. L'ampleur que pourraient avoir ces pertes de revenus est cependant difficile à estimer, étant donné le manque de recherches quantitatives sur les divers usages qui sont faits à l'heure actuelle des billets de banque et l'incertitude qui existe quant à l'attrait relatif des porte-monnaie électroniques pour les consommateurs et les commerçants.

Même s'il est peu probable que le numéraire cesse d'être utilisé dans un avenir prévisible, les chances qu'un substitut électronique acceptable soit mis au point se sont améliorées, du fait que la technologie des cartes à

puce est de mieux en mieux connue et que les coûts de production unitaires de ces dernières ont beaucoup baissé ces dernières années.

L'auteur conclut qu'au cours des prochaines années l'utilisation de la technologie des cartes à puce pour la mise au point de cartes prépayées à usage unique et de cartes de débit et de crédit devrait se répandre au Canada. L'utilisation des porte-monnaie électroniques pourrait mettre un peu plus de temps à se généraliser puisqu'elle exige que les habitudes des consommateurs et l'infrastructure de paiement des institutions financières et du marché de détail subissent d'importants changements.

CONTENTS

ACKNOWLEDGMENTS	ix
1 INTRODUCTION	1
2 CONCEPTS AND SOME HISTORY	3
2.1 The smart card vs. the magstripe card	3
2.2 The electronic purse	5
2.3 Smart cards – some historical notes.....	7
2.4 Advantages of electronic purse systems.....	8
2.5 Barriers to the development of purse systems.....	10
3 RECENT AND PROSPECTIVE PILOT PROJECTS	13
3.1 Overseas projects.....	13
3.2 North American projects.....	17
4 SELECTED POLICY ISSUES	21
4.1 Regulatory issues and the payments system	21
4.2 Legal monopolies on the note and coin issues	25
4.3 Seigniorage	26
4.4 Monetary policy implications	30
5 CONCLUDING REMARKS	33
APPENDIX: Major electronic purse projects, by country	35
REFERENCES	57

ACKNOWLEDGMENTS

I would like to thank various colleagues in the Bank, especially Steve Poloz, Irene Ip and David Rose, for helpful comments. Any errors are my responsibility.

1 INTRODUCTION

Futurists have been speculating about the prospects for a cashless society for many years and such predictions became more frequent following the introduction of “smart” cards – cards containing a computer chip – in the mid-1970s. While it is doubtful that physical currency will fall into disuse in the foreseeable future, growing familiarity with smart card technology and the substantial reductions in the unit production costs of smart cards in recent years have nonetheless improved the prospects for a feasible electronic replacement for cash.

The use of both magnetic stripe (magstripe) and smart cards for single-purpose prepaid payments transactions has become increasingly common. One smart card application of particular interest to central banks is the electronic purse or wallet, which can be used as a means of payment for a variety of small-value purchases. A large number of purse trials are currently under way worldwide. This report provides an overview of current major electronic purse projects and other prepaid card applications around the world and examines selected policy issues.

The following section begins by comparing the smart card with the magstripe card and describing the innovative electronic purse. This is followed by some notes on the history of smart card technology, a discussion of the advantages of electronic purses and an overview of barriers to the development of purse systems. One advantage, in particular, of electronic purses as a means of payment is that they may very well reduce the cost of undertaking small-value transactions. However, implementation of this innovation has been slow because of high start-up costs and uncertainty regarding acceptability of the device to the average consumer.

The third section is a review of the major electronic purse projects and other prepaid card applications that are under way or being planned worldwide. A Canadian example is the UBI home electronic highway project, which incorporates an electronic wallet feature and which is likely to begin in 1996 in the Saguenay region of Quebec. Another project with a global scope is the Mondex electronic purse system. In May 1995 the Royal

Bank and the Canadian Imperial Bank of Commerce announced their intention to buy the Canadian franchise for Mondex, while still other purse systems are likely to be tested in Canada over the next year or so. Many other electronic purse pilot projects have begun or are being planned in the United States and in various overseas countries. Denmark, Finland, Portugal and Taiwan are already launching national purse systems.

In the fourth section of the paper, some key policy issues associated with the use of electronic purses are examined, particularly in the Canadian context. The soundness of both electronic purse products and their issuers could be matters of interest to central banks and other financial regulatory bodies, as emphasized in a recent report prepared for the Council of the European Monetary Institute (Working Group 1994). Furthermore, if electronic purses prove to be successful, national governments may stand to lose a substantial amount of revenue associated with the issuance of coinage and paper currency. The magnitude of such revenue losses would be difficult to estimate, however, both because of limited quantitative understanding of the various current uses of bank notes and because of uncertainty as to the relative attractiveness of electronic purses to consumers and merchants.

The report concludes with an assessment of future prospects. Over the next few years, the use of smart card technology for single-purpose prepaid cards and for debit and credit cards is likely to become more widespread in Canada. Electronic purses may take somewhat longer to come into general use, given that substantial changes will be required both in the payments habits of consumers and in the payments infrastructure of financial institutions and retailers.

2 CONCEPTS AND SOME HISTORY

2.1 The smart card vs. the magstripe card

A smart card, sometimes also termed a chip card, is essentially a small computer embedded in a card.¹ These cards have self-contained operating systems and so are ideal for applications where security is an issue. Their memory capacity is also considerably larger than that of the more conventional magstripe cards. Specially designed card readers-writers are required to read or alter the information on a smart card.

The magstripe card, a card in which a strip of magnetic tape is sealed, is in common use for retail transactions.² These cards normally have three tracks for the storage of information, one of which is used in a read-only mode for identification and verification purposes. Another track can be used in a read-write mode and its contents change each time the card is employed. It is worth noting that verification of the personal identification number (PIN) is done by the card-reading terminal in an off-line transaction. While the unit production cost of magstripe cards can be as low as 30 cents, the cost of the readers is currently at least \$450. These cards, while most familiar in credit and debit transactions, have also found use in prepaid applications, mainly for specific transactions such as phone calls.

In contrast, the smart card has been defined as a “portable data storage device with intelligence and provisions for identity and security” (Bright 1988, 33). The microprocessor chip in the card is specialized and custom-designed, with specific and patented control and protection circuits. Certain data, primarily related to the security of the card, can be entered only at the time of manufacture. Another type of information, placed in what is sometimes termed the “secret zone” of the card’s memory, can be entered only at the time of purchase of the card; in the case of a

1. For more detailed discussions of various types of card technologies, see Bright (1988) and McIvor (1985).

2. The magnetic tape is similar to that used in audio recordings.

financial transactions card, this would include the customer's PIN and account number. Finally, other data, such as a record of transactions, are stored in the card each time it is used. The security of smart cards is enhanced by the fact that the card never has to reveal the customer's password to any external system. The memory capacity of these cards is currently in the 2 to 64 KB range in commercial applications, though higher levels are planned.

The normal life of smart cards is at least five years, compared with a two- to three-year range for magstripe cards. Smart card chips are usually smaller and thinner than normal computer chips and have to be able to function well in an electronically "noisy" environment. The manufacturing cost of multifunction smart cards starts at about \$4, while the cost for the simpler single-purpose payment cards is about \$2. A spokesperson for Visa has indicated that these costs may well be halved if the cards are manufactured in sufficiently large volumes (Giannone and Jarman 1995).

Up to now, most smart cards have been passive in nature, in the sense that a separate terminal has been required to read information in the card. Although most passive smart cards require direct contact with a card reader-writer, there are "contactless" cards which could prove to be particularly useful in transportation applications. The manufacturing cost of the latter card now starts at about \$10.

"Active" smart cards are now being developed, however, in which a terminal is in effect integrated into the card. One example, the Ulticard, has a mini keyboard and display on the reverse face of the card and also contains a battery. For large data transfers, such cards can be inserted into a master terminal.

Both magstripe and smart cards have found many prepaid uses.³ One of the simplest uses of both types of card has been as a means of

3. Various governments in North America and overseas have studied the use of smart cards as a means of reducing the administrative costs associated with making payments to individuals. Smart cards have also been used to store large amounts of data, such as personal medical information, while providing secure identification.

payment for single-purpose transactions, such as telephone calls, urban transit or vehicular travel on toll roads and bridges.⁴ Such a prepaid card application is conceptually the same as any other arrangement where the consumer is required to deposit funds in advance of the receipt of a good or service and does not seem to raise any special financial regulatory issues.

2.2 The electronic purse

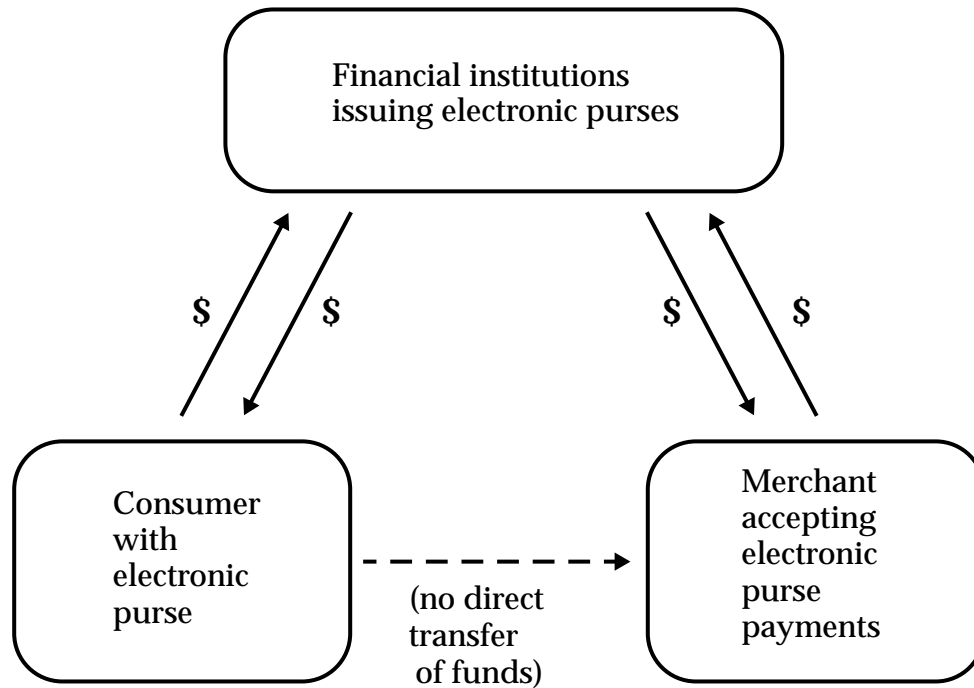
Interest is fast developing in a multipurpose prepaid smart card commonly known as the electronic purse. In contrast to a debit card, the electronic purse is intended to facilitate a variety of small-value retail transactions and so is a clear substitute for currency. It might function as follows.

Monetary value would be loaded onto the card, with a corresponding debit to the cardholder's account at a financial institution. In a retail transaction, monetary value would be transferred from the purchaser's card into the merchant's terminal in an off-line mode. The value of consumer purchases made with electronic purses would accumulate in the merchant's terminal and would be transferred to the merchant's account at a financial institution from time to time through on-line transactions.

More technically, in many purse systems the financial institution issuing the card would earmark or put a hold on an amount of funds in the cardholder's account that is equivalent to that recorded on the smart card, and would in effect be providing a guarantee of the value shown on the card. When a transaction is cleared through the payments system, a debit would be made to the cardholder's special suspense account, and a credit would be made to the merchant's bank account. This type of electronic purse would essentially function as an off-line debit card (Figure 1).

4. In single-purpose applications, the cards are generally not designed to be recharged with value.

Figure 1
Electronic purse system – off-line debit card model



In most proposed systems, the cardholder would be able to “replenish” the monetary value on the card at automatic banking machines (ABMs) specially built to read smart cards. Such electronic purses would have to be equipped with personal identification in order to keep track of individual transactions. This feature would also assure the cardholder of enhanced security.

Other purse systems are being designed that share physical currency’s characteristic of anonymity; they would be an even closer substitute for cash. Any institution issuing this type of electronic purse would have to establish a general suspense account for the amount outstanding in its issued purses. In such systems, monetary value could be transferred directly between cards without the action of an intermediary.

2.3 Smart cards – some historical notes

The smart card technology originated in both France and Japan and much of the impetus for its development has come from the national governments of these two countries (Bright 1988).

In France, the Directorate General of Telecommunications, faced with modernizing the national telephone system in 1974, decided that using smart cards would be a good way to update its pay phone system. It was also felt that this new technology could be a key factor in responding effectively to an expected strong growth in demand for home banking and shopping services. Furthermore, the French banks were interested in smart cards because of an earlier explosive increase in the issuance of cheques and because of a problem with fraud related to their ABMs, which operated, generally speaking, in an off-line mode. Finally, the French government had invested substantially in computer research and development in the second half of the 1970s, contributing still further to the development of the smart card.

In Japan, the national government placed special emphasis on the role of computer technologies in its national economic development programs. The subsequent emergence of a large computer-chip manufacturing industry in Japan also contributed to the development of smart card applications in that country.

Smart cards have found extensive applications overseas, with an estimated half a billion cards in use worldwide as of 1994 (Ravensbergen 1994). The diffusion of smart card payments applications has been particularly rapid in Europe and East Asia, reflecting in part the relatively higher cost of telecommunications services in those countries than in North America. At the moment, most prepaid cards are employed for single-purpose transactions, although interest in the electronic purse application is growing rapidly. Many electronic purse pilot projects have been announced over the past year, both in North America and overseas.

Still more recently, there has been interest in developing payments systems for use on the Internet and other personal computer networks

(Crone 1995; Holland and Cortese 1995). While some of these systems simply involve the use of bank and credit card numbers for purchases on the Internet, other systems are to include the “virtual” equivalent of an electronic purse card.

2.4 Advantages of electronic purse systems

There are a number of reasons why interest in electronic purses is building.⁵ Many firms, particularly those involved in handling large amounts of coinage and bank notes, are finding the costs of handling cash to be increasingly onerous. These costs include expenses related to point-of-sale transactions, accounting, theft, loss of cash, safekeeping and security, deposits of currency and other services related to the handling of cash provided by financial institutions.⁶ Indeed, various businesses in Canada and abroad have already begun to use various kinds of prepayment arrangements to reduce the use of cash, particularly of coinage. Prepaid telephone cards and public transit passes used in various countries are obvious examples. Now electronic purses would seem to be a clear way to consolidate and extend such means of reducing the costs of undertaking small-value retail transactions.

Financial institutions also incur substantial costs in handling cash.⁷ The introduction of the electronic purse could possibly reduce their total costs, either now or at some point in the future. They would also benefit from the new source of revenue generated from the outstanding balances in electronic purses. This latter issue is discussed in somewhat greater detail later.

5. A brief discussion of the advantages, as well as some drawbacks, of an electronic purse system is provided in Wenninger and Laster (1995).

6. Humphrey and Berger (1990) estimated such costs to U.S. retailers to have been about U.S.\$9 billion in 1987. This estimate was based on an earlier study by Curtin (1983).

7. Humphrey and Berger (1990) also estimated that the costs to U.S. banks of distributing cash over the counter were nearly U.S.\$1.7 billion in 1987. This figure would not include the various costs associated with handling cash for business customers, which would presumably be covered by service fees.

Finally, a multifunction card incorporating the features of a credit card and an electronic purse could be a useful marketing tool for both financial institutions and retailers.

The advantages to consumers of the electronic purse are numerous. Some consumers might find an electronic purse to be much more convenient than cash for small-value transactions. They would no longer need to have the correct change for a transaction or to handle numerous small coins. The incidence of error in calculating change from a transaction would also be reduced. Electronic purse owners might be able to carry fewer bank cards, especially if credit card and debit card functions were also included on the electronic purse card. If they could replenish their electronic purse at home over the telephone, they would no longer need to make special trips to ABMs in order to pick up additional cash. The time required to complete a transaction with an electronic purse would be much less than that associated with a credit or debit card, simply because on-line authorization for the transaction would not be required.

Consumers might also appreciate the enhanced security associated with an electronic purse, particularly versions incorporating a security feature such as a PIN. The costs associated with card fraud and theft of both existing payment cards and cash would likely be much reduced by the use of electronic purses.

Furthermore, if consumers find it more convenient to hold increasingly large balances in electronic purses, competition may eventually lead purse issuers to pay interest on the outstanding balances in purses or to provide additional services (Browne and Cronin 1994). Payment of interest would be technically feasible in purse systems in which each purse is equipped with personal identification, but not in other systems in which the purse is anonymous. At this stage of development, it is envisaged that the average user would maintain only a small balance in a purse, so that attempting to pay interest would not be practical.⁸

8. Even so, issuers of electronic purses in a pilot project in South Africa are already paying interest on purse balances, since the average balance is relatively high (Electronic Payments International 1995b).

2.5 Barriers to the development of purse systems

In spite of the strong interest worldwide in the electronic purse, the adoption of this innovation has been comparatively slow.⁹ There are a number of reasons for this. First, the market for the electronic purse, like other innovations that involve the creation of networks between the suppliers of services and their customers, needs to attain a critical mass before the purse can be used effectively. Prior to this stage, there will be considerable uncertainty among both consumers and merchants as to the potential usefulness of the product. Clearly, the benefits to consumers will rise as the new means of payment becomes acceptable to merchants, while the benefits to merchants will rise with greater usage by consumers. Second, the attractiveness of electronic purses to both consumers and retailers may be hindered by the presence of competing and incompatible systems, as was the case for videocassette recorders a number of years ago.

One major barrier to the development of electronic purse systems, up until recently, has been the lack of commonly accepted international technical standards for smart cards. However, Visa, MasterCard and Euro-pay set up a working group on smart card standardization near the end of 1993 (Martin 1994a) and reached agreement on basic technical specifications for both smart cards and terminals in November 1994 (Piskora 1994). Similarly, in March 1994 Visa USA announced plans for the "Electronic Purse" product, in its role as the project leader for a group of nine international financial companies (Kutler 1994a, 1994b). Initial work has focussed on the development of common technical standards for the electronic purse, although it is expected that products from the project will soon be marketed.

The substantial start-up costs associated with the introduction of stored-value chip cards – for new card-reading terminals or for the retrofit

9. The speed of diffusion of innovations such as the electronic purse can be analysed with economic models of network effects. The electronic purse is a good example of a product that has little intrinsic value but which may be highly useful as part of a network of products forming a payments system. For an excellent overview of network effects as one barrier to the use of debit cards in the United States, see Caskey and Sellon (1994). For a more general discussion of network externalities, see Liebowitz and Margolis (1994).

of existing terminals – has been still another factor holding back the implementation of the electronic purse innovation. In Canada, financial institutions are still absorbing the infrastructure costs associated with the implementation of the debit card system and until very recently have been understandably hesitant to introduce another major payments innovation. As well, the unit production cost of a smart card can still be 10 times more than that of a typical magstripe card, the latter on average costing about 50 cents (U.S.). However, the prices of both smart cards and card-reading terminals have decreased substantially in recent years, and further price decreases are expected over the next few years, a development which should strengthen the business case for the introduction of smart card technology.¹⁰

The average consumer may also prove to be slow to accept the electronic purse, because cash is still such a basic feature of daily life. Many people may consider an electronic purse more complicated to use than cash and may have concerns about the risk of card or equipment failure or about difficulties in recharging an electronic purse. Others may also be bothered by the potential loss of privacy, particularly in the case of multi-function applications, where a variety of personal information might be stored on a single card. The question of who would be authorized to access the information on the card would certainly be an important issue.

10. To the extent that electronic purses would replace debit cards in small-value transactions, operating costs may be reduced even further: on-line transactions and the associated telecommunications charges would decrease (Svigals 1994).

3 RECENT AND PROSPECTIVE PILOT PROJECTS

Many projects involving electronic purse applications have been announced over the past year, both overseas and in North America. A detailed catalogue of these applications may be found at the end of this report. This section will review the more important projects in progress.

3.1 Overseas projects

France continues to be a leader in the application of smart card technology to financial transactions. The French financial institutions have completed the conversion of their bank cards from magstripe cards to smart cards (Bank for International Settlements 1993).¹¹ The new cards incorporate both a microprocessor and a magnetic stripe, so that they are still acceptable in other countries. This project has already resulted in a substantial reduction in the cost of credit card fraud in France (McCullagh 1993). The major French bank card consortium, Groupement Cartes Bancaires, is also a member of the international consortium led by Visa USA that is involved in the electronic purse project (Martin 1994b).

Another significant electronic purse project called Mondex involves a group of British companies led by the National Westminster Bank (see under "United Kingdom" in the Appendix).¹² The Mondex system has been deliberately designed to mimic many of the features of physical currency. In particular, the funds in the Mondex electronic purse system are anonymous, in contrast to many other purse systems under development. All individuals participating in such a system would need to have a Mondex card on which monetary value would be stored in any of up to five separate currencies. Some cardholders might also choose to acquire an electronic Mondex wallet, so that monetary value could be transferred

11. In June 1994, Europay announced plans to spend over U.S.\$1 billion to begin converting all its magstripe cards to the smart card format in 1996 (American Banker 1994). In August 1993, the German banks had indicated that all of their Eurocheque cards were being converted to chip cards.

12. See also National Westminster Bank (1993), Gapper (1993), The Economist (1994) and Drohan (1995).

directly between cards without passing through a financial intermediary (Figure 2). For added convenience, transactions could be conducted over special telephones as well as at special terminals in retail establishments. One financial institution or industry consortium issuing Mondex monetary value in each country would need a general suspense account for the amount outstanding on its issued purses. No audit trail would be associated with this system, so that overall security would be entirely dependent on the reliability of the merchant terminals.

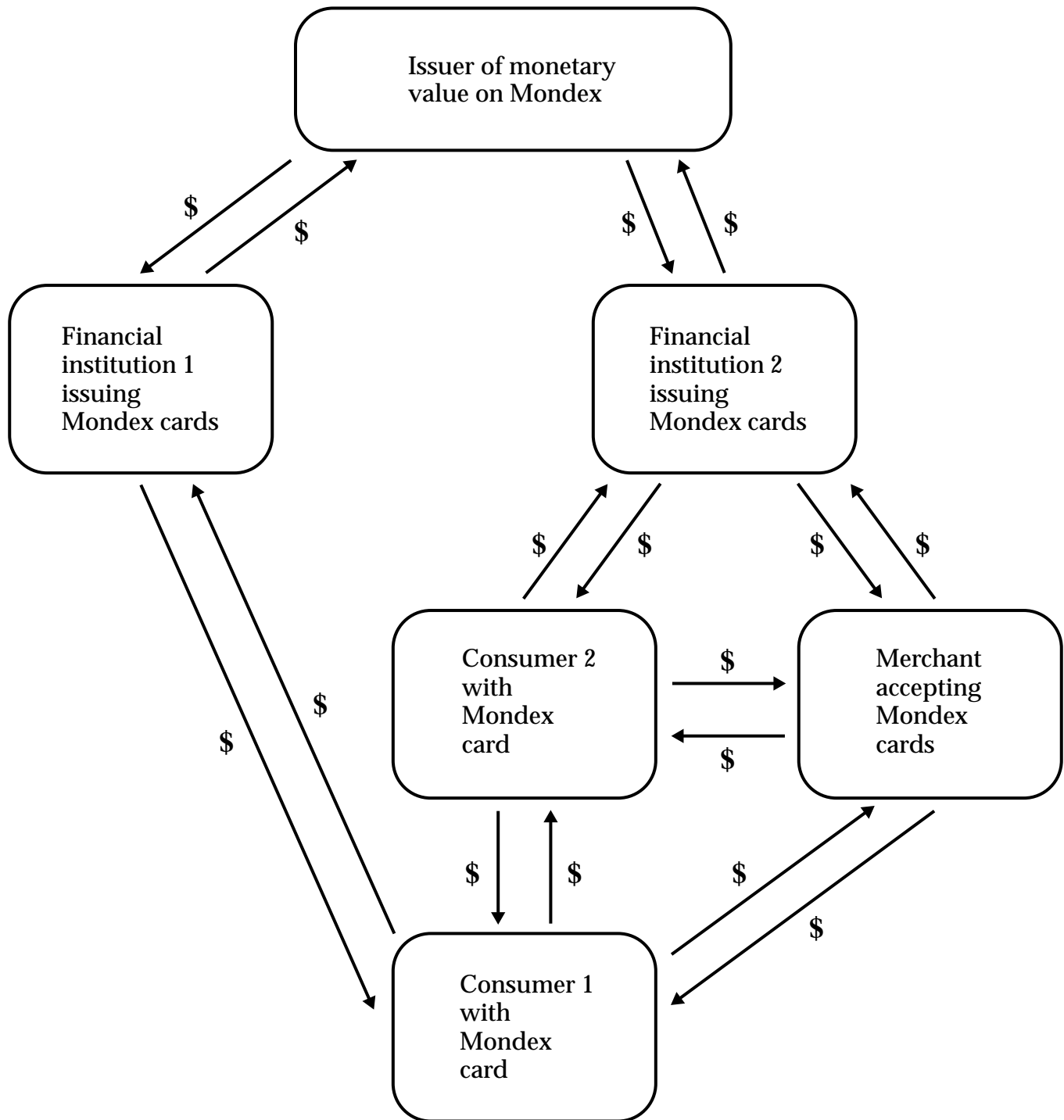
In 1996, after a pilot project that began in mid-1995 in the United Kingdom, the developers of Mondex hope to market the system nationwide and also to establish an international consortium for worldwide distribution. In October 1994, the Hongkong and Shanghai Banking Corporation Limited announced that it would acquire the rights to franchise Mondex throughout most of Asia (Kutler 1994e). Still more recently (May 1995), the Royal Bank and the Canadian Imperial Bank of Commerce announced their intention to buy the Canadian franchise. Negotiations are also under way with potential partners in the United States. The head of Mondex International, Tim Jones, expects a general spread of Mondex around the world beginning in early 1997. He predicts that the Mondex system will account for about 60 per cent of the volume of cash transactions worldwide within 15 years (Partridge 1995b).

Efforts to apply smart card technology to financial and retail transactions have been actively pursued in Japan. Prepaid cards issued by NTT, Japan's largest telephone company, and by Japan Railways are already in common use (Bank for International Settlements 1993).

Implementation of electronic purse systems is also under way in Denmark, Finland, Taiwan and Portugal. The main intent of the organizers of the Danish system at this time is to reduce coin collection costs.¹³ In this system, the merchant's terminal would usually be off-line, but transactions would be periodically forwarded to a concentration point, batch-processed

13. Information on the Denmark project can be found in Jensen (1992), Lipis (1992), Martin (1992), Electronic Payments International (1994), Kutler (1994c) and Lindboe-Larsen (1994).

Figure 2
Electronic purse system – Mondex Model



and then sent to a special clearing system for purse transactions operated on behalf of the national payments organization.

The Bank of Finland, by setting up a subsidiary specifically entrusted with developing and marketing its own version of the electronic purse, has clearly indicated that it considers this innovation to be a viable and efficient replacement for cash (Toimiraha Ltd., n.d.; Kokkola and Pauli 1994). Its "Avant" money card was expected to go into nation-wide use in 1995 (Jarman 1994). The national payments organization in Taiwan is planning to put a combined chip and magstripe card into common use, which would include an electronic purse function (Banerjee, Ody and Poynder 1995).

In Portugal, the national payments organization started a nation-wide launch of an electronic purse product in early 1995 (Meneses 1994; Mollett 1995).

A number of electronic purse pilot projects are either in progress or have been announced in such countries as Australia, Belgium, Bulgaria, Guatemala, Holland, Korea, Latvia, Singapore, South Africa and Spain.¹⁴

Furthermore, in September 1994 MasterCard International announced that it intended to develop a multipurpose, prepaid card product which would be available on a limited basis in 1996 (Kutler 1994d). In particular, MasterCard International is involved in a stored-value chip card pilot project to begin in Australia in the first quarter of 1996 (Martin 1995).

14. References on selected projects are as follows: Australia (Block 1995a; Lawson 1995; Martin 1995), Belgium (Banksys 1994; Giannone 1995a; Hennessy 1994b; McCullagh 1994), Holland (Hennessy 1994b; Power 1994a, 1994b), Singapore (Electronic Payments International 1995a; Ping 1995; Sikes 1992), South Africa (Electronic Payments International 1995a, 1995b; Martin 1994c; Ras 1994) and Spain (Brown 1994a, 1994b, 1995). A company called Applied Systems Institute Inc. is involved in projects in Bulgaria, Guatemala and Korea (Applied Systems Institute Inc., n.d.).

3.2 North American projects

In North America several company consortia are currently involved in electronic purse projects. In Canada, the recently announced UBI (universal, bidirectional, interactive) project is being led by the major Quebec cable company Le Groupe Vidéotron, with the National Bank acting as financial intermediary for a larger consortium (Bastien 1994; UBI 1994). The UBI project is essentially an “electronic store” offering various services such as games, electronic mail and at-home shopping. After a pilot project that is to start sometime in 1996 in the Saguenay region of Quebec, spokespersons for the project expect that UBI will be used by up to 80 per cent of Quebec households by the year 2002. They hope that other Canadian cable TV companies will be interested in purchasing the service. Current plans call for users to be supplied with the necessary hardware at no additional cost. UBI revenues would come from fees charged to suppliers of services on the network. Providing the targeted number of Quebec households with the appropriate hardware would account for a substantial portion of the estimated required investment of up to \$750 million.¹⁵

In the UBI system, customers will be able to pay for services with conventional credit or debit cards as well as with a smart card or “electronic wallet.” The UBI card is intended for use in an off-line mode as a means of payment for small-value transactions, with very rapid transaction times and no transaction fees. The customer will be able to load value into the electronic wallet either with a debit or a credit card, at home.

More technically, funds will be held in a suspense account by the National Bank between the time funds are withdrawn by the consumer and loaded onto the electronic wallet and the time the National Bank receives payment instructions from the consumer. At this point the funds would be transferred to the service provider on the network. In effect, the National Bank will be operating a clearing system for electronic wallet transactions in the closed environment of this home electronic highway

15. Jacques Borel of Nova Services Conseils, a consulting firm in Montreal, also provided useful information on the UBI project.

project. The group running the UBI pilot project will operate a card management system that links each card with the corresponding customer's name, so that a customer could be reimbursed for the amount outstanding on the card if the card was lost or stolen.

It is not yet clear how the wallet would operate in an open environment involving two or more financial institutions. Probably it would be used as an off-line debit card. The issuer would put a hold on funds in the cardholder's account at the time that value was loaded onto the card, and the transfer of funds between the cardholder's account and those of various retailers would occur through the Canadian Payments Association at the end of each day. The payments arrangements would likely be similar to those for certified cheques.

As noted earlier, the Royal Bank and the Canadian Imperial Bank of Commerce announced in May 1995 that they had signed a letter of intent to buy the Canadian franchise for Mondex. Furthermore, Bell Canada will be assisting these partners with a pilot project, which will likely take place in 1996 (Partridge 1995b). As well, spokespersons for both Visa Canada and MasterCard have announced plans for pilot projects to test other electronic purse systems in Canada within the next year or so (Blackwell 1995; Partridge 1995a, 1995c).

A considerable number of electronic purse pilot projects are under way in the United States, involving such major banks as Banc One Corp., Chase Manhattan Bank and Chemical Bank. Electronic Payment Services Inc., a joint venture of a group of U.S. financial institutions, has indicated that it plans to test an electronic purse product more widely in an area within the state of Delaware beginning in early 1996.¹⁶ Finally, in March 1995, Visa International and three U.S. banks announced plans for a stored-

16. These various projects are discussed in Kutler (1993), Strachman and Kutler (1993), Achs (1993), Fickenscher (1994), Purcell (1994), Giannone (1994, 1995b) and Block (1995b).

value card project to be carried out in Atlanta around the time of the 1996 Summer Olympics (Piskora 1995).¹⁷

The use of prepaid cards, whether smart or magstripe, for such specific payments applications as pay phones and toll booths is now starting to become more common in North America. In Canada there is active interest in prepaid cards for long-distance calls from pay phones,¹⁸ and truckers in British Columbia have been using smart cards at certain toll booths. The enhanced security features associated with smart cards have also found an application in wholesale banking services offered by both Chase Manhattan Bank (Crockett 1993) and the Royal Bank of Canada (Strachman 1994). Magstripe cards have been extensively used as prepaid cards in the United States, although mainly in closed environments such as company cafeterias (Credit Card Management 1993).

Governments in both Canada and the United States have shown active interest in smart cards and other electronic systems as a means of distributing transfer payments to individuals. In Quebec, for instance, the health care system has been issuing smart cards with personal medical information to all health care recipients in that province (Davis 1995).

17. Visa is also involved in other proposed electronic purse pilot projects in Germany, Latin America and the United Kingdom. The VisaNet system is expected to be enhanced to accommodate smart cards by the end of 1996. Visa also expects to develop another multicurrency purse product by 1997 (Electronic Payments International 1995c; Giannone and Jarman 1995).

18. Bell Quebec recently introduced a prepaid smart card for use in public pay phones. A similar card was to be introduced in Ontario in September 1995 (Leger 1995).

4 SELECTED POLICY ISSUES

4.1 Regulatory issues and the payments system

One of the most important policy issues associated with the electronic purse innovation concerns its potential impact on the integrity of the retail payments systems, a matter given special emphasis in the recent report on prepaid cards by the Working Group on EU Payment Systems, prepared for the Council of the European Monetary Institute (Working Group 1994). The transfer of funds from an electronic purse would serve, after all, as a final means of payment wherever it was accepted by retailers. The soundness of both the issuer of an electronic purse product and of the instrument itself could be matters of concern for central banks and other financial regulatory bodies. Indeed, the European Union (EU) central banks have come to the view that only institutions subject to banking regulations should be allowed to issue purses. They consider the funds received by the issuer of an electronic purse to be just another type of bank deposit and they are mindful of the risk to national retail payments systems should a company issuing such purses fail (Working Group 1994).

The issue of whether similar kinds of restrictions should apply in Canada may soon have to be addressed. It would appear reasonable for issuers of electronic purses to be subject to the same regulatory restrictions as any other institution accepting deposits from the general public: complications could arise if a form of electronic purse is used for making payments on the Internet and if a number of non-financial companies come to see a role for themselves in this field along with the financial institutions. However, it remains to be seen whether any non-financial firms will want to be the direct issuers of such a product. If regulatory restrictions were imposed on purse issuers, consideration might need to be given to whether the outstanding balances in electronic purses should be defined as “deposits” and should therefore qualify for deposit insurance.

In some quarters the risk of electronic purse counterfeiting is also perceived as a very real concern, particularly in the case of products that are highly anonymous (such as the Mondex card) and that allow monetary

value to be transferred between cards. In particular, the EU central banks have indicated that they expect prospective issuers of electronic purses in the EU to pay careful attention to security issues. (It is well to note, however, that many of the purse systems being developed around the world will be much more secure than conventional credit or debit cards, even if some security features, such as a PIN, will increase transaction times and reduce the attractiveness of electronic wallets for very small transactions.) Market forces, as well, will force issuers of electronic purses to ensure a high level of security. Otherwise, individuals would not want to use these cards, and issuers would be wary of the large potential losses associated with counterfeiting. All in all, such concerns about security may be more relevant for the prepaid magnetic stripe cards than for electronic purses, which, owing to their more complex nature, require the more secure smart card technology.

There is also a risk that the introduction of electronic purses, especially the more anonymous products such as the Mondex card, will facilitate money laundering activities. The smaller size of an electronic purse relative to the equivalent in bank notes, as well as the possibility of transferring monetary value over the telephone, may prove advantageous to participants in the underground economy and in criminal activities (Wenninger and Laster 1995).

Some restrictions on the issuers of electronic purses, such as a limit on the maximum balance that could be loaded onto a card, may prove to be desirable in order to reduce the risk of purse fraud. However, such restrictions may very well be imposed by the issuers themselves, in response to customer preference. Most individuals probably would only want to hold a small balance in a purse if no interest is payable on the outstanding balance, as in virtually all proposed systems. Furthermore, most retailers would likely be hesitant to accept payment from an electronic wallet for a large-value purchase, as tends to be the case even now with the larger-denomination bank notes, such as the one-thousand dollar bill.

Smart cards will clearly raise a number of important issues for financial system regulators. However, some economists question the value

of purse regulation and even the need for a central bank. The development of the electronic wallet and other innovations leading to a cashless monetary system and a more competitive financial system may well renew this debate. Several arguments are therefore worth reviewing in this context.¹⁹

The increase in trend inflation around the world in the early 1970s helped promote consideration of alternative monetary regimes that could curb what some economists felt to be the inherent inflationary tendencies of central banks with discretionary authority over monetary policy. One widely discussed suggestion was the imposition of rules on the conduct of monetary policy. Another group of economists recommended even more radical changes in the form of partial or even full deregulation of national financial systems.

For example, in the 1970s Friedrich Hayek argued in favour of the use of competing national currencies in each country (Hayek 1976). In fact, more stable foreign currencies such as the U.S. dollar have been widely used as media of exchange in countries experiencing hyperinflation. However, in more normal situations such innovations would face the inherent difficulty that the use of two or more currencies would substantially increase transaction costs (Congdon 1981).

Some economists have gone further in recommending the merits of a regime with private sector issuance of money and no central bank or other regulatory control (“free banking”).²⁰ The current consensus among this group of economists is that competition would lead financial institutions to issue money that would be convertible into a commodity such as gold or even a basket of commodities with relatively constant purchasing power, so that such a system would be less inflationary than present

19. Browne and Cronin (1994) argue that the development of new payment media such as electronic purses could be an important factor in the gradual evolution of a *laissez-faire* banking system. A recent comprehensive review of various aspects of the literature on pure monetary *laissez-faire* is provided in Selgin and White (1994).

20. Recent monographs on the case for free banking include Selgin (1988), Dowd (1989) and Sechrest (1993).

monetary regimes. It has also been argued that a free banking system would avoid the efficiency losses associated with regulation.

Nonetheless, the mainstream view continues to be that a free banking system would be an impractical alternative to present monetary regimes. There is a fundamental concern that banking systems are inherently unstable and prone to bank runs, given the illiquidity of most bank assets and the incentive for depositors to withdraw their money at the first hint of financial difficulties in a bank (Summers 1991). It has also been argued that in emergency situations, such as wars, many persons and firms would want to switch from bank deposits and private bank notes to currency issued by a central bank, so that banks would still need a lender of last resort (Humphrey 1992). Advocates of free banking might respond that many types of regulatory restrictions, such as the prohibition on private bank note issues, have in fact been major factors in the past instability of many national banking systems and the tendency to bank runs.²¹

Furthermore, critics of free banking have suggested that there is considerable historical evidence of a natural tendency for central banks to develop based on lender-of-last-resort functions and the need for a leader in a payments clearing house (Goodhart 1988). In particular, private banks would naturally tend to reduce costs by developing arrangements to pool their reserves of outside money in a centralized institution (Laidler 1992). It has also been suggested that the issuance of bank notes leads to a natural monopoly, because the circulation of different kinds of notes would increase transaction costs (Cooper and Palasek 1989). Doubts have also been expressed as to whether banks would agree to issue liabilities redeemable either in commodities or baskets of commodities that maintained relatively constant purchasing power, even in a completely deregulated financial environment (McCallum 1994).

21. It used to be commonly accepted that historical evidence supported the case against free banking. This conclusion is now suspect in the context of the recent wave of research on historical episodes of free banking (Dowd 1992).

There has also been a discussion in the academic literature about why currency should coexist with default-free interest-bearing assets such as government-issued savings bonds (see, for instance, Wallace 1983). It has been suggested that this can take place only in the presence of legal restrictions, such as the prohibition of small-denomination interest-bearing securities. This view does seem to ignore the costliness of paying interest on small-denomination securities, particularly if these securities were to play the same role as small-denomination bank notes (Sumner 1993). It is, however, a more valid concern in trying to explain the substantial demand for large-denomination bank notes, when similar denomination default-free interest-bearing assets are readily available. The efficiency of large-denomination bank notes as an anonymous and non-taxable store of value may provide a partial explanation.

4.2 Legal monopolies on the note and coin issues

The Bank of Canada has a legal monopoly on the issuance of bank notes, as spelled out in the Bank of Canada Act, section 25 (1):

The Bank has the sole right to issue notes intended for circulation in Canada and those notes shall be a first charge on the assets of the Bank.

Bank notes must be accepted as a means of final payment and hence constitute legal tender. Subsequent subsections of section 25 suggest that bank notes are defined in a narrow sense, insofar as references are made to printing and signing.

Similarly, the Minister of Finance has the sole authority to issue coins for circulation in Canada.

The legal question is whether the distribution of electronic purses would constitute a violation of the respective legal monopolies of the Bank of Canada and the Minister of Finance on the issuance of bank notes and coins. The large physical difference between cash and electronic purses would weigh heavily in such a debate.

Reviewing the distinctions between cash and such other widely used media of exchange as cheques, credit cards and debit cards may also be helpful in analysing this question. First of all, cheques came to be widely used as a medium of exchange in the last century and have been treated as legally distinct from currency for many years. Furthermore, currency constitutes a means of final payment: the seller has no further claim on the purchaser once currency has changed hands. In contrast, in the case of a transaction involving a cheque, settlement is final only once the transfer of funds between the purchaser's and seller's bank accounts has taken place.²² The distinction is even clearer in the case of a credit card, where the financial institution issuing the card extends credit to the purchaser to facilitate the transaction and continues to have a claim on the purchaser until the credit card balance has been paid.

With the development of debit cards, we have come full circle, as the transfer of funds between the purchaser's and seller's bank accounts takes place at the time of purchase. In this sense, an electronic purse transaction is very much like a debit card transaction in that both can be considered a final means of payment. Since debit cards are considered legally different from currency, the same logic might reasonably apply to electronic purses.

It is of interest that this legal issue has already been studied in most European countries. The consensus of legal opinion there is that the legal monopoly on bank notes does not extend to electronic purses (Working Group 1994).

4.3 Seigniorage

Canada's federal government could stand to lose a substantial amount of revenue if electronic purses, in place of bank notes and coins, come to be widely used in Canada as a means of settling small-value transactions. The bulk of the liabilities of the Bank of Canada are in the form of

22. This distinction between means of payment and medium of exchange is reviewed in Goodhart (1989).

non-interest-bearing notes in circulation (\$28.3 billion at the end of 1994), with the offsetting assets represented by federal government securities. If the introduction of electronic purses and other financial innovations were to reduce substantially the demand for bank notes, then the Bank would see a decline in the size of its balance sheet, an erosion of the revenue stream from its investments (\$1.7 billion in 1994) and hence a decrease in the profit transferred back to the federal government.²³ Widespread use of the electronic purse would also have an impact on the demand for coins and a further effect on the revenues of the federal government (\$90 million in fiscal 1993/94). This report does not address the question of the preferred sources of government revenues, but rather, in the remainder of this section, asks whether the net revenue loss would in fact be considerable.

At the outset, it is important to emphasize the high degree of uncertainty associated with any estimates of the long-run impact of the electronic purse innovation on the demand for currency. It is difficult to quantify these effects both because of limited quantitative understanding of the various current uses of bank notes and because of a lack of concrete evidence as to the relative attractiveness of electronic purses to consumers and merchants.

First, it is entirely plausible that a substantial part of the total stock of currency outside banks in Canada, which amounted to about \$850 per capita in mid-1994, may be used for purposes other than to facilitate retail transactions. Studies in other countries have suggested that reported personal cash holdings, most of which would presumably be used for transactions purposes rather than for savings, generally accounted for only a relatively small proportion of the total amount of national currency outstanding. For example, in the United States studies have indicated that the amount of reported cash held by individuals accounted for only about 12 per cent of the total stock of currency outside banks (Avery et al. 1986,

23. There would be some offsets: presumably the operating costs of the Bank of Canada could be reduced, as the bank note function alone cost about \$100 million in 1994. Furthermore, federal corporate income tax revenues could be expected to increase, to the extent that the profitability of financial institutions issuing such electronic purses would improve.

1987), although the situation in the United States may be somewhat special, as discussed below.²⁴

A study of household wealth in Canada implied that personal cash holdings in 1977 amounted to only about 20 per cent of the stock of currency outside banks (Statistics Canada 1979). Reliable data on the cash holdings of Canadian non-financial enterprises do not seem to be available. However, U.S. studies have suggested that holdings by U.S. retailers, the major non-financial business users of cash, would at most amount to one day's worth of retail purchases made with currency (Anderson 1977; Sumner 1990). Such an assumption, as well as an additional allowance for cash in transit, would suggest that in Canada, the value of currency held by non-financial businesses would constitute at most 5 per cent of the total currency stock held outside banks.

Hence, currency appears to have uses other than as a medium of exchange in the above-ground economy (Sprenkle 1993). It is frequently suggested that a considerable amount of cash is used in the underground economy. In contrast, U.S. studies of income tax compliance suggest that the amount of currency in use for underground transactions in the United States probably is relatively small, perhaps less than 7 per cent of the total amount of currency outside banks. While it is probable that a considerable proportion of U.S. currency winds up in less-developed countries, only a relatively small share of Canadian currency is likely to leave Canada. This leads to the conclusion that a large amount of Canadian currency, especially in the higher denominations, may be used as a store of value.²⁵ This conclusion emerges, however, through a process of elimination and is unclear as to the motivation for such behaviour, considering the risk of theft and the lack of any financial return from holding higher denominations.

24. As another example, Viren (1993) reported that a recent survey of the average money holdings of households in Finland accounted for only about one-third of total currency per capita.

25. Studies of currency demand in other countries have come to a similar conclusion; see, for instance, Boeschoten and Fase (1992) for Holland.

The electronic purse as currently conceived is intended as an alternative medium of exchange for small-value transactions and not as an alternative savings instrument. If this indeed is how it comes to be used, then as the above analysis suggests, the maximum reduction in the value of Canadian currency outstanding might be less than 30 per cent. The relative impact on coin circulation would likely be considerably larger. These conclusions, while admittedly speculative in nature, are supported in a qualitative fashion by a recent study. Bos (1993) estimated that for the European Union, the average reduction in the value of currency in circulation arising from complete acceptance of the purse in small-value transactions could be as much as 18 per cent for the value of bank note circulation and 88 per cent for the value of coin circulation.²⁶

Furthermore, it is not at all clear what proportion of consumers and merchants will use electronic purses over the long term. Many people may prefer to use physical cash because of habit and unfamiliarity with various electronic products. As well, smaller retailers might well hesitate to invest in the costly equipment capable of reading and transferring value from an electronic purse, especially if many consumers still use physical cash.

The risk of electronic purses replacing currency for uses other than as a medium of exchange nevertheless must be acknowledged. As noted earlier, there is concern as to the degree to which such anonymous products as the Mondex card might be used for money laundering activity. However, limited quantitative understanding of the various uses of physical currency makes it difficult to determine how important such non-transaction uses of electronic purses might be. As a result, restrictions on the use of electronic purses, whether imposed by the issuing financial institutions or by regulatory authorities, may limit the use of the electronic purse to its intended purpose as a medium of exchange.

26. Bos used information on the frequency distribution of retail payments expressed in terms of the value of individual transactions, taken from a 1986 survey of Dutch households.

While there is considerable uncertainty regarding the long-term impact of electronic purses on the demand for currency, it seems likely that quantitatively significant effects will take a number of years to show up. The infrastructure will take considerable time to set up, especially in a situation where competing purse systems are likely to be marketed. In addition, as mentioned earlier, consumers may be hesitant to use electronic purses unless the devices are widely acceptable by merchants, while retailers may hold back on their investment in equipment unless the purse becomes widely acceptable to consumers or until they know which kind of purse is most popular with consumers (the “VHS–Beta problem”).

4.4 Monetary policy implications

At the time that discussions were being held on the establishment of a central bank in Canada, a monopoly over the note issue was considered an essential element in the effective implementation of monetary policy: it would allow the central bank to control credit volumes and hence ensure price stability (Canada 1933).

This is a rarely held view nowadays. While many economists remain convinced that control over base money is essential to the effective conduct of monetary policy, shifts in the composition of base money between currency and deposits of financial institutions at the central bank would not be considered a major policy issue. Gradual shifts in the demand for currency arising from such innovations as the electronic purse could be offset by the Bank of Canada through its control over the supply of settlement balances held by the direct clearers in the Canadian Payments Association.

If electronic purses do come to be widely used in Canada, then the outstanding balances in such products probably should be included in narrow measures of the money stock, since such “electronic money” would be a clear substitute for cash. A similar recommendation has also recently been made to the EU central banks (Working Group 1994). The information content of the narrow monetary aggregates might also be gradually affected over time, if consumers are satisfied with holding a smaller

average outstanding balance in the electronic purse than is their habit with cash, particularly if the value in the purse can be replenished over the telephone.

5 CONCLUDING REMARKS

It is highly probable that the number of single-purpose prepaid card applications in Canada will increase over the next few years, particularly for telephone calls, transportation and vending machines. Use of these cards is likely to have a relatively larger effect on the demand for coins as opposed to bank notes. There are no obvious implications of such a development for monetary policy.

Increasing use in Canada of smart cards in conventional financial applications such as credit and debit card payments over the next 10 years also seems likely. Such cards may be attractive to consumers because of their enhanced convenience and security, to many large retailers for marketing purposes and to financial institutions as a means of reducing losses from card fraud. This development is of interest to the Canadian Payments Association in the context of developing standards and guidelines for smart card payments but does not appear to pose any special policy issues for the Bank of Canada.

Finally, and most importantly, the electronic purse innovation may well have a significant long-term effect on currency demand, although much will depend on how acceptable it turns out to be both to consumers and retailers. In any case, significant effects on the demand for currency may well take a number of years before becoming apparent.

Companies that handle large volumes of coins and small-denomination bank notes should find the purse attractive as a means of reducing cash-handling costs, while some consumers will appreciate the added convenience, particularly in the context of home banking and electronic highway applications. Nonetheless, such a major change in payments practices for small-value transactions will require substantial adjustments both from financial institutions and retailers, in terms of changes in infrastructure, and from consumers, in terms of a shift in payments habits. In the meantime, central banks and other financial regulatory bodies may soon have to address issues related to the soundness of both electronic purse products and their issuers.

APPENDIX

Major electronic purse projects, by country

Australia

Project and/or leading member	Other members	Timing	Description of project
<p>OneCard (a four-company consortium, including Visa)</p>		<p>Trial of stored-value smart card planned in Newcastle, New South Wales. Started in November 1995.</p>	<p>This project arises from a tender by the government of New South Wales for a general application of the stored-value technology.</p> <p>In the pilot project the card may be accepted by over one thousand retailers, as well as by government-owned buses and trains and by two telephone companies. Anonymous disposable cards are being used initially.</p>
<p>MasterCard International</p>	<p>A consortium of major Australian banks and a British bank with a presence in Australia</p>	<p>Pilot project to begin in the first quarter of 1996 in Canberra.</p>	<p>The stored-value chip card is to be linked to existing credit card and debit card bank accounts. The merchants involved in the project will include gasoline stations, convenience stores and specialty retailers.</p>

Belgium

Project and/or leading member	Other members	Timing	Description of project
Banksys (Belgium's national payments organization)		Pilot project began in February 1995.	<p>The purse ("Proton" card) is intended as a replacement for cash and small-denomination cheques in retail transactions in neighbourhood shops, and in vending machines, parking meters, public transit and pay phones.</p> <p>Cardholders are able to load the card in existing cash-dispensing machines specially adapted for the purpose. The pilot project involves selected retailers and vending machines.</p> <p>All transactions are on-line.</p>

Canada

Project and/or leading member	Other members	Timing	Description of project
<p>UBI (universal, bidirectional, interactive) - Le Groupe Vidéotron</p>	<p>National Bank, Hearst Publishing Group, Hydro-Québec, Loto-Québec, Canada Post</p>	<p>Pilot project to begin in 1996 in Saguenay region of Quebec.</p>	<p>UBI may be thought of as an “electronic store.” Services such as games, electricity consumption management, home automation, electronic mail and tele-shopping will be offered, in addition to at-home financial services.</p> <p>The electronic wallet in this project is intended for use in an off-line mode as a means of payment for small-value transactions. Value would be loaded onto a UBI smart card by a debit or credit card transaction.</p>
<p>Mondex Canada - CIBC, Royal Bank</p>	<p>Hongkong Bank of Canada</p>	<p>Pilot project expected in 1996 in Guelph, Ontario.</p>	<p>The Royal Bank and CIBC have signed a letter of intent to buy the Canadian franchise for Mondex.</p> <p>Bell Canada will also be participating in the pilot project.</p>

Canada (continued)

Project and/or leading member	Other members	Timing	Description of project
Visa Canada	Bank of Nova Scotia, Toronto-Dominion Bank, Vancouver City Savings Credit Union, La Caisse centrale Desjardins du Québec	Various tests to be conducted in early 1996.	Cards will initially be disposable. Reloadable cards to be available by the spring of 1996.
MasterCard - Bank of Montreal		Pilot project expected in 1996.	

Denmark

Project and/or leading member	Other members	Timing	Description of project
Danmont - Danish payments organization	Copenhagen Telephone Company (on behalf of all Danish telephone companies)	Pilot project ran between September 1992 and March 1993. National implementation is under way.	Cards in use are still disposable, though a rechargeable card is expected to follow. The merchant's terminal is to be off-line, but transactions would be periodically loaded to a concentration point, batch-processed and then sent to the clearing system. The intent at this time is to reduce the use of coins, particularly for vending machines, pay phones, trains, buses and parking meters.

Finland

Project and/or leading member	Other members	Timing	Description of project
Avant money card - Toimiraha Ltd. , (subsidiary of Bank of Finland)		Expected to go into nation-wide use in 1995.	<p>The Bank of Finland sees the electronic purse as a means of reducing the costs associated with small-value transactions. Applications to date have included pay phones, postal services, public transit and parking meters.</p> <p>Participating retailers can send a record of small-value transactions on a daily basis to Toimiraha Ltd.</p> <p>A consortium of private companies, backed by the Bank of Finland, is now reported to be involved in the project.</p>

France

Project and/or leading member	Other members	Timing	Description of project
French post office (la Poste)	Groupement Cartes Bancaires	Pilot project was completed in 1993.	The cost of the project was to be divided among cardholders, processing banks and payees. Cardholders were to pay only for the electronic purse, the price of which had been estimated at about 100 French francs. Groupement Cartes Bancaires decided not to proceed further with the project in the fall of 1993.

Holland

Project and/or leading member	Other members	Timing	Description of project
Consortium of Dutch banks		Pilot project was to begin by the end of 1995 or in early 1996.	A smart card with an electronic purse feature is to be introduced. The Dutch central bank has indicated that multipurpose electronic purses are to be issued only by banks and that legislation will be required.

International

Project and/or leading member	Other members	Timing	Description of project
Electronic Purse - Visa USA	Gemplus, VeriFone Inc., Electronic Payment Services Inc., FISC (Taiwan), and major payments-processing groups in Belgium, France, Portugal and Spain	Announced in March 1994.	<p>The card is intended to take the place of cash in transactions with a value of under \$10. The card could be loaded or reloaded at ABMs and debited at such cash-oriented locations as vending machines, pay phones, gas stations and fast-food restaurants.</p> <p>The consortium has been concentrating initially on technical standards for the electronic purse. It was planning to begin marketing products from the project by late 1995.</p>
Visa International		Pilot project at 1994 Winter Olympics in Norway	The pilot project involved a magstripe card, as it would have been too costly to retrofit ABMs to read smart cards. The card was a form of electronic traveller's cheque and could be used at ABMs to withdraw local currency. The card could not be recharged.

Portugal

Project and/or leading member	Other members	Timing	Description of project
Payments organization in Portugal (SIBS)		National launch of purse product began in early 1995.	The electronic purses in the initial pilot phase were single-function cards, though debit or credit cards with a purse function are to be available later on.

Singapore

Project and/or leading member	Other members	Timing	Description of project
<p>Consortium of banks in Singapore (NETS)</p>		<p>The pilot phase of the project was delayed once again in late 1994.</p>	<p>Future plans include a version of the prepaid smart card that is linked to the customer's current account.</p> <p>One goal of the project is to reduce the level of currency in Singapore by 3 to 4 per cent by the late 1990s.</p>

South Africa

Project and/or leading member	Other members	Timing	Description of project
Consortium of South African banks		A six-month pilot project was launched in September 1994 in a Johannesburg suburb.	<p>The products to be tested in the pilot project were to include an off-line debit card and both protected (by means of a personal identification number) and unprotected purse products.</p> <p>In this project, the banks are paying interest on the outstanding balances in the electronic purses.</p>

Spain

Project and/or leading member	Other members	Timing	Description of project
<p>La Caixa (Spain's largest savings bank)</p>	<p>Payments system owned by Visa España (SEMP)</p>	<p>Pilot project began in September 1994.</p>	<p>SEMP is interested in issuing debit cards with an electronic purse feature, as the cost of on-line processing for small-value transactions is relatively high in Spain.</p>
<p>Sistema 6000 (Spanish savings banks' payments operator)</p>		<p>Launch of electronic purse scheme planned for mid-1996.</p>	

Taiwan

Project and/or leading member	Other members	Timing	Description of project
<p>National payments organization in Taiwan (FISC)</p>		<p>Electronic purse system is reported to already be operational.</p>	<p>The Financial Information System Center (FISC) is planning to make a dual purpose (chip and magnetic stripe) card the standard one for the nation. An electronic purse function had been developed and retailer linkages were being arranged at the end of 1993.</p> <p>FISC is also involved in the electronic purse consortium led by Visa USA.</p>

United Kingdom

Project and/or leading member	Other members	Timing	Description of project
<p>Mondex - National Westminster Bank</p>	<p>Midland Bank and British Telecom</p>	<p>Pilot project began in Swindon, England, in July 1995, with a national launch expected in 1996.</p>	<p>The user can make purchases, transfer money in and out of bank accounts and carry out transactions over the phone. Funds can be transferred between cards by means of an electronic wallet. The electronic terminals of retailers will be able to accumulate the total value of Mondex transactions, which can then be banked by telephone at any time. The card is designed to be locked with a personal code, so that if the card is lost, no one can use the value on the card. The card is capable of holding up to five separate currencies at any one time. About six hundred retailing organizations are participating in the pilot project.</p> <p>National Westminster is hoping to establish an international consortium to market Mondex worldwide. The Hongkong and Shanghai Banking Corporation Limited announced in October 1994 that it will acquire the rights to franchise Mondex throughout most of Asia. The Royal Bank and the Canadian Imperial Bank of Commerce have signed a letter of intent to buy the Canadian franchise.</p>

United States

Project and/or leading member	Other members	Timing	Description of project
Banc One Corp.	Advanced Promotions Technologies (APT)	Test phase was to have been completed by the second quarter of 1994.	The partners were testing credit cards (MasterCard) with a smart card feature, to be used as part of the Vision Value Club, which features the frequent shopper option and other promotions. The payment function was an extension of the system's primary function of market research.
Bank of America		Pilot project is under way at its Concord, California, technology centre	The Bank of America is testing a stored-value reloadable card. It is also operating a disposable chip-card pilot project at three Visa International sites in California.

United States (continued)

Project and/or leading member	Other members	Timing	Description of project
Chase Manhattan Bank		Pilot project has been under way for the past two years.	Chase Manhattan expects to offer a smart card to its account holders by 1996, incorporating ABM accessibility and the prepaid option.
Chemical Bank	AT&T	Trial is under way at an employee cafeteria.	The smart card can be replenished at an ABM and debited at the point of transaction. A contactless technology is being used. The partners were hoping to market the cards in the near future.

United States (continued)

Project and/or leading member	Other members	Timing	Description of project
Electronic Payment Services Inc. (EPS)		Pilot project to start in early 1996.	<p>In October 1992, EPS introduced a multipurpose smart card version of its Money Access Service (MAC) ABM card, which can also function as an electronic purse. The card was successfully tested at MAC headquarters.</p> <p>An electronic purse product is to be tested more widely through a pilot project in an area of Delaware in early 1996.</p>
SmartCard VeriFone and Gemplus SCA (VeriGem joint venture)		Announced in 1993.	This project is aimed at such cash-intensive markets as fast-food restaurants and convenience stores.

United States (continued)

Project and/or leading member	Other members	Timing	Description of project
Visa International	Three U.S. banks (First Union, NationsBank, Wachovia)	Pilot project in Atlanta to run concurrent with the 1996 Summer Olympics.	<p>All three banks will offer disposable stored-value cards.</p> <p>First Union will also offer a reloadable card that will function as both an ABM and a debit card. BellSouth will be installing public telephones that can be used for loading monetary value onto the card.</p> <p>It is expected that more than one million cards will be issued and that they will be accepted by over five thousand merchants.</p> <p>Visa is also testing disposable cards at its Visa International headquarters in California using technology supplied by Danmont.</p>

REFERENCES

- Achs, N. R. 1993. "MAC to Launch Stored-Value Smart Card." *Electronic Payments International* (March): 5.
- American Banker. 1994. "Europay to Invest \$1 Billion in Smart Cards," 24 June, 2.
- Anderson, P. S. 1977. "Currency in Use and in Hoards." *New England Economic Review* (Federal Reserve Bank of Boston) (March/April): 21-30.
- Applied Systems Institute, Inc. n.d. Brochures on the Balkancard, Kwangju Card and Elite Card.
- Avery, R. B., G. E. Elliehausen, A. B. Kennickell and P. A. Spindt. 1986. "The Use of Cash and Transaction Accounts by American Families." *Federal Reserve Bulletin* 72 (February): 87-108.
- . 1987. "Changes in the Use of Transaction Accounts and Cash from 1984 to 1986." *Federal Reserve Bulletin* 73 (March): 179-96.
- Banerjee, R., P. Ody and R. Poynder. 1995. *The Case for Smart Cards*. 2nd edition. London: IBC Press Ltd.
- Bank for International Settlements. 1993. *Payment Systems in the Group of Ten Countries*. Basel: BIS.
- Banksys. 1994. "The Intersector Electronic Purse." General information, May.
- Bastien, R. 1994. "UBI Paves Way for Smart Card Payment Applications." *Forum* (Canadian Payments Association) 10 (March): 1-3.
- Blackwell, R. 1995. "Visa Plans 'Smart' Cards: Next-Generation Cards Likely to Include Built-In Computer Chips Able to Monitor Stored Value." *Financial Post*, 14 February, 8.

- Block, V. 1995a. "MasterCard Going Down Under to Put Over Stored Value." *American Banker*, 4 April, 15.
- . 1995b. "Network Pushes Ahead with Smart Card Trial." *American Banker*, 6 April, 18.
- Boeschoten, W. C. and M. M. G. Fase. 1992. "The Demand for Large Bank Notes." *Journal of Money, Credit, and Banking* 24 (August): 319-37.
- Bos, J. W. D. 1993. "Effects of Prepaid Chipcards on Note and Coin Circulation in the EC Countries." Research Memorandum WO&E nr. 9314. De Nederlandsche Bank.
- Bright, R. 1988. *Smart Cards: Principles, Practice, Applications*. New York: Halsted Press.
- Brown, S. 1994a. "The Spanish Stay on Course." *Electronic Payments International* (February): 13-15.
- . 1994b. "Servicaixa Growth Hindered." *Electronic Payments International* (September): 5.
- . 1995. "Sistema 6000 to Launch Chips Card." *Electronic Payments International* (December): I.
- Browne, F. and D. Cronin. 1994. "How Technology Is Likely to Mould the Future Shape of Banking." *Irish Banking Review* (autumn): 3-29.
- Canada. 1933. *Report of the Royal Commission on Banking and Currency in Canada*. Ottawa: The Macmillan Commission.
- Caskey, J. P. and G. H. Sellon, Jr. 1994. "Is the Debit Card Revolution Finally Here?" *Economic Review* (Federal Reserve Bank of Kansas City) 79 (fourth quarter): 79-95.
- Congdon, T. 1981. "Is the Provision of a Sound Currency a Necessary Function of the State?" *Quarterly Review* (National Westminster Bank) (August): 2-21.

-
- Cooper, R. N. and K. Palasek. 1989. Comment on "What Kinds of Monetary Institutions Would a Free Market Deliver?" by L. H. White, *Cato Journal* 9 (fall): 367-403.
- Credit Card Management. 1993. "A Smart Future for Small-Change Cards." *Credit Card Management* 6 (September): 20-21.
- Crockett, B. 1993. "Chase Turns to Smart Cards for Cash Management Clients." *American Banker*, 21 December, 14.
- Crone, R. 1995. "Notes on the Infobahn: Finding the Right Mechanism for Internet Sales." *American Banker*, 5 June, 8A.
- Curtin, R. T. 1983. *Payment Method Costs: Assessments by Retailers*. Ann Arbor (MI): Survey Research Center, University of Michigan.
- Davis, C. 1995. "Canada: The Future Is Now." *Electronic Payments International* (March): 12-15.
- Dowd, K. 1989. *The State and the Monetary System*. New York: St. Martin's Press.
- . ed. 1992. *The Experience of Free Banking*. London: Routledge.
- Drohan, M. 1995. "Virtual Money Pays the Bill in British Test of Smart Card." *Globe and Mail*, 5 July, B1, B4.
- The Economist. 1994. "The Smart Card Cashes In." *The Economist* 330 (29 January): 73-74.
- Electronic Payments International. 1994. "Leading the Way in Smart Cards." *Electronic Payments International* (April): IV.
- . 1995a. "Payments Come of Age: Smart Cards." *Electronic Payments International* (January): 8-9.
- . 1995b. "South Africans Push Smart Cards." *Electronic Payments International* (March): IV.

-
- Electronic Payments International. 1995c. "Visa Prepares for Latin American Pilots." *Electronic Payments International* (June): IV.
- . 1995d. "Top Banks Favour Mondex." *Electronic Payments International* (December): I-II.
- Federal Reserve Bank of Richmond. 1990. *The U.S. Payment System: Efficiency, Risk and the Role of the Federal Reserve, Proceedings of a Symposium on the U.S. Payment System*, sponsored by the Federal Reserve Bank of Richmond, 25-26 May 1988, edited by D. B. Humphrey. Boston: Kluwer Academic Publishers.
- Feldstein, M. ed. 1991. *The Risk of Economic Crisis*. National Bureau of Economic Research Conference Report. Chicago: University of Chicago Press.
- Fickenscher, L. 1994. "Banc One Gears up to Go National with its Microchip Smart Cards." *American Banker*, 27 January, 12.
- Gapper, J. 1993. "Smart Money Riding on a Plastic Card." *Financial Times* (U.K.), 11 December, London edition.
- Giannone, J. A. 1994. "EPS Releases Pilot Details." *Electronic Payments International* (September): I, III.
- . 1995a. "Proton Roll-Out in Belgium." *Electronic Payments International* (March): I, IV.
- . 1995b. "BoA Staff Test \$50 Card." *Electronic Payments International* (May): I.
- Giannone J. A. and A. Jarman. 1995. "Visa's Chip Card Strategy." *Electronic Payments International* (April): IV.
- Goodhart, C. A. E. 1988. *The Evolution of Central Banks*. Cambridge (MA): MIT Press.
- . 1989. *Money, Information and Uncertainty*. 2nd edition. Cambridge (MA): MIT Press.

-
- Hayek, F. A. 1976. *Denationalisation of Money: An Analysis of the Theory and Practice of Concurrent Currencies*. London: Institute of Economic Affairs.
- Hennessy, G. 1994a. "Visa Prepaid Card Launched at Olympics." *Electronic Payments International* (February): 6.
- . 1994b. "Moving Debit to Chip." *Electronic Payments International* (October): 13-15.
- Holland, K. and A. Cortese. 1995. "The Future of Money: E-Cash Could Transform the World's Financial Life." *Business Week* (12 June): 66-78.
- Humphrey, D. B. and A. N. Berger. 1990. "Market Failure and Resource Use: Economic Incentives to Use Different Payment Instruments." In *The U.S. Payment System: Efficiency, Risk and the Role of the Federal Reserve, Proceedings of a Symposium on the U.S. Payment System*, edited by D. B. Humphrey, 45-76. Boston: Kluwer Academic Publishers.
- Humphrey, T. M. 1992. "Lender of Last Resort." In *The New Palgrave Dictionary of Money and Finance*, edited by P. Newman, M. Milgate and J. Eatwell, vol. 2, 571-74. New York: Stockton Press.
- Jarman, A. 1994. "Finland Launches Avant, Its First Electronic Purse." *Electronic Payments International* (October): I-II.
- Jensen, H. N. 1992. "Danmont – The Replacement of Coins by IC-Cards." *European Financial Marketing Association Newsletter* (May): 28-30.
- Johnston, C. 1994. Notes for a presentation on smart card technology, Card Technology Conference at Toronto (1-2 March 1994) organized by the Advanced Card Technology (ACT) Association of Canada.
- Kokkola, T. and R. Pauli. 1994. "Electronic Cash." *Bank of Finland Bulletin* 68 (December): 9-14.

-
- Kutler, J. 1993. "Chemical Exec Takes Lead Role in Smart Cards." *American Banker*, 15 December, 20.
- . 1994a. "Visa Starts Push for Smart Card to Replace Cash." *American Banker*, 22 March, 1.
- . 1994b. "Verifone, Gemplus Join Visa on Electronic Purse Project." *American Banker*, 30 March, 12.
- . 1994c. "Card Technology: Prepaid Cards, Even in Concept Stage, Sparking Interest Among Consumers." *American Banker*, 27 April, 12.
- . 1994d. "MasterCard, Visa Clash on Smart-Card Development." *American Banker*, 15 September, 13.
- . 1994e. "NatWest Makes First Major Sale of Smart-Card Payment System." *American Banker*, 25 October, 1.
- Laidler, D. 1992. "Free Banking: Theory." In *The New Palgrave Dictionary of Money and Finance*, edited by P. Newman, M. Milgate and J. Eatwell, vol. 2, 196-97.
- Lawson, M. 1995. "OneCard Launches Smart Card Trial." *Electronic Payments International* (January): I, III.
- Leger, K. 1995. "Bell Rings in Plastic for Quebec Public Phones." *Financial Post*, 8 April, 15.
- Liebowitz, S. J. and S. E. Margolis. 1994. "Network Externality: An Uncommon Tragedy." *Journal of Economic Perspectives* 8 (spring): 133-50.
- Lindboe-Larsen, J. 1994. "The Danish Prepaid Card Experience – Overview of the DANMONT Concept and Experiences from Running a Prepaid System." Danmont memorandum.
- Lipis, L. 1992. "Denmark Joins the Pack." *Electronic Payments International* (November/December): 10.

-
- Martin, R. 1992. "Danish Pre-paid Card Goes on Test Run." *Electronic Payments International* (August): 9.
- . 1994a. "Associations Work Towards a Smart Future." *Electronic Payments International* (January): 7.
- . 1994b. "Visa Heads Chip Consortium." *Electronic Payments International* (April): 10-11.
- . 1994c. "South African Banks Launch Smart Card." *Electronic Payments International* (September): I.
- . 1995. "A Battle for Hearts and Minds." *Electronic Payments International* (December): III-IV.
- McCallum, B. T. 1994. "Monetary Policy Rules and Financial Stability." Working Paper No. 4692. National Bureau of Economic Research, Cambridge (MA), April.
- McCullagh, E. 1993. "Chip Makes a Dent in Fraud." *Electronic Payments International* (March): 6.
- . 1994. "Banksys Chooses Towns for Pilot Run." *Electronic Payments International* (February): 4.
- McIvor, R. 1985. "Smart Cards." *Scientific American* 253 (November): 152-59.
- Meneses, R. 1994. "Multibanco Electronic Purse: A National Banking Service." Sociedade Interbancária de Serviços, S. A. Presentation notes.
- Mollett, F. 1995. "SIBS Launches National Purse." *Electronic Payments International* (March): I.
- National Westminster Bank. 1993. "Natwest, Midland and BT to Develop New Electronic Cash Payment Service." News release, 8 December.

-
- Newman, P., M. Milgate and J. Eatwell. eds. 1992. *The New Palgrave Dictionary of Money and Finance*. New York: Stockton Press.
- Partridge, J. 1995a. "Banks Unite on 'Smart' Cards." *Globe and Mail*, 12 May, B1, B4.
- . 1995b. "U.K. Cash-Card Firm Targets U.S." *Globe and Mail*, 13 May, B3.
- . 1995c. "Four Institutions Sign up to Test Visa's 'Smart Card.'" *Globe and Mail*, 12 December, B5.
- Ping, F. B. 1995. "NETS Hit by Breakdowns." *Electronic Payments International* (January): 2.
- Piskora, B. 1994. "Visa, MasterCard, and Europay Set Technical Standards for Smart Cards." *American Banker*, 14 November, 12.
- . 1995. "Visa Breaks Records with Project to Launch a Stored-Value Card at the 1996 Olympics." *American Banker*, 22 March, 9.
- POS News. 1993. "Smart Card Venture Aims to Find Markets, or Create Them." *POS News* 10 (August): 1-2.
- Power, C. 1994a. "Retailers Launch Chip Card." *Electronic Payments International* (October): 3.
- . 1994b. "Dutch Banks Plan Smart Card Roll-Out." *Electronic Payments International* (December): I, IV.
- . 1995. "Danmont to Supply Visa Technology." *Electronic Payments International* (April): II.
- Purcell, L. 1994. "Prepaid Debit on Its Way In." *Bank Systems and Technology* 31 (April): 14-16.
- Ras, J. 1994. "The South African Position on Smart Cards." The South African Interbank Electronic Purse Project. Presentation notes.

-
- Ravensbergen, J. 1994. "'Smart Card' Maker Deals into Canada: Embedded Microprocessor Key to Opening Information Superhighway." *Montreal Gazette*, 7 April.
- Sechrest, L. J. 1993. *Free Banking – Theory, History, and a Laissez-Faire Model*. Westport (CT): Quorum Books.
- Selgin, G. A. 1988. *The Theory of Free Banking – Money Supply under Competitive Note Issue*. Totowa (NJ): Rowman & Littlefield.
- Selgin, G. A. and L. H. White. 1994. "How Would the Invisible Hand Handle Money?" *Journal of Economic Literature* 32 (December): 1718-49.
- Sikes, J. 1992. "Pulling the Electronic Purse Strings." *Electronic Payments International* (September): 8.
- Sprenkle, C. M. 1993. "The Case of the Missing Currency." *Journal of Economic Perspectives* 7 (fall): 175-84.
- Statistics Canada. 1979. *The Distribution of Income and Wealth in Canada, 1977*. (Cat. No. 13-570). Ottawa.
- Strachman, D. 1994. "Smart Card a Secure Access Ramp for Royal Bank's Clients." *American Banker*, 7 November, 12A.
- Strachman, D. and J. Kutler. 1993. "Convention Goers See Bank Future in Smart Cards." *American Banker*, 30 November, 16.
- Summers, L. H. 1991. "Macroeconomic Consequences of Financial Crises." In *The Risk of Economic Crisis*, edited by M. Feldstein, 135-58. Chicago: University of Chicago Press.
- Sumner, S. B. 1990. "The Transactions and Hoarding Demand for Currency." *Quarterly Review of Economics and Business* 30 (spring): 75-89.
- . 1993. "Privatizing the Mint." *Journal of Money, Credit, and Banking* 25 (February): 13-29.

Svigals, J. 1994. "Microchip Smart Cards Will Save Money." *American Banker*, 2 February, 14.

Toimiraha Ltd. n.d. *The Finnish Electronic Purse*. Brochure.

UBI project. 1993-94. Press releases. January 1993 – March 1994.

Viren, M. 1993. "Large Banknotes Dominate Currency Demand." *Bank of Finland Bulletin* 67 (March): 8-13.

Wallace, N. 1983. "A Legal Restrictions Theory of the Demand for 'Money' and the Role of Monetary Policy." *Quarterly Review* (Federal Reserve Bank of Minneapolis) 7 (winter): 1-7.

Wenninger, J. and D. Laster. 1995. "The Electronic Purse." *Current Issues in Economics and Finance* (Federal Reserve Bank of New York) 1 (April): 1-5.

Working Group on EU Payment Systems. 1994. *Report to the Council of the European Monetary Institute on Prepaid Cards*. Frankfurt Am Main: Working Group.