Electronic Cash—
Technology will denationalise money

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by David G.W. Birch and Neil A. McEvoy

ABSTRACT

Emerging technologies, particularly the synthesis of cryptographic software and tamper–resistant smart card hardware into the electronic purse, will make the cost of entry into the currency issuing 'market' quite small. Many organisations may then wish to enter this market, for example as a means of supplying credit (as envisaged by Frederick Hayek), of raising finance, or of encouraging customer loyalty (explored by Edward de Bono). Whereas the world's currencies are currently organised on territorial lines, we foresee a future in which currencies occupy (overlapping) niches according to the 'virtual', as well as geographic, communities to which people belong and a vigorous 'foreign' exchange market where people (or, more likely, their PCs) trade these currencies. Just a couple of years ago the concept of electronic cash was unknown in the mass market, but soon it will be taken for granted and will be as widespread as credit cards and chequebooks are today—and the ramifications of such a widespread deployment deserve serious examination and debate.

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INTRODUCTION

Both cyberspace and 'brickspace' are the focus of new developments in the technologies, functions and applications of money. In Europe, virtually every country has smart card–based electronic money schemes in trial, pilot or services. On the Net a multitude of payment options are emerging, ranging from cyber–analogues of existing mechanisms–such as Secure Electronic Transactions (SET) for credit cards–to micropayment and microbilling schemes that are wholly new. Surveying this situation, we believe can identify some trends.

In the world of payment cards, the Net and smart card sectors are moving closer together all the time: Visa, Mastercard and Europay have announced their intention to bring the SET and EMV smart card standards together in a specification for release later this year. (In France, Groupement des Cartes Bancaries have already started the C–SET project to implement SET using smart cards [1].) These developments are relatively easy to factor in to business plans because they implement well–understood business models: but electronic cash (e–cash) is different.

In the world of e–cash and the Net the early phases of market development are over and the business is shaking out. Soon, e–cash will be taken for granted and will be as widespread as credit cards and chequebooks are today. But will the business be the same? Will the e–cash business model be the same as the credit card, debit card, charge card, loyalty card and other card–based business models that the industry is familiar with?

In the world of physical cash, problems with notes and coins [2] are becoming more visible (see Table 1 below). The general public might be comfortable with notes and coins, but just as a postal service is bypassed in an e–mail world (it might soon be cheaper to give every

Cash is…	*So What?*
Dirty	The New Jersey Turnpike tried to punish toll collectors for wearing latex gloves (giving a "bad impression") but who can blame them?
Heavy	$1 million in $20 bills weighs more than you can lift, and drug dealers have noted that their powdered merchandise is handier for smuggling than the equivalent money.
Inequitable	If you are one of the 50 million Americans poor enough to be "unbanked" you pay extortionate fees to seedy check–cashing outfits (even more than the fees for using ATMs, often 1%–2% and rising).
Quaint	Unless you're impressed by intaglio steel–plate–printed paper with embedded polyester strips (meant to inconvenience counterfeiters).
Expensive	Tens of billions of dollars drain from the economy each year merely to pay for the printing, trucking, safekeeping, vending, collecting, counting, armoured–guarding and general care and feeding of currenc .

Table 1. Cash is... (from the New York Times Magazine)

household a modem and send mail electronically), moving money around with security guards and armoured trucks is arcane in a country like the US where 96 million households have telephones and 37.5 million households have personal computers [3].

This paper attempts to synthesise directions in payment cards, the Net and physical cash to make some informed suggestions as to some of the ways in which e–cash will be the trigger for major changes in both business and society over the coming years. The key assumption throughout the paper is that the combination of intelligent devices (PCs, PDAs and so forth) and tamper–resistant smart cards will be the platform for the development of e–cash in the foreseeable future. Both software–only e–cash and on–line e–money schemes have no long term future and should be regarded only a transient solutions awaiting the widespread deployment of consumer smart cards. This is not just because of consumer behaviour in the "real world" but also because of the pressures of Net commerce, which are demanding efficient solutions in the micropayment sector [4].

MONEY, MONEY, MONEY

What is Money?

As almost any book about banking (*e.g.* [5]) begins by stating, money has four basic functions:

- *A Unit of Account*. The unit of account does not, of course, have to have any physical reality. We have received purchase orders and issued invoices denominated in European Currency Units (ECUs), despite the fact that we have never seen a ECU note or coin (and may never, being based in the UK!);

- *An Acceptable Medium*. Money is useless as a medium of exchange unless it is acceptable to both parties to a transaction. Much of the discussion about e–cash and Net payments tends to focus on this function alone[1];

- *A Store of Value*. Unfortunately, inflation may erode the value of stored money no matter what medium is chosen!

- *A Means for Deferred Payment*. In order for a society to function, it must support contracts between parties that include provision for future payment.

Each of these functions may be implemented in a different way. An often quoted example is the American colonies at the turn of the 18th century: a time when bullion for coins was scarce. The colonists used sea shells (known as *wampun*) for their medium of exchange, a form of cash borrowed from the local Indians who were (in effect) the central bankers of this monetary system, converting the shells into animal pelts which were used to store wealth and for external trade [7]. Contracts between buyers and sellers were denominated in Sterling (which many of the colonists might never have actually seen) and quoted in gold or silver (which they didn't have). When contracts fell due, of course, the gold payment in Sterling was commuted into some equivalent payment in wampun, or whatever.

The shortage of bullion for coins led the colonies into the forefront of the last great revolution in money: the issuing of banknotes not as a means of substituting for some otherwise inconvenient means of exchange but as a means of creating money [8]. There's a very great

difference between issuing banknotes as a claim on a bar of gold in a vault somewhere (because banknotes are more convenient for trade than bars of gold) and issuing banknotes because there isn't any gold in the vault at all. It's quite likely that the more revolutionary impact of e–cash might come from its ability to create new stores of value rather than its ability to act as a means of exchange.

One more point of vocabulary: notes and coins are cash in a way that other forms of money—such as Visa cards, Digicash and cheques—are not. If someone gives you a £5 note, you can take it to a shop and spend it: you don't have to deposit it in a bank account or have it cleared in any way. This is a crucial characteristic of true e–cash schemes such as Mondex[2]. Throughout this paper we use the words money and cash specifically and not interchangeably!

Where is Money?

The means of exchange and the store of value used to be related to some commodity such as gold–or whatever: the United States was on a tobacco standard for twice as long as it was on a gold standard since tobacco was made legal tender[3] in Virginia in 1642 and remained so for two centuries [9] while the US gold standard lasted only from 1879 to 1971.

By contrast, currencies today are "fiat" currencies: they are backed by government promises (and enforcement) rather than by anything tangible. It's more than 60 years since you were able to take your £5 note to the Bank of England and get gold for it. What's more, while the general public still visualise 'money' as being physical notes and coins, the fact is (as Figure 1 shows) that in the UK most money slid into cyberspace years ago: notes and coins are a small fraction of the money supply[4].

SUPERMARKETS AND SUPERHIGHWAYS

The Basis for Change

It's the interpersonal nature of true e–cash that is the key to understanding why the electronic purse[5] (e–purse) is the root cause of so much change. A useful analogy compares electronic money with mainframe computing and e–cash with PCs. Mainframe computing enabled

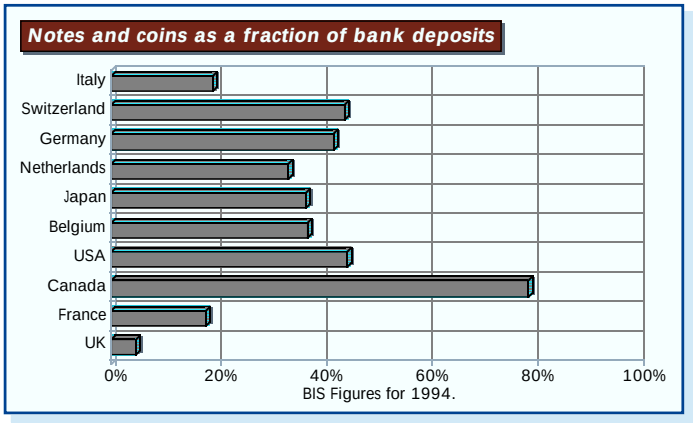

Figure 1. M0/M1 (Physical Money/Electronic Money)

organisations to implement existing business processes (*e.g.* acquring and processing customer orders) more efficiently, but didn't change any of the processes. It was the arrival of PCs and networks that enabled organisations to re–engineer their business processes. The PC and Net are already indicating how this restructuring might extend throughout society. Therefore it's safe to make the prediction that e–cash and the internet will restructure banking and financial services in the next decade as thoroughly as the PC and networks restructured organisations in the last one.

An e–purse is personal, something anyone can carry and use. Why would I send you a cheque for the £25 I owe you when I can just ring you up and pass the cash to you over the telephone there and then? E–purses match the prevailing payment habits of (for example) Americans, since in the U.S. it is estimated that 88% of transactions are done by cash or check, and of these 83% are for less than $10. At the time of writing, it seems that the e–purse looks set to succeed all around the world. The Visacash trials during the Atlanta Olympics even gave smart cards an opportunity to get some headlines in the US [11] and they are no longer seen as a new and untried technology. Smart cards have already become the preferred e–purse implementation because of pressures from:

- Consumers, who use payments cards already and are very familiar with the card format.
- Banks and Retailers, who are attracted by all of the familiar characteristics of smart cards: security, portability, capacity and so on.

The use of smart cards is well advanced in Europe. In France, home of the smart card, all payment cards have been smart for some time and most other European countries are following. In the UK, all payment cards will be smart by 1999 (the UK is an important player in this field, because there are 86 million payment cards in circulation, more than any other European country).

Superhighway

There's no need to present a gratuitous exponential graph of Net users. In our model of future commerce, we can assume that most customers will have access to the superhighway (and all customers will have access to a telephone) and that the marginal cost of communications over that superhighway will be (to all intents and purposes) zero. Just as it is reasonable to assume that consumers (and retailers) will make a medium–term shift to the e–purse for physical transactions, so it is reasonable to assume that these consumers will want to use the same e–purse for on–line transactions. In fact, it may well be that the ability to make on–line transactions becomes the defining characteristic of e–purses that makes them desirable to consumers. Existing trials and pilots seem to indicate that the simple ability to load a purse at home (by telephone, Net or whatever) instead of going to an ATM is a key competitive advantage of e–cash over its physical counterpart.

The use of smart cards by consumers working across the Net is set to grow substantially over the coming year. One of the main reasons for this is that the Microsoft–backed PC/SC Workgroup have begun to publish their specifications [12] which define a framework for interoperating smart cards, devices and applications. In a relatively short time, Windows–standard smart card devices will be common. Bearing this in mind, the pressures coming from both the supermarket and the superhighway (as shown in Figure 2) seem to be aligned.

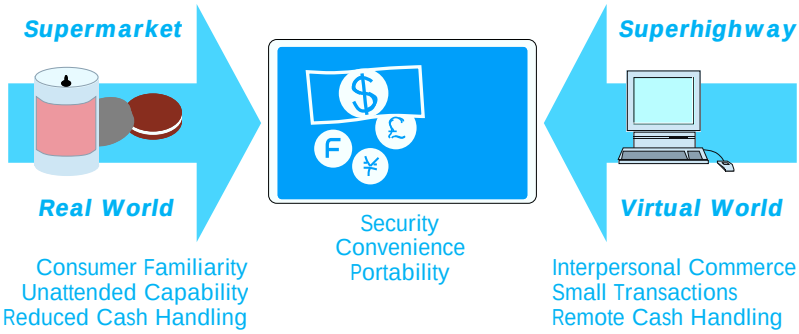

Figure 2. Pressures for Electronic Purses.

The overall medium– to long–term effect of a shift to e–cash is in general a significant reduction in transaction costs for business. The savings are substantial (the costs of handling cash are widely estimated to be the equivalent of 1% of gross national product[6]), but e–cash isn't just about cost reduction: card issuers are looking at a variety of new income streams, including fees, advertising, charges and float [13].

Global Market

This notion of superhighway commerce as being based on interpersonal commerce with small transactions leads to a view of the superhighway as a global car boot sale[7]. Remote buyers and sellers—who may or may not be actual people or organisations (in other words, they may be pseudonyms)—doing business with each other. In this situation, liquidity substitutes very effectively for identity: this is a significant stimulus for e–cash schemes such as Mondex and promises purse issuers a global market for their wares.

No Limits

There are two factors often brought into play as potential barriers to the introduction of e–cash schemes that will limit the expansion of the "new economy". These are the issues of money laundering and transactional privacy.

i. Money Laundering. Last year's BIS report on the security of e–purse schemes [14] said that provided that the limit on the amount of cash that could be stored on a consumer smart card was kept low then large scale money laundering would still require the "active collusion of a financial institution", much as it does now. Limiting cards to, say, £500 would seem to be a perfectly acceptable solution for consumers, banks and regulators.

ii. Privacy. If consumers' every action and purchase can be tracked and traced, they will be reluctant to shop online. This view is commonly held in *digerati* circles, but there doesn't seem to be much evidence to support it in the mass market. Should any loss of transactional privacy occur, it is unlikely to impede the growth of e–cash payments on the Net[8].

In our opinon, then, while these issues may be perceived as barriers to growth in certain circles at present they are not real barriers to the spread of the purse.

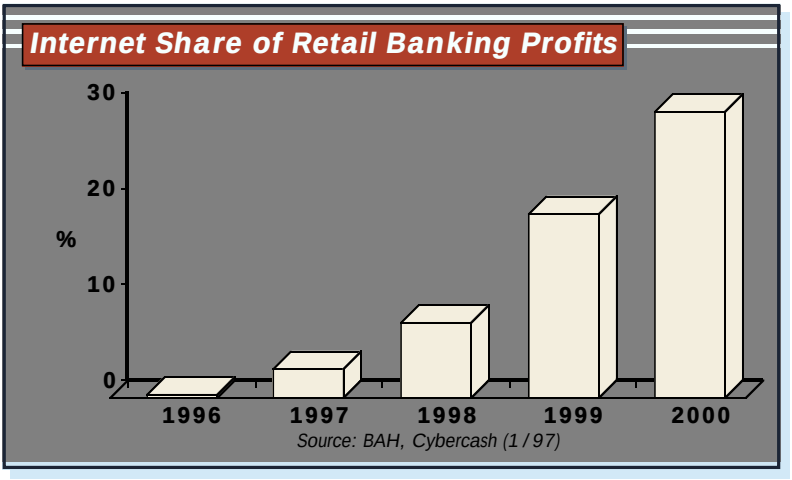

Figure 3. Retail Banking and the Internet.

CHANGE, PLEASE

Banking on Change

It is generally accepted that the initial use of the Net and related delivery channels by banks and their customers will come from a substitution of existing remote delivery channels (such as telephone centres and ATMs) that have a high ratio of fixed to variable costs. This means, as Figure 3 shows, the Net will have a significant impact on bank profits even in the short term. Remote banking to date has been incomplete since it couldn't offer the most rudimentary of banking functions: the deposit and withdrawl of cash. The addition of e–cash to the banking environment will change this, making remote banking the dominant channel not because of some passing technological fad, but because the cost of moving e–cash on the Net is not only less than the cost of existing electronic money systems (ranging from EFT to credit cards) but less than the cost of using physical cash. In the world of electronic payments it's economics, not fancy graphics, that mean the Net wins.

A major implication of this shift is that because e–cash eliminates the need for any kind of physical presence (even ATMs), it lowers the entry level barriers for competitors to come into the banking business. This will accelerate the trend, already evident in the UK where the major supermarket chains have already begun offering retail financial services, towards the fragmentation of the "traditional" retail banking business structure.

Central Banking

It isn't just retail banks that will be affected profoundly. As the BIS point out [15], central banks stand to lose significant revenues should e–cash begin to replace notes and coins in circulation. (Since notes and coints represent non–interest bearing central bank liabilities, their replacement by e–cash would lead to a corresponding decline in central bank asset holdings and interest earned on those assets: the *seigniorage*.) The BIS calculate that the Bank of England would lose half of its seigniorage income even if e–cash replaces only coins and low value notes (Figure 4).

If Not Now, When?

One reason for the current surge of interest in e–cash in Europe is the wider debate on European Monetary Union (EMU). The costs associated with the transition to a single currency are, noted by the BIS [15], likely to tip the balance further towards smart cards. Irrespective of whether the UK joins the single currency or issues Euros, financial institutions are still facing huge investments anyway because the UK will continue to do business with Europe [16].

The relationship between e–cash and EMU must be high up the central banks' list of priorities at present. Since e–purses mean that the costs both of currency exchange and of obtaining cash from accounts are low (and the transactions are quick), consumers won't hold significant balances on them (leaving their funds on deposit in whichever currency offers the best interest rate). If e–purses become widespread, then the consumer's choice of currency becomes a significant factor in developing and establishing monetary policy [17].

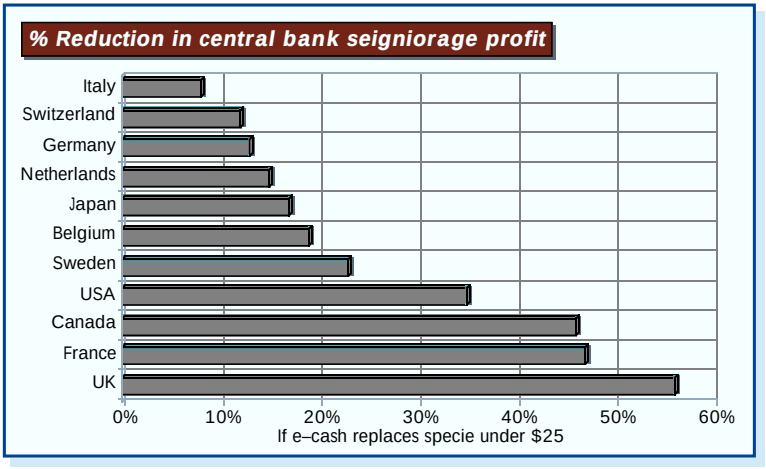

Figure 4. Central Bank Seigniorage Reduction.

PRIVATE CURRENCY

As noted, the discussion of e–purses solely as a new medium of exchange may be a short–term view because the most revolutionary aspect of e–cash is that it lowers entry level barriers to the "money business" and allows new entrants to compete with existing stores of value. E–cash as the basis for alternative currencies and e–cash as an alternative and more liquid investment instrument, are discussed in the following subsections.

Business Finance

In a pamphlet for the Centre for the Study of Financial Innovation, Edward de Bono[9] put forward the idea of private currency as a claim on products or services produced by the issuer. In his example, IBM might issue "IBM Dollars" which consumers would use to obtain IBM products or services in the future. This gives a practical segmentation of the 'currency market'. Purchases of software could be carried out in a currency issued by Microsoft, and pur-

chases of topical information could be in a currency issued by Reuters. Of course if Microsoft or Reuters issued more currency than these sectors of the economy need, or if it were generally felt they may become unable to meet their likely obligations to redeem units of their currency, then currencies issued by IBM or News International would start to gain market share and exchange rates would shift appropriately. Dr de Bono wrote [18]:

> "Companies like BA or Sainsburys could issue their own currencies, and could benefit from the float until these currencies were used."

Economic Imperative

Nobel prize–winning economist F.A. Hayek argued persuasively against government monopoly on the issue of money and in favour of private institutions competing to provide currencies. The core of his thesis was that governments have systematically defrauded their subjects by forcing them to accept depreciating money and caused economic instability through using 'monetary policy' in misguided attempts to 'manage' the economy. He thought that commercial organisations competing for profit would be more successful in providing money that retains its value, but noted some practical difficulties:

- Firstly, Hayek saw that people are used to dealing with one currency and would find the concept of choice strange. However, he also noted that traders in border areas are usually happy to accept payment in the currency of a neighbouring country, providing its currency is reasonably stable at the time. Today, notions of locality and borders are being redefined. On the Net, we all inhabit a "border zone" and are already confronted with dealing in multiple currencies[10].

- The second difficulty noted by Hayek was a technical problem to do with the use of "cash registers" or "vending machines", where issuers might mint coins of differing denominations, size or weight, and where in any case their relative values would fluctuate. Hayek foresaw that within a well-defined region (the internet?) perhaps one currency would predominate, or (with amazing prescience) that smart cards[11] might be invented to solve the problem [19].

Route Map

How might these new currencies come ito exist? Some commentators foresee a return to *laissez faire* banking as the likely route [20] and this is certainly a possibility, although it doesn't seem congruent with the current dynamics of the marketplace. We feel the most likely route to private currency is not via banks at all.

Loyalty schemes are exploding in the UK [21]. The Tesco *Clubcard*, introduced in February 1995, had 6 million users within 9 months and triggered an 'arms race'. By the end of 1996, some 42% of the adult population had at least one supermarket loyalty card. Safeway hit back with *ABC Points*—which can actually be spent in their stores—and Sainsbury's launched it's *Reward* card. All three have now moved into financial services with deposit accounts and payment cards. Competition is no longer about offering loyalty schemes but offerring the best one. What could make these schemes better? BA had paper notes—much like Canadian Tire money [22]—that were desirable but costly to process so they switched to an account based system. A smart card carrying Air Miles or Safeway ABC Points would bring the best of both worlds: consumers could pass points amongst themselves (just like paper notes) using

widely available smart card readers and could redeem them in person or over digital networks. It's interesting to note, however, that consumers' loyalty seems to be towards the loyalty points themselves [21] rather than the retail outlets that provide them: more evidence that they are proto–currencies.

Elementary *keiretsu* are already emerging. Shell, for example, issues a smart card which consumers use to accumulate *Shell Points* when buying petrol. BT gives telephone customers *Talking Points* based on their phone bills. Sainsbury's gives out *Reward* vouchers. The desirability of these schemes, to many consumers, is not the fact that you can use the points gained to order ceramic monkeys from a catalogue but that you can exchange them for Air Miles. Thus, Air Miles are already a sort of reserve currency which many people (*e.g.* the authors) are happy to accept.

There's no technological difference between using a Mondex card to store Dollars and using it to store Sainsbury's *Reward Points*. As Table 2 indicates, there are actually a wide range of organisations that might gain from issuing their own e–cash. The European Monetary Institute (EMI) has already made representations to the effect that only banks should be allowed to issue e–cash [23] but there is a grey area here between the issuing of electronic purses to store national currency and the issuing of purses to store other forms of value[12]. The development of e–cash also raises a number of interrelated policy issues of potential concern to central banks and other public authorities. Those of particular relevance to central banks relate to their oversight function for payment systems, seigniorage, the operation of monetary policy and, to the extent that central banks have supervisory responsibilities, the possible financial risks borne by issuers of e–cash.

It might seem to be anticompetitive to restrict the issuing of purses to banks, because it would be in the interests of consumers to have banks and other organisations competing, both over the purse itself and over the units of value it is carrying. An example of type of the competition to come might be the alliance of five telephone companies including U S West, Bell Canada, PTT Telecom Netherlands (who already issue an e–purse), GTE, and Telekom Malaysia that is seeking to create an open standard which would make it possible for any smart card to function in any pay telephone [24]. The technology developed here could eventually be used to implement an e–purse that, for example, stores "telephone points".

SUMMARY

Governments derive their economic power from four key sources: their ability to tax, to create currency, to borrow, and to regulate financial markets [25]. In taxation, currency, and regulation they have traditionally held a monopoly position while in borrowing they have had a position of privilege derived primarily from their ability to print the money they need to repay debts—which really means the ability to devalue when debts become onerous. Printing money is still the legal privilege and monopoly of governments and—although the standard to which governments are being held in terms of the soundness of their currency is getting stricter (those currencies that fail the test have to link themselves with stronger money and this can cause great economic problems and dislocations)—they are unlikely to give this up. However, there is a significant possibility that viable international e–cash will be available before the single currency and that could make the latter redundant. If consumers in any European country can use a smart card to transact business in any currency then they will transact in strong currencies and weaker currencies will progressively be reduced to being used for a residual rump of "legal tender" transactions, such as tax payments.

Issuers	*Why Bother?*
Banks	They already issue dumb cards and are moving to smart cards: currently for national currency, but in the future this might change.
Retailers	They have both loyalty and store credit cards in circulation and are bringing payments cards into their portfolio. Their loyalty points could be the basis of 'currency keiretsu'
Telcos	Everyone has aphone (and they know where you live). A telco electronic pursemight link nicely to on–line microbilling and other value–added network services.
Financial Services	If everyone's carrying a car insurance smart card, why not put Direct Line Pounds on it? Why not issue insurance money that can only be redeemed in stores that are part of the scheme?
Countries	A national smart identity card could be the basis for an electronic purse to replace specie.
Major Brands	Consumers might be well disposed to a Virgin Pound or a Disney Dollar and these would have international acceptance.
IT Companies	If Windows 97 comes with a Microsoft smart card loaded with 50 of Bill's Dollars for you to start spending on the Net, it could be tough to persuade ou to change back to a bank card.

Table 2. Who wants to Make Money?

Suppose that the same technolgy currently used for e–cash enabled some form of the IBM Dollar to come into existence and this began to compete with nationalised currency? We would argue that loyalty are already on this road and they, not claims on commodities, are gradually mutating into private currency.

It is clear that there is no need for monopoly national currencies, which are out–moded symbols of nationhood. Just as 'flag carrier' airlines have been subject to competition and have either been privatised or soak up unsustainable public subsidy, minting of money will increasingly become an area where governments opt out. As a result, the 'money supply' will cease to be a political issue. Just as no-one worries about the 'airline seat supply' (apart from the directors of BA, Virgin, *etc*) so the money supply will only be of concern to the competing companies which issue money. The over or under supply of one currency competing for use could not cause an economic catastrophe for a whole nation.

Finally, many economists would argue that the 'business cycle' is amplified by inappropriate manipulation of the money supply by politicians and central bankers, even when acting with the best of intentions. Devolving responsibility for the issue of money to a number of competing instituitions whose livelihood would depend on issuing approximately 'the right amount' of money, would in effect remove a 'single point of failure' in our current economic system. On the other hand, concentrating this power in the hands of one institution for the whole of Europe is equivalent to flying a 747 across the Atlantic on one engine—even with the best engineers and pilots, concerned with their own and others' safety, one day there will be an accident.

END NOTES

[1] As an example. when Walter Wriston (the ex–CEO of Citibank) was widely quoted as saying “The future of money is smart cards” [6] he meant that smart cards will become a dominant means of exchange and was not predicting any impact on the store of value or unit of account.

[2] Hyperion are retained as consultants by Mondex and have been since 1990.

[3] By the interesting device of outlawing contracts calling for payments made in gold or silver.

[4] It has to be said that, counter–intuitively, the number of cash transactions is actually going up in the UK at present (supposedly because of the impact of the introduction of the National Lottery [10]).

[5] This paper takes ‘electronic purse’ to mean a smart card carrying some form of e–cash.

[6] The 1% is our amalgamation of reported estimates (from Visa, Europay and banks).

[7] Or global yard sale, for North American readers!

[8] As noted in Ovum’s 1996 report on e–cash.

[9] The noted “lateral thinker”.

[10] As economist David Riccardo wrote in his Proposals for an Economic and Secure Currency (1816): “In the use of money, everyone is a trader.”

[11] Not being a technologist, of course, he simply refers to them as “plastic tokens”.

[12] In March 1997, some months after the original draft of this paper, the *Smart* smartcard–based loyalty consortium (which includes Shell, Dixons and others) CEO said that they were creating a “virtual currency” and that they “act as the bank”.

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