
Looking Forward: The Role for Government in Regulating Electronic Cash

By Stacey L. Schreft

In his 19th century novel, *Looking Backward*, Edward Bellamy described a man who falls asleep in Boston in 1887 and awakens in the year 2000 to find that the United States has evolved into a utopian society. No longer are paper or metallic currency in circulation. Instead people pay for everything with paperboard cards that carry a certain value in dollars. To make a purchase, a person need only hand the card to the merchant, who deducts the purchase's value from the card (Bellamy).

Although Bellamy's cashless society is not yet a reality, in some ways Bellamy was unusually prescient. With the year 2000 rapidly approaching, the cards he imagined, which are already popular in some countries, are being introduced into the United States by private companies.

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Now, though, they are called stored-value cards and are made of plastic.

Stored-value cards are one form of electronic cash—electronic substitutes for paper currency. Digital cash (also known as cybercash or ecash) is the other form of electronic cash coming into use today. It consists of bits and bytes in cyberspace and substitutes for paper currency in transactions made over the Internet.

Someday privately issued electronic cash may be a common means of payment in the United States. Looking forward to that day, government policymakers need to assess the impact these new forms of currency might have on the nation's currency stock. If privately issued electronic cash, once commonplace, could threaten the long-standing safety, uniformity, and relative stability of the U.S. currency, then policymakers must decide what, if any, forms of government intervention are appropriate.

This article argues that there is a limited role for government in ensuring the quality of the nation's currency when private issuance is allowed. It first describes the emerging forms

of electronic cash and how they differ from today's paper currency. It goes on to argue that the concern for policymakers is not that electronic cash is electronic, but rather that private firms are issuing it. The article then looks forward from the perspectives of economic theory and economic history to the impact privately issued electronic cash might have on the nation's currency and to the potential role for government. From the perspective of economic theory, how well the market will do at ensuring the currency stock's quality depends in part on the degree of substitutability of electronic-cash products for one another. While theory is silent on how substitutable such products will be in practice, the economy's historical experience with privately issued paper currencies provides insight into what might happen if electronic cash is privately issued and how market institutions might interact with various government regulations. Finally, the article considers some specific regulatory alternatives for ensuring that the U.S. currency remains stable, safe, and uniform.

I. WHAT IS ELECTRONIC CASH?

The use of electronic methods of payment is widespread today. General credit cards, which have been around in some form since 1949, were used for \$662 billion in purchases in 1996, up 13.4 percent from 1995 (Mandell; The Nilson Report). Debit cards, first introduced in the 1970s, are now rapidly gaining favor with consumers. Even some elementary school students are now using them to buy their lunches (Block). In 1996 there were 1.45 billion Visa or MasterCard debit-card transactions, involving \$45.81 billion in purchases, a 76 percent advance from 1995 (The Nilson Report). Automatic payments to and from checking accounts also are in widespread use. People can have their paychecks deposited directly into their bank accounts, and can have funds withdrawn automatically to purchase mutual fund shares or pay their utility

bills. Most million-dollar transactions are conducted electronically as well.¹

Stored-value cards

Electronic substitutes for cash are the newest electronic means of payment. One form of electronic cash is the stored-value card. Stored-value cards look just like credit cards but work more like traveler's checks. Consumers pay in advance for purchases by buying a card with a certain amount of value that they can exchange for goods. These cards are designed to be a substitute for cash in small transactions, say those for \$10 or less. Fast food, vending machine, and convenience-store purchases fall into this category. The Congressional Budget Office estimates that in 1994 consumers spent more than \$200 billion on such purchases (U.S. Congress).

There are two types of stored-value cards. Those already in use worldwide have a magnetic stripe on the back, just as credit cards do, and are used to make a single type of purchase, usually from a single merchant. Examples include the cards used to pay mass-transit fares in many urban areas and the cards available at Kinko's Copy Centers for use at the company's self-service copying machines. Some stored-value cards, such as the mass-transit fare cards, are disposable: the card owner throws away the card after spending the value on it. Other cards, such as the Kinko's cards, are reusable. Each Kinko's has freestanding machines from which cardholders can use cash to buy more copies by adding value to the card.

The newer stored-value cards are a type of "smart card" in that they have an embedded computer chip that can hold much more information than a magnetic stripe.² Smart stored-value cards are essentially electronic recordkeeping systems that can record the monetary value added and subtracted as payments are made. They can

HOW ELECTRONIC CASH WORKS

Stored-value and digital-cash products are still in a developmental stage. As the technology underlying these products develops, the products themselves will evolve. While it is too soon to tell what form they ultimately will take, they likely will work much like the electronic-cash products in use today.

A smart stored-value card typically works as follows. A consumer buys a stored-value card from an issuer, which need not be a bank. The issuer presumably sets aside the receipts from all such sales in a separate general account. The consumer can use the card to make purchases either from other consumers or from merchants, providing the recipient has electronic equipment that can read the card.⁴² In making a purchase, the consumer gives the card to the seller, who in turn runs the card through a card reader. The card reader effectively deducts value from the customer's card and stores information on the value transferred. The consumer can transfer additional value to the card from an account the customer keeps with the card issuer. So far stored-value transactions allow the individual consumers and merchants involved to remain anonymous, as is true of cash transactions. There is no record of who transferred which funds to whom.⁴³

After making a sale, the seller or recipient of the stored value can electronically transfer the information about its transactions to its stored-value issuer and request payment. This directs a transfer of funds from the

general account at the customer's stored-value issuer to the recipient's stored-value issuer. The recipient's account is credited for the total value of the transactions. Instead of getting credit for the stored value it received, the recipient could keep the value and use it to compensate other consumers. For example, a merchant could use it to give customer refunds, and consumers could use it to make purchases from yet other consumers. In the latter case, the stored value is said to circulate because it changes hands many times without clearing and settlement occurring.

What is striking about this example is its complexity. Cash purchases are simple exchanges between buyer and seller: the customer hands the merchant the cash needed to finance the purchase. The transaction is complete at the time of the purchase, and both participants witness the entire exchange. Purchases with smart stored-value cards are more complicated, involving multiple parties and a computer network. Behind the scenes there is an electronic transfer of funds either directly from the card issuer to an account at what often is a different issuing institution, or indirectly through a clearinghouse. In terms of its settlement then, a stored-value purchase is more like a check than cash.⁴⁴

Digital cash works differently than stored value because it is used in cyberspace rather than physical space. The digital-cash products that are farthest along in their development

Continued . . .

work something as follows (Mark Twain Bank; DigiCash). The developer of a digital-cash product—a software program—licenses its product to a bank. The bank, in turn, lets customers open special deposit accounts from which they can create digital cash using the digital-cash software, which the bank provides.

To make a digital-cash purchase, a customer must first use the software to initiate a transfer of funds from the deposit account to a personal computer. The software proceeds to create digital currency—either coins or notes. The digital coins and notes have no physical representation. Each is just a unique random number with a denomination, or value, assigned to it. The software decides which denominations to create. To effect the transfer, the software instructs the bank to withdraw funds equal to the value of the currency from the customer's account and to validate the coins and notes by signing them digitally. This digital signature resembles a handwritten signature. The software hides the customer's identity during the validating process so the bank can never associate the customer with the coins.

The customer can now make a purchase from an Internet-based merchant or another individual that also has an account with the bank and the necessary software. The customer simply decides what to buy and instructs its computer to send currency electronically as payment. When the currency arrives, the recipient's software verifies the bank's digital signature and that the currency has not been spent already. Once the recipient knows the currency is valid, it can deliver the customer's purchase.⁴⁵ The recipient can transfer the currency received to its bank account or store the currency in its computer's memory for use later. This latter option allows the digital currency to circulate.

Like stored-value cards, digital cash is, from the consumer's perspective, comparable to coins and paper notes, only for purchases in cyberspace. But because of the verification required, purchases with digital cash require a third party's involvement. So far, the third parties are banks that have licensed digital-cash software, but that need not be the case.

be used for a single type of purchase, just like their not-so-smart cousins, but also can be used more widely, at any merchant that has electronic equipment to read the cards. Already popular in Europe, especially for buying telephone services, they now are being issued in the United States on an experimental basis. The most prominent U.S. experiment with smart stored-value cards occurred in Atlanta, Georgia, during the 1996

Summer Olympics, and many other experiments are under way.

So far banks have been the leading issuers of smart stored-value cards. That need not be the case, however. Any business could issue general-purpose stored-value cards. Some of the mass-transit systems and universities that now issue single-purpose cards, for example, are arranging

for other merchants to accept their stored value. An affiliated bank will settle the transactions across the merchants. In the future, such joint ventures between bank and nonbank firms, especially technology firms, likely will arise to issue stored value that is widely accepted (McAndrews 1996). It would not be surprising if this stored value ultimately begins to circulate, meaning that it changes hands in multiple transactions without clearing and settlement along the way.

Digital cash

Whereas stored-value cards are available for making purchases at the point of sale, digital cash is being developed for making purchases over computer networks such as the Internet. A unit of digital cash is just a unique random number with a denomination associated with it. These numbers are created and stored as bits and bytes in computer memory. When digital cash is used to make a payment, the numbers representing it are simply transferred electronically from the payor's to the payee's computer.

This new form of cash is needed because traditional means of payment do not work well at this time for Internet transactions. Paper currency and checks cannot travel through cyberspace, and concerns remain about whether credit and debit cards can be used securely over computer networks. In addition, merchants operating on a small scale or selling small-value items, such as newspaper articles or photographs, may find these payment methods too costly. There is a role, then, for digital cash that can offer the same finality of payment and anonymity as coins and currency, only in cyberspace (Bauer).

Someday technology will allow customers to use digital cash and smart stored-value cards in combination. Customers could, for example, load digital cash onto their stored-value cards and pay for goods purchased over computer

networks by transferring value to sellers via card readers connected to their computers.

The demand for digital cash, alone or in combination with stored-value cards, could grow along with commerce in cyberspace. Joint ventures of banks and technology firms, the current issuers of digital cash, are likely to be the dominant providers in the future. They could provide digital-cash products that circulate widely.

II. WHY POLICYMAKERS SHOULD CARE ABOUT ELECTRONIC CASH

The electronic cash being issued today has two distinguishing characteristics. First, it is electronic, in contrast to the metallic and paper monies historically used to make small payments. Second, private firms are issuing it, rather than the government, which is the sole issuer of metallic and paper currency in most countries today. For policymakers, only the private issuance of electronic cash poses a new challenge.

Electronic cash's electronic nature is not a concern. . .

To see that there really is no difference between electronic cash and paper currency, consider the following. A federal task force recently redesigned the U.S. currency. It enlarged and moved off center the portrait that appears on the currency (for example, Benjamin Franklin's portrait appears on the \$100 bill). The task force made many other changes as well, some not visible to the naked eye, to inhibit counterfeiting. The Federal Reserve and Treasury educated the public about the change and encouraged people to exchange their old bills for the new ones. The public now holds the newly designed currency just as it did the old currency, with no change in purchasing power and no implications for government regulatory policy.

One can imagine other, more extreme redesigns of the U.S. paper currency. For example, the government could print the money with red ink or use plastic-coated paper, and the public probably would accept this currency just as it accepted the recent redesign. The government also could take the more drastic step of converting the entire stock of paper currency into electronic currency. People could bring their currency to the Federal Reserve, which could then scan the money to create an electronic image—serial number and all—and then destroy the paper bills. The scanned images of each person's bills could go into a computer file that acts like a wallet for the person's currency holdings. The entire currency stock would be electronic, but that only means that it would have a different representation. It would look the same, but its representation would be in terms of a graphic computer image of the bits and bytes that make up the bill in computer memory. Of course, to save on computer memory, the Federal Reserve ultimately would want to replace the graphic images of the currency with simple numeric entries representing units of currency. The conclusion is clear: whether a currency takes an electronic or paper form has no implications for government regulatory policy.³

. . . But the private issuance of electronic cash matters

The provision of electronic cash by private firms, on the other hand, is potentially problematic, especially once the cash begins circulating. Private issuance of electronic currency could, for example, bring with it multiple currencies with different values in exchange, fraudulent issuance, and increased default risk. For this reason, a concern for policymakers is that private issuance might someday reduce the quality of the currency stock, as measured by the currency's stability, safety, and uniformity.⁴

Stability. A stable currency maintains its value, or purchasing power, over time. For a currency to maintain its value, the currency's supply must not increase relative to its demand. Otherwise, its price, or value, decreases over time, and people become less willing to hold it. In the extreme, people could refuse to use the currency at all and resort to using other, possibly more costly, means of payment.

With private issuance, a currency's stability might be threatened because an issuer aiming to maximize its profits has an incentive to increase the supply of its currency. The profit generated from issuing currency is the difference between the currency's market value (or sales price) and its cost of production. What effect an increase in supply has on a currency's value depends on what properties the issuer gives its currency.

One option is for an issuer to supply a fiat currency, one that is nonredeemable and unbacked. A currency is nonredeemable when the holder does not have the option of returning it to the issuer for a full refund. An unbacked currency is one that is not a claim to any other assets that back, or guarantee, its value. A fiat currency, then, has no intrinsic value. Rather, its value comes solely from the holder's ability to use the currency in exchange.

An issuer of a fiat currency is free to spend its profit immediately, either to buy goods or services or an interest-earning asset. When an issuer spends the proceeds from its currency sales, it puts those funds into circulation along with the new currency it has issued. This increases the supply of currency in circulation. Given the demand for the currency, the increase in supply devalues the currency. That is, by selling a nonredeemable currency and spending its profit, an issuer implicitly defaults on its currency. The issuer sells a unit of currency with a particular market value and, by spending the proceeds of

the sale, leaves the buyer holding currency whose market value is lower. The devaluing of the currency transfers wealth from the currency holder to the issuer.⁵

Alternatively, an issuer could supply currency that is redeemable and backed. The issuer does this by using the proceeds from its currency sales to buy assets that it holds to guarantee the currency's value and redeemability. It also could commit to return to the holder any interest earnings on the assets it holds as backing. This commitment transforms the currency into an asset with the same return and risk properties as the assets that serve as backing. As a result, the currency then more closely resembles a share in a mutual fund than today's government-issued currency. People are indifferent between holding the currency and holding the currency's underlying assets because the creation of the currency in this manner thus amounts only to a portfolio reallocation for the private sector. In addition, the increase in the supply of a fully backed and redeemable currency is offset by a corresponding increase in demand, so the value of the currency remains unaffected.⁶

Safety. Safety is related to stability in that a safe currency is one that holders can always redeem in full. That is, it protects holders from loss due to explicit default by the issuer. A currency's safety depends on how the currency is backed. An issuer that backs its currency incompletely or with risky assets might not be able to redeem fully on demand. In contrast, for a currency to be fully redeemable and thus perfectly safe, its issuer must hold backing with a market value always at least equal to the face value of its outstanding currency. The easiest way for an issuer to guarantee safety is by holding safe, liquid assets, such as government-issued currency and short-term U.S. government securities.

An issuer has an incentive to hold riskier or

longer term assets for the higher rates of return—and profit—those assets offer. The market value of such assets fluctuates, however, and could fall below the face value of the issuer's currency. In this case, the issuer might not earn enough from selling its assets to fully redeem all of its currency.

Likewise, an issuer can increase its profit from holding safe assets but backing only part of its currency. This strategy makes sense when an issuer expects to redeem only a fraction of its currency at any time. The catch is that if the issuer needs to redeem a larger fraction of its currency, it will be unable to do so. It follows that profits are greatest if the issuer does not back its currency at all, assuming that the penalty for defaulting on its promise to redeem is not too large. Thus, an issuer has an incentive not to back fully with safe assets, which puts it at risk of explicitly defaulting on its currency. It follows that private currency issuance, free of backing requirements, may threaten the safety of the nation's currency stock.

Uniformity. Backing also is critical to whether a national currency consisting of many independently issued currencies is uniform. Uniformity requires that each currency trades at par, or face, value. For example, if each currency is denominated in dollars, then uniformity requires that each trades one-for-one, dollar-for-dollar, with each other—in other words, that people view the currencies as identical parts of a single, or uniform, currency. A uniform currency is desirable because it spares people the expense of identifying the value of the many currencies that they might be offered as payment when transacting. With private currency issuance, however, there could be many different currencies in circulation, each with a different value in exchange.

At this time, the United States has few legal restrictions on who may issue electronic cash

and what steps issuers must take to protect the public's interests.⁷ The challenge confronting policymakers today lies in determining what restrictions, if any, are needed to maintain the currency stock's quality in the presence of privately issued electronic cash.

III. LOOKING FORWARD FROM THE PERSPECTIVE OF ECONOMIC THEORY

Economic theory suggests the government may indeed have a role to play in ensuring the stability, safety, and uniformity of the currency stock.⁸ According to economic theory, two types of outcomes are possible when unregulated, private firms issue electronic currency in an economy where government-issued fiat currency is well established.⁹ One type of outcome involves the public viewing the currencies as perfect substitutes. That is, although many different firms might produce electronic currencies, all the currencies have essentially the same characteristics, and consumers view them as virtually identical. In this case, consumers do not care which firm's currency they hold, and they readily exchange one for another. Necessarily, then, the privately issued currency supply is uniform, although the total currency stock, consisting of both privately and government-issued currencies, might not be. Likewise, perfectly substitutable currencies that are held by the public must, by definition, all be perceived as equally stable and safe. Their degree of stability and safety is likely to be so low that it seriously diminishes the quality of the currency stock.

The other type of outcome involves the public viewing the currencies as imperfect substitutes. Brand names have value in this case. Different firms offer currencies that differ in their acceptability in exchange, their expected return, and the expectation of redemption by the issuer. The latter depends in part on the issuer's reputation.

Thus, in this case, many different outcomes are possible in terms of the currency's stability and safety. At worst, the outcomes are as bad as those in the perfect-substitutes case. The currency stock, however, necessarily is not uniform.

Whatever the degree of substitutability among currencies, a private-sector firm has an incentive to promise to redeem its currency issues for the well-accepted government currency. The reason is that when a private-sector firm first starts issuing currency, it lacks a reputation for supplying a stable, safe, and uniform product. Consequently, people will be more willing to hold the firm's currency if they think they ultimately can redeem it for something known to be acceptable for making purchases. The issuer, then, might promise to redeem either at the holder's request or at a specified date.

But just because an issuer promises to redeem its currency does not mean it actually will be able to do so. As explained above, redemption might not be possible if the currency has inadequate backing. And there is always the possibility that the issuer might abscond with the assets that serve as backing or might simply refuse to redeem.

The rest of this section describes the outcomes with perfect and imperfect substitutes and considers the theoretical basis for government regulation to ensure a high-quality currency. The perfect-substitutes outcomes are extreme and unlikely, but they serve as an important limiting and worst case from which the outcomes with imperfect substitutes might deviate. This section shows that whether competing currencies are perceived as perfect or imperfect substitutes is related to the perceived quality and quantity of the currencies' backing.¹⁰ The quality and quantity of backing determine the degree to which a country's currency remains stable, safe, and uniform in an environment of unregulated private

issuance. What role exists for the government in regulating privately issued currencies depends on the extent to which the private market can bring about a stable, safe, and uniform currency.

The outcome when electronic currencies are perfect substitutes

From the perspective of economic theory, privately issued currencies that are perfect substitutes may or may not have backing. The extent to which backing arises is related to the extent to which issuers expect to have to redeem their currencies. If issuers expect never to have to redeem, they will choose to spend their profit from issuing currency rather than use it to purchase backing. This will be the case when people view privately issued currencies as perfect substitutes for government-issued currency and thus have no reason to request redemption for government currency.¹¹ If, instead, privately issued currencies are perfect substitutes for each other but not for government-issued currency, then people probably will at times want to redeem them. Realizing this, currency issuers may choose to hold some backing, assuming there is a sufficiently large legal penalty for defaulting on a promise to redeem. They will fully back, however, only if they expect 100 percent of their currency to be presented for redemption. Since 100 percent redemption is unlikely to arise in practice, private issuers should be expected to “overissue” currency in the sense that they do not fully back at the time of issue.

Stability. This overissuing of currency has implications for both a currency’s value and the general price level.¹² Overissuing is especially problematic when all currencies are perfect substitutes because the public perceives each currency as just a part of a whole currency stock that is expanding. As a result, the overissuing of one currency causes all other currencies, whether issued privately or by the government, to fall in

value equally and the price level to rise.¹³ Overissuing, then, threatens the stability of a nation’s currency and an economy’s price level.

Profit-seeking suppliers of perfectly substitutable currencies have an incentive to overissue until there is no further gain from doing so. Unfortunately, that point occurs only when currency has lost all value and been driven out of use. This is true as long as there is free entry into currency issuance.¹⁴ It also is true if all issuers partially back their currencies to the same extent with the same assets, say government-issued currency. In this case, suppliers are overissuing, only to a smaller extent. Over time, then, they will still drive currency out of use.¹⁵ In theory, either the private market or the government can reduce the destabilizing effect of overissuing by requiring suppliers to back their currencies fully.

Safety. For currencies to be perfect substitutes, the public must view them as equally safe and thus as having comparable backing. An issuer of such a currency is not likely to back fully, so its currency will bear some risk of explicit default if holders try to redeem. The magnitude of the risk depends on how much backing is held and how safe the backing is. The currency is safer the more fully it is backed with safe assets.

Uniformity. As already stated, currencies must have comparable backing if the public considers them to be perfect substitutes and thus to be virtually identical. The implication is that the privately issued component of the currency stock must be uniform if the currencies are perceived as perfect substitutes.¹⁶ But since issuers are not likely to fully back such currencies, the currencies are likely to sell at a discount, reflecting their default risk relative to government currency. The currency stock as a whole, then, consisting of currencies issued both by private firms and by the government, will not be uniform.

The outcome when electronic currencies are imperfect substitutes

When people treat currencies as imperfect substitutes, it must also be the case that they perceive issuers as differing in the backing they hold and thus in their likelihood to redeem. That is, people also must perceive differences in the currencies' stability and safety. The stability and safety of the currencies depend largely on how well informed the public is about the currencies' backing and on the degree of competition among issuers.¹⁷

Stability. When currencies are imperfect substitutes, overissuance and the price-level effects it brings are likely to be less problematic than when currencies are perfect substitutes, assuming that the public is as well informed about the currencies' backing as are the suppliers. In this case, if a particular supplier overissues, that supplier's currency loses value. The overissued currency becomes an inferior means of payment relative to the other currencies available.¹⁸ It loses market share as people shift to other currencies with more stable values. Thus, as long as firms can freely enter into currency issuing, the potential competition should give issuers an incentive to maintain the value of their currencies.

In contrast, when the public has less information about the quality of currencies than the currencies' suppliers, potential competition from other firms might not keep suppliers from overissuing. This situation is probably the norm since it seems unlikely that people can evaluate and monitor the many currencies that might be available with unrestricted private issuance. In this case, the currency could at worst be as unstable as when the currencies are perfect substitutes.

Safety. In much the same way, the safety of

privately issued and imperfectly substitutable currencies also depends on how well the public can monitor the quality of the currencies in circulation. When people can monitor effectively, and there is free entry into currency issuance, market competition might drive issuers to hold adequate backing.¹⁹ This does not guarantee, however, that currencies will have full backing at all times because the public might be willing to hold currencies that have some risk of default.²⁰ Market competition, however, will tend to bring about privately issued currencies that are safer than they would be otherwise. In contrast, if the public is not as well informed as issuers about the quality of the currencies available, then potential competition might not be sufficient to drive issuers to provide safe currencies. The worst-case outcome could be as bad as that in the perfect-substitutes case.

Uniformity. In the imperfect-substitutes case, a variety of currencies are likely to be in circulation, differing in terms of their stability and safety. Some privately issued currencies will trade below par and at a discount relative to government-issued currency. Those currencies will be held by people willing to accept some risk of default. It is highly unlikely, then, that the currency stock will be uniform in the imperfect-substitutes case.

The theoretical basis for government regulation

Is there a role for government regulation in ensuring a high-quality currency? The answer depends on whether the market can achieve that objective itself. When currencies are perfect substitutes, theory suggests that private issuance will not result in stability, safety, or uniformity because firms are unlikely to limit supply or hold adequate backing. In contrast, when currencies are imperfect substitutes, the outcome depends on the nature of competition among issuers and the extent to which issuers

are better informed about the quality of their backing than the public. If the public is well informed, then a fairly high-quality currency stock could arise. It is not likely, however, that individual consumers will be able to monitor the backing of the many private currency issuers that might operate. And it is not at all clear what competition among currency issuers might look like.

To some extent the market will generate institutions to protect the currency's quality. Private-sector organizations such as clearinghouses can monitor and regulate currency suppliers to limit overissuing. Likewise, private-sector firms can collect and sell information on the quality of the currencies in circulation. This can help resolve the asymmetric-information problem.

But these private-sector institutions might not be able to overcome the impact that the quality of one supplier's currency can have on the perceived quality of other currencies. A devaluation or default by one issuer could raise doubts about the stability and safety of other issuers' currencies. This third-party effect could lead to runs on other issuers and potentially disrupt the entire payments system. It also could result in the public's substituting more costly means of payment for currency, causing a loss of efficiency for the economy. Thus, the market might not bring about the desired degree of stability, safety, and uniformity. There might, then, be a role for government in regulating private currency issuance.

In fact, economists have long recognized a regulatory role for government in maintaining a currency's quality. Adam Smith considered the issuance of currency to be a "natural liberty" of private firms, but he also thought that government should prevent issuers from endangering the quality of the currency. In 1776, he proposed that the government require issuers to redeem

their currencies fully and immediately on demand. To ensure redemption, Smith advocated a minimum-denomination restriction on currencies. This restriction would result in currency circulating primarily among the wealthier and better educated members of society. It also would result in currency holders losing a greater share of their wealth if an issuer defaults. Currency holders, then, would be better able, and have a greater incentive, to monitor issuers' ability to redeem (A. Smith).²¹

Forty years later, David Ricardo also advocated that the government require full and immediate redemption "to bring the . . . currency as near as possible to perfection." To ensure redemption, Ricardo preferred a security-deposit requirement to Smith's minimum-denomination restriction. He proposed requiring currency suppliers to hold government securities on deposit with the government. The value of the government securities, in Ricardo's view, should be proportional to the value of the currency issued. Ricardo also endorsed a security deposit on the grounds that it would stabilize the currency's value and prevent currency holders from having to monitor issuers, which he believed they could not do effectively (Ricardo).

More recently, Milton Friedman and Anna Schwartz have supported allowing private firms to issue currency. The open question, according to them, is whether the government has a necessary role in requiring registration, providing information, and imposing capital or reserve requirements. Some government involvement, at least as a lender of last resort, might be desirable. Friedman and Schwartz see this as especially true when the economy is moving toward unregulated, private currency issuance because the chance of third-party effects increases at that time and makes financial crises more likely (Friedman and Schwartz 1986).

IV. LOOKING FORWARD FROM THE PERSPECTIVE OF ECONOMIC HISTORY

Before determining the appropriate government regulation of privately issued currencies, an understanding is needed of which outcome the market is likely to bring about and of how market institutions might interact with various government regulations. Comparing the U.S. historical experience with privately issued currencies during the free banking era to its experience in adjacent periods can provide some insight.²² During the free banking era, which ran from 1837 to 1863, private-sector banks could issue paper currency virtually free from federal regulation, although they were subject to considerable state regulation.²³ When the effects of these state regulations are considered and compared with the effects of the regulations in place before and after the free banking era, it becomes clear that some regulation was needed to bring about a high-quality currency, but that the regulations used were not always well designed.

Banking before the free banking era

In the early years of the United States, private-sector banks issued most of the country's currency, and each state tightly controlled entry into banking.²⁴ Opening a bank required getting the state legislature to grant a charter. The banking industry thus was relatively concentrated and political.

The states did not have standard bank charters. Instead, state legislatures granted banks individualized charters that specified what activities could be conducted and what conditions had to be met to operate. Most of the early charters did not require any specific backing behind currency issues. In practice, then, banks' general assets served as backing. Likewise, most charters did not require redemption or penalize failures

to redeem. States that imposed redemption requirements rarely enforced them. When a bank refused to redeem its currency, the only recourse the public often had was to sue the bank.

During that early period, the states struggled to achieve stable, safe, and uniform currencies. They first imposed laws specifying a minimum denomination for currency issues. These laws, based on proposals by economists such as Adam Smith, were designed to give currency holders greater incentive to monitor issuers. They were difficult to enforce, however, because each state was free to set its own minimum denomination. When a state's denominational restriction was binding, the lower denomination currency of out-of-state banks would flow into the state. States either had to prohibit the circulation of out-of-state banks' currencies or abandon their minimum-denomination restrictions (E. White).

As an alternative to denominational restrictions, some states set up insurance funds to protect currency holders against losses. Of those states, some required issuers to belong to the funds; others made membership voluntary. States assessed the member banks a share of their capital to finance the funds. The funds then covered the obligations of failed member banks. The insurance programs thus were much like the modern-day FDIC deposit insurance program. But the programs had the adverse effect of reducing the public's incentives to monitor banks' behavior and increasing banks' incentives to engage in riskier activities. States that did not regulate their banks for safety and soundness suffered numerous bank failures and found their insurance funds exhausted. States that regulated banks strictly were accused of encouraging banks to collude. The insurance programs left states searching for an alternative means to protect their currencies (E. White).

The free banking laws

The free banking era began after the Second Bank of the United States was closed in 1836 for political reasons. The Second Bank's mission had been to issue a safe and uniform national paper currency and to serve otherwise much as a central bank. Its closure, then, left private-sector banks as the only issuers of paper currency. Many states responded by developing free banking laws, which aimed at making entry into banking easier while ensuring the quality of the currency stock. The laws varied across states, but most states modeled their laws after New York's, which was the first to be proposed.

Under the free banking laws, anyone who could satisfy a minimum capital requirement, often payable in installments, could open a bank. A bank could begin operating once it paid a portion of the requirement and worry later about paying the rest.²⁵ Once open, a bank enjoyed limited liability, although liability often was limited to twice the bank's capital.

In terms of spurring the banking industry's growth, the laws seem to have achieved their objective. There is evidence that entry into banking did increase (Economopoulos and O'Neill). In New York, for example, more than 50 banks opened shortly after the law took effect, and within two years of the law's enactment 120 banks opened.

Once a bank opened, it could issue paper currency as long as it met two conditions. First, a bank had to redeem its currency on demand for gold or silver coins. Eventually many states required that a bank hold a small share of its capital, typically between 5 percent and 10 percent, in coins to help ensure redemption on demand.²⁶

The second condition was that a bank had to

deposit certain assets with the state, as Ricardo and his followers had recommended. Most states required banks to deposit state bonds; some also accepted U.S. government bonds. This security-deposit (or backing) requirement was a hallmark of the free banking legislation and represented a shift away from the backing of currency with general assets.²⁷

These conditions typically interacted in two ways. First, a bank could issue currency up to some fraction of either the market value or the face value of the deposited bonds, whichever was lower. For much of the free banking era, many states allowed unlimited currency issues. To issue more currency, a bank only had to deposit the required additional bonds. In the latter years, however, most states restricted currency issues to a fraction of a bank's capital.

Second, the state laws imposed penalties on banks that failed to redeem. If a bank ever failed to redeem on demand at par, currency holders could notify the state banking regulators, and the state would close the bank, sell the bank's bonds, and use the proceeds to redeem the currency outstanding. If the proceeds were insufficient to cover the value of the currency in circulation, the state would sell the bank's other assets. Currency holders often had preference over a bank's other creditors in claims to the bank's assets.²⁸

The currency of the free banking era

As early economists such as Smith and Ricardo anticipated, the redemption and backing requirements of the free banking era led to a relatively stable and safe currency. A uniform currency, however, remained an elusive goal.

Stability. The redemption and backing requirements typically adopted helped limit—but not prevent—overissuing. In fact, overissuing that

arose from fraud was sufficiently common that a special name arose for banks engaging in it: wildcat banks. A wildcat bank was considered at the time to be a bank that opened in an isolated location and then issued currency far away (Dillistin). Its objective was to make redemption difficult, and thus unlikely, so it would not have to hold backing. The bank would reap its profit quickly and then close.

The most notorious instances of fraud-related overissuing occurred in Michigan, which in 1837 was the first state to enact a free banking law. Michigan's law unfortunately went into effect during a temporary suspension of the state's redemption requirement, which made fraudulent overissuing all too easy. Banks could issue notes at essentially no cost to themselves and without having to satisfy redemption requests.

Nevertheless, Michigan's experience was the exception, not the rule. If wildcatting had been common, many banks would have operated for only a short time. The historical record shows that few banks actually suspended operations within a year of opening. Thus, the free banking era gave rise to a relatively stable currency.

Safety. While fraudulent currency issues were not common, losses did occur that were associated with the riskiness of the backing that banks held. At the time a bank issued currency, the currency typically had full backing because the banking laws required it. But the government bonds generally permitted as backing were subject to large price fluctuations. At a later date, then, the market value of a bank's bond holdings could decline substantially, falling below the value of the outstanding currency. As a result, a bank could find itself unable to redeem and subject to closure by the state. Thus, the free banking laws, by allowing risky assets to serve as backing, may have made the currency less safe than it otherwise would have been. Most of the banks

that closed without fully redeeming did so during periods of large declines in bond prices.

Banks had an incentive to close when they found themselves with insufficient backing to redeem. If they stayed open, they would have had to use their own funds to satisfy redemption requests. This could have been quite costly for them. Since bonds held as backing actively traded in national markets, currency holders generally knew when bond prices fell and were likely to seek redemption. Alternatively, banks could close, and the state would sell their bonds and any other assets needed to pay off currency holders as fully as possible. Evidence suggests this might have been the more common outcome, probably because it allowed banks to share the capital losses on their portfolios with currency holders. Some currency holders in fact incurred large losses. In Minnesota, for example, some currency holders received only 16 cents on the dollar when the issuers closed. Those losses were associated with the closure of banks that held state railroad bonds as backing. The suspension of construction on Minnesota's railroads in 1859 reduced the price of the railroad bonds well below par. Surprisingly, though, when other states' free banking experiences are also considered, the currency appears to have been fairly safe. Most banks redeemed their currency at par when they closed, so the average loss to currency holders was small.

Uniformity. Despite the likelihood of par redemption when a bank closed, a bank's currency often traded at a discount while the bank was operating. The extent of the discount depended on two factors: the transportation cost of redeeming currency and the riskiness of the bank's portfolio. The discount increased with the distance between the location where the currency was traded and the location where it was issued. This discount reflected the transportation costs that banks and private currency brokers incurred

in seeking redemption in gold and silver from issuers located far away. Currencies issued by relatively new banks, which had not yet developed good reputations, also faced a stiffer discount because the public had less information about their portfolios. Likewise, the discount was steeper on currencies backed with bonds considered more likely to lose value.

With so many currencies in circulation, people found transacting with the currencies time-consuming and risky.²⁹ Businesses arose that monitored the prices of the numerous legitimate and counterfeit currencies. They published their findings in specialized periodicals known as bank note reporters (Dillistin). These publications listed each bank by location, along with the discount on the bank's currency in a major financial center. They also described any counterfeits and noted whether a bank had closed or was in the process of doing so. The bank note reporters are evidence that the currency of the free banking era was not uniform in general.³⁰

There was one prominent exception to the lack of uniformity, however. The Suffolk Banking System operated in New England from 1824 to 1856.³¹ A coalition of Boston banks started Suffolk initially as a business to broker paper currency, and Suffolk quickly evolved into the nation's first net clearinghouse. It required members to back their currency with assets they deposited with it and to redeem the currencies of all members at par.³² It then accepted and cleared any currency that member banks brought it, rather than return the currency to issuers for redemption, as was the practice previously. This was a major innovation in banking, for it significantly reduced the cost of accepting other banks' currencies. By the mid 1830s, almost all New England banks were members, and the region enjoyed almost universal par exchange. This favorable situation ended when competition drove Suffolk out of business.

A major factor in Suffolk's long-lived success appears to be the Massachusetts laws that taxed nonmembers and shielded Suffolk from competition. To date, there is no evidence of institutions similar to Suffolk that succeeded in bringing a uniform currency to other regions (Rolnick, Smith, and Weber).

The end of the free banking era

The free banking era ended in 1863, when Congress, dissatisfied with the quality of the nation's currency stock, especially its nonuniformity, passed the National Currency Act. In 1864, Congress substantially revised this Act in the National Bank Act. This latter Act had four key provisions regarding currency issuance. First, it allowed banks to get national charters as long as they met minimum capital requirements. Second, it allowed national banks to issue notes printed by the federal government. The banks could stamp their names on the notes, which were uniform in appearance, and issue them just as they had issued notes previously. Third, the Act required banks to deposit with the Comptroller of the Currency U.S. bonds with a face value of \$1.11 for every \$1 of notes they issued. This was the first time that currency issuers had to hold safe backing with a value exceeding 100 percent of their currency's face value. Finally, the U.S. Treasury cleared all notes and charged issuers for the cost of redemption, thus facilitating par exchange.

To encourage banks to obtain national charters and switch to issuing the federal government's notes, Congress in 1865 imposed a costly 10 percent tax on all state bank notes issued. The tax was effective; soon thereafter the country had its first safe and uniform currency that circulated at par nationwide (Spong; Klose). In 1935, Congress withdrew the right of national banks to issue notes and gave the Treasury liability for all bank notes still outstanding

(Friedman and Schwartz 1963). Since then, the government has been the predominant issuer of currency in the United States.³³

Assessing the historical evidence

The U.S. historical experience with privately issued currencies in and around the free banking era shows that the era's bank regulations played a critical role in the resulting quality of its currency stock. During the free banking era, the ease of entry into banking led to hundreds of currencies circulating side by side. The currencies were imperfect substitutes, differing with respect to the issuers' reputations for backing and redeeming. But in the era's early years, when backing requirements were not in place, issuers did not fully back their currencies, making stability a problem. This led to government-imposed backing requirements. Likewise, when redemption was not required, or was required but not enforced, issuers rarely redeemed on demand, making safety a problem. This led to redemption requirements and laws giving states the right to close any bank that failed to redeem. And, during the free banking era, there was only one instance of par exchange across a large region for an extended period. Some unusual state regulations appear to have been critical in producing the conditions that made that instance possible. Uniformity, then, also was a problem. The government ultimately dealt with the problem by assuming responsibility for clearing all currency and charging issuers for the cost of redemption.

The historical record thus shows the state and federal governments struggling to achieve a high-quality currency. When regulations were not in place, the currency was not of the desired quality. When regulations were in place, the desired quality still did not arise. Some of the regulations, such as those allowing risky assets as backing, might even have magnified the problems they were designed to resolve. When exist-

ing regulations proved unsuccessful, additional or modified regulations were tried. Only after many years and much regulatory experimentation did the United States achieve a safe, uniform, and relatively stable currency. That accomplishment essentially coincided with the prohibition of private issuance.³⁴

V. THE ROLE FOR GOVERNMENT

While the historical experience with privately issued currencies can be read as suggesting a role for government regulation, at first glance that experience might not seem relevant to today's economy. Financial markets, for example, are better developed, and better able to self-regulate, today than they were during the free banking era. On closer inspection, however, history does appear to be relevant. Many of the factors that gave rise to a need for government intervention historically still exist. As Friedman and Schwartz (1986) have written:

“the peculiar difficulty of enforcing contracts involving promises to pay that serve as a medium of exchange and of preventing fraud in respect to them,” remains alive and well. . . . The improvements in communication and in the extent and sophistication of financial markets have in some respects increased, in others decreased, the difficulty of enforcing contracts and preventing fraud. They certainly have made it more difficult politically for governments to remain uninvolved.

Supporting this conclusion is the recent U.S. experience with prepaid phone cards, which are typically nonredeemable stored-value cards usable for making long-distance calls. A test of the prepaid phone cards of 70 different issuers found that 53 percent were worthless (Mitchell). While the prepaid-phone-card market is relatively small, this finding suggests large-scale default within the market. Furthermore, it suggests that if the market for electronic cash becomes large, fraudulent issuance could be a big problem. Thus,

the lesson of both economic theory and economic history—namely that there may be a role for government in regulating electronic cash to protect the quality of the currency stock—is relevant to today's economy. The government has many regulatory options, ranging from strict entry restrictions to no intervention at all.

Government restrictions on entry into electronic-currency issuance

The government could choose to regulate who can issue electronic currency. An obvious—and extreme—entry restriction is a government ban on issuance by private firms. If implemented, this restriction would leave the government as the only possible issuer of electronic currency. This approach is not necessarily desirable for two reasons. First, it would deprive society of the variety and innovativeness of electronic cash products that the private sector might develop. Second, it might deprive the economy of a higher quality currency. For example, competition among private-sector issuers of brand-name currencies might, as a byproduct, make the value of the government-issued currency more stable. When privately issued currencies are available, if the government inflates and devalues its currency, people can choose to use the private currencies instead of the government's currency. Thus, with competing currencies, the government must be more attentive to maintaining the value of its currency (Craig).

A less extreme entry restriction would allow only banks and other depository institutions to issue electronic cash. This is the restriction recommended by the European Union central banks (Working Group of EU Payment Systems). It has the advantage of allowing some competitive private issuance while protecting the payments system. Nondepository firms, if allowed to issue electronic cash, could pose a risk to the payments system if their products

become a dominant means of payment. The failure of such firms' electronic cash could lead the public to lose confidence in the electronic cash of depository institutions. This, in turn, might lead to runs on depository institutions, disrupting the entire payments system.³⁵

The disadvantage of this approach is that it might limit the role of technology firms in the development of electronic cash. Information-technology firms with expertise in designing electronic networks have intellectual capital that is valuable in the development of electronic currencies. Their participation can bring many benefits in terms of product design and efficiency.

Alternatively, the government could choose not to restrict entry, instead letting any firm issue electronic currency. One problem with this approach is that supervising and regulating a nondepository issuer—whether a commercial firm or a nondepository financial firm—can be difficult if the issuer's payments activities are not isolated from its other activities.³⁶ This problem is perhaps more serious with firms that issue electronic currency through joint ventures. When the issuer is a joint venture, the additional question arises of how to attribute liability for the currency across the joint venture's members, unless the joint-venture contract itself assigns liability.

Another problem is whether to extend discount window access and deposit insurance coverage to nondepository issuers. With discount window access, such issuers might be able to obtain emergency credit from the Federal Reserve if they encounter liquidity problems. In addition, the Federal Reserve would have to evaluate the quality of the collateral each issuer offers against a loan, which could be difficult if the collateral differs from that of the typical depository institution.

With deposit insurance coverage, nondepository

issuers might end up receiving a net subsidy that reduces their cost of operation if they do not pay the full, risk-adjusted cost of the insurance. In fact, there is a debate today over whether banks receive such a subsidy (Whalen). A lower operating cost as a result of the subsidy would induce issuers to increase their involvement in risky activities. Depositors would accept this increased risk without the promise of higher deposit rates because the insurance would protect their returns.

Extending deposit insurance to nondepository issuers also may be too extreme a step. It is not obvious that the government should guarantee the safety of privately issued currencies, especially since government-issued currency is available to the public as a safe alternative means of payment. To the extent that the public demands a guarantee of safety, the issuers could insure themselves by holding adequate backing.³⁷

Government restrictions on issuers' operations

To avoid some of these problems, the government could regulate the way issuers do business. For example, it could require nondepository issuers—whether operating independently or through a joint venture—to conduct their payments activities through depository subsidiaries. The government then could subject these subsidiaries to the safety and soundness regulations that apply to banks.

Alternatively, instead of restricting currency issuance to depository firms or subsidiaries, the government could require redemption and full backing with relatively safe and liquid assets. The safer the backing, the more likely it is that at any time the backing's market value will at least equal the currency's face value. The advantage of this operating restriction is that it directly

aims to prevent issuers from overissuing or failing to redeem.³⁸ Thus, it focuses directly on bringing about a stable, safe, and uniform currency. Today's money market mutual funds and traveler's checks face similar backing requirements.³⁹

Requiring issuers to hold only the safest and most liquid assets (for example, short-term U.S. government securities) as backing would bring about a very safe currency, but might go too far. If the return on the backing is not high enough to make providing electronic currency profitable, the backing requirement could eliminate private provision. In addition, the requirement seems extreme given that most of today's government-issued paper currencies have no backing. Since going off the gold standard, the U.S. government has made no promise to redeem its currency for anything of value. Without a binding promise of redemption, the government is free to devalue its currency, and thus increase the price level, which it has done.

Allowing issuers to hold a wider range of assets in terms of riskiness would raise the likelihood of losses on their currencies. To offset the increased risk of loss, the government could require issuers to hold additional backing. Such a requirement might not be necessary, however, because competition might drive issuers to inject capital into their funds in the face of losses. This is how money market funds have responded to losses on their commercial paper holdings.

Market regulation of electronic-currency issuance

Instead of imposing entry or operating restrictions, the government could let the currency-issuing industry regulate itself. There have been numerous instances of industry self-regulation. In the banking industry, for example, clearinghouses arose late in the free banking era to monitor bank deposits. In particular, the New

York Clearinghouse Association, established in 1853, screened and regulated its members. It imposed capital requirements, reserve requirements, and interest rate restrictions; and it conducted regular audits to ensure compliance. In addition, the clearinghouse required its members to publish balance-sheet information for the public. This information helped consumers assess the quality of deposits across banks (Gorton 1985b).

Historically, however, private-sector discipline has not generated a stable, safe, and uniform currency. Nor has it prevented periodic financial crises and disruptions to the payments system. The banking panics of the late 19th and early 20th century were testimony to the inability of the market to regulate itself.

The government could take steps to help the market along. One option would be to give issuers unlimited liability for losses on their currency. This would provide issuers with a greater incentive to ensure the safety of their currency.

Alternatively, the government could help the market overcome the information asymmetry between issuers and their customers. As economic theory indicates, uncertainty about issuers' backing is crucial in determining whether the private market will produce a high-quality currency. The most minimal intervention to improve information flows would be for the government to require that issuers disclose specific financial information and to let the buyer beware in using electronic cash. This disclosure requirement would benefit consumers by ensuring uniform disclosure across issuers, thus making it easier to compare electronic currencies. Disclosure also would have the advantage of forcing consumers to accept responsibility for their choice of payment instrument. Such a requirement seems reasonable since consumers have

the option of using government-issued currency instead of the potentially risky currency of a private issuer.

Requiring disclosure, however, would not ensure that issuers would disclose the optimal amount of information. The regulation could have the adverse effect of setting a maximum rather than a minimum amount of information disclosure. That is, it could result in less information being released than if the government had not intervened.⁴⁰

VI. CONCLUSION

In the end, what role the government should play in regulating electronic cash depends on how large a role electronic cash plays in the payments system. Most experts are predicting that, in the United States at least, it will be a long time before electronic cash comes into widespread use. One reason is the availability in the United States of other means of payment, such as credit and debit cards, which offer ease of payment and considerable security. Another reason is that checks are extremely popular in the United States, despite their high resource cost compared to existing electronic forms of payment (Humphrey, Pulley, and Vesala; Wells). The public's reluctance to embrace electronic payments might extend to stored value and digital cash.⁴¹

Even if electronic cash becomes a common means of payment in the United States, the market for it might not be large. The Commerce Department, for example, has estimated that the potential market for stored value could be the size of the market for traveler's checks, about \$20 billion annually, or 0.26 percent of 1996 gross domestic product (U.S. Congress). The market for digital cash will depend on the demand for a currency substitute for electronic commerce. If the security concerns regarding

the use of credit and debit cards over the Internet are eliminated, the market for digital cash could be small, dependent only on small-dollar Internet purchases. If the market is small, the private provision of electronic cash is likely to have a negligible effect on the quality of the U.S. currency stock.

Of course, once a new means of payment becomes available, new products and ways of doing business are likely to arise that make use of it. Shoppers may someday see, for a wide range of goods, variants of today's vending machines that accept stored value and allow greater self-service. Grocery stores, for example, might arise that consist solely of such machines, and have no checkout lines. And as the availability of digital cash grows, the demand for goods from Internet-based stores might soar as a result of the greater accessibility of the sellers to potential customers. If the market for electronic cash does turn out to be large, then the

private issuance of electronic cash could reduce the quality of the currency stock.

Because electronic cash might someday be a common means of payment, the United States must consider designing policies to ensure that its currency remains stable, safe, and uniform. The best policies will strive to maintain the currency's quality without forfeiting the benefits of competitive issuance. In moving forward with the design of such policies, it is critical not to lose sight of the lessons of theory or history. Over 200 years of theory and history suggest that the best policy might be one that requires issuers to redeem fully on demand, back their currencies fully with safe and liquid assets, and disclose the financial information needed to monitor the backing. This regulatory policy improves upon the free banking era's regulations while retaining many of the benefits from competition that free entry brings.

ENDNOTES

¹ For a description of how credit-card and debit-card transactions work and compare to the new electronic payment methods, see U.S. Congress, Congressional Budget Office (1996, chap. 1).

² Smart cards need not store only monetary value. They also can serve simultaneously as one or more credit, debit, and insurance cards, and can store personal information (for example, information about identity, social security number, and medical history).

³ Thus, this article uses the term “currency” broadly, as something that circulates as a medium of exchange. This usage contrasts with the Federal Reserve’s narrow definition of the currency stock as the stock of government-issued paper notes in circulation.

⁴ History shows governments struggling to achieve stability, safety, and uniformity. The United States, for example, spent over 150 years engaged in that struggle. And, in fact, today the Federal Reserve considers maintaining stability, safety, and uniformity to be part of its fundamental mission (Board of Governors of the Federal Reserve System 1996). Countries that today have not yet achieved a high-quality currency are still striving for that end. The desire to reduce the transaction costs of converting currencies that are not stable in value relative to each other and are not uniform is a primary motive behind Europe’s move toward monetary union. Thus, this article adopts the view that nations desire currencies that are stable, safe, and uniform.

⁵ This is the approach that the U.S. government takes. The government increases the money supply through Federal Reserve open market purchases: the Federal Reserve creates money and injects it into the economy by using it to purchase U.S. government bonds. The Federal Reserve transfers to the Treasury its profit from interest earnings on its bond holdings. The Treasury uses the profit to finance the government’s expenditures.

⁶ This is an application of the Modigliani-Miller theorem, which states conditions under which portfolio rearrangements—in this case between currency and other assets—do not affect prices or resource allocations. The following papers apply the Modigliani-Miller theorem to currency issuance and/or discuss the role of backing in whether currency issuance affects the price level: Fama 1980, Sargent 1982, Smith 1984, Wallace 1981.

⁷ Electronic-cash products are subject to the principles of the common law of contract and product liability, as are

other means of payment. Federal laws governing the provision of negotiable instruments and state laws governing the sale of checks (for example, traveler’s checks and money orders) could be extended to cover electronic cash. Likewise, the Federal Reserve Board has the authority to extend the Electronic Funds Transfer Act (EFTA) of 1978 to cover new forms of electronic funds transfer. The statute and its legislative history suggest that the EFTA, as implemented through the Federal Reserve’s Regulation E, is broad enough to apply to some stored-value and digital-cash products if the Federal Reserve sees fit to apply it. To date, the Federal Reserve has not done so (Board of Governors of the Federal Reserve System 1997, pp. 57-67).

⁸ The theoretical analysis here draws on the following articles: Black 1970; Cavalcanti and Wallace 1997; Fama 1980; Freeman 1996; Hellwig 1985; Kareken and Wallace 1981; Klein 1974; Schreft 1992; Selgin and White 1994; Taub 1985; Wallace 1981, 1986, 1987.

⁹ This article asks a very specific question: What outcomes are possible when the unregulated and competitive private issuance of currency is allowed in an economy in which an unbacked and nonredeemable government-issued paper currency is the predominant means of payment for hand-to-hand transactions? While there is a large literature on competitive private currency issuance, none of the existing articles asks the question asked here. Nor does this article address the questions that the previously published articles have addressed. For example, this article does not ask how prices and resource allocations are affected by changes in the supply of money when all monies are fully backed and privately issued (see, for example, Fama 1980). This article also does not explore the outcome when there are only unbacked, privately issued currencies in an economy with perfect competition among issuers (for example, Freeman 1996). Likewise, it does not explore whether private-sector firms that issue brand-name fiat currencies will issue currency at the socially optimal rate in a Nash equilibrium (for example, Taub 1985). The most notable distinction between this article and the existing literature is that this article does not assume that privately issued currencies will be backed or that any conditions hold that would generate backing, but it does assume that government-issued currency is a well-established means of payment when privately issued currencies are introduced into the marketplace.

¹⁰ Whether currencies are perfect or imperfect substitutes and how they are backed are determined endogenously by market forces.

¹¹ It is not clear whether privately issued currencies and government-issued currency will circulate side by side. Since government currency does not pay interest, privately issued currencies will circulate along with government currency only if they too pay a risk-adjusted rate of return of zero. Competition among private-sector issuers might drive them to pay interest on their currencies. In this case, unless government currency also starts paying interest or the government requires people to use the currency for certain purposes, people will stop using it altogether. The government is not likely to let this occur. But if it does occur, the privately issued currencies will be either nonredeemable or redeemable in something other than government-issued currency.

¹² Since overissuing occurs when a supplier does not use all the proceeds from currency sales to purchase backing, it can be associated with a violation of the Modigliani-Miller theorem.

¹³ It is natural to wonder whether a currency supplier who observes another supplier overissuing would take actions to inform customers about its competitor's overissuing and the relative stability of its own currency. That may very well happen, but if it does, the currencies are no longer perfect substitutes. Thus, such actions are inconsistent with the perfect-substitutes outcome.

¹⁴ It is true whether there are many currency issuers, each too small to influence the market price, or a few large issuers, each with some market power.

¹⁵ Technically, a rational, forward-looking public will never choose to hold a currency that it expects to become worthless at some future date. In this case, then, allowing private firms to issue currency has serious consequences: it immediately and entirely eliminates the use of currency.

¹⁶ This assumes that redemption is costless for all people and all currencies. Differential redemption costs could be reflected in currencies being accepted in exchange only at differential discounts from face value.

¹⁷ The conditions under which government-issued currency will circulate alongside privately issued currency are the same as in the perfect-substitutes case (see endnote 10): Since government currency does not pay interest, the risk-adjusted rate of return on privately issued currencies would have to be zero for them to coexist with government currency. In the imperfect-substitutes case, though, competitive forces are more likely to drive issuers to differentiate their currencies by paying interest. To pay higher interest, issuers have to back with assets that offer a higher return at the cost of being more risky. If the

risk-adjusted rate of return is positive, government currency will drop out of use.

¹⁸ If the overissued currency accounts for a sufficiently large share of the total currency supply, the overissuing could affect the general price level and thus the value of other currencies.

¹⁹ People who hold the currency of new issuers that lack reputations have an incentive to try to redeem at times as a test of whether the issuers are capable of redeeming. New issuers, through their success at handling these redemption requests, can establish their reputations (Gorton 1996).

²⁰ This is particularly true if there are other asset markets in which people can somehow shed the risk from holding currency.

²¹ Economists later realized that strict redemption requirements by themselves can lead to liquidity problems at banks and thus to bank runs once the public begins doubting whether redemption will occur. A government lender of last resort can prevent or stem these runs.

²² This section is based primarily on the following publications: Dewey 1910; Dwyer 1996; Gorton 1996; Redlich 1951; Rolnick, Smith, and Weber 1997; Rolnick and Weber 1982, 1983, 1984, 1986, 1988.

²³ One difference between today's economy and that of the free banking era is that the latter did not have a government-issued fiat currency as a dominant medium of exchange. In the free banking era, gold and silver coins, which have value independent of their value in exchange, played the role of today's government-issued paper notes.

²⁴ The notable exception was the currency issued by the federally chartered Bank of the United States (1791-1811) and Second Bank of the United States (1816-36).

²⁵ The chartered banks that were operating when the free banking laws went into effect remained in operation, at least initially. Any free banks that opened had to compete with them (Gorton 1996, p. 372).

²⁶ Some states allowed banks to count as reserves funds that they deposited with other banks to finance redemptions.

²⁷ Canada also had a long experience with private currency issuance by banks. The Canadian banks were allowed to back their issues by general assets, but the outcome was more positive than that which the United States experienced when it allowed similar backing. This is due, at least in part, to Canada's having a much more

concentrated banking industry; more liberal laws on capital, branching, and diversification; and laws that allowed for more cooperation and coordination among banks (Williamson; Breckenridge).

²⁸ The backing laws proved more successful than the previously used minimum-denomination restrictions and insurance requirements (E. White).

²⁹ Dillistin (p. 75) quotes Hoyt Sherman, an Iowa banker in the 1850s, as describing what was involved in dealing with state bank notes:

To illustrate how the bank note deposits were assorted and treated by the bankers [during the free banking era], I copy literally the labels on the several compartments in an old currency tray, in which the notes were assorted as they came in, and from which the checks were paid. These labels were: Eastern Penn., N.Y. and New England, in one compartment; Ohio, Indiana and Missouri, in another; then Va., Md. and Ky.; in another Ill. and Wis., and lastly, Western Mixed.

The first named notes were choice par funds, rating next to gold, and they were shipped to New York for exchange purposes. The next two (O., Ind., Mo., Va., Md. and Ky.) were "bankable funds," so-called, and graded as among the safest of bank notes. "Illinois and Wisconsin" took in the few legitimate free banks in those states, located principally in Chicago and Milwaukee; but the last label was more comprehensive than all the others put together. It included "rag tag and bob-tail," everything not comprehended under the other labels but resembling a bank note. "Western Mixed" was the dignified and formal name for it. . . . The vigilant banker watched that pile of currency closer than the others. Its increase in quantity caused much anxious concern—and its decrease corresponding elation. As the close of the business day approached, if the supply was large, he prayed inwardly for checks to come in for payment; and if he could close up with that part of his tray empty, his sleep that night would be calm and peaceful.

³⁰ Dillistin (p. 46) quotes an anonymous historian as describing in 1896 what was involved in verifying the authenticity of free bank currency:

The bank notes were bits of paper recognizable as a specie by shape, color, size and engraved work. Any piece of paper which had these came within the prestige of money; the only thing in the shape of money to which the people were accustomed. The person to whom one of them was offered, if unskilled in trade and banking, had little choice but to take it. A merchant turned to his "[counterfeit] detector." He scrutinized the worn and dirty scrap for two or three minutes, regarding it as more probably "good" if it was worn and dirty than if it was clean, because those features were proof of long and successful circulation. He turned it up to the light and looked through it, because it was the custom of the banks to file the notes on slender pins which made holes through them. If there were many such holes the note had been often in bank and its genuineness was ratified.

³¹ Suffolk operated mostly before 1851, when Massachusetts passed its free banking law.

³² There is some mixed evidence regarding whether the Suffolk System resulted in a safer and more stable currency in New England than would have existed otherwise. Suffolk did require its members to hold additional backing, and took steps to monitor its members' activities. It appears, though, that only at times was it successful in limiting overissue and thus protecting the quality of the currency stock (Redlich; Dewey).

³³ The private firms that have issued traveler's checks since 1891 are the notable exception (Bailey and Hagedorn). Federal regulations define a traveler's check as a check that is drawn on a bank, is designated as a traveler's check on its face, requires the purchaser's signature at the time of purchase, requires the name of the payee to be specified, and provides for a countersignature of the purchaser when the check is transferred to the payee. Traveler's checks also typically come with a guarantee against loss or theft. These requirements make it difficult for traveler's checks to serve as a circulating currency.

³⁴ Scotland's experience with free banking in the 1700s is typically considered a great success, especially compared with the U.S. experience (L. White; Gorton 1985a). The explanation usually given for the difference in the Scottish and U.S. experiences is that the Scottish banks were virtually unrestricted in their note-issuing activities, while U.S. banks faced considerable regulations, many of which did more harm than good. But the Scottish experience also can be read as showing that Scottish banks in fact faced some operating restrictions that were critical to their success with free banking. The Scottish banks bore unlimited liability for fully redeeming their currencies and were limited to issuing notes with denominations above a specified minimum level. The unlimited-liability condition gave them a strong incentive to hold adequate backing at all times. The minimum-denomination restriction gave currency holders a strong incentive to monitor the banks' backing. Friedman and Schwartz (1986) discuss features of the Scottish experience that were not present in the United States free banking era. Those features also are not present in the United States today and thus might limit the effectiveness of the Scottish operating restrictions at ensuring the quality of electronic currencies.

³⁵ If the failure of a nondepository issuer would lead only to a loss of confidence in the electronic currency of other nondepository issuers, then there is no risk to the payments system. The failure of such issuers would result in a loss of wealth to the currency's holders, but would not adversely affect payments-system usage, because people could easily

resume using the government's paper currency for payments formerly made with electronic cash.

³⁶ One way that a firm can isolate its payments activities is by conducting them through a subsidiary. A firm might choose this approach in anticipation of the regulatory and supervisory cost it might otherwise face.

³⁷ The FDIC has decided that most types of stored value are not deposits and thus do not qualify for deposit insurance coverage (Federal Deposit Insurance Corporation).

³⁸ See endnote 20 regarding the possible problems with a strict redemption requirement.

³⁹ The SEC (17CFR270.2a-7) requires money market mutual funds to invest in top-quality assets, to strictly limit the share of their assets in the securities of a single issuer, to invest only in assets with a remaining maturity of less than one year, and to maintain an average portfolio maturity of no more than 90 days. Nevertheless, these restrictions allow for considerable variation in money market fund portfolios. Based on their portfolios, the funds can be divided into three groups that differ in terms of their riskiness. One group holds only U.S. Treasury securities and some repurchase agreements collateralized with Treasury securities. Another group holds securities issued by the U.S. government and by various government-sponsored enterprises. The third group, which is the largest, also invests in a variety of highly rated, privately issued money market securities, such as commercial paper and domestic and Eurodollar CDs (Cook and Duffield; Collins and Mack).

Likewise, the private firms that issue traveler's checks face regulations in most states, but at the state level. The regulations typically require the issuer to meet a minimum capital standard. Most states require in addition that the issuer deposit with the state a surety bond in a fixed amount and relatively safe assets with a market value equal the face

value of the traveler's checks issued. See, for example, the laws of Florida (Florida Annotated Statutes, §560.200-213, West 1997) and Missouri (Missouri Annotated Statutes, §361.700-718, Vernon 1997). Other states require a fixed-size deposit of relatively safe assets, and an additional fixed-size deposit for each additional location beyond the first at which the issuer sells the checks, up to a maximum deposit. See, for example, the laws of Kansas (Kansas Statutes Annotated, §9-508-509, 1991) and Nebraska (Nebraska Revised Statutes, §8-1001-1009, 1991).

⁴⁰ This is apparently what happened in the cigarette industry, where the Federal Trade Commission's regulations on advertising in the 1950s reduced manufacturers' disclosure of the health risks associated with their products (Henderson).

⁴¹ In many other countries, electronic cash is expected to come into widespread use much sooner. These countries each lack a well-developed telecommunications infrastructure, have credit and debit cards without the consumer protections that exist in the United States, and have a populace that embraces electronic means of payment.

⁴² A handheld device known as an electronic wallet has been developed that allows individuals to transfer funds from one card to another. At this time it can handle transfers in up to five currencies (Kezar).

⁴³ Stored-value products also are being designed that can track transactions, providing an electronic trail of the fund transfers made.

⁴⁴ Roberds (1997) discusses the similarity of electronic cash to checks.

⁴⁵ For an accessible discussion of methods for securing Internet payments, see McAndrews (1997).

REFERENCES

- Bailey, Henry J., and Richard B. Hagedorn. 1992. *Brady on Bank Checks: The Law of Bank Checks*, 7th ed. New York: Warren Gorham Lamont, pp. 1-28—1-29.
- Bauer, Paul W. 1995. "Making Payments in Cyberspace," Federal Reserve Bank of Cleveland, *Economic Commentary*, October 1.
- Bellamy, Edward. 1888. *Looking Backward*. New York: Penguin Books, p. 73.
- Black, Fischer. 1970. "Banking and Interest Rates in a World Without Money," *Journal of Banking Research*, August, pp. 8-20.
- Block, Valerie. 1997. "Pilot Test Explores a New Frontier for Debit Cards: Grammar School," *American Banker*, May 14, pp. 1, 21.
- Board of Governors of the Federal Reserve System. 1997. *Report to the Congress on the Application of the Elec-*

- tronic Funds Transfer Act to Electronic Stored-Value Products*, March.
- _____. 1996. *Strategic Framework 1997-2002*, December.
- Breckenridge, Roeliff Morton. 1910. *The History of Banking in Canada*, National Monetary Commission Vol. 9. Washington: Government Printing Office.
- Cavalcanti, Ricardo, and Neil Wallace. 1997. "A Model of Regulated Private Bank-Note Issue," mimeo, June.
- Collins, Sean S., and Phillip R. Mack. 1994. "Avoiding Runs in Money Market Mutual Funds: Have Regulatory Reforms Reduced the Potential for a Crash?" Board of Governors of the Federal Reserve System, Finance and Economics Discussion Series Paper 94-14, June.
- Cook, Timothy Q., and Jeremy G. Duffield. 1993. "Money Market Mutual Funds and Other Short-Term Investment Pools," in Timothy Q. Cook and Robert K. LaRoche, eds., *Instruments of the Money Market*, 7th ed. Richmond, Va.: Federal Reserve Bank of Richmond, pp. 156-72.
- Craig, Ben. 1996. "Competing Currencies: Back to the Future?" Federal Reserve Bank of Cleveland, *Economic Commentary*, October 15.
- Dewey, Davis R. 1910. *State Banking Before the Civil War*, National Monetary Commission Vol. 4. Washington: Government Printing Office.
- DigiCash. 1997. "DigiCash—Numbers That Are Money," available on the Internet at <http://www.digicash.com/publish/digibro.html>, June 3.
- Dillistin, William H. 1949. *Bank Note Reporters and Counterfeit Detectors, 1826-1866*. Portland, Maine: The Anthonen Press.
- Dwyer, Gerald P., Jr. 1996. "Wildcat Banking, Banking Panics, and Free Banking in the United States," Federal Reserve Bank of Atlanta, *Economic Review*, December, pp. 1-20.
- Economopoulos, Andrew, and Heather O'Neill. 1995. "Bank Entry During the Antebellum Period," Part 1, *Journal of Money, Credit, and Banking*, vol. 27, no. 4, November, pp. 1071-85.
- Fama, Eugene F. 1980. "Banking in a Theory of Finance," *Journal of Monetary Economics*, vol. 6, pp. 39-57.
- Federal Deposit Insurance Corporation. 1996. "General Counsel's Opinion No. 8; Stored Value Cards and Other Electronic Payment Systems," *Federal Register*, vol. 61, no. 150, August 2, pp. 40490-94.
- Freeman, Scott. 1996. "Clearinghouse Banks and Banknote Over-Issue," *Journal of Monetary Economics*, vol. 38, pp. 101-15.
- Friedman, Milton, and Anna Jacobson Schwartz. 1986. "Has Government Any Role in Money?" *Journal of Monetary Economics*, vol. 17, pp. 37-62.
- _____. 1963. *A Monetary History of the United States, 1867-1960*. Princeton, N.J.: Princeton University Press, p. 442.
- Gorton, Gary. 1996. "Reputation Formation in Early Bank Note Markets," *Journal of Political Economy*, vol. 104, no. 2, pp. 346-97.
- _____. 1985a. "Banking Theory and Free Banking History: A Review Essay," *Journal of Monetary Economics*, vol. 16, pp. 267-76.
- _____. 1985b. "Clearinghouses and the Origin of Central Banking in the United States," *Journal of Economic History*, vol. 45, no. 2, June, pp. 277-83.
- Hellwig, Martin F. 1985. "What Do We Know About Currency Competition?" *Zeitschrift für Wirtschafts- und Sozialwissenschaften*, vol. 105, no. 5, pp. 565-88.
- Henderson, David R. 1997. "Joe Camel: Brought to You by the FTC," *Fortune*, July 21, p. 31.
- Humphrey, David B., Lawrence B. Pulley, and Jukka M. Vesala. 1995. "Cash, Paper, and Electronic Payments: A Cross-Country Analysis," mimeo, November.
- Kareken, John, and Neil Wallace. 1981. "On the Indeterminacy of Equilibrium Exchange Rates," *Quarterly Journal of Economics*, vol. 96, May, pp. 207-22.
- Kezar, Michelle. 1995/96. "Logging on to Electronic Means of Payment," Federal Reserve Bank of Richmond, *Cross Sections*, Winter, pp. 10-18.
- Klein, Benjamin. 1974. "The Competitive Supply of Money," *Journal of Money, Credit, and Banking*, November, pp. 423-53.
- Klose, Nelson. 1972. *American History*, Vol. 1: To 1877. Woodbury, N.Y.: Barron's Educational Series, Inc.
- Mandell, Lewis. 1990. *The Credit Card Industry*. Boston: Twayne Publishers, p. xii.
- Mark Twain Bank. 1997. "An Introduction to Ecash," available on the Internet at http://marktwain.com/ecash_in.html, June 3.
- McAndrews, James J. 1997. "Making Payments on the Internet," Federal Reserve Bank of Philadelphia, *Business Review*, January/February, pp. 3-14.
- _____. 1997. "Banking and Payment System Stability in an Electronic Money World," Federal Reserve Bank of Philadelphia Working Paper 97-9.
- Mitchell, Richard. 1996. "Lots of Calls for Phone Cards," *Credit Card Management*, vol. 9, no. 9, December, pp. 14-18.
- The Nilson Report*. 1997. Oxnard, Calif., no. 640, March, pp. 7-8.
- Redlich, Fritz. 1951. *The Molding of American Banking: Men and Ideas*. New York: Hafner Publishing Company, Inc.
- Ricardo, David. 1816. "Proposals for an Economical and Secure Currency," in Piero Sraffa, ed., *The Works and Correspondence of David Ricardo*, vol. IV: Pamphlets and Papers, 1815-1823, 2d ed., London. Cambridge,

- England: Cambridge University Press, 1951, p. 72.
- Roberds, William. 1997. "What's Really New About the New Forms of Retail Payments?" Federal Reserve Bank of Atlanta, *Economic Review*, First Quarter, pp. 32-45.
- Rolnick, Arthur J., Bruce D. Smith, and Warren E. Weber. 1997. "The United States' Experience with State Bank Notes: Lessons for Regulating E-Cash," speech at "Conference on the Organization of Transactions in a Market Economy," Federal Reserve Bank of Minneapolis, January.
- Rolnick, Arthur J., and Warren E. Weber. 1988. "Explaining the Demand for Free Bank Notes," *Journal of Monetary Economics*, vol. 21, pp. 47-71.
- _____. 1986. "Inherent Instability in Banking: The Free Banking Experience," *Cato Journal*, vol. 5, no. 3, Winter, pp. 877-90.
- _____. 1984. "The Causes of Free Bank Failures," *Journal of Monetary Economics*, vol. 14, pp. 267-91.
- _____. 1983. "New Evidence on the Free Banking Era," *American Economic Review*, vol. 73, no. 5, December, pp. 1080-91.
- _____. 1982. "Free Banking, Wildcat Banking, and Shinplasters," Federal Reserve Bank of Minneapolis, *Quarterly Review*, Fall, pp. 10-19.
- Sargent, Thomas J. 1982. "The Ends of Four Big Inflation," in Robert E. Hall, ed., *Inflation: Causes and Effects*. Chicago: University of Chicago Press, National Bureau of Economic Research Project Report, pp. 41-97.
- Schreft, Stacey L. 1992. "Transaction Costs and the Use of Cash and Credit," *Economic Theory*, vol. 2, pp. 283-96.
- Schuler, Kurt, and Lawrence White. 1992. "Free Banking: History," in Peter Newman, Murray Milgate, and John Eatwell, eds., *New Palgrave Dictionary of Money & Finance*. New York: The Stockton Press, pp. 198-99.
- Selgin, George A., and Lawrence H. White. 1994. "How Would the Invisible Hand Handle Money?" *Journal of Economic Literature*, vol. 32, December, pp. 1718-49.
- Smith, Adam. 1776. *The Wealth of Nations*. New York: Alfred A. Knopf, Inc., reprint 1991, pp. 288-89.
- Smith, Bruce D. 1984. "Money and Inflation in Colonial Massachusetts," Federal Reserve Bank of Minneapolis, *Quarterly Review*, Winter, pp. 1-14.
- Spong, Kenneth. 1990. *Banking Regulation: Its Purposes, Implementation, and Effects*, 3d ed. Kansas City: Federal Reserve Bank of Kansas City.
- Taub, Bart. 1985. "Private Fiat Money with Many Suppliers," *Journal of Monetary Economics*, vol. 16, pp. 195-208.
- U.S. Congress, Congressional Budget Office. 1996. *Emerging Electronic Methods for Making Retail Payments*. Washington: Government Printing Office.
- Wallace, Neil. 1987. "A Suggestion for Oversimplifying the Theory of Money," *Economic Journal*, Supplement, vol. 98, pp. 25-36.
- _____. 1986. "The Impact of New Payment Technologies: A Macro View," in Colin Lawrence and Robert P. Shay, eds., *Technological Innovation, Regulation, and the Monetary Economy*. Cambridge: Ballinger Publishing Company, pp. 201-06.
- _____. 1981. "A Modigliani-Miller Theorem for Open Market Operations," *American Economic Review*, June, pp. 267-74.
- Wells, Kirstin E. 1996. "Are Checks Overused?" Federal Reserve Bank of Minneapolis, *Quarterly Review*, Fall, pp. 2-12.
- Whalen, Gary. 1997. "The Competitive Implications of Safety Net-Related Subsidies," Office of the Comptroller of the Currency, Economics Working Paper 97-9, May.
- White, Eugene N. 1995. "Free Banking, Denominational Restrictions, and Liability Insurance," *Money and Banking: The American Experience*. Fairfax, Va.: George Mason University Press, pp. 99-117.
- White, Lawrence H. 1984. *Free Banking in Britain*. New York: Cambridge University Press.
- Williamson, Steve. 1989. "Restrictions on Financial Intermediaries and Implications for Aggregate Fluctuations: Canada and the United States 1870-1913," in Olivier Jean Blanchard and Stanley Fischer, eds., *NBER Macroeconomics Annual 1989*. Cambridge, Mass: The MIT Press, pp. 303-40.
- Working Group of EU Payment Systems. 1994. *Report to the Council of the European Monetary Institute on Prepaid Cards*, May.