i

Electronic Money and Monetary Policy

Jeffrey M. Lacker[*]

Federal Reserve Bank of Richmond[**]

November 15, 1996

Abstract: Briefly reviews the potential consequences of electronic money for the management of the government's balance sheet through open market operations and for the regulations governing the public and private issue of payment instruments.

[**]P.O. Box 27622, Richmond, VA 23261, Phone: 804-697-8279, E-mail: eljml02@rich.frb.org.

Electronic money -- stored value cards, internet-based cash and the like -- is a new way of providing payment instruments. In this paper I review the likely consequences of electronic money for monetary policy, where by monetary policy I mean the way the government provides payment instruments. Monetary policy thus encompasses both control of the government's balance sheet through open market exchanges of government bonds for government money -- currency and reserve accounts -- and the regulations affecting private payment instruments, such as reserve requirements, prohibition of private bank note issue, and so on.

One well-known consequence of monetary policy is the welfare loss associated with inflation. I discuss the consequences of inflation for (1) the incentive to substitute private payment instruments for government money, and (2) the incentive to create new payment instruments like electronic money. Finally, I consider possible policy responses to the new payment instruments. The discussion draws heavily on recent research on monetary models with multiple means of payment, particularly work by Stacey Schreft (1992). Most of what is asserted below is shown formally in a forthcoming paper of mine (Lacker 1996). The discussion also owes a substantial debt to the insights of Neil Wallace, who wrote quite perceptively about electronic money over a decade ago (Wallace 1986).

Seigniorage and the welfare costs of inflation

Inflation generates seigniorage, an implicit source of revenue for the government. If instead of issuing base money the government had to issue interest-bearing debt, total interest payments on the government debt would be larger. The reduction in interest expense from issuing money instead of bonds thus accrues to the government in the form of reduced future outlays. Monetary arrangements in the U.S. make seigniorage revenue explicit. The Federal Reserve holds the government debt that would have been issued to the public in the absence of the base money issued by the Fed. The interest earnings on the Fed's portfolio would have been paid to the public if not for the base money issued by the Fed.

Seigniorage can be viewed as a tax on holders of government money. The opportunity cost of holding currency is the additional real return that could have been earned by holding some other asset instead, a Treasury discount bill, for example. Bills and base money are both virtually risk-free, and both provide a fixed quantity of currency at some fixed future date. The real return on the bill is its nominal yield minus an adjustment for the depreciation due to inflation. The currency earns no nominal return, but merely depreciates due to inflation. The difference between the real rate of return on the two investments is just the nominal interest rate on the bill. The foregone nominal interest earnings thus measure the

opportunity cost of holding base money.

Seigniorage is a tax in the sense that the opportunity cost faced by holders of the monetary base is greater than the real social cost of providing the monetary base, which is virtually nil.[1] As long as the nominal interest rate is appreciably greater than zero, the cost of holding government money is greater than the social cost of provision. A monetary policy that made the nominal rate essentially zero would eliminate the tax on government monetary instruments.

Taxes can distort economic activity, and the seigniorage tax is no exception. The magnitude of the welfare loss can be portrayed on a familiar graph depicting the demand for the monetary base. In Figure 1 the demand for money is the downward sloping line labeled D; the horizontal axis measures the real quantity of money demanded, while the vertical axis measures the opportunity cost of money.[2] If the nominal interest rate is given by i, then the demand for money is the quantity m.

A tax generally induces people to economize on the taxed good. The welfare loss associated with a tax is the aggregate willingness to pay for the goods people forego due to the tax, net of the social cost of producing those goods. Here, the social cost of providing government money is essentially zero, so the welfare cost of the seigniorage tax is measured by the shaded area under the demand curve D to the right of m in Figure 1. This is the welfare cost of inflation. It measures the willingness-to-pay of consumers who would hold money if the opportunity cost were lower.

The welfare costs of inflation arise from the actions people take to economize on the use of government money. A number of different explanations of these activities have been given, but they are not mutually exclusive. In the traditional textbook account, inflation causes people to reduce average money holdings by making more frequent exchanges between interest-earning assets, like savings accounts, and money. This might require more frequent trips to the bank, the so-called "shoe leather costs" of inflation. The deadweight cost of inflation, in this version, is the value of the time used making more

---

[1]The cost for currency and coin averages 0.18 cents per dollar outstanding: Lacker (1996). The cost for reserve account balances averages over half a cent per dollar, but is recovered from fees charged to banks: Lacker (1993).

[2]For a general equilibrium model in which a demand curve like that of Figure 1 holds every period, see Schreft (1992). In her model agents can use either government currency or costly private credit. Credit costs vary across locations, and credit is used at more locations when the nominal rate is higher. See Dotsey and Ireland (1996), however, for qualifications and a thorough analysis of the welfare costs of inflation. They argue that the welfare costs of inflation are grossly underestimated if one does not take into account effects on labor supply and growth.

frequent bank visits.[3]

Another explanation of the deadweight cost of inflation is that a positive opportunity cost of using money induces consumers to substitute away from transactions requiring money and toward consumption of goods that do not require cash in advance. Examples of the latter include leisure time and goods that can easily be purchased on credit.[4]

Another explanation of the deadweight cost of inflation is that rather than use government money, consumers use a private payment instrument such as checks, credit cards, debit cards, or traveler's checks.[5] These instruments involve their own direct resource costs, such as printing checks or manufacturing cards. In addition, private monetary instruments all constitute credit arrangements of one form or another; the seller acquires a debt obligation. The use of credit as a means of payment thus incurs real costs associated with screening, monitoring, enforcement, and resolution of defaults. Clearing and settling private instruments is costly as well. And if an alternative means of payment is physically less convenient for consumers or merchants to use than government money, this too must be counted as a cost.

When the opportunity cost of using government money is large, it is more worthwhile to incur the costs associated with private payment instruments. These costs dissuade consumers from using private money when opportunity costs are low. In this case the area under the demand curve represents the resource costs associated with the alternative means of payment. Thus when the nominal rate is positive some of the resources devoted to supplying private payment instruments represent a welfare loss from society's point of view.

Not all of the costs associated with private means of payment are necessarily deadweight loss. Private payment instruments may also provide some worthwhile benefits for which people are willing to pay. To put this another way, even if the nominal interest rate were essentially zero, private payment instruments would coexist alongside of government money. For example, consumers may find checks safer or more convenient and may be willing to compensate banks for the cost associated with check processing, fraud losses, and so on. Nevertheless, the excess costs induced by a positive nominal interest rate are wasteful from society's point of view.

The general assumption underlying this view is that a particular private monetary instrument will

---

[3]See McCallum and Goodfriend (1988) for a survey of models in this class.

[4]See Lucas (1988) for a formalization of this approach.

[5]Schreft (1992) pioneered this approach.

be used in a particular setting if, taken together, the incremental benefits to various parties to the transaction -- consumers, merchants, banks, and so on -- exceed the incremental costs. The benefits and costs to private parties to the transaction represent genuine social benefits and costs, with one exception. One benefit of using a private money rather than a government money is that it avoids the seigniorage tax. The seigniorage tax is an opportunity cost to private participants in the payment system, but is not a true social cost because the government's cost of providing the monetary base is virtually zero. Monetary policy that results in positive nominal interest rates therefore provides an external subsidy to private providers of payment instruments that substitute for government money.

Introducing new monetary instruments

If the argument that inflation induces excessive use of existing private substitutes for government money is correct, then the same argument should apply to the introduction of new private payment instruments. If positive nominal interest rates provide a subsidy for existing private payment instruments then they provide a subsidy for implementing new electronic payments technologies. This suggests that electronic money might result in a welfare loss, in the sense that society would be better off without it. On the other hand, the new electronic payment instruments might in some applications substitute for existing payment instruments that are more costly from society's point of view. Thus, new payments technologies might benefit society by inducing substitution away from more expensive private payments arrangements.[6]

Figure 2 depicts the introduction of electronic money. The new instrument reduces the demand for government money at any given nominal interest rate, and the demand curve shifts to the left, from D to D'. If monetary policy is such that the nominal interest rate stays the same, then the monetary base falls from m to m'. As depicted in Figure 2a, the welfare cost of inflation rises, since the area under the demand curve D' to the right of m' is greater than the area under the demand curve D to the right of m. Figure 2b depicts a case in which the welfare cost of inflation falls. In principle, either case is possible. Clearly, whether electronic money is good or bad is an empirical question.

. The scenario portrayed in Figure 2 assumes that monetary policy responds to the new technology with open market operations that reduce the real supply of base money to m', keeping the nominal rate unchanged. Seigniorage falls proportionally, from im to im'. There is no reason for the price level or the

---

[6]Lacker (1996) presents a formal model illustrating this argument.

inflation rate to be affected, since monetary policy has merely accommodated a shift in money demand. The main effect of this policy is on the budget; seigniorage revenues are lower, interest payments are higher and more government debt is in the hands of the public.

The scenario portrayed in Figure 2 also assumes that new technologies do not result in the complete disappearance of government money. An alternative scenario, perhaps not very likely, is that new payment instruments completely displace the monetary base. Since currency serves as unit of account, it is not clear what would play that role after it disappears. Nominal interest rates could well be positive in the new unit of account.

The complete disappearance of the monetary base seems quite unlikely however. One reason is that none of the electronic money schemes that have been proposed seem like perfect substitutes for paper currency. Monetary transactions take place in many varied settings, and although electronic money appears to be superior in some, it seems likely that many consumers will continue to prefer currency in at least some settings. Another reason to doubt that government money will disappear entirely is that while many new payment instruments will displace currency, most will ultimately be cleared and settled in reserve account balances. In other words, some new technologies might be complements of reserve account balances, even though they are substitutes for currency.

Again, I take as given the general presumption that if the total benefits to participants of adopting a new payment arrangement exceed the total costs, then that payment arrangement will tend to be adopted. The new arrangement might impose additional costs on particular participants, but other participants for whom the benefits outweigh the costs will find ways to compensate those inconvenienced. This presumption should not be controversial, since the same presumption underlies all competitive analysis, and there does not seem to be a convincing reason to believe that any market failure affects the adoption of new payments arrangements, aside from the inefficiencies, described above, associated with monetary policy. The rebates and "frequent flyer miles" many consumers receive for using credit cards in retail transactions are examples consistent with the notion that participants in payment arrangements are able to compensate consumers for cost-savings.

Policy responses

From the point of view of the models underlying Figure 1, the best policy is to reduce the inflation rate enough to make the nominal interest rate essentially zero, completely eliminating the welfare cost of

inflation. This is Friedman's (1969) prescription for the optimal quantity of money. Then there would be no external subsidy for adopting payment instruments, new or old, that substitute for the monetary base. The private incentive to implement payment arrangements would be aligned with social benefits and costs.

What has been left out of the discussion so far, however, is why one would want the nominal rate to be positive. One potential reason for a positive seigniorage tax is that all taxes are distortionary, and alternative revenue sources would be even more distortionary. In this view, the seigniorage tax is a component of an optimal tax scheme that equalizes the marginal welfare loss per dollar of revenue raised from each revenue source. This view actually strengthens the case I presented above. If the loss of seigniorage revenues had to be recovered by raising other distortionary taxes, the additional deadweight burden would have to be added to social cost of any new payment instrument that substituted for base money. This is another reason why the social cost of electronic money might exceed the social benefit.

Another potential reason for a positive nominal rate, at least for a time, is that in the presence of nonneutralities the optimal disinflation might be gradual rather than abrupt. Until disinflation is achieved, under this view, we must cope with the current deadweight burden of inflation, including its affect on the efficiency of the payments system.

If we take the current level of the nominal interest rate as given, however, one can imagine regulatory policies aimed at curbing excessive electronic money. Figure 2a indicates that in some cases banning the new payments technology would make society better off. The case for banning the new technologies depends critically on the properties of the new technologies. The case is strongest when marginal cost rises slowly, so that average cost is relatively high, as in Figure 2a. The case is weakest when marginal cost is low but rises sharply for the most costly applications, as in Figure 2b.

Alternatively, it would be better still if we could devise a way to restrict the most costly applications of the new technologies. The most costly applications are the ones for which the excess resource cost is greatest; their profitability is most dependent on capturing seigniorage. These applications are also the ones which are least likely to be replacing some more costly seigniorage-avoiding activity. If quantitative limits on the issue of electronic money could be devised, participants would limit their use to the least costly settings. Figure 3 portrays the effects of the ideal quantitative constraints. Demand becomes inelastic where the constraint binds, and the welfare loss shrinks. This would improve welfare in *either* the Figure 2a case or the Figure 2b case. I admit, however, that I do not know of a practical method of imposing the proper quantitative constraints.

Reserve requirements or some other tax on private monetary instruments might be useful in limiting excessive payment system innovation; Figure 4 shows how it would effect money demand. Unlike

the ideal quantitative constraint, a reserve requirement is not always welfare enhancing, however. A reserve requirement reduces the seigniorage subsidy for supplying alternative payment instruments, and this has two effects. One is to make the most costly applications unprofitable. This effect eliminates the applications that are most wasteful and is strictly welfare enhancing. The second effect is to raise the cost of the alternative payment technology to inframarginal users, encouraging wasteful activities to avoid the seigniorage tax. This effect reduces welfare, for the same reason that inflation itself reduces welfare. The desirability of a reserve requirement thus depends on which effect predominates, again an empirical question.

Yet another possible policy response would be for the government to provide electronic money itself. The advantage of government provision is that electronic money could be priced to prevent overuse. By earning as much seigniorage on electronic money, net of real supply costs, as is earned on currency, the external subsidy for substituting electronic money for other government money would be eliminated. The demand for government money in Figure 1 would shift outward to include the demand for government provided electronic money. But would the deadweight cost be reduced? It depends on the margin of substitution between private payment instruments and electronic government money. If some private payment instruments are close substitutes for electronic money, then the demand curve will be flatter under government monopoly provision of electronic money, and the deadweight burden will be larger. For example, if the government monopolized stored value cards, on the grounds, say, that they are currency-like bearer instruments, then the question is whether other privately provided electronic payment instruments, such as debit cards, are close substitutes for stored value. Given the technologies involved, it seems plausible that stored value is a closer substitute for debit cards than for paper currency, but again, this is an empirical question.

To summarize, the economic models we have at hand indicate that the desirability of most policy options depends on the nature of the new technologies. Reserve requirements or an outright ban may or may not be desirable, depending upon whether the inframarginal benefits of electronic money in supplanting more costly seigniorage-avoiding activities dominates the marginal cost of excessive resource costs. The desirability of nationalizing electronic money is similarly dependent on the nature of the technologies. Only reducing the inflation rate or, if practical, quantitative constraints would unambiguously increase welfare.

An Assessment

Policies aimed at inhibiting electronic money would be consistent with a long history of regulations that prevent or restrict the use of private substitutes for the monetary base. For example, since at least the Civil War private bank note issue has been restricted or effectively banned. Reserve requirements on bank deposits have a long history as well, and were extended by the Monetary Control Act of 1980 to all depository institutions. If there is a rationale for such policies, "then it would seem that it would also apply to other payment instruments that potentially substitute for the monetary base." (Wallace 1986, p. 205)

One rationale for such restrictions is that in the presence of one distortionary tax a second distortion can sometimes improve economic welfare. The policy responses discussed above are all versions of this principle. A positive nominal interest rate, I have argued, is a distortionary tax on the holders of government money. A well known result from the theory of optimal taxation tells us that close substitutes should be taxed at similar rates. Similarly, rationing close substitutes for a taxed good is generally welfare improving, so prohibiting some of the actions people take to economize on the use of government money could be worthwhile. By reducing the slope of the demand curve they make the demand for money less elastic, and the less elastic the demand the less the deadweight burden of the tax.

Neil Wallace (1983) has emphasized that without restrictions on private substitutes for government money the ability of the government to earn seigniorage would be sharply restricted. Without legal restrictions private intermediaries could issue currency backed by risk-free government bonds. The demand for government money in Figure 1 would then be horizontal at an interest rate equal to the cost of such intermediation. Without legal restrictions, Wallace argues, no seigniorage (net of real supply costs) is possible. A second role for such restrictions, however, is to impede socially wasteful efforts to avoid the seigniorage tax. Not only do legal restrictions make seigniorage possible; they reduce the deadweight burden of collecting it.

A restrictive policy response would conflict with the usual efficiency argument in favor of unfettered private intermediation. According to this argument, binding restrictions on private intermediation would inhibit socially beneficial intertemporal trade. Versions of this argument may have motivated many of the exceptions to the regulations described above. Traveler's checks, for example, are a relatively close substitute for currency. Similarly, money market mutual funds and money market deposit accounts do not bear reserve requirements and yet are functionally equivalent to reservable checking accounts, except for the regulatory constraint limiting withdrawals to six per month. Versions of this argument may also have motivated the recent repeal of the state banknote tax and removal of the

restrictions on national bank note issue.[7]

It should be clear, however, that the usual efficiency argument for a laissez-faire approach is incomplete under the current monetary regime. If we continue to maintain a flow of seigniorage earnings, then every payment system innovation must be scrutinized for its effect on the deadweight burden of inflation. As Chairman Greenspan stated in a recent speech, "it may be difficult for us to determine whether profitable and popular new products are actually efficient alternatives to official paper currency or simply a diversion of seigniorage from the government to the private sector" (Greenspan 1996, p. 8). If we intend to hold on to the payment instrument monopolies we currently have -- paper bearer notes and interbank transfer instruments -- every payment system innovation, public or private, should be subject to cost-benefit analysis.

In the same speech Chairman Greenspan goes on to argue that "a diversion of seigniorage may be an inevitable byproduct of creating a more efficient retail payment system in the long run" (Greenspan 1996, p. 8). This suggests a trade-off between deadweight burden in the short-run and the long-run. It suggests that we might accept an increase in burden in the short-run as a cost of reaching a more efficient payment system in the long-run. In other words, the near-term inefficiency of payment system innovations can be viewed as the transition costs associated with a path toward a payment system with a sharply reduced role for government money. Whether this tradeoff is worth accepting is again an empirical question, but this view is certainly consistent with the recent repeal of the legal restrictions supporting our monopoly on paper currency. This view is also consistent with the belief that an imminent decline in the inflation rate will soon significantly reduce the magnitude of the distortion.

---

[7]Title VI of the Community Development Banking Act, P.L. 103-325 (1994) repealed all restrictions on note issue by National Banks except the 1/2 percent semi-annual tax on outstanding notes. Section 1904(a) of the Tax Reform Act of 1976 repealed the 10 percent tax on note issue by corporations other than national banks. De facto restrictions by bank regulators may still prevent private note issue.

References

Dotsey, Michael, and Peter Ireland. "The Welfare Cost of Inflation in General Equilibrium." *Journal of Monetary Economics* vol. 37 (February 1996), pp. 29-47.

Friedman, Milton. "The Optimum Quantity of Money," in *The Optimum Quantity of Money and Other Essays*. Chicago: Aldine, 1969.

Lacker, Jeffrey M. "Stored Value Cards: Costly Private Substitutes for Government Currency," *Federal Reserve Bank of Richmond Economic Quarterly*, vol. 82 (Summer 1996), pp. 1-24.

Lacker, Jeffrey M. "Should We Subsidize the Use of Currency?" *Federal Reserve Bank of Richmond Economic Quarterly*, vol. 79 (Winter 1993), pp. 47-73.

Lucas, Robert E., Jr. "Money Demand in the United States: A Quantitative Review," *Carnegie-Rochester Conference Series on Public Policy*, vol. 29 (1988), pp. 137-168.

McCallum, B. T. and M. S. Goodfriend. "Theoretical Analysis of the Demand for Money," *Federal Reserve Bank of Richmond Economic Review*, vol. 74 (January/February 1988), pp. 16-24.

Schreft, Stacey L. "Welfare-Improving Credit Controls," *Journal of Monetary Economics*, vol. 30 (1992), pp. 57-72.

Wallace, Neil. "A Legal Restrictions Theory of the Demand for "Money" and the Role of Monetary Policy," *Federal Reserve Bank of Minneapolis Quarterly Review*, vol. 7 (Winter 1983), pp. 1-7.

Wallace, Neil. "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, Massachusetts: Ballinger, 1986.
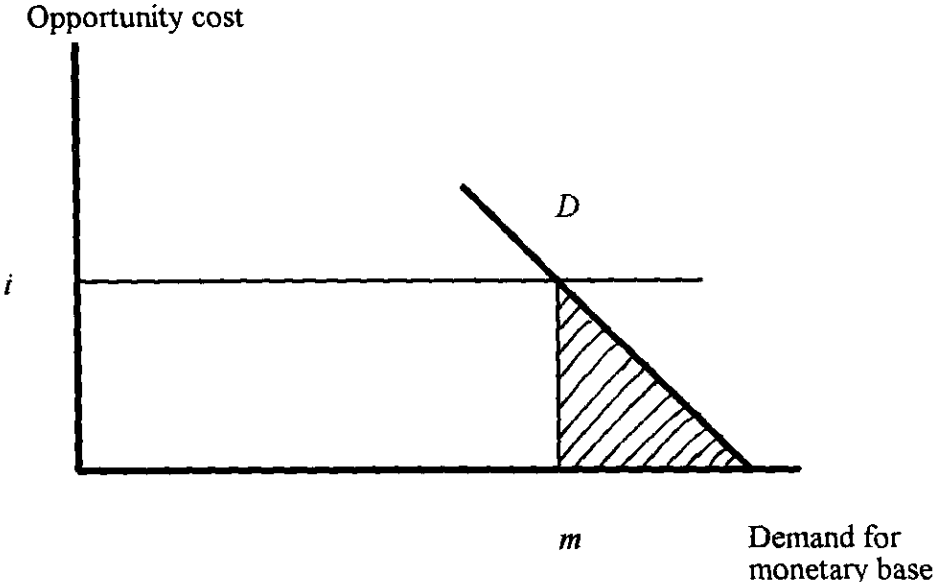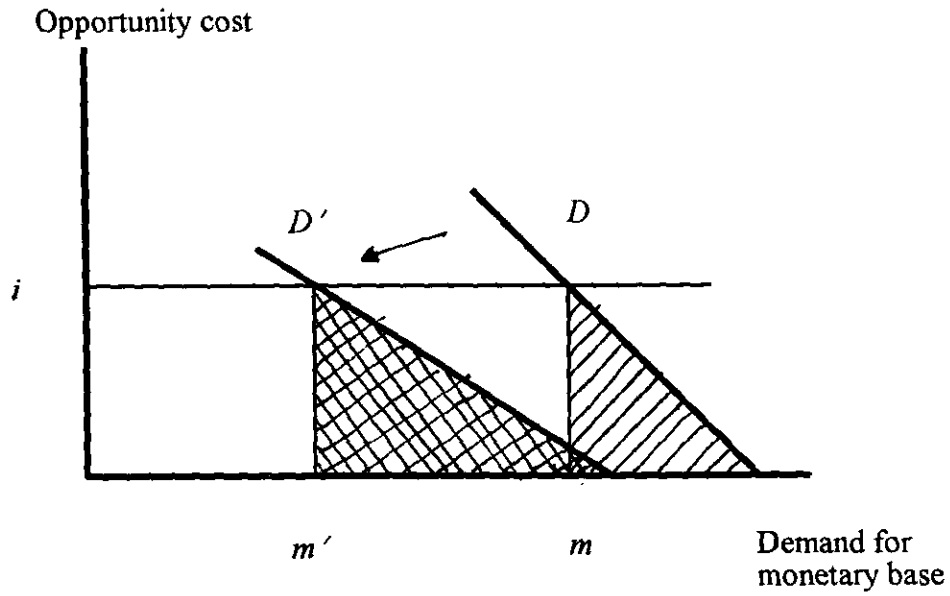
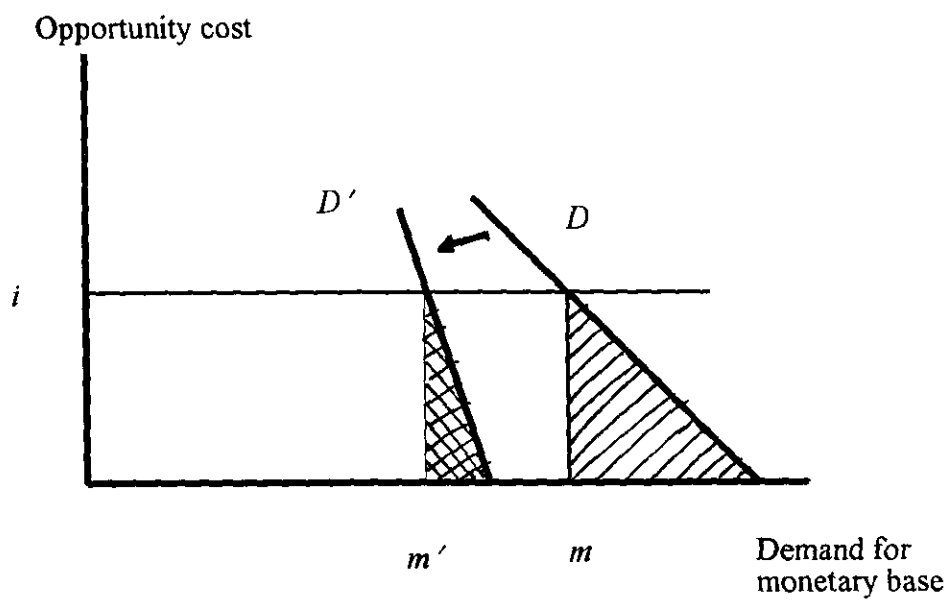**Figure 1** The welfare loss due to inflation

Opportunity cost

i

D

m

Demand for
monetary base

Figure 2   Introduction of electronic money

Opportunity cost

i

m ′   *m*   Demand for
                           monetary base

a. Welfare cost of inflation rises

Opportunity cost

i

m ′   *m*   Demand for
                           monetary base

b. Welfare cost of inflation falls

Figure 3   Quantitative restrictions
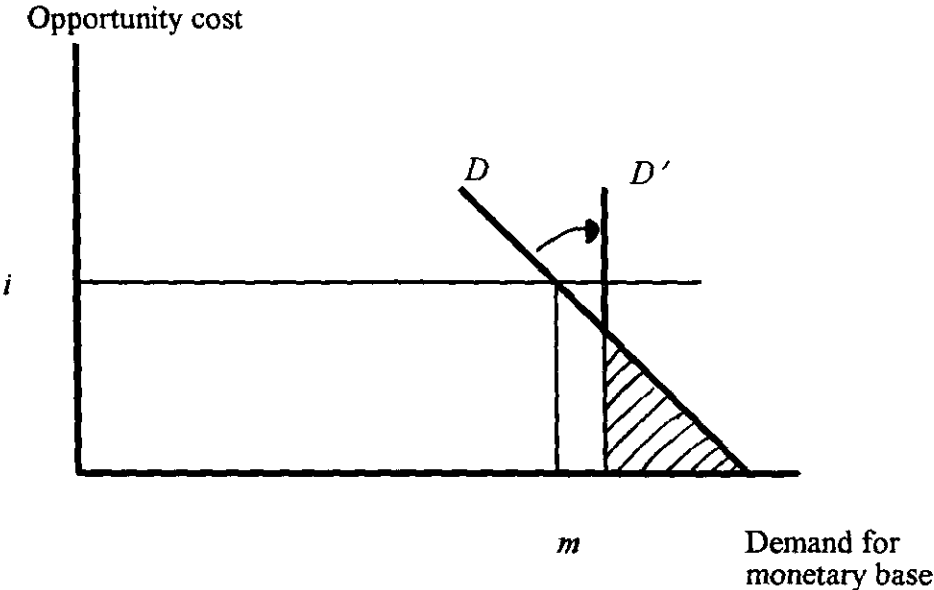
Opportunity cost

i

D   *D'*

m

Demand for
monetary base

Figure 4   Reserve requirement

Opportunity cost

i

D   *D'*

m

Demand for
monetary base