
FINANCIAL MARKET EFFICIENCY AND THE EFFECTIVENESS OF MONETARY POLICY

Improvements in information processing technology and deregulation, among other forces, are profoundly transforming the financial sector of the United States and other advanced economies. Many of these changes are likely to improve the efficiency of financial intermediation, in the sense that the dispersion of valuations of claims to future payments across different individuals and institutions is minimized. For familiar reasons, this should be generally beneficial for the allocation of resources in the economy.

Some fear, however, that the job of central banks will be complicated by improvements in the efficiency of financial markets, or even that the ability of central banks to influence the markets may be eliminated altogether. This suggests a possible conflict between the aim of increasing *microeconomic* efficiency—the efficiency with which resources are correctly allocated among competing uses at a point in time—and that of preserving *macroeconomic* stability, through prudent central bank regulation of the overall volume of nominal expenditure.

Here I shall briefly address two possible grounds for such concern. The first is the possible elimination of a special role for commercial banks in the provision of credit. This might be expected to weaken the Fed’s leverage over aggregate expenditure through its ability to control the supply of bank reserves (and, to a lesser extent, through its regulatory

oversight of member banks). The second is the dramatic reduction in recent years in the volume of Fed balances that banks must hold to satisfy reserve requirements. This has led to concern that reserve requirements may soon cease to bind, and that as a result the Fed would lose its main source of control over the pace of spending in the economy.

I believe that there is little ground for concern on either count. The effectiveness of monetary policy does not depend on the ability of central banks to manipulate significant market distortions, and the development of methods that allow central banks to achieve their stabilization objectives with as little interference as possible through the exercise of free choice over how funds are obtained to finance business activity should be beneficial to economic performance. Nor does effective central bank control over the pace of nominal expenditure depend on the creation of an artificial demand for central bank balances through the imposition of legal reserve requirements. This has already been illustrated by the experience of a number of other countries, such as Canada. It is true that the countries that have eliminated reserve requirements implement monetary policy in a somewhat different manner than is currently used in the United States. However, the United States could easily adopt the methods used in countries like Canada, and I suspect that there would be advantages to doing so.

Michael Woodford is the Harold H. Helm ’20 Professor of Economics and Banking at Princeton University.

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1. FINANCIAL EFFICIENCY VERSUS MACROECONOMIC STABILITY: IS THERE A CONFLICT?

A first question is whether the growing role of nonbank intermediaries and money markets as sources of business finance—reducing the special role once played by commercial banks, the institutions subject to the most direct control by the Fed—is likely to imply a reduced ability of the Fed to control the pace of spending in the economy and hence ultimately to achieve its inflation-stabilization objectives. I am inclined to be skeptical about the importance of such a threat. The presumption that monetary policy's effectiveness depends on some special role of banks is based on an old-fashioned idea that monetary policy acts by rationing the flow of credit that would otherwise occur; the Fed acts by controlling the flow of oxygen to the economy, and must maintain a sort of choke-hold to do it. If one takes that view, one might well be worried that the increasing efficiency of the financial system, giving private parties opportunities to substitute away from the particular channels that the Fed is best able to obstruct, should reduce the effectiveness of monetary policy.

But the exploitation of distortions in the efficient allocation of credit by the market system is neither essential nor, in my view, a particularly desirable aspect of monetary control under present circumstances, whatever its importance may have been at certain times in the past. The main way that monetary policy now works—in the United States and throughout the industrialized world—is by affecting the level of interest rates, rather than through quantitative controls over credit flows. And not only does this seem to be a sufficient channel for central banks to achieve their stabilization goals fairly well—for central banks worldwide have done better at stabilizing both inflation and real variables over the past decade, despite having largely forsworn efforts to intervene directly in markets—but it is the one that is most consistent with an important argument for the use of monetary policy as our main tool of stabilization policy. This is the idea that monetary policy has an advantage of acting relatively uniformly on spending decisions throughout the economy, allowing policymakers to stabilize inflationary pressures without creating undue allocative distortions across sectors of the economy.

Some might argue that it should not be possible to control interest rates without controlling the supply of credit, so that the difference in the two approaches is more superficial than fundamental; and that while it might be preferable to restrict the supply of credit uniformly rather than solely through particular channels, *some* choke-hold will be needed, and regulations will likely be necessary to ensure that the part of the

credit supply that the Fed can restrict will continue to matter for aggregate credit flow. But this represents an error in economic analysis, though not one that I can explain in detail on this occasion.

The important point is that there is *not* a particular level of interest rates that would be determined by the forces of supply and demand if the Fed were not able to interfere with them, for example, by preventing private institutions from offering credit on the terms with which they would otherwise be content. A typical partial equilibrium analysis of “the market for credit” might make it seem that there should be. But an intertemporal, general equilibrium analysis reveals that there is not. Specifically, general equilibrium analysis—in a model where, for the sake of simplicity, we suppose that all wages and prices are perfectly flexible—reveals that while *relative* prices have well-defined equilibrium values in the absence of distortions due to taxation or other government intervention, market forces cannot similarly determine the *absolute* prices of goods and services in terms of a fiat unit of account. The meaning of a “dollar”—the unit of account by which the prices of real goods and services happen to be quoted—would have to be determined by the policies of the Fed, even in a world where markets were completely efficient and completely unconstrained by government interference, for a dollar refers to nothing other than a type of Fed liability. And the central bank's role in defining the meaning of a fiat unit of account need not involve any interference with the freedom of contract, any more than the establishment of a standard meaning of a unit of measure such as the “yard” represents interference with the freedom of contract in markets where goods such as cloth may be sold by the yard.¹

It should furthermore be noted that not only is the meaning of a “dollar” something that can be determined by an arbitrary decision of the Fed, without any defiance of market forces being required, but there is a separate arbitrary decision of this kind to be made *at each point in time*. Just as market forces do not determine the value of a dollar on any given day, they do not require that its value (in terms of real goods and services) be the same from day to day. (Nor do the principles of geometry require that a yard be the same length from day to day, though life is simpler given the decision to define it so!) This means that the *nominal* interest rate that should be available between any two dates is not determined by market “fundamentals,” but is instead up to the arbitrary decision of the central bank, insofar as the nominal yield in question is defined in units of the liabilities of that central bank. This is important because in practice central banks find it more convenient to pursue their policy aims through control of short-term nominal interest rates (something they can do

through purely financial transactions) rather than by directly seeking to fix the exchange value of their liabilities in terms of any real goods and services.

At this point, one might object to my only providing an argument for the indeterminacy of the *nominal* interest rate in a world without government interference in markets; there would still be a well-defined, market-determined *real* rate of return over any time period, whereas central banks actually need to control *real* rates if they are to affect real expenditure. It may furthermore be argued that the apparent ability of a central bank to control nominal interest rates as it wishes depends upon the assumption that prices in terms of dollars can be freely adjusted without any consequence for relative prices, while there are important nominal rigidities in practice. It might then seem that even central bank control of nominal interest rates should be ineffective in practice, unless it is possible to obstruct credit flows.

But a more careful analysis would reveal that the existence of nominal rigidities undermines the argument that *real* interest rates should be determined by economic “fundamentals” in the absence of distortions resulting from government policy. Economic fundamentals (preferences, technology, and property rights) should determine an equilibrium real rate of interest consistent with *market clearing*—the real rate of interest required to induce people to demand at each point in time exactly the amount that the economy is able to produce. But if wages and/or prices do *not* immediately adjust in order to clear goods markets and labor markets, then the real interest rate need *not* be at this level, even in the absence of any interference with the behavior of private parties; a different real interest rate is simply associated with a different intertemporal pattern of imbalances between supply and demand.² The possibility of central bank control over nominal interest rates—indeed, the *necessity* for the central bank to signal to the private sector how nominal variables should evolve, if there is to be any determinate level of nominal interest rates—remains; but in such a world (which is our own world), central bank control over nominal interest rates also implies an ability to shift real interest rates, at least temporarily.³

Adjusting the real rate of interest does not require the obstruction of credit flows, because it does not require that there be any difference of opinion between different parts of the economy as to what the marginal rate of substitution would be between additional real income at two different dates. (Actual interference with the process of financial intermediation instead creates heterogeneity of this kind: some people assign a higher relative value to income now than to income tomorrow, but are nonetheless unable to borrow from

those that assign it a lower relative value, and so have a motive to lend.) A reduction in the interest rate by the central bank can lead *everyone* to perceive expenditure now to be cheaper than usual, in terms of foregone expenditure tomorrow; this remains consistent with equilibrium because a larger quantity of goods is made available for use today in response to the surge in demand, owing to the rigidity of wages and/or prices.

Once this is understood, it becomes clear that improvements in the efficiency of the financial system—such as the entry of new participants into credit markets, or into the federal funds market, or into wholesale securities markets—need pose no threat to the effectiveness of monetary policy. Instead, one should expect developments of this kind to increase the efficiency of the link between the particular interest rate that the Fed directly targets, the federal funds rate, and the general structure of interest rates and asset prices (including the *shadow* cost of funds to various households and firms, which may not show up as any market interest rate at all when financial markets are inefficient). This is exactly what one should hope for, in order to make monetary policy a more reliable instrument for accurately controlling spending decisions in the economy, and one that can do so in a way that distorts allocative decisions to the minimum possible extent.⁴ Thus, there is no reason to seek to slow down improvements in financial efficiency on the grounds that this should allow better control by the Fed over macroeconomic conditions.

2. THE DISAPPEARANCE OF REQUIRED RESERVES AND CENTRAL BANK CONTROL OF INTEREST RATES

Some may accept that central bank influence upon macroeconomic conditions through the control of short-term interest rates does not depend on any special role for commercial banks in financial intermediation, and yet nonetheless be concerned about another recent development: the sharp reduction in recent years in the quantity of Fed balances that banks need to hold in order to satisfy their reserve requirements.⁵ Indeed, it is already the case that many individual banks need hold no balances at the Fed for this purpose: their reserve requirements are already more than satisfied by their holdings of vault cash. This has led to expressions of concern that reserve requirements may soon cease to bind in the United States. The fear is that this may eliminate the Fed’s ability to control the volume of spending in the U.S. economy, or at least impair the accuracy with which it does so.

That this trend may continue is quite possible; banks have, after all, a clear motive to reduce their required reserves, as long as they do not pay interest, as they do under current U.S. arrangements. And given the motive, it is hardly surprising that institutional innovations (such as the spread of sweep accounts) should appear that serve this end. But once again, I think that there is little ground to fear that such developments should seriously impair the Fed's ability to pursue macroeconomic stabilization policy.

One reason to fear the possibility that nonbinding reserve requirements would mean a loss of Fed control is again the choke-hold view of monetary policy. According to this view, the Fed has to be able to obstruct credit flows somewhere; reserve requirements (together with quantitative control of the supply of reserves) imply a quantitative limit on the flow of funds through commercial banks, but if the requirements do not bind, the Fed's control of the supply of reserves does not do anything to limit bank credit. I have already taken issue with this general view. All that matters is that the Fed be able to control overnight interest rates; this gives it the leverage that it needs in order to pursue its stabilization objectives.

A more subtle question is whether elimination of a need to hold balances at the Fed to satisfy reserve requirements could interfere with the Fed's control of the funds rate. The funds rate is determined in an interbank market for overnight Fed balances; the Fed's ability to control the market-clearing rate through its control of the supply of Fed balances depends on the existence of a nontrivial demand for such balances that is at least somewhat interest-elastic. Traditional textbook accounts of the demand for Fed balances stress the demand for such balances to satisfy reserve requirements; if such demand disappears, can the Fed still exert any influence over overnight interest rates?

The answer is surely yes. A number of countries, including the United Kingdom, Sweden, Canada, Australia, and New Zealand, have completely eliminated reserve requirements. Yet these countries' central banks continue to implement monetary policy through operating targets for an overnight interest rate, and continue to have considerable success at achieving their operating targets. Indeed, some of these central banks achieve much tighter control of overnight interest rates than does the Federal Reserve.⁶

The elimination of required reserves in these countries has not meant the disappearance of a market for overnight central bank balances. Instead, central bank balances are still used to clear interbank payments. Indeed, even in the United States, balances held to satisfy reserve requirements account for less than half of total Fed balances at present,⁷ and Furfine (2000) argues that variations in the demand for clearing balances account for the most notable high-frequency patterns in the

level and volatility of the funds rate in the United States. In the countries without reserve requirements, this demand for clearing purposes has simply become the sole source of demand for central bank balances. Given the existence of a demand for clearing balances, a central bank can still control the overnight rate through its control of the net supply of central bank balances.

Nonetheless, the disappearance of a demand for required reserves may have consequences for the way that a central bank can most effectively control overnight interest rates. In an economy with an efficient interbank market, the aggregate demand for clearing balances will be quite small relative to the total volume of payments in the economy. Exactly for this reason, random variation in daily payment flows can easily lead to fluctuations in the net supply of and demand for overnight balances that are large relative to the average level of such balances.⁸

A consequence of this volatility is that quantity targeting—say, adoption of a target for aggregate overnight clearing balances while allowing overnight interest rates to attain whatever level should clear the market, as under the nonborrowed reserves targeting procedure followed in the United States in the 1979-82 period—will not be a reliable approach to stabilization of the aggregate volume of spending, if practicable at all. And even in the case of an operating target for the overnight interest rate, the target is not likely to be most reliably attained through daily open market operations to adjust the aggregate supply of central bank balances, the method currently used by the Fed. The overnight rate at which the interbank market clears is likely to be highly volatile, if the central bank conducts an open market operation only once, early in the day, and there are no standing facilities of the kind that limit variation of the overnight rate under the “channel” systems used by many of the countries without reserve requirements.

In the United States at present, errors in judging the size of the open market operation required on a given day can be corrected only the next day without this resulting in daily fluctuations in the funds rate that are too great, owing to the intertemporal substitution in the demand for Fed balances stressed by Taylor (2001). But the scope for intertemporal substitution results largely from the fact that U.S. reserve requirements apply only to average reserves over a two-week period; and indeed, funds rate volatility is observed to be higher on the last day of a reserve maintenance period (Spindt and Hoffmeister 1988; Hamilton 1996; Furfine 2000). There is no similar reason for intertemporal substitution in the demand for clearing balances, as penalties for overnight overdrafts are imposed on a daily basis.⁹ Hence, the volatility of the overnight interest rate, at least at the daily frequency, could easily be

higher under such an operating procedure, in the complete absence of (or irrelevance of) reserve requirements.¹⁰

But many central banks in countries that no longer have reserve requirements nonetheless achieve tight control of overnight interest rates through the use of a “channel” system. In a system of this kind, the overnight interest rate is kept near the central bank’s target rate through the provision of standing facilities by the central bank, with interest rates determined by the target rate. It is largely the interest rates associated with the standing facilities that determine the interest rate at which the interbank market clears each day.¹¹

Under such a system, in addition to supplying a certain aggregate quantity of clearing balances (which can be adjusted through open market operations), the central bank offers a lending facility, through which it stands ready to supply an arbitrary amount of additional overnight balances at a fixed interest rate. In Canada, Australia, and New Zealand, this lending rate is generally set exactly 25 basis points higher than the target rate. Thus, there is intended to be a small penalty associated with the use of this lending facility rather than the acquisition of funds through the interbank market. But funds are freely available at this facility (upon presentation of suitable collateral), without the sort of rationing or implicit penalties associated with discount-window borrowing in the United States.

Depository institutions that settle payments through the central bank also have the right to maintain excess clearing balances overnight with the central bank at a deposit rate. The deposit rate is positive but slightly lower than the target overnight rate, again so as to penalize banks slightly for not using the interbank market. Typically, the target rate is the exact center of the band whose upper and lower bounds are set by the lending rate and the deposit rate; thus, in the countries just mentioned, the deposit rate is generally set exactly 25 basis points below the target rate. The lending rate, on the one hand, and the deposit rate, on the other, then define a *channel* within which overnight interest rates should be contained. Because these are both standing facilities, no bank has any reason to pay another bank a higher rate for overnight cash than the rate at which it could borrow from the central bank; similarly, no bank has any reason to lend overnight cash at a rate lower than the rate at which it can deposit with the central bank. Furthermore, the spread between the lending rate and the deposit rate gives banks an incentive to trade with one another (with banks that find themselves with excess clearing balances lending them to those that find themselves short) rather than depositing excess funds with the central bank when long and borrowing from the lending facility when short. The result is that the central bank can control overnight interest rates within a fairly tight range regardless of what the aggregate supply of

clearing balances may be; frequent quantity adjustments accordingly become less important.

Woodford (2001) gives further details of a simple model of overnight rate determination under such a system. The key idea is that the demand for clearing balances should depend on the location of the interest rate at which such balances can be traded in the interbank market *relative to the bounds of the channel*, rather than in absolute terms. (This determines the opportunity cost of leaving funds overnight in one’s clearing account that might otherwise have been loaned in the interbank market, and the cost of having to cover an overdraft in one’s clearing account that could have been avoided by borrowing in the interbank market.) Hence, the central bank can shift the rate at which the interbank market is likely to clear by shifting the interest rates associated with the two standing facilities without any immediate need for an adjustment of the supply of clearing balances. Under the system described, such adjustments occur automatically whenever the central bank changes its target overnight rate.

Even if reserve requirements were to become completely negligible in the United States, owing to further improvements in the ability of banks to serve the needs of their customers without holding appreciable overnight balances in reservable accounts, effective control of the funds rate should still be possible through the adoption of a channel system for implementing the Fed’s operating targets for the funds rate.¹² Such a system should be highly effective, and would not require any change in the way that the Fed formulates its operating target for the funds rate. The effectiveness of funds rate control as a means for influencing the overall level of spending and hence inflationary pressures would be unaffected.

3. ADVANTAGES OF PAYMENT OF INTEREST ON FED BALANCES

Implementation of a channel system in the United States would, of course, require certain institutional changes. One of the more obvious of these is that interest would have to be paid on Fed balances, contrary to current practice. But this is a development that would have much to recommend it, quite apart from the way in which it would be possible to enhance control of the funds rate through linkage of the interest rate paid on reserves to the funds rate operating target.

First of all, payment of interest on Fed balances should improve the efficiency of the financial system by eliminating the penalty that currently exists for the use of means of payment (for example, checks drawn on reservable accounts) that result in increases in the balances that commercial banks

must hold at the Fed. The argument is one that was probably most famously articulated by Friedman (1960), who called for the payment of interest on required reserves at a rate similar to the market rate on short-term Treasury securities.

Friedman's basic argument is fairly simple. Requiring banks to hold non-interest-earning reserves at the Fed in proportion to the volume of reservable accounts at those banks is equivalent, in terms of the economic consequences, to taxing the banks for allowing their customers to maintain such deposits. Like other taxes, this one has economic consequences that go beyond the mere transfer of revenue from private parties to the government. Taxing transactions deposits penalizes banks for allowing customers to maintain accounts of that kind. As a result, banks will take actions that discourage their customers from maintaining as much money in such accounts as they would in the absence of the tax—for example, by paying less interest on account balances of this kind. This penalty will in turn discourage the banks' customers from holding such large balances in these accounts, and this will require them to carry out transactions in ways that allow them to maintain lower average balances in reservable accounts. The result is wasted effort as the banks' customers complicate their lives for the sake of tighter management of their reservable account balances.

Even supposing that one grants the desirability of reserve requirements—though I have argued above that they are not essential for monetary control—this unfortunate consequence of the legal requirement can be eliminated by payment of interest on reserve balances at a rate that is similar to what the banks could reasonably have expected otherwise to earn on those funds. This implies an efficiency gain from paying interest on such balances.

One might ask whether the mere fact that a requirement to hold non-interest-bearing reserves is like a tax implies that it would be in the public interest to repeal it. After all, taxes are necessary in order to finance essential government activities. Does the contribution to government revenues perhaps not outweigh the economic importance of the distortion of the way that transactions are arranged that I have just mentioned?

In fact, in the literature on "optimal taxation," a substantial consensus has emerged, according to which it is not desirable to tax transactions balances at all, despite the assumed necessity of financing the activities of the government and despite the fact that all available sources of government revenue create distortions of one sort or another.¹³ While the theoretical analysis of this question is fairly subtle, and the exact conclusions reached depend on many details of the assumed structure of the economy, the basic insight involved is again relatively straightforward.

When one penalizes people or firms for holding transactions balances, one is also penalizing them for making the purchases that are facilitated by those balances. The result is a distortion both of people's decisions to make those purchases, which have effectively been made more expensive, and of their decisions about how to organize their transactions so as to reduce the holdings of reservable balances required to carry out any given volume of purchases. The second of these distortions could be eliminated by directly taxing the purchases, say, through an increase in sales taxes. This alternative form of taxation could raise for the government the same level of revenue with a lower overall distortion of the pattern of economic activity. Hence, the conclusion obtained by most students of the question is that an optimal taxation system would not involve any taxation of transactions balances. This would require payment of interest on reserves, at a rate similar to the market rate of interest available to banks that lend funds overnight to private parties.

The arguments just reviewed for the payment of interest on Fed balances held to satisfy reserve requirements would apply equally to Fed balances held for clearing purposes.¹⁴ Taxing clearing balances similarly penalizes banks for using Fed balances for that purpose, and hence ultimately penalizes the customers of banks for using means of payment (checks cleared in this way) that require the banks to hold such balances. Payment of interest at a rate that reduces the opportunity cost to banks of holding clearing balances to a level close to the social cost of providing them would again eliminate a deadweight loss,¹⁵ and again, this particular source of revenue is likely to be an inefficient tax, on account of the general argument just sketched against the desirability of taxing a particular means of payment.

At the same time, the payment of interest on Fed balances—at least if implemented in the right way—should facilitate Fed control of overnight interest rates, rather than impair it. One reason has been discussed above: the possibility of using adjustments in the interest rate paid on Fed balances to help steer the funds rate to its target level, as under a channel system. But it should also be noted that the threat to the effectiveness of present Fed methods of implementation of the funds rate operating target discussed in the previous section would also likely be greatly reduced if interest were paid on reserve balances. If the opportunity cost of holding balances at the Fed were substantially reduced, the incentive to substitute away from reservable balances (for example, through the use of sweep accounts) would be correspondingly reduced. The likely result would be a larger demand for Fed balances to satisfy reserve requirements. This in turn would facilitate control of the funds rate by the Fed through open market operations by

increasing the intertemporal substitutability of the demand for Fed balances, as discussed above.¹⁶

It is important to note, however, that much depends on the details of the scheme according to which one plans to pay interest on reserves. There are some ways of doing this that could hamper Fed adjustment of overnight rates in response to changing economic conditions.

One problematic proposal would be the payment of a *constant* interest rate—say, a legislatively mandated interest rate of 5 percent per annum—on Fed balances that would apply to excess reserves as well as required reserves. The problem with this proposal is that banks would then never have any reason to lend funds overnight to one another at any rate lower than 5 percent; it would always be possible to obtain that much by leaving the funds with the Fed and there would be no credit risk to worry about, either.

The consequence would be that the Fed would never be able to push the fed funds rate below 5 percent, no matter how many reserves it chose to pump into the system through open market operations. This would limit the Fed's ability to lower overnight rates when necessary. The events of 2001 illustrate the fact that at times, the Fed needs to be able to lower the federal funds rate sharply relative to normal levels; if legislated interest payments on reserves had established a floor of 5 percent for the funds rate, we would surely have regretted this in the fall of 2001.

An equally problematic proposal would be the payment of a variable interest rate on all reserves—excess as well as required reserves—that is tied to the federal funds rate itself. I have summarized above the familiar argument that the distortions resulting from effective taxation of transactions balances would be eliminated as long as the interest on reserves is always equal to the rate that banks could earn on these funds if not required to hold them at the Fed; this might suggest that a commitment to pay interest on reserves at a rate equal to that day's fed funds rate would be desirable. But such a commitment would destroy the federal funds market. For no bank would ever lend funds overnight to another bank at any rate of interest if it knew that it can obtain the same rate by simply depositing the funds overnight with the Fed.

Moreover, promising to pay a rate equal to the current federal funds rate minus a fixed spread would also be problematic. For in that case, any shortage of reserves relative to banks' demand—due, for example, to a misestimate of the

size of open market operations required to stabilize the funds rate on a given day—that results in an increase in the federal funds rate would automatically raise the interest rate paid on balances held with the Fed as well. But this increase in the interest rate on Fed balances would further reduce the supply of funds in the interbank market, as banks would find it less attractive to lend to one another given the availability of a higher earning alternative use of their funds. Thus, increases in the rate paid on Fed balances would drive up the market-clearing rate in the fed funds market, causing further increases in the rate paid on Fed balances and so on in a self-reinforcing spiral. The result is that large swings in the funds rate (in either direction) could result from small initial imbalances between the supply of and demand for reserves. Such a system would complicate the Fed's control over the funds rate through its daily open market operations and likely lead to much greater funds rate volatility than we observe under present arrangements.

However, both of the problems just mentioned could be avoided if the Fed were to pay an interest rate on Fed balances that was tied to its current operating target for the federal funds rate, as under a channel system. This would avoid the problem of a fixed rate that constrains the ability of the Fed to lower interest rates when necessary. For when the Fed lowered its funds rate target, the rate paid on Fed balances would be correspondingly reduced so as to allow the funds market to clear at the lower rate.

It would also avoid the instability resulting from the self-reinforcing mechanism just described. For if the Fed were to underestimate the supply of reserves needed to satisfy demand at the target funds rate on a given day, the resulting rise in the funds rate would not increase the rate paid on Fed balances; the latter rate would continue to be tied to the funds rate target, rather than to the actual funds rate.

Thus, it is possible to pay interest on Fed balances in such a way as not only to avoid these problems, but actually to enhance the Fed's ability to control overnight interest rates. Such a system would increase the efficiency of cash management and payments in the U.S. economy as well. Finally, both the feasibility and effectiveness of such a system have already been demonstrated in other countries, such as Canada, Australia, and New Zealand. The United States would do well to consider following their example.

ENDNOTES

1. The difference between relative and absolute prices in this regard, and its consequences for a proper conception of the role of monetary policy, was first stressed by Wicksell (1936). See Hall (1999) and Woodford (2002a) for more recent discussions.

2. In the familiar Hicksian terminology, there is an “IS schedule,” rather than a single equilibrium real rate of interest, and monetary policy can determine which point on that schedule the economy reaches.

3. In such a model, it is useful to distinguish, as Wicksell (1936) does, between the “natural rate of interest”—the equilibrium real rate of return that would occur, given current fundamentals, under conditions of full wage and price flexibility—and the actual (real) rate of interest, determined by monetary policy. This distinction is developed analytically in the context of an explicit intertemporal general equilibrium model of the monetary transmission mechanism in Woodford (2002b), which also discusses the usefulness of the concept as a guide for monetary policy.

4. Woodford (2001) makes a similar point about the desirability of increased private sector information about central bank policy. Even if the inability to catch markets by surprise means a smaller effect on market rates of a given size of trade by the central bank, a change in rates that occurs should be *more effective* in achieving the central bank’s goals, owing to the tighter linkage between current conditions in this market and the rest of the economy—the source of the smaller effect on market rates.

5. This has been documented in this volume by Bennett and Peristiani (2002).

6. See the figures presented in Woodford (2001). For example, in Canada, the standard deviation of daily deviations of the effective overnight rate from the Bank of Canada’s target rate has been reduced to about 1 basis point, while in the United States it continues to be larger than 10 basis points.

7. See, for example, Woodford (2001, Table 1). Roughly the same quantity of Fed balances represents “required clearing balances.” These are amounts that banks agree to hold on average in their accounts at the Fed, in addition to their required reserves; the banks are compensated for these balances in credit that can be used to pay for various services for which the Fed charges fees. However, the balances

classified this way do not fully measure the demand for clearing balances. Banks’ additional balances, classified as “excess reserves,” are also held largely to facilitate clearing; these represent balances that the banks choose to hold *ex post*, above the “required balances” negotiated with the Fed in advance of the reserve maintenance period. Furthermore, the balances held to satisfy reserve requirements also facilitate clearing, insofar as they must be maintained only on average over a two-week period and not at the end of each day. Thus, in the absence of reserve requirements, the demand for Fed balances might well be nearly as large as it is at present.

8. See, for example, Woodford (2001, Figure 3), showing the daily variation in aggregate overnight balances at the Reserve Bank of Australia over several periods during which the target overnight rate does not change and over which the actual overnight rate was also relatively stable.

9. This is emphasized by Furfine, for whom it is crucial in explaining how patterns in daily interbank payments flows can create corresponding patterns in daily variations in the funds rate. However, the system of compensating banks for committing to hold a certain average level of “required clearing balances” over a two-week maintenance period introduces similar intertemporal substitution into the demand for Fed balances, even in the absence of reserve requirements.

10. The increase in funds rate volatility in 1991 following the reduction in reserve requirements is often interpreted in this way; see, for example, Clouse and Elmendorf (1997). However, declines in required reserve balances since then have to some extent been offset by increased holdings of required clearing balances, and this is probably the reason why funds rate volatility has not been notably higher in recent years.

11. See Woodford (2001) for a detailed discussion of such systems and details of their recent implementation in Canada, Australia, and New Zealand.

12. Meyer (2001) also proposes this as a possible solution to the problem.

13. For a recent survey of relevant literature, see Chari and Kehoe (1999).

ENDNOTES (CONTINUED)

14. They would also apply to the payment of interest on Federal Reserve notes (that is, currency), if it were practical to do so. The only reason why proposals to pay interest on reserves have been more widely discussed is that it is quite easy to see how the Fed can arrange to pay interest on balances held with it, should it wish to do so, whereas it is less easy to think of practical ways to pay interest to the holders of Federal Reserve notes. But the payment of interest on vault cash, at least, would seem completely practical.

15. Efficiency would best be served by having the Fed charge for its clearing services but not for maintaining higher average balances in clearing accounts.

16. This is the most important reason for the desirability of paying interest on reserves, in the view of Meyer (2001).

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