Modern Central Bank Operations—
The General Principles

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The debates between the structuralists and horizontalists within Post Keynesian economics highlighted the fact that endogenous money proponents had a very different understanding of monetary operations than did neoclassical economists. Indeed, as Fullwiler (2003) reports, until recently, research among neoclassicals related to bank behavior in the U. S. federal funds market had little relation to research on the Fed's behavior, and vice versa, aside from a few notable exceptions. This has all changed considerably since the late 1990s, as neoclassical researchers found several issues that required bringing the two together—such as concerns about policy options at the zero bound, retail sweep accounts, payments system crises, and increased use of non-central bank wholesale settlement options. Whereas a detailed understanding of monetary operations has been central to research in the endogenous money tradition for decades now, it is not a stretch to suggest that it is now also a well-established area of research within neoclassical monetary economics.

There are sharp differences between the two approaches that nonetheless remain. Among neoclassicals, the literature on central bank operations is not integrated into models of financial asset pricing or into the so-called "new consensus" model of the economy. Though the latter assumes interest-rate targeting, new consensus models are concerned with the *strategy* of monetary policy,

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not the *tactics* or daily operations; though well-established as a research topic for journal publications, monetary policy implementation remains "a side issue" in neoclassical monetary theory graduate textbooks like Walsh (2003) (Bindseil 2004, 1). Further, neoclassicals still do not consider money to be endogenously created in the banking system, as Marc Lavoie repeatedly points out; indeed, as Charles Goodhart has argued in a series of recent papers, there is in fact *no* private banking system whatsoever in the new consensus model (e.g., Goodhart 2008a).

This is disappointing, naturally, since the evidence published in the recent neoclassical literature on central bank operations has in fact been remarkably consistent with the endogenous money view of central bank operations. The horizontalist view that central banks only target interest rates directly (not reserve or monetary aggregates) and can do so as precisely as desired has been in particular repeatedly supported by this literature. While the relevant literature could fill several volumes, of special note here is the book by Ulrich Bindseil (2004), former Head of the ECB's Liquidity Management Section, which describes in substantial detail the operations of the Fed, ECB, and Bank of England in a manner that closely resembles the horizontalist story.

The purpose of this chapter is to describe ten general principles of modern central bank operations. These ten principles are not intended to be exhaustive or comprehensive; neither are the discussions of the individual principles necessarily exhaustive. Rather, these principles represent "what every economist should now be expected to know" given the large quantities of orthodox and heterodox research in this area and the empirical or anecdotal evidence contained in speeches and publications of central bank officials. As noted already, this research generally confirms the earlier points made by Moore (1988) and other authors associated in one way or another with the horizontalist literature.

Principle 1: *Reserve balances are held for only two purposes: payment settlement and (where applicable) meeting reserve requirements. Reserve balances do not "fund" loans or otherwise aid the creation of outside money.*

As endogenous money proponents have known for some time, loans create deposits as a matter of accounting. Pollin (1991) notes that both horizontalists and structuralists accept Alan Holmes's (1969) argument that "real-world banks extend credit, creating deposits in the process, and then look for the [reserve balances] later." Pollin argued, however, that the two approaches diverged on the issue of "how and where do the banks . . . obtain the additional [reserve balances] once they have 'extended more credit, creating deposits in the process'?" (1991, p. 367). His question, though, itself begs the more fundamental question: does the fact that a bank has extended credit necessarily mean that it must actively attempt to acquire additional reserve balances? The answer is found by considering the two reasons banks need reserve balances in the first place: banks hold reserve balances in their central bank accounts to settle payments and to meet reserve requirements.

Pollin's query was made within the context of reserve requirements; his argument implied that the existence of additional credit would raise deposits and thereby raise reserve requirements, which would thereby necessitate that the bank would hold more reserve balances (absent an increase in vault cash). Moore (1991, p. 407) appropriately counters Pollin, noting that the creation of a new loan need not lead to greater reservable deposits, but could be met with an increase in liabilities that have lower (or zero) required reserve ratios. Moore noted further that this would be all the more likely where interest rates were higher or where reserve balances were non-earning assets, both of which raise the opportunity cost of holding reserve balances or deposits and encourage banks to immediately seek ways to reduce their reserve requirements. Consistent with Moore's argument, since the emergence of retail sweep accounts in the mid-to-late 1990s, reserve requirements have been largely voluntary in the U. S. as banks use computer software to monitor deposit account activities of customers and "sweep" idle balances into non-reservable money market deposit accounts (Fullwiler 2003; Anderson and Rasche 2001).

Furthermore, as Moore noted in several papers in the 1980s, the need to meet reserve requirements occurs with a lag in the U. S. (particularly given the return to lagged reserve accounting in 1998) and in other countries. The maintenance period—the period of time during which banks have to meet reserve requirements

on average—ends (and, in most cases, begins) after a bank's reserve requirement has been determined. In the U. S, for instance, a given two-week maintenance period *starts* 17 days after a bank's reserve requirement for the maintenance period has been set. In the European Monetary Union, the maintenance period is lagged *and* lasts twice as long as in the U. S. In short, the act of extending credit and the act of acquiring reserve balances to meet reserve requirements should be kept quite separate. Banks short of their reserve requirement (which happens rarely given carry-over provisions that enable banks to meet in the following maintenance period deficiencies incurred in the current maintenance period) will automatically receive an overdraft into their reserve accounts at the central bank's stated penalty rate for such deficiencies; as such, even if maintenance and computation periods were truly contemporaneous (as some economists have proposed), required reserve deficiency would simply mean that a bank would incur an overdraft in its reserve account at the central bank's stated penalty rate. In other words, there is no additional constraint on bank behavior arising from the manipulation of the relative timing of maintenance and computation periods. Overall, the act of acquiring reserve balances to meet reserve requirements has to do with keeping the bank's cost of funds below the central bank's penalty rate, and has *nothing* to do with constraints on a bank's *ability* to create outside money.

Though still important in Japan and Europe, for instance, reserve requirements are now of little significance in the U. S. and are absent in many other countries. In these cases, the role of reserve balances is to settle payments. Here again, the extension of credit, which usually is accompanied by a payment transmitted by the bank on behalf of the new borrower, often does not require the bank to have reserve balances or to otherwise acquire them in money markets. In some nations, for instance, a significant percentage of payments are settled on a netted basis while banks are responsible for settling only a small percentage of these payments via their central bank accounts (Fullwiler 2006, 505-510). Further, in the U. S., banks sending payments within the minute that they receive another payment of equal or greater value do not incur a debit from their reserve accounts; consequently, banks frequently batch and send most of their payments during high

settlement periods (McAndrews and Rajan 2000). Finally, as explained in Principle 2 below, central banks generally provide overdrafts to banks at some price, enabling banks to send payments even when reserve account balances have zero or negative balances. In short, that a bank extends credit and (in most cases) clears a payment on behalf of the borrower does not necessitate that the bank has or otherwise actively seeks out additional reserve balances; instead, at issue for the bank is the *price* at which it is able to obtain needed reserve balances from other banks or at a penalty from the central bank in order to effect final settlement of the day's payments.

The point here is to decouple the quantity of reserve balances held by a bank from analysis of a bank's decision or its ability to extend credit, which is not usually understood by neoclassicals or by even some endogenous money proponents. Again, rather than asking where or how banks obtain reserve balances once they have extended credit, the more fundamental issue is to consider when banks use reserve balances in the first place. Otherwise, as demonstrated, one might be assuming a constraint upon bank behavior where none in fact exists, even within the endogenous money paradigm. In short, a bank deficient in reserve requirements or needing to settle an overdraft in its central bank account will seek to obtain reserve balances at the lowest possible cost, or it will obtain the reserve balances at a penalty from the central bank. As such, expanding its balance sheet (that is, creating additional outside money) creates a potential short position in reserve balances for the bank, which can affect the *profitability* of any loan it creates (at the initiation of a credit-worthy borrower), but does not affect the bank's *ability* to create the loan.

Principle 2: *As monopoly suppliers of the aggregate quantity of reserve balances, central banks have a fundamental, legal obligation to promote the smooth functioning of the national payments system.*

As Shen (1997) puts it, a nation's payments system is at the core of the infrastructure of the modern business world. An earlier statement by the U. S.

Board of Governors concurs that "a reliable payments system is crucial to the economic growth and stability of the nation. The smooth functioning of markets for virtually every good and service is dependent upon the smooth functioning of banking and financial markets, which in turn is dependent upon the integrity of the nation's payments system" (Board of Governors 1990, 2). Table 1 presents payments data for several countries published by the Committee on Payment and Settlement Systems at the Bank for International Settlements. As reported in column 8, in the U. S., payments settled using balances held in Fed accounts amounted to almost $2.1 trillion per business day in 2005, which—as shown in column 11—is nearly 17 percent of *annual* GDP. In other words, within about six business days, the total dollar volume of payments settled using balances held in Fed accounts is comparable to *annual* GDP. Daily payment settlement using central bank balances is similar in size relative to GDP in other countries—about 17 percent in the Great Britain, Japan, and Sweden, and over 20 percent in Switzerland and the Euro countries. Daily payment settlement using balances held in accounts at the Bank of Canada at nearly 11 percent of GDP is still very large even as it is the one of the lowest reported in the table. Consider further that a large percentage of these payments provide final settlement for still more payments previously cleared via netting arrangements on private payments systems (such as the Clearing House and Interbank Payments System (CHIPS) or the Depository Trust and Clearing Corporation (DTCC) in the U. S.).

The significance of such large quantities of payments requiring settlement on the central bank's books is that central banks are the monopoly suppliers of net reserve balances to the banking system. This is obvious when considering the typical central bank balance sheet, which it is now commonplace to refer to when discussing its operations (see, for instance, Bell (2000), Fullwiler (2003), Hamilton (1997), Lavoie (2001, 2003), Lavoie and Rodriguez (2006), Mosler (1997-8), and Wray (1998, 2003-4). Bindseil (2004) even dedicates an entire chapter to central bank balance sheets. As Lavoie (2001) and Lavoie and Rodriguez (2006) suggest, in general a central bank balance sheet will look something like Table 2. While there are substantial variations across central banks in terms of the relative sizes of

different components on the balance sheet and also less significant variations in terms of how certain parts of the balance sheets are defined, the basic balance sheet in Table 2 is a core characteristic of modern central banking.

Due to double-entry accounting, banks in the aggregate cannot alter the total quantity of reserve balances in circulation. Instead, the aggregate quantity of reserve balances changes *only* when there is a change in the central bank's balance sheet as a result of changes in claim on domestic banks, open market operations (to alter claims on governments or the outstanding quantity of central bank bills), or changes to other parts of its balance sheet (such as the government's account or foreign reserves). That is, while an individual bank can lend balances it deems are in excess of its desired holdings, in the aggregate such lending by banks simply shifts balances from bank to bank, but does nothing to alter the aggregate quantity. Similarly, an individual bank desiring more reserve balances can borrow in the interbank or other money markets, while such borrowing between banks again can only shift balances between banks and does not alter the aggregate quantity.

Due to both the large quantity of payments settled via reserve balances and the fact that only changes to the central bank's balance sheet can affect the aggregate quantity of balances, it is increasingly recognized, as a previous report by the U. S. Government Accountability Office put it, that "the primary objective of all central banks is to ensure the smooth functioning of their countries payments systems" (Government Accountability Office 2002, 2). Richmond Fed President Lacker has suggested that interbank deposit services are the "core" of central banking (2006, 3). As in Principle 1, central banks provide intraday or at least overnight credit (and usually both) to banks at *some* price. Indeed, in a survey of national payments systems around the world, Emmons (1997) finds that central banks do this via direct overdrafts, collateralized overdrafts, intraday repurchase agreements, or, at the very least, overnight lending. As column 3 of Table 1 shows, all of the central banks listed in Table 2 provide intraday credit; Canada, for which column 3 shows intraday credit of 0, actually utilizes a system in which banks pledge collateral at the start of business to cover negative intraday balances (Bank of International Settlements 2007, 21n), which is qualitatively almost the equivalent

intraday credit. Furfine (2000, 539) notes that in the U. S. it is not uncommon for banks active in the payments system to send and receive payments whose value are around 200 times their average overnight balances. To enable this, as columns 3 and 4 respectively show, the Fed has about $36 billion in intraday overdrafts to banks outstanding on average throughout the business day while the peak amount of intraday credit averages about $116 billion. Further, Column 5 shows that the U. S., U. K., Switzerland, Sweden, and the EMU all provide overnight credit, while several countries also provide "term loans" or—in other words—loans to the private sector via repurchase agreements, many of which are also overnight. Canada is the one country listed as providing neither overnight credit nor loans via repurchase agreements; however, Canada's system is such that all banks are effectively guaranteed the opportunity to clear net positive or negative balances in central bank accounts prior to the close of business (this is discussed in more detail in Principle 8; see also Lavoie (2005) and Rochon and Rossi (2007)).

Whereas large central bank operations to support the financial system are usually considered a "last resort," less often recognized is the fact that central banks are actually carrying out operations (via some combination of overdrafts, lending, or term loans) of substantial size on a *daily* basis. Further, while some recently have questioned the *ability* or *willingness* of central banks to carry out frequent and large-scale operations to support interest rate targets (e.g., Friedman 2000, 271), it is again clear that central banks *already* do this as needed on a typical business day to support normal payments system functioning. It is also worth mentioning that central banks face no operational constraint in carrying out such large operations—as they simply involve debiting or crediting balances on the central bank's own balance sheet—even as there might be legal or political constraints to doing so imposed by national governments.

Principle 3: *The money-multiplier view in which the central bank engages in direct targeting of reserve balances or the monetary base is untenable in practice. The only possible direct target is an interest rate target.*

As nearly every beginning student in economics learns (at least in the U. S.), the money multiplier-view of central banking suggests that the central bank directly alters the monetary base, which then enables it to adjust the aggregate money supply through a multiplier effect determined primarily by the required reserve ratio. Those invoking the money multiplier model often take for granted that the central bank *can* use the monetary base or reserve balances as a direct operating target. This principle demonstrates that central bank operations are in fact not consistent with the money multiplier and that the central bank's direct operating target is necessarily an interest rate.

The monetary base is composed of currency (including vault cash) plus reserve balances; the currency portion is in most cases the overwhelming portion. But currency is also entirely endogenous in the control sense. Far from Milton Friedman's description of "helicopter drops," central banks provide currency to banks needing to replenish vault cash, which is in response to the desired currency holdings of their customers. Similarly, rather than being a *source* of outside money creation—as the money-multiplier view suggests—an increase in currency in circulation is, if anything, a *response* to outside money creation. Consequently, the currency portion of the monetary base does not behave as the money-multiplier view suggests.

Regarding the reserve balance portion of the monetary base, consider a central bank that attempts to supply aggregate balances in quantities that differ significantly from banks' needs to settle payments or to meet reserve requirements. This would be a highly questionable operating tactic, to say the least. As in Principle 2, central banks are monopoly suppliers of reserve balances and thus are obligated to ensure the smooth functioning of national payments systems; they thereby provide intraday or overnight credit at some price. Similarly, it would "seem inappropriate or even legally questionable that the central bank should use its power to squeeze the market in a way that makes it impossible for banks to comply with [reserve] requirements" (Bindseil 2004, p. 236). In practice, and as previously mentioned, individual banks deficient in meeting reserve requirements

automatically receive a central bank loan at a pre-specified penalty rate, much like central bank overdraft policies associated with payment settlement.

Because the demand for reserve balances is very interest inelastic on a daily basis (where payment needs dominate the demand for reserve balances) or at least by the end of the maintenance period (where reserve requirements dominate), supplying more or fewer reserve balances than banks in the aggregate desire to hold will simply result in the interbank rate falling to the rate banks earn on balances in reserve accounts (if too many balances are supplied) or rising to the penalty rate assessed on overdrafts from the central bank (if too few are otherwise supplied). As such, a reserve balance "target" would be actually a *de facto* interest rate target at either the rate paid on balances in reserve accounts or the central bank's penalty rate. In practice, a reserve balance operating target would send the interbank rate fluctuating between these two rates, as banks' demand for reserve balances can shift significantly from day-to-day (depending upon the particulars of the national payments settlement system and the reserve requirement regime).

Significant volatility in the overnight rate is not desirable, however. As a member of the Fed's Board of Governors explained,

> A significant increase in volatility in the federal funds rate would be of concern because it would affect other overnight rates, raising funding risks for most large banks, securities dealers, and other money market participants. Suppliers of funds to the overnight markets, including many small banks and thrifts, would face greater uncertainty about the returns they would earn and market participants would incur additional costs in managing their funding to limit their exposure to the heightened risk. (Meyer 2000, 4).

Even within neoclassical economic theory, such volatility in the overnight rate would become problematic from a monetary policy perspective "if [it were] transmitted to maturities which are deemed directly relevant for decisions of economic agents (Bindseil 2004, 100-101). As a result, even when the Fed's stated strategy during 1979-1982 was to target a reserve aggregate such as non-borrowed reserves, in order to keep volatility in the federal funds rate from becoming excessive—which was highly likely given that reserve balances earned no interest while there were also significant "frown costs" historically associated with borrowing from the Fed—the

actual tactic employed ensured that the federal funds rate remained within an acceptable range, as confirmed in Meulendyke (1988). Thus, Moore (1988) labeled this tactic "dirty interest-rate targeting," the Fed's public statements notwithstanding.

Overall, then, the operating target in modern central banking is necessarily an interest rate target given a central bank's obligation to the payments system, its responsibilities associated with regulatory oversight of reserve requirements (where applicable), and the need to minimize volatility in money market rates. Reserve aggregates, the monetary base, or monetary aggregates can be targeted only *indirectly* via manipulation of the interest rate target—though the link between these has proven to be rather unreliable since loans and deposits are created at the initiative of creditworthy borrowers whose motivations are often not easily explained by the central bank's interest rate target alone. Of course, the key assumption of the money multiplier model—that increases in reserve balances or the monetary base enable outside money creation (or vice versa)—violates Principle 1. Since loans create deposits, neither of these can provide additional "funding" for bank lending. Neoclassical economists now acknowledge that central banks use interest rates as operating targets, rather than the monetary base or a reserve aggregate. However, in most cases, they have embraced interest rate targets only after grudgingly accepting the unpredictability of the velocity of money as a modern fact of life; thus, they still maintain a view of the money supply as exogenously determined via the monetary base or reserve balances. Further, a significant number of economists—many of whom are associated with the St. Louis Fed—remain "true believers" in money supply targets and continue searching tirelessly for a more perfect measure of money or eagerly anticipating the return of predictable behavior to the velocity of money (e.g., Anderson and Rasche 1996, Anderson et al. 2003). Thus, it is not well understood among neoclassicals that the money multiplier view was always untenable in practice, even as Post Keynesians and circuitistes have understood this for decades.

Principle 4: *Central banks accommodate banks' demand for reserve balances at the targeted interest rate while in the process offsetting changes to their own balance sheets that would otherwise be inconsistent with such accommodation.*

Since a central bank's operating target is necessarily an interest rate, its general approach to daily operations is to accommodate banks' demand for reserve balances at that rate. The process of accommodating the demand for reserve balances varies for different central banks depending upon particulars of the payments system and how/if there are reserve requirements (discussed a bit more in Principle 6). As discussed in Principle 2, all central banks face an intraday demand for reserve balances that is accommodated at some price either through intraday or overnight credit. If there are reserve requirements, then the central bank also accommodates a demand to hold reserve balances overnight at least by the end of the maintenance period. Even without reserve requirements, there may be reasons for banks to desire to hold reserve balances overnight as a buffer against the uncertainty of overnight overdrafts (discussed in Principle 8 below). In each case, the demand for reserve balances will be subject to shifts—rising during peak settlement times during the day, during high payment flow days (often related to calendar effects), and/or during the end of the maintenance period. Because the current state of central banking practice is such that the target rate is set above the rate paid on reserve balances and below the penalty rate on central bank loans (discussed in Principle 9 below), the central bank must accommodate these shifts in real time if it is to achieve the target rate on a consistent basis. Again, to "under" or "over" accommodate would lead to the overnight rate rising to the penalty rate on borrowing from the central bank or falling to the rate paid on reserve balances, respectively.

As changes to the central bank's balance sheet are the only possible source of changes to the aggregate quantity of reserve balances, in the process of accommodating the demand for reserve balances, central banks offset changes in their own balance sheets that occur autonomously or outside the direct control of those in charge of central bank operations. In most cases, this refers to offsetting

the reserve balance effects of additions to currency or changes in the government's account, but any of the changes to the central bank's balance sheet (such as that shown in Table 2) not consistent with accommodating the demand for reserve balances will be offset in practice.

In achieving the target rate, different central banks use different approaches within the context of the principle of accommodation and defensive reaction to balance sheet changes. For instance, the Fed relies on a combination of overnight, short-term, and long-term repurchase agreements, and then outright open market operations primarily to offset reserve balance drains from currency. The ECB, on the other hand, carries out operations only an average of once per week and utilizes repurchase agreements only (no outright operations). Also, while the Fed customarily carries out overnight or multiday operations in the morning only, the Bank of Canada and the Bank of England normally carry out operations at multiple times during the day.

The fundamentals of monetary accommodation of the demand for reserve balances and offsetting of autonomous changes to the central bank's balance sheet clarify three issues that have arisen in the monetary economics literature. First, the national government's account is a liability on the central bank's balance sheet, which means spending necessarily credits reserve balances to reserve accounts of recipients' banks, while taxation debits them. The operations of the Treasury and of the central bank are therefore necessarily interdependent, since in the presence of a fiscal deficit (surplus) either the Treasury or the central bank *must* sell (buy) bonds or otherwise drain (add) reserve balances in order to avoid the overnight target falling (rising) to the rate paid on reserve balances (penalty rate for borrowing reserve balances). For this reason, a number of researchers have argued that the operational purpose of government bond sales is "interest rate maintenance" to aid the central bank's operations, *not* government finance (e.g., Bell 2000, Fullwiler 2005, Mosler 1997-8, Wray 1998).

Second, the central bank's ability to achieve its interest rate target would not be threatened—as several previously suggested—if the so-called "revolution" in electronic money ("e-money") at some point resulted in the complete elimination of

currency in circulation. When the public demands more currency, it is supplied endogenously and reserve balances are drained in kind. If, for instance, the rise of e-money were to somehow result in the total elimination of the public's demand for currency, the central bank's operations would actually be *simplified*, as a major source of changes to the central bank's balance sheet that daily operations must offset would be eliminated.

Third, central banks necessarily sterilize currency operations that move the quantity of reserve balances away from that desired by the banking system at the target rate. Much like attempting to target reserve balances at a level below or above that desired by banks at the target interest rate, unsterilized interventions that alter central bank foreign exchange reserves (part of central bank assets in Table 2) would raise the rate to the central bank's penalty rate or lower it to the rate paid on reserve balances (Wray 1998). Many neoclassical economists have concluded that unsterilized intervention in foreign exchange markets occurs because their empirical analyses have presumed sterilization would occur via open market operations (usually of the outright variety); however, while at times central banks may utilize repurchase agreements, outright operations, or central bank advances as the offsetting operation, in other cases they may initiate transfers to/from the government's account *vis a' vis* the accounts of private banks or even issue central bank securities (Lavoie 2001, Lavoie and Rodriguez 2006). Many, if not most, of these operations could be autonomous, offsetting changes to the central banks balance sheet—what Lavoie and Rodriguez (2006) refer to as the compensation mechanism—as banks invest excess balances in Treasuries or the government transfers balances between its own account at the central bank and correspondent bank accounts in the commercial banks.

Principle 5: *Reserve requirements are related to interest rate targets, not control of monetary aggregates.*

Mostly resulting from the widespread use of the money multiplier model in neoclassical monetary economics, it has long been taken erroneously as fact that

fractional reserve requirements are related to control of monetary aggregates. Such was the foundation of provisions related to reserve requirements in the U. S. Monetary Control Act of 1980. As in Principle 3, this belief is inconsistent with Principle 1. The question is, then, what is the role of reserve requirements in modern central banking? As Bindseil (2004, 202) explains, "there is consensus that the main purpose of reserve requirements is stabilization of short-term interest rates."

That reserve requirements are related to interest rate targeting is most clear when one considers—as in Principle 1—the central bank's operations in the absence of reserve requirements. Without reserve requirements, banks hold reserve balances only to settle payments such as checks drawn on customer accounts or transfers for direct payments to other banks, the government, or as settlement of netted clearinghouse transactions. Loans create deposits, while reserve balances *only* settle payments and obviously provide no operative constraint on bank lending. However, the demand for reserve balances is extremely interest inelastic at the quantity of balances banks desire to settle payments for the day. If there are too many or too few balances relative to banks' demand, the interbank rate will respectively fall to the rate paid by the central bank on balances or rise to the central bank's penalty rate. Further, as in Principle 2, there is the possibility of substantial instability in the payments system if insufficient balances for settling the day's payments are not provided.

To lessen the difficulty of the central bank's task of achieving the targeted interest rate without excessive volatility, banks may be directed to hold additional reserve balances where reserve requirements are in effect, but loans still create deposits and reserve balances still do not "fund" the creation of bank liabilities. Instead, reserve requirements will accomplish three things. First, significant reserve requirements raise the quantity of balances held and thereby reduce the likelihood that banks will end the day in overdraft, thereby reducing the likelihood of instability in the payments system and undesirable increases in the interbank rate as banks attempt to avoid overdraft charges. Second, given a multi-day maintenance period, they reduce the inelasticity of the demand for reserve balances

on most days—aside from the end of the maintenance period—by permitting averaging of reserve balances held against reserve requirements across days; this reduces the potential effects on the target rate of incorrect forecasts of changes to the central bank's balance sheet. Third, they reduce the uncertainty on the parts of both banks and the central bank regarding the quantity of reserve balances demanded at the target rate on a given day whenever the maintenance period lags the end of the computation period. Fourth, given the reduced inelasticity of the demand for reserve balances, there may be a reduced need for operations by the central bank to sustain the target rate; for instance, both the Fed (2-week maintenance period) and the ECB (month-long maintenance period) carry out less frequent operations (currently about one per day at the Fed; one per week at the ECB) than at the Bank of Canada or the Bank of England—both of which have effectively no reserve requirements and (as noted in Principle 4) carry out more frequent operations. This point is further confirmed when considering that prior to the reduction in reserve requirements due to the proliferation of retail sweep accounts in the U. S. the Fed did not see a need for temporary open market operations on about 25-30 percent of business days.

It bears noting, however, there is at least a bit of a tradeoff in that reserve requirements can introduce some additional complexities for achieving and sustaining the target rate, as well. First, the less lagged the maintenance period is from the end of the computation period, the more uncertainty will exist for banks in determining reserve needs and therefore also for the central bank in correctly estimating the demand for reserve balances; as the point of reserve requirements is stabilization of short-term interest rates, the more "contemporaneous" the maintenance and computations periods are, the more counterproductive such a reserve requirement regime may be, *ceteris paribus*. Second, as Whitesell (2006) notes, without some sort of provision for carrying over deficiencies or surpluses from one maintenance period to the next, interbank rates on the last days of the maintenance period can be volatile as capacities for averaging balances held across days become exhausted. Third, it is difficult for the central bank to respond too precisely to previous, current, or expected temporary deviations from the target rate

since it may be difficult or even impossible for the banking system to "work off" excess balances or "build up" from shortages by the end of the maintenance period. Finally, banks will speculate on the near-term direction of the overnight rate and in the presence of averaging provisions these expectations can become self-fulfilling; this is because it is often not reasonable for the central bank to completely offset these actions as it would likely entail leaving the banking system with too large an excess or deficient position (e.g., Krieger 2002, Whitesell 2003). As Lavoie (2005) puts it, "averaging provisioning flattens the relevant segment of the demand curve for reserves, but it also tends to induce vertical shifts in the middle horizontal portion of the demand curve, due to changing expected overnight rates, which may differ from the target rate" (704-705). In the U. S. such "anticipation effects" are known to be related to target rate changes, historical patterns of rate deviations from the target within the maintenance period, high-payment flow days, and calendar-related events such as end-of-quarter "window dressing" of bank balance sheets (Carpenter and Demiralp 2006, Krieger 2002).

Principle 6: *The potential size of deviations in the overnight target from the central bank's target rate is set by the width of the spread or corridor between interest paid on reserve balances and the penalty assessed to borrowing from the central bank.*

In the debates between horizontalists and structuralists, Pollin (1996) suggests that central banks—the Fed, in particular—do not have complete ability to achieve their target rates, and presents econometric evidence to support this argument. Given the large quantity of research on this point since, it is now clear that one needs to make a distinction between operating procedures in place for the purposes of achieving the target and the actual ability of the central bank to achieve the target with a minimum of volatility. While numerous central banks have utilized procedures that enable significant (or at least statistically significant) volatility, that a central bank *could* achieve its target rate as precisely as desired is now well established.

Though reserve requirements can improve the central bank's ability to hit the overnight rate target, they are merely one possible way of reducing variability in the overnight rate. In the U. S., after the rise of retail sweep account technology, banks became far more likely to incur overnight overdrafts as the quantity of reserve balances demanded became less tied to reserve requirements and more closely tied to the more variable, daily payment settlement needs of banks rather than the more predictable, bi-weekly demand for reserve requirements. Not surprisingly, federal funds rate volatility increased dramatically. However, the increased volatility in the federal funds rate was possible only as a result of the sizeable spread between the penalty rate charged on borrowing from the Fed and the interest rate paid on reserve balances (zero percent). Though the Fed set the discount rate below the target federal funds rate prior to 2003, the non-monetary costs associated with borrowing from the discount window combined with the substantial penalty historically assessed on overnight overdrafts (the day's federal funds rate plus 400 basis points) meant that the federal funds rate could rise substantially if reserve balances provided were insufficient to accommodate the existing demand. On the other hand, if more reserve balances circulated than banks desired to hold, the federal funds rate could slip well below its targeted rate and fall (theoretically) to zero if a reserve excess persisted.

Many countries without reserve requirements—for example, Canada, Great Britain, Norway, Sweden, New Zealand, and Australia—have kept overnight rate volatility low by paying interest on central bank balances at, say, 0.25 percent below the targeted overnight rate, and charging interest for overnight lending at, say, 0.25 percent above the targeted overnight rate (Sellon and Weiner 1997, Woodford 2001, Lavoie 2005). The overnight rate then settles between the two rates, without moving outside the range or "spread"; in practice some of these central banks have achieved their target rates with substantially more precision than the Fed (Woodford 2001, Lavoie 2005). This is so even as the demand for reserve balances in these countries is a function only of existing settlement technologies and payment flows and thus is very interest inelastic.

The Fed's primary lending facility implemented in January 2003 lends to all banks (secured by appropriate collateral) at one percent above the targeted federal funds rate (which was reduced to 25 basis points above the target in March 2008). By eliminating the non-monetary costs historically associated with borrowing from the Fed and lending at a penalty rate, the Fed is operationally similar to other central banks that have chosen to directly limit the upside potential of the overnight rate. The New York Fed noted the effect of reducing the range of potential volatility in the federal funds rate in its annual report:

> Volatility in the federal funds rate was exceptionally low in 2003 and 2004, when target rates for federal funds were at historical lows [one percent]. At that time, the gap between the target rate and the lower bound for rates—zero percent [since the Fed does not pay interest on reserve balances]—narrowed substantially which, in conjunction with the primary credit facility adopted in 2003, effectively limited the potential trading range for rates. Since that time, the potential room for downward movements has widened substantially [as the target rate has increased]. (Federal Reserve Bank of New York 2006, 21)

Consistent with this principle, it recognized that "the increased in federal funds rate volatility in 2005 may have been at least partly due to the higher interest rate environment" that had served to widen the potential trading range.

In some cases, operating procedures aimed at improving the central bank's ability to offset autonomous changes to its balance sheet or accommodate bank demand more precisely have been employed to reduce volatility (some examples related to the Bank of Canada are provided in Principle 8). Combined with a narrow "corridor" between the rate paid on reserve balances and the penalty rate, these tactics can be particularly effective in nearly eliminating deviations from the target rate. But while the former are consistent with the central bank's duties of accommodating the demand for reserve balances described in Principle 4, there are even simpler procedures for effectively eliminating volatility that are consistent with the principle that potential volatility is determined by the width of the corridor. For example, Fullwiler (2005), Whitesell (2006), and Lacker (2006) independently propose that the central bank set the target rate equal to the rate paid on reserve balances while leaving a substantial excess of balances circulating. As Richmond

Fed President Jeffrey Lacker explained, "the market funds rate would not rise above the [rate paid on balances] except to reflect borrower-specific risk. The New York Fed staff would merely need to provide an amount of reserves that will be sufficient to oversupply the system with reserves and meet daylight settlement needs. But they would not need to estimate daily reserves" (2006, 3).

Given the difficulties in money markets beginning in the late summer and fall of 2007, Mosler (2007) and Goodhart (2008b) propose going a step further and set *both* the penalty rate and the rate paid on reserve balances equal to the target rate, creating a corridor equal to zero, at least (in Goodhart's proposal) for desired balances equal to some (policy-determined) percentage of a bank's retail deposits. In the context of substantial market unrest, Mosler (2007) argued that "when the [central banks] fully understand their own monetary operations . . ., they will offer funds at or just over their target rates and also have a bid for funds at or just under their target." The relevant point here is to recognize that such a procedure would obviously enable the central bank to achieve the target rate with essentially no volatility and little, if any, effort expended, even when extraordinary circumstances prevail in the financial system.

Overall, the quantity of reserve balances demanded by banks has nothing to do with a central bank's *ability* to achieve the interest rate target with minimal volatility. Though in the absence of reserve requirements the demand for reserve balances becomes much more interest inelastic, the corridor set by the central bank's penalty rate and the rate paid on reserve balances sets the limit for potential deviations from the target rate. That some central banks have left in place operating procedures that permit greater volatility is quite different from suggesting that they *cannot* do otherwise.

Principle 7: *There is no "liquidity effect" associated with central bank changes to its operating target.*

There is a vast literature on the term "liquidity effect," most recently focusing on identifying the effects on the interest rate—if any—at the daily frequency of

"shocks" to the quantity of reserve balances. The use of the term here, however, refers to the use of open market operations when the central bank changes its target rate to more or less permanently alter the supply-demand balance of reserve balances (at least until the next target change occurs) in the overnight market in order to generate the desired change in the target rate. A liquidity effect as defined here is the procedure for changing the target rate generally assumed by most economists and textbooks. In fact, however, a good deal of recent empirical research has generally concluded that there is no such liquidity effect in practice (e.g., Thornton 2006, 2007a, 2007b; Demiralp and Jorda 2002). The lack of evidence has led many to suggest there is instead an "announcement effect" at work when the central bank changes the target rate; that is, central banks simply announce a new target rate, rather than carrying out any actual operations to effect the change (e.g., Guthrie and Wright 2000, Demiralp and Jorda 2002).

An understanding of modern central bank operations outlined in the foregoing principles makes clear that there is no liquidity effect related to target rate changes. As Sandra Krieger (head of domestic reserve management and discount operations, New York Fed) put it,

> The conventional textbook view is that the Trading Desk buys and sells securities in response to easings and tightenings [i.e., the liquidity effect]. From the [Trading] Desk's perspective, however, the supply-demand balance is primarily a function of the demand for required balances, which is almost completely insensitive to small changes in policy. Consequently, any change in the target has no effect on excess supply or demand in the funds market. (Krieger 2002, 74)

Since there is no change in the supply-demand balance for reserve balances with a target rate change, there is no need for open market operations related to a liquidity effect as defined here. In the case of the Fed, while it might *temporarily* change the quantity of balances in order to "signal" a new rate to traders or to "nudge" the rate when traders do not move to the new target quickly enough, any changes inconsistent with the given demand for reserve balances—unlike a liquidity effect—are necessarily reversed later in the maintenance period (Krieger 2002, 74). This in fact was the Fed's operational procedure prior to 1994—after which it began publicly

announcing its target changes—which likely accounts for the empirical evidence some have uncovered of open market operations correlated with target changes in this earlier period; note, however, consistent with "signals" or "nudges," none have found empirical evidence of a change in the supply-demand balance in the federal funds market related to a target change either before or since 1994.

The mistaken belief that the central bank alters the quantity of balances in circulation in order to change the target rate erroneously implies that banks can "do" something with additional reserve balances when they are supplied, as with the money multiplier model. Again, however, from Principle 1, loans create deposits, and thus reserve balances do not provide additional "funding" for expanding the quantity of bank liabilities. As with previous principles, permanently changing the quantity of reserve balances in circulation would simply send the overnight rate to the central bank's penalty rate or the rate paid on reserve balances if the change in quantity supplied were inconsistent with the quantity banks desired to settle payments and meet reserve requirements. Also, while there is evidence of a negative historical correlation over several weeks between reserve balances held and interest rates associated with reserve requirements—even as the demand for reserve balances for the *current* maintenance period is very interest inelastic—the causation is well-known to run from changes in the interest rate to changes in the public's holding of interest bearing versus non-interest bearing assets, which, again, has nothing to do with a liquidity effect as defined here.

Of course, this point is all the more valid where the demand for reserve balances is due mostly or even purely to payment settlement, which, again, exhibits still greater interest inelasticity. In this case, there is clearly no point in attempting to add or subtract reserve balances to change an interest rate target, since banks only desire that quantity necessary to settle payments for the day. Recalling the case of Canada—where there are no reserve balances held overnight system-wide—providing banks in the aggregate any quantity of net balances other than zero would send the overnight rate to the Bank of Canada's penalty rate or to the rate paid on reserve balances.

Instead of a liquidity effect, then, modern central bankers can simply announce rate changes. This is obvious when one considers a corridor tactic that leaves a narrow range between the central bank's penalty rate and the rate paid on reserve balances; in this case, the central bank can simply announce a new corridor and the target rate would necessarily be achieved within this new range. The point is similarly obvious when alternative procedures available to central banks are considered, such as setting the target rate equal to the rate paid on reserve balances while leaving substantial excess balances circulating (as advocated by Fullwiler, Lacker, and Whitesell in Principle 6) or narrowing the corridor further to zero or nearly zero (as advocated by Mosler and Goodhart in Principle 6).

Principle 8: *The quantity of reserve balances in circulation is primarily determined by the central bank's method of interest rate maintenance.*

There are a number of reasons why researchers have concerned themselves with the quantity of reserve balances circulating. Of course, the money-multiplier view posits that changes to reserve balances lead directly to changes in the money aggregates. More recently, others have been concerned that falling quantities of reserve balances demanded due to sweep accounts or the e-money revolution could impede central banks' abilities to target interest rates (discussed in Principle 10). However, instead of being related to an attempt to enable more (or less) lending or being an indicator of a central bank's ability to set an interest rate target, this principle demonstrates that the quantity of reserve balances circulating is mostly set by the central bank's method of interest rate targeting. More specifically, the primary factors determining how many reserve balances banks desire to hold at the target rate (and which the central bank will accommodate) are the existence and size of reserve requirements, the certainty banks have regarding their abilities to avoid ending the day with an overdraft or otherwise avoid holding more/fewer balances than desired, and whether the interest rate target is set at or above the interest rate paid on reserve balances. These characteristics are set either by the

central bank itself or by the political/regulatory context within which the central bank operates.

Reserve requirements obviously result in *more* reserve balances circulating, and depending upon the size of reserve requirements, the quantity might be much larger. Whether reserve requirements can be met by bank vault cash held (as in the U. S.) or not (as in the European Monetary Union) also clearly affect the quantity of balances banks desire to hold and which the central bank necessarily accommodates in order to achieve its interest rate target (as in Principles 3 and 4).

Absent reserve requirements, banks would desire to hold only an amount of excess balances related to the uncertainty surrounding needs to settle payments by the end of the business day. Bindseil (2004, 79) writes that Orr and Mellon (1961) were the first to suggest that a demand for excess reserves exists only when banks face some uncertainties regarding payment flows. Obviously this is correct, as absent such uncertainty, banks should want to hold zero balances where there are no reserve requirements or, where there are reserve requirements, just that amount which meets reserve requirements on average, since reserve balances historically earn below-market returns. Consider, however, how much the existence of such certainty or uncertainty depends upon the central bank's operations. In the case of no reserve requirements, the desire to hold overnight reserve balances exists simply as a precaution against overnight overdraft penalties; however, any balances held at the end of the day are exactly offset by outstanding overdrafts if the central bank can reliably offset all net changes in its balance sheet. Rather than a sign of reduced importance of reserve balances or of the central bank's operations, zero overnight balances can be the result of increased precision in monetary operations such that neither overnight overdrafts nor the fear of such overdrafts existed. With reserve requirements, as Furfine (2000) shows for the U. S., the demand for excess balances can also be strongly related to uncertainties surrounding payment flows, in addition to being affected by penalties on overdrafts, carryover provisions, and other aspects affecting banks' abilities to substitute balances across days of the maintenance period (which are likewise part of the central bank's method of setting interest rates).

The ability of the central bank to forecast changes to its balance sheet and its ability to correctly anticipate payment settlement needs therefore largely will frame the context for whether banks desire to hold excess balances in the aggregate. For instance, the Bank of Canada knows with certainty the changes that have occurred to its balance sheet by the end of the day and undertakes operations to completely offset them at that time; then, as the there are then no net autonomous changes to its balance sheet, the banking system is left with no net change in aggregate reserve balances. Banks are then provided a final opportunity after the close of business to enter the interbank market and eliminate offsetting individual overdraft or surplus positions with complete certainty (Lavoie 2005, Rochon and Rossi 2007). In the U. S., on the other hand, the Fed has far less certainty regarding its estimates of changes to its balance sheet, which result in net changes to aggregate balances held by banks. There is no mechanism in place, as in Canada, to bring together banks with net surplus or net overdraft positions after the close of business; further, the U. S. system of payment settlement and lending is quite decentralized and includes thousands of banks (compared to systems such as Canada, with few banks and centralized settlement (Lavoie 2005)). These reduce certainty among individual U. S. banks regarding end-of-day reserve positions and result in the desire to hold a positive quantity of aggregate balances overnight beyond that necessary to meet reserve requirements in order to avoid the possibility of overdraft penalties; this is again well known to be particularly the case on high payment flow days (Furfine 2000, Krieger 2002).

Obviously, in theory at least, the Fed's operating procedures might be adjusted to enable it to offset its balance sheet more effectively (perhaps by following the Bank of Canada's example of carrying out payment transfers or other operations to offset balance sheet changes near or at the end of the business day), enabling interbank trades between overdraft and surplus banks after the close of business (again, as in Canada), or carrying out more frequent securities operations (as in the U. K.). Any combination of these would result in fewer reserve balances circulating, *ceteris paribus*.

Note, however, that the move by banks to reduce excess positions held in any of the above cases is based most fundamentally on the fact that reserve balances held earn below market rates, which is effectively a tax on holding reserve balances. The near-universal tactic of central banks to this point, of course, has been to set the target rate *above* the rate paid on interest. Recall that this requires the central bank to drain all undesired excess balances to avoid the overnight rate falling to the rate paid on reserve balances. As this has been the overwhelming real-world experience, it is understandable that the endogenous money literature and most of the discussion of the principles to this point have considered the central bank's provision of reserve balances as necessarily defensive and endogenously driven by banks' aggregate needs for settlement and reserve requirements. However, a target rate set equal to the rate paid on reserve balances—as proposed in Principle 6—in fact would enable *exogenous* control over the quantity of reserve balances circulating, provided that the quantity circulating was at least sufficient for banks to meet payment settlement needs and reserve requirements; as noted in Principle 6, the primary benefit to central bankers of this tactic is a substantial simplification of operations since they would no longer need to precisely estimate reserve demand in order to drain undesired balances and could achieve the target rate simply by providing an oversupply of balances to banks. (As Lacker (2006) notes, this operating tactic could also enable the central bank to minimize or even eliminate intraday credit to reserve accounts if excess balances circulating are large enough.) However, the result of raising the quantity of excess reserve balances circulating under such an operating procedure would be greater control over the interest rate target; as in Principle 1, it would have nothing to do with an increased ability of banks to create outside money.

One can thus conceive of a wide spectrum of possible methods of interest rate targeting that would result in substantial differences in the quantity of reserve balances circulating. At one extreme are central banks like the Bank of Canada, whose interest rate targeting environment includes no reserve requirements, considerable precision in offsetting the central bank's balance sheet, no uncertainty on the part of banks regarding overnight overdrafts, and the interest rate target is

set above the rate paid on reserve balances; total reserve balances held overnight are essentially zero under these circumstances. At the other extreme would be the Bank of Japan during the period of zero interest rate targeting and so-called "quantitative easing." In that case, since the interest rate target and the rate paid on reserve balances were both zero, a very large quantity of undesired excess balances could be allowed to circulate while still being consistent with achieving the target rate. The current U.S. method of interest-rate maintenance sits between these two extremes. With the federal funds rate target above the rate paid on reserve balances (zero percent), all undesired excess balances are drained; thus a given deficit requires bond sales for interest rate support. Reserve requirements and uncertainty related to end-of-day overdrafts in payment settlement, on the other hand, raise the quantity of reserve balances banks desire to hold. In the ECB, since reserve requirements cannot be met through vault cash, reserve balances desired are more than in the U. S.; but balances held by Japanese banks during the zero rate targeting period could be substantially larger than those held by EMU banks since in the later case the target rate is set above the rate paid on balances.

In short, then, the quantity of reserve balances circulating primarily has to do with how the central bank achieves and maintains its target rate. As in Principle 1, the quantity of reserve balances circulating is unrelated to traditional notions of "tight" or "easy" monetary policy as the money-multiplier model assumes.

Principle 9: *Under current operating procedures, the central bank's balance sheet expands and contracts endogenously while these changes neither create nor destroy net financial assets for the non-government sector.*

Central to the monetarist view is the argument that "money does not burn holes in pockets" (Yeager 1968); thus, even as real-world central banks do not actually drop money from helicopters, since central bank operations are presumed to have the power to generate excess liquidity (in the form of reserve balances and/or the monetary base) and wealth effects, in the monetarist and neoclassical paradigms, they might as well be dropping money from helicopters. This principle

demonstrates to the contrary that central bank operations do not affect "excess liquidity" or net financial wealth in the non-government sector (except for a special case described below, which in fact has more to do with fiscal policy).

As in Principles 3 and 8, neither reserve balances nor the monetary base can be expanded or contracted exogenously by the central bank as long as the central bank's target rate is above the rate paid on reserve balances. Under these conditions, from Principle 2, the central bank necessarily accommodates the demand for reserve balances related to payment settlement; from Principles 3 and 5, the central bank necessarily accommodates the demand for reserve balances to meet reserve requirements; from Principle 4, the central bank necessarily offsets changes to its own balance sheet that are not consistent with accommodating the demand for reserve balances at the target rate. It is noteworthy that a recent restatement of monetarism by Nelson and Schwartz (2008, 32) argues that a central bank "is always able to expand its total balance sheet at a sufficient rate so that bulges in currency demand do not translate into drains on bank reserves"; the point here, though, is that a central bank *can do no other*—if the quantity of balances circulating is less than that desired by banks, the central bank's balance sheet *will* expand either via open market operations or as banks incur overdrafts in payment settlement or in meeting reserve requirements. Also not clear from Nelson and Schwartz's statement is whether they understand that with the target rate set above the rate paid on reserve balances the central bank *cannot* expand its balance sheet *exogenously* in a manner that would be inconsistent with banks' demand for reserve balances at the target rate.

Recent "non-traditional" operations at the Fed, ECB, and other central banks beginning in late 2007 demonstrate the endogenous nature of changes to the central bank's balance sheet. For instance, the Term-Auction Facility (TAF, which provided short-term loans to a greater number of banks than typically engage in repurchase agreements with the New York Fed's Trading Desk), the Primary Dealer Credit Facility, and some other changes made in the Fed's operations were intended to provide lender of last resort-type of functions to banks and to some non-banks; these resulted in a rebalancing of the Fed's balance sheet, not an exogenous increase in it.

Throughout the period, the aggregate demand for reserve balances was mostly unchanged (aside from a temporary increase in August 2007); consequently, the Fed needed to offset the increase in reserve balances resulting from (for example) TAF loans by simultaneously selling Treasury securities to drain an equivalent amount of reserve balances. (In fact, the Fed's overall balance sheet *decreased* in size during the late 2007 to early 2008 period as the private sector's desired level of currency holdings declined.) At the ECB, large loans made to commercial banks during fall 2007 were consistent with the temporarily increased demand for reserve balances to settle payments under conditions of severe stress in money markets for obtaining refinancing; the ECB's well publicized "$500 billion day" was short lived, as its balance sheet expanded and contracted endogenously in response to the lender of last resort needs of the banking system. Suggestions in the financial press that the Fed and the ECB were "flooding" financial markets with money or liquidity were inapplicable; instead, under current operating procedures, there is no such thing as a central bank providing "excess liquidity," as this would violate Principles 2, 3, 4, and 5.

This refutation of the "excess liquidity" argument has been at the core of the horizontalist literature. Lavoie (2003, 2005) uses the terms "asset-based" and "overdraft" to distinguish between central bank operations respectively based largely upon open market operations and those based on central bank overdrafts or loans. As he notes, while much neoclassical analysis of central bank operations has historically presumed an asset-based approach, all central banks in fact utilize the overdraft approach in practice even if not explicitly acknowledged. This is consistent with the general principles discussed here—central bank operations accommodate banks' demand for reserve balances and offset changes to the central bank's balance sheet not consistent with such accommodation; central banks cannot use open market operations to directly target a quantity of reserve balances if the target rate is set above the rate paid on reserve balances. That an asset-based system functions essentially like an overdraft system is all the more clear given substantial intraday credit explained in Principle 2 and that day-to-day open market operations in asset-based systems like the U. S. and Canada are carried out largely

or even exclusively via repurchase agreements (Lavoie 2005); as Bindseil (2004, 156) notes, repurchase agreements—since they are simply collateralized loans—are functionally equivalent to overdrafts. In the case of the Fed (and for many other central banks, as well), the quantity of outstanding repurchase agreements for decades has been larger than the quantity of reserve balances circulating. Since under current operating tactics central bank operations are consistent with Lavoie's description of an overdraft system, logically it cannot be the case that the central bank is creating "excess liquidity" since loans or overdrafts are created at the initiation of the borrower, not the lender.

As in Principle 8, if the target rate is set equal to the rate paid on reserve balances, in this case the central bank *can* increase or decrease its balance sheet in an exogenous manner, provided that enough reserve balances are supplied to satisfy bank demand for them at the target rate. Recognition of this fact appears to be behind the Fed's recent request that Congress enable it to pay interest earlier than the 2011 date set in previous legislation (Ip 2008), since this permission could enable the Fed to engage in TAF lending and some of the other "non-traditional" operations without necessitating offsetting drains via security sales or reverse repurchase agreements. Consistent with Principles 6 and 8, if the interest rate is set equal to the target rate, monetary operations can be more consistent with an asset-based approach that oversupplies the system with reserve balances. However, even in that case, the concept of "excess liquidity" would remain meaningless in the sense that market rates would still be anchored to the target rate—discussed below in Principle 10—while—as in Principle 1—greater quantities of reserve balances circulating do not enhance banks' abilities to create loans.

If the central bank does expand its balance sheet, whether endogenously under current operations or exogenously in the case of interest payment at the target rate, this does not add to the net financial assets (that is, net financial wealth, or total financial assets less total financial liabilities) of the private sector. Instead, expansion of the central bank's balance sheet simply alters the private sector's relative holdings of reserve balances and securities. Open market operations to purchase government securities, for instance, simply substitute government debt

earning a below-market rate of interest (where interest is paid on reserve balances) or no interest at all (where no interest is paid) for government debt of greater maturity earning market rates of interest—there is no net change in financial assets held by the non-government sector. A rise in currency held by the private sector—including the extreme case of the uncertainty surrounding Y2K—which some in the financial press suggested contributed to U. S. inflation—likewise does not raise the non-government sector's net financial assets but rather rebalances the existing national debt such that there is more currency circulating relative to reserve balances and Treasury securities. That "money does not burn holes in pockets" is not the point; instead, none of these increases in the central bank's balance sheet enable greater bank lending or greater spending than otherwise, since—again from Principle 1—banks do not require additional reserve balances or currency to create loans, while the holder of a Treasury security (which is a highly liquid form of wealth that is also highly valuable as collateral) is not less able to spend than the holder of reserve balances, deposits, or currency.

Finally, it is useful to consider the monetarist argument regarding exogenous expansion of the central bank's balance sheet to avoid or correct a deflationary and contractionary environment in the context of this principle. Monetarists propose that the central bank use open market operations to raise asset prices significantly enough to eventually stimulate spending via a wealth effect. (The discussion here abstracts from whether the central bank can set the term structure of interest rates, since its ability to do this is accepted by both monetarists and most Post Keynesians, while the transmission of interest rate effects are analytically separate from the wealth effects at issue here.) This, again, would be operationally possible only if the target rate is equal to the rate paid on reserve balances. If so, the operations *could* raise, perhaps significantly, the net financial assets of the non-government sector over time via capital gains if the central bank substantially bid up Treasury prices. However, since this simply raises the value of the total national debt outstanding (currency plus reserve balances plus Treasury securities), it is more akin to fiscal deficits (albeit, a less conventional application) that would be less direct in terms of the effects on aggregate spending (that is, via capital gains) in comparison to more

conventional uses of fiscal policy. Going further, as Bindseil (2004, 42-43) puts it, central banks could in theory "threaten to purchase all the assets in the world" in order to stop or prevent a deflation. Some propose, for instance, purchasing foreign currency until a rise in the price level results; one might similarly imagine purchasing stocks or other assets such as real estate until aggregate prices increased. Again, though, these are indirect and even blunt means for achieving the true goals of increased employment and aggregate spending; from a Post Keynesian perspective, these goals are more directly pursued via conventional applications of fiscal policy.

Principle 10: *The central bank's interest rate target "matters" because banks use reserve balances to settle payments.*

In his critique of the horizontalists, Pollin (1996) argues that changes to central bank targets are not exogenous but are rather endogenous responses to other market rates. A number of researchers have recently raised again the issue of how or if it is that the central bank's interest rate target "matters" in terms of its effect on the determination of other interest rates. The issue was most widely discussed following Benjamin Friedman's (1999) questioning of the central bank's abilities to affect other market interest rates given the small size of its open market operations relative to dollar value of trades overall in these other markets. He concluded in a second paper that it was markets that "go along" with the central bank's target given its "credible threat" to engage in larger operations, and that if the central bank's "willingness" to engage in such operations were ever doubted "in time, the market would cease to do the central bank's work for it," leading to a "decoupling" of the market interest rates from the central bank's target rate (Friedman 2000, 271). Thornton (2006, 24) agreed that "as long as market participants believe the Fed can control the federal funds rate through open market operations, such operations are unnecessary."

Thornton's empirical research (cited in Principle 7) finds no evidence of a statistically significant liquidity effect at the daily frequency associated with the

Fed's open market operations; however, this leads him, like Friedman, to argue that the Fed is not actually exhibiting exogenous control over short-term interest rates, but rather that target changes are endogenously made in response to changes in the "equilibrium" short-term market rate (Thornton 2006, 2007a, 2007b). In other words, he argues, as did Pollin, that there is a market "equilibrium" short-term interest rate set by money markets independent of the central bank's target; again, like Friedman, to the conclusion that "it would take very large open market operations to defend a target rate that differed significantly from the equilibrium rate should market participants come to doubt the Fed's ability to defend its rate objective" (Thornton 2006, 24).

Thornton's analysis, however, *does not* demonstrate that the central bank would need large operations to set and sustain (or "defend," as he puts it) its interest rate target. Thornton's study deliberately abstracts from high payment flow days and the few days that there were significant "outlier" shocks to the Fed's balance sheet that unexpectedly affected the aggregate quantity of reserve balances. Thus, what his analysis actually demonstrates is the already well-documented ability of banks to substitute balances across days within the maintenance period to meet reserve requirements; for this reason, his finding that shocks to the Fed's balance sheet do not have a statistically significant correlation with daily movements in the federal funds rate is quite expected. Consider once again the case of Canada, with no reserve requirements: since there are zero reserve balances circulating overnight in Canada, there obviously would be no econometric evidence of a daily liquidity effect to uncover; though, just as self-evidently, the Bank of Canada *does* set and sustain its own target rate. From Principle 6, a central bank can set its own target rate as precisely as it desires; this is most easily done by narrowing the range between the rate paid on reserve balances and the penalty charged on borrowing from the central bank.

More importantly, Thornton, Friedman, and others making similar arguments neglect the fundamental fact that banks *need* reserve balances to settle payments each day and (where applicable) to meet reserve requirements; that is, there is no other financial asset that can substitute for central bank balances in

these cases, and thus the central bank's target rate influences other short-term rates, not vice versa. In other words, because banks *need* reserve balances, the central bank's target rate "matters" and serves as an "anchor" in the determination of other short-term rates via arbitrage even as the central bank makes no attempt to directly affect these other rates (Fullwiler 2006, Rochon and Rossi 2007). For the U. S., this is confirmed empirically in numerous studies, most recently by Bartolini et al. (2005), Cyree et al. (2003), Demiralp et al. (2004), Griffiths and Winters (1997), and Lee (2003), all of which find evidence of day-of-maintenance period and high-payment-flow day effects in overnight Eurodollar and/or repurchase agreement markets that mimic well-documented and well-understood patterns of the federal funds rate. Research shows that arbitrage between these markets is *very* active to the point that differences in default risk, collateral, and availability of offshore facilities come into play. Atesoglu's econometric studies similarly find one-way causation between the federal funds rate target and both the prime rate (Atesoglu 2003-4) and the long-term Treasury rate (Atesoglu 2005). In short, there is no "equilibrium" short-term rate besides the rate targeted by the central bank; instead, as shown in Principle 7 the central bank is clearly able to achieve its target, while it is the its target that serves as the anchor for these other rates.

Fullwiler (2006) explains that considering the relative size of the central bank's open market operations or the quantity of reserve balances demanded by banks as indicators of its ability to affect market interest rates is misplaced, just as (from Principles 6, 7, 8, and 9) the quantity of reserve balances circulating is not indicative of the central bank's ability to achieve its own target or of its policy stance. From Principle 4, because open market operations offset changes to autonomous parts of the central bank's balance sheet, central bank operations usually need be only as large as these autonomous changes to its balance sheet. On the other hand, the central bank *is* in fact *already* carrying out significant intraday operations to support the payments system, as explained in Principle 2 and shown in Table 1, so the suggestion that central bank operations are small is in fact at least somewhat misplaced to begin.

Most fundamentally, the quantity of reserve balances banks desire to hold over any time period, whether the quantity is zero or a very large sum, is immaterial; the central bank's target will serve as an anchor for other market rates as long as banks' demand for reserve balances remains *non-trivial* in the sense that arbitrage occurs between it and other short-term rates. Further, recall from Principle 8 the quantity banks desire is mostly set by the central bank's method of achieving its interest rate target, from Principle 5 that reserve requirements are a tool for aiding interest rate targeting, and from Principle 6 that reserve requirements are simply one way of enabling interest rate targeting, while several central banks have found success with other methods. Consequently, as Fullwiler (2003, 853) explains, "the payments system, rather than [the traditional focus on] reserve requirements, is the proper starting point for analysis" of central bank operations, which is consistent with the discussion in Principle 2. Rochon and Rossi (2004) also make much the same point. Overall, then, the influence of the central bank's target rate on other interest rates is fundamentally based upon the continued, *non-trivial* use of the central bank's balances for payment settlement, which again is obvious when considering central bank operations in nations in which there are no reserve requirements.

There is, though, disagreement in recent Post Keynesian literature between some horizontalists and chartalists regarding "why" banks use central bank reserve balances for payment settlement in the first place. The context for the disagreement is the recent publication of several papers by a number of authors questioning whether final settlement on the central bank's books would necessarily continue. King (1999), for instance, suggested that "there is no reason, in principle, why final settlements could not be carried out by the private sector without the need for clearing by the central bank" (49). Friedman (1999) concurred that "a private mechanism [for payment settlement] like CHIPS could evolve into a system of purely bilateral transfers among private banks" (333). Palley (2001-2) further suggested that securitization and information technology will evolve together to such a degree that "mutual fund money" would enable final payment settlement to bypass reserve accounts at the central bank, while King also came to much the same

conclusion. All agreed that this would mean the central bank would not be able to affect market interest rates via its target. Even Woodford—a frequent defender of central banks' abilities to set interest rate targets that "matter"—suggests the possibility of "a future . . . in which improvements in the efficiency of communications and information processing so change the financial landscape that national central banks cease to control anything that matters to national economies," which could occur "if the functions of central banks today are taken over by private issuers of means of payment who are able to stabilize the values of the currencies that they issue" (2001, 349).

Some horizontalists argue that such a future is simply not possible given the inherent nature of private settlement in a modern, credit-money economy. Rochon and Rossi (2007) argue that while "banks and non-bank financial institutions may use a variety of payments systems, including retail netting systems, . . . at the end of the day all netted positions *must be* finally paid in central bank money" (7; emphasis added). That is, banks "*have to* use central bank money in order for their obligations on the interbank market to be paid finally" (3; emphasis added). Sardoni (2006) concurs that the central bank's interest rate target "rules the roost" because its liabilities are the economy's unit of account or standard of value—the central bank's importance is the "outcome of complex historical, social, and economic processes" and its "demise cannot be simply the result of spontaneous processes triggered by innovation" (5). Horizontalists also emphasized the inherent safety and default-risk free nature of settlement using central bank balances (Sardoni 2006, Rochon and Rossi 2004, 2007)—"banks will prefer using central bank money to settle their Interbank debt because this alone ensures that any instability in the payments system is contained" (Rochon and Rossi 2007, 3).

From the chartalist perspective (e.g., Wray 1998, Mosler and Forstater 1999), by not considering payments to/from the state as fundamental to the demand for reserve balances, these authors have simply demonstrated *that* central bank liabilities sit at the top of the hierarchy of money (with which chartalists agree), not *why* this is so. According to chartalists, such analyses suffer from the logical fallacy of "infinite regress" since "what is missing is the process by which the unit of

account is endowed with value" in the first place such that it would be used to settle payments (Mosler and Forstater 1999, 167). The response of Fullwiler (2006) to the above concerns regarding e-money is that only reserve balances can settle the tax liabilities of banks and their customers, which is alone sufficient for a non-trivial demand for reserve balances to exist. Note that the chartalist response here does not rely on the state's monopoly over the means of payment settlement; private means of final settlement have always existed and will continue to exist indefinitely, but the state's money and its interest rate target will still "matter" since reserve balances settle tax liabilities. Furthermore, modern states also use other, complementary means to "name the thing" that settles payments (as Keynes put it), such as regulatory or statutory requirements that final settlement of wholesale payments occur via central bank liabilities (as in Canada (e.g., Lavoie 2003, 541)) or the design of book-entry securities record-keeping systems where delivery of securities requires payment using the central bank's liabilities (as with the Fed's book-entry record-keeping system, which is the only means for final settlement versus delivery in the primary or secondary markets for U. S. Treasury or government agency securities).

It is important to reiterate for the purposes here, however, that *both* horizontalists and chartalists agree with the overarching principle that the central bank's interest rate target "matters" in the determination of other financial asset prices as long as there is a "non-trivial" demand for the central bank's liabilities for settling payments. Further, both agree that such a demand is a given in a modern capitalist system—though for different reasons—and thereby disagree with those who raise concerns regarding the rise of e-money or any other possible innovations that might one day emerge for the future ability of central banks to set an interest rate target that "matters."

Lastly, it is worth adding that debate will surely continue among Post Keynesians regarding the implications of exchange rate policy for the central bank's ability to exercise discretion in setting its interest rate target and the ability of this target to anchor (instead of being anchored by) other financial market prices. For instance, some argue the points made in this principle presume flexible exchange

rates, which they argue is a precondition for creating the policy space necessary to set an interest rate target independently of "market forces" except in those cases when the nation accumulates a substantial reserve of foreign currency (e.g., Kam and Smithin 2004, Sardoni and Wray 2007; Wray 2006). Others advocate fixed (albeit potentially adjustable) exchange rates to reduce international financial instability but also affirm the points made in this principle regarding the central bank's ability to exogenously set a target rate and for this target to "anchor" other market rates. Still others argue that there is no such thing as truly flexible exchange rates that provide true discretion over interest rates independent of "market forces." For instance, Nevile and Kreisler (2006) probably summarize the views of many when they argue that "policy makers in even moderately open economies cannot ignore the effects of their actions on the exchange rate" given the extraordinary mobility of international capital.

Concluding Remarks

While operations of individual central banks differ, there are several "general principles" that apply. Given that there is a growing neoclassical empirical literature on central bank operations to go with decades of Post Keynesian research on the topic, present-day monetary economists should be expected to understand many of these principles; in other words, for an economist in either camp to suggest, for instance, that reserve balances are a discretionary variable (with the target rate set above the rate paid on reserve balances), that the central bank cannot reliably achieve its target rate, or that central bank operations have any similarities with the money multiplier model, all would demonstrate a lack of familiarity with volumes of published research. In this regard, Bindseil (2004) could be required reading for current monetary economists of all persuasions, though it is disappointing that well-known Post Keynesian literature is not cited aside from fairly cursory mention of Moore (1988); indeed, Bindseil's book would be all the more groundbreaking except that many of the general arguments therein to a large degree

were made previously by horizontalists, circuitistes, and chartalists. Looking forward, a comprehension of the general principles of central bank operations is a necessary stepping stone for understanding current issues in macroeconomic policy such as fiscal deficits, saving and capital investment, and public pension reform; it is further a necessary precondition for relating the complexities of the modern global macroeconomic environment—which is increasingly *more* complex given continuous innovation in derivatives, securitization, and other forms of structured finance—into the development of proposals for financial and macroeconomic stability within such an environment.

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Table 1: Central Bank Payments System Data for 2005

1	2	3	4	5	6	7	8	9	10	11
	3									
Countries	Reserve Balances	Average Daylight Overdrafts*	Peak Daylight Overdrafts*	Overnight Loans*	Term loans* #	Participants	Annual Transfer Value*	Daily Transfer Value*	Annual GDP*	Daily Transfers as % of GDP
USA	17.50	36.20	116.50	0.26	N/A	6,819	518,546	2,074	12,487	16.61%
UK	3.39	13.56	N/A	21.10	N/A	15	51,899	208	1,226	16.93%
Japan	25,093	16,168	N/A	N/A	51,756	594	21,645,000	86,580	501,343	17.27%
Canada	0.05	0.00	N/A	0.00	0.00	86	36,725	147	1,372	10.71%
Switzerland	4.96	6.78	N/A	5.15	N/A	325	41,057	164	456	36.01%
Sweden	0.25	N/A	N/A	12.51	N/A	21	111,174	445	2,671	16.65%
Euro Area	N/A	N/A	N/A	N/A	N/A	10,216	494,028	1,976	7,999	24.70%
Belgium	9.46	4.21	N/A	0.00	28.95	85	17,268	69	299	23.10%
France	28.52	35.43	N/A	0.01	22.06	167	121,914	488	1,710	28.52%
Germany	39.27	N/A	N/A	0.14	209.81	8,420	138,498	554	2,241	24.72%
Italy	16.59	8.47	N/A	0.01	21.91	762	32,881	132	1,423	9.24%
Netherlands	15.48	20.52	N/A	0.00	16.05	155	30,695	123	506	24.26%

* Amounts listed in the column are in billions of local currency units

Term loans include repurchase agreements outstanding for one or more days to maturity for Japan and the Euro countries
Source: Bank for International Settlements (2007) and author's calculations

Table 2: Typical Central Bank Balance Sheet

Assets	Liabilities and Capital
Claims on Domestic Government	Currency in Circulation
Claims on Domestic Banks	Bank Reserve Balances
Net Foreign Reserves	Government Deposits
Other Assets	Central Bank Bills
	Central Bank Capital or Equity