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Setting interest rates in the modern money era

Abstract: *Financial innovations have reduced banks' reserve holdings significantly. Some argue the Fed's ability to set interest rates might eventually be compromised as a result. This concern arises from a misunderstanding of Fed operations. Regardless of the quantity of reserve balances, the Fed can always set its federal funds rate target. The quantity of reserve balances circulating, or the relative size of the Fed's operations, is also unrelated to its influence on other interest rates. That banks must settle their customers' tax liabilities using reserve balances is sufficient for the Fed's interest rate target to influence other interest rates.*

Key words: *demand for central bank liabilities, monetary operations, monetary policy, payments system.*

Several economists in the late 1990s noted that the decline in required reserves had complicated the Fed's task of maintaining its federal funds rate target (e.g., Bennett and Hilton, 1997; Clouse and Elmendorf, 1997). While variability in the federal funds rate was eventually reduced (discussed below), a new round of research emerged that went a step further. Here, most notably, Friedman (1999; 2000) and Palley (2001–2; 2004), and several others (e.g., Costa Storti and De Grauwe, 2001; Gormez and Capie, 2000; King, 1999), suggest that technological innovations in the payments system—that is, "e-money"—could further reduce an already declining demand for central bank reserve balances. Eventually, they argue, with increased alternative methods of payment settlement, there might be no reason for banks to hold reserve balances to settle payments, and, in that scenario, they question the ability of the

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Fed to influence interest rates and asset prices and to thereby affect the broader economy. As Friedman and Palley separately have put it:

> The threat to monetary policy from the electronic revolution in banking is the possibility of a "decoupling" of the operations of the central bank from the markets in which financial claims are created and transacted in ways that, *at some operative margin,* affect the decisions of households and firms. (Friedman, 2000, p. 262, emphasis in original)

> The challenge to interest rate control stems from the possibility that e-money may diminish the financial system's demand for central bank liabilities, rendering central banks unable to conduct meaningful open market operations. (Palley, 2001–2, p. 217)

Palley even posited that "e-money poses a challenge to [the] Post Keynesian description of the credit money creation process by challenging the central bank's ability to control interest rates" (ibid., p. 218). On the other hand, he argued, "the e-money revolution fits naturally into the history of money as told by Austrian economists . . . [since their] approach emphasizes the endogeneity of the 'form' of money, which changes in response to technical innovations and market competition" (ibid., pp. 217–218).

As for possible remedies, Friedman (1999) argues that absent aggressive regulatory actions, the central bank would, at some point, be unable to affect aggregate demand other than by "signaling" its interest rate desires via announcement and hoping markets follow. Palley proposed asset-based reserve requirements (ABRR), which would create a reserve requirement for banks and possibly other institutions based upon assets (rather than liabilities). ABRR would guarantee a considerable demand for reserve balances and thereby affirm the Fed's ability to set or otherwise influence interest rates.

This paper argues that much of this literature regarding the Fed's ability to set interest rates suffers from a flawed understanding of Fed monetary operations. It explains that the quantity of reserve balances in circulation is irrelevant to the Fed's ability to set and sustain its federal funds rate target or to influence other rates via this target. Because banks use reserve balances to settle their customers' tax liabilities, this alone is sufficient to ensure demand for reserve balances, which means the federal funds rate target will remain "coupled" to other interest rates. E-money and private settlement systems do nothing to diminish the Fed's ability to implement monetary policy as long as taxes must be paid in reserve balances, while neither development in fact poses a threat to the Post Keynesian—and, particularly, the horizontalist—view of credit

money creation and interest rates. As outlined in Wray (1998), the imposition by the state of a tax liability payable in its own money is *sufficient* for a demand for the state's money to exist. The counterpart here is the recognition that such demand is similarly sufficient for the central bank to set interest rates. As such, the coming "e-money era" will be much the same as the "modern money" (ibid.) eras that preceded it.[1]

Monetary operations and federal funds rate volatility

This section reviews Fed monetary operations related to setting and sustaining the Federal Open Market Committee's (FOMC) targeted rate in the federal funds market. It demonstrates that while the federal funds rate has exhibited substantial variability in recent years as the quantity of reserve balances fell, the Fed always has the option to exercise total control over the federal funds rate, regardless of the quantity of reserve balances in circulation. Developments such as the continued decline in reserve requirements or the e-money revolution are of no consequence in this regard. Proposals intended to raise the demand for reserve balances in order to improve the Fed's ability to achieve its federal funds rate target misunderstand the details of the Fed's operations.

To begin, the federal funds market is a wholesale market in which banks borrow and lend balances in reserve accounts, mostly on an overnight basis. The vast majority of trades are effected either through brokers or through preexisting lines of credit. Banks use reserve balances to meet reserve requirements and to settle payments, borrowing when they are short of funds and lending when they have excess. While individual banks can alter their own reserve account balances by interacting with other banks to borrow/lend or send/receive payments, in the aggregate, these actions leave the quantity of balances unchanged. Fed open market operations (both temporary and permanent) and lending function to accommodate banks' demand for reserve balances given daily changes to the Fed's balance sheet beyond its direct control. Ceteris paribus, increases (decreases) in the asset side of the Fed's balance sheet (e.g., discount lending, securities owned, float) raise (reduce) reserve balances, while increases (decreases) in the liability side (e.g., currency/vault cash, Treasury's account) reduce (raise) them. Thus, for example, payments

[1] The terms *modern* money or *sovereign* money, as used here and in Wray (1998; 2003), imply a flexible exchange rate regime.

from bank reserve accounts to the Treasury reduce reserve balances, and vice versa. Contrary to the money multiplier model, the Fed's daily open market operations offset current and anticipated changes to the Fed's balance sheet as part of the broader process of accommodating banks' demand for reserve balances, rather than proactively adding or subtracting reserve balances to directly "control the money supply." While these facts are self-evident from a careful reading of the Open Market Desk's annual reports, and, for several years, have been integrated into the Post Keynesian endogenous money literature (e.g., Lavoie, 1992; Moore, 1988; Wray, 1990, 1998), a growing number of neoclassical monetary economists (e.g., Clouse and Elmendorf, 1997; Furfine, 2000; Hamilton, 1997; Woodford, 2000, 2001) have joined the fold.

Such fundamentals of monetary operations demonstrate why Fed interest rate targets would not be threatened if the e-money revolution led to the complete elimination of currency in circulation. While such a change in the retail payments system (i.e., the use of bank deposits and the credit card network in place of currency and coin) has not been seriously considered a threat to the Fed by those publishing research on the e-money revolution—because it is the *wholesale* payments system, in which reserve balances are important for settlement primarily among banks and which is discussed in the following section, that is at issue—it is worth reviewing here. When banks anticipate greater withdrawals of currency by depositors, they, in turn, purchase additional vault cash from the Fed and pay for this via debits from their reserve accounts. Thus, as the public demands more currency, it is supplied endogenously and reserve balances are drained in-kind, ceteris paribus, because both reserve balances and currency are liabilities on the Fed's balance sheet. For the Fed to not supply currency endogenously in this manner would be inconsistent with its mandate laid out in the Federal Reserve Act, as it would bring unnecessary trauma upon the retail payments system and possibly to the banking system as well. The vast majority of the Fed's permanent open market operations offset this resulting drain in reserve balances in order to accommodate the demand for reserve balances at the targeted federal funds rate. If the e-money revolution were to somehow result in the total elimination of the public's demand for currency, the Fed's operations would actually be *simplified,* as a major source of changes to the Fed's balance sheet that daily operations must offset would be eliminated.

Banks' demand for reserve balances arises from reserve requirements and payment settlements. Regulation D requires banks to hold reserve balances (based on deposits less vault cash) during the computation pe-

riod that ends 17 days prior to the beginning of the two-week maintenance period. Reserve balances held at the end of most business days count once toward the maintenance period average for each calendar day the balances are held. Banks' reserve accounts are used to settle interbank payments, government payments, net settlement transfers from private clearinghouses, automated clearinghouse (ACH) transactions, and currency deposits/withdrawals from the regional Fed banks. While the volume of checks and ACH transactions is 175 times as large as the volume of transfers on Fedwire (the Fed's real-time gross settlement payment system), Fedwire transfers total 95 percent of dollar value payments from reserve accounts (Panigay Coleman, 2002, p. 74). In 2004, the total dollar value of Fedwire funds transfers was $470 trillion, or around $1.86 trillion per business day (Board of Governors, 2005).[2] Beyond these two activities—meeting reserve requirements and settling payments—there is no other reason for banks to hold noninterest bearing reserve balances, rendering the demand for reserve balances insensitive in the short run to changes in interest rates.[3]

Banks that fail to meet their reserve requirement for the two-week period traditionally have been assessed a penalty rate of 2 percent plus the discount rate on the deficiency and must also hold a higher average level of reserve balances during the following maintenance period. There

[2] Banks can also contract with the Fed to hold required clearing balances during the maintenance period, which earn "credits" at the federal funds rate that can be used to pay for clearing and settlement costs incurred using the Fed's services. Required clearing balances combine with required reserves to make up total required balances during a maintenance period. In recent years, required clearing balances have grown to outnumber required reserve balances, as both required reserves and the federal funds rate have fallen.

[3] The exception, though it does not affect or otherwise undermine the arguments here, is that averaging provisions for reserve requirements encourage speculation about short-term changes in the effective federal funds rate; much of the potential for speculation can be attributed to the fact that banks cannot substitute reserve balance holdings perfectly across days within the maintenance period (Fullwiler, 2003). Such speculative activity creates deviations from the targeted rate within the maintenance period that are usually small (most are only a few basis points in size) but that can become relatively large at times (in some cases, most often associated with high payment flow dates or other calendar-related effects, deviations can exceed 50 or even 100 basis points). Lavoie (2005) argues that these deviations may have contributed to the reluctance of some American Post Keynesians to recognize the full endogeneity of reserve balances and the full exogeneity (in the control sense) of interest rate targets. In addition, there is a substantial literature documenting rising variability in the federal funds rate toward the end of the maintenance period. See Cyree et al. (2003), Furfine (2000), Griffiths and Winters (1995), Hamilton (1996), and Lee (2003) for further discussion.

are further penalties assessed when a bank's reserve account falls into overdraft, as the Fed provides intraday credit (daylight overdrafts) or overnight credit (overnight overdrafts). Provision of overnight or intraday credit, or both, at *some* price, is a common characteristic of *all* central banks, as they are each legally obligated to maintain stability in the payments system (Government Accounting Office, 2002). Intraday credit is relatively inexpensive at 36 basis points; however, if an intraday negative balance persists through the end of the day, the penalty for overnight credit is the day's federal funds rate plus 400 basis points and carries with it the threat of additional regulatory oversight for repeat offenders, a combination that banks obviously attempt to avoid (Clouse and Elmendorf, 1997; Edwards, 1997; McAndrews and Potter, 2002). Banks unable to secure funding to clear daylight overdrafts have traditionally not taken on overnight overdrafts but have instead borrowed at the discount window. However, because the discount rate was set below the federal funds rate, historically, the Fed strongly dissuaded such borrowing unless all other sources of credit had been exhausted. As a result, banks have been less than eager to borrow at the discount window, even as the federal funds rate at the time rose well beyond its target (Hakkio and Sellon, 2000).

Given the substantial penalty on overnight overdrafts, and the nonmonetary costs associated with borrowing at the discount window, the federal funds rate could rise substantially if reserve balances provided were insufficient to accommodate the existing demand. On the other hand, given that beyond settling payments and meeting reserve requirements there is no other reason for banks to hold noninterest bearing reserve balances, should the Fed leave circulating more reserve balances than banks desire to hold, the federal funds rate could slip well below its targeted rate and even fall to zero if a reserve excess persists (as in Japan).

It is therefore the existing combination of regulations and penalties creating a substantial spread (hereafter, the "spread") between the rate paid on reserve balances (0 percent in the United States) and the penalty (both monetary and nonmonetary) assessed to overnight overdrafts (or, alternatively, the nonmonetary costs traditionally associated with borrowing from the discount window to cover an intraday overdraft and thereby avoid an overnight overdraft) that permits wide swings in the rate if too many or too few reserve balances are supplied by the Fed. The two-week maintenance period has traditionally reduced the interest rate variability on most days *within* the maintenance period. Reserve requirements—if large enough to raise reserve balance demand significantly—

can reduce the likelihood of overnight overdrafts, while a relatively modest surplus or deficiency of reserve balances supplied on most days (except for the last few days of the maintenance period, at least) could often be offset later in the period. Reserve requirements—particularly when the maintenance period lasts several days or more and begins after the end of the computation period—also provide the Fed with a more predictable demand for reserve balances (Clouse and Elmendorf, 1997; Edwards, 1997; Fullwiler, 2003).[4] Consequently, the Fed has traditionally accommodated the demand for reserve balances with just one open market operation per day.

Because reserve balances are unremunerated, reserve requirements are widely known to be essentially a tax that banks attempt to avoid if possible. In the mid-1990s, banks began using technology to sweep idle customer deposit balances into money market accounts not subject to reserve requirements. Sweep accounts rose from near zero in 1994 to over $370 billion by 2000; checkable deposits fell from $810 billion in 1994 to $595 billion in 2000 (Federal Reserve Bank of St. Louis, 2004a; 2004b). The fall in deposits reduced systemwide reserve requirements significantly, with many banks then able to meet reserve requirements entirely through vault cash. As a result, reserve balances held fell significantly, but banks were then far more likely to incur overnight overdrafts; the quantity of reserve balances demanded became more closely tied to the more variable, daily payment settlement needs of banks rather than the more predictable, biweekly demand for reserve requirements. The Fed's ability to reliably accommodate the demand came into question as federal funds rate volatility increased dramatically. Some researchers, however, recognized that the excessive volatility in the federal funds rate was simply the result of the Fed's own penalties on overnight overdrafts in combination with its traditional hesitation to lend from the discount window (Bennett and Hilton, 1997; Clouse and Elmendorf, 1997; Furfine, 2000). By 2000, volatility in the federal funds rate had been reduced to earlier (presweeps era) levels due to a combination of factors

[4] As discussed in note 3, a technical, though economically insignificant, exception is that the averaging of reserve balances across days to meet reserve requirements encourages mostly small, predictable deviations from the targeted rate within the maintenance period and greater volatility toward the end of the period. For many reasons, such deviations have not been present for the most part where reserve requirements have been abandoned (Lavoie, 2005; Woodford, 2001). As the Open Market Desk always emphasizes, the federal funds rate target is nonetheless achieved *on average.*

including changes to Regulation D in 1998 (switching from near-contemporaneous accounting of reserve balances to the above-described lagged-accounting method), closer attention to the daily reserve balance needs of banks in planning operations (whereas, without the threat of overnight overdrafts, more attention had been paid to the maintenance period average needs of banks), and enhanced monitoring of payment flows by banks (Demiralp and Farley, 2005; Fullwiler, 2003).[5]

The increase in federal funds rate volatility that accompanied the reduced quantity of reserve balances in the late 1990s made explicit the connection between the payments system and the Fed's implementation of monetary policy.[6] For decades, economists had focused on reserve requirements in modeling monetary operations rather than on the payments system; nearly every textbook still retains such a focus via the money multiplier model. However, analysis of the Fed's implementation of monetary policy more appropriately begins with the Fed's defensive provision of sufficient reserve balances (Fullwiler, 2003). Reserve requirements—because they can reduce the likelihood of overnight overdrafts, enable substitution of balances across days, and encourage a predictable demand for reserve balances—are one possible way of reducing variability in the federal funds rate given the wide "spread" and traditional practice of executing just one open market operation per day. It is self-evident, however, that the most direct way to reduce potential funds rate volatility is to reduce the "spread" itself. Less onerous penalties or conditions on overnight credit extension by the Fed and payment of interest on reserve balances would reduce the size of potential deviations in the federal funds rate regardless of the inelasticity, variability, or unpredictability of the demand for reserve balances.

Many countries *without* reserve requirements—including Canada, Great Britain, Norway, Sweden, New Zealand, and Australia—have thus 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, at a Lombard-type lending facility (Lavoie, 2005; Sellon

[5] The switch to lagged reserve accounting reduced uncertainty about the demand for reserve balances for the Fed in planning open market operations; it also reduced individual banks' uncertainty about reserve needs throughout the maintenance period.

[6] Similar volatility temporarily accompanied the Fed's decrease in reserve requirements on time deposits and eurodollar accounts in the early 1990s (Clouse and Elmendorf, 1997).

and Weiner, 1997; Woodford, 2001). In theory, the overnight rate then fluctuates between the two rates; in practice, and partly also due to differences in the frequency and timing of daily operations (as well as the elimination of the averaging provisions discussed in notes 3 and 4), these central banks have achieved their target rates with substantial precision (Lavoie, 2005; Sellon and Weiner, 1997; Woodford, 2001). 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 quite interest inelastic, variable, and often unpredictable.

The Fed's primary lending facility—implemented in January 2003—lends to all banks (secured by appropriate collateral) at 1 percent above the targeted federal funds rate (slightly higher rates are required of banks deemed to be greater credit risks). By eliminating the nonmonetary 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 (Sellon and Weiner, 1997; Woodford, 2001). Not surprisingly, the Federal Reserve Bank of New York (2004) reports that the primary lending rate has resulted in reduced deviations on the upside from the targeted rate. The Fed has also spoken in favor of legislation permitting it to pay interest on reserve balances, indicating that it desires the ability to reduce the "spread" still further, as in countries without reserve requirements (Kohn, 2003).

Given a sufficiently narrow "spread," it is also obvious that the need for *any* open market operations to change the targeted rate is eliminated *regardless of the quantity of reserve balances in circulation.* With a narrow "spread," the Fed could simply announce changes to the upper and lower bounds to change its target rate, as other central banks without reserve requirements already do (e.g., Guthrie and Wright, 2000). However, because the demand for reserve balances is a function of reserve requirements and payment settlement needs only, when the Fed announces a new federal funds target, traders already adjust the rate without operations to change the quantity of reserve balances, even with a wide "spread." As Sandra Krieger (head of domestic reserve management and discount operations, New York Fed) noted, the Fed's announcement of a new target is sufficient for federal funds traders to adjust their rates, because "any change in the FOMC's target has virtually no effect" on the quantity of reserve balances demanded (2002, p. 74). While the Fed might *temporarily* change the quantity of balances in order to "signal" a new rate to traders (as was the case prior to 1994) 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 (ibid., p. 74). Researchers have confirmed that changes in the federal funds rate target are carried out through an "announcement effect" rather than through additional operations (e.g., Demiralp and Jorda, 2002). The main point is that while the magnitude of possible federal funds rate deviations from the target are determined by the width of the "spread," *changes* to the federal funds rate *target* require *no* open market operations regardless of the width of the "spread" (Fullwiler, 2003, pp. 869–871).

The errant concern that the Fed could lose the ability to reliably achieve the federal funds rate should the quantity of reserve balances decline substantially results from a misunderstanding of Fed operations. For instance, while Palley acknowledged the "extreme short run inelasticity" of the demand for reserve balances, he then suggested—erroneously—that this "explains why only small changes in the quantity of reserves . . . are needed to make changes in the monetary authority's target interest rate stick" (2001–2, p. 227). By invoking the liquidity effect to describe Fed operations, Palley confused the regulatory factors enabling daily swings in the federal funds rate (i.e., the "spread") with the reason why announced changes to the Fed's targeted rate can be carried out *entirely without* changes in reserve balances, even with a wide "spread" (i.e., the inelasticity of demand for reserve balances). Palley's proposed "solution" to funds rate volatility is for ABRR to replicate what reserve requirements against deposits previously had accomplished. As such, however, the ABRR proposal takes the "spread" and the Fed's operating procedures (i.e., one operation per day) as given. On the other hand, simply reducing the "spread" would more directly minimize deviations in the federal funds rate from its target without additional regulatory burdens on banks; this approach has already proven to be effective in regimes that do not impose *any* reserve requirement "tax."[7]

In sum, the Fed's ability to both *set* and *sustain* a federal funds rate target is "threatened" only by its own implementation of available operating procedures. Innovations that reduce the demand for reserve balances will raise variability in the federal funds rate only if the Fed supports such effects, a conclusion that has been confirmed by others (Demiralp and Farley, 2005; Sellon and Weiner, 1997; Woodford, 2001).

[7] This is not to argue that ABRR would not be useful for other policy goals, such as preventing booms and busts on the balance sheets of financial institutions; such uses, in fact, appear to be the primary motivations for Palley's proposal.

Innovations in the payments system and the Fed's influence over market rates

Having established that declining demand for reserve balances—whether from falling required reserves or e-money–related innovations in the payments system—is of no consequence for the Fed's ability to set and sustain the federal funds rate, we now turn to the Fed's ability to influence other interest rates in the economy. That the Fed can set the federal funds rate is of little importance if there is no transmission mechanism to speak of. This section discusses the Fed's monetary operations within the context of the wholesale payments system, because some believe that innovations in the latter will have the potential to eventually render the Fed's target irrelevant.

In a widely discussed paper, Friedman (1999) labels it a "puzzle" that central banks are able to engender such large effects in the economy when their securities transactions are so "miniscule" in comparison to the value of financial market transactions. As just one example, open market operations by the Fed are rarely more than a few billion dollars on any given day (and are at times smaller than this); this value is vastly outpaced, for instance, by the $1.86 *trillion* in funds transferred daily via Fedwire. As financial innovations continue, the disparity in the size of central bank operations and total financial market transactions will continue to widen. Friedman (1999; 2000) argues that, at some point, the Fed's target rate could become "decoupled" from other rates and asset prices, leaving the Fed much like "an army with only a signal corps," able to announce its priorities while unable to alter market interest rates or asset prices. Palley agreed that "although demand for reserves has been reduced, remaining transactions and settlement sources of demand for reserves have been sufficiently large and connected to economic activity that central banks have still been able to control short-term interest rates through open market operations. The challenge of e-money is that this will also change" (2001–2, p. 220).

Given these viewpoints, it is useful to begin by considering the decline in reserve balances in wholesale payment settlement and its relation to monetary policy implementation. Because reserve balances are non-interest bearing, banks routinely minimize their holdings. Similar to their attempts to reduce the reserve requirement "tax" imposed by Regulation D through retail sweep accounts, banks have also continuously sought to reduce the quantity of reserve balances used in payment settlement. As early as 1957, Hyman Minsky discussed financial innovations that, at that time, enabled a given quantity of reserves to be correlated with

far greater economic activity. More recently, Hancock and Wilcox point out that electronic payment settlement has contributed over the course of many years to continuous declines in the quantity of reserve balances necessary to settle a given quantity of payments:

> In recent decades, even while the banking industry was growing faster than real economic activity, the dollar value of funds transmitted via large-dollar electronic payments systems was growing relative to the size of banks. . . . Two decades ago, daily transfers were less than one-tenth as large as total bank liabilities. By the mid-1990s, the ratio had risen to seven times its value in the early 1990s. . . . [During the same period] the sum of banks reserves and clearing balances . . . at Federal Reserve Banks relative to their total liabilities fell markedly: After averaging close to 4 percent in the early 1970s, reserve balances as a proportion of liabilities averaged less than 1 percent by the mid-1990s. As a consequence, the value of banks' electronic payments relative to their reserve balances increased dramatically: By 1994, the ratio of the value of Fedwire transfers to reserve balances was about forty times its 1973 value.[8] (1996, p. 871)

Analysis of current data suggests that payment flows for individual banks can easily rise to 100 to 200 times larger than their end-of-day reserve balances (Furfine, 2000; McAndrews and Potter, 2002).

One of the most important reasons for the decline in the ratio of reserve balances held to settle payments is the use of netted payments by clearinghouses, which enable their members to settle a small, "netted" percentage of total transactions via Fedwire, often at the end of the business day. During the day, implicit intraday credit is provided to those banks with net debit positions. The Fed has actively promoted clearinghouse netting to improve payments system efficiency by reducing transactions and risk exposure of participants (Bank for International Settlements, 1989). For example, the Clearing House and Interbank Payments System (CHIPS) clears many international transactions and other payments between large New York banks. Gross CHIPS payments rival Fedwire transactions in terms of dollar value; netted CHIPS payments are settled via Fedwire. Similarly, most small banks use local clearinghouses to clear local transactions while settling netted obligations using Fedwire.[9] A large percentage of securities transactions are cleared through

[8] Henckel et al. (1999) report similarly evolving ratios in other countries.

[9] Some banks settle netted local payments with the Fed's National Settlement System rather than Fedwire, though net settlements still occur via reserve balances in this case.

subsidiaries of the Depository Trust and Clearing Corporation (DTCC); net settlements occur through Federal Reserve accounts and Fedwire. DTCC's subsidiaries—the Depository Trust Corporation (DTC), the National Securities Clearing Corporation (NSCC), and the Fixed Income Clearing Corporation (FICC)—provide clearance services for "virtually all equity, corporate debt, municipal debt, government securities, mortgage-backed securities, and emerging market sovereign debt trades in the United States totaling more than $1.7 trillion daily" (Bond Market Association and Depository Trust Clearing Corporation, 2003, p. 9).

Another important reason is that various money markets offer competing avenues for borrowing or lending. Consequently, banks frequently use overnight eurodollar and repurchase agreement markets as substitutes to overnight trading in the federal funds market (Cyree et al., 2003; Demiralp et al., 2004; Griffiths and Winters, 1997; Lee, 2003; Meulendyke, 1998, ch. 3). For instance, regarding repurchase markets,

> Instead of holding unremunerated settlement balances, banks hold liquid securities which they can use at any time to borrow the settlement balances that they exactly need to avoid end-of-day overdrafts in their current account at the central bank. As a result, the volume of Treasury securities held on the books of commercial banks in the U.S. (hence available for repurchase operations) has increased very rapidly and is now twelve times their reserve balances. At the same time, the growth of the treasury bill repo market has been spectacular, particularly in the 1990s. (Henckel et al., 1999, p. 16)

Certificates of deposits and sales of commercial paper, particularly by the parent holding company, are also alternative sources of funds. These competing sources/uses of funds are also related to the previous discussion of netting, because a large percentage of eurodollar, repurchase trades, and commercial paper transactions are netted in settlement via CHIPS, FICC, and DTC, respectively.

Thus, whereas banks might have utilized more federal funds trades requiring gross settlement on Fedwire in previous decades to manage liquidity for payment settlement and to perform asset/liability management, they now accomplish a large percentage of both via netted settlement.

To relate this to monetary operations, return now to Friedman's earlier "puzzle": Palley's "answer" was that the interest inelasticity of the demand for reserve balances enabled relatively small-sized Fed operations to induce changes in the Fed's target rate (2001–2, p. 227), but this missed the point in several ways. To be sure, and as explained in the previous section, such inelasticity means that changes to the Fed's target rate actually require no operations at all. But, regarding day-to-day operations

(i.e., how does the Fed *sustain* its target daily given its relatively small-sized operations?), Friedman's "puzzle" actually has an alternative, albeit trivial, "solution": end-of-day reserve balances desired by banks are now a mere $10–$20 billion largely due to retail sweep accounts and the above innovations in the payments system. Fed operations simply adjust this quantity *at the margin*—usually by a few billion dollars—in order to offset net changes to the Fed's balance sheet while accommodating the demand for reserve balances. This is not reducible to inelasticity in the demand for reserve balances; for instance, when net changes in the Fed's balance sheet are larger in size—as during the Y2K buildup when the public desired to hold far greater quantities of currency than in normal times or during periods when Treasury tax receipts overwhelm the capacity of the Tax and Loan system (discussed below)—Fed operations likewise are much larger in size. In general, it is the size of net changes in the demand/supply of reserve balances that must be accommodated/offset—not the inelasticity of the demand for reserve balances—that matters for the Fed's daily operations.

Recall also that Friedman's "puzzle" was primarily concerned with how *other* rates in the economy are affected given that open market operations are insignificant in relative dollar terms. Changes to the federal funds rate target affect other short-term rates, because, as already noted, bank borrowing or lending in the federal funds market can substitute for the commercial paper, negotiable time deposit, eurodollar, repurchase agreement, and short-term Treasury markets. Aside from small differences due to collateral, default risk, and so forth, rates in these markets move together via arbitrage (Cyree et al., 2003; Demiralp et al., 2004; Griffiths and Winters, 1997; Lee, 2003; Meulendyke, 1998, ch. 3).[10] Long-term Treasury rates are known to be primarily influenced by expectations of future short-term rates once one accounts for an additional "risk" or "liquidity" premium on long-term investing. This provides another answer to Friedman's "puzzle": the Fed can influence other rates simply by setting and sustaining the federal funds rate alone; it generally makes no attempt to intervene directly in other markets—re-

[10] According to Cyree et al. (2003), Demiralp et al. (2004), Griffiths and Winters (1997), and Lee (2003), there is evidence of day-of-maintenance period and high payment flow day effects in overnight eurodollar and repurchase agreement markets similar to those in the federal funds market. This indicates that arbitrage between these markets is *very* active up to the point that differences in default risk, collateral, and availability of offshore facilities come into play. Demiralp et al. found that arbitrage opportunities of only a few basis points are left unexhausted in these markets.

gardless of the dollar volume of trades in these markets—because some manner of arbitrage against the Fed's target occurs in each.

Indeed, according to Sellon (2002), several market interest rates—particularly the prime rate, mortgage rates, consumer loan rates, and Treasury note and bond rates—have, since the 1990s, become *more* closely linked to movements in the Fed's federal funds rate target than in previous decades, even as reserve balances were falling precipitously. Sellon showed that some of the innovations related to the e-money revolution—financial deregulation, disintermediation in capital markets, and securitization—have actually facilitated faster and larger pass-through responses of interest rates to changes in the federal funds rate. It is worth noting that this evidence also supports the Post Keynesian horizontalist view of money and interest rates.

Finally, Friedman's "puzzle" is called into question by its singular focus on the quantity of *end-of-day* (or *overnight*) reserve balances. But the *end-of-day* quantity, which is most relevant to Fed open market operations or discount window loans, is not necessarily relevant to the quantity of reserve balances banks desire *throughout* the day. Average daylight overdrafts supplied by the Fed are typically over $30 billion dollars, with peak overdrafts averaging $100 billion (Panigay Coleman, 2002, p. 76). The intraday quantity of reserve balances is clearly significantly greater than the end-of-day quantity, and the Fed's daily overdraft transactions are thereby much larger in size than its open market operations. Consequently, one must consider $100 billion of peak daily credit extension—or an average of $30 billion of credit outstanding *each minute*—to be "miniscule" to support the validity of Friedman's hypothesized "puzzle" in the first place.

In sum, and contrary to the apparent logic giving rise to Friedman's "puzzle," the relative size of the Fed's own operations or of the end-of-day quantity of reserve balances is unrelated to whether or not the Fed's target rate influences other interest rates. The Fed achieves the federal funds rate target on a continuous basis—including accommodating the intraday demand for reserve balances—but needs make no attempt to affect other rates directly. In some countries without reserve requirements—such as Canada, Sweden, New Zealand, and Australia—the quantity of reserve balances is effectively *zero* at the end of each day; payment settlement is carried out almost exclusively via use of intraday reserve balances, while the abilities of these central banks to influence other rates have not been questioned (Woodford, 2001). In a more general sense, absent reserve requirements, the desire to hold overnight reserve balances exists mostly 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 Fed can reliably offset all net changes in its balance sheet. Rather than a sign of reduced importance of reserve balances or of the Fed's operations, zero overnight balances would simply imply increased precision in monetary operations such that neither overnight overdrafts nor the fear of such overdrafts existed.

To further reinforce the lesson that "quantity does not matter," note that a fall in the quantity of *intraday* balances/credit would similarly not be alarming. For instance, as banks attempt to minimize reserve balance holdings *and* overdraft fees, the coordinated timing of outgoing Fedwire payments with incoming payments enables a given dollar value of payments to be settled with fewer *intraday* overdrafts. Because Fedwire payments that net within the same minute do not generate daylight overdraft charges, banks now manage to batch and send 25 percent of total outgoing payments within the same minute as an incoming payment arrives (McAndrews and Rajan, 2000, p. 18). One could also envision future innovations in federal funds market brokering—perhaps even facilitated by the Fed, as Henckel et al. (1999) suggest—which would enable net surplus banks and banks in overdraft to "find each other" more easily throughout the day and thereby reduce average intraday overdrafts, though the plausibility of this scenario is rather small given the low (and, in many cases, negligible) price of intraday credit at the Fed.

The question, therefore, is not *how many* reserve balances banks will desire to hold, whether overnight or intraday, because, even if the answer is zero, this may be of no consequence to the Fed's ability to influence other rates. Rather, because the Fed's influence on other rates occurs via arbitrage in other markets against the federal funds rate, what matters is that a demand for reserve balances exist that is significant enough—call it a *nontrivial* demand for reserve balances—for such arbitrage to continue into the future. Note that this also means that the Fed need not necessarily "corner" the market for wholesale settlement balances or be the monopoly supplier, as Henckel et al. (ibid.) and King (1999) claim, but only that there be a compelling enough reason for banks to hold reserve balances in a *nontrivial* sense. Other methods of wholesale settlement already exist and more will surely emerge over time, but the Fed's influence merely requires that arbitrage against its target continues.

However, as Jordan and Stevens point out, "some have posed the theoretical possibility that, in the limit, there will be no appreciable [i.e., *nontrivial*] domestic demand for central bank money" (1996, p. 8). The Fed's target rate might then become "decoupled" from other short-term rates and from the broader economy. As King argued, "there is no rea-

son, in principle, why final settlements could not be carried out by the private sector without the need for clearing by the central bank" (1999, p. 49). Jordan and Stevens hypothesized that banks could eventually "organize and participate in multilateral clearing and net settlement arrangements for money and securities transfers" without using reserve balances (1996, p. 10). Friedman concurred:

> A private mechanism like CHIPS could evolve into a system of purely bilateral transfers among private banks. . . . A quarter century or so into the future . . . it is readily conceivable that one or more of these private clearing mechanisms may sufficiently erode banks' need for central bank reserves as to undermine the relevance of the [central bank]. (1999, p. 333)

Palley took the argument further and argued that banks might eventually exchange virtually any private financial asset—once securitized—to settle netted payments:

> The key to the emergence of such a system is the ability of banks to value assets to market in real time. The information technology (IT) revolution may be the final development necessary for this. Over the past two decades, the growth of markets for securitized bank loans has meant that bank assets have become much more liquid. Securitization combined with the IT revolution means that banks and financial institutions (FIs) may be approaching the point where the bulk of bank assets can be valued in real time, thereby making it possible to settle debts between banks by transfer of title to these assets. The combination of securitization and IT therefore creates the prospect of a new form of settlement—call it "mutual fund e-settlement money." (2001–2, pp. 222–223)

King also came to the same conclusion:

> Pre-agreed algorithms would determine which financial assets were sold by the purchaser of the good or service according to the value of the transaction. And the supplier of that good or service would know that incoming funds would be allocated to the appropriate combination of assets as prescribed by another pre-agreed algorithm. Eligible assets would be any financial assets for which there were market-clearing prices in real time. The same system could match demands and supplies of financial assets, determine prices, and make settlements. (1999, p. 48)

And, again, according to Palley and King, the outcome for the Fed and for other central banks was clear:

> The elimination of banks' demand for reserves (say because of adoption of mutual fund e-settlement money) . . . would undo the ability to target interest rates. (Palley, 2001–2, p. 227)

> Any securities for which electronic markets exist could be used as part of the settlement process. There would be no unique role for base money. . . . Central banks would lose their ability to implement monetary policy. (King, 1999, p. 49)

Some other economists argued to the contrary that current and future developments in the payments system ultimately would not reduce to a nontrivial degree the use of reserve balances for wholesale payment settlement. For instance, Freedman (2000) and Goodhart (2000) note that, due to the Fed's "unimpeachable solvency" (Freedman's term), unlike private clearinghouses, it can always provide intraday credit or (in extreme cases) lender of last resort loans to ensure payments are settled without regard to its own financial standing. Hawkins (2001) and Goodhart likewise point out that the Fed is widely recognized as the safest counterparty in payment settlement. And, because private clearinghouses sell their services based upon both efficiency *and* safety, they both suggested it is unlikely that all or even most clearinghouses would stop settling netted liabilities via members' accounts at the Fed. Furthermore, netted or gross settlement via crediting/debiting to/from securitized financial asset balances—as in the scenarios suggested by Palley and King—would expose a payee to the risk that an asset's price would fall after the asset was acquired but before the payee could use it to discharge his or her own payment commitments. Thus, Hawkins argued that if financial assets of varying creditworthiness were to be used in settlement, discounting would likely occur.

The counterargument was that the safety of settlement afforded by reserve balances was not enough to presume their continued use in the face of innovations in the payments system. King argued that the creditworthiness of a counterparty could someday be confirmed—given rapidly advancing information technology—in the process of clearing a transaction. And while Henckel et al. and Palley acknowledged that settlement via purchase and sale of securities could expose payees to price volatility, they argued that this would not be the case with short-term bills or repurchase agreements:

> The risk associated with price volatility, which is small in the case of short-term bills, can be factored into the price of repurchase contracts through the use of margins (haircuts). Thus, the only cost to a bank of holding treasury bills rather than central bank balances is the opportunity cost of the additional bills that are needed to constitute the margins. This cost—particularly in the case of short-term bills (less than a year)—is clearly of a second order of importance compared to the opportunity cost

> of holding fully unremunerated settlement balances instead of remunerated treasury bills. (Henckel et al., 1999, p. 17)

One might imagine this scenario extended to the short-term liabilities of private institutions having virtually no credit risk, such as large clearing banks, as well as to repurchase agreements using their liabilities as collateral.[11]

As mentioned in this paper's introduction, Friedman, Palley, and others have therefore argued in favor of various regulations in order to ensure a robust demand for reserve balances into the future. In Australia and Canada, for instance, use of central bank liabilities in wholesale payment is compulsory. King, on the other hand, thought even these measures might ultimately be ineffective; he argued that "in just the same way as the Internet is unaware of national boundaries, settlement facilities would become international" and thereby elude the regulatory reach of any particular government (1999, p. 49).

Another potential solution put forth was for the Fed to pay interest on reserve balances (Goodfriend, 2002; Goodhart, 2000; Woodford, 2000, 2001, 2002). Woodford, a leading proponent of interest payment, argued that "in order to prevent a competitive threat to the central-bank managed clearing system, it should suffice that the opportunity cost of holding overnight clearing balances be kept low" (2001, p. 325). By reducing the opportunity cost via remuneration to reserve accounts, an important historical incentive for minimizing balances in these accounts would be eliminated. Recall from the previous section that reducing the "spread" limits the range of possible variability in the federal funds rate. The rate paid on reserve balances and the primary lending rate would become bid and ask rates, respectively, and the Fed would effectively become a market maker in real time in the federal funds market. There would be no reason to borrow or lend in other short-term markets at rates outside this range aside from slight differences in maturity, liquidity, and default risk. Friedman, in agreement with Woodford, accepted that "nobody should doubt that a large enough borrower or lender, willing to enter into transactions in infinite volume, can set market rates" (2000, p. 269). Goodhart also made much the same argument (2000, pp. 204–205).

[11] In fact, the scenario would undermine the nontriviality of reserve balances *only* if it were extended to repurchase agreements and short-term liabilities of private institutions, because, as pointed out in the following section, delivery of Treasuries in primary, secondary, and repurchase markets occurs against payment of reserve balances using Fedwire's book-entry system.

However, Friedman then questioned whether such market making by the Fed would require large-scale operations; related to his original "puzzle," he concluded that it was the Fed's "credible threat" to engage in large-scale operations that enabled it to influence market rates with so few actual operations. If the Fed's willingness to do this were ever doubted, Friedman argued, "in time, the market would cease to do the central bank's work for it," and the rates set by the Fed would then become "decoupled" from other interest rates and asset prices (2000, p. 271).

A brief critique of this claim—Friedman's parting argument in this series—also provides review of this section's discussion of his—and some others'—flawed understanding of monetary operations. First, the Fed is able to influence interest rates, because it can exogenously set a target rate; it need not directly intervene in other markets or rely on a "credible threat" as long as there is active arbitrage against this target in other financial markets. Its influence over market rates is thus consistent with however many or few operations are necessary to achieve its target or however many or few reserve balances banks demand. Second, because the Fed must accommodate overnight *and* (even larger) intraday demands for reserve balances to achieve its target, contrary to a "credible threat," the Fed's commitment to its target is *always* being "tested." Finally, the Fed's operations entail simply crediting or debiting member bank reserve accounts; there are no relevant "costs" to providing substantially more reserve balances when banks desire them. This is even more obvious when one considers the Fed's "unimpeachable solvency"; as the Fed has demonstrated repeatedly in times of crisis, it can (indeed, it *must*) carry out substantial operations whenever necessary. What matters for its ability to influence market interest rates is merely that a nontrivial demand for reserve balances exists.

What is missing from the discussion thus far is recognition of an already existing, compelling reason for banks to desire reserve balances in a nontrivial sense such that the Fed's ability to influence other interest rates through its federal funds rate target is undisturbed by future innovations in the payments system. In this sense, a better critique of interest payment on reserve balances as facilitator of a nontrivial demand is to question why it would do so if there were no demand for reserve balances *absent* such remuneration? Interest payment is, after all, merely a credit to a bank reserve account. While interest payments would encourage closer arbitrage against the Fed's target *if* banks *already* had some fundamental reason to hold reserve balances, suggesting that this alone assures a nontrivial demand does not *provide* such a reason but rather *presupposes* one. Even Woodford allows in his conclusion—in a pas-

sage suggestive of Palley or King—that "a future is conceivable 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" and 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, p. 349).

The fundamental source of a nontrivial demand for reserve balances

The previous section discussed concerns regarding the Fed's ability to influence interest rates, which have mostly focused on the use of reserve balances in settlement of private transactions and how innovations in the payments system might seriously reduce or even eliminate this practice. It also showed that instead of ensuring that private settlement occurs via reserve balances in the future, what is sufficient to permit the Fed's influence over interest rates is that a nontrivial demand—as opposed to a demand of any particular size—for reserve balances exists. In fact, there is *already* a type of payment settlement for which *only* reserve balances will do—and which is quite clearly nontrivial in nature—namely, the settlement of payments with the federal government. Indeed, as Garbade et al. note:

> The U.S. government is the largest transactor in the world. During fiscal year 2003, aggregate federal receipts and expenditures averaged $18.8 billion daily. Money was disbursed to pay for purchases of goods and services, civilian and military salaries, transfer payments such as social security, and interest on the national debt. Receipts came primarily from personal and corporate income taxes and social security contributions. (2004, p. 1)

The most fundamental of payments settled with the federal government is the payment of federal tax liabilities by corporations and individuals, because these are obviously compulsory payments. Although not widely reported, a few economists did mention that tax liabilities payable in reserve balances would comprise a nontrivial demand for reserve balances:

> Even with little public demand to hold central bank liabilities, central banks remain the only source of the national currency units that are required to settle domestic tax obligations. (Jordan and Stevens, 1996, p. 11)

> Even if [other] reasons did not prove enough, governments could require that transactions with them (*tax payments,* pensions, government employees' salaries, purchases, etc.) are settled on the central bank's books. (Hawkins, 2001, p. 101, emphasis added)

Friedman, in a short, rather isolated passage that he curiously did not pursue any further, even acknowledged this:

> A potential solution that I suspect has a greater likelihood of success [is] requiring all government tax payments to be made in central bank liabilities. Tax payments in most modern economies do not constitute a small, potentially isolated market likely to end up as part of some corner solution [i.e., an interest rate target that does not matter]. Most firms and most individuals pay taxes, many in sizeable amounts compared to their incomes or profits. Requiring them to do so in bank checks might go a substantial way toward keeping the demand for [reserve balances] coupled to the expansion or contraction of economic activity. (2000, p. 265)

In the United States, tax payments from corporations and individuals are settled through banks via reserve balance debits when a credit is made to the Treasury's account at the Fed (e.g., Bell, 2000; Bell and Wray, 2002–3; Garbade et al., 2004; Hamilton, 1997; Lovett, 1978; Wray, 1998). All federal tax payments by businesses—including employee income tax withholding, Social Security/Medicare (FICA), and corporate income taxes—are transferred to the Treasury by banks participating in the Treasury's Tax and Loan program (hereafter, TT&L). The path of funds transferred from a business's account depends upon the nature of the processing bank's participation in the TT&L system. For the more than 11,000 collector institutions (formerly known as remit option depositaries), tax payments are transferred immediately to the Treasury's account via a debit of the banks' reserve accounts (at which time the taxpayers' accounts at the banks are also debited). For the more than 900 retainer institutions and the more than 150 investor institutions (both formerly came under the heading of note option depositaries), payments are held in investment accounts as liabilities on the banks' balance sheets until called in by the Treasury. Prior to being called in by the Treasury, these balances merely involve the change of ownership of the banks' liabilities. When called, transfers to the Treasury's Fed account debit both the TT&L accounts and the banks' reserve balances. Investor institutions differ from retainer institutions in that they also accept deposits from the Treasury's account at the Fed (such as recently received tax payments from collector institutions), which are invested in accounts at these banks until called back in. Collection of individual income tax

payments is done in a similar manner to that of collector institutions above, as the IRS deposits payments received into accounts at around a dozen commercial "lockbox" banks; after processing, payments are transferred to the Treasury's account at the Fed or to investor TT&L accounts until called by the Treasury.[12]

Palley understood as well that "the reality is that taxes are paid using liabilities of the central bank, which creates a demand for reserves for purposes of tax payments" (2001–2, p. 224). As such, it would be unfair to say he did not recognize that a nontrivial demand would remain; indeed, he acknowledged that "in practice, such complete elimination of demand is unlikely" (ibid., p. 228). His concern, however, was that "relying on the demand for tax settlement balances as the means of conducting monetary policy is . . . likely to be associated with increased interest rate volatility. This is because tax payments are highly seasonal, and taxes are also paid in arrears [and, as a result, the] central bank would have to engage in significant seasonal open-market operations . . . to smooth interest rate spikes" (ibid., p. 229). As in the first section of this paper, Palley's error arose from his misunderstanding of the Fed's daily operations, not to mention the TT&L system. Concerning the latter, it is widely known that the Treasury already adds to investor TT&L accounts and calls balances in from both retainer and investor TT&L accounts in order to offset daily variations in the Treasury's balance at the Fed and to thereby reduce Fed balance sheet changes that must be offset by open market operations (e.g., Bell, 2000; Garbade et al., 2004; Hamilton, 1997; Lovett, 1978). More generally, Palley again failed to recognize that potential volatility in the federal funds rate would not be the result of added variability/seasonality in payment flows to the Treasury but only due to the size of the "spread" between the rate paid on reserve balances and the penalty rate for borrowing reserve balances, as discussed earlier. Whether tax flows to the Treasury are only a few million dollars or less on some days and several billion dollars on others, a demand for reserve balances based solely on tax payments—even in the absence of offsetting TT&L calls or adds—would bring additional volatility in the federal funds rate only if monetary policy operating procedures, regulations, and penalties that enable such volatility were in place.

While requiring that tax payments be made in reserve balances is alone sufficient to create a nontrivial demand for reserve balances, and while

[12] The discussion of the Treasury's tax collections and the TT&L system is based on Garbade et al. (2004) and U.S. Treasury (2000).

the Fed's operating procedures determine the potential for federal funds rate variability, the demand for reserve balances arising exclusively from payments that can currently be settled only via Fedwire is perhaps more substantial than commonly thought. As mentioned, balances in TT&L note option accounts are frequently called in by the Treasury, particularly on days when revenues are smaller than scheduled disbursements; these calls can only be met with reserve balances. Settlement after auctions for Treasury securities are made in reserve balances, as are some securities sold by government-sponsored enterprises. Further, all Treasury securities and many government agency/enterprise securities can only change ownership—whether in the primary, secondary, or repurchase markets—through use of the Fed's Fedwire book-entry securities system, which records changes in ownership against payment sent with reserve balances. (The notable exceptions among government agency/enterprise securities are those issued by the Government National Mortgage Association [GNMA], which do not trade over Fedwire, though the Federal National Mortgage Association [FNMA] and Federal Home Loan Mortgage Corporation [FHLMC] securities do.) Even when such trades are settled on a netted basis by FICC, final settlement in many cases *must* occur through Fedwire.[13] Although the majority of such securities (particularly Treasuries) are held on the books of only a few large clearing banks—that are then responsible for maintaining records to identify which securities are held on behalf of individual customers—total securities trades settled via Fedwire's delivery versus payment system still averaged more than $1 trillion per business day in 2004 (Board of Governors, 2005).

The major implication of the foregoing is that the Fed's ability to set interest rates in an age of technological innovation in financial markets and (specifically) in the payments system is not much different from its ability to do so in earlier eras; the issue is not the innovations as much as

[13] An exception is FICC's popular netted general collateral finance (GCF) repurchase agreements. GCF repos currently do not require any reserve balances for settlement, because FICC will only handle those trades in which one of the two major clearing banks is involved (Bank of New York and JPMorgan Chase Bank). Prior to March 24, 2003, FICC would enable transactions in which both clearing banks were involved, which would require payment in reserve balances sent via Fedwire against the Treasuries changing ownership. Interbank GCF settlement was suspended by FICC due to concerns that either bank's net liability might be more than the daylight overdraft allowed by the Fed, in which case the paying bank might delay some or all of its payment. See Christie (2003).

it is the federal government's acceptance of reserve balances in payment settlement with the private sector. Thus, even as the current era is one of financial innovation and e-money, current and future eras nonetheless remain *modern money* eras (Wray, 1998). Much as recent neo-Chartalist research has demonstrated that the state can create a demand for its own money by levying a tax liability payable in its money, the parallel here is that the central bank's ability to set interest rates has similar origins, because a nontrivial demand for reserve balances exists when reserve balances settle tax liabilities. As Goodhart explained, "the ability of the central bank to control interest rates is an issue of *political* economy. To ignore the role of governments and power would be to miss the key point" (2000, p. 206, emphasis in original).

It is useful to return to the earlier topic of the Fed's open market operations from a modern money perspective. Just as the state has the authority to determine that it will accept its own money in payment for taxes, it also has the authority to exercise complete control over the overnight interest rate earned by those lending out its money or paid by those borrowing its money independent of how much of its money is circulating. The rather complex nature of the Fed's open market operations has obscured this fact for many economists for many years, leading them to erroneously believe in deposit multipliers and liquidity effects and to then fear that a fall in the quantity of reserve balances would reduce the Fed's ability to set and manage volatility in the rate for which *its own* money is traded. Regardless of how the Fed's open market operations actually evolve in the future, the Fed's ability to have direct control over the federal funds rate is completely unrelated to the quantity of reserve balances and is thus also unrelated to how many deposits are swept into money market accounts, how large reserve requirements are, or evolving payment technologies. While the quantity of reserve balances is endogenously determined and will vary according to reserve requirements and technologies in the payments system, *the state nonetheless always has within its power the ability to set the bid and ask prices for its own money and to minimize variations in its target rate regardless of the quantity of reserve balances in circulation,* though it may choose not to use this power.

Whether the quantity of reserve balances circulating is zero dollars or trillions of dollars, or whether the size/frequency of central bank operations is large or not relative to transaction volumes in financial markets, is of no consequence to the ability to influence interest rates in the economy. If private clearing and settlement arrangements in the future were to completely eliminate the use of reserve balances to settle private

transactions, *the fact that banks or other institutions must deliver reserve balances to the Treasury to settle their customers' tax liabilities would be sufficient to ensure a nontrivial demand for reserve balances and the central bank's ability to influence market interest rates through arbitrage between the overnight rate and other rates.*[14] The ability to set interest rates thus does not rely upon the central bank's monopoly of the means of settlement, the perceived safety of using reserve balances, use of the central bank as counterparty in netted settlement of private transactions, or the central bank paying interest on reserve balances. Rather, what remains of each of these, as Wray (2003) notes, is the perplexing question of why the nonstate sector would accept a fiat money—the state's liabilities—when it is not exactly clear for what the state would be liable. By contrast, from a modern money perspective, the state is liable only to accept its fiat money in payments made from the nonstate sector to itself (ibid., p. 89). And just as research into the history of money has demonstrated that money did not originally emerge from some need to overcome the "double coincidence of wants" inherent in barter trade (e.g., Forstater, 2006; Ingham, 2004; Peacock, 2003–4; Wray, 2004), so is a "reverse barter" view mistaken in which technology advances sufficiently for "mutual fund e-settlement money" to overcome the "double coincidence" problem in financial transactions. As Goodhart recognized,

> there is no *technological* barrier now, nor has there ever been one, to financial intermediaries settling with each other. Central banks do not now exist because of some technological imperative, but because they have evolved to meet a combination of both governmental and structural needs. . . . In this respect, the future will be *exactly* like the past. (2000, p. 206n, emphasis in original)

To conclude this section, the requirement that reserve balances be used by banks to settle depositors' tax liabilities with the federal government is sufficient to ensure a nontrivial demand for reserve balances and the continued arbitrage between the federal funds rate and other short-term interest rates. As such, it is *modern money* in the sense defined by Wray (1998)—not e-money or other innovations—that is fundamental to un-

[14] From the modern money perspective, the elimination of so-called seigniorage revenue from reduction in reserve balances or even currency in circulation is not a concern—contrary to concerns raised by Palley (2004) or Stevens (2002)—because a sovereign currency–issuing government operating under flexible exchange rates does not *need* its own money; rather, it is the public that must acquire the government's money to settle its liabilities with the state.

derstanding the Fed's ability to set interest rates. While researchers have been led astray due to misinterpretations of an admittedly complicated process of monetary policy implementation, were one to *begin* from an understanding of modern money and the ability of a state issuing a sovereign currency to levy a tax liability in its own money, the ability of the central bank to set the overnight rate, to minimize this rate's variability, and to influence other rates through arbitrage would be clear even given the ever-accelerating pace of the e-money revolution.

Concluding remarks

Instead of the Austrian view of money, it is, on the contrary, into a modern money or neo-Chartalist view of money—which begins with a demand for the state's money to settle tax liabilities—that the future of e-money and the ability to set interest rates "fit naturally." What matters is not whether there are other, private methods of settling payments, or whether private payments are settled at all on the Fed's books, but whether there is a nontrivial demand for reserve balances; that tax liabilities are settled with the Treasury via debits to reserve accounts is sufficient for such a nontrivial demand to exist. Consistent with the horizontalist view, even neoclassical economists such as Woodford have acknowledged that, absent the Fed's target, there is no "natural" or "equilibrium" interest rate toward which private markets are moving; given a nontrivial demand for reserve balances, the Fed can set its overnight target at any level—even zero (Forstater and Mosler, 2005)—and other rates will follow its lead.

It is important to recognize that the increased variability in the federal funds rate and potential elimination of reserve balances in private settlement—which together gave rise to the literature discussed in this paper—have been influenced by the state's ability to "rewrite the dictionary," to recall Keynes's famous phrase. In the United States, both have been heavily dependent upon the Fed's own authorization of sweep account technologies, penalties imposed by the Fed on overdrafts (particularly the substantial penalties on overnight overdrafts), the nonmonetary costs associated with borrowing at the discount window prior to 2003, legal prohibition of interest payment on reserve balances, and the Monetary Control Act of 1980 requirement that the Fed recoup its own imputed costs of capital by charging banks for its settlement services (which is explicitly intended to *encourage* private competition with the Fed's settlement services). Thus, while the state *can* ensure its own ability to set interest rates even in an era of revolution in payments technologies, it can

likewise relinquish this power if it so chooses. In sum, the ability to set interest rates is most assuredly a matter of *political* economy.

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