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Changes in Central Bank Procedures During the Subprime Crisis and Their Repercussions on Monetary Theory

Abstract: *The subprime financial crisis has forced several central banks to take extraordinary measures and to modify some of their operational procedures. These changes have made the deficiencies and lack of realism of mainstream monetary theory even clearer, as can be seen in undergraduate textbooks as well as in most macroeconomic models. They have forced monetary authorities to publicly reject some of the assumptions and key features of mainstream monetary theory, fearing that, on that mistaken basis, actors in the financial markets would misrepresent and misjudge the consequences of the actions taken by the monetary authorities. These changes in operational procedures also have some implications for heterodox monetary theory, in particular for post-Keynesian theory. My objective in this article is to analyze the implications of these changes in operational procedures for an understanding of monetary theory. I take the evolution of the operating procedures of the Federal Reserve since August 2007 as an exemplar. The U.S. case is particularly interesting, both because it was at the center of the financial crisis and because the U.S. monetary system and its federal funds rate market are the main sources of theorizing in monetary economics.*

Key words: *central bank procedures, federal funds rate, interest on bank reserves, money multiplier*

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The subprime financial crisis that started in August 2007 and was later called the global financial crisis, has forced several central banks to take extraordinary measures and to modify some of their operational procedures. These changes have made the deficiencies and lack of realism of mainstream monetary theory even clearer, as can be seen in undergraduate textbooks as well as in most macroeconomic models. They have forced monetary authorities to publicly reject some of the assumptions and key features of mainstream monetary theory, fearing that, on that mistaken basis, actors in the financial markets would misrepresent and misjudge the consequences of the actions taken by the monetary authorities. These changes in operational procedures also have some implications for heterodox monetary theory, in particular for post-Keynesian theory.

My objective in this article is to analyze the implications of these changes in operational procedures for an understanding of monetary theory. To do so, having already studied the case of the Canadian monetary system (Lavoie and Seccareccia 2009), I focus on the case of the U.S. monetary system, examining the evolution of the operating procedures of the Federal Reserve (the Fed) since August 2007. The U.S. case is particularly interesting, both because it was at the center of the financial crisis and because the U.S. monetary system and its federal funds rate market are the main sources of theorizing in monetary economics.

I start by recalling how the federal funds rate was determined before August 2007 and up to mid-September 2008. I then outline how the Fed lost control of the federal funds rate following the bankruptcy of the Lehman Brothers investment bank and what changes in operational procedures were undertaken to regain control. I then discuss the implications of these changes for mainstream monetary theory, and in particular the efforts of officials at the Federal Reserve Bank of New York (New York Fed) to steer observers toward a new understanding of monetary theory. This is followed by a discussion of the implications of these same changes for post-Keynesian monetary theory and possibly for fiscal policy.

Timeline 1 at the Fed: Credit Easing with Neutralization

As is well known, the beginning of the global financial crisis can be dated to August 9, 2007, when European banks stopped lending to each other, forcing the European Central Bank (ECB) to lend nearly €100 billion to commercial banks. This confidence crisis had immediate repercussions in other monetary markets, in particular in the United States and in Canada, where central banks also had to provide advances to banks so that the payment system could clear. The crisis quickly subsided, and most observers were led to believe that central bankers had cleverly avoided further financial trouble, that the self-regulating forces of the financial system were strong enough to make it resilient enough to face large losses, and that this would have no impact on the real economy. Furthermore, central bank and government officials, along with economists working at private banks, kept repeating their mantra: the "fundamentals are sound."

Despite this, however, the Federal Reserve (the Federal Open Market Committee [FOMC]) felt compelled in mid-September 2007 to make its first of a long list of reductions in the Fed fund rate target. In addition to various sporadic and temporary injections of liquidity, the Fed also decided to proceed to more permanent credit-easing operations, with the introduction of the so-called term auction facility in mid-December 2007. The term auction facility allowed banks to take collaterized loans from the central bank for a period going roughly from one to three months—a much longer period than usual. This meant that the Fed was providing loans, that is, providing reserves and hence liquidity to the banks that were most keen on getting it (by making the highest bids at the auction), without these banks having to borrow at the dreaded discount window or having to get the liquidity from other (reluctant) banks.

These credit-easing operations, unless they had been neutralized, would have led to a decrease in overnight rates within the peculiar U.S. monetary setup that then existed. Indeed this is what occurred for about one month during the turbulences of August–September 2007, when the effective federal funds rate stood on average at nearly30 basis points below the target. To keep the actual federal funds rate around its target despite the provision of credit-easing operations, the Fed would have needed to conduct open-market operations by entering the repurchase (repo) market and selling Treasury bills to the private sector. After September 2007 and until September 15, 2008, the expansionary effects of the advances being granted by the Fed were being roughly compensated by repo operations conducted by the Fed, thus keeping the size of the balance sheet of the Fed approximately constant. Actually, as a result of the combination of credit facilities with compensating repo operations, the Fed, at the aggregate level, was simply swapping highly liquid assets—short-term Treasury bills—for less liquid ones, such as long-term government bonds or private securities, thus providing more liquidity to the banking system without having to give up its interest rate target. This could be achieved because the neutralizing operations kept the total supply of reserves in the system equal to its approximate required level, or more precisely equal to the amount of compulsory reserves plus the desired amount of excess reserves at the target federal funds rate.

Table 1 shows the standard deviation of the differential between the federal funds rate and the federal funds rate target for various time periods. Except for September 2001, as well as August and December 2007, it can be seen that the Fed was able to move the federal funds rate around its target rate with a great deal of success until the bankruptcy of Lehman Brothers in mid-September 2008, as the standard deviation between mid-September 2007 and 2008 stayed relatively small, around 9 or 10 basis points on average, slightly higher than what occurred before the outset of the crisis and lower than in 2001.

The determination of the federal funds rate is represented in Figure 1, which illustrates the situation of a monetary system with compulsory reserve requirements and a multiday reserve maintenance period in which banks are asked to hold a given level of reserves on average. More precisely, Figure 1 illustrates the situation before

Table 1

Standard deviation, in basis points, between the effective federal funds rate and the FOMC interest rate target

Period	2001	2002	2003	2004	2005	2006	Jan. 1, 2007 Aug. 8, 2007
Standard deviation	17.7	5.2	6.1	3.9 4.2*	7.1	5.4	2.9
Peak monthly value	50.1 (Sept.)	8.4	13.2	7.0	10.9	8.3	3.4

Period	Aug. 9, 2007 Sept. 14, 2007	Sept 17, 2007 Dec 31, 2007	Jan. 1, 2008 Sept. 14, 2008	Sept. 15, 2008 Oct. 8, 2008	Oct. 9, 2008 Nov. 5, 2008	Nov. 6, 2008 Dec. 5, 2008	Dec. 6, 2008 Apr. 30, 2010
Standard deviation	18.8	10.8 15.6*	9.0	62.8	16.9	19.4	4.1
Peak monthly value		23.5 (Dec.)	11.0				5.2

Source: Federal funds rate and FOMC target taken from the data bank of the Federal Reserve Bank of Saint Louis.
Notes: Friday deviations are counted three times.
*Includes the large spread that occurred at year-end.
August 9, 2007: Start of subprime crisis
September 17, 2007: Apparent end of tensions in money markets
September 15, 2008: Lehman Brothers declares bankruptcy
September 10, 2008: Fed starts paying interest on reserves
November 6, 2008: Federal funds rate target equals interest paid on reserves
December 6, 2008: Federal funds rate target is set between 0% and 0.25% (the target is assumed to be at 0.125% until February 19, 2009, when it is assumed to be 0.19%, as the primary credit rate is pushed from 0.50 to 0.75%).

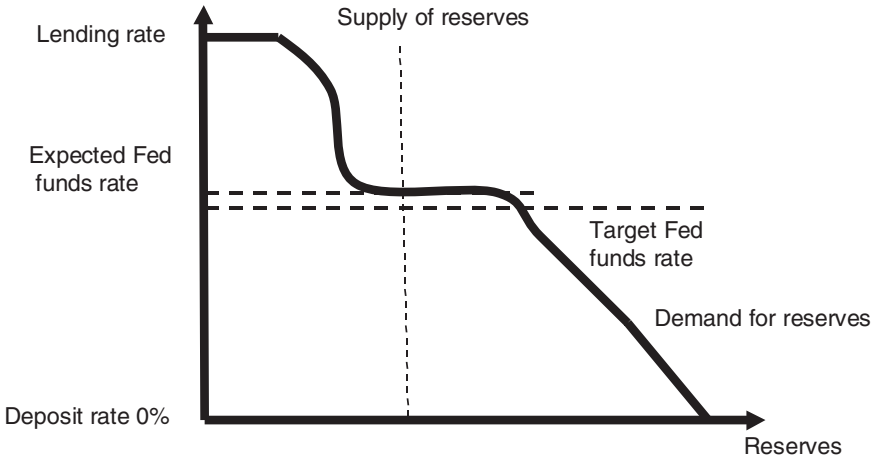

Figure 1. **The Determination of the Federal Funds Rate with Compulsory Reserve Requirements and a Multiday Reserve Maintenance Period**
Source: Based on Ennis and Keister (2008) and Whitesell (2006).

the last day of the maintenance period. The larger the average amount of reserves that must be held, and the farther away from the last day of the maintenance period, the longer the flat middle segment will be. On the very last day of the maintenance period—settlement day—the middle segment of the demand curve would have its standard downward slope, which explains why federal funds rates are likely to be more volatile on settlement days. Figure 1 also represents another component of monetary implementation in the United States before the crisis, as the rate of interest on deposits at the central bank, that is the interest rate on bank reserves at the central bank, is equal to zero.

The demand curve for federal funds rate has three flat components. If the overnight interest rate were to tend to exceed the lending rate—the rate at which banks can borrow from the central bank—banks would instead borrow from the central bank, which explains the first flat portion. Similarly, after the federal funds rate falls to zero, banks are willing to hold any amount of reserves. Finally, the middle flat segment corresponds to the federal funds rate that is expected on the following days, before the end of the maintenance period. The demand curve for reserves is flat at this rate because banks know that, as long as they hold a fair amount of reserves relative to stochastic payment inflows and outflows, they can either lend or borrow reserves at this expected rate over the next few days, without being caught on settlement day with either excess reserves that would provide a zero rate of return or with a deficiency in reserves that would encounter a penalty rate. The expected federal funds rate, if the central bank has previously shown that it is able to hit its interest rate target, ought to be equal or close to the federal funds rate target. Obviously, the institution of an average multiday maintenance period helps central banks to achieve their interest rate target. As long as expected and target federal funds rates

do not diverge too much from each other—and as long as the monetary authorities are able to correctly forecast changes in the demand for reserves and autonomous changes in the supply of reserves (due to central bank and government transactions that transit through the clearing and settlement system)—the actual federal funds rate should remain close to its target; this is illustrated in Figure 1.

Timeline 2 at the Fed: Credit Easing Without Neutralization

Despite the financial difficulties of the two huge government-sponsored enterprises, Fanny Mae (Federal National Mortgage Association) and Freddie Mac (Federal Home Loan Mortgage Corporation), with these two giant mortgage finance companies put into federal conservatorship in early September 2008, the Fed was still able to keep good control over overnight interest rates, as they settled around the target 2 percent rate that had been in place since May 2008. This all changed, however, on September 15, when the Treasury Department and monetary authorities were unable to find a buyer for the failing Lehman Brothers investment bank, as they had in March 2008 for another investment bank rival—Bear Stearns—and as happened on that very same day in the case of Merrill Lynch. As we all know now, this was the beginning of the end, as the decision of government officials not to proceed to the only other option—full nationalization—sent a chilling message to the world financial markets, giving supporters of free markets a glimpse at the true meaning of unfettered markets: no counterparty was judged to be safe anymore, the commercial paper market became frozen, and the repo market nearly frozen, whereas mutual money market funds were submitted to a "bank run" until a blanket deposit insurance was provided. In addition, the failure of Lehman Brothers created huge financial problems for all those who had sold credit default swaps, including the too-big-to-fail giant insurer American International Group (AIG), which had to be bailed out. After Lehman Brothers was forced to declare Chapter 11 bankruptcy, banks once more declined to lend to one another and the demand for reserves rose precipitously, with the Fed losing any true control over the federal funds rate.

At first, the Fed underestimated the demand for liquidity, causing federal funds rates to rise far above their target level, whereas Treasury bill yields became completely disconnected from the federal funds rate, falling to near-zero levels as a wild stampede toward security brought the government yields down. Then, during the following two weeks, the Fed injected huge amounts of liquidity, purchasing asset-backed commercial paper and other private assets. Initially these reserve-creating operations were partially neutralized, as the Fed asked the Treasury to auction billions of dollars worth of government bills that the financial markets had purchased. This was the so-called Treasury supplementary financing program (SFP). The proceeds of these Treasury bill sales were then repatriated in the form of government deposits at the Fed, thus draining or neutralizing the reserves created by the use of the various credit facilities of the central bank.[1]

Once again, the impact of such a scheme was a kind of swap in which the central

Table 2

Accounting for Balance Sheet Changes at the Fed

Central bank (the Fed)		Commercial banks	
Assets	Liabilities	Assets	Liabilities
(A) T-bills: –100	(C) Reserves: +100	(A, B) T-bills: +100	Deposits
	(B) Government deposits: +100	(C) Reserves: +100	Own funds
ABS: +100		ABS: –100	

bank took in illiquid private financial assets and the private sector acquired liquid short-term government securities. But this time, in contrast to what had occurred previously, the size of the Fed's balance sheet rose precipitously. The rise in its holdings of private assets was not compensated for by a decline in its holdings of government securities; instead, it was accompanied by a rise in its liabilities—at first mainly the increased deposits of the federal government at the central bank and then later the increased amount of bank reserves at the Fed, when the Fed resolved to let bank reserves rise above their required levels, as much as twenty-five times the required amounts, with excess reserves being more than 500 times their previous normal levels. The three main programs that the Fed used to provide liquidity to the financial sector in exchange of illiquid private assets (here assumed to be asset-based securities) are illustrated with the help of Table 2. The sterilizing actions conducted through standard open-market operations until September 2008 correspond to the A case, when the size of the Fed balance sheet remained roughly constant; by contrast, the sum on the balance sheet ballooned when sterilizing actions were conducted through the Treasury SFP—the B case—and when sterilization was abandoned—the C case.

Figure 2 shows what happened with respect to interest rates. During the week after the Lehman Brothers bankruptcy, the demand for reserves rose to the new dotted line, due to increased counterparty uncertainty. As mentioned, for a few days, the Fed initially underestimated this shift in the demand for reserves and thus failed to accommodate it, as it did not sufficiently increase the supply of reserves. With the supply of reserves given by the S′ vertical line, the federal funds rate jumped above the target rate. In the following weeks the Fed reversed its previous attempts to fully neutralize its operations, providing a much greater supply of reserves, shown here with the S″ line. But this led to a federal funds rate that was much lower than the federal funds rate target. The Fed had lost its tight control over the federal funds rate.[2] Indeed, this case can be assessed with the help of Table 1, which shows that the standard deviation of the spread between the effective and the target federal funds rates rose to unprecedented levels, 62 basis points, during the three weeks after the Lehman Brothers failure.

As Beck and Klee say, "The intensifying financial turmoil over the course of 2008 required larger and larger injections of liquidity into the financial system

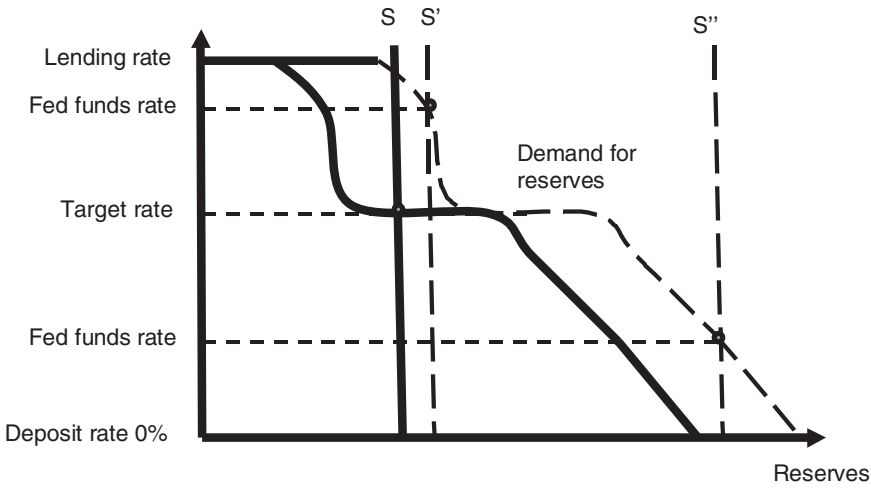

Figure 2. **The Impact of the Large Increase in the Demand for Reserves, First with an Insufficient Supply Response, and Then with No Attempt to Sterilize Liquidity Operations**

and made it infeasible for the Federal Reserve to sterilize the resulting increases in reserve balances by redeeming or outright selling Treasury securities from the System Open Market Account portfolio" (2009: 8–9). Indeed, as its stock of Treasury bills had already been depleted by its previous neutralizing actions, the Fed could not conduct any further reserve-reducing open-market operations. As to the other means to drain reserves—the Treasury SFP—it was felt that there were limits to its use as the Treasury approached its legal debt limit defined by Congress (Haubrich and Lindner 2009).

Determined to gain back its control over short-term interest rates, the Fed managed to get the authority to pay interest on required and excess reserves on October 6, 2008, implementing this decision on October 9. Such an authority had been granted by Congress in 2006 but was not supposed to be effective until October 2011. The financial crisis induced the monetary authorities to implement this power three years earlier than planned. The ability to pay interest on bank reserves at the central bank thus allowed the Fed to adopt the corridor system that has been in existence for about fifteen years in several countries, among them Canada. Figure 3 illustrates what should have happened, at least under normal circumstances, with the adoption of the corridor system.

In the case of the symmetric corridor, the target overnight rate is set in the middle of the band, halfway between the lending rate (the primary credit rate) for credit facilities and the rate of interest on deposits at the central bank, which constitute the ceiling and the floor of the corridor. As long as the supply of reserves accommodates demand, the actual overnight rate ought to remain near the middle of the band and hence near the target rate (as with supply curve S).[3] With the corridor, even

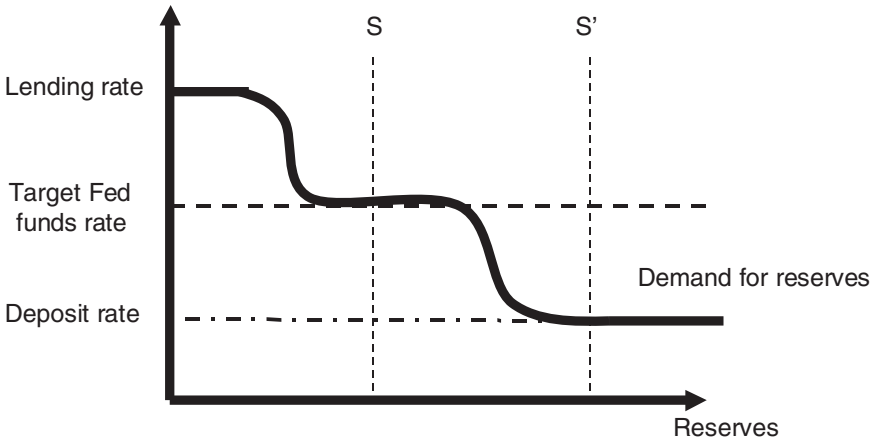

Figure 3. **The Corridor System, with the Target Rate at the Midpoint of the Corridor**

if there are wide fluctuations in the demand for reserves or in the supply of reserves, overnight interest rates can only fluctuate between the ceiling and the floor of the corridor, and so cannot get away too much from the target federal funds rate. Thus even if the monetary authorities provide an excessive amount of reserves, such as the S′ line, the overnight interest rate should not fall any lower than the floor rate, thus remaining not too far from the target. But despite all this, between October 9 and October 29, when the federal funds rate target was at 1.50 percent, the primary credit rate at 1.75 percent, and the floor at 1.40 percent for compulsory reserves and 0.75 percent for excess reserves, the effective federal funds rate hovered between 0.67 percent and 1.04 percent—far below the target.

On November 6, 2008, no doubt in part as a response to this substantial discrepancy between the actual and the target federal funds rates, the Fed moved on to a modified corridor system, the so-called floor system, in which the central bank sets the target interest rate equal to the deposit rate. The floor system is illustrated in Figure 4. In the floor system, the central bank supplies an excess amount of reserves to deliberately bring the actual overnight interest rate to the level of the floor rate. But then the actual federal funds rate ought to be equal to the target federal funds rate because the floor rate is the target rate. Normally, the federal funds rate should not fall any lower than the deposit rate on reserves, despite the creation of large excess reserves, because banks that are in a positive position within the clearing and settlement system will prefer to deposit their funds at the central bank rather than lend them at a lower rate on the overnight market. Despite this, with the target rate and the deposit rate on both required and excess reserves set at 1 percent, the federal funds rate hovered between 0.10 percent and 0.62 percent.

The Fed then moved on to its last procedural change and to its last decrease in interest rates. On December 17, 2008, it set the primary credit rate at 0.50 percent

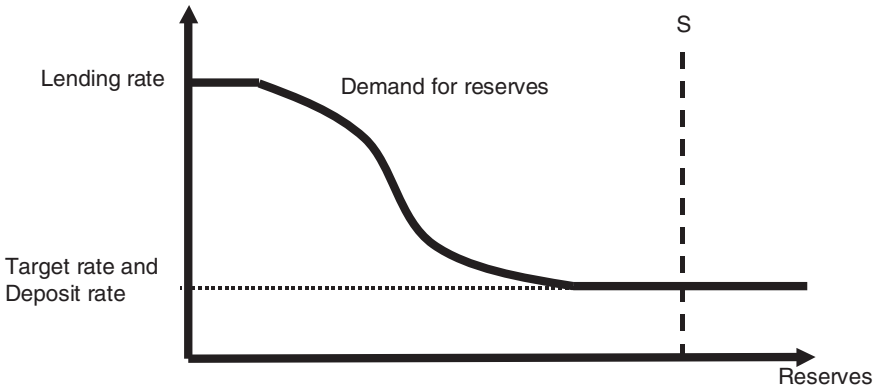

Figure 4. **The Floor System, with the Target Rate at the Bottom of the Corridor**

and the deposit rate on all kinds of reserves at 0.25 percent. It also finally recognized that it still did not fully control short-term interest rates by announcing that the federal funds rate target would stand somewhere between 0 and 0.25 percent. And indeed, ever since this announcement, the effective federal funds rate has stood at or below 0.25 percent (until October 2010, when this article was revised). Checking Table 1, one can see indeed that this last move has been successful: Spreads between the effective and the target federal funds rates have been at their historical levels since mid-December 2008.

An intriguing question, of course, is why the federal funds rate did not stay above or at the bottom of the corridor after the corridor and the floor systems were put in place. At the time, this was an intriguing question, and few answers could be provided. In Canada, in the wake of the financial crisis in spring 2007, there had been a period in which the actual overnight rate had stayed consistently below the target overnight rate, inducing the Bank of Canada to provide a negative aggregate amount of reserves in the monetary system (a negative amount of settlement balances) in an effort to bring up the overnight rate. The main reason advanced to explain this phenomenon is that financial markets for a while had taken the target to mean the uncollaterized overnight rate, whereas the Bank of Canada had the collaterized rate in mind. As a result, during that period, the uncollaterized overnight rate had been close to the target, whereas the collaterized rate, the one targeted by the central bank, had been below the target. But in the United States, the federal funds rate is an uncollaterized rate, so this explanation could not apply to the U.S. situation.[4]

In the case of the U.S. financial system, the major explanation is that not all participants in the federal funds market are eligible to receive interest payments on their reserve balances. In particular the government-sponsored enterprises, such as Fannie Mae and Freddie Mac, get nothing on their deposits at the Fed (Bech and Klee 2009). In addition, there are foreign institutions that hold balances at the Fed

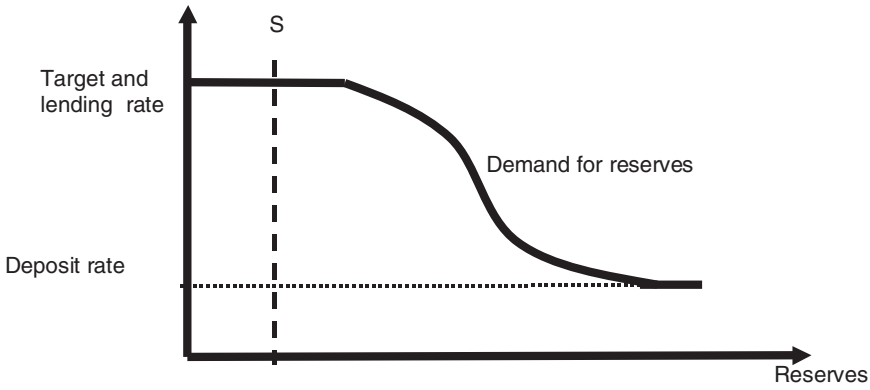

Figure 5. **A Hypothetical Ceiling System, with the Target Rate at the Top of the Corridor**

but do not receive interest on reserves. All these institutions thus lack bargaining power and are being forced to lend some of their surplus balances at a rate below the floor. A similar explanation was provided in Canada, when the overnight rate fell by a few basis points below the overnight floor target of 25 basis points in 2009. It is said that some participants in the repo market cannot deposit their funds overnight at the Bank of Canada, and thus "a small spread between the overnight rate and the deposit rate would not necessarily be arbitraged away."[5]

Before we move on to the implications of all this for monetary theory, let us discuss another possibility. Just as the monetary authorities can set the target overnight interest rate equal to the floor rate (the deposit rate) and provide an excessive amount of reserves, they can alternatively decide to fix the target rate equal to the ceiling rate, that is, equal to the lending rate of the central bank. This is illustrated in Figure 5, in which the supply of reserves is such that private banks are forced in the aggregate to access the discount window and borrow from the central bank. As mentioned above, this can occur even in countries where there are no reserve requirements, so banks normally have a zero demand for reserves. In this case, the central bank only needs to ensure that the overall position of the participants in the clearing and settlement system is negative, so they need to borrow from the central bank in the aggregate to settle their position in the payment system.

In fact, we can say that in the not-so-recent past, this was exactly the situation of many continental European monetary systems and even of the British system when banks were said to be "in the Bank," being forced to borrow from the Bank of England. Clearly, in that case, the overnight rate of interest would tend to rise to the lending rate, and hence the effective overnight rate would equal the target set by the central bank, as too many banks would be unable to find a counterparty on the overnight rate market. Such a system was gradually abandoned as advocates of free-market capitalism convinced central bankers of the advantages of a system based on open-market operations. Some observers have claimed, however, that one

could just as well get rid of the overnight market altogether, by setting the deposit and lending rates nearly equal, with the central bank both taking the deposits of any institution running a surplus position and granting credits to any institution running a deficit position in the clearing and settlement system (Fullwiler 2009 and references therein). Those who still believe in the efficiency of financial markets would argue, however, that such a system would eschew the disciplinary effects of overnight markets and of auction markets. Although the ECB does not have a ceiling system, it should be noted that banks in the eurozone are normally constantly borrowing funds from the ECB, giving rise to the main refinancing rate, so banks in the eurozone are indeed partly "in the Bank."[6]

Implications for Monetary Theory

Economists have been aware for some time that the overnight interest rate and the amount of reserves *can* be divorced. Thus in contrast to the mainstream view, it is not necessary to augment bank reserves to decrease the overnight rate of interest: reserves are not the dual of overnight interest rates. This has been well known since the mid-1990s, when some central banks adopted the corridor approach. It is particularly obvious in the case of countries that have eliminated reserve requirements, as in Canada. Without the corridor, as can be seen in Figure 1, all things being equal, a change in the overnight rate of interest requires a change in the supply of reserves.

However, as pointed out by Ennis and Keister (2008: 244), some clever modification of the central bank lending rate could also achieve the same objective, but with much imprecision. By contrast, as can be guessed from Figure 3, with the corridor system, it suffices to change both the floor and the ceiling of the corridor to induce movement of the actual overnight rate toward the middle of the new corridor, without any change in the supply of reserves. As demonstrated in the Canadian corridor system, the convergence of the actual overnight rate toward the target rate can be nearly perfect. However, with the standard corridor system, too great a departure of reserves from their normal level should lead to an increase or a decrease of the overnight rate relative to the target rate.[7] Indeed, this is why central banks such as the Bank of Canada are careful to supply zero or close to zero reserves when reserve requirements are nil. In a sense the divorce is not complete; it is more like a separation.

The divorce between reserves and interest rates is fully consumed with the newly adopted floor system. In this specific variant of the corridor system, with the floor rate being equal to the target rate, the rate of interest can be raised simply by raising the lending and the deposit rates; but in addition, once the supply of reserves largely exceeds the demand for reserves, central banks need not worry about fluctuations in reserves because the excess amount of reserves will keep the overnight rate at the floor level, and hence at the target overnight rate. This is what two economists at the Bank for International Settlements, Borio and Disyatat (2009), call the "de-

coupling principle." Ennis and Keister (2008), Fullwiler (2005), Goodfriend (2002: 3), and Woodford (2000: 255) have briefly proposed the floor system, and a more detailed argument in favor of this proposal can be found in Keister et al. (2008). Indeed both the Reserve Bank of New Zealand and the central bank of Norway adopted a floor system *before* the financial crisis got under way.

Borio and Disyatat (2009: 3) claim that the decoupling principle has "far-reaching implications," presumably because the link between interest rates and the supply of reserves is completely severed. This means that the monetary authorities now dispose of two instruments instead of one. They can pursue an interest rate policy by acting upon the corridor or the floor, and if they adopt the floor system they can also have a supply of reserves policy, because the level of reserves is completely disconnected from the overnight interest rate as long as there are sufficient excess reserves.

One may wonder, however, about the usefulness of an independent reserve supply policy. The main advantage that I can see is that the central bank need not proceed to neutralizing operations when a floor system has been adopted, and thus there is no need to forecast the demand for reserves. As a consequence, there should be less volatility in overnight interest rates. Thus, with a floor system, there is no need for compulsory reserves and the reserve-averaging system as a means to stabilizing interest rates in a financial system in which banks and the central bank do not have perfect knowledge of their position in the clearing and settlement system.[8]

In the corridor system, if the central bank engages in credit-easing operations, purchasing illiquid private assets to prevent the prices of these financial assets from falling, it needs to provide liquid government securities in exchange to neutralize the reserve-creating effects of its credit-easing operations. As we saw earlier, this can be done either by keeping the size of the central bank balance sheet constant when the central bank engages in open-market operations and repo operations or by letting its balance sheet increase in size, by having the government agree to sell securities and accumulate deposit balances at the central bank. If the central bank starts to run out of Treasury bills, it will have to switch to the second option, letting the bottom line on its balance sheet rise. But this implies that the gross debt of the federal government is increasing, which may arouse suspicions among financial market participants.[9]

In a country like the United States (and also in the eurozone), there is a second advantage to the floor system. The U.S. payment system is based on a gross clearing and settlement system that requires high clearing balances during the day. A payment cannot go through unless the bank that is the payee has enough clearing balances to avoid holding negative balances or unless the payee can obtain daylight credit from the central bank (for a fee or with the help of collateral, as is done elsewhere). In normal times, the central bank is thus constrained to be part of a balancing act, "expanding the supply of reserves during the day and shrinking it back overnight" (Keister et al. 2008: 47). Making use of the floor system and providing large amounts of reserves at the deposit rate helps to remove the credit risk of the

central bank on its daytime advances, as these advances are no longer necessary, and it removes the risk that delayed payments will lead to gridlock. This problem does not exist in Canada, because banks can be in a negative position (half the banks are normally in such a position) within the clearing and settlement system during the day (up to a certain limit, determined every morning by the participants of the clearing system themselves).

The third advantage of the floor system in times of recession, according to some mainstream economists, is that large excess reserves will induce banks to make more loans. Some observers have claimed that the Fed was pursuing quantitative easing during the subprime financial crisis, adding reserves to the banking system in the hope that some of these reserves would be lent to the productive sector, thus easing the credit crunch. Indeed, several mainstream U.S. economists kept recommending quantitative easing to the Japanese monetary authorities when they were caught in their own depression before the occurrence of the global financial crisis, not understanding why the Bank of Japan declined for a long time to follow such advice (Koo 2009: 73).

My reading of the papers of the officials at the New York Fed leads me to believe otherwise: The Fed did not go for quantitative easing. The creation of reserves was a by-product of the credit-easing policies, and its intent was not an expansion of the supply of reserves. Indeed, New York Fed staff members Keister and McAndrews write

> It is important to keep in mind that the excess reserves in our example were not created with the goal of lowering interest rates or increasing bank lending significantly relative to pre-crisis levels. Rather these reserves were created as a by-product of policies designed to mitigate the effects of a disruption in financial markets. In fact, the central bank paid interest on reserves to prevent the increase in reserves from driving market interest rates below the level it deemed appropriate given macroeconomic conditions. (2009: 8)

Thus Keister and McAndrews (2009) clearly object to the proposals that have been put forward to discourage banks from holding their excess reserves, such as a special tax on excess reserves and the elimination of the interest payment on excess reserves, as they reject the notion that private banks are hoarding funds and refusing to make loans to loan-hungry customers. Unfortunately, this idea of idle reserves, associated with credit-rationing banks, is also rampant among some heterodox economists (Palley 2010; Pollin 2010). Paying interest on reserves is not deflationary. It does not discourage banks from lending to firms or households. Taxing reserves will not encourage banks to make more loans to the nonbanking sector. It will only lead to a reduction in the federal funds rate, as the alternative, holding reserves, now has a lower rate of return.[10]

Ever since the increase on its balance sheet, the Fed has been at pains to explain that only part of this increase was associated with an increase in reserves and also that increases in reserves did not imply increases in the money supply. The textbook story, based on the money multiplier, says that excess reserves will

feed into additional loans and deposits, thus leading to excess money creation and thus inflation. Old-time monetarists such as Allan Meltzer (2010) have come out of their closets, trying to instill fear in the heart of rentiers and market observers. Even Keynesian economists, brought up on the standard IS/LM model, believe that more reserves lead to lower interest rates and hence higher aggregate demand and more inflation.

Fed officials have had to wage two battles. First they had to explain that, because of the decoupling principle, the central bank could raise the target rate and federal funds rates despite the presence of excess reserves. The corridor system certainly provides such an explanation. Second, they had to convince market observers that the money multiplier story is invalid and that private banks will not create money at will just because they are holding excess reserves.

U.S. central bankers have been keen to convince financial experts and portfolio managers that previous monetary theory is wrong and that excess reserves are not inflationary. As William Dudley, the president and CEO of the New York Fed, said, "It is not the case that our expanded balance sheet will inevitably prove inflationary. It is important that this critical issue be well understood" (2009: 1). And as Borio and Disyatat point out, among policymakers "there is a concern that markets may at some point, possibly based on the 'wrong model,' become excessively concerned about the potential inflationary implications of these policies" (2009: 22)—the reserve-creating credit-easing policies. Such expectations would undermine the efforts of the monetary authorities to ease conditions in credit markets, in particular long-term assets, as they would lead to higher long-term interest rates. Incidentally, this concern jeopardizes all models based on rational expectations that assume that all agents believe in the same macroeconomic framework and the same macroeconomic causal mechanisms.

The crucial issue here is whether it is true that "An expansion of bank reserves endows banks with additional resources to extend loans" (Borio and Disyatat 2009: 18). If it does, then it must be the case that banks need reserves to make loans or to be induced to make more loans. Then, "Either bank lending is constrained by insufficient access to reserves or more reserves can somehow boost banks' willingness to lend" (Borio and Disyatat 2009: 19). But as Borio and Disyatat write, lending officers do not make their lending decisions after checking the reserve position of their bank at the central bank. Rather these two authors point out that "the amount of credit outstanding is determined by the banks' willingness to supply loans, based on perceived risk-return trade-offs, and by the demand for loans" (2009: 19)—a simple statement of the credit-led endogenous money view so popular among post-Keynesians. Thus a bank that has easy access to free reserves will not necessarily provide more loans than a bank that has to borrow them, because the lending decision depends on whether the banks are able to find a creditworthy borrower. Borio and Disyatat further point out that the availability of reserves cannot constrain bank lending simply because "central banks supply reserves *as demanded by the system*"—a claim long made by post-Keynesian horizontalists, as is the next point

made by Borio and Disyatat, that is, the claim that reserve requirements and the degree of reserve remuneration are not a quantitative constraint but instead affect the cost of intermediation.[11]

But here the main issue is not what happens when the central bank supplies exactly the amount of reserves demanded by banks, but rather what happens when, as is the case now in several countries including the United States, the central bank supplies a large excess amount of reserves. The graphical apparatus that we developed in the previous sections gives us a quick answer. With no interest remuneration on reserves, the overnight rate will drop to zero. This should lead to lower interest rates throughout the short-term spectrum, and hence it should induce both lenders and borrowers to engage in credit operations, unless banks are determined to keep the credit crunch going. If there is a corridor system, the overnight interest rate should drop to the level set by the deposit rate at the central bank. And with a floor system, the overnight interest rate will remain where it was, at its floor level, and nothing else will happen. Keister and McAndrews provide a story that underlines the effect of excess reserves on interest rates, undermining their quantitative effects. Banks holding excess reserves when reserves carry no remuneration, say Keister and McAndrews,

> will seek to lend out those reserves at any positive interest rate, and this additional lending will lower the short-term interest rate. This lending also creates additional deposits in the banking system and thus leads to a small increase in reserve requirements. . . . The process then repeats itself, with banks making more new loans and the short-term interest rate falling further. The multiplier process could continue until excess reserves are eliminated—that is, until the increase in lending and deposits have raised required reserves all the way up to the level of total reserves. If this happens the money multiplier will be fully operational. However the process will stop earlier if the short-term interest rate reaches zero. When the market interest rate is zero, the opportunity cost associated with holding reserves disappears. At this point, banks no longer have an incentive to lend out their excess reserves, and the multiplier process halts. (2009: 8)

The story provided by Keister and McAndrews is interesting, as it implies that the money multiplier story is unlikely to be fully operational, but in my view it yields too much to the standard money multiplier view. Here is what I wrote to Keister:

> You seem to imply that the textbook multiplier still applies when reserves earn no interest. I think that this is a misleading statement. . . . It implies that there is a bunch of agents out there, waiting for banks to provide them with loans, but that they are being credit rationed because banks don't have access to free reserves. This contradicts your September 2008 article [Keister et al. 2008] where you show that the Fed normally tries to supply the reserves demanded by the banking system at the target interest rate. So it means that if banks make more loans, hence create more deposits, and need more reserves, the Fed will supply them to keep the fed funds rate on target. Rather what happens when excess reserves are being provided with no remuneration of reserves is that the fed funds rate drops down, as banks with surplus reserves despair to find banks with insufficient reserves, having no alternative but a zero rate. The drop in the fed funds rate may induce banks to lower their lending rates, and hence induce new borrowers to ask for

> loans or bigger loans, but it really has nothing to do with the standard multiplier story. If there is no change in the lending rate, new creditworthy borrowers just won't show up. There is never any money multiplier effect.[12]

Keister responded:

> I agree with you on the money multiplier, but I would state things in a slightly different way. In order for the money-multiplier story to make sense, it must be the case that it (implicitly, at least) works through lowering interest rates. The process must go just as you described, with the increase in reserves lowering market rates, which makes more potential projects profitable. I understand your comment to be that this mechanism is not the "money multiplier" as commonly described. We decided to be more generous to the textbooks and say that this mechanism must be what they had in mind, even if they left out the part about interest rates to simplify things for the students. Importantly, I think we agree on the point that discussions of the money multiplier have done more harm than good in terms of helping people understand what is going on.[13]

Thus it is clear that Keister and McAndrews do reject the quantitative money multiplier story. Their story is in line with what Paul Davidson (1972: 227) called the portfolio-change process and in line with what I have argued in the past when claiming that the increase in bank reserves had an impact on loans and money deposits through the interest rate channel: "Loans may increase because the general fall in interest rates has induced an increase in borrowing: at the new interest rates, more projects are profitable. This has nothing to do with the deposit multiplier" (Lavoie 1992: 183). This rejection becomes clearer when the floor system, with interest on reserves, is considered. The two Fed officers write

> Most central banks now pay interest on reserves. When reserves earn interest, the multiplier process will not continue to the point where the market rate of interest is zero. Rather it will stop when the market rate reaches the rate paid by the central bank, since if these rates are the same, banks no longer face an opportunity cost of holding reserves. If the central bank pays interest on reserves at its *target* interest rate, . . . then banks never face an opportunity cost of holding reserves and the money multiplier does not come into play. (Keister and McAndrews 2009: 8)

Thus, in this case, the higher level of reserves induces no change in interest rates, and hence no change in lending behavior. The money multiplier story vanishes entirely. As a consequence, it cannot be claimed that large excess reserves have a potentially large inflationary effect. The causal mainstream link between reserves, money, and prices is thus broken.

Implications for Post-Keynesian Monetary Theory

The financial crisis has certainly vindicated post-Keynesian theory at large and its Minskyan Wall Street component in particular. What about monetary theory? New consensus followers—a mixture of new classical and new Keynesian economics—had already adopted the endogenous view of money by removing from its main

equations the exogenous stock of money, only reintroducing a demand for money equation through the back door. What about the link between the central bank and the rest of the financial system?

Post-Keynesians usually represent the supply of high-powered money as a horizontal line set at the target overnight rate. This representation can also be found in some money and banking textbooks (Cecchetti 2008: 463). This is meant to represent the claim that between meetings of the interest-setting committee of the central bank (the FOMC in the United States), the monetary authorities will supply any amount of reserves that corresponds to the demand for reserves at the given target overnight interest rate. The shape of this supply curve was the subject of an intense debate among post-Keynesian economists, as many argued that the central bank reaction function ought to make it upward sloping when several periods came to be considered. By contrast, in this article, I have taken the view that from a daily perspective, the supply of reserves can be considered a vertical line, as the central bank has substantial control (as in the United States or Europe) or perfect control (as in Canada) over the supply of reserves.[14]

In some of my past writings, this distinction was not always made clear. For instance, in Lavoie (1992: 181–86), my main point was that central banks had little control over the supply of reserves, first, as argued here, because the main focus of central banks was the interest rates, but also because if the central bank was providing too many reserves, banks that had taken advances at the central bank would use these extra reserves to reduce their indebtedness vis-à-vis the central bank—the case of overdraft economies—thus getting the supply of reserves equal to the demand for reserves through a kind of Kaldorian reflux mechanism.

What should now be clear is that if the central bank is ready to let the overnight rate of interest drop to zero, or if there is a corridor system, it is possible for central banks to control the amount of reserves in the system, as long as they are willing to accept that the target rate of interest be set at the deposit rate on bank reserves at the central bank. There can thus be a supply of reserves that far exceeds the amount of required or demanded reserves. In systems with no compulsory reserves, similarly, the central bank can have a supply of reserves that is way beyond zero. In that sense, the supply of reserves is not necessarily equal to the demand for reserves. There is nothing that banks can do in the aggregate to remove excess reserves as long as they are not indebted toward the central bank.[15] As Fullwiler points out, "banks cannot use reserve balances for anything other than settling payments or meeting reserve requirements; reserve balances do not fund additional lending" (2005: 549). Even in an overdraft economy, as in the eurozone, banks cannot remove excess reserves (immediately) if advances from the central bank were taken on a long-term basis.

There are fiscal implications to this finding. If central banks can control both the rate of interest and the amount of reserves, instead of one or the other as we were long led to believe, it becomes clear that the deficits of federal governments can be nearly indifferently financed either by issuing government securities or by

forcing banks to hold reserves at a deposit rate that is close to the interest yield on Treasury bills. This certainly requires more thinking.

Although the present article has emphasized the divorce between bank reserves and overnight interest rates as a means to reject mainstream monetary theory, it should be clear that this divorce is not required to legitimize post-Keynesian monetary theory. But the divorce, as exemplified with the corridor system, reinforces post-Keynesian theory, as it gives additional support to the reversed causation argument. The support is well illustrated by this passage from Carpenter and Demiralp, two other researchers at the Fed:

> The Fed can and does affect total balances by changing interest rates. However the flow of events is different. When the FOMC changes its monetary policy stance (say by raising the funds rate target), demand for reserve balances declines, which in turn prompts the Fed to reduce total balances via open-market operations. There are two things to emphasize: First the decline in supply of balances follows a demand adjustment (and does not precede it), and second, the Fed's control over broader aggregates is limited to total balances. (2010: 2)

In this case, the lower demand for reserves can be explained by the lower level of economic activity and hence the ensuing lower level of bank deposits caused by the higher interest rates.

Conclusion

The financial crisis and the reaction to it are bound to have an impact on monetary theory. Already, the new consensus view, popular among central bankers, has introduced the notion of endogenous money and the idea that interest rate steering is the appropriate way to model monetary policy or central bank reaction functions (Bindseil 2004). The financial crisis has made these features of the real world even more obvious and it should make it clear that nearly all mainstream monetary theory as applied to central banking is nearly worthless, as is for instance the infamous money multiplier fable and the presumed causal relationship running from bank reserves at the central bank to price inflation.

Notes

1. The SFP program was resurrected February 2010, presumably as a means to start reducing the amount of excess reserves in the banking system.

2. A detailed account of what happened to the balance sheet of the Fed and its implementation procedures can also be found in Fullwiler (2009). I read it after writing this article, thus they constitute two independent but similar accounts of what happened.

3. The Canadian case is discussed in more detail in Lavoie (2005) and Lavoie and Seccareccia (2009).

4. Another proposed reason is that some participants to the repo market borrow government securities and thus sometimes need to cover their position. It is claimed that in the spring of 2007, there was a shortage of Government of Canada securities, thus propelling up the prices of T-bills and driving down the repo rate.

5. E-mail communication from Timothy Lane, from the Bank of Canada, to Keith Newman, January 22, 2010. Thanks to Keith for providing me with this information.

6. Although, right now, because so many reserves have been borrowed on a long-term basis from the ECB, the overnight rate has fallen to the floor, as in the United States, and as in Canada between April 2009 and June 2010.

7. I am using the conditional tense because such a claim may underestimate the force of central bank "announcement effects." On June 1, 2010, the Bank of Canada declared that it was moving out of the floor system back into the corridor system, with the target overnight rate moving from its floor at 0.25 percent up to 0.50 percent, in the middle of the corridor. Despite the presence of excess settlement balances (reserves) of 3 billion dollars, which were previously supplied to keep the overnight rate at the floor, the actual overnight rate immediately jumped up toward its new target, at 0.49 percent. Officials at the Bank of Canada claim that this is because financial market participants know that the central bank has the power to enforce its target rate.

8. In Canada they do, so there is no need for reserve averaging in the standard corridor system.

9. A third neutralization option, as is well known in China and in some other East Asian countries, is for the central bank to issue its own central bank bills, thus swapping illiquid private financial assets for liquid central bank debt.

10. Another argument of Palley's is that "paying banks interest on reserves must increase bank profitability" (2010: 55). In a sense, this is true, but as Table 2 shows, once it has been decided that banks have to be bailed out, the alternative is to provide banks with T-bills that also generate interest payments.

11. Borio and Disyatat, who incidentally cite Basil Moore (2006), add that "the main exogenous constraint on the expansion of credit is minimum capital requirements" (2009: 19), a (questionable) claim also made by some post-Keynesian authors.

12. E-mail communication to Todd Keister, January 5, 2010.

13. E-mail communication from Todd Keister, January 7, 2010.

14. This may fit the neo-Chartalist (or modern monetary theory) distinction between the vertical and horizontal components of money. See Wray (1998).

15. As pointed out by Charles Bean, the deputy governor for monetary policy at the Bank of England: "The level of commercial banks' reserves in aggregate is determined by the way we have funded the asset purchases, not by the commercial banks' own decisions. The size of banks' reserves cannot, as is frequently claimed, be a sign that they are sitting on them" (2009: 3).

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