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THE PROBLEMS OF MONETARY CONTROL
UNDER QUASI — CONTEMPORANEOUS RESERVES

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The Problems of Monetary Control Under Quasi - Contemporaneous Reserves

by

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In recent years the reserve accounting system used by the Federal Reserve has received a great deal of attention. In particular, after the Fed announced the adoption of a reserve targeting procedure of monetary control in October 1979, there was strong and mounting criticism of lagged reserve accounting. In response, the Fed adopted a "contemporaneous" reserve system in February, 1984. This new reserve accounting system appears to have pleased many critics of lagged reserve accounting who apparently see the new system as a solution to the problems posed by lagged reserves for a reserve targeting procedure. This paper examines the motivation behind, and the effects of the move to the new reserve accounting system.

The monetary policy history of the last two decades has been replete with changes in reserve accounting or operating procedures which have failed to produce the effects intended. The adoption of lagged reserves itself in 1968 produced exactly the opposite effects from the expected results that motivated the adoption of the system.[1] The adoption of reserve targeting in 1979 produced an increase in short-run deposit volatility rather than the intended decrease.[2] Other changes such as operating through RPD's (reserves against private deposits) proved simply impossible to implement. This history suggests that changes in reserve accounting or operating procedure have often been advocated and/or adopted without a true understanding of either the nature or consequences of the changes. In the vernacular, changes in reserve

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[1]See the paper by (Burger) and the article by (Coates).

[2]Laurent (1982)

accounting or operating procedure have often been a "pig in a poke." The analysis in this paper suggests that the new reserve accounting system is but the newest "pig in a poke".

This paper argues that the reserve accounting system adopted in February, 1984 differs in its monetary control properties in a substantive way from the contemporaneous reserve system that those who advocated the change suppose it to be. The major reason for this difference is the existence of a two day lag in the new system, making it, in fact, a quasi-contemporaneous reserve system. The paper argues that the two day lag in the quasi-contemporaneous system significantly changes the role of the monetary authority under a reserve targeting procedure and raises both the costs of reserve management for banks and the level and volatility of excess reserves in the banking system above that of a true contemporaneous reserve system. The analysis in the paper shows quasi-contemporaneous reserves, while inferior to contemporaneous reserves, to be a potential improvement over the previous lagged reserve system. However, the potential improvement is likely to be minor and obtained at both increased adjustment costs to the banks and a increased complexity, which could easily lead observers to the erroneous conclusion that reserve accounting changes have little potential for improving monetary control.

Perhaps as interesting as the analysis of the effects of a switch to quasi-contemporaneous reserves is the paper's analysis of the reason why so many critics of lagged reserves failed to understand that the new reserve accounting system is not a true contemporaneous system, and why the difference is important. The paper argues that this failure stems from a widely held, but inappropriate model of money stock determination that utilizes a mechanistic multiplier approach where changes in reserves lead directly to changes in money. The paper argues for a model in which the

impact of reserves on deposits works through its influence on interest rates. This latter approach reveals a potentially substantive difference in monetary control between quasi-contemporaneous and contemporaneous reserves.

The first section of the paper discusses the connection between reserve accounting and monetary control and presents two contrasting views of the money stock determination mechanism. The second section contrasts the monetary control problems of lagged reserves as perceived through these two differing views of money stock determination. Section three describes the difficulties of operating a reserve targeting procedure under the quasi-contemporaneous reserve system and how it differs from the usual conception of a reserve targeting monetary control system. The fourth section contrasts the monetary control properties of quasi-contemporaneous and contemporaneous reserves under a reserve targeting procedure. Conclusions are presented in section five.

I

Though present discussions of reserve accounting are inextricably intertwined with monetary control, reserve requirements were originally imposed in 1864 for the purposes of increasing bank liquidity. At that time monetary control was not even considered a goal of monetary policy. It did not become an accepted goal of monetary policy until the 1970s. Even after the monetary authority adopted a money stock goal for monetary policy, a controversy remained over whether superior monetary control was obtained by targeting interest rates or by targeting reserves. Through most of the 1970s the monetary authority attempted to control money through an interest rate targeting procedure. As long as monetary control was attempted through interest rate targeting, little attention was paid to the reserve accounting system. It was only with the announcement by the Fed of a reserve targeting

procedure of monetary control that the impact of reserve accounting on monetary control attained importance. To understand the development of the association between reserve accounting and monetary control it is helpful to understand both the common perception and the actual mechanism of money stock determination through reserves.

Banks change the money stock by exchanging earning assets with the public. If banks buy earning assets (i.e make loans or buy securities) they increase the money stock while if they sell earning assets (i.e reduce their loans outstanding or sell securities) they reduce the money stock. The analysis of money stock determination then, is essentially an analysis of what induces banks to exchange earning assets with the public. The standard description of the process of deposit expansion or contraction in the elementary money and banking textbooks is that the level of excess reserves determines money expansion or contraction. In the usual textbook scenario a bank eliminates its excess reserves or reserve deficiency by purchasing or selling a quantity of earning assets equal to its excess or deficiency in reserves. This first bank's adjustment then disturbs another bank's deposits (and excess reserves) by a somewhat smaller amount. This process continues until the banking system comes to an equilibrium in which, according to the textbook scenario, required reserves have been equated to the level of reserves. The banking system thus comes to equilibrium through a series of successively smaller adjustments by individual banks.

One widely held view, characterized here as the "mechanistic multiplier" view, of the relationship between reserves and money stock determination seems to approach the issue much in the spirit of the standard textbook approach. In this "mechanistic multiplier" approach, changes in the level of reserves are believed to induce a proportional change in deposits through the operation

of a money "multiplier" which magnifies and transmits the effect of changes in reserves onto money. The typical adherent of the "mechanistic multiplier" view of money stock determination may acknowledge that in the very short run the multiplier might be erratic, but the multiplier is viewed as sufficiently stable, over the longer periods of time considered important for monetary policy (e.g. a quarter) to guarantee reasonably accurate monetary control. The typical "mechanistic multiplier" adherent can cite extensive empirical evidence of the stability of the money multiplier over longer periods of time. The implication is that such multipliers can be used to forecast the monetary control properties of a reserve targeting policy. However, the operation of the mechanism that underlies the multiplier is seldom detailed, but presumably involves something akin to the mechanism in the standard textbook description of the deposit expansion or contraction process - where banks react to excess reserves and reserve deficiencies. It is probably true that the great majority of those who have criticized lagged reserves and advocated the adoption of contemporaneous reserves since the adoption of reserve targeting could properly be classified as adherents of the "mechanistic multiplier" approach to money stock determination.

However useful the textbook scenario may be as a pedagogical device for demonstrating the ability of banks to produce a multiple expansion or contraction in the money stock from a given change in reserves, it is clearly not an accurate description of the reaction of banks that alters the level of deposits and the money stock. In practice, banks have available a federal funds market where they may buy or sell reserves at the current federal funds rate. Banks, therefore, do not feel obligated to move their earning assets to conform to the level of deposits they have attracted. Rather, the price of reserve credit relative to the return available on bank earning assets determines whether a bank increases or decreases its earning assets purchased

from the public and therefore increases or decreases the money stock. For example, even a bank currently deficient in reserves will extend additional loans or purchase securities, and thereby increase the money stock, if the rate on current and expected future federal funds is low enough. The bank acts as an intermediary and simply purchases enough federal funds to cover the reserve loss from the purchase of new assets as well as cover its original deficiency. Conversely, a high federal funds rate will induce banks to reduce their holdings of securities and loans (thereby reducing deposits) and channel the funds obtained into the federal funds market.

This view of bank behavior is consistent with the fact that many large banks continuously purchase, and many small banks continuously sell funds in the federal funds market. This pattern reflects a profit maximizing adjustment by banks to a situation where, in the absence of federal funds transactions, the rate on the marginal earning asset is above the federal funds rate at large banks and below the federal funds rate at small banks. In many cases, large banks consistently purchase more reserves in federal funds than their level of required reserves, so that without these funds the banks would not only be deficient, they would actually have negative levels of reserves. If banks mechanistically responded to tne level of reserves associated with their deposits, these banks would long since have reduced their earning asset holdings to cover the potential reserve deficiency.

In this "interest rate" view of money stock determination the impact of the federal funds rate on bank behavior and the money stock is clear. The higher is the federal funds rate, the higher will banks expect future federal funds rates to be, and the fewer earning assets purchased from the public a bank will hold and the lower the level of deposits created by the bank. Banks compare the return expected on an earning asset that could be purchased from the public over some period of time with the return expected on federal funds

rolled over daily during the same period. At higher expected federal funds rates lending in the federal funds market will appear more attractive and lending to the public less attractive. Thus, a higher federal funds rate leads to a lower money stock and a lower federal funds rate leads to a higher money stock. The important point to emphasize is that it is the federal funds rate and not the level of reserves that is the proximate determinant of changes in the level of deposits and money. Most importantly, for the analysis that follows, it is critical to understand that if perchance the reserve accounting system allowed a discrepancy in the signals sent to the banking system by reserves and interest rates, it is interest rates, and not reserves, that will determine the actual money stock changes.

As noted earlier, there has long been a controversy between advocates of reserve targeting and the previous Fed policy of interest rate targeting with regard to the better method of monetary control. If as in the "interest rate" view of money stock determination, interest rates determine changes in the money stock, can it make any sense to advocate a reserve targeting procedure? It will be argued here that it is perfectly defensible to argue for a reserve targeting procedure of monetary control even in the "interest rate" view of money stock determination, but it must be understood that such an argument is actually a call for a specific automatic mechanism for setting the price of reserve credit (i.e. the federal funds rate). Conceptually, the mechanism is designed to automatically move the federal funds rate to facilitate monetary control. Under such a mechanism, the monetary authority first sets the level of reserves that it believes corresponds to the desired level of the aggregate that it wishes to control. In this respect the "interest rate" view is no different than the "mechanistic multiplier" view of a reserve targeting procedure. The difference lies in the delineation of the mechanism that underlies the money control mechanism.

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In the "mechanistic multiplier" view, the setting of reserves seems almost automatically to lead to deposits (and required reserves) moving into equilibrium with the level of reserves. In the "interest rate" view the level of reserves tethers an automatic mechanism that moves the federal funds rate to a level that produces a money stock consistent with the level of reserves provided. If the actual level of deposits is such that required reserves (which should, with properly set reserve requirements, correspond to the level of the target aggregate) are too low for the level of reserves provided, then the federal funds rate should fall. As it falls, it induces banks to increase their holdings of earning assets purchased from the public and thereby increase the target aggregate. This process continues until the target aggregate changes enough to move required reserves into equilibrium with reserves. The monetary authority simply sets the level of reserves. After that the market is left to determine the federal funds rate on the basis of the difference between reserves and required reserves. Reserve targeting, as interpreted by the "interest rate" view of money stock determination does not deny the importance of interest rates, but argues for a system in which interest rates are guided automatically by the market. Having set a predetermined level of reserves, reserve targeting relies on there being no interference placed on the movements in the federal funds rate by the monetary authority.

II

Even after the monetary authority adopted a monetary target goal in the 1970s, it continued to operate by setting a federal funds rate. It proved extremely difficult, however, to know what rate was appropriate for the desired level of the money stock. It was frustration with this approach that led to the announcement of a shift to a reserve targeting procedure in October, 1979. The shift was initially greeted with enthusiasm by adherents

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of money stock control through reserve targeting. Increasingly though, advocates of money stock control through reserve targeting began to complain about the effects of lagged reserves on the implementation of a reserve targeting procedure.

As long as the monetary authority had implemented policy by setting a federal funds rate, little attention was paid to the reserve accounting system. To one who holds a "mechanistic multiplier" view of money stock determination, an interest rate targeting procedure means that the monetary authority will essentially move reserves to parallel changes in the level of required reserves. It rules out a policy of hitting some pre-determined target level of total reserves. From the "interest rate" view of money stock determination, the problem of an interest rate targeting procedure is that interest rates are being determined by the monetary authority rather than the automatic mechanism that underlies a reserve targeting procedure. In either view, interest rate targeting by the monetary authority makes the reserve accounting system irrelevant for monetary control.

The Fed announcement in October, 1979 that it was shifting from an interest rate targeting procedure to a reserve targeting procedure, brought increased scrutiny to the lagged reserve accounting system. The problem most often identified with lagged reserves under a reserve targeting procedure is the fact that the monetary authority must supply a level of reserves at least equal to the level of required reserves set by the banking system two weeks earlier. Thus, the monetary authority is constrained from supplying a level of reserves below the level of required reserves set by the banking system two weeks earlier. This constraint is effective when the monetary target is far enough below the actual level of deposits two weeks earlier to cause required reserves in the current week to be above the level of reserves the monetary authority would like to provide. The problem this poses in the "mechanistic

multiplier" view of money stock determination, where reserves lead directly to money, is that the monetary authority is precluded from producing the decline in reserves necessary to reduce an excessive level of deposits.[3]

Indeed, an analysis of a contractionary reserve targeting policy under lagged reserves is very informative in contrasting the validity of the "mechanistic multiplier" and "interest rate" views of the relationship between reserves and money. If required reserves are above the monetary authority's target level of reserves then it is clear that more reserves must be provided than the monetary authority would wish. When confronted with this constraint, the typical adherent of a "mechanistic multiplier" view might concede that it may be necessary to provide more reserves than desired in the current settlement period, but that sticking to a slower rate of reserve growth over the longer run would produce slower deposit growth. This observation is correct, but it begs the important operational question. That question, under lagged reserves, is what the monetary authority can do in the current settlement period to reduce deposits in the current settlement period so that the level of reserves provided two periods later can be reduced. The answer is clear. The monetary authority must provide sufficient reserves to cover the level of required reserves, but it can change the price at which it provides the reserves. By supplying less of the requisite quantity of reserves through open market operations, the monetary authority forces banks to borrow more reserves at the discount window and thereby pushes up the federal funds rate. The fewer reserves provided through open market operations, the higher will be the level of borrowings and the federal funds rate, and the lower will be deposits in the current week. The lesson is clear - interest rates, not reserves, move deposits and the money stock.

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[3]See the articles by Rosenbaum (1984) and Goodfriend (1984).

The problems presented by lagged reserves for short run monetary control are much more pervasive in the "interest rate" view than in the "mechanistic multiplier" view of money stock determination. Recall that in the "interest rate" view of money stock determination, a reserve targeting procedure involves having the monetary authority set the target level of reserves, and then the reserve market is supposed to automatically move the federal funds rate, on the basis of the difference between reserves and required reserves, so as to guide required reserves and deposits into equilibrium with the level of reserves. One way of viewing a reserve targeting procedure is that the monetary authority dictates where it wants the banking system to go by setting a level of reserves and the market then automatically adjusts the federal funds rate to move the system on the basis of the difference between where the monetary authority wants the system to go and where the system presently is. Thus, there are two problems with lagged reserves. One is the aforementioned problem, also recognized by the "mechanistic multiplier" view, that on occasion, the monetary authority is constrained from accurately setting reserves as low as they would desire on the basis of where they want the system to go. The second problem, which occurs all the time, is that the mechanism by which the present position of the system feeds back into the determination of the federal funds rate, so as to guide the system to the desired position is faulty. Under a lagged reserve system, the current level of deposits, and therefore any changes in the current level of deposits, have no influence or feedback onto the federal funds rate so as to guide deposits and required reserves into equilibrium with the level of reserves supplied. Indeed, it is this second continual problem which explains the fact that not only did interest rates become more volatile, as was expected with the adoption

of a reserve targeting procedure under lagged reserves, but short run deposit changes also became more volatile - which was not expected.[4]

III

Monetary control through total reserve targeting under contemporaneous reserves has a somewhat mythical quality. This arrangement underlies the policy procedures recommended by virtually every advocate of steady monetary growth. It is also the system implicit in every money and banking textbook description of the banking system's role in deposit expansion and contraction. It's somewhat surprising therefore, to observe that total reserve targeting and a contemporaneous reserve system has never characterized monetary policy in the U.S. Only in October 1979, under a lagged reserve system, did the monetary authority announce for the first time a reserve targeting procedure. Even then, the policy was an unborrowed reserve policy and there is a very serious question as to whether the monetary authority actually could have pursued a total reserve operating procedure.[5] The reserve accounting system in place before the 1968 switch to lagged reserves, was not a contemporaneous system, but actually a one day lagged reserve accounting system.[6] An analysis of monetary control under a combination of contemporaneous reserves (or quasi-contemporaneous reserves) and a total reserve targeting procedure must therefore rely heavily on theoretical analysis since empirical evidence is not available.

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[4]See Robert D. Laurent "A Critique of the Fed's New Operating Procedure" "Staff memoranda 81-3. Federal Reserve Bank of Chicago, 1981.

[5]Ibid.

[6]A bank's required reserves were calculated on the basis of its deposits at the beginning of the day, so that it was effectively based on deposits at the end of the preceding day.

The reserve accounting system adopted in February, 1984 differs in a number of significant ways from the combination of a total reserve operating procedure and a contemporaneous reserves system implicit in the textbooks. First, the Fed cannot set the level of unborrowed reserves accurately. In practice, such factors as float and Treasury deposits cause random disturbances to the level of unborrowed reserves. Second, banks are able to borrow at the discount window at the sum of the explicit cost of the administratively set discount rate and the implicit cost of Fed surveillance entailed in the discount window. Third, and most significant is the fact that the new system retains a two day lag. That is, the period from which deposits are taken to compute required reserves runs from the end of business on the Tuesday of the first week to the end of business of the Monday two weeks later. This is referred to as the reserve computation period. Banks satisfy reserve requirements with reserves in the period from the end of business on Thursday two days after the first Tuesday, to the end of business on the Wednesday two days after the second Monday. This period is referred to as the reserve maintenance period. Figure 1 illustrates the two day lag in the quasi-contemporaneous reserve system.[7]

Figure 1
Reserve Computation and Reserve Maintainence Periods

Reserve Computation

Reserve Maintainence

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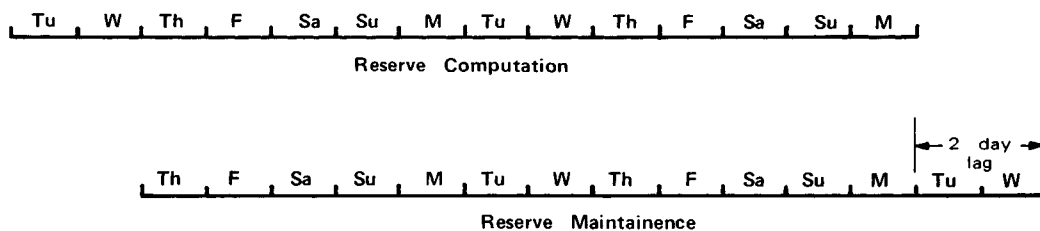
[7]For a more complete description of the reserve accounting changes adopted in February, 1984 see (Gilbert & Trebing).

IV

Reserve requirements are designed to help control money under an operating procedure in which the monetary authority hits a target level of total reserves. Therefore, a total reserve operating procedure is the appropriate background against which to compare the present quasi-contemporaneous reserve system with the contemporaneous system it is often thought to be.[8] There are, however, a number of problems impeding the monetary authority's conduct of a total reserve operating procedure under either contemporaneous or quasi-contemporaneous reserves. Two of the problems, existing under either reserve accounting system - the inability of the monetary authority to precisely set unborrowed reserves and the availability of the discount window for banks to acquire reserves - are of relatively minor importance. The major problem presented for the monetary authority in trying to control money through a total reserve operating procedure, occurs under quasi-contemporaneous reserves and arises precisely from the two day lag which differentiates the present quasi-contemporaneous reserve system from the contemporaneous reserve system with which it is often mididentified. This two day lag, together with the fact that a bank may satisfy its reserve requirements with any pattern of reserves over the settlement period,[9] produces critical differences for monetary control between quasi-contemporaneous and contemporaneous reserves.

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[8]Essentially, a contemporaneous reserve system is one in which the Reserve Computation and Reserve Maintainence period are coterminus, so that it's possible for the banking system to change required reserves after the target level of total reserves has been set.

[9]Except that a bank cannot have a reserve account which is overdrafted (i.e. have negative reserve balances) at the end of any day.

One may quickly grasp why the two day lag is so important, by considering an extreme example. Suppose that, under the present reserve accounting system, the monetary authority acted so as to convince the banking system that the federal funds rate would be, say 8 percent on the final two day, lagged portion of the settlement period. Then it is clear that the federal funds rate will not deviate far from 8 percent on the first twelve days of the settlement period. No bank will sell federal funds at less than 8 percent, or pay more than 8 percent if it knows that the federal funds rate will be 8 percent sometime later in the settlement week. In this extreme situation the monetary authority could literally move reserves anywhere they wanted on the first twelve days of the settlement period and not affect the level of deposits. The major point of such a hypothetical consideration is that (because banks can satisfy reserve requirements with any pattern of reserves over the settlement period) the behavior of the vital federal funds rate in the twelve day, non-lagged portion of the settlement period depends critically on the expected actions of the monetary authority in the two day lagged portion at the end of the settlement period.

In presenting the "interest rate" view of money stock determination earlier, it was argued that the degree to which one follows a reserve targeting procedure depends upon the extent to which the monetary authority allows the federal funds rate to be determined by the interaction of the target level of total reserves and required reserves based on the existing level of deposits. Since the current federal funds rate is influenced by future expected federal funds rates in the same settlement period, a true reserve targeting procedure requires that the monetary authority set the target level of reserves and then avoid constraining or further affecting expected federal funds rates in the remainder of the settlement period. It will be argued here that the two day lag in the quasi-contemporaneous reserve

accounting system significantly inhibits the ability of the monetary authority to do this, and thus the possibility of controlling money through a total reserve targeting procedure.

A reserve targeting procedure of monetary control requires that the monetary authority set the target level of total reserves. In practice, one minor problem is that the monetary authority is not able to set the level of unborrowed reserves accurately. Fluctuations in Fed float and treasury deposits at the Fed cause the level of unborrowed reserves to fluctuate unpredictably. It is not possible, at present, to predict and offset these fluctuations before they occur, but it is possible to almost completely neutralize disturbances after they occur. For example, the monetary authority could offset daily the disturbances to unborrowed reserves on each preceding day. This means that the level of unborrowed reserves over the settlement period would be off target only by the unexpected disturbance on the final day of the settlement period. This would be a close approximation to a total reserve targeting procedure.

A second, somewhat more major, problem afflicting a reserve targeting procedure under quasi-contemporaneous reserves is the existence of the discount window. At the discount window, banks can choose to borrow and move the level of reserves above the target level. Banks would only choose to do this if the cost of reserves at the discount window was attractive relative to the cost of reserves in the federal funds market. The cost of reserves at the discount window has two components - the explicit cost embodied in the discount rate and the implicit cost embodied in the surveillance imposed on borrowers by the Fed. In the "mechanistic multiplier" view, the discount window causes a problem for monetary control through reserve targeting by allowing reserves to deviate, at the initiative of the banks, from the monetary authority's target level. In the "interest rate" view of money stock

determination the problem of the discount window is that it acts to constrain and influence interest rates, thereby preventing the automatic operation of the money stock determination model underlying reserve targeting. The discount window influences the federal funds rate once that rate surpasses the discount rate. As the level of unborrowed reserves falls below the level of required reserves, the federal funds rate rises. As the federal funds rate rises above the discount rate, banks have an increased incentive to borrow from the discount window, increasing the level of reserves and dampening the rise in the federal funds rate.[10]

Perhaps the simplest solution to the discount window problem is to increase the discount rate to a very high level where there would be no incentive for banks to borrow at the discount window. This proposal, which has often been linked with the adoption of a contemporaneous reserve accounting system, is designed to eliminate borrowed reserves and cause total reserves to be identical to unborrowed reserves. This high discount rate along with the correction of disturbances to unborrowed reserves, would seem to produce a system closely approximating a reserve targeting procedure of monetary control.[11] It will be argued here that whether this is so depends critically on whether the reserve accounting system retains a lag - and that the existence of the two day lag in the quasi-contemporaneous reserve accounting system is the major problem impeding monetary control through reserve targeting.[12]

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[10]See the paper by Kasriel and Merris.

[11]See Pakko p. 66.

[12]For a more mathematical treatment of quasi-contemporaneous reserve accounting under a very rigid set of assumptions see Kopecky.

To demonstrate the importance of the two day lag consider first an approximate total reserve targeting procedure (i.e. offsetting the previous day's disturbance to unborrowed reserves and setting a high, penalty discount rate) under a true contemporaneous reserve system where it is possible for the banking system to affect required reserves after the final level of unborrowed reserves has been set.[13] How does such a system come to equilibrium if the level of reserves is initially set below the level of required reserves determined by the current level of deposits? The deficiency of reserves causes the federal funds rate to rise. As the federal funds rate rises, banks find the sale of earning assets to be attractive and thereby reduce the level of deposits. As the level of deposits falls, required reserves also fall until they are in equilibrium with reserves and the rise in the federal funds rate stops. One can easily imagine a discount rate set so high that the discount window is never used and the federal funds rate always equilibrates at a level under the discount rate. So with a high enough discount rate, under true contemporaneous reserves, the monetary authority can, for all practical purposes, run a total reserve targeting procedure.

However, the same arrangement does not produce a total reserve targeting procedure under quasi-contemporaneous reserves. The two day lag means that when the target level of total reserves (adjusted for the error on the last day) is below the level of required reserves established by the twelfth day of the settlement period, then no matter how high the federal funds rate rises and how much banks reduce the level of deposits, the level of required reserves cannot be reduced below the level of reserves provided by the monetary authority. In this case, the federal funds rate increases until it is above

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[13]One way to view this system is that the monetary authority has completed its open market operations by the morning of the last day and the banking system has until the close of business of the last day to set deposits and required reserves.

the discount rate, however high, and banks borrow sufficient reserves to move total reserves above the level of required reserves. Thus, in this case, the administratively set discount rate serves to influence and constrain the federal funds rate and therefore determine the level of deposits. This scenario of federal funds rate and money stock determination is contrary to the description of the mechanism underlying a total reserve targeting procedure of monetary control.

It may seem that a total reserve targeting procedure could be closely approximated under the two day lag by setting the discount rate so high that the banking system would never enter the last two days with higher required reserves than the level of reserves provided by the monetary authority. That is, by setting the discount rate high enough, it might seem that one could eliminate all borrowings. If this were possible, it would allow the monetary authority to approximate a true total reserve targeting procedure even with a two day lagged quasi-contemporaneous system.

To see why this is not always possible, consider the behavior of an individual bank under such a system. A bank, knowing that the monetary authority sets a target level of unborrowed reserves, might initially look at the high discount rate and decide to avoid any possibility of needing reserves later in the week. All banks would try to build up excess reserves as insurance earlier in the week. If all banks try to do this, then either there are already excess reserves in the system or the federal funds rate would have a tendency to rise early in the week and induce banks to reduce their earning assets (and deposits in the system) so that the banking system would enter the last two days of the settlement week with required reserves well below the level of reserves provided, eliminating the possibility of banks being forced to borrow reserves at the discount window. However, if banks always act this way then the federal funds rate would always fall on the last two days of the

settlement week and the high discount rate would never influence the federal funds rate.[14] Essentially, the situation would be one in which banks always hold insurance (i.e. excess reserves) for an accident that never occurs. This is clearly impossible as a long run solution.

If the banking system continuously acts so as to cause the federal funds rate to fall on the last two days of the settlement period, then the individual bank would eventually realize that it has no incentive to try to build up its excess reserve holdings early in the period. On the contrary, the incentive would be for the individual bank to run a deficiency early in the settlement period and then cover the deficiency on the last two days of the settlement period. As long as other banks act so as to cause the federal funds rate to fall on the last two days, banks that run deficiencies on the first twelve days will do well, and this will increase the incentive for more banks to run larger deficiences earlier in the period. Finally, a period must occur when the banking system as a whole enters the final two days with required reserves above the fixed level of reserves provided by the monetary authority. This is a period when the federal funds rate rises until it surpasses the discount rate by an amount sufficient to induce banks to borrow the requisite quantity of reserves to make up the shortfall between required reserves and the target level of reserves. Thus, periods must occur when some banks will be forced to borrow from the discount window under reserve targeting and quasi-contemporaneous reserves.

It is important to understand how this occasional occurence affects monetary control under a total reserve operating procedure and quasi-contemporaneous reserves. The monetary authority can come closer to

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[14]This is because the demand for excess reserves becomes very low and very interest inelastic late in the settlement period at any rate high enough to cover transactions costs in the federal funds market.

implementing a total reserve targeting procedure by raising the discount rate. A higher discount rate causes the role of the monetary authority in constraining the federal funds rate to diminish in the sense that the fedeal funds rate will be less frequently constrained by the administratively set discount rate. This is what it means to move toward a reserve targeting procedure. However, it is also clear that the quasi-contemporaneous system is different than a true contemporaneous system in that it is possible under a true contemporaneous reserve system (where the banks can affect required reserves after the level of reserves is set) for the administratively set discount rate to be set so high that it never serves to constrain the federal funds rate. Under a quasi-contemporaneous system, there must be some times when the administratively set discount rate, even under an approximation to a total reserve targeting procedure, importantly influences the federal funds rate.

The problem a low discount rate poses for the conduct of a reserve targeting procedure is that it can hamper the monetary authority's attempts to slow down money growth. In the "mechanistic multiplier" view this problem appears as an inability to constrain the level of reserves while it appears in the "interest rate" view as a constraint on the ability of the federal funds rate to rise and force the banking system to contract deposits into equilibrium with the level of reserves that the monetary authority would have preferred to set. Raising the discount rate to a very high level can solve these problems under a contemporaneous reserve system (where it is possible for banks to alter required reserves once reserves are set). The discount rate can be set so high that banks would never borrow, thereby avoiding the problem of having the discount window alter the level of reserves in the "mechanistic multiplier" view or influence the federal funds rate in the "interest rate" view.

However, under a reserve accounting system that retains a lag there must be occasions when banks will find it necessary to borrow at the discount window, thereby increasing reserves above the target level the monetary authority would like to provide, and causing the federal funds rate to be influenced by the administratively set discount rate. Raising the discount rate benefits a monetary policy designed to operate through total reserves by reducing the frequency with which banks make use of the discount window. It might appear then, that monetary procedure under a total reserve targeting procedure and a quasi-contemporaneous reserve system can be made to asymptotically approach the same policy under contemporaneous reserves by raising the discount rate. However, while this improves monetary policy by reducing the occasions when the banking system borrows at the window and the discount rate constrains the federal funds rate, it also raises the level and volatility of excess reserves and the cost of reserve management to the individual bank. Thus, while a higher discount rate has the monetary authority play a role closer to the role it is meant to play under a reserve targeting procedure (i.e. the monetary authority becomes more important in determing the level of total reserves), it has an additional effect which weakens monetary control by making the relationship between reserves and required reserves less stable. Thus, there is a tradeoff between the monetary authority's ability to implement a reserve targeting procedure and constrain monetary growth by raising the discount rate and the level and volatility of excess reserves. Figure 2 illustrates the nature of this tradeoff. Increasing the discount rate initially improves, but eventually worsens monetary control. This occurs because the lower the discount rate, the higher will be the average level of borrowed reserves, and the greater will be the average amount by which reserves exceed the target level of total reserves and deposits exceed the target level of deposits. At low discount rates, deposit

Figure 2

**The Length of the Lag, the Discount Rate, and the
Pattern of Errors in Monetary Control**
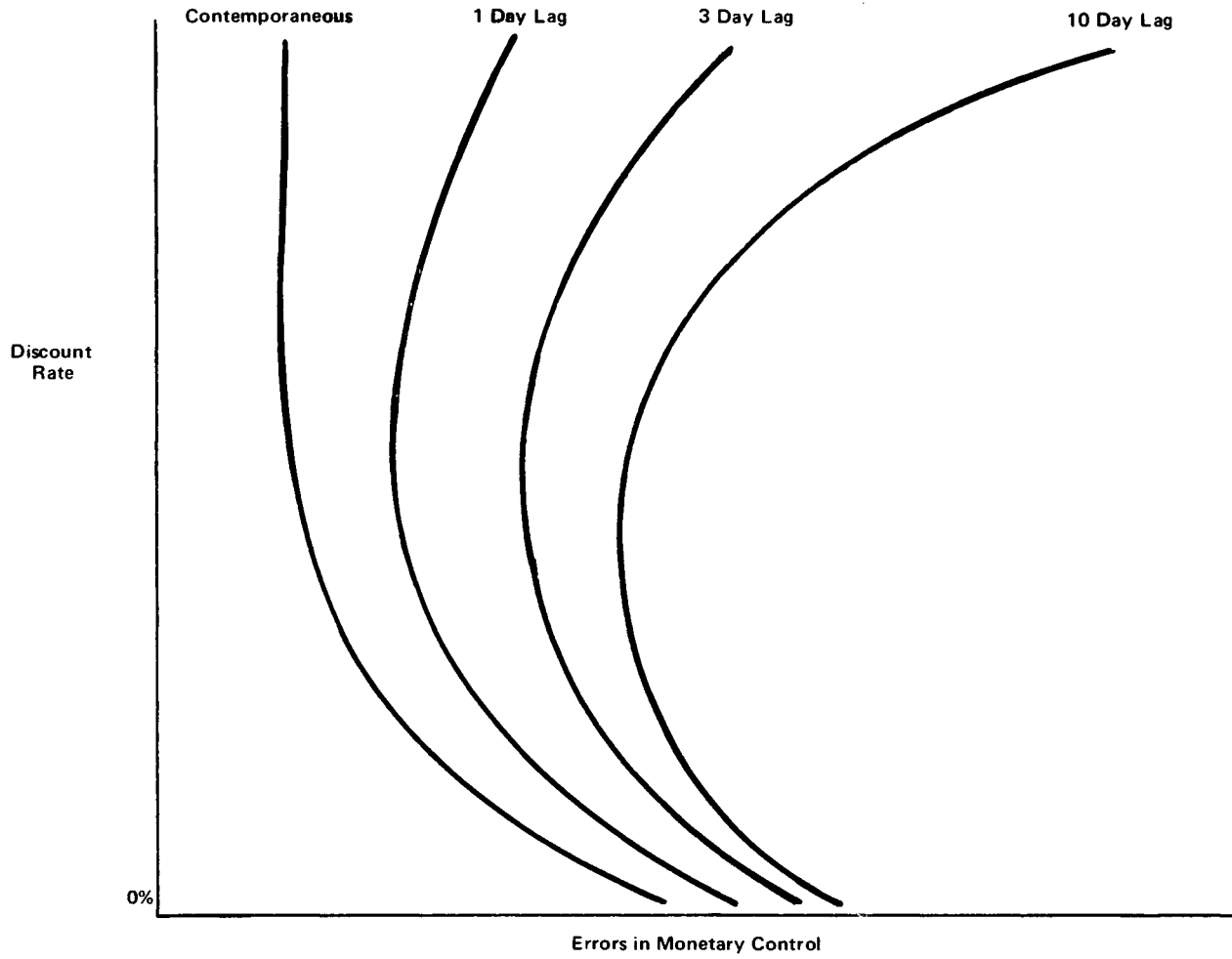
expansion is basically constrained only by the impact of discount window surveillance costs on the federal funds rate. The response of the federal funds rate to borrowing tends to be sluggish and gradual, working as it does solely through the reaction of the discount officers to extended periods and increased levels of individual bank borrowing. As the discount rate is raised, the response of the federal funds rate to borrowings at the discount window is heightened and accelerated. This reins in excessive monetary growth more quickly. However, under a quasi-contemporaneous system where there remains some lag, it was shown earlier in this paper that there will always be some occasions when banks must borrow at the discount rate, no matter how high. As the discount rate is raised, the costs of this borrowing increase. In response banks will increase their holdings of excess reserves as protection against a possible high federal funds rate late in the settlement period. Since banks do not have prior knowledge of the periods in which rates will rise, the increase in the level and volatility of excess reserves will have the effect of weakening monetary control. As the discount rate is raised, the detrimental effects of an increasing volatility in excess reserves finally outweighs the beneficial effects of an increased ability to constrain reserves, monetary control deteriorates and the curves bend back.

One way to represent this relationship is to express money as the product of reserves and a multiplier, each of which has an error term, ϵ_R, and ϵ_m respectively. Then

$$M = (R + \epsilon_R)(m + \epsilon_m)$$

as the discount rate is raised the level and volatility of ϵ_R falls but the level and volatility of ϵ_m rises. Thus the optimal arrangement for the discount window under a quasi-contemporaneous reserve system is more complicated than simply setting a high, penalty discount rate as is often implied.

The curves in Figure 2 also show that the trade-off between monetary control worsens as the length of the lag is extended. The reason for this is that when the banking system borrows (i.e., the federal funds rate is above the discount rate) then the cost to the banking system is proportional to both the federal funds rate and the number of days that one has to borrow. Thus when the banking system is forced to borrow, costs are higher, the longer is the lag. In response, banks will hold higher and more volatile levels of excess reserves and monetary control will worsen as the length of the lag increases. The figure also shows that for a contemporaneous reserve system the curve does not bend back. Because banks can bring required reserves into line with reserves under contemporaneous reserves, any increase in the discount rate above the level needed to induce the largest adjustment in required reserves necessary, does not increase the cost to banks or the holding of excess reserves. Therefore it does not weaken monetary control.

The operation of a reserve targeting system of monetary control requires that the federal funds rate respond to the difference between the level of reserves and the level of required reserves based on the current level of deposits. Conducive to the operation of this system is the transmittal by banks of the pressures from their excess reserve position into the federal funds market. The more volatile the federal funds rate, the more effectively will banks transmit their reserve position into the federal funds market. It is informative to consider the adjustment in the behavior of the individual bank as the discount rate is raised under an approximate reserve targeting procedure. As the discount rate is raised, the bank comes to expect more volatility in future federal funds rates over the remainder of the settlement week. This means that the bank will monitor its reserve position more closely earlier in the settlement period.

Perhaps, the best way to see why this happens is to consider the opposite situation - where a bank knows that the federal funds rate will be a constant fixed rate over the remainder of the settlement week. Under a situation of absolutely constant expected rates, it makes no sense for a bank to monitor its reserve position earlier in the week. A bank that monitored its reserve position earlier in the week and offset any unexpected disturbances, would simply be increasing its costs. That is, it might offset an unexpected inflow by selling federal funds at one time and then have to offset an unexpected outflow by buying federal funds at another time. It could reduce both monitoring and transactions costs by waiting until the end of the settlement period and then offset net unexpected disturbances with one transaction. This is a preferable means of operating since the bank knows that the federal funds rate will be the same later in the week.

The more the federal funds rate is expected to fluctuate in the rest of the settlement period, the more sense it makes for an individual bank to monitor its reserve position earlier in the week. In this way the bank can reduce the risk of having to sell reserves at a low rate or buy reserves at a high rate later in the settlement period. If many banks monitor their reserve position early in the settlement week, then the basic position of the banking system (i.e. reserve surplus or deficiency) will influence the federal funds rate and cause the rate to move in the appropriate direction early in the week. This causes banks to adjust their earning assets (and deposits in the banking system) early in the week which results in better monetary control and a reduced probability of having the banking system enter the last two days with required reserves above the level of reserves.

One way of viewing the problem of the lag in a quasi-contemporaneous system is as an inefficient pricing mechanism. The federal funds rate is supposed to reflect the relative magnitudes of reserves and required reserves

(based on the current level of deposits) and thus guide the banks to move deposits and required reserves into equilibrium with reserves. The problem of the lag is that it throws this pricing system out of whack. Banks continue to respond to the rate as if it accurately reflected the discrepancy between reserves and required reserves. In fact, however, the rate is responding to the current level of reserves and the level of required reserves in the system at the beginning of the lagged portion of the settlement period. Thus, the banking system loses the benefits of its ability to respond to the pricing system. It causes the monetary authority to intervene in a more obtrusive way than it should in the federal funds market. This means that the monetary authority can, through movements in the discount rate, trade off its ability to constrain reserve expansion for increased levels and volatility in excess reserves. This trade-off stems from a pricing impediment in the federal funds market produced by the lag.

This same analysis of the federal funds market also shows why monetary control under a reserve targeting procedure with quasi-contemporaneous reserves will be easier and more accurate than would be the case under the same procedure with the previous lagged reserve system. The improvement in the new reserve accounting system stems from the fact that if the monetary authority convinces the banking system that it will hold to the target level of reserves whenever possible and that it will allow large changes in the federal funds rate when it is not possible to hold to the target level of reserves, then banks can reduce the pressures imposed on the banking system through appropriate responses in the first twelve days of the settlement week under the quasi-contemporaneous system. If the banking system learns that the monetary authority will allow large changes in the federal funds rate at the end of the settlement period, then banks will more closely monitor their reserve position early in the settlement period and produce larger changes in

the federal funds rate early in the settlement period. These large movements in the federal funds rate early in the settlement week will cause banks to respond through their holdings of earning assets and produce changes in deposits under either lagged reserves or quasi-contemporaneous reserves. The advantage of quasi-contemporaneous reserves over the old lagged system is that, to the extent that banks respond and change the level of deposits in the proper direction in the first twelve days of the settlement period, a quasi-contemporaneous system reduces the pressure on the banking system and the cost of reserve management to the individual bank while simultaneously giving a more accurate and less volatile money stock because the level and volatility of excess reserves are reduced.

But finally, it is extremely important to note a less desirable effect of quasi-contemporaneous reserves on the over-all progress toward accurate short run monetary control. The costs of adopting the new reserve accounting system have been substantial. It has been argued here that the system adopted retains the same problems, though to a lesser degree, that troubled the previous lagged reserve system. Imposing such substantial costs to adopt a change that fails to remove the pervasive fundamental problem of lagged reserves may well reinforce the feeling of some observers that reserve accounting changes have little potential to improve monetary control. Nothing could be further from the truth; changes in reserves accounting could provide the monetary authority with accurate short run monetary control even while vastly simplifying reserve management for banks.[15] However, after the experience with quasi-contemporaneous reserves, it is not likely that the reserve accounting system will soon again be changed with the goal of improving monetary control. Those advocates of short run monetary control who

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[15]See Laurent (1983)

applauded the move to quasi-contemporaneous reserves have unwittingly hampered the longer run move toward accurate monetary control by basing their view of money stock determination on a "mechanistic multiplier" model of money stock determination and thereby confusing a quasi-contemporaneous reserves with true contemporaneous reserves.

V

The analysis of quasi-contemporaneous reserve accounting indicates that while it is a potential improvement, quasi-contemporaneous reserves retains the same fundamental problem that plagued the previous lagged reserve system. This analysis, must of necessity be based on theory, since a total reserve operating procedure under a contemporaneous reserve system has never been the monetary control process used by the Federal Reserve. Quasi-contemporaneous reserves has the advantage over lagged reserves that if the federal funds rate moves in the first twelve days of the settlement period, the resulting changes in deposits produced by these interest rate changes will affect required reserves and relieve the interest rate pressure on banks and the banking system. That is, the federal funds rate functions as it should under a reserve targeting procedure in the first twelve days of the settlement period - as a reflection of the discrepancy between reserves and required reserves and a guide to banks on the actions necessary to eliminate the discrepancy. However, to obtain this advantage, the monetary authority must, at least occasionally, determine the federal funds rate through the discount rate on the last two days of the settlement week, irrespective of the changes produced in deposits on those days by the banking system. That is, interest rates do not function as they should under a reserve targeting procedure on the last two days of the settlement period and quasi-contemporaneous reserves presents the same problems, in microcosm, as lagged reserves presented for monetary control. Even when the potential improvement in quasi- contemporaneous

reserves over lagged reserves is realized by having the monetary authority impose a high discount rate, quasi-contemporaneous reserves remain inferior to contemporaneous reserves by imposing a higher level and volatility of excess reserves and imposing higher reserve management costs on banks and the banking system.

Perhaps most important, the paper investigates the basis of the analysis which led many critics of lagged reserves to accept quasi-contemporaneous reserves. The paper argues that it stems from a widely held but seriously deficient view of the linkage between reserves and money, labeled in the paper the "mechanistic multiplier" view of money stock determination. This view perceives changes in reserves to lead directly to changes in deposits without any description of the mechanism which causes the level of reserves to influence the level of deposits. As a result, the importance of the federal funds rate, expected future federal funds rates and the consequences of the fungible nature of reserves within the settlement week are lost in the "mechanistic multiplier" view of money stock determination. The paper presents an alternative "interest rate" view of the linkage between reserves and deposits which gives a decidedly less sanguine view of the adoption of quasi-contemporaneous reserves. This latter view argues that the new reserve accounting system cannot be made to function under a reserve targeting procedure like the contemporaneous reserve system it is widely believed to be.

The implementation of reserve targeting under quasi-contemporaneous reserves can be made to more closely approach the same policy under contemporaneous reserves by targeting unborrowed reserves and raising the discount rate. However, unlike the role the discount rate might play under a true contemporaneous reserve system, the administratively set discount rate under quasi-contemporaneous reserves must, at least occasionally, serve to influence the price of reserves to the banking system. Not only does this

characteristic of the discount rate under quasi-contemporaneous reserves mean that the monetary authority plays a more significant role in determining the federal funds rate than it should in a reserve targeting procedure, it also presents the monetary authority with a true dilemma in that an increase in the discount rate, while allowing the monetary authority to more closely implement a total reserves policy, also has the effect of increasing the level and volatility of excess reserves. Thus, it is not always true, under a quasi-contemporaneous system, that the higher the discount rate, the better the monetary control. Setting the discount rate presents a difficult optimization problem.

Finally, the paper suggests that the shift to quasi-contemporaneous reserves, even though an improvement over lagged reserves, may actually work to the detriment of the longer run quest of achieving accurate monetary control. By advertising the shift to quasi-contemporaneous reserves as a major improvement in monetary control, advocates of the shift may eventually contribute to the erroneous idea that reserve accounting is not important for monetary control. Many advocates of short run monetary control, who have been critical of lagged reserves have unwittingly contributed to this outcome by failing to adequately understand the mechanism underlying a reserve targeting procedure of monetary control and accepting quasi-contemporaneous reserves as a true contemporaneous reserve system.

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