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Reserve Requirements—Are They Lagged in the Wrong Direction?

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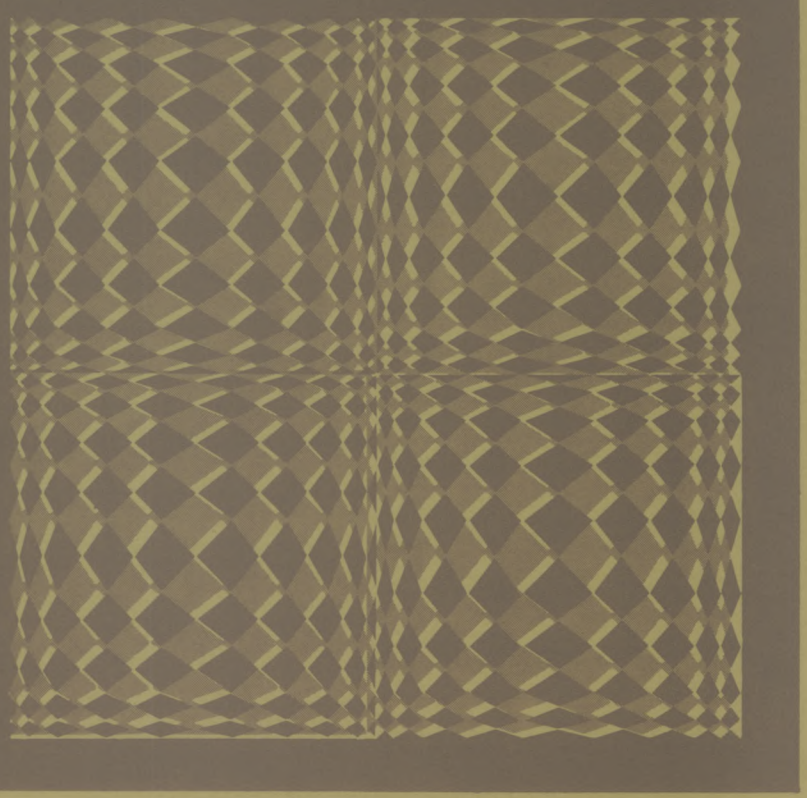

Research Paper No. 75 - 2

RESERVE REQUIREMENTS--
ARE THEY LAGGED IN THE WRONG DIRECTION?

By

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In September 1968, the Federal Reserve System instituted a number of changes dealing with the computation of reserve requirements and the treatment of reserve deficiencies. The most important of these changes was a shift to lagged reserve requirements, i.e.--setting a banks weekly average required reserves on the basis of its average deposits at the close of business in the settlement period two weeks earlier, rather than on the basis of deposits in the current week (coincident reserve requirements).[1] This paper analyzes the effects of the shift to lagged reserves and finds them generally deleterious. Lagged reserves increase the costs of the individual bank's reserve management, and by increasing uncertainty, decrease the precision of monetary policy and increase the costs to the banking system of policy shifts. Conceptually, the basic problem with the lagged reserves scheme is that it seems designed to facilitate the provision of a level of reserves consistent with a given level of deposits, whereas monetary policy utilizes the reverse process. The analysis suggests that the lag in reserve requirements might well be reversed--reserves being set first, with banks setting required reserves two weeks later. A reverse lag system is developed which would allow monetary authorities to accurately move the banking system to a desired level of required reserves.

The views expressed are those of the author alone and do not represent the views of the Federal Reserve Bank of Chicago or the Federal Reserve System. The author has benefited from the comments of John Hill, Jack Kalchbrenner, George Kaufman, Nick Lash and William Poole. The paper has also been significantly improved as the result of a presentation at the Money and Banking Workshop of the University of Chicago. The author is especially indebted to Milton Friedman for a number of organizational suggestions and to Carl Vander Wilt for his many valuable insights.

[1]Other changes were: 1) to establish the same one week reserve settlement periods for country banks as for reserve city banks, 2) to count average vault cash held at the close of business two weeks earlier in satisfaction of reserve requirements and 3) to provide that an excess or deficiency in reserves may be carried forward only into the next settlement week in an amount not to exceed 2 percent of average required reserves. For analyses of the effects of one or more of the 1968 changes see Burger (1971), Coats (1972) (1973) (1974), Gilbert (1973), Laufenberg (1975) and Poole and Lieberman (1972). It should be noted that a theoretical analysis of the combined 1968 changes or an empirical analysis of any single change would be extremely complicated.

The first section of the paper examines the effects of the change to lagged reserves on the individual bank. The second section examines the impact on the banking system as a whole. Section three examines the impact of lagged reserves on the conduct of monetary policy. In section four, the analysis of the first three sections forms the basis for suggested changes in the reserve computation scheme.

I. Effects on the Individual Bank

Because individual banks know with certainty their required reserves entering the settlement week, it may appear that the adoption of lagged reserves would aid individual bank reserve management. However, closer examination of lagged reserves indicates the opposite. In reserve management, banks are concerned about the variability of the difference between actual and required reserves (i.e., excess reserves) rather than the variability of the level of required reserves alone. Fundamentally, unanticipated fluctuations in reserves result from unanticipated fluctuations in deposits.[2] Lagged reserves do not help the individual bank handle unexpected deposit flows. In fact, by not allowing required reserves to move with deposits, lagged reserves increase the volatility of excess reserves and make the bank's reserve management problems more difficult. Under coincident reserves the adjustment pressure of unanticipated deposit flows falls because required reserves move to offset some of the change in reserves. Under lagged reserves there is no offset because required reserves do not change. Given the same deposit volatility, and assuming that transactions costs rise with the size of transactions, it will cost a bank more to manage its reserve position under lagged reserves and the

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[2]There are a number of ways in which bank reserves may change without deposits changing. However, the major ways in which this occurs (e.g., changes in bank asset holdings, transfers of federal funds, changes in borrowings from the Federal Reserve, raising of capital or paying of dividends) are readily predictable and controllable by banks. The unpredictable elements in this category would appear to be relatively minor, consisting of loan prepayments and the drawing down of loan commitments.

banks holdings of excess reserves will rise.[3]

II. Effects on the Banking System

Relative to coincident reserves, lagged reserves alter the relative importance of those factors determining the level of deposits and bank credit which the banking system creates with a fixed level of unborrowed reserves. Specifically, lagged reserves enhance the role of the banking systems future interest rate expectations at the expense of the influence of the level of unborrowed reserves in determining the banking systems equilibrium.

The reaction of deposits and interest rates to a fall in banks expected future interest rates under coincident and lagged reserves, given a fixed level of unborrowed reserves, are quite different. Under both systems, banks attempt to expand their holdings of assets (loans and investments) since lower expected future interest rates imply greater capital gains for asset holders.[4] With coincident reserves, the increase in bank assets increases deposits and required reserves in the current week. Since unborrowed reserves are fixed, the Federal funds rate will rise by an amount necessary to contrain deposits to a level at which required reserves do not exceed the level of reserves (assuming no reserve deficiencies). Deposits will increase and other interest rates fall only to the extent that excess reserves fall and borrowed reserves

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[3]For a more complete exposition of this point see Gilbert (1973). The Gilbert analysis differs from and produces more ambiguous results than those in the text because it analyzes a system in which both reserve requirements and vault cash are lagged.

[4]Throughout the paper assets refers to instruments such as loans and investments which are exchanged between banks and the public. The purpose is to differentiate these changes which affect deposits in the system from those bank adjustments such as changes in borrowings from the central bank and Federal funds transactions which do not affect deposits.

increase as a result of the increase in the Federal funds rate.[5] Coincident reserves serve to tether required reserves to the level of reserves in the system, thereby constraining changes in bank assets, deposits, and the resulting movement in interest rates. Conversely, the Federal funds rate will be relatively unconstrained, rising to whatever level is necessary to induce the banking system as a whole to forego a greater deposit expansion. The level of the Federal funds rate required to do this will largely be determined by the banking systems new level of future interest rate expectations. The sharper the expected fall in future interest rates, the higher the current Federal funds rate must rise to induce banks to forego a further expansion in their asset holdings.

Under lagged reserves, the expansion in bank assets resulting from lower expected future interest rates has quite different results. The creation of deposits resulting from the purchases of assets does not change required reserves since these were set two weeks previously. The Federal funds rate is not affected since required reserves and the level of reserves have not changed. The banking system will continue to purchase assets from the public, expand deposits and lower interest rates until the rate of return on these assets has fallen to a level which removes any expected future profits. The deposit expansion and the resulting fall in interest rates will be primarily determined by the banking systems expectations for future interest rates.

The reaction of the banking system to changed interest rate expectations under the two reserve computation schemes is symmetrical. In the coincident

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[5] Theoretically, banks could expand asset holdings by attracting a currency inflow. However, as a practical matter, the rates paid for reserves in the federal funds market do not hit high enough levels to justify the public holding currency as a supply of reserves for banks in periods of tightness even were Regulation Q not preventing banks from paying these rates to the public. Thus, in this discussion and elsewhere in the paper, the possibility of banks adjusting their intra-week reserve positions through currency flows is ignored.

system it is primarily reserves which determine bank asset holdings, deposits and interest rates while expectations primarily determine the Federal funds rate. Under lagged reserves, reserves primarily determine the Federal funds rate while expectations primarily determine bank asset holdings, deposits and interest rates. Lagged reserves reduce the importance of reserves in determining the behavior of the banking system while enhancing the role of future interest rate expectations.

III. Effects on Monetary Policy

The effects on monetary policy of the shift to lagged reserves may be demonstrated by comparing the demand for reserves under coincident and lagged reserves. For expository purposes, it is assumed that the percentage of deposits held in each reserve requirement category is held constant and that unborrowed reserves are provided over the settlement week in a given fixed way (e.g., equal levels of unborrowed reserves each day or unborrowed reserves three percent higher than average on the first four days and four percent lower on the last three). These assumptions eliminate from the analysis complications arising from both shifts between different deposit categories and simultaneous changes in both the level and pattern of unborrowed reserves within the week.

Coincident Reserves

Under coincident reserves, the monetary authorities conduct policy by manipulating the level of unborrowed reserves so as to produce desired changes in deposits and interest rates. An increase (decrease) in unborrowed reserves lowers (raises) the Federal funds rate because the level of reserves has been increased (decreased) relative to the level of required reserves. The lower (higher) Federal funds rate is the mechanism by which the increase (decrease) in unborrowed reserves is transmitted into new equilibrium levels of borrowed reserves, excess reserves and required reserves. An increase (decrease) in

unborrowed reserves and the resultant fall (rise) in the Federal funds rate will cause borrowed reserves to fall (rise) while required reserves and excess reserves rise (fall). Borrowed reserves fall (rise) because as a substitute source of reserves, the discount window will be utilized less (more) as the price of reserves in the Federal funds market falls (rises). Required reserves increase (decrease) because the spread between the rate of return on bank assets and the lower (higher) Federal funds rate is a measure of the incentive for banks to buy assets and thereby increase required reserves. Excess reserves rise (fall) because the return to a reduction in excess reserves as represented by the lower (higher) rates on Federal funds and bank assets has fallen (risen).

The demand for various types of reserves and the implementation of monetary policy under coincident reserves is represented in Figure 1.[6] A level of unborrowed reserves equal to OA would produce a Federal funds rate of OE, a level of excess reserves equal to DC, a level of borrowed reserves equal to DB, and a level of required reserves equal to EB. At an increased level of unborrowed reserves equal to OF, the equilibrium Federal funds rate would be lower at OG, borrowed reserves would fall to IH and excess reserves and required reserves would rise to IJ and GH respectively.

Under coincident reserves, the role played by the Federal funds rate in moving the banking system to the new equilibrium is quite important. The

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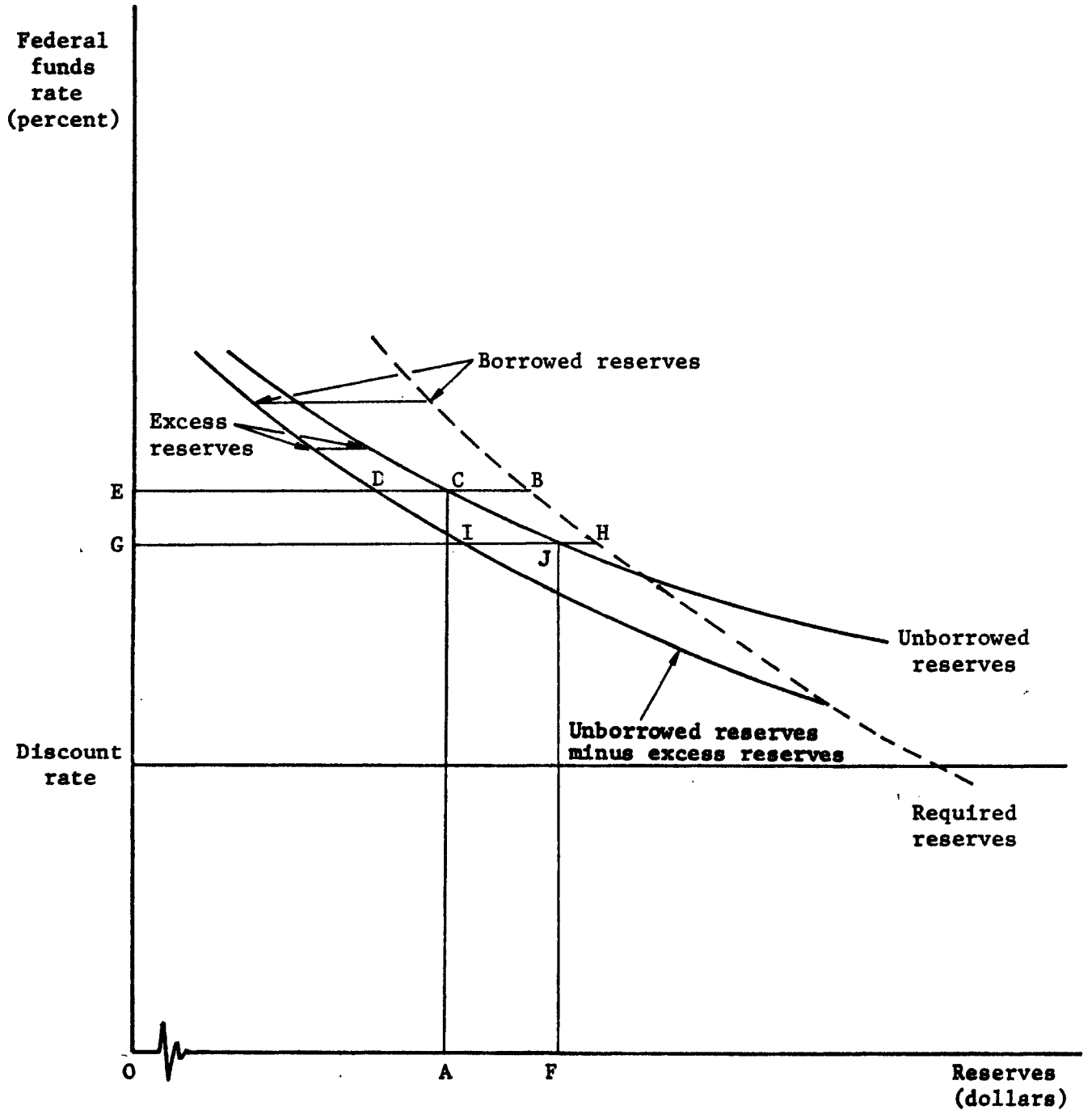
[6]Figure 1 represents a segment of the demand for reserves. The demand for unborrowed reserves reflects the increasing volume of deposits which would be created at lower Federal funds rates. Borrowed reserves decline (becoming zero at a Federal funds rate above the discount rate) and excess reserves increase as the Federal funds rate falls.

FIGURE 1

The Market for Reserves under Coincident Requirements



lower (higher) Federal funds rate, relative to returns on loans and investments, induces banks to expand (contract) their holdings of such assets. As the banks expand (contract) their holdings of assets, the rate of return on these falls (rises) while the resulting increase (decrease) in deposits increases (decreases) required reserves and raises (lowers) the Federal funds rate. The increase (decrease) in deposits continues until the gap between the marginal rate of return on assets and the Federal funds rate is back in equilibrium with both rates at a lower (higher) level. Under coincident reserves, a deviation of deposits from the equilibrium level causes the Federal funds rate to move so as to induce banks to change their holdings of assets and move deposits in the system back to the equilibrium level.

Lagged Reserves

The conduct of monetary policy under lagged reserves is similar in some ways to that under coincident reserves. Once again the monetary authorities conduct policy by varying the level of unborrowed reserves. Again an increase (decrease) in unborrowed reserves lowers (raises) the Federal funds rate. Again a lower (higher) Federal funds rate moves the banking system to lower (higher) levels of borrowed reserves and higher (lower) levels of excess reserves. The fundamental difference under lagged reserves is that required reserves are fixed at a level determined two weeks previously and are not affected by deposit changes in the current week. As a result, lagged reserves eliminate intra-reserve settlement week changes in required reserves as a means of the system absorbing increases or offsetting decreases in unborrowed reserves. This means that a given change in unborrowed reserves will produce a greater change in the Federal funds rate under lagged reserves because required reserves cannot change to cushion the impact of the change in unborrowed reserves.

The demand for various types of reserves and the implementation of monetary policy under a lagged reserve scheme is represented in Figure 2.[7] The fixed level of required reserves set two weeks previous is represented by the vertical line at magnitude OK. A level of unborrowed reserves equal to OA would produce a federal funds rate of OE, a level of excess reserves equal to DC, and a level of borrowed reserves equal to DB. At an increased level of unborrowed reserves equal to OF, the equilibrium Federal funds rate would be lower at OG, borrowed reserves would fall to IH and excess reserves would rise to IJ. A comparison of Figures 1 and 2 illustrates the greater sensitivity of the Federal funds rate to changes in unborrowed reserves under lagged reserves.

Just as under coincident reserves, an increase (decrease) in unborrowed reserves and the resulting fall (rise) in the Federal funds rate under lagged reserves induces banks to buy (sell) assets, thereby increasing (decreasing) deposits and lowering (raising) interest rates. Under lagged reserves, however, the feedback from changes in the level of deposits in the banking system to the Federal funds rate has been eliminated. Thus, the Federal funds rate does not serve to guide deposits to a level at which required reserves are in equilibrium with the level of reserves in the system. Banks observe two apparently disparate phenomena in the aftermath of a change in unborrowed reserves. The lower (higher) Federal funds rate signals banks to expand (contract) their holdings of bank assets. However, the resulting increase (decrease) in deposits which banks observe does not make them any more willing to tolerate the increased (decreased) level of unborrowed reserves. Without the feedback from changes in deposits to the Federal funds

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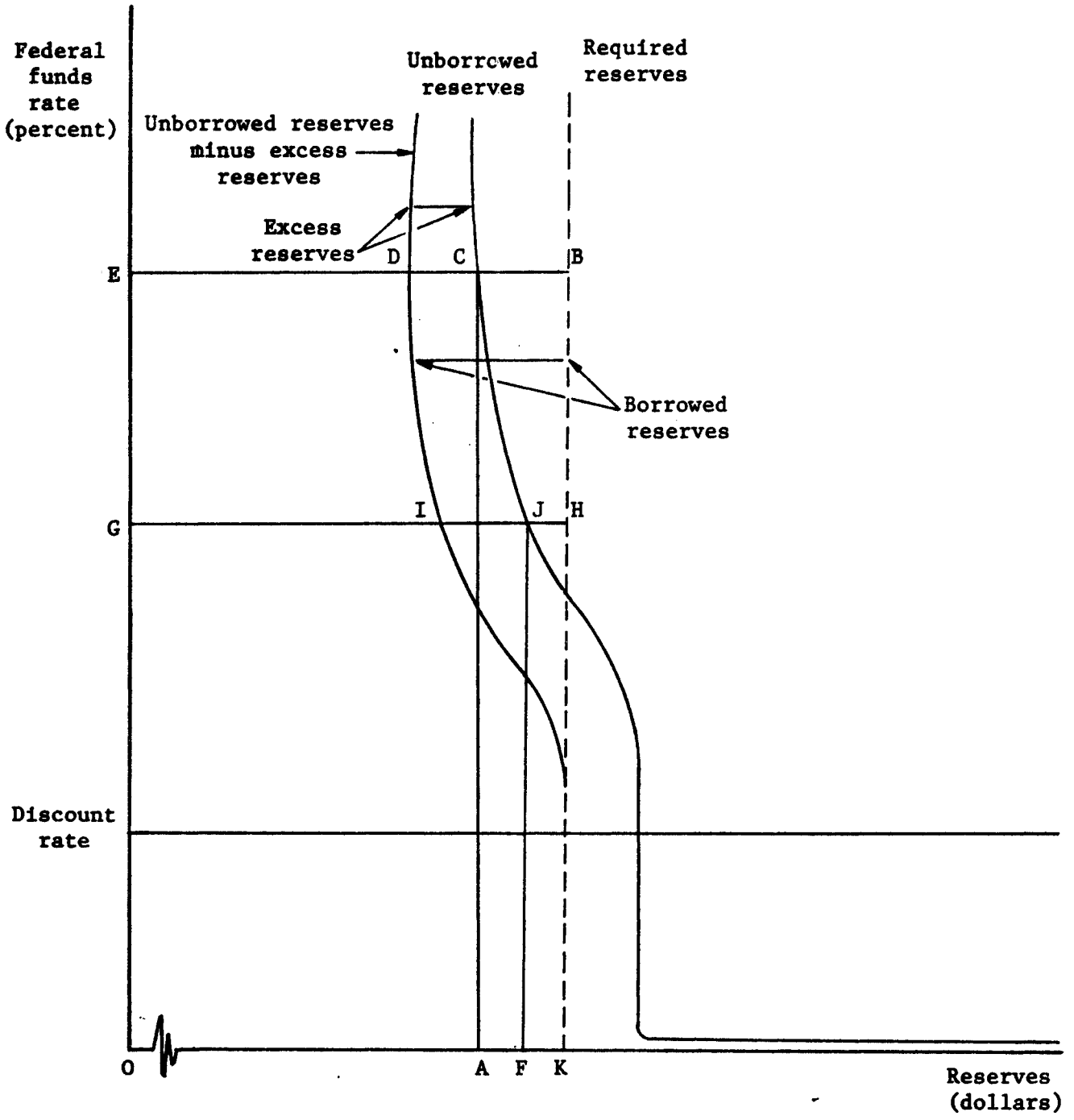
[7] Both figures 1 and 2 use the same relationships between the Federal funds rate and excess reserves and the Federal funds rate and borrowed reserves.

FIGURE 2

The Market for Reserves under Lagged Requirements



rate, banks persist in responding to the initial change in unborrowed reserves. Thus, under lagged reserves, a given change in unborrowed reserves will cause a sharper change in the Federal funds rate, deposits and the interest rate on bank assets.

Determination of Deposit Levels

Under lagged reserves, the extent of the deposit expansion and interest rate decline arising from an increase in unborrowed reserves depends on a number of factors. The fall in the Federal funds rate induces banks to repay borrowings. If the increase in unborrowed reserves is less than the level of borrowings in the system then the Federal funds rate will not fall below the discount rate. If the added reserves are greater than the initial level of borrowings in the system then the Federal funds rate will fall toward zero as the end of the settlement week approaches. In either case, as the Federal funds rate falls, banks will continue to purchase assets and expand deposits as long as they can increase their expected profits relative to selling Federal funds.[8] The increasing level of deposits relative to reserves will not deter banks from continuing their purchases of assets, though they are aware that above some level of deposits, either assets must be transferred into reserves two weeks in the future or reserves must be purchased or borrowed. Assets maturing this settlement week will be purchased as long as they yield a higher return (after transaction costs) than Federal funds sales. Assets maturing in the next two settlement weeks will be purchased until the return on these assets equals the expected return on Federal funds sales over the period to maturity. Assets maturing more than two weeks in the future involve the risk of capital loss when they must be sold and they will be bought until the expected return

[8] An individual bank may take part in the adjustment without having excess reserves. As the Federal funds rate falls relative to bank asset rates, a bank without excess reserves may expand deposits in the system by purchasing assets and covering the reserve loss with Federal funds.

on these assets (including capital gains or losses) falls below the expected return on Federal funds sales over the same period. Monetary policy influences the size of the expansion through the effect of the lower current Federal funds rate on banks expectations of future Federal funds rates. Finally, deposit expansion is constrained by the physical limitation on the value of assets that can be purchased within the settlement period. Since a bank must retain sufficient reserves to satisfy reserve requirements in the current week, it must have either excess reserves on hand or purchase reserves through the Federal funds market when acquiring assets. The time required for the purchase of assets and the shift of reserves from one bank to another, given the level of excess reserves, imposes a limit on the deposit expansion.

Under lagged reserves, a contractionary policy is constrained with regard to the level of total reserves that can be supplied. Since required reserves were set two weeks previous and cannot be changed, a level of total reserves at least equal to required reserves must be provided. A contractionary policy may still be implemented by providing a low level of unborrowed reserves. In this way the monetary authorities cause banks to bid up the Federal funds rate until a sufficient amount of reserves are borrowed, in the aggregate, to meet requirements. The Federal funds rate will rise until the costs of borrowing are attractive enough (relative to buying Federal funds) to induce some banks to borrow the requisite quantity of reserves. Thus, in periods of tight policy any changes in unborrowed reserves will be nearly completely offset by changes in borrowed reserves. The extent of bank asset sales, the fall in deposits and the interest rate increases which result from the contractionary policy again depend on the influence of the higher Federal funds rate on banks' expectations for future Federal funds rates. The declining level of deposits relative to reserves will not deter banks from continuing their liquidation of assets, though if deposits drop below a level consistent with reserves, banks

will realize that reserves could be transferred into assets two weeks hence. Banks will sell assets maturing within the settlement week if the return on these assets is below the rate on Federal funds (taking account of transaction costs). Assets maturing in the next two settlement weeks will be sold as long as the expected return on these assets is less than the expected rate on Federal funds over the period to maturity. Assets maturing more than two weeks in the future will be sold as long as the return on these assets over the next two weeks is expected to be lower than the return on Federal funds (including any expected capital gains or losses from reinvesting the funds into assets two weeks in the future).

This analysis of monetary policy reveals a symmetry between coincident and lagged reserves similar to that described in examining the effects of these schemes on the banking system as a whole, given a fixed level of unborrowed reserves. Under coincident reserves, the Federal funds rate moves to whatever level is necessary to induce the banking system to set required reserves (and therefore deposits, bank assets and interest rates) at a level determined by, and consistent with, the new level of unborrowed reserves in the system. The level of the Federal funds rate required to achieve equilibrium is determined by the present and expected future interest rates on bank assets. Under lagged reserves there is no mechanism moving the banking system to a level of deposits consistent with the level of unborrowed reserves in the system. Rather, the level of unborrowed reserves determines the Federal funds rate and the influence of the current Federal funds rate on the banking systems expectations of future Federal funds rates determines the change in deposits, bank assets and interest rates. The shift to lagged reserves has enhanced the role of future Federal funds rate expectations in monetary policy while diminishing the role of unborrowed reserves.

Precision and Costs of Monetary Policy

There is reason to believe that the adoption of lagged reserves has adversely affected the precision with which monetary policy is conducted. While the adoption of lagged reserves does not affect the impact on deposits or interest rates of the initial purchase or sale of securities by the monetary authorities, it does affect the precision of monetary policy, by changing the predictability of the banking systems response to the initial change in unborrowed reserves. The preceding analysis indicates that the shift to lagged reserves has enhanced the role of expected future Federal funds rates in determining the effects of monetary policy, at the expense of the role played by unborrowed reserves. Were the economic relationships known perfectly, the monetary authorities could conduct policy with absolute accuracy under either system.[9] However, given the apparently more difficult task involved in estimating a monetary mechanism in which unobservable expectations play an important role, the shift to lagged reserves would appear to have reduced the precision of monetary policy. Under lagged reserves the monetary policy effect of a change in unborrowed reserves and the Federal funds rate depends critically on the effect on banks expectations of future Federal funds rates. If the movement in the Federal funds rate is thought temporary then the changes in deposits and interest rates will be minor. Alternatively, if the banks believe the movement in the Federal funds

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[9]The analysis of monetary policy under lagged reserves indicates that if the authorities wished to change the equilibrium level of unborrowed reserves in the system, they would initially make a smaller change in unborrowed reserves. This smaller change would be precisely that change which would cause the banking system to set a level of deposits consistent with the desired long-run level of unborrowed reserves. In two weeks the monetary authorities would change unborrowed reserves by an amount sufficient to bring the total change in unborrowed reserves to the desired amount.

rate is a precursor of future movements then the changes in deposits and interest rates could be very large.[10]

An additional consideration in evaluating lagged reserves is the effect of a shift in monetary policy on banking system costs of adjustment. Ideally, the banking system minimizes the costs of a change in policy by immediately changing its asset holdings so as to move the gap between the return on bank asset holdings and the cost of reserves (Federal funds rate) back to an equilibrium level. This is the process which occurs under coincident reserves when, following the initial change in reserves, changes in bank asset holdings move both the return on bank assets and the cost of reserves toward the new equilibrium. Under lagged reserves however, changes in bank asset holdings cannot change required reserves and so do not affect the price of reserves (Federal funds rate). Thus, saddled with a level of required reserves set two weeks previously, banks cannot cushion the effects of a change in monetary policy on the cost of reserves, no matter what their response in setting deposits.

The drawbacks of the present lagged reserve scheme seem clear. Under lagged reserves, banks set a particular policy by their expansion or contraction of deposits based on expectations of the future cost of reserves. Two weeks later, the monetary authorities enter the picture by, in essence, supporting or resisting the banks behavior. The monetary authorities can only change this behavior by imposing costs on the banks at a time when the ability of the banks to reduce these costs is sharply constrained, even were they to move deposits immediately to the level desired by the monetary authorities. As used here, the adjustment costs to banks of monetary policy are the returns foregone by the holding of excess reserves under an expansionary monetary policy and the difference between

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[10] In connection with this last point it is interesting to note the recent emphasis given by the open market desk to an apparent increase in banks securities speculation and its impact on monetary policy (Federal Reserve Bank of New York 1972, pp. 90-91)

the marginal cost of reserves (Federal funds rate) and the return on the marginal dollar of deposit creation when banks are forced to borrow under a contractionary policy.[11] These costs rise, the more monetary authorities wish to cause banks to deviate from their past behavior. The discussion presented here argues that the same monetary policy (i.e. open market operations) would involve higher bank adjustment costs with lagged reserves than coincident reserves.

If the monetary authorities are reluctant to let the Federal funds rate move by large amounts, or to impose costs on the banking system, then monetary policy under lagged reserves will tend to conform more closely to the policy set by the banks, thereby altering the behavior of the system only slowly.[12] In this case the cost of the lagged reserves scheme would fall less heavily on member banks but rather result in a less optimal monetary policy.

Summary

The preceding analysis indicates that lagged reserves raise the costs of reserve management to the individual bank. Lagged reserves increase the volatility of both interest rates and the level of deposits in the adjustment process to a given change in unborrowed reserves. Lagged reserves make the task of predicting the results of a change in unborrowed reserves on either deposits or interest rates more difficult. Lagged reserves raise the costs to the banking system of the conduct of a given change in monetary policy.

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[11]It might seem that excess reserves are a cost only in the sense of an opportunity cost. However, if banks compete for deposits and do not identify those deposits which are added to excess reserves (e.g., those made late on a Wednesday afternoon) then there appear to be explicit costs to an addition to excess reserves.

[12]For a less critical view of lagged reserves which makes somewhat the same point, see (Holmes 1973, pp. 73-75).

Against these effects, lagged reserves have made it easier, assuming the level of unborrowed reserves can be set with precision, for the monetary authorities to set the Federal funds rate.[13] This is because under lagged reserves the monetary authorities know the demand for reserves in the current week since it is based on the level of deposits two weeks previous. However, this potential increased control over the Federal funds rate does not appear to be a great gain. The same factor which makes the Federal funds rate potentially easier to control--the breaking of the connection between changes in deposits and the Federal funds rate--makes it more difficult to predict the effect on the level of deposits or other interest rates of a given Federal funds rate. In short, the losses entailed in the shift to lagged reserves seem to far outweigh the gains.

IV. Proposed Reverse Lag System

The problems with lagged reserves arise because the system reverses the fundamental mechanism of monetary policy. Every beginning student of monetary policy learns that the monetary authorities change reserves and banks react with a multiple expansion or contraction in deposits which moves required reserves to a level consistent with the new level of reserves. That is, monetary authorities act and banks react. However, under the present lagged reserves system the banks act, the monetary authorities react, and banks respond to this reaction by the monetary authorities. If the monetary authorities are hesitant to impose costs on the banking system then policy will be sluggish in changing bank actions. In addition, a great deal of uncertainty is generated. Banks must determine what a particular current

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[13] It is not clear that the monetary authorities control over unborrowed reserves is sufficiently precise to insure that the shift to lagged reserves has, in fact, improved their control over the Federal funds rate.

policy portends for future policy. Monetary authorities must determine what current policy will generate expectations on the part of banks consistent with the desired changes in the level of deposits or interest rates. It would seem more appropriate to have the monetary authorities act and banks react. Reversing the lag between required reserves and reserves would accomplish this. Reserves would be set in the current week with required reserves determined by the banks two weeks hence. This would allow the banking system to make changes in the level of deposits more easily since banks would know ahead of time the adjustment required.

Fundamental Changes

Two changes in the present reserve computation scheme would create a system in which the monetary authorities initiate policy and the banking system reacts to the known level of reserves set by the authorities. This new system would appear to be superior to either the old coincident system or the present lagged system. The changes are:

1) Reserve settlement in a given week would use required reserves based on deposits in the given week and the level of reserves held two weeks previous.
2) A banks net clearings (i.e., the value of checks deposited minus the value of checks drawn against the bank at the Federal Reserve so far in the settlement week) would create an equal amount of interbank deposits. A bank with positive net clearings so far in the week will be considered to have an equal amount of interbank deposits "due from" other banks as of the end of the day, while a bank with negative net clearings in the week has an equal amount of interbank deposits "due to" other banks.

Reserves at the Federal Reserve would be determined at days end, just as at present. A banks reserves each day would be equal to the banks reserves at the beginning of the week plus the banks net clearings so far in the week. Weekly average reserves would be the average of the daily reserves.

Reversing the lag creates a reserve computation system consistent with the broad scheme of monetary policy. Banks enter the settlement period with a fixed level of reserves, necessitating adjustment through changes in required reserves. The process of the individual bank moving to equilibrium mirrors that of the banking system as a whole, which does not move into equilibrium through changes in reserves, but through changes in required reserves.[14]

As shown below, treating a banks net clearings as interbank deposits, sharply reduces the influence of factors outside the banks control which affect its required reserves. Since interbank deposits "due from" other banks are subtracted and interbank deposits "due to" other banks are added to deposits in computing required reserves, flows of demand deposits between banks leave the banks with unchanged required reserves.

Under the reverse lag, banks may move into equilibrium very easily. A bank with reserves two weeks ago that could support $100 more than its level of deposits entering the current reserve settlement week, knows that the purchase of $100 in assets at the beginning of the week will move it into equilibrium for the week. The bank pays for the assets with a check for $100. If the check is deposited at the bank itself then deposits rise by $100 and the bank is in equilibrium. If the check is deposited at another bank, the other bank has an increase in demand deposits of $100 offset by an increase of

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[14]Ignoring again the possibility of adjustment occurring through changes in the publics currency holdings.

$100 in "due from" interbank deposits when the check is cleared. The adjusting bank has an increase of $100 in deposits "due to" other banks when the check is cleared and thus achieves equilibrium. Deposits in the system increase $100, the adjusting bank is in equilibrium and no other bank experiences a change in required reserves. A bank with deposits $100 higher than its level of reserves two weeks previous could support, would sell $100 in assets and move into equilibrium by either reducing its deposits or adding to its deposits "due from" other banks in the check clearing process.

The adjusting bank's reserves in the current week are affected primarily by the banks net clearings at the Federal Reserve to which the check issued (received) by the bank expanding (contracting) its asset holdings contributes a loss (gain) of $100 in reserves. This reserve shift only affects the reserve computation period two weeks in the future.

Markets facilitating Adjustment

In practice, bank adjustments would not be as extreme as the process outlined above. Adjustment would be facilitated by two separate markets. The first is the Federal funds market just as exists presently. Imagine Bank A and Bank B are both in equilibrium (having deposits just equal to the amount which could be supported by their reserves two weeks previous) and assume that a $100 check written on Bank B is deposited at Bank A. After the check is cleared, Bank A has a $100 increase in demand deposits offset by a $100 increase in deposits "due from" other banks, while Bank B has a $100 decrease in demand deposits offset by an increase of $100 in deposits "due to" other banks. While the banks remain in equilibrium this week, it is clear that both must adjust two weeks in the future. Assuming reserve requirements are 20 percent, Bank A's current level of deposits is $400 below, and Bank B's $400 above the level of deposits which they could have two weeks in the future. While they could adjust as described above (i.e., Bank A buying

$400 in assets and Bank B selling $400 in assets at the beginning of the settlement period two weeks hence), this could lead to large reserve flows two weeks in the future. It is possible that some of the adjustment will occur through a sale of Federal funds from Bank A to Bank B in the current week. The sale of $80 in Federal funds would obviate the need for any asset adjustments two weeks in the future.

A second market facilitating adjustment, which would likely develop, would be one for future interbank deposits. An interbank deposit for some week in the future is a demand deposit "due from" another bank for that week and thus would be an offset to deposits requiring reserves in that future reserve settlement week. These future interbank deposits would not involve the transfer of reserves and so would involve only banks without the participation of the Federal Reserve.

Assume the banking system is in equilibrium, under the reverse lag, when the Federal Reserve purchases $100 in securities. This increases deposits in the system by $100, offset by a $100 increase in the banking systems net clearings at the Federal Reserve.[15] For the banking system as a whole, there are $80 more in reserves than the current level of deposits would require. Banks holding these $80 know that in two weeks they can purchase $80 in assets, creating $80 in deposits and not be reserve deficient. This is exactly the reaction of banks in the same situation under a coincident reserve system. But under the reverse lag these banks also know that these reserves they currently hold could support yet an additional $320 in deposits two weeks hence. This ability to support future deposits may be sold in an interbank deposits market. The rate on these future "due from" interbank deposits will fall until some banks find the rate attractive relative to the expected return on assets they might acquire and

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[15]The assumption here is that the monetary authorities purchase the securities from a non-bank dealer. Transactions with bank dealers will be discussed later.

hold during the settlement period two weeks hence. A bank entering a week for which it holds previously purchased "due from" interbank deposits can purchase and hold during the week, additional assets equal to the value of the interbank deposits. The clearing of the check used to purchase the assets results in an equal amount of "due to" interbank deposits which will be offset by the previously purchased "due from" interbank deposits. The "due to" interbank deposits resulting from the asset purchase involve an equal loss of reserves for use two weeks in the future which is not offset by the previous purchase of future interbank deposits since there is no reserve transfer associated with the purchase of future interbank deposits.

Conversely, if the Federal Reserve sold assets, some banks would find themselves with less reserves than their current level of deposits would require two weeks hence. These potentially deficient banks would bid up the future interbank deposit rate until future interbank deposits are created by other banks willing to sell assets or the deficient banks themselves decide to sell assets in the future settlement week.

Advantages of the Reverse Lag

The basic attraction of the reverse lag is that it allows banks to know precisely what action is necessary to get into equilibrium before entering any settlement week. Markets will then allow the banking system to make an efficient adjustment. A net negative level of clearings for the banking system in the current week signals that deposits must contract two weeks in the future. The interbank deposit rate for two weeks in the future moves up to a level at which an appropriate value of interbank deposits two weeks in the future will be sold. Banks selling future interbank deposits in the current week will be those banks with the lowest expected marginal return on assets two weeks in the future. This is an efficient way for the banking system to contract the level of deposits two weeks in the future.

Reserve computation schemes may be compared by examining the individual bank adjustment to equilibrium in light of what is required for the banking system as a whole. Since the banking system cannot change the level of reserves, it must adjust to disturbances (e.g., currency flows, monetary policy actions) through changes in deposits. The extent to which individual banks adjust through reserves or deposits depends on the reserve computation scheme. A problem with the present lagged reserves, is that the individual bank adjusts entirely through reserves. In adjusting, banks put other banks out of equilibrium by the same amount. The banking system as a whole cannot get into equilibrium (i.e., change excess reserves) regardless of what happens to deposits. Under coincident reserves, individual banks adjust primarily through reserves but some adjustment occurs through deposits since deposit flows affect required reserves in the reserve settlement week. Under coincident reserves each adjusting bank puts other banks out of equilibrium but by a progressively smaller amount until equilibrium is achieved. Under the proposed reverse lag where complete adjustment occurs through deposits, adjustments required for individual banks are the same as those required for the entire banking system and no other banks are put out of equilibrium in the process of adjustment. This makes the banking systems adjustment under the reverse lag quicker and less disequilibrating than either the coincident or the present lagged reserve scheme.

Setting Required Reserves

Adoption of the two changes proposed above would greatly improve the monetary authorities' control over the quantity of deposits while simultaneously reducing the banking systems costs of adjustment to changes in the level of reserves. More importantly, the proposals suggest the possibility that a system could be devised in which a bank's level of excess reserves, within the settlement week, would not be affected by factors outside its control.

Banks could then eliminate excess reserves by adjusting asset holdings so as to set their required reserves exactly equal to their level of reserves two weeks previous. Counting net clearings as interbank deposits already removes intra-week changes in required reserves arising from demand deposit flows. Four additional changes would create a system in which banks would set a level of required reserves equal to their level of reserves two weeks previous without fear of reserve deficiences.

The four changes are:

3) Count a fraction of current vault cash equal to the reserve requirement against demand deposits as reserves in the current week.

4) Compute required reserves against non-demand deposits as at present except that net changes in the level of these deposits from the end of the previous week will be considered for reserve requirement purposes to release or require reserves as though they were demand deposits.

5) Eliminate the reserve carry-over allowing a bank to carry over an excess or deficiency of up to two percent of required reserves for one week.

6) Assess deficiences a severe penalty such as ten percent above a market rate such as the three month treasury bill rate.

Counting current vault cash as reserves against current deposits completes the reversal of the present lagged reserves. Under the present lagged reserves system, vault cash from two weeks previous counts in satisfaction of required reserves. Counting a percentage (equal to the reserve requirement against demand deposits) of current vault cash as reserves available against deposits this week serves two purposes. It prevents changes in excess reserves as a result of shifts by the public between currency and demand deposits. It also provides an incentive for banks to quickly transmit vault cash changes to the Federal Reserve where the monetary authorities may offset the impact

on the future level of deposits.

Setting reserve requirements equal to those against demand deposits for the weekly net change in non-demand deposits removes any effect on excess reserves, in the current week, of changes in non-demand deposits. Thus, the effects of a change in time deposits would be offset by the effects of the simultaneous change in demand deposits, vault cash, or check clearings at the Federal Reserve. For example, a shift from demand deposits to time deposits will not change a banks required reserves in the initial week. In the following week the reserve requirements against the increased time deposits will be equal to the level set by regulation and the bank will know at the beginning of the week the increased quantity of assets it may purchase (and therefore deposits it may create) due to the shift from demand deposits to time deposits in the previous week.[16]

Elimination of the present carry-over of excesses and deficiencies by banks is necessary if banks are to move to a level of required reserves equal to the level of reserves provided two weeks previous. If banks are allowed to run excesses or deficiencies to be compensated for in future weeks, required reserves in any week could deviate from the level of reserves two weeks earlier.

A significant penalty on deficiencies would prevent banks from intentionally being deficient. Banks could easily avoid being deficient since no actions other than changes in the banks holdings of assets could affect required reserves in the current week.

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[16]Though the present graduated reserve system would not prevent the banking system from setting required reserves equal to the level of reserves two weeks previous, it would seem desirable to eliminate graduated reserves from the reverse lag system. Unless it can be shown that the setting of reserve requirements dependent on a banks total deposits gives a more useful aggregate for monetary policy, graduated reserves would appear to be an unnecessary complication. The reader is referred to Kaufman (1972, pp. 20ff) for a description of the problems entailed in a proliferation of reserve categories.

Constraints under the Reverse lag

Some constraints would be imposed on monetary policy by adoption of the changes listed above. Under the reverse lag, monetary authorities would lose some control over interest rates in the markets for reserves. In a sense, the thrust of the changes advocated up to this point has been to construct an institutional framework in which the interest rates on reserves (i.e., the Federal funds rate and the interbank deposit rate) would go wherever they must to insure the banking system establishes a level of required reserves equal to the level of reserves two weeks previous. This does not mean these rates would be more volatile. If the rate on bank assets were stable, so would be the rate on Federal funds and inter-bank deposits since these rates will gravitate toward the bank asset rate. Monetary policy could change these rates only by running operations large enough to change bank asset rates. In addition, under the present system, control over the Federal funds rate is not as great an advantage as might appear at first. As mentioned previously, this still leaves the monetary authorities with the major problem of estimating the response of deposits and other market rates to a given Federal funds rate and the solution to this problem has become more difficult.

Under the reverse lag, response to policy actions would be slower. Unlike the present lagged reserves or coincident reserves where there can be an immediate response to monetary policy, policy cannot have an impact for two weeks under the reverse lag since equilibrium for the banking system in the current week is determined by the level of reserves two weeks previous. This does not appear to be a serious constraint since two weeks would appear too short a time to produce irreversible influences on the ultimate goals of policy (e.g., prices, unemployment and output). It is also possible to reduce the lag to one week, though it would then be preferable to have the settlement week begin on Monday to facilitate inter-week adjustments.

It should also be noted that the required reserves which the banking system would set under the reverse lag differs somewhat from required reserves as defined currently. Since changes in non-demand deposits within the week are treated as if they had reserve requirements equal to those against demand deposits, the level and distribution of deposits set under the reverse lag will differ from one whose regulatory required reserves are equal to the level of reserves two weeks previous. The fundamental cause of this discrepancy is the existence of two differing relationships between different types of deposits. The public can exchange different types of deposits, dollar for dollar, while the reserve requirements against different types of deposits may not be equal. In such a situation, the reserve computation system cannot avoid the existence of some imprecision. If a banks reserve requirements against various types of deposits are always equal to the level set by regulation, banks would be impelled to move, within the week, to offset shifts by the public between different types of deposits. Though this would produce movement by the banking system toward a deposit aggregate whose regulatory required reserves equalled the level of reserves two weeks previous, imprecision still enters since banks would hold excess reserves to guard against changes in required reserves due to shifts by the public between different types of deposits. The choice made in the reverse lag system is to remove from banks the effects of deposit shifts on required reserves by equating the marginal reserve requirements on all types of deposits. This approach accepts the discrepancy of having the regulatory required reserves of bank deposits in the current week differ from the level of reserves two weeks previous by a factor dependent on the magnitude of the net shifts between demand and

non-demand deposits in the current week.[17]

Since shifts in non-demand deposits are treated as if they require or release reserves like demand deposits only in the week during which the shift occurs, required reserves will change as a result of the deposit shifts in the following week. Banks, knowing this, will change their asset holdings in the following week so as to move required reserves to a level consistent with the shift between deposit types and the reserve requirements set by regulation. For example, in the week following a shift from time deposits to demand deposits, banks will sell assets and deposits will fall because the increased reserve requirements due to the increase in demand deposits will no longer be offset by the decrease in reserve requirements due to the decline in time deposits. Under a reverse lag then, as under other reserve computation schemes, there should be careful consideration of which aggregate monetary policy is intended to influence. As presently set, reserve requirements appear designed to influence a monetary aggregate in which a dollar of demand deposits is given a weight approximately five times that of a dollar of time deposits. If it were desired to influence narrow money--M_1 (currency plus demand deposits), the dropping of reserve requirements against time deposits would be appropriate. It it were desired to influence broad money--M_2 (M1 plus time deposits), equal requirements would be appropriate.[18] For a system designed to control M2 (i.e. equal reserve requirements on demand and time deposits) under the reverse lag,

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[17]Another reason for differences between actual deposits and a level of deposits whose regulatory required reserves equal reserves two weeks previous is open market operations in the current week. An open market transaction affects deposits if conducted with a non-bank dealer. This would not appear to be a great problem under a reverse lag. A quick solution would be to accept the change in deposits involved in open market operations with non-bank dealers and omit checks directly exchanged between the Federal Reserve and dealer member banks from those banks net clearings and interbank deposits. A more thorough solution would involve an analysis of the virtues of conducting open market operations with member banks and/or non member-bank dealers, which is beyond the scope of this paper.

[18]Equal requirements for all types of deposits would also be appropriate for a policy focused on interest rates.

the actual level of M2 would be one whose level of required reserves was equal to the reserves of two weeks previous, eliminating the discrepancy described above.

Setting Reserves

The six changes proposed above would still not allow the monetary authorities to set the level of required reserves exactly because of the effects of Federal Reserve float, currency flows and Treasury deposits at the Federal Reserve on the level of reserves. Four additional changes however, would enable the monetary authorities, under the reverse lag, to precisely set the level of reserves and therefore required reserves two weeks later:

7) Eliminate the discount window.

8) Eliminate Federal Reserve float by ceasing to provide funds to banks for checks being cleared before the checks have been debited from other banks.

9) Eliminate Treasury deposits at the Federal Reserve.

10) Add a banks net shipment of currency to the Federal Reserve in the previous two weeks to actual vault cash holdings in computing daily vault cash used in satisfaction of reserve requirements.

Under the reverse lag there would appear to be no reason for a discount window. Banks would know before the settlement week begins what they must do to achieve equilibrium and factors outside their control could not cause disequilibrium. Bank solvency problems could be handled in an ad-hoc manner.

The practice whereby the Federal Reserve sometimes credits a bank presenting a check for collection before it debits the bank on which the check is drawn adds a fluctuating quantity of reserves to the system week by week. Ending this practice under the reverse lag would eliminate Federal Reserve float. Reserves would be credited to one bank only at the same time as they are debited from another.

Treasury deposits at the Federal Reserve make it more difficult to accurately set reserves because variations in the value of Treasury checks cleared affect the provision of reserves to the banking system. Under the reverse lag the Treasury would not hold deposits at the Federal Reserve. Aside from the benefits for monetary control, elimination of Federal Reserve Treasury deposits would appear to have benefits for the Treasury.[19] Services now provided for the Treasury by the Federal Reserve would be provided by commercial banks.

Under the reverse lag, shifts between currency and deposits by the public have no effect on banks in the first instance since the change in reserves through the change in vault cash (i.e., the reserve requirements against demand deposits times the change in vault cash) will exactly match the change in required reserves due to deposit changes. As long as the currency changes on the part of the public are not reflected in currency shipments to or from the Federal Reserve, there would be no need for the Federal Reserve to offset the flows. However, under the reverse lag computation scheme there is an incentive for banks to economize on holdings of vault cash since reserves at the Federal Reserve count in full while only a percentage of vault cash counts as reserves. Thus it could be expected that there would be substantial shipments of currency between the banks and the Federal Reserve. A shipment of vault cash from a bank to the Federal Reserve under the reverse lag scheme would reduce reserves available from vault cash immediately but would not increase reserves available to meet required reserves at the Federal Reserve for two weeks. Reserves are lost for two weeks. Conversely, a ship-

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[19]Current practice costs the Treasury the amount of money spent by the Federal Reserve in servicing Treasury deposits while the Treasury receives an implicit interest rate equal to the Treasury bill rate on its deposits at the Federal Reserve. Placing these deposits at commercial banks would likely lower net costs to the Treasury.

ment of currency from the Federal Reserve to the banks does not reduce reserves available to meet required reserves at the Federal Reserve for two weeks while increasing reserves available from vault cash immediately. There is a form of double counting for two weeks.[20]

A solution is to adjust the definition of vault cash by adding net currency shipments to the Federal Reserve in the previous two weeks to the actual vault cash position. Thus, a shipment of currency to the Federal Reserve would not produce a gap in reserves nor a shipment from the Federal Reserve a double counting. While this avoids the immediate change in reserves as a result of a change in vault cash, the monetary authorities still must offset the impact of a currency shipment on reserves for use two weeks in the future. A shipment of currency to (from) the Federal Reserve will, unless offset, increase (decrease) reserves available for use two weeks in the future by one minus the reserve requirement against demand deposits times the currency shipment. A shipment to (from) the central bank increases (decreases) reserves available for use two weeks in the future at the Federal Reserve by the full amount while the decline in vault cash reduces (increases) reserves by the reserve requirement against demand deposits times the value of the shipment. To offset the influence of currency shipments on reserves for future use, the monetary authorities would sell (buy) securities equal to one minus the reserve requirement against demand deposits times the value of currency shipped to (from) the central bank.

Two changes involved in adopting the reverse lag would impose additional costs on member banks of the Federal Reserve system. The elimination of Federal Reserve float and the counting of only a percentage of vault cash

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[20]For an exposition of the reserve adjustment possibilities opened to banks as a result of the counting of vault cash reserves from one time period and reserves at the Federal Reserve from another see Coats (1973).

as reserves would reduce reserves available to member banks. Due to the increased precision with which required reserves could be set under the reverse lag, reserve requirements could be reduced far more than the approximately twenty percent necessary to offset the reduction in reserves. Besides resulting in a lowering of costs to member banks, a sharp cut in reserve requirements would further improve the monetary authorities control over monetary policy by making Federal Reserve membership more attractive.

Conclusion

Analysis indicates that the 1968 shift to lagged reserves has had deleterious effects on the individual bank, the banking system and monetary policy. Lagged reserves increase the costs of reserve management for the individual bank, while increasing the costs imposed on the banking system by shifts in monetary policy. Lagged reserves also reduce the precision with which monetary policy may be conducted. The analysis further suggests that a reserve computation scheme in which required reserves are set two weeks after reserves would be more in keeping with the fundamental scheme of monetary policy.

The reverse lag system developed here would allow the monetary authorities to precisely set a level of reserves in the current week which the banking system would match with required reserves two weeks hence. Banks, knowing precisely what change in asset holdings is required to set and keep required reserves equal to their level of reserves two weeks previous, would eliminate excess reserves. Since banks would know their required adjustments ahead of time, markets would develop enabling the banking system to make the necessary changes in required reserves efficiently. The precision with which required reserves could be set would allow reserve requirements to be cut sharply, lowering the costs of membership in the Federal Reserve system and further improving the precision of monetary policy. The resulting banking

sector would be much simplified without a discount window or reserve carry-over. Monetary authorities would no longer be required to take account of Federal Reserve float, Treasury deposits or changes in public currency holdings to implement policy. Only knowledge of net currency shipments between banks and the Federal Reserve would be required.

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