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Kazuo Ueda

Faculty of Economics
The University of Tokyo
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Faculty of Economics

University of Tokyo

7-3-1 Hongo, Bunkyo-ku

Tokyo 113, JAPAN

tel: 03-3812-2111, x5603

fax: 03-3818-7082

Kazuo Ueda is associate professor at the Faculty of Economics, The University of Tokyo.

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Introduction

Three major building blocks of the analysis of a country's monetary policy are: the reaction function of the central bank, or the ultimate targets of policy; short-run monetary control; and the transmission mechanism. Japanese monetary policy has been unique in all these three aspects. This paper attempts to analyze the special features of the second and third, but not the first, building blocks of Japanese monetary policy. That is, it discusses the daily monetary control of interest rates and the mechanism by which interest rate changes affect the real economy, but does not address the question of what causes a change in policy instruments.

In our analysis of the short-run monetary control and the transmission mechanism we try to relate the discussion, to a maximum extent, to current researches on the same topics in the U.S. A perspective relevant for both aspects is that Japanese monetary policy has been moving very rapidly over the last few years from an old-fashioned direct control of interest rates and quantities of transactions through moral suation to the one relying more heavily on the price mechanism in money and capital markets.

The Federal Reserve (henceforth, the Fed) has alternated between controlling the federal funds rate and bank reserves. The funds rate volatility was much higher during 1979-82--the period of bank reserve control. In either case the Fed uses open market operations to hit the target. Operations consist of "defensive" ones by which the Fed accommodates short-run temporary fluctuations in the demand for high

powered money, and "dynamic" ones directed toward changing the level of the target.[1]

Has the Bank of Japan (BOJ) controlled bank reserves? How stable is the call rate relative to the funds rate? How important are "defensive" and "dynamic" operations? What are the instruments available to the BOJ to control the call rate or bank reserves? These are the major questions we address in our comparative analysis of Japanese monetary control.

We argue that the BOJ, in its daily operations, has long targeted the call rate and other interbank rates. It has never targeted bank reserves in the sense of setting target growth ranges for reserves and hitting them within a short period of time such as a few months. We show this by first presenting evidence of the stability of interbank rates in Japan relative to the U.S. and then by pointing out the importance of "defensive" operations by the BOJ for stabilizing interbank rates.

An important consequence of interbank rates targetting in Japan is that the stock of high powered money has been an endogenous variable. That is, the BOJ has been accommodating fluctuations in the demand for high powered money at target levels of interbank rates.

Another feature of Japanese monetary policy is that for both "defensive" and "dynamic" operations, the BOJ uses changes in lendings at the discount window very extensively. That is, discount window lending is an important daily instrument for the BOJ. This is unlike the role of borrowings at the Fed that move more or less passively in response to the request of commercial banks. The difference results from the absence of large scale open markets in Japan.

An important question discussed in the literature is whether the call rate has been at the level to clear the market for high powered

money. We do not offer a definitive answer. But we supply casual evidence pointing to the importance of more direct control, possibly with moral suasion, of the interbank rates by the BOJ at least for certain subperiods of the post war period. We discuss in a related context the new operating procedure introduced in 1988. The new procedure has allowed freer movements of interest rates and funds.

In the second part of the paper, we look at the transmission mechanism of Japanese monetary policy. The analysis is again related to the current research on the topic in the U.S. The controversy between credit vs money view of the transmission mechanism is receiving renewed interest in the recent literature, although conclusive evidence is yet to be offered.

The topic is even more interesting in Japan because of the availability of a unique policy instrument-- window guidance by which bank loans are directly controlled by the BOJ. Hence, loans may be important not only as a channel of policy transmission but also as an instrument of policy.

We apply techniques used in the recent U.S. literature to analyze Japanese data. We find two important conclusions. First, the results of time series analysis of Japanese data involving monetary aggregates are extremely sensitive to the choice of prefiltering technique. Hence, robust results are rather hard to obtain.

Second, despite the sensitivity to the methods used, we find support for the importance of loans in the transmission mechanism of Japanese monetary policy.

We also find that both the call rate and bank loans cause other monetary indicators in the Granger sense. Hence, we might summarize the behavior of the BOJ as using both the call rate and window guidance to

move bank loans and other interest rates, which in turn change other monetary aggregates and real variables of the economy.

The BOJ has announced in June 1991 to discontinue its use of window guidance. Perhaps, this had followed the adoption of the new operating procedures in 1988 in the BOJ's attempt to rely more heavily on the price mechanism in money and capital markets for carrying out monetary policy. Whether such moves will be permanent, or whether they will be successful is yet to be determined.

Part I of the paper starts with a brief summary of the Fed's operating procedure. We then compare it with the BOJ's operations. Detailed analysis of the behavior of interest rates and bank reserves are presented. We then turn to the analysis of the transmission mechanism of Japanese monetary policy in Part II. Here, time series analysis of monetary indicators are carried out, paying particular attention to the comparison of the predictive powers of money and lending. The last section summarizes major conclusions of the paper.

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Part I, The Short-run Monetary Control Technique of the BOJ

In this part we discuss daily operating procedures of the BOJ and related issues. In doing so, we try to relate the discussion as much as possible to that of the U.S. monetary control. In order to do this we begin this section by briefly summarizing what appears to be the consensus view of the Fed's operating procedure. We then turn to the explanation of the operating procedure by the BOJ, highlighting similarities and dissimilarities between the operating procedures of the two central banks.

It will also be important to keep in mind the time unit of analysis. Some discussions below refer to daily operations of the central banks. Some others abstract from daily movements and look at averages over reserve accounting periods. And there are others not affected by the time unit.

1, The Operating Procedures of the Federal Reserve

It will be useful for later purposes to discuss the operating procedures of the Fed. The following discussion owes much to Fed [1981] & [1988], Kanzaki [1988] and Partlan, Hamdani & Camilli [1986].

A convenient starting point is the balance sheet of the Fed shown in Table 1. From the equality of total assets and liabilities, we have

$$S = R + VC + CU + DG - (BL + FL + NA). \qquad (1)$$

This can be rewritten as

$$S = (TR - BL) + RF \;=\; NBR + RF \qquad (2)$$

where TR is total reserves defined as R+VC and RF is reserve factors, which is the sum of all other items on the right hand side of (1). NBR is non-borrowed reserves. By taking the first difference of (2), we obtain

an identity involving open market operations, OMO:

$$OMO = d(TR-BR) + d(RF) = d(NBR) + d(RF) \qquad (3)$$

where d(x) indicates the first difference of x.

The Fed derives the objective for NBR or d(NBR) by estimating the demand for required and excess reserves consistent with medium-term targets for monetary aggregates and by subtracting the estimate of the level of discount window borrowing. This sets the "dynamic" objectives of the FOMC--the first part of the right hand side of (3) with d(NBR) equal to its targets. The second term, d(RF), in addition to being volatile and uncertain, is believed by many central bankers to be outside of their control in the very short run, for example, at the daily level. Therefore, it would be best to estimate as precisely as possible the fluctuations in RF and offset them using open market operations in order to avoid unnecessary volatility in short-term interest rates[2]. This is the so-called "defensive" part of open market operations.

Most observers of the Fed's operating procedures suggest that borrowings at the discount window are not rationed even if the discount rate is below the federal funds rate. Member banks pay surveillance costs which are increasing in the amount of discount window borrowings. Hence, rational behavior on the part of member banks suggest that BL is determined at a finite level and is increasing in the difference between the federal funds rate and the discount rate.

Assuming that total reserves are a decreasing function of the federal funds rate, equation (3) gives the equilibrium condition of the federal funds market. To the extent that "defensive" operations fail to fully offset changes in reserve factors, the Fed will observe unexpected changes in discount window borrowings.[3] The Fed tightens its stance by decreasing the "dynamic" part of open market operations. This will create

a rise in the federal funds rate and increased borrowings at the discount window.

It is widely recognized that the Fed targeted non-borrowed reserves during the 1979-82 period, and the federal funds rate in other periods.[4] However, the difference is more of emphasis than substance. Obviously, the Fed cannot set targets for reserves on a day-to-day or even month-to-month basis and hit them exactly. If tried, it would create enormous movements in interest rates and confusion in short-term money markets. Targetting reserves just means more frequent adjustments of the "dynamic" part of open market operations in response to deviations of actual reserves from targets and , consequently, more fluctuations in the federal funds rate than in the case of targeting the federal funds rate.

2, The BOJ's Operating Procedures

Let us now turn to the description of the BOJ's operating procedures using the argument in the last section as a benchmark.

Some institutional features of the Japanese money markets and the regulation on banks should be remarked at the outset. Japanese banks are required to hold reserves as deposits at the BOJ;therefore, vault cash is not included in the calculation of legal reserves. The TB market is not comparable in size to that in the U.S. In addition, the current accounting system implies that an operation in the TB market on a certain day is settled three days later. Because of these problems TB operations are not very useful for daily adjustments of bank reserves.[5]

Let us reproduce equation (1) for the Bank of Japan, ignoring the float and net assets.

$$BL + S = R + VC + CU + DG. \qquad (4)$$

A favored rearrangement of this equation by the BOJ is the following:

$$d(R) = d(BL) + OMO - d(VC + CU + DG). \quad (5)$$

Some of the differences between the BOJ's and Fed's operating procedures are already appearant. The Japanese counterpart to d(RF)--technical reserve factors-- is the third term of the right hand side of (5) and unlike (3) it includes vault cash. This is because vault cash cannot be used to meet legal reserve requirements. It also implies that the BOJ regards that vault cash is exogenous in the short run. Just as the Fed regards d(RF) in equation (3) as exogenous, the BOJ treats the d(VC+CU+DG) term as exogenous in its daily operations.

Another difference between equations (3) and (5) is that BL is not subtracted from R to arrive at non-borrowed reserves. In fact, the concept of non-borrowed reserves has never been used in Japan.[6] This reflects the use of discount window borrowings as a control variable by the BOJ. The discount rate has always been lower than the call rate. Therefore, discount window lendings have been rationed in Japan. And the level of lendings have been changed at the initiative of the BOJ, not of private banks.[7] In fact, they have been the major policy instrument of the BOJ as shown below.

The BOJ calls the d(CU+VC+DG) term of equation (5) the shortage (or surplus if negative) of funds in the money market. The "defensive" operations of the BOJ are directed toward offsetting the effects of changes in this term. The BOJ devotes considerable efforts to estimating the shortage of funds. Funds are supplied either through the BOJ's discount window, BL, or by open market operations, OMO. For "defensive" operations both instruments are usually used.

The difference between the total supply of funds by the BOJ and the amount of "defensive" operations is, of course, the "dynamic" operations of the BOJ and this determines the change in bank reserves. Assuming that

the demand for reserves by banks responds to the call market rate, we see that equation (5) determines the equilibrium call rate.

3, Interbank Rates Targetting in Japan

The question we now address is what has been the target of the BOJ's operations? As far as I know, the BOJ has never targeted bank reserves or high powered money.[8] In a sense short-term (month to month) control of bank reserves ia almost impossible in Japan because of the lagged reserve accounting system and the near absence of excess reserves.[9] Since the mid 1970s the BOJ has payed attention to the behavior of broader monetary aggregates as intermediate targets of monetary policy. However, it seems that they have never used information on monetary aggregates to calculate target levels for bank reserves or interbank rates in a mechanical way.

The short-term operating target of the BOJ has long been interbank interst rates. During normal times when tightening or loosenening of monetary policy is unnecessary the BOJ stabilizes interbank rates. A change in the stance of monetary policy creates new target levels for interbank rates. New targets are almost immediately achieved by "dynamic" operations as explained in section 4. The precise manner in which they calculate target levels of interbank rates has never been disclosed. I doubt if they use any quick formula to do this. As stated above, they have never targetted bank reserves. But they do pay close attention to the level of reserve supply relative to required reserves on a daily basis in order to achieve interest rate targets. This will be explained below in 4.(1).

We now show more formally that the BOJ has targetted interbank

rates. This is done in two steps. First, we show that as a statistical matter the call rate has been much more stable than the federal funds rate. Second, we argue that the stability of the call rate is a result of "defensive" operations of the BOJ rather than a result of the stability of or high interest rate elasticity of the demand for high powered money.

The relative stability of the Japanese interbank rates is shown in Table 2. In the table the standard deviations of daily interest rates for the periods since the late 1970s are presented for the U.S. and Japan. Clearly, interest rate volatility is higher in the U.S. The differences in the standard deviations between the two countries are significant for all three interest rates on the basis of the usual F-test on two variances.

< Table 2 about here.>

The difference in the degree of volatility is largest for the interbank rates. The volatility of the federal funds rate for the entire period is affected by the increased volatility in the 79-82 period when the Fed payed more attention to the control of reserves. However, the volatility of the call rate is lower than that of the federal funds rate even in periods excluding the 79-82 years. The numbers in parentheses are standard deviations calculated from the sample excluding Wednesday observations. They are presented because the volatility of the federal funds rate is much affected by its behavior on the last day of the reserve accounting period--Wednesday. However, the volatility is still much higher than that for the call rate. Though significant, the difference in the volatility of long-term rates between the two countries is not very large.

Consequently, the stability of Japanese interbank rates as evidenced in Table 2 must come from one of the following three possibilities: the

shortage or surplus of funds is more stable than the U.S. reserve factors; the interest rate elasticity of the demand for high powered money is higher in Japan; the BOJ carries out more accurate "defensive" operations.

Table 3 shows the variability of currency in circulation, the largest component of high powered money in both countries. Unambiguously, the demand for currency by the non-bank public fluctuates more in Japan than in the U.S. Okina [1991], though less formally, presents evidence of the larger volatility of other components of high powered money in Japan than in the U.S. as well.

<Table 3 about here.>

Estimates of the interest elasticities of the components of high powered money--currency held by the public and bank reserves-- are presented in Table 4. The specification of the demand functions is the conventional one of partial adjustment in which the right hand side of the demand functions includes the lagged dependent variable. The table shows only the short-run elasticities, that is, the response of CU or TR within a month of a change in the interest rate. The magnitude of the elasticity of CU is about the same between the two countries, but that of the reserves is smaller in Japan.

<Table 4 about here.>

We have now seen that there is no evidence of more stability of or higher interest elasticity of the demand for high powered money in Japan. Consequently, accurate "defensive" operations by the BOJ must have been the key to stable interbank interest rates in Japan. A back of the envelope type calculation helps to understand the magnitude of interest rate fluctuations in the absence of "defensive" operations. Monthly variations in the RF term can easily come close to a few trillion yen.

Suppose that the bank of Japan did not accommodate these and that the elasticity of CU+TR, let us say, was at most .002 based on Table 4. High powered money stands at about 40 trillion yen. One would need to change the call rate by close to 100 percentage points to bring about a few trillion yen change in the demand for high powered money.

Fortunately, the daily data on the shortage/surplus of funds and its expectation on the day before published by the BOJ enable us to check the accuracy of "defensive" operations. If they are successful, they would purge interest rates of any systematic response to shortage/surplus of funds. Thus, we have regressed daily changes in the unconditional/collateral call rate on the shortage/surplus of funds of the same day, using its forecast as of a day before as an instrument. The results are:

$$d(ic) = \underset{(.071)}{.00713} + \underset{(.080)}{.00690}*d(VC+CU+DG), \quad D.W.=1.99$$

SMPL 1990:8:9-1991:1:10,

where t-statistics are in parentheses. The equation rejects the existence of any systematic effect of the shortage/surplus of funds on the call rate. The operations of the BOJ must have been accommodating these fluctuations in the demand for high powered money.[10]

To summarize, the BOJ has deliberately aimed at stabilizing the call rate around its target level. To achieve this the BOJ has used "defensive" operations extensively. An important consequence of such a policy has, of course, been that the stock of high powered money has been an endogenous variable responding to changes in the demand for high powered money.

4, Changing the Target Level of the Call Rate

(1) Adjustment of the Reserve Progress Ratio

We now turn to the discussion of "dynamic operations" , that is, the mechanism by which the BOJ changes the target level of the call rate. Toward the end of the 1980s, many new means of operations have become available for the BOJ such as operations in TB, FB and CP markets. However, the sizes of these markets are too small for the BOJ to carry out large scale operations. Consequently, the BOJ has depended on changes in lendings at the discount window and operations in the bill market for carrying out "dynamic" operations.[11] <Table 5 about here.>

Table 5 presents some regression results highlighting the use of BL as the most important instrument for "dynamic" operations. Equation (2) in the table explains the (daily average of the) call rate in a month by the discount rate and the share of BL in high powered money both at the end of a month earlier. The regressors are lagged by one month in order to avoid biases stemming from the correlation between the regressors and the error term. It shows that the more funds are supplied through the discount window the lower will be the call rate. Equation (3) shows a similar result in the first difference form. These results are at least consistent with the hypothesis that a lowering of interest rates is initiated by an increase in discount window lendings.

On the other hand, the correlation between the federal funds rate and the discount window borrowings is positive in the U.S. as shown in equation (1) of the table. Such a pattern of correlation will result if open market operations are used as the vehicle of monetary policy and borrowings respond passively to resulting movements in the funds rate.

During periods of monetary tightening or loosening, the BOJ changes the time path of reserve supply within a reserve accounting period.[12]

Both the BOJ and the market look at what they call the reserve progress ratio,cumulated sum of actual daily reserves since the beginning of the current reserve accounting period relative to the required reserves of the period. During normal times this ratio is assumed to start at zero and increase by about 1/30 every day to reach 1 at the end of the period. A "dynamic" initiative by the BOJ to tighten (loosen) its stance is reflected in a slowing (quickening) of the pace of the increase in this ratio relative to the normal pattern of increase. This is accomplished by, for example, a decrease (increase) in BOJ lendings.

When the BOJ slows the pace of the increase of the reserve progress ratio, it sends a signal of monetary tightening to the market, forcing private banks to take more funds in the call market and thus achieving the policy objective of raising the call rate.

Let us finally make a remark on the endogeneity of high powered money. We pointed out in the last section that high powered money is endogenous during normal times because of interest rate targetting. The above interpretation of "dynamic" operations suggests that a process of tightening is started by a decrease in the stock of high powered money. However, by the end of the reserve accounting period, the BOJ will be obliged to supply (because of lagged reserve accounting) a pre-determined amount of reserves albeit at a higher interest rate.[13] The total stock of high powered money will decrease to the extent that a higher interest rate will decrease some other components of the demand for high powered money, for example, the demand for currency by the non bank public. But the amount of response is usually very small. Hence, most of the movements in the stock of high powered money are driven by demand side factors even in periods when a strong "dynamic" initiative is exercised by the BOJ.

(2) An Alternative View of Interest Rate Control

An alternative explanation of interest rate control by the BOJ is that the BOJ determines the call rate at whatever rate it desires and sometimes forces market participants to take undesired positions. This view has been fairly strong among market participants (for example, Asami[1963]) and academics (for example, Horiuchi & Kato [1989]). Of course, direct quoting of the call rate by the BOJ would not be much different from the control mechanism explained in the last section if the BOJ accommodates all changes in the demand for high powered money at the quoted call market rate. However, there are reasons to believe that the call market had not been in equilibrium at least until 1988.

Direct quoting of the call rate by the BOJ has been achieved by the following mechanism, despite the fact that the BOJ is not a player in the call market. The BOJ has exerted strong influence on the behavior of the call loan dealers who act as brokers and dealers in the call market. Under the "tatene" system, i.e., until 1979, every day after the close of the market the BOJ and the representative call loan dealer met and discussed the next day's call rate-- in effect, the BOJ told the call rate to the dealer. And the rate would be announced in the morning of the next day. Under the "kehaichi" system, between 1979 and 1988, the role of the BOJ in the determination of the call rate was officially weakened, but actually remained the same.

The next question is whether the call rate that had been quoted was clearing the market. Anecdotal evidence against this abounds. Large citibanks have been chronic takers of funds in the call market. Interviews with these bankers reveal that their daily demand for reserves is interest inelastic. They say that they just take funds supplied by call loan dealers. This would ocurr if the call rate was set by the BOJ

at artificially low levels so that the market was in a state of excess demand. On the other hand, suppliers of funds in the interbank markets have the incentive to move funds into more flexible markets such as Euro markets. They speak of various informal guidance by the BOJ asking not to move large amounts of funds away from the interbank markets.

Direct dealings of funds in the call market have been strictly prohibited. Such a regulation would be necessary if the call rate quoted by the BOJ was not at the equilibrium level. <Table 6 about here.>

Table 6 shows the chronology of regulations on interbank rates as summarized by Horiuchi & Kato. During years before 1988, the only period in which the BOJ did not quote the call rate either directly or indirectly was between August 1955 and June 1957. We have calculated the variance of monthly changes in the call rate for each period. Clearly,the variance is much higher for this period than in the others. This and the anecdotal evidence discussed above raise doubt about the explanation of the stability of Japanese interbank rates on the basis of accurate defensive operations of the BOJ. The call rate may well have been stable because it has been set by the BOJ and because movements of funds between markets have been limited by non-market oriented forces such as moral suasion. Horiuchi & Kato also present evidence consistent with such an interpretation of the stability of interbank rates.

(3) The Liberalization of Short-Term Money Markets

In a sense the BOJ admitted such heavy use of moral suasion when they introduced the new operating procedure in November 1988. (See BOJ [1990] for the details of the new procedure.) In the summer of 1988 short-term rates in open markets such as the CD rate and Euro Yen rates increased as a result of the expectation of a future tightening of

monetary policy. But the BOJ wanted to keep interbank rates at relatively low levels. The difference between interbank and open market rates widened as illustrated in Figure 1 and transactions shifted to open markets. However, the large gap between the two types of rates and the existence of transactions in both markets imply that implicit regulations existed prohibiting at least part of the arbitrage between the markets.

In November 1988 the BOJ announced that it will liberalize transactions in the interbank markets and arbitrage between open and interbank markets. The alleged purpose of such a policy change was to increase the degree of arbitrage between interest rates and to enhance more free determination of interbank rates.

Since then, the difference between interbank and open markets rates has never been as large as in the summer of 1988. In that sense the new procedure has increased arbitrage between markets.[14] However, the variability of the call rate has not increased as shown in Table 6. Calculations using daily data also show that the volatility of the call rate has decreased since 1988. (See Table 2.) This is partly attributable to the decline in the volatility of long-term rates, also shown in Table 2. That is, it has been a relatively calm period.[15] But more research needs to be carried out on this point.

To summarize the discussions so far, the call rate has been the target of the BOJ policy for most of the postwar period. It has been much more stable than the federal funds rate. The major reason for the stability has been the extensive and accurate use of "defensive" operations of the BOJ. However, the heavily used practise of the BOJ directly quoting the call rate, together with moral suasions prohibiting arbitrage between markets, might have played a role.

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Part II. Transmission Mechanism

Let us now turn to the analysis of the transmission mechanism of Japanese monetary policy, again comparing it with the U.S. transmission mechanism.

Recent researches in the field have centered on the question of credit vs money view of the transmission mechanism of monetary policy. Thus, on the one hand, Bernanke & Blinder [1990] present evidence of the importance of bank loans, while King [1986] and Romer & Romer [1990] argue for the importance of bank liabilities. In addition, Bernanke & Blinder make an interesting finding that the federal funds rate is a good indicator of monetary policy. That is, the funds rate is markedly superior to various monetary aggregates and other interest rates as a forecaster of major macroeconomic variables.

The analysis of Japanese monetary transmission mechanism is especially interesting in the context of such recent developments. A unique policy instrument available to the BOJ is the so-called window guidance whereby the BOJ controls the amount of bank loans directly. This may have increased the importance of bank loans relative to countries in which such an instrument is not used.

The stability of the call rate relative to the federal funds rate as analyzed in the last section may imply that the call rate is a very good indicator of Japanese monetary policy and at the same time a good predictor of macro variables. The predictive power of the call rate may be higher than that of the federal funds rate in the U.S.

Unfortunately, the answers to these questions are not easy to pin down. Time series analyses involving monetary aggregates and other

macroeconomic variables are extremely sensitive to the choice of end of period vs average of period data, the way series are detrended and seasonally adjusted. It almost seems as if one can come up with any conclusion by searching over ways of prefiltering the data.

Tables 7 & 8 show results of money vs loan type causality tests and the comparison of predictive powers of various monetary variables. In Table 7 the predictive power, in the Granger sense, of monetary indicators are shown in bivariate regressions involving the pace of economic activity (the log of the index of production plus that of CPI) and one of the indicators. The data are monthly and 12 lags of each variable were included.

As warned above, the results are amazingly sensitive to small changes in the data or specification. Thus, it would be better to use seasonally adjusted data to come up with strong effects of monetary indicators, while better to use nonajusted, end of month data in level form with time trend to support perhaps the real business cycle theory. The use of monthly averages of daily data implies strong effects of indicators for the 1970s; end of period data imply strong effects for the 1980s. Money supplies (M1 and M2) appear to exert strong effects on the economy in terms of the number of times they are siginificant in the table. So is the call rate. <Tables 7 & 8 about here.>

In Table 8 we carry out an exercise similar to the one by Bernanke & Blinder [1990]. When more than one indicator was significant in Table 7, we included all the indicators in the regression to compare the preidictive power of each more accurately. In contrast to the finding of Bernanke & Blinder that the federal funds rate is unambiguously the best indicator, we find mixed results. None seem to be markedly superior to the others.

The results of variance decomposition shown in the table, however, is less ambiguous. Even with reordering of equations bank loans (L) possess the highest explanatory power in 80% of the cases. This result is, at least, suggestive of the importance of bank loans in the Japanese monetary transmission mechanism. If this is indeed the case, bank loans affect the real economy through their effects on other indicators such as monetary aggregates, hence, their predictive power in the Granger sense.

Such an interpretation is broadly consistent with the perception of staffs of the BOJ or market participants about the transmission mechanism. Their perception is conveniently summarized in the flow-chart (Figure 2, adopted from Bryant [1990]) used occasionally by the BOJ. In the middle of the chart we see that the call rate is the most important direct target (or instrument) of policy which is controlled by mainly BOJ lendings, open market operations and the discount rate. This part was analyzed in the last section. Changes in the call rate cause changes in other interest rates, including the loan rate. These, together with the effect of window guidance, will affect bank loans and then real variables. This has long been the establihed view of Japanese monetary policy, and it highlights the importance of bank loans. The chart also includes the direct effects of the money supply and other interest rates on the real sector, but these have not been regarded as the centerpiece of the transmission mechanism. <Figure 2 about here.>

Slightly more robust time series evidence than that presented in Table 7 is shown in Table 9. Here we check the Granger causality among monetary indicators only and we find exactly the pattern of causation expected from the above discussion. That is, loans and the call rate are not caused by the other variables except for minor cases, while these two help predict other variables. <Table 9 about here.>

One additional piece of evidence on the importance of loans is offered using the technique employed by Romer & Romer [1990]. They focus on periods when the Fed deliberately shifted to tighter monetary policy in their study of money-lending-output correlation. This allows them, to avoid confusion between the effects of monetary indicators on output and the effects working in the reverse direction.

Dates of deliberate shift to tighter monetary policy are easy to identify in Japan. Most people assume that a change in the discount rate provides such information. (Such dates are:1957/3,59/12,61/7,64/3,67/9,69/9,73/4,79/4,89/5.) In certain cases window guidance preceded an increase in the discount rate. But we do not make adjustments here for clarity of criterion.

Essentially, what Romer & Romer do is to first calculate forecast errors of money and bank lending from a regression of each on its own right after the shifts to tighter monetary policy. Forecast errors (actual minus predicted) are, of course, negative because of sudden shifts to tightening. However, the errors contain two parts: independent decrease of money or lending and the response of money or lending to output. The latter may be large in magnitude because tighter policy decreases output over time. In the second part of their analysis they recalculate forecast errors from a regression of money or lending on its own lag and ouput. The larger the forecast errors from the second exercise and the smaller the difference between the two exercises, the more important that monetary indicator is in the transmission mechanism of monetary policy. Based on such an analysis they conclude that money is more important than lending.

Figures 3 and 4 present the results of the same analysis using the Japanese data. For money we use M2 and bank loans are total loans of the

banking accounts of all banks. The data are monthly at the end of each month and are seasonally unadjusted. Regressions run are money (lending) on a constant, monthly dummies and either 12 lags of money (lending) and the index of production. Variables are in the log difference form. We show the forecast errors from regressions without involving output in Figure 3. We find that the errors move in almost the same way for money and lending although in the first few months the errors in lending move ahead. (This is already somewhat different from the Romer-Romer finding in which the errors for lending are much larger than , but initially lag behind those for money.)

<Figures 3 & 4 about here.>

The forecast errors from the regressions involving output as presented in Figure 4 are significantly different between money and lending. Both are much smaller in absolute value than in Figure 3, but more so for money. Moreover, the peak in forecast error ocurrs after 18 months for money, but after 23 months for lending. The quicker response of the errors for lending to monetary tightening than those for money is more evident in Figure 4 than in Figure 3. This is also in sharp contrast to Romer and Romer. They find that the error for lending does not become significantly negative until after 15 months of tightening.

The results in Figures 3 & 4 are supportive of the more important role of bank lending than money in the transmission mechanism. Also, they are consistent with the interpretation that bank lending itself is an instrument of monetary policy. The results were not sensitive to whether or not the data were seasonally adjusted or to the choice of monetary aggregate, M1 or M2.

One needs to fully appreciate the important implication of the exogeneity of bank loans together with their high explanatory power of

real variables. Bank loans are important not just because monetary policy affects real variables through loans. In addition, they have been under more direct influence of the BOJ--hence, the exogeneity. The BOJ uses both instruments--the call rate and window guidance-- to affect real variables.

Conclusions

The major findings of the present paper are the following. In its daily operations the BOJ's policy target has been the call rate. It has never targeted bank reserves. The call rate has been much more stable than the federal funds rate even for periods during which the Fed were targetting the funds rate. Because of this the stock of high powered money is an endogenous variable.

The BOJ stabilizes the call rate by using "defensive" operations extensively, which accommodates movements in the shortage/surplus of funds. Although the BOJ also fully accommodates changes in the demand for bank reserves at the monthly level, it carries out "dynamic" operations at the daily level to change the target level of the call rate. Changes in BOJ lendings at the discount window is an important instrument for this purpose.

The possibility of the existence of a more direct control of the call rate by the BOJ has also been pointed out. In some periods the BOJ had quoted the call rate either directly or indirectly at the same time preventing arbitrage between markets by moral suation. The importance of such non-market oriented control of the call rate and the change in importance over time need to be more carefully studied.

Bank loans play an important role in the transmission of monetary policy in Japan. We find stronger support of the credit view for Japan than for the U.S. The interpretation of this finding, however, involves

more than just pointing out that monetary policy affects the real sector through its effect on bank loans.

The call rate is not the best indicator of monetary policy in the sense of being the best predictor of the real sector of the economy. Monetary aggregates and loans also predict real variables fairly well. However, the call rate and bank lending cause other monetary indicators in the Granger sense. This is plausible because the BOJ uses window guidance to control bank lending directly at times of monetary tightening.

Abstracting from daily operations, we may say that the call rate and bank lending are the instrument of monetary policy in Japan.[16] Changes in these will create changes in other interest rates and monetary aggregates, in turn moving real variables.

Footnotes:

1. See, for example, Roosa [1956] for "defensive" and "dynamic" operations.

2. The reason for central bankers' aversion to interest rate volatility is a question yet to be answered in the literature. But it has played a major role in daily operations of many central banks. In the U.S.-Japan context, there is more aversion on the part of the BOJ as the following analyses reveal.

3. Spindt & Tarhan [1987] show that discount window borrowings respond in this sense to fluctuations in other items. They show, for the 1979-82 period, that changes in money, which creates change in TR, cause discount window borrowings in the Granger sense.

4. See Menlendyke[1985] for a more careful, historical review of the Fed's operating procedure.

5. See, Okina [1991], for a more careful description of the Japanese short-term money markets. The report of the committee on Japanese money markets [1990] discusses other institutional problems, including the effects of taxatin in money markets.

6. Interestingly, more than all reserves are borrowed; that is, non-borrowed reserves are regative in Japan. In 1990 reserves were about 4.9 trillion yen while BOJ lendings stood at 6.3 trillion yen.

7. Royama [1971] is one of the first to point this out. Although the interbank rate being higher than the discount rate is the same in the U.S., private banks may borrow at its initiative from the Fed in the U.S. while this is not the case in Japan.

8. Bryant [1990] makes a similar observation.

9. For the period of 1967-87, excess reserves are, on average, 1.225% of required reserves in the U.S, while 0.142% in Japan. It is possible, though, that this near absense of excess reserves is a result of passive

accommodation of reserve demand by the BOJ.

10. Bernanke & Blinder offers similar evidence for the U.S. using weekly data for the period of funds rate control.

11. Operations in the bill market are not "open". That is, the BOJ picks up a bank with which it trades bills. In this sense operations in the bill market are close to discount window lendings.

12. See, for example, Kanzaki [1988] and Suzuki, Kuroda & Shirakawa [1989] for a more detailed description of this process.

13. Many have discussed what may happen if the interest elasticity of high powered money was zero. In that case one could argue that the BOJ may not be able to change the call rate because it cannot change the stock of high powered money. Private banks may just as well wait until the BOJ supplies enough reserves, making changes in the reserve progress ratio an ineffective tool of monetary control.

Some (Suzuki [1980] & Okina [1987], [1991]) have pointed out the high costs of discount window borrowings at close to the end of a reserve accounting period as an important vehicle for the control of the call rate. For example, the BOJ may charge two days of interest (at the discount rate) for a 24 hour borrowing from the discount window on the last day of the accounting period. In such a case the daily interest rate is double the usual discount rate and easily exceeds the call rate. Market participants point out another form of penalty for private banks not taking enough funds in interbank markets. (See Ueda & Uekusa [1988]. The penalty is calling off of discount window lendings. Since BOJ lendings are at a subsidized rate (that is, lower than the call rate), such banks would lose part of the subsidies they receive from the BOJ. The BOJ does not have to impose these penalties all the time. It suffices to create an expectation of such a possibility by using the penalty out

once in a while.

These are interesting arguments but rely on special features of the current reserve accounting system such as absence of a carry over procedure or lagged reserve accounting and/or the discount rate being lower than the call rate. Moreover, the issue itself disappears if the interest rate elasticity of high powered money is nonzero as shown in Table 4.

14. However, even as of early 1991, market participants admit that there is guidance by the BOJ and the Ministry of Finance as to the proportion of funds they can supply to the non-collateral call market relative to the collateral market.

15. The practice of the BOJ setting the call rate indirectly--the Kehaichi-sei--remained for the collateral rate until November 1990. But the difference in the volatility of the call rate before and after November 1990 is very small.

16. At the end of June 1991 the BOJ announced that it will not use window guidance again. The implication of this decision for the conduct of the BOJ's monetary policy is a topic for future study.

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Table 1, The Fed's Balance Sheet

Assets	Liabilities
BL (discount window lendings)	R (member bank deposits)
S (security holdings)	VC (vault cash)
FL (float)	CU (currency held by the public)
NA (net other assets)	DG (treasury deposits)

Table 2 The Volatility of Daily Interest Rates

	period	interbank rate	3-month rate	long-term rate
U.S.	77-91	.523 (.466)	.221	.143
	77-79	.211 (.159)	.180	.0581
	79-82	.841 (.738)	.402	.239
	82-91	.437 (.400)	.111	.112
Japan	78-91	.139	.0725	.121
	78-79	.125	.047	
	79-88	.147	.0801	.136
	88-91	.102	.0254	.0877

Notes: 1, Entries are the variance of deviations of each rate from its centered moving average with 10 observations on each side.

2, Interest rates are:the federal funds rate, TB rate, and 7-year bonds rate for the U.S. and the call rate, CD rate, and 10-year bonds rate.

3, Precise dates are:77/1/1-79/10/7,79/10/8-82/10/22, 82/10/24-91/2/11 for the U.S.;78/1/1-79/4/30,79/5/1-88/10/31,88/11/1-91/2/14 for Japan.

4, Entries in parentheses are calculated by excluding Wednesday observations.

Table 3 The Volatility of Currency in Circulation

	Japan	U.S.
seasonally adjusted data	$3.0*10^{-4}$	$7.5*10^{-6}$
unadjusted data	$5.6*10^{-3}$	$8.0*10^{-5}$

Notes: 1, Entries are the variance of the monthly rate of change in the currency in circulation.

2, The sample period is 1967-90 for the U.S. and 1963-90 for Japan.

Table 4 Interest Rate Elasticities of the Components of High Powered Money

	Japan	U.S.	
CU	-.0014	-.00097	IP
	-.0022	-.000516	C
TR	.0032	-.0013	IP
	$-.62*10^{-4}$	$-.62*10^{-3}$	RR

Notes: 1, Equations estimated are, for example, the log of CU on a constant, the call (or funds) rate, the log of an activity variable and the lagged dependent variable. CU is currency in circulation and TR is total reserves, including vault cash, both deflated by CPI. Entries are short-term (semi) elasticities.

2, The last column shows the activity variable used. IP: index of production, C: sales of department stores deflated by CPI, RR: required reserves deflated by CPI.

3, * means insignificance at the 5% level.

4, Sample period of estimation is the same as in Table 4.

Table 5, Discount Window Lendings and Interbank Interest Rates

	SMPL	LHS Variable	RHS Variables	
(1)	1967:1-87:12	Log(BL/p)	$.257*i_f$ - $.171*i_d$ (2.19) (-1.00)	k=.867 (28.4)
(2)	1966:11-89:10	i_c	$.792*i_d(-1)$ - $1.50*(BL/H)(-1)$ (11.2) (-2.56)	k=.949 (55.1)
(3)	1966:11-89:10	$d(i_c)$	$.667*d(i_d)(-1)$-$.216*d(Log(BL(-1))$ (9.13) (-3.56)	k=.0884 (1.46)

Notes:1, Constant terms were also included in the equations.

2, Numbers in parentheses are T-statistics.

3, Equation (1) is estimated by Fair's method using the log of real non-borrowed reserves as an instrument.

4, Equations (2) and (3) uses the maximum likelihood method to correct for serial correlation. k is the estimated coefficient of the first order serial correlation ofthe error term.

5, i_f:federal funds rate.

i_c:call rate.

i_d:discount rate.

p: index of CPI.

H: stock of high powered money.

BL:Borrowings at Central Bank.

Table 6 Chronology of Regulations on Interbank Rates

period	regualtions	Variance
1948/1-55/7	The BOJ set guidance rates for the call rate at levels not higher than the maximum indicated in "The Temporary Law for Interest Rates Adjustment"	
55/8-57/6	Guidance rates were abolished.	4.18
57/7-67/8	Private banks (under the strict guidance of the BOJ) set the "jishuku" rate.	0.31
67/9-79/4	Call loan dealers, in consultation with the BOJ,set "tatene" for the call rate daily, and announce it to market participants.	0.17
79/5-88/10	Interbank rates are set daily by the BOJ and dealers announce it as "kehaichi"	0.20
88/11-	The new monetary control regime has been introduced. But the "kehaichi" system for the call transactions with collateral remained until 90/10.	0.04

Notes: 1, The first and second columns are from Horiuchi & Kato[1989]. (Translation by the present author.)

2, The third column shows the variance of monthly changes in the unconditional call rate with collateral.

Table 7 Predictive Poweres of Monetary Indicators in Bivariate Regressions with Index of Production

data	seasonal adjustment	depend. variable	H	M1	M2	L	IC	SMPL
av.	y	level	y	y	y	y	y	1
			y	.	y	.	.	2
av.	y	f.d.	.	.	.	.	y	1
			y	.	.	.	.	2
av.	dummy	level	y	y	.	y	.	1
			.	.	.	.	.	2
av.	.	annual change	y	y	.	.	.	1
			.	.	.	.	.	2
eop.	y	level	.	.	y	.	y	1
			.	y	y	.	y	2
eop.	y	f.d.	.	.	.	.	y	1
			.	y	y	.	y	2
eop.	dummy	level	.	.	.	.	.	1
			.	.	.	.	.	2
eop.	.	annual change	.	.	.	.	.	1
			.	y	y	y	.	2

Notes to Table 7:

1, av.:average of daily data, eop.:end of period.

2, Dummy for seasonal adjustment implies inclusion of monthly dummies as independent variables.

3, The dependent variable is the log of the index of production plus the log of CPI. In level, the regression included linear time trend. F.D. means the log difference. Annual change indicates the log annual change. Money supplies are also differenced in the same way. 12 lags were used for all dep. and indep. variables.

4, y indicates significance at the 5% level. 1:1969/1-79/4. 2:79/5-89/10.

Table 8 Marginal Significance Levels of Monetary Indicators for Forecasting Index of Production

data	seasonal adjustment	depend. variable	H	M1	M2	L	IC	Period
av.	y	level	.012	.093	.212	.120 **	.165	1
			.008	.103	.009	.012 **	.030	2
av.	.	annual change	.147 *	.045	.242	.646 *	.564	1
eop.	y	level	.010	.010 *	.011 *	.795	.002	1
			.467	.115	.009	.030 **	.021	2
eop.	.	annual change	.501	.097	.011 *	.277 *	.116	2

Notes: 1, Regressions in this table include 12 lags of all the monetary indicators. Results are shown only for those cases in which more than one indicator was significant in Table 8 and at least one indicator was siginificant when all indicators were included.

2, * indicates the indicator had the highest explanatory power in terms of variance decomposition either in the order appearing in the table or the reverse. ** indicates highest explanatory power in both decompositions.

Table 9 Granger Causality Among Monetary Indicators

	M1	M2	H	L	IC
M1	...	n,n	n,y	y,y	n,y
M2	n,y	...	n,y	y,n	n,y
H	y,y	y,n	...	n,n	y,y
L	n,n	n,n	n,n	...	n,n
IC	y,n	n,n	n,n	n,n	...
M1	...	n,y	n,y	n,y	n,y
M2	n,n	...	n,y	n,y	n,y
H	n,n	n,n	...	n,n	y,n
L	n,n	n,n	n,y	...	n,n
IC	n,n	n,n	n,n	n,n	...

Notes: Entries indicate significance in the Granger sense in the regression of a row variable on the column variables. y indicates significance at the 5% level, and n insignificance. The upper half uses average of daily data, while the lower half, end of month data. The sample is 69/1-79/4 for the first half of the paired entry and 79/5-89/10 for the secon half. Regressions included 12 lags of each and a time trend. Monetary aggregates were seasonally adjusted.

Figure 1 Tegata & CD rates

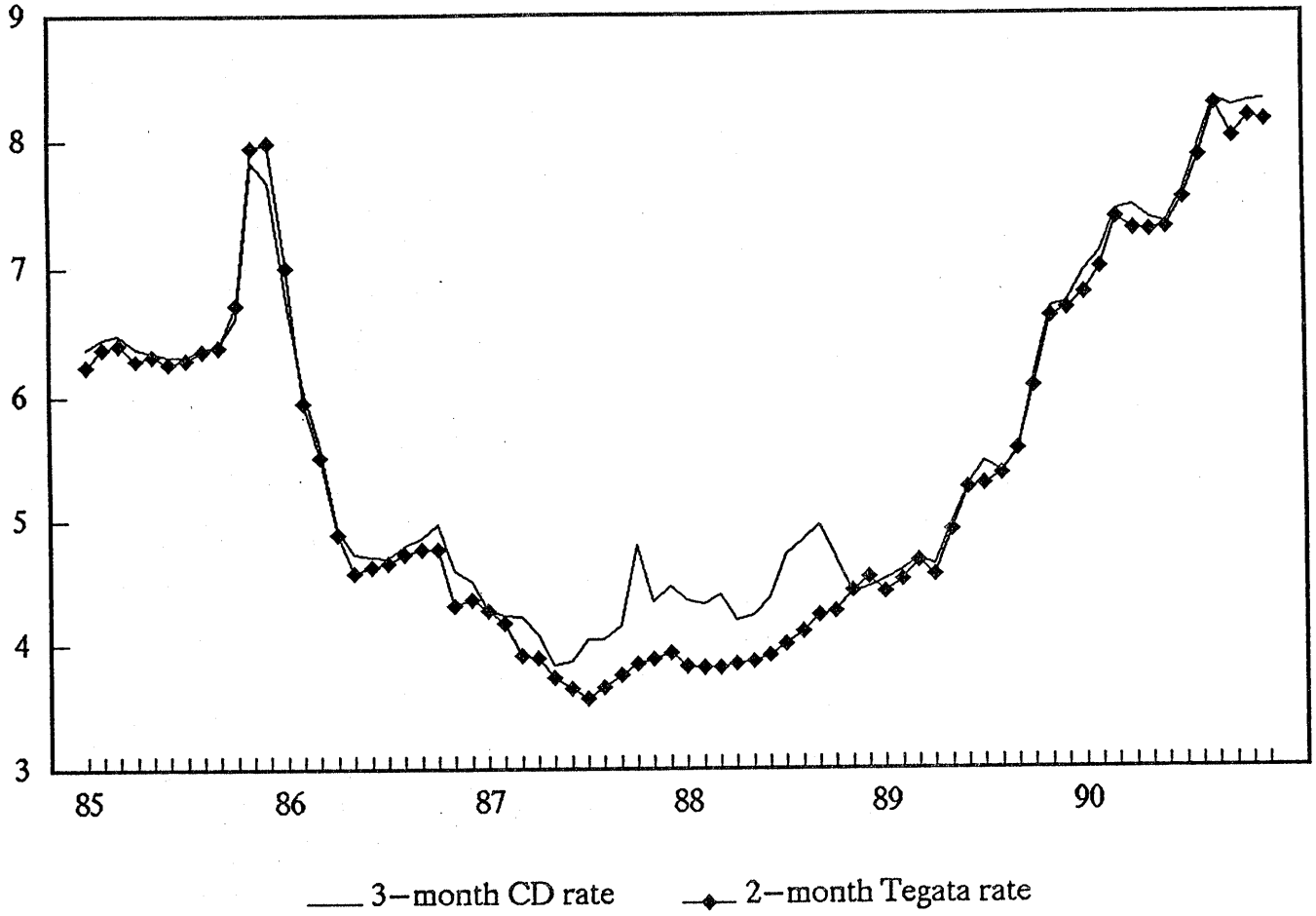

Figure 2

SCHEMATIC DIAGRAM OF THE CONDUCT OF JAPANESE MONETARY POLICY

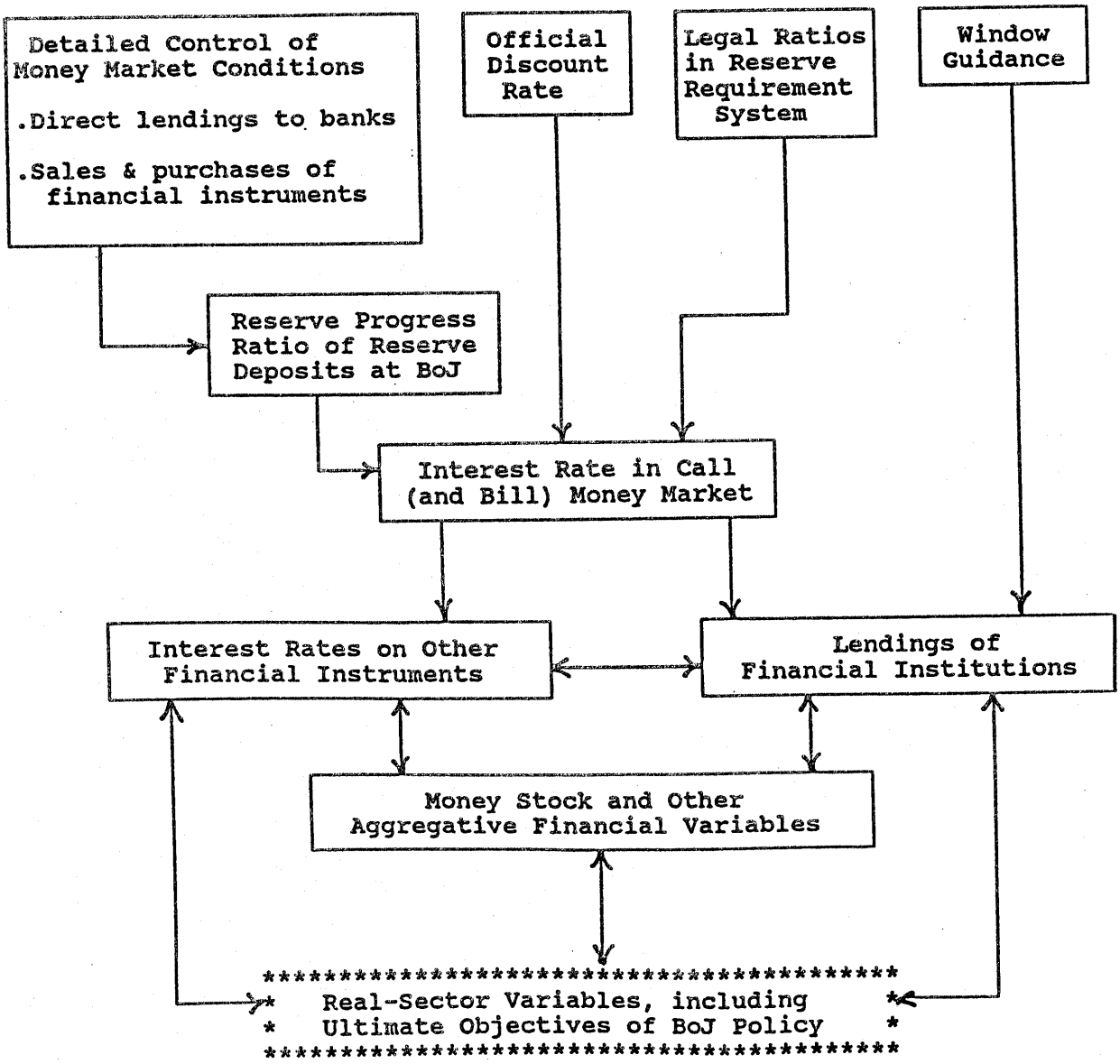

Figure 3, Average Forecast Errors for

Money and Lending After Tightening

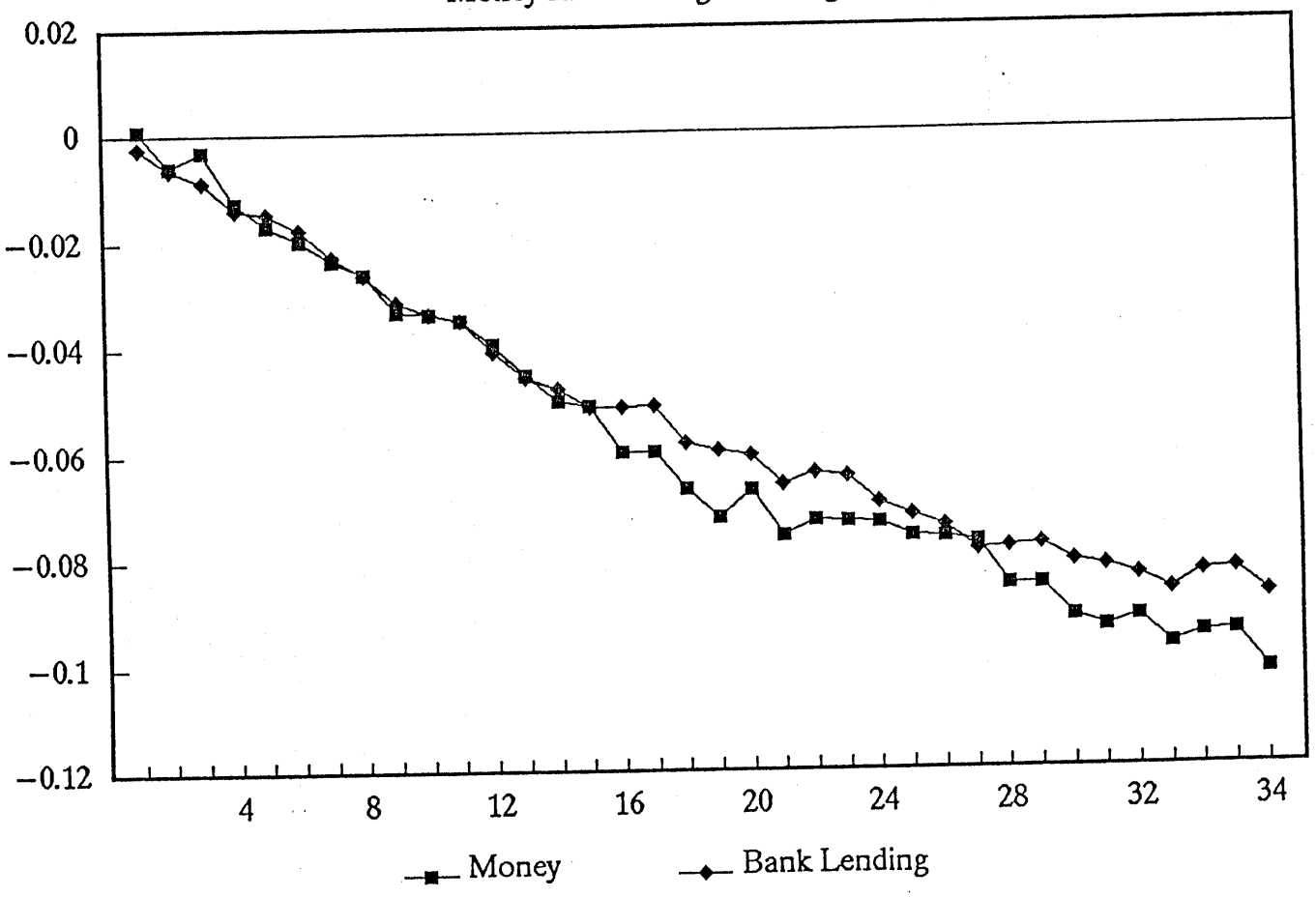

Figure 4, Average Forecast Errors

Given Actual Path of Production