Internationales Asienforum, Vol. 11 (1980). No. 3/4, p. 337-356

# THE CALL MARKET AND THE MONEY SUPPLY PROCESS IN JAPAN

Kazumasa Iwata and Koichi Hamada

## I. INTRODUCTION

This paper is designed to formalize a model which explores the role of the call market in the transmission mechanism of monetary policy under the special features of the Japanese financial system, incorporating the supply behaviour of money into the model.

The call market operates as one of the most important short run money markets where banks accommodate the need for bank reserves. The call rate has been regarded as one of the few interest rates which are relatively freely determined in the market, compared with other legally regulated or cartelized interest rates. It is sometimes pointed out that in Japan even the call market is under the influence of various interventions by the monetary authorities, especially after 1965 when substantial amounts of government bonds have been floated for the first time after the war. It should be, however, noticed that the call rate displays quite flexible movements, corresponding to the demand and supply conditions in the market, together with the rate of bond trading with repurchase agreement among non-financial business enterprises.

The important role of the call market in the transmission process of monetary policy in Japan has been initially stressed by Suzuki (7) who pointed to the flexible changes in the call rate highly sensitive to the central bank actions. He assigned a crucial role to the movements in the call rate in evaluating the effectiveness of monetary policy in Japan during the post-war period, in contrast with the widely held view that the moral suasion exercised by the Bank of Japan has been the major monetary instrument in relation to bank lendings, especially city banks' lendings.

In line with this view initiated by Suzuki, this paper elaborates the interrelationship between policy actions and the determination of the call rate, drawing attention to the institutional characteristics peculiar to the Japanese financial system. In constructing the model, the paper describes the supply behaviour of money, thereby focussing on the attainment of equilibrium in the bank reserve market.

It is usual to derive the supply behaviour of money from the interaction of the impacts of central bank actions and the portfolio adjustments of the banking sector and the public; the supply of money depends on the demand for and supply of various assets. There are, however, alternative ways to incorporate portfolio behaviours of banks and the public into this supply process of money. Recent empirical studies by Meigs (1), Goldfeld (2) and Cooper (3) center on the free reserve or borrowings from the central bank and the excess reserve, and are taken into the monetary sector model of large econometric models such as the Brookings-Model and the FRB-MIT-PENN-Model. This theory of money supply presumes that the deposit supply is derived through the attainment of equilibrium in the money market which is mainly related to bank reserves.

On the other hand, Friedman provided a reduced form framework which gives equilibrium stock of money as a function of policy variables and exogeneous variables to both financial and real sectors. We call this framework a reduced form because this formula is derived after solving all the structural equations in the financial and real sectors simultaneously. This theory presumes equilibrium stocks of various assets in describing the supply behaviour of money. Brunner/Meltzer formulated the credit market theory of money supply which is different from Friedman's approach in assigning to the credit market a central position in the money supply process. According to this theory, the stock of money and interest rates on the credit market are simultaneously determined through the interaction of bank's demand for earning assets and the public's portfolio adjustment.

The free reserve theory of money supply mentioned above specifies the structural equation explicitly and constructs a short run theory of money supply, compared with monetarists' long-run theory. The difference between them seems to lie in the ceteris paribus assumptions about portfolio adjustments of banks and the public. In order to take into account the specific features of the Japanese monetary policy and financial system, we adopted a structural approach rather than a reduced or semi-reduced form framework so that we can analyse the short-run adjustments of bank reserves and their related market. When dealing with the problem of money supply, it is necessary to consider the public's demand for cash currency and deposits which merges in the supply process of money. In order to focus on the call market, we handle this subtle problem by assuming that the public's cash currency is entirely determined by the demand of the public. Though we realize that the demand for currency and deposits plays an important role in the supply process of money, we concentrate on the determinants of deposits supply.

In the following section, we shall formalize the demand for and supply of call money under additional constraints imposed by the central bank, assuming that deposits are given to the banking sector. In the next section it is shown that the deposits supply is determined through the attainment of equilibrium of the excess reserve and call money. Instead of centering on the demand for free reserves, we focus on the demand for and supply of call money. Then we shall evaluate the effects of various monetary instruments of the central bank and derive some interesting implications for the effectiveness of monetary policy in Japan. Lastly, we shall test the hypotheses obtained in this way with an econometric model and examine the empirical results.

## II. THE DEMAND FOR AND SUPPLY OF CALL MONEY UNDER ADDITIONAL CONSTRAINTS

In order to construct a theoretical framework to analyse the transmission mechanism of monetary policy in Japan, we formalize a rational banking behaviour under institutional constraints. According to the traditional theory of commercial banking, banks are supposed to maximize their profit (or expected profit) under the balance sheet requirements and the legal reserve requirements for deposits. In Japan, however, it is more appropriate to formulate the banking behaviour as "profit maximizing under additional constraints", since some of the monetary instruments of the central bank take the form of quantitative constraints; they are a quantitative restriction on the Bank of Japan's credit to the commercial banks, especially to the city banks, and a ceiling on the increase in commercial loans.

We start from the balance sheet of a bank as follows:

(1) $R_i + L_i = (CM_i - CL_i) + B_i + D_i$

The notations are used as follows:

$R_i$: Reserves (currency held by bank and bank's deposit at central bank)

$L_i$: Discounts, loans and securities held by bank

$CM_i$: Liabilities in the call market and the private bill market, including the borrowing from other financial institutions

$CL_i$: Loans in the call market and the private bill market, including loan directly supplied to other financial institutions

$B_i$: Borrowing from central bank

$D_i$: Deposits at bank

and i indicating i'th bank.

As in other countries, the Japanese commercial banks are under the restraint of legal reserve requirements for deposits. It is often maintained that during most years of the postwar period they were in a so-called "over-loan" position, and the excess reserve of the commercial banks consists of working balance which is prepared to meet deposits drains: it depends only on deposits. But even if banks' demand for excess reserve is the need for transaction balance, it is considered to be inversely related to the interest rate of the money market[1].

$$(2)\quad R_i = RR_i + RE_i = kD_i \geqq qD_i$$

where $k = q + e\ (rc)$, $e' < 0$

We denote q and rc as required reserve ratio and the call rate respectively.

Let us define $F_i(L_i)$ as the earnings resulting from loans and security-holdings net of the cost involving in handling them. More precisely, if we denote rl as the interest rate for earning assets and $h_i\ (L_i)$ as the handling cost in the management of earning assets, the net revenue function of earning assets can be written as:

$$F_i(L_i) = rlL_i - h_i(L_i)$$

It is assumed that the interest rate for earning assets is either constant or a decreasing function of $L_i$, and the handling cost has properties as follows:

$$h'(L_i) > 0\ ,\ h''_i(L_i) > 0$$

Therefore $F_i(L_i)$ has properties such as

$$F'_i(L_i) > 0\ ,\ F''_i(L_i) < 0$$

where

$$(3)\ F'_i(L_i) = rl - h'_i(L_i)$$

In the conventional theory of commercial banking, banks are assumed to maximize their profit under constraints (1) and (2).

$$(4)\ \pi = F_i(L_i) - rc\ (CM_i - CL_i) - rdB_i - G_i(D_i) - rc\ (k-q)\ D_i$$

where rd indicates the discount rate of the central bank.

$G_i(D_i)$ is defined as the cost of collecting deposits including the interest payments on them, and has properties as follows:

$$G_i'\ (D_i) > 0\ ,\ G''_i(D_i) > 0$$

Further it is assumed that the amount of deposits is exogeneously given to commercial banks.

Due to the quantitative restrictions on borrowings from the central bank and the ceiling on the increase in bank loans, the Japanese commercial banks are supposed to maximize their profit under additional constraints. Concerning borrowing from the central bank, some authors argue that the amount of borrowing from the central bank is almost passively supplied, since the Bank of Japan has only limited ability to control this amount. However, if one observes the fact that the call rate exceeds the discount rate substantially during most years of the postwar period, we can see that some quantitative constraints must be effectively working on the maximum amount of borrowing (from the central bank) each commercial bank can obtain. Otherwise it could gain more profit by borrowing more credit from the Bank of Japan instead of increasing the liabilities in the call market. If not so, the commercial bank's behaviour contradicts to the hypothesis of profit maximizing behaviour assumed in this paper.

In the United States it is often maintained that the normal commercial bank hesitates to borrow from the central bank, since the bank does not want to be under the administrative guidence of the central bank. This assumption is not well-suited to the Japanese situation, where the city banks are almost permanently dependent on borrowings from the central bank.

As long as we adopt the above mentioned profit theory, it is appropriate to assume that the quantitative constraint on borrowings from the central bank is effectively working. And this quantitative constraint actually working is considered not to be the formal maximum credit limit, but a *de facto* one, because the formal credit ceiling has been never reached and on average only 70 to 80 per cent of the credit ceiling is actually allowed to each bank.

In our earlier study (EPA, 1975) we have distinguished three types of methods determining the actual limit on the Bank of Japan's credit to each bank. We concluded that the aggregate limit on the central bank credit is determined first and then is allocated to each bank in proportion to its scale (such as its total deposits). In this case, a maximum limit on the credit of the Bank of Japan is exogeneously determined to each bank and is not considered to be functionally related to the short-run behaviour of the commercial bank. Therefore, we can regard borrowing from the central bank as policy-determined (except, probably, for the period of easy monetary policy when the balance of payments had turned into surplus and the commercial bank began to repay borrowings to the central bank). We can write this restraint as follows:

(5) $B_i \leq \bar{B}_i$

Another constraint is the ceiling on the increase in bank loans. In our static model this constraint can be expressed as

(6) $L_i = \bar{L}_i$

When no additional constraints are imposed on commercial banks they try to maximize their profit subject to the restraints (1) and (2). The marginal conditions are given as

(7) $F'_i(L_i) = rc$

(8) $rc = rd$

But when the central bank credit is quantitatively limited, we can obtain equation (8)' instead of (8).

(8)' $rc - rd = \lambda$

where $\lambda$ is the Lagrange multiplier attached to the limitation on the central bank credit. This multiplier indicates that the profit of a bank will increase by rc-rd, if the limitation on the central bank credit is relaxed by a unit; then the bank will substitute borrowings from the central bank for call money.

If the ceiling on the increase in bank loans is effective in addition to this constraint on borrowings from the central bank, we obtain equation (7)' instead of (7).

(7)' $F'_i(L_i) - \mu = rc$

where $\mu$ is the Lagrange multiplier attached to the constraint (6).

There was a controversy between Tachi and Suzuki concerning the relative effectiveness of these two constraints as monetary instruments of the Bank of Japan[2]. The former stressed that the ceiling on the increase in bank loans was dominantly effective as a weapon of Japanese monetary policy during the postwar period, while the latter emphasized the role of the call rate which is strongly influenced by the quantitative limitation on the central bank credit; the stronger the limitation on borrowings from the central bank, the higher the call rate will be, which will affect the loan supply of both city banks and local banks substantially.

If these Lagrange multipliers were measurable, we can decide on which of these instruments was more effective. In reality, however, we do not have such shadow prices, since the handling cost of earning assets is not easy to calculate, and the term structure between various interest rates should be suitably taken into account in measuring these shadow prices[3].

So far we have treated the banking sector as a whole. In order to analyse the call market, it is however necessary to divide the banking sector into two groups, taking into account the specific structures of the Japanese financial system such as:

(a) Almost only the city banks are entitled to borrow from the Bank of Japan. The city banks are located in large cities and thus have more ample opportunity for lending than local banks and other financial institutions.
(b) The quantitative restriction on the increase in bank lending was imposed exclusively on city banks until the most recent restrictive monetary policy period.
(c) City banks are dominant demanders of call loan, while local banks and other financial institutions are suppliers of call loans.

From the marginal conditions (7) we can derive the loan supply function of a bank:

(9) $L_i^s = L_i^s\,(rl - rc)$ or $L_i^s = L_i^s\,(rl - rc,\ D_i)$

if we take into account the scale factor of loan supply.

When the constraint on the increase in city bank loans is effective, the loan supply of the city banks is, of course, exogeneously determined by the central bank.

(9)' $L_i^s = \bar{L}_i^s$

The net demand of city banks for call loan can be obtained from equations (1), (2) and (9):

(10) $CM_i^e = CM_i - CL_i = L_i^s - (1-e-q)D_i - B_i$

The net supply of call loan of local banks and other financial institutions is expressed as:

(11) $CL_j^e = CL_j - CM_j = (1-e-q)D_j - L_j^s$

In July 1971, the discount markets were separated from the call market, and the Bank of Japan began to operate in this market. If we integrate the discount markets into the call market, we can write the market clearing equation for the call market including the discount markets as follows:

(12) $\sum_i CM_i^e = \sum_j CL_j^e + \bar{C}$

where $\bar{C}$ is the net amount of private bills bought by the Bank of Japan. This source of the monetary base is now taking the place of borrowings from the central bank.

## III. DETERMINANTS OF DEPOSITS SUPPLY

We propose here to explore the supply behaviour of deposits, thereby specifying the demand and the source of bank reserves. As was assumed in section II, the banks' demand for reserves can be divided into required reserves and excess reserves, where the latter depends on interest rates, while the source of reserves is composed of borrowed and unborrowed reserves. Borrowed reserves are made up of the borrowing from central bank and call money including private bills sold to other banks and the central bank:

$$(13)\quad R_i = BR_i + UR_i = [B_i + (CM_i - CL_i)] + UR_i$$

As for the components of unborrowed reserves, we must turn to the source of the monetary base which is obtained by integrating the balance sheets of the central bank and the government sector:

$$(14)\quad R + C^p = FA + (S^c - \bar{S}) + B + \bar{C}$$

Here the notations are used as follows:
FA: Foreign assets held by monetary authority
$S^c$: Government securities held by the central bank
$\bar{S}$: Net securities issued by government
$C^p$: Cash currency held by the public

Summing up equation (13) over the whole banking sector, we have the following relationship between unborrowed reserves and the components of the monetary base:

$$(15)\quad \sum_i UR_i = FA + (S^c - \bar{S}) - (\sum_i CM_i - \sum_j CL_j - \bar{C}) - C^p$$
$$= FA + (S^c - \bar{S}) - C^p$$

From (15) it can easily be seen that the unborrowed reserves fluctuate through the variation of the public's demand for currency and the other sources of monetary base when the equilibrium is attained in the call market in a wider sense. From the viewpoint of a bank, the unborrowed reserve is reduced if the deposits are drawn because of the increased public demand for currency, or if the Bank of Japan makes selling operations of government securities, or if the surplus of balance of payments is decreased. The Bank of Japan thus can influence the amount of unborrowed reserves through the market operations of government securities directly. But whether the market operations can dominate the movement of unborrowed reserves remains an unsettled question, since the marketable securities are fairly thin to make large enough operations in order to offset the movements arising from other determinants of unborrowed reserves. The government securities are neither attractive as an earning asset (because their interest rates are regulated at a low level) nor have any merit as a liquidity asset (because the market operations are made on face to face negotiations between the Bank of Japan and the commercial banks). However, even if the Bank of Japan failed to control the unborrowed reserves, other weapons are left: a quantitative restriction on the Bank of Japan credit and the market operations of private bills. The total reserves of city banks are directly influenced through the management of these weapons, while those of local banks are indirectly affected by the increase of the call rate. The rise of the call rate induces local banks to increase the call loans to city bank who cannot borrow from the central bank any more and seek to increase liabilities in the call market. So much for the determinants of the source of bank reserves. Deposits supply is derived through the interplay between supply and demand for bank reserves. From equations (2) and (13), we have the following condition for the equilibrium of bank reserves

$$kD_i = (k-q)D_i + qD_i = BR_i + UR_i$$

$$(16) \quad D_i = \frac{1}{q}(BR_i + UR_i - RE_i) = \frac{1}{q}\left[B_i + (CM_i - CL_i) + UR_i - RE_i\right]$$

When handling the total money supply (cash currency held by the public plus deposits at banks), it is necessary to draw attention to the movements in the ratio of the public's demand for currency to the demand for deposits. The change of this ratio influences the supply behaviour of money substantially, as we indicated elsewhere. In this paper we have treated the public's demand for currency as an exogeneous variable which influences the unborrowed reserves of the banking sector. The public's demand for currency enters into this supply process of deposits as one of the determinants of unborrowed reserves.

## IV. EFFECTS OF MONETARY POLICY

Let us assume a representative city bank and a representative local bank such as a Marshallian representative firm. Then we can treat the banking sector as if it consisted of one city bank and one local bank and we can write the balance sheets of these representative banks as follows:

$$(17) \quad R + L = CM^e + B + D \qquad \text{city bank}$$

$$(18) \quad R^* + CL^e + L^* = D^* \qquad \text{local bank}$$

By adding up together (17) and (18), we can obtain:

$$(19) \quad L + L^* = B + (CM^e - CL^e) + D + D^* - R - R^*$$
$$= B + \bar{C} + D + D^* - R - R^*$$

namely

(19)' $L + L^* = B + \bar{C} + (1-q-e)(D + D^*)$

whereby we assume that the values of q and e are the same for city and local bank and disregard the compensation balance for the sake of simplicity. The obtained results on qualitative assessments would not be affected by dropping these assumptions.

In the following we shall analyse the policy effects on the banking behaviour and the call rate by differentiating two cases: the former handles the policy effects when only the limitation on the central bank credit is effective, while the latter examines the policy effects when not only the limitation on borrowings from the central bank but also the quantitative restriction on the lending of the city banks is effective.

Case I

Even if the limitation on the central bank credit is effective ($B = \bar{B}$), the marginal net revenue from lendings of the city bank is equal to that of the local bank:

(20) $F'(L) = F'^*(L^*) = rc$

Through the total differentiations of (19)' and (20) with respect to L, $L^*$, $\bar{B}$ and $\bar{C}$, the following equations are derived:

$$dL + dL^* + e'(D + D^*)drc = d\bar{B} + d\bar{C} - (D + D^*)dg + (1-g-e)(dD + dD^*)$$
$$F''dL - drc = 0$$
$$F''^*dL - drc = 0$$
where $e' = de/drc$.

From these three equations, we can derive the impact of the central bank's lending policy as well as the operation on the private bill market on bank lending and the call rate:

$$\frac{dL}{d\bar{B}} = \frac{dL}{d\bar{C}} = F''^*/\Delta > 0$$

$$\frac{dL}{d\bar{B}} = \frac{dL}{d\bar{C}} = F''/\Delta > 0$$

$$\frac{drc}{d\bar{B}} = \frac{drc}{d\bar{C}} = F''F''^*/\Delta < 0$$

whereby $\Delta = F'' + F''^* + F''F''^*e'(D + D^*) < 0$

The increase in central bank lending and the buying operation on the private bill market make bank lendings expand while lowering the call rate. Similarly, the effects of changes in the required reserve ratio on the loan supply and the call rate can be shown as:

$$\frac{dL}{dq} = -F''^{*}(D + D^{*})/\Delta < 0$$

$$\frac{dL^{*}}{dq} = -F''(D + D^{*})/\Delta < 0$$

$$\frac{drc}{dq} = -F''F''^{*}(D + D^{*})/\Delta > 0$$

Compared with the results of the effects of $\bar{B}$ and $\bar{C}$ on the loan supply, the impact of the change in the required reserve ratio is shown to be in proportional relation to each other with opposite signs. The rise in the required reserve ratio leads to the rise in the call rate.

Case II

When the quantitative restriction on the lending of the city banks is effectively working, the amount of city banks' lending is fixed as $L = \bar{L}$ in the equation (19). Thus,

$$dL^{*} + e'(D + D^{*})drc = d\bar{B} + d\bar{C} - (D + D^{*})\,dq - d\bar{L} + (1-g-e)(dD + dD^{*})$$

$$F''^{*}dL^{*} - drc = 0$$

Accordingly,

$$\frac{dL^{*}}{d\bar{B}} = \frac{dL^{*}}{d\bar{C}} = -1/\bar{\Delta} > 0$$

$$\frac{drc}{d\bar{B}} = \frac{drc}{d\bar{C}} = -F''^{*}/\bar{\Delta} < 0$$

$$\frac{drc}{d\bar{L}} = F''^{*}/\bar{\Delta} > 0$$

whereby $\bar{\Delta} = -\left[1 + F''^{*}e'(D + D^{*})\right] < 0$

The last result implies that strengthening the restriction on city banks' lending tends to lower the call rate. In other words, the authorities are in a position to keep the call rate at a lower level by intensifying the restriction on city banks' lending.

Finally, the lending by local banks will increase by imposing the quantitative limit on city banks' lending: it will be, however, partly offset by the increased demand for excess reserves through the decline in the call rate:

$$\frac{dL}{d\bar{L}} = 1/\bar{\Delta} < 0$$

The net increase in local banks' lending does not exceed one. In any case, it is necessary to impose the quantitative limitation on the central bank credit in order to attain the aimed decrease in total loan supply, because the restriction on city banks' lending results in the expansion of lending by local banks.

Let us summarize the results obtained by comparative static analyses: (1) The quantitative limitation on borrowing from the central bank influences the credit supply of both the city bank and the local bank. The effect on loan supply is proportionally related to that of the change in the required reserve ratio. (2) The quantitative restriction on the city bank's credit works to increase the local banks' lending and to decrease the call rate. Therefore, it is necessary to impose the quantitative limitation on the central bank credit, in order for the Bank of Japan to make its monetary policy effective.

## V. EMPIRICAL RESULTS

Before we test and estimate the functions of the demand for and the supply of call money, we must incorporate the deposits supply relationship into (10) and (11), derived in section IV. To this end, we can rely on (16) and we can substitute for deposits from (16) and solve for $CM^e$ and $CL^e$:

(21) $CM^e = (q + e) L^s - (1-q-e)\ UR - B$

(22) $CL^e = -(q + e) L^{*s} + (1-q-e)\ UR^*$

In these equations we can regard the required reserve ratio and unborrowed reserve as exogeneously given to the banking sector. But borrowing from the central bank is not exogeneously determined when the limitation on this amount is not effectively working. In this case, the demand for borrowings from the central bank is considered to be a function of the discount rate and the market interest rates. Expectations such as factors as receipts and payments patterns and the term pattern of yields of earning assets would affect the demand for borrowings. It is postulated that the demand for borrowings would increase with increased call rate at a given discount rate, since the call money is a close substitute for borrowings from the central bank. As is assumed in section II, the demand for excess reserves, similarly, is expected to be a function of the market interest rates. Then it is easily shown that the call money is a decreasing function of the call rate, while the call loan is an increasing function of the call rate:

$$\frac{\partial CM^e}{\partial rc} = (q + e)\frac{\partial L}{\partial rc} - \frac{\partial B}{\partial rc} + \frac{\partial e}{\partial rc}(L + UR) < 0$$

$$\frac{\partial CL^e}{\partial rc} = -(q + e)\frac{\partial L^*}{\partial rc} - \frac{\partial e}{\partial rc}(L^* + UR^*) > 0$$

On the other hand, the effect of a change of the loan rate on call money or call loan is ambiguous, because an increase in the loan rate is supposed to reduce the banks' demand for excess reserves and increase the demand for borrowings from the central bank. Only if the effect of a change in the loan rate on loan supply dominates the other effects mentioned above, an increase of the loan rate induces an increase of the demand for call money[5]. It may be plausible to expect a positive (negative) effect of an increase of the loan rate on call money (call loan), if one takes into consideration the fact that the interest elasticity of excess reserves is small and borrowings from the central bank are almost always exogeneously supplied to each bank.

By linearizing the equations (21) and (22) with respect to the call rate and other exogeneous variables, we can obtain the basic equations for final specification as follows:

$$CM^e = A_o - A_1 rc + A_2 rl - A_3 UR + A_4 q$$

$$CL^e = B_o + B_1 rc - B_2 rl + B_3 UR^* - B_4 q$$

In order to incorporate the effects of quantitative constraints into this call money function, we adopt dummy variables attached to both quantities subject to constraints and interest rates: the quantitative constraints imposed on the central bank credit and the city bank credit affect the demand for call money not only through the quantities supplied directly, but also through changes in interest rates indirectly. Then we can have the linearized call money function under additional constraints as follows:

$$CM^e = A_o - \left[A_1 + A_2\,(1-DMB) + A_3\,(1-DML)\right] rc + \left[A_4 + A_5\,(1-DMB) + A_6\,(1-DML)\right] rl - A_7 UR - A_8 B\cdot DMB + A_9 q\cdot L^s\cdot DML + A_{10} q$$

As for dummy variables we have regarded the ceiling on the central bank credit as effective when the difference between the call rate and the discount rate is larger than 0.5 per cent. This criterion is of course arbitrary, but is is consistent with quantitative movements of borrowings from the Bank of Japan : whenever borrowings have been repaid by city banks, the difference has been almost less than 0.5 per cent[6]. And we have chosen the periods where the constraint on the loan supply of city banks was imposed from announcements of the Bank of Japan. The preliminary investigation on two dummy variables attached to the call rate disclosed that the coefficient multiplied by the dummy variable relating to the central bank credit has been always significant, while another coefficient in the bracket has proved to be insignificant. Hence we have deleted the dummy variable related to the latter constraint in the coefficients of interest rates from the equation specified above.

Moreover, in the actual estimation of two equations we have eliminated the loan rate both from the demand and the supply functions. This is because the loan rate in Japan shows substantial rigidities caused by close connection with the discount rate whose changes are closely related to the imposition of quantitative constraints and thus the call rate.

Finally, we come to the final specifications of the demand and supply function as follows:

$$CM^e = A_0 - \left[A_1 + A_2\ (1-DMB)\right] rc - A_3UR - A_4B\cdot DMB + A_5q\cdot L^s\cdot DML + A_6CM^e_{-1}$$

$$CL^e = B_0 + B_1rc + B_2UR - B_3q + B_4CL^e_{-1}$$

The results estimated by ordinary least squares are shown in Table 1. Firstly, we note that all the coefficients have the expected sign, and are fairly significant, except for the coefficient of the call rate not multiplied by dummy variable. This indicates the more effective function of price mechanism in the absence of quantitative constraints. At the same time it should be recognized that the coefficients of the call rate are most seriously subject to the simultaneous bias.

Secondly, we have picked up only local banks as suppliers of call loan. Recently, however, the share of call loan supplied by other financial intermediaries such as trust banks, mutual loan and savings banks, credit associations and credit federations of agricultural cooperations is increasing in the Japanese call market. But these financial institutions show substantially different behaviour in supplying the call loan from local banks, and hence we have eliminated the call loan supplied by these financial institutions.

Thirdly, we have normalized the variables by dividing both sides of equations by scale variables. As a scale variable we have chosen the total assets of city banks and local banks, respectively. But we observe that the residuals in both equations show a decreasing trend: it might be possible that the assumption of homoscedacisity is not tenable, even if we have normalized the variables. It is, therefore, necessary to examine whether the assumption of homoscedacisity is satisfied or not, according to the procedure proposed by Goldfeld/Quandt (10). We have divided the data into two subperiods and applied F-test to these equations. It is revealed that the assumption of homoscedacisity is clearly not satisfied in the call money function, while it is likely untenable in the call loan function. The work to re-estimate both functions by normalizing with suitable variables is left for further research.

Table 1: Call money and call loan estimates

(sample period 1955. 6 - 1974. 12)

(OLS)

$$\frac{CM^e}{TAC} = \underset{(2.94)}{0.004915763} - \left[\underset{(-0.61)}{0.00008173685} + \underset{(-3.71)}{0.0006840913}\,(1\text{-}DMB)\right] rc -$$

$$\underset{(-3.41)}{0.06824882}\,\frac{UR}{TAC} - \underset{(-3.53)}{0.08067061}\,\frac{B \cdot DMB}{TAC} + \underset{(4.15)}{0.002078535}\,\frac{q \cdot L^s \cdot DML}{TAC} +$$

$$\underset{(34.93)}{0.8899792}\,\frac{CM^e}{TAC\text{-}1}$$

$R^2 = 0.975$, $S = 0.0000084$, $DW = 1.92$

$$\frac{CL^e}{TAL} = \underset{(-11.10)}{-0.01936939} + \underset{(2.93)}{0.0002443068}\,rc + \underset{(14.08)}{0.564176}\,\frac{UR^*}{TAL} - \underset{(-4.99)}{0.0017563}\,q^*$$

$$+ \underset{(14.85)}{0.5145402}\,\frac{CL^e}{TAL-1}$$

$R^2 = 0.878$, $S = 0.0000056$, $DW = 1.70$

(TSLS)

$$\frac{CM^e}{TAL} = \underset{(3.09)}{0.009576164} - \left[\underset{(-1.91)}{0.00083226} + \underset{(-3.96)}{0.0006309732}\,(1\text{-}DMB)\right] rc -$$

$$\underset{(-3.34)}{0.05974698}\,\frac{UR^*}{TAC} - \underset{(-2.42)}{0.0516111}\,\frac{B \cdot DMB}{TAC} + \underset{(3.74)}{0.003448315}\,\frac{q \cdot L^s \cdot DML}{TAC} +$$

$$\underset{(38.33)}{0.9033899}\,\frac{CM^e}{TAC-1}$$

$R^2 = 0.975$, $S = 0.0000083$, $DW = 1.90$

$$\frac{CLe}{TAL} = \underset{(-10.93)}{-0.02107276} + \underset{(4.30)}{0.0005581372}\,rc + \underset{(14.11)}{0.5581372}\,\frac{UR^*}{TAL} -$$

$$\underset{(-5.86)}{0.002295861}\,q^* + \underset{(14.36)}{0.5038484}\,\frac{CL^e}{TAL-1}$$

$R^2 = 0.878$, $S = 0.0000056$, $DW = 1.72$

*) Monthly data are used

Fourthly, we have added a distributed lag to the equations estimated above. The coefficients of lagged variables seem to be much larger than we have expected, especially in the call money function. If a stochastic term shows a positive autocorelation, the coefficient of lagged variable will be over-estimated, while the other coefficients will be under-estimated.

Among various problems in estimating the equations, we can eliminate the simultaneous bias by adopting simultaneous estimating methods. Since the equations system is over-identifiable, it is appropriate to estimate the equations by two-stage least squares or limited information method. The results estimated by two-stage least squares method are shown in Table 1. Compared with the coefficients estimated by ordinary least squares, the coefficients of the call rate estimated by two-stage least squares are more significant and their t-values larger.

Firstly, as can be seen in the table, the empirical results are quite favourably in accordance with our hypothesis. We have here specified the structural equations of the demand and supply function of call money by taking into account the additional two constraints imposed on city banks by the central bank. The results obtained imply that the call rate fulfils its function to clear the demand and supply in the bank reserve market during the period under consideration, as is indicated in the significant coefficients attached to the call rate in the demand and supply equations based on a simultaneous estimation method, although the possibility that the central bank could intervene the market directly is not entirely excluded.

Secondly, it is explicitly shown that the additional constraints imposed on the city bank portfolio behaviour exercise the influence on the development of the call rate through direct quantitative restrictions and indirect impacts via interest rates. As regards the quantitative effects, both coefficients relating to borrowing from the central bank and the city bank lending, respectively, multiplied by dummy variables have been highly significant; this provides the evidence that the strengthening of restriction on the Bank of Japan credit causes the call rate to increase, while the ceiling on city bank lendings induces the reduction in the rate. Furthermore, it suggests that the effect of former constraint on city banks is transmitted through the increase in the call rate to local banks and other financial institutions. In other words, the loan supply behaviour of the banking sector as a whole can be considerably affected through the quantitative restriction on the central bank credit which is provided almost exclusively to city banks. Concerning the indirect impacts via interest rates on the demand for call money, only the coefficient of the call rate multiplied by the dummy variable (DMB) discriminating the period where the restriction on the central bank credit is supposed to have been effectively working has been significant: it can be inferred from this fact that the constraint on borrowing from the central bank has imparted much more important effects on the call rate, compared with the credit ceiling on city banks' lending.

Thirdly, we could not obtain clear assessments on the effects of changes in the loan rate on the call rate, partly due to the multicollinearity between two rates and partly due to the institutional rigidity in the Japanese loan market where the rate is strongly influenced by changes in the discount rate and the voluntary maximum ceiling on the loan rate among banks[7].

## VI. CONCLUDING REMARKS

In this paper we presented a model which formalizes the rational behaviour of the Japanese banking sector under additional constraints. We have derived the functions of the demand for and the supply of call money under these constraints, after making the deposits supply endogeneously determined. We have analysed the effects of these constraints on the banking behaviour, especially with respect to the call market, and have confirmed the hypotheses relating to policy actions and the call rate determination with the aid of an econometric model on the call market.

The Japanese call market transmits the effects of monetary policy of the Bank of Japan to local banks and other financial institutions which have not been directly influenced by moral suasion of the Bank of Japan until recently (1973). It is shown that it is always necessary to impose quantitative limitations on the Bank of Japan's credit to the city banks, in order for the central bank to make its actions through moral suasion (i. e. the quantitative restriction on the city banks' credit) effective, since this moral suasion works to reduce the demand for call money. The former restriction leads to the increase of the call rate which affects not only the loan supply of the city banks but also that of the other financial institutions; the empirical results give strong support to this proposition and suggest that the restriction on the central bank credit has been a much more important factor in determining the call rate.

In conjunction with this route of the monetary transmission process, the Bank of Japan seems to have adopted the call rate as an operational target, as well as bank lendings as an indicator of monetary policy. This combination of target and indicator variables seems to have been quite appropriate in controlling the monetary aggregate at least until the late 1960s, because the central bank credit constituted a dominant source of the monetary base, while bank lending dominated the movement in money supply. From the latter part of the 1960s, however, both credit to the government sector and foreign assets gradually increased their share in the source base. In particular, the accumulated foreign reserves associated with delayed adjustments of exchange rate seriously disturbed the conduct of monetary policy by the Japanese monetary authorities who were not well accustomed to the situation where city banks had not to rely on borrowings from the central bank and other financial institutions. After shifting the monetary indicator from bank lending to money supply (M2) since 1974, the Bank of Japan has strengthened its position and extended the ceiling on bank lendings to other financial institutions, in view of controlling the monetary aggregate.

The analysis undertaken implies that one can rely strongly on the market mechanism in attaining the desired level of the indicator variables, instead of (solely) depending on direct quantitative restrictions on the portfolio behaviour of the banking system.

Notes:

1) See, for example, Tobin (4). We have estimated the interest elasticities of excess reserves of city banks and local banks; the short-run elasticities are -0.122 and -0.140 and the long-run elasticities -0.439 and -0.257, respectively.

(City Banks) (Sample period: 1965.1 - 1974.12)

$$\log RE = \underset{(0.88)}{0.140670} - \underset{(-1.91)}{0.122471} \log rc + \underset{(3.13)}{0.186946} \log D + \underset{(10.49)}{0.720768} \log RE_{-1}$$

$\bar{R} = 0.921$, $S = 0.069264$, $DW = 2.28$

(Local Banks)

$$\log RE^{*} = \underset{(-3.81)}{-0.493024} - \underset{(-3.08)}{0.139574} \log rc + \underset{(6.11)}{0.507848} \log D^{*} + \underset{(5.34)}{0.456400} \log RE^{*}_{-1}$$

$\bar{R} = 0.972$, $S = 0.045471$, $DW = 2.04$

2) See Tachi (6) and Suzuki (7).

3) See Hamada, K., Iwata, K., Shimauchi, A., and Ishiyama, Y. (5).

4) We calculated proxy variables of these shadow prices in our earlier study, however the results have not fitted well in with prior assumptions. While the proxy variable of the shadow price attached to the limitation on the central bank credit conforms to our assumptions, the proxy variable of the shadow price attached to the restriction on the city bank credit shows unexpected movements: it rises during periods of easy money policy, and falls during periods of monetary restraint. This contradictory movement

of the shadow price attached to the restriction on bank loans is mainly due to a slow and institutional adjustment of the loan rate and unexpected movements of compensating balances of enterprise at commercial banks. Therefore, we could not get a clear-cut answer to this controversy even with the shadow price approach.

5) The partial derivatives with respect to loan rate can be shown to depend on the relative magnitude of interest rate elasticities of excess reserves and loan supply:

$$\frac{\partial CM^e}{\partial rl} = (q+e)\frac{\partial L}{\partial rl} - \frac{\partial B}{\partial rl} + \frac{\partial e}{\partial rl}(L + UR) \gtrless 0$$

$$\frac{\partial CL^e}{\partial rl} = -(q+e)\frac{\partial L^*}{\partial rl} - \frac{\partial e}{\partial rl}(L^* + UR^*) \gtrless 0$$

6) The level of call rate exceeds almost always that of the discount rate, except for 1955, which is regarded as a result of direct and indirect interventions by the Bank of Japan, preventing the call rate from being below the discount rate.

7) For more details about the determination process of the loan rate in Japan, see Hamada, K., Ishiyama, Y., and Iwata, K. (8).

References:

1. Meigs, A. J.: Free Reserves and the Money Supply, Chicago: University of Chicago Press (1962).

2. Goldfeld, S.: Commercial Bank Behavior and Economic Activity, Amsterdam: North-Holland (1966).

3. Cooper, J. Ph.: Development of the Monetary Sector, Prediction and Policy Analysis in the FRB-MIT-PENN Model, Lexington: Lexington Books (1974).

4. Tobin, J.: The Interest Elasticity of Transactions Demand for Cash, Review of Economics and Statistics (August 1956).

5. Hamada, K., Iwata, K., Shimauchi, A. and Ishiyama, Y.: Monetary Policy and Banking Behavior: The Role of the Bank of Japan Credit in Japan (in Japanese), Keizai Bunseki (July 1975). Economic Planning Agency, Economic Research Institute.

6. Tachi, R.: The Effectiveness of Monetary Policy, (in Japanese), Keizaigaku Ronshū (July 1965).

7. Suzuki, Y. : The Effects of Monetary Policy: Theory and Estimation of Banking Behaviors, (in Japanese), Tokyo: Oriental Economists (1966).

8. Hamada, K., Ishiyama, Y. and Iwata, K. : The Loan Market Structure in Japan, (in Japanese), Keizai Bunseki, (March 1976). Economic Planning Agency, Economic Research Institute.

9. Griliches, Z. : Distributed Lags: A Survey, Econometrica (January 1967).

10. Goldfeld, S. and Quandt, R. : Some Tests for Homoscedasicity, Journal of the American Statistical Association (June 1965).