A Study of Credit Rationing in Japan

by

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The existence of non-price credit rationing by financial institutions as a wide-spread empirical phenomenon has been debated in detail in the literature of recent years. This debate is, perhaps, due to theoretical research on the effectiveness of monetary policy with non-market clearing price and interest rate movements which suggests that such rationing may prove of substantial impact toward policy goals.[1/] Alternatively, it may be due to the continued interest in the customer relationship and its role in the distributional effects of credit stringency.[2/] In any case, the importance of the subject is clear. However, at this time little evidence has been offered for its general existence. Indeed, few empirically testable hypotheses have been offered. The single exception, of course, to this void present in the literature is the work of Jaffee and Modigliani [1969] and its expanded treatment in Jaffee [1971].

In this pioneering work the authors presented both a theoretical basis for the phenomenon and an empirical test of its existence from United States data for the period 1952-II to 1965-IV. And, while some aspects of the work have been questioned by Frost [1973] and others have been generalized by Smith [1972], the work still remains the major piece of empirical evidence.

The purpose of the present study is to supplement the evidence of Jaffee and Modigliani by examining credit rationing in another environment--that of Japan. It can be contended both that the Jafee-Modigliani model requires further substantiation and that the Japanese banking system requires further elaboration in the journals. This study encompasses both goals. Concerning the first, new supportive evidence is reported here for the general nature of credit rationing, as the Japanese data substantially supports all of the Jaffee-Modigliani hypotheses. As to the latter, the study brings to light the Japanese banking structure and system of operation with specific reference to effective interest rates, short term optimum interest rates and lending profiles.

Specifically, the study may be outlined as follows. In Section I the Jafee-Modigliani theoretical model is presented in abreviated form. Here the reasons for the existence of what is referred to as dynamic and equilibrium credit rationing are presented, with special reference to relevent considerations for the Japanese financial environment. Section II discusses the financial structure of Japan in overview fashion to lead the reader to an appreciation of its basic institutional and behavioral framework. It will be noted at this time that its fundamental structure most certainly satisfies the basic requirements for non price rationing. The reader familiar with the banking and financial system of Japan may wish to skip this portion of the paper. Section III develops the relevant test for credit rationing. Here the Jaffee-Modigliani empirical analysis is adapted to the Japanese banking system and tested for the period December 1965 through June 1973. Finally Section IV offers some summary remarks.

I. The Jaffee-Modigliani Model of Credit Rationing

A. The Theoretical Underpinnings

JM embark upon their analysis of credit rationing from a micro model of the commercial bank facing a large number of customers. Each project offered by the customer has an <u>ex ante</u> terminal period value of x, where x is a random variable with a subjective probability distribution $f_i[x]$. For a given risk, as defined by $f_i[x]$, the bank's expected profit from the ith customer's loan, P_i, is a function of the size of the loan made, L_i, and the loan rate, r_i. Bounding the doman of possible outcomes from any investment project, i, within the closed interval $[k_i K_i]$, the expected value of the project may be written as

$$E_i = \int_{k_i}^{K_i} x f_i[x] \, dx.$$

Accordingly the profit from a loan in connection with project i, net of opportunity cost, is:

$$(1) \qquad P_i\left[R_iL_i\right] = R_iL_i \int_{R_iL_i}^{K_i} f_i[x]dx + \int_{k_i}^{R_iL_i} x f_i[x]dx - IL_i,$$

where R_i is the interest rate factor, $(1 + r_i)$, and I is the opportunity cost factor $(1 + j)$, and other variables have been previously defined. This expression may be simplified, as shown by JM (1969), to

$$(2) \qquad P_i\left[R_iL_i\right] = (R_i - I)L_i - \int_{k_i}^{R_iL_i} F_i[x]dx,$$

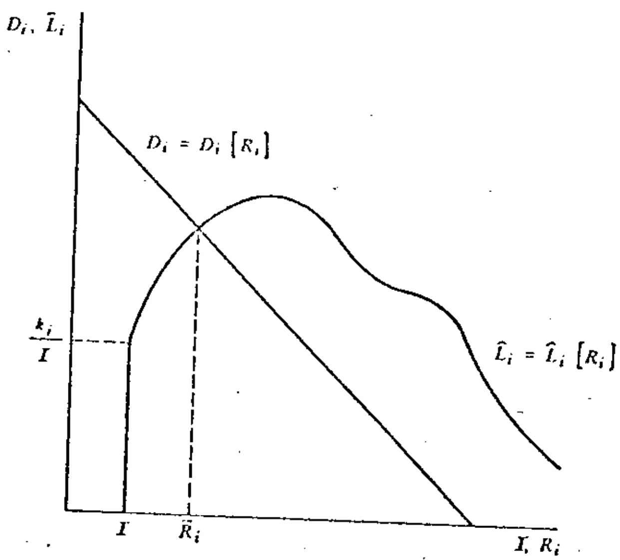
$$\text{where } F_i[A] = \int_{k_i}^{A} f_i[x]dx,$$

and is defined as the probability that x will be less than A. The maximization of the bank's profit is achieved by selecting the quantity of funds to be loaned for a particular project, with the residual supplied by the firm. Formally this process is modeled by maximizing equation (2) with respect to L_i to obtain the first order condition relating the optimum loan offer for a given loan rate, contingent upon a stable probability function $f_i[x]$. This derivative can be shown to take the form,

$$(3) \qquad \frac{\partial P_i\left[R_iL_i\right]}{\partial L_i} = R_i(1 - F_i\left[R_iL_i\right]) - I = 0.$$

Mapping the implicit solution to the loan offer function contained in equation (3) in (L_i, R_i) space against a standard downward sloping demand curve yields the supply of loanable funds facing the individual firm. A representative mapping is contained in figure 1. As noted the actual loan size will be

Fig. 1



determined by the intersection of supply and demand at the rate factor $\overline{R}_i$. The implied quantity, however, need not be the profit maximizing, optimum optimorum of the banking firm, denoted as the quantity loaned at the rate R_i^*, not necessarily equal to $\overline{R}_i$.

In any case, the optimal loan offer curve has the following properties, with the derivation of these properties contained in J-M [1969] and J [1971].

I. (a) $L_i = 0$ for $R_i < I$,

(b) $0 \leq L_i \leq K_i/I$ for $R_i = I$,

(c) $R_i L_i \leq K_i$ for all R_i,

(d) $\lim_{R_i \to \infty} L_i = 0$.

II. For a given interest rate factor, R_i, expected profits decrease monotonically as the loan size varies from the optimal size, $L(R^*)$, in either direction.

III. Expected profits increase along the offer curve for successively higher interest rate factors.

IV. The market equilibrium value of R_i, denoted as $\overline{R}_i$, and derived by demand-supply equalization is bounded from above by the optimal rate set by a discriminating monopolist, R_i^*.

V. If a common rate, R^*, must be charged to two customers the common rate factor that maximizes the bank's expected profit must be bounded by the maximum rates that would obtain if each rate were set independently by the discriminating monopolist, such that

$$R_1^* \leq R^* \leq R_2^*$$

VI. For the customer for whom R^*, the joint rate, is below the bank's optimal rate, individual 2 in this case, credit rationing is profitable. However, for customers for whom $R^* \geq R_1^*$, credit rationing is not profitable.

VII. By extension property VI can be shown to imply that neither a banker acting as a discriminating monopolist, nor a banker charging all customers the same rate, will ration the risk free customer.

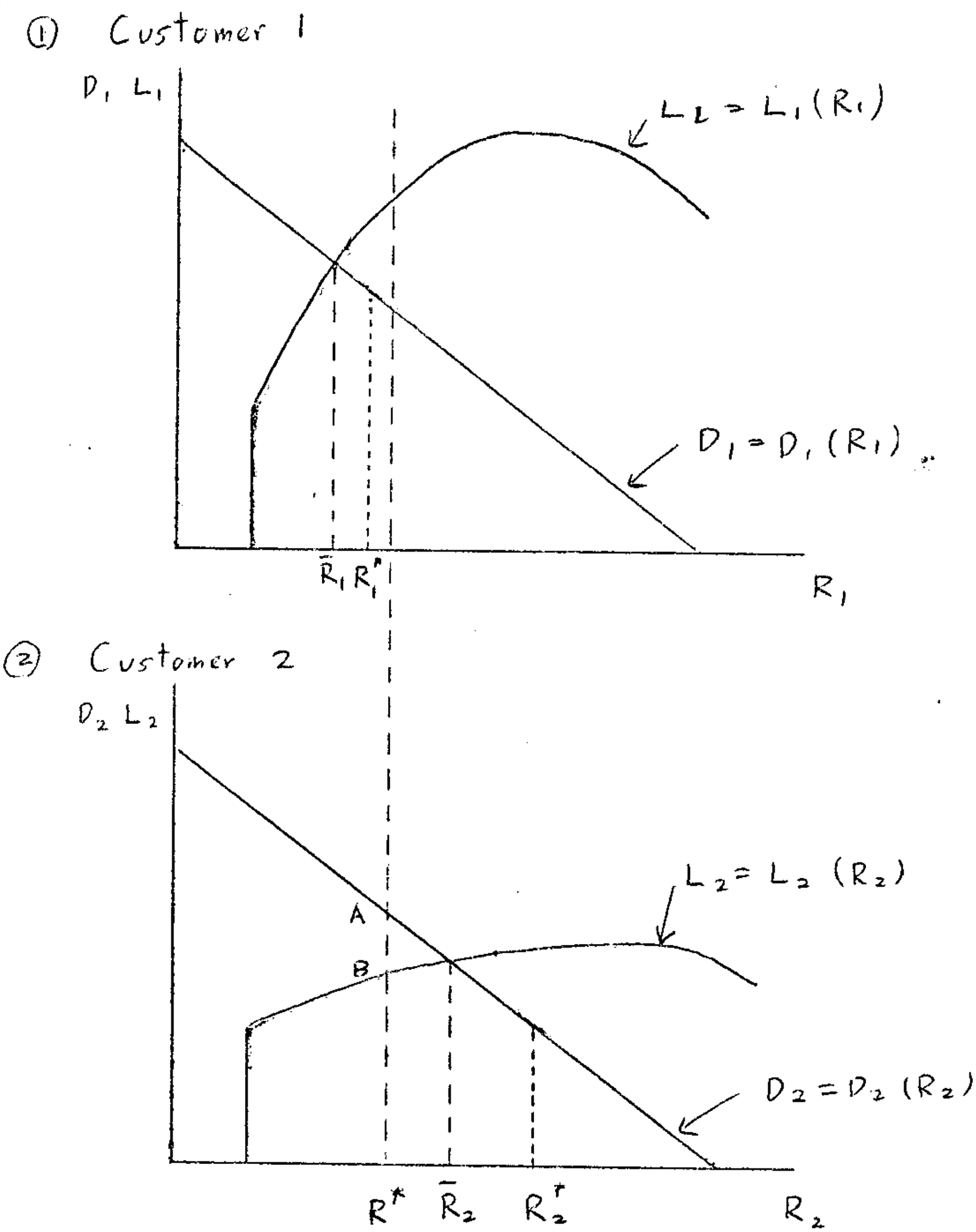
VIII. A certeris paribus increases in the opportunity cost causes the optimal loan offer curve to shift downward at every interest rate.

IX. The common optimal rate factor R^*, applicable if the bank were constrained to satisfy all demand functions, is positively related to the opportunity cost I.

From the above properties one can construct an accurate characterization of the phenomenon referred to as equilibrium credit rationing. Here, rationing the quantity of funds available to an individual borrower exists due to an institutional situation whereby common rates are charged to different customers. This common rate, R^*, differs from both the equilibrium rate for any one market, $\overline{R}_i$, and also the optimum discrimination rate R_i^*. At this rate the relatively less risky customer, customer one in Figure 2, is never rationed while customer two may be constrained by the bank's offer curve. Equilibrium credit rationing, then, results directly from heterogeneity in any one risk classification. No systematic relationship exists between the quantity of credit rationing and the level of interest rates, or the absolute riskiness of the customer.

In addition to equilibrium rationing the above model offers observations as to dynamic credit rationing. Dynamic rationing is defined as the transitory difference in the quantity of excess demand for funds that arises due to the sluggish movement of R to its new equilibrium position, after a disturbance. By definition dynamic rationing may be positive or negative and can be shown to be a positive function of the spread between the actual rate, R, and the new long run optimal rate, R^*. This may be seen as follows. Consider an initial long run equilibrium that is disturbed by an increase in the market rate of interest.[3/] Such a shift results in a rise in the opportunity cost, I, facing the banker, and, according to proposition VIII, the loan offer curve shifts downward. During the period of disequilibrium and interest rate adjustment, given heterogeneous groupings of customers within a small number of risk classifications, (a) all customers that were previously rationed are futher restricted, and (b) the customers who were previously in excess supply are either shifted to excess demand and rationed, or are still not rationed.

Fig 2


① Customer 1
D₁ L₁
L1 = L1(R1)
D1 = D1(R1)
R̄1 R1*
R1
② Customer 2
D2 L2
L2 = L2(R2)
A
B
D2 = D2(R2)
R* R̄2 R2†
R2

In any case two fundamental results are obtained. First, there is an aggregate increase in the quantity of credit rationing. Second, the segment of the population most effected by the disturbance, and concommitant credit rationing, is the relatively more risky set. Further, if the total loan market is segmented into prime and non-prime borrowers, the fraction of the bank's total loan portfolio to the prime customer catagory would increase. Eventually the equilibrium rate structure would be achieved and dynamic credit rationing would go to zero. However, in the interim, this ratio of prime to total loans increases with deviations from R^*.

B. The Empirical Estimation Procedure

The testing conducted in connection with the credit rationing model above centers upon the existence of dynamic credit rationing in the United States. For this purpose, a proxy variable for credit rationing capturing the movement of the ratio of prime to non-prime lending is used. From above, it is demonstrated that this ratio, denoted as H_1, is positively related to the difference between the optimal rate and the market quoted rate. The null hypothesis tested, then, may be written as:

$$(4) \qquad H_1 = \beta_o + \beta_1(R_L^* - R_L) + \epsilon ,$$

with $\beta_o > 0$,

$\beta_1 > 0$,

ϵ = stochastic error term.

After some discussion and development of a reasonable proxy for R_L^* in the United States, the model is successfully tested. It is concluded that dynamic credit rationing, and, by extension, the basic model of non-zero credit rationing, are supported by the data.[4/]

In terms of the present study, our interest is in the basic model and empirical hypothesis testing procedure as they relate to the general phenomenon of credit rationing. In this regard one may summarize the sufficient conditions of the economic environment as,

(a) Less than perfect price discrimination on the part of the banking community, implying equilibrium credit rationing,

(b) Less than perfect flexibility of interest rate movements, implying dynamic credit rationing.

Further, if the economic environment satisfies these conditions the empirical observations necessary to determine its widespread importance are,

(a) The movement of the ratio of prime to total loans outstanding in time series,

(b) The optimal rate of return and its relation to the quoted market rate.

In the next section an overview of the Japanese financial structure is presented to demonstrate that this particular environment clearly satisfies the sufficient conditions outlined above. Once that has been established the stage will be prepared for empirical verification of credit rationing during the period December 1965 to June 1973.

II. The Japanese Banking Structure[5/]

A. The Institutional Framework

The Japanese financial environment is, to a large degree, dominated by its commercial banking sector. While other financial institutions exist (the most notable of these are insurance companies, financial institutions for agriculture, government finance institutes and mutual savings and loan banks) the focal point of the financial markets is still the banking community. Rather heavily concentrated, the total number of banking institutions is a mere 86 for the entire country. This total includes 76 commercial banks, 3 long term credit banks and 7 trust banks,[6/] as of December 1974.

As their names would indicate the banks in the latter two categories restrict themselves to a subset of the total banking function and account for approximately 10% of total deposits of the sector. This leaves the remaining 76 with a complete control over banking activity. Yet concentration is greater than that. Within the commercial bank category only 13 banks are defined as city banks, a term synonymous with national, and in many cases international, banking activities.

The remaining 63 are local or regional banking institutions of deposit size varying from quite small to approximately equal to some of their city bank counterparts. In general, however, average size is one-ninth that of the larger national organization. Their operations are principally in local enconomic areas, defined as their prefecture and neighboring prefectures. The deposit base is from the marketing area and loans are split approximately equally between local and small enterprises and larger national organizations. Typical of regional banks, however, their deposit base is in excess of the profitable alternatives. This, accordingly, leads them to supply large quanities of funds to the city banks in the form of call loans, the Japanese equivalent of the U.S. Federal Funds market.

The city banks, on the other hand, are always in an excess demand situation, relative to their deposit base. As the major supplier of funds to the industrial sector, these 13 banks[7/] have constantly resorted to heavy dependence upon the call market and the Bank of Japan for additional funds. While this is referred to in the institutional literature as a chronic case of overborrowing the basic mode of operation is not dissimilar to their U.S. counterparts use of borrowed funds, though to a much expanded scale.

Perhaps the most distinctive element in the Japanese financial environment that leads to the dominant position of the city bank, however, is the lack of a viable primary and secondary market for corporate debt. The predominant part of the financial assets in Japan is in the form of bank deposits, with little in terms of directly held corporate issues. Accordingly, corporate funds are obtained through the banking community, with indirect financing and bank intermediation an accepted way of business.

This results in a dominant role for a mere dozen institutions, an environment that permits careful monitoring and control by the Japanese Government's financial regulation agencies. This regulation usually takes two forms. First, the Bank of Japan can directly alter the quantity of base money in the system by administration of the borrowing privilege. Given the dependence of city banks upon borrowings from the central bank any alteration in its availability or terms quickly affects the banking community's supply functions facing the industrial sector. Secondly, interest rates are administered by the Temporary Interest Rates Adjustment Law and tacit agreement between the Bank of Japan and the Federation of Bankers Associations of Japan. Enacted in December 1947 the Temporary Interest Rate Adjustment Law sets maximum rates on loans of over ¥ 1 million ($300,000) for periods under 1 year. While initially altered each time rates changed, during the late 1950s the Bankers Association implemented changes within the bounds of legislated limits without adjusting legal rate extremes. Further since 1959 a "standard interest rate" system, modelled after the U.S. prime rate, was instituted whereby standard rates moved with the Bank of Japan discount rate. Non-regulated off-prime rates, at the same time, fluctuate with the regulated prime rate, therefore, resulting in relative inflexibility in all interest rates within the banking lending area.

B. Testing For Interest Rate Inflexibility

As indicated in section I above, a sufficient condition for credit rationing is heterogeneity of risk classification and inflexibility of interest rates over time. Concerning the first of these conditions, the maximum ceiling rate structure, based upon size and term rather than risk class, clearly indicates heterogeneity of classification. It may be argued that this follows only if the constraint is binding upon the city bank's rate structure. This is indeed the case in Japan as the Bankers Federation alters rate structures so that they do in fact represent the industry's supply curve for large banks.

Relative to the second condition for rationing, interest rate stickiness, due to the institutional mechanism which determines interest rates on loans in Japan, it is probable that Japanese loan rates[8/] are not infinitely flexible. Actually, many Japanese economists have emphasized the inflexibility of loan rates.[9/] By way of comparison Suzuki analyzed the movement of relevent interest rate variables for Japan, the United States, and Britain. He obtains the results of Table 1, using coefficients of variation. It will be immediately noticed that this data indicates that interest rates on loans in Japan are very inflexible compared to call rates in Japan and loan rates in both the U.S. and U.K. This method of analyzing the inflexibility question is suspect, however, for two reasons. First, relatively stable market with high price elasticity may account for the relatively stable interest rate.[10/] Second, the maturity structure in each category between countries is neglected.

A more efficient estimate of the flexibility of interest rates can be obtained by comparing the actual quoted loan rate, R_{Lt}, with the perfectly flexible rate which may be denoted as R^*_{Lt}. In this case, one may analyze the movement in R_{Lt}, ΔR_{Lt}, with the movement in R^*_{Lt} during the same period, ΔR^*_{Lt}, using as a null hypothesis that $\Delta R_{Lt} = \Delta R^*_{Lt}$. This testing procedure requires the estimation of .

Table 1

International Comparison of Coefficient

of Variation of Interest Rates

	JAPAN	U.K.	U.S.A.
Official Discount Rate	0.064	0.187	0.148
Yields on Bonds	0.027	0.048	0.062
Loan Rate	0.020	0.168	0.055
Call Rate	0.204	0.241	---
Federal Fund Rate	---	---	0.395
T B Rate	---	0.214	0.223

Coefficient of Variation = Standard error from trend/mean

See Suzuki [1966], p. 186.

(5) $$R_{Lt} - R_{Lt-1} = \gamma_o + \gamma_1(R^*_{LT} - R^*_{Lt-1})$$

with the null hypothesis,

$$Ho: \gamma_o = 0$$
$$\gamma_1 = 1$$

However, to do so would require that a series on R^*_L be constructed, as it is unobservable. Toward this end, one may obtain a proxy, from available data, that is both relevant for the Japanese environment and closest to the optimum rate in terms of being indicative of the financial position of the banking sector, and highly flexible, varying with economic conditions. In Japan the consensus is that the call rate most closely satisfied these criterion.[11/] Yet it is not without drawbacks. First, there is marked seasonality in the monthly data. This may be dealt with by seasonal adjustment. In addition, however, the majority of call loans are of overnight, over-month-end, and unconditional terms. Therefore, while the dependent variable is the prime loan rate for maturity up to one year, the independent variable is of shorter duration. Accordingly adjustment must be made for the implied future structure of rates as they relate to the prime (or standard) rate and its relation to the call loan market.

The latter problem clearly implies a term structure estimation problem. For computational convenience and for its _a priori_ acceptable theoretical base the Modigliani-Sutch preferred habitat synthesis model is used to deal with the term structure area. The model suggests an operational form[12/] to estimate the long term rate as a distributed lag of previous short term rates,

(6) $$R^*_{Lt} = \alpha_o + \Sigma\alpha_i r_{t\ i} + \xi_t$$

where r_{t-i} = call rate at period t-i

ε_t = stochastic error term $\sim N(o,\sigma_\varepsilon)$.

The lag structure is assumed to be a polynomial of degree k and length T, specified by a search procedure of the reduced form equation to minimize the standard error of the regression.13/

However, since data on the optimal rate is not directly observable one can not obtain direct maximum likelihood estimates of the coefficients of equation (6). Yet in the estimation of the credit rationing model below (Section III) such estimates are obtained. At that time the Jaffee-Modigliani equation, revised to conform to the Japanese economic environment, is estimated in the form

$$(7) \qquad H_1 = \beta_o + \beta_1(\alpha_o + \Sigma\alpha_i r_{t-i} - R_t) + \eta_t ,$$

where equation (7) follows directly from equation (4) above. From the best estimate of equation (7) one may derive $\hat{\alpha}_i$ estimates from equation (6), and therefore estimates of the optimal rate of return on loans from quarterly data for the period December 1965 to June 1973.14/

The above procedure yields a series on optimal rates which may then be compared with the actual loan rates. However, adjustment of the latter is required to obtain effective rates for the period, as compensating balances and other tied relationships are empirical realities in Japan. Traditionally banks offer loans to the firm on the condition that some proportion of the loan be deposited into time deposit balances. This implies a reduced availability from a given size, or equivalently, a higher effective rate of return to the bank. Recently, September 1969, this formal condition of a loan agreement was prohibited by the Ministry of Finance due to the violation of the

Anti-Monopoly Law. Yet the custom continues but it is somewhat less uniformly practiced. To capture this implied higher cost it would be necessary to adjust the actual rate to account for such idle balances. If it may be assumed that time deposits, the main vehicle of compensating balances, are either held because of the commercial bank's requirement for outstanding loans or are weighed in the granting of any such loan, then the actual effective loan rate for any individual firm, $\bar{R}^i_{Lt}$, may be defined as

$$(8) \quad \bar{R}^i_{Lt} = \frac{(R^i_{Lt} \cdot L^i_t - R^i_{Tt} T_i)}{(L^i_t - T^i_t)} ,$$

where T^i_t = time deposit balances held by individual firm i,

R^i_{Tt} = rate of return on time deposits for individual firm i.

Using equation (8) as typical of the representative firm and aggregating with the assumptions that (a) all time deposits of firms are compensatory, and (b) $\bar{R}^i_{Lt}$ is independent of $(L^i_t - T^i_t)$ for all i, the actual effective rate for time t becomes

$$(9) \quad \bar{R}_{Lt} = \frac{(R_{Lt} L_t - R_{Tt} T_i)}{(L_t - T_t)} . \quad \underline{15/}$$

The resultant series for $\bar{R}_{Lt}$ and R^*_{Lt} are contained in Figures 3.1, 3.2 and 3.3, for the total banking community, city banks, and local banks respectively. As casual observation would indicate the optimal rate varies to a greater extent than the actual effective rates, supporting the inflexibility argument outlined above. Further estimating equation (5) to test the hypothesis yields the following results from ordinary least squares regression procedure with first order serial correlation correction.

Fig. 3 - 1 (Total Banks)

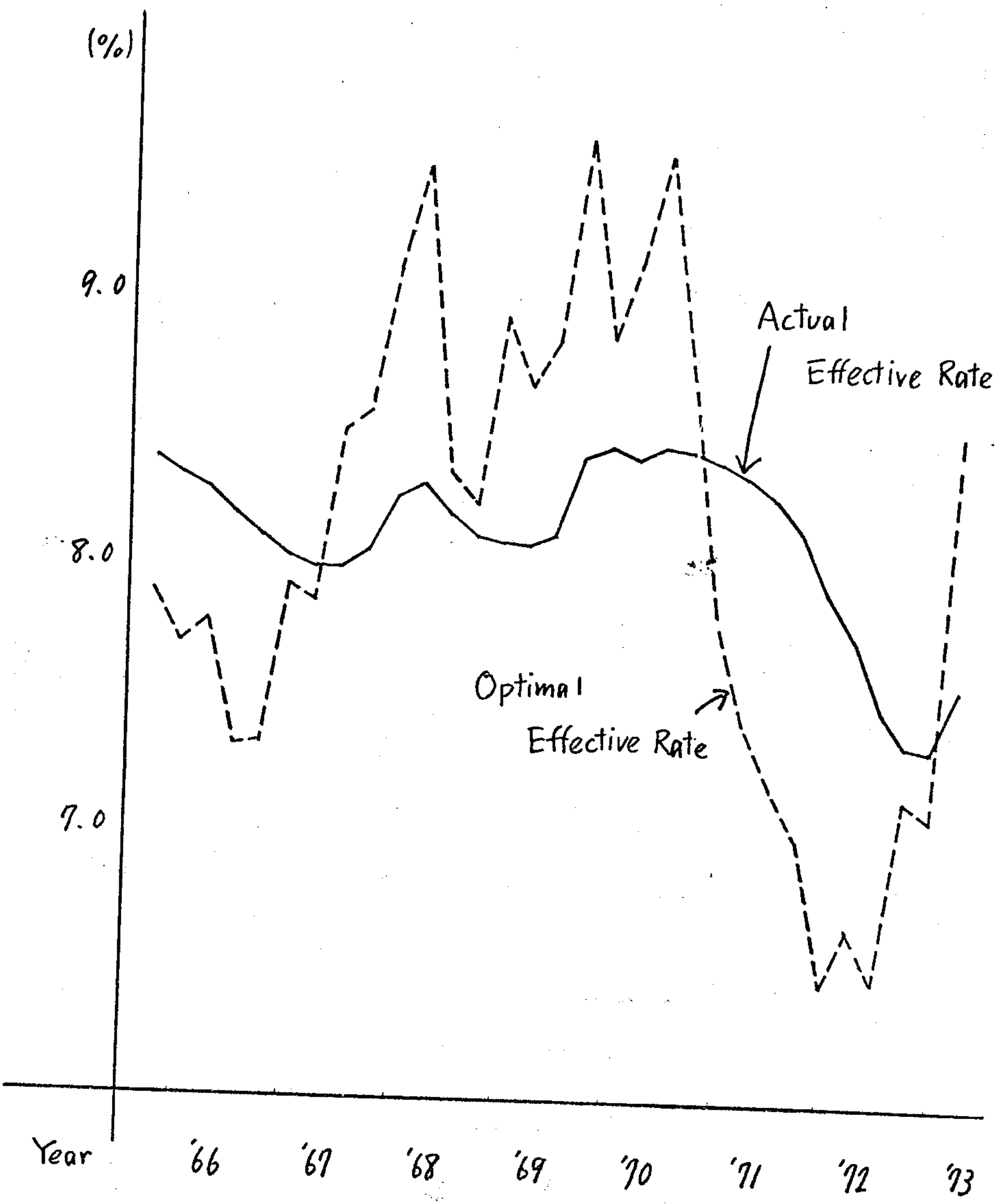
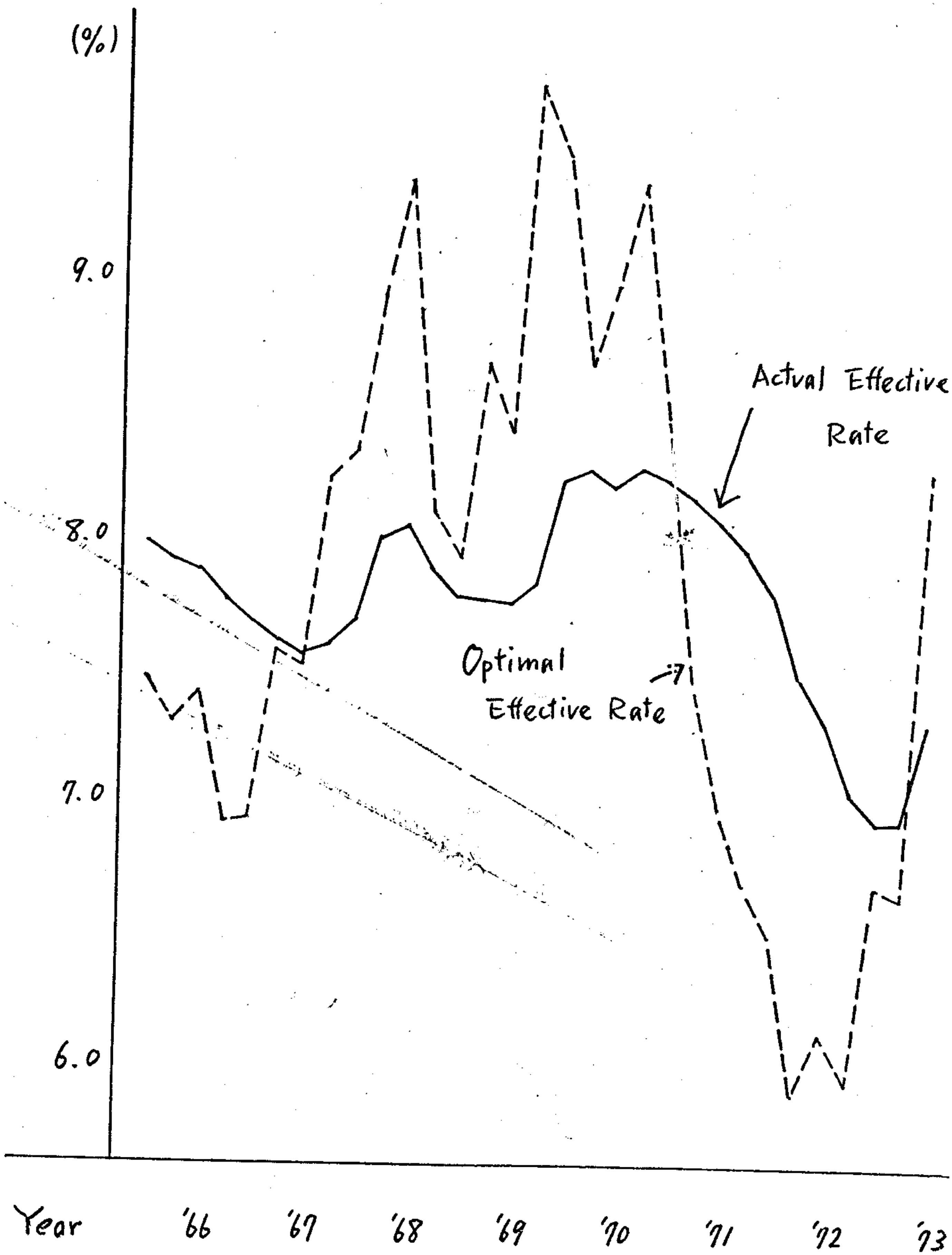
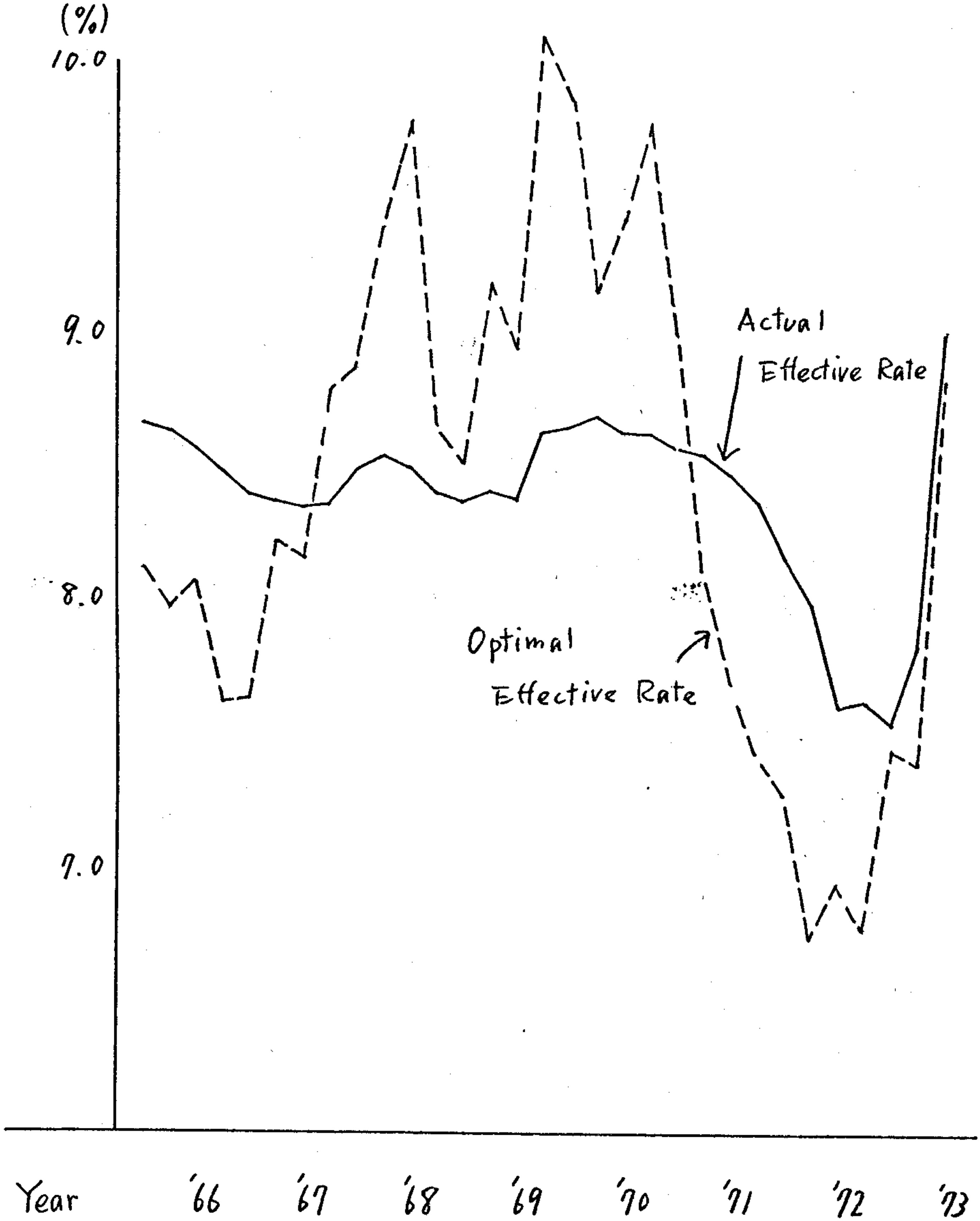


Fig. 3 - 2 (City Banks)



3-3 (Local Banks)



A. Total Banks

$$\text{(10A)} \qquad \bar{R}_{Lt} - \bar{R}_{Lt-1} = - .0180 + .0531 \, (R^*_{Lt} - R^*_{Lt-1})$$

$$(- .4373) \qquad (1.884)$$

$R^2 = .3580$ DW 1.7015 $s = .2695$ $\rho = .550$

B. City Banks

$$\text{(10B)} \qquad \bar{R}_{Lt} - \bar{R}_{Lt-1} = - .0136 + .0840 \, (R^*_{Lt} - R^*_{Lt-1})$$

$$(- .277) \qquad (2.476)$$

$R^2 = .3792$ DW = 1.7171 $s = .4697$ $\rho = .506$

C. Local Banks

$$\text{(10C)} \qquad \bar{R}_{Lt} - \bar{R}_{Lt-1} = + .1968 + .0934 \, (R^*_{Lt} - R^*_{Lt-1})$$

$$(.8159) \qquad (1.736)$$

$R^2 = .3431$ DW = 1.5346 $s = 1.190$ $\rho = .8427$

where DW = Durbin Watson Statistic,

s = standard error of the regression,

ρ = first order correlation coefficient,

() = t statistic.

The coefficients of $(R^*_{Lt} - R^*_{Lt-1})$ in all three equations are of the right sign and significant at the 90% level. Yet they clearly are significantly lower than unity, suggesting less than complete adjustment, and, therefore, relative inflexibility. Of particular note is the magnitude of the estimated adjustment coefficients. While the basic cyclical pattern of actual and optimal rates are consistent the data suggests that the loan rate moves very sluggishly relative to call rate movements.[16/]

One must, therefore, conclude from these results that there is strong evidence of an economic environment conducive to credit rationing in Japan, and hence the sufficient conditions of the model are met.

III. Testing For Credit Rationing In Japan

A. The Estimated Equation

As indicated at the outset the present study tests for the existence of credit rationing using the Jaffee-Modigliani prime to total borrowing ratio. The Japanese counterpart to this ratio is the "standard loan" quantity to total loans. However, the conditions to qualify as a standard borrower are not identical to conditions to be classified as prime in the U.S. money market. As noted above, standard rates are applied to all large firms that satisfy borrowing quantity and maturity classifications covered by the Temporary Interest Rate Adjustment Law. In addition, a small number of extremely profitable, highly riskless medium and small size firms are also so classified. The standard borrower, therefore, spans a larger segment of the total borrowing demand than might otherwise have been assumed. Yet two specific factors should be kept in mind in relation to the classification. First, the political and economic significance of prime (standard) borrowers in the highly regulated Japanese economy bears heavily upon the potential risk of bankruptcy. Very few cases of failure or re-organization exist in post World War II history. Secondly, the Japanese financial custom of having a main commercial bank where a large majority of the funds and services are kept suggests that the size itself leads to substantial benefits from the customer relationship that would be detrimentally affected by rationing attempts.

In any case it is clear that the standard classification as a group is the closest counterpart to the U.S prime borrowing set. Accordingly, it appears appropriate to use this classification in the ratio form,

$$(11) \qquad H_1 = \frac{L_S}{L_T}$$

where L_S = standard loans

L_T = total loans

This ratio completes the set of data required to test the hypothesis on the Japanese economy. The equation to be estimated is (from equation (4) above)

$$(4) \qquad H_1 = \beta_o + \beta_1(R^*_{Lt} - R_{Lt}) + \epsilon_t$$

where (from equation (6)) the optimal rate is assumed to be a distributed lag of previous value of the call rate,

$$(6) \qquad R^*_{LT} = \alpha_o + \Sigma\alpha_i\ r_{t-i} + \xi_t\ .$$

This yields, by substitution and collection of terms, the final form to be estimated,

$$(12) \qquad H_1 = A + \sum_{i=0}^{n} B_i r_{t-i} - \beta_1 R_{Lt} + \eta_t\ .$$

Four separate series are tested using equation (12). The first is based upon a monthly data series using the quoted rate for total banks. The second test uses quarterly data on the actual effective rate discussed above. Unfortunately data limitations prohibited estimation monthly using effective rates.

The third and fourth tests disaggregate the H_1 ratio into city bank lendings and local bank lendings, respectively.

In each case an Almon polynomial distributed lag function is searched and estimated. The lag structure is presented. And, actual versus fitted values are graphed.

B. Total Banks Using Quoted Monthly Data

Using monthly data for the period December 1964 to June 1973 the search procedure yielded a third degree polynomial of six period lag. The estimated form is[17/]

$$(13) \qquad H_1 = \underset{(2.340)}{0.5989} + \sum_{i=0}^{6} B_i r_{t-i} - \underset{(-\ 2.237)}{0.0898}\ R_{Lt}$$

$$R^2 = .7757 \qquad s = .0232 \qquad D.W. = 1.9052$$

with

$B_0 = .0719$ (5.791)	$B_4 = -\ .01358$ (-3.934)
$B_1 = .00241$ (.4732)	$B_5 = .00411$ (.6996)
$B_2 = -.02677$ (-3.047)	$B_6 = .01275$ (1.981)
$B_3 = -\ .02798$ (-4.155)	$\sum_{i=0}^{6} B_i = .0228$

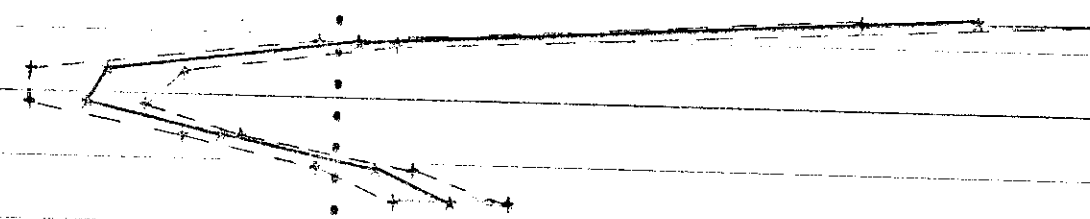
The estimated lag structure is shown in Figure 4.1. The lag structure shows a strong first period effect with regressive elements in the recent past values of the call rate.

Fig. 4-1

DISTRIBUTED LAG INTERPRETATION

	COEFFICIENT	STØD. ERROR	T-STATISTIC
0	.7189E-01	.1241E-01	5.791
1	.2412E-02	.5097E-02	.4732
2	-.2677E-01	.8779E-02	-3.049
3	-.2798E-01	.6736E-02	-4.155
4	-.1358E-01	.3452E-02	-3.934
5	.4110E-02	.5876E-02	.6996
6	.1275E-01	.6601E-02	1.981

PLOT OF THE LAG DISTRIBUTION(*) AND STØD. ERROR BAND(+)



MEAN LAG = -4.04552

In the basic equation, using quoted rather than effective rates, the variance of the ratio of standard to total loans is substantially explained by reference to the difference between optimal and quoted rates. The sign on the coefficient R_{Lt} is as expected and significant at the one percent level. The lag structure of the call rate, in its proxy for the optimal rate, appears reasonable, and is significant in five of the 7 lag periods. To see the performance of the model in its ex post prediction of the H_1 variable Figure 4.2 traces the path of actuals and expecteds within the sample period.

C. Total Banks Using Effective Rates

If the theoretically preferred effective rate is used on quarterly data for the period September 1965 to June 1973 a third degree polynomial of four period length results in further support from the data.

(14)
$$H_1 = \underset{(1.685)}{.2654} + \sum_{i=0}^{3} B_i r_{t-i} - \underset{(-2.400)}{.0564} R_{Lt}$$

$$R^2 = .8363 \qquad s= .0227 \qquad D.W. = 1.675$$

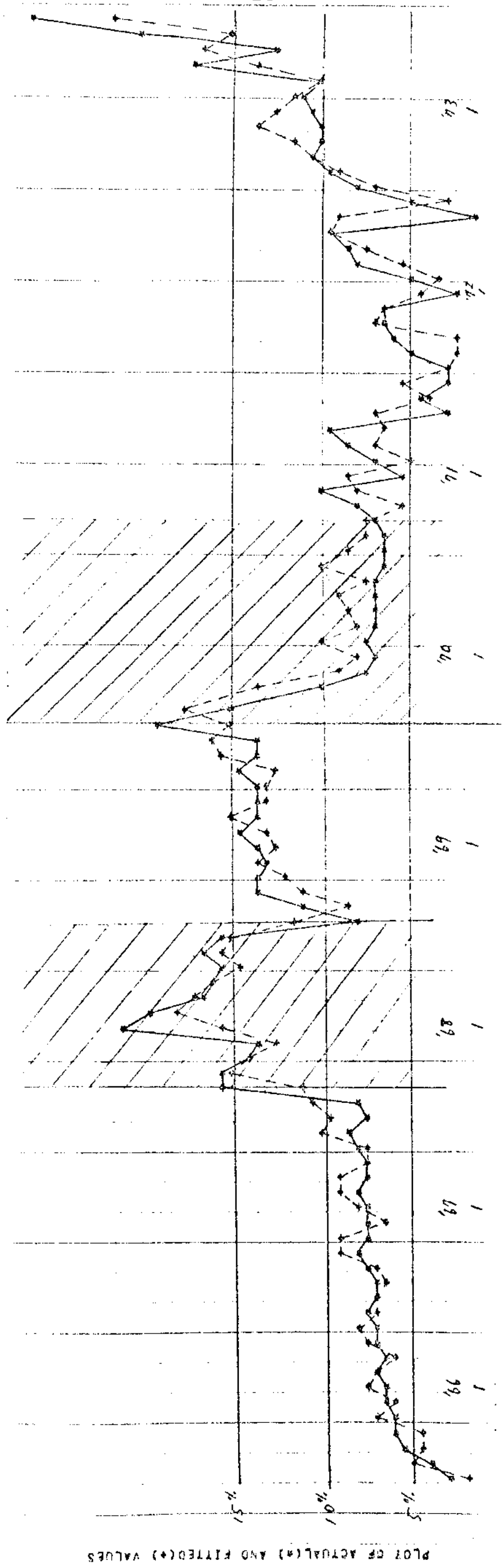
where

$$B_0 = \underset{(7.555)}{.08130} \qquad B_2 = \underset{(-4.866)}{-\ .02424} \qquad \sum_{i=0}^{3} B_i = .0410$$

$$B_1 = \underset{(-3.712)}{-\ .0446} \qquad B_3 = \underset{(3.253)}{.02856}$$

As above the estimated lag structure is presented in Figure 5.1. As in section B above the lag structure exhibits the same regressive characteristics. Notice also that the optimal lag structure selected by the minimization of standard error search procedure on past call rates occurs at a shorter lag

Fig. 4-2



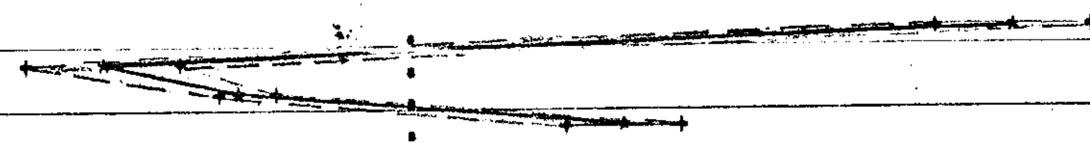
Shaded areas indicate the periods when the tight money policy is adopted.

Fig. 5-1

DISTRIBUTED LAG INTERPRETATION

	COEFFICIENT	ST@D. ERROR	T-STATISTIC
0	.8130E-01	.1076E-01	7.555
1	-.4460E-01	.1198E-01	-3.721
2	-.2424E-01	.4982E-02	-4.866
3	.2856E-01	.8780E-02	3.253

PLOT OF THE LAG DISTRIBUTION(*) AND ST@D. ERROR BAND(+)



MEAN LAG = -.180660

lag function than above. This is, of course, consistent with the periodicity of the data, and adds credence to the underlying hypothesis as to the construction of R^*_{Lt}.

...y of the data, and adds credence to the underlying hypothesis as to the construction of R^*_{Lt}.

In terms of basic results notice that the use of effective rates over the quarterly data somewhat improves the overall quality of results. This may be due to either the elimination of "noise" in the data series, or, as the basic model suggests, the effective rate series outperforms the quoted series. In any case all signs are as expected and significant.

Figure 5.2 is also presented to illustrate the actual versus predicted for the entire banking system data.

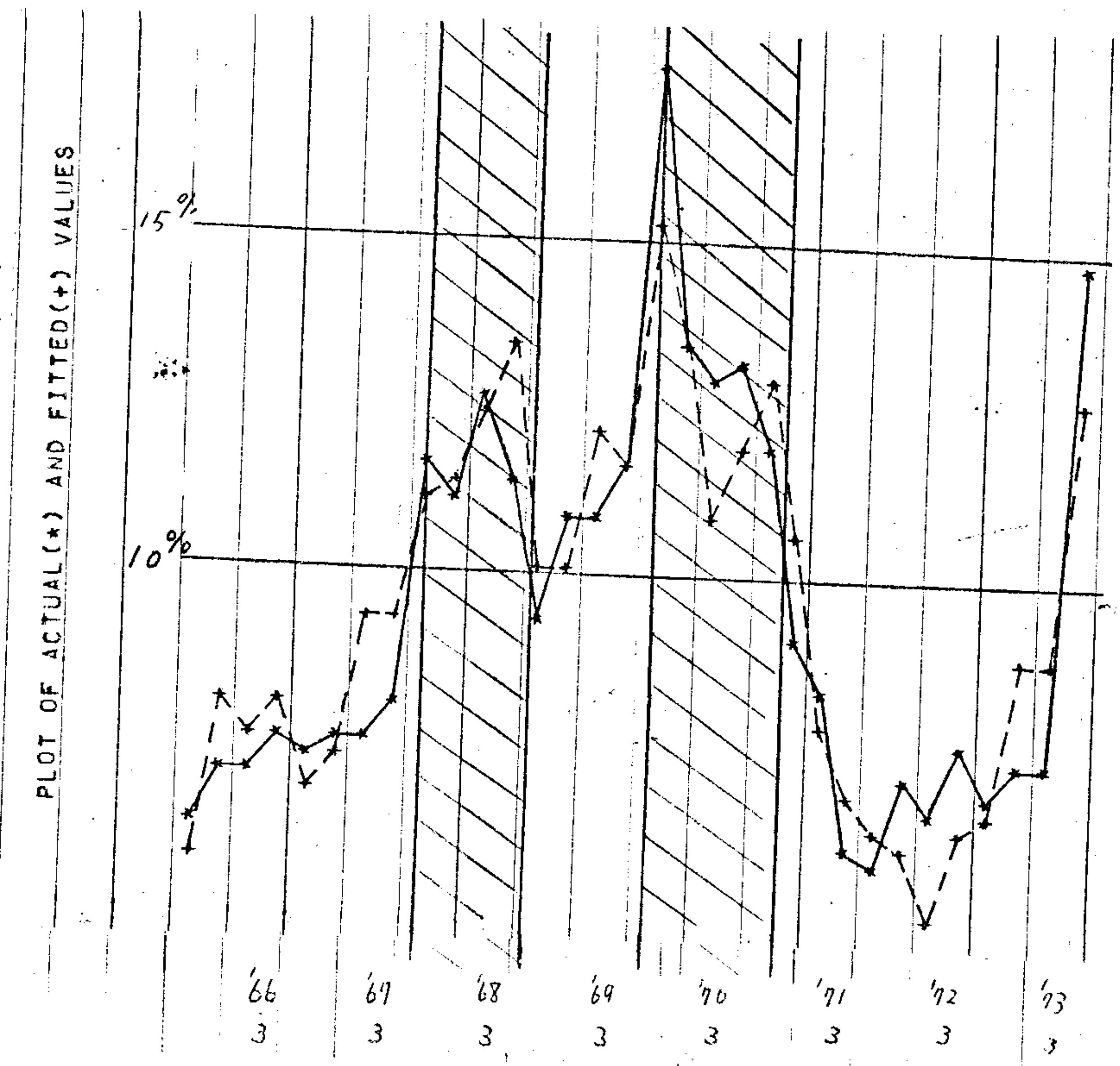
D. Disaggregation of the Banking Sector

As indicated in the discussion of the basic structure of the Japanese banking system, there exists two, quite distinct, sets of banks in the society. On one hand we have the larger, aggressive city banks, borrowing from both the smaller local banks through the call market and from the Bank of Japan by the discount mechanism. These banks are chronic borrowers and view the call rate as the cost of funds. On the other hand the local banks are in a chronic excess supply situation, relative to demand at given market rates. Accordingly they supply a substantial portion of their funds to the call loan market. Here funds yield returns that are considerably higher than the local alternative.

By this description it may be suggested that each subsector reacts differently, or at least at a different speed, to shifts in the interest rate structure. Accordingly, here the individual sectors are estimated separately. The results indicated below, substantiate the a priori conjecture.

City Banks: $$H_1 = .2686 + \sum_{i=0}^{3} B_i r_{t-i} - .0652\, R_{Lt}$$
$$(1.6315) \qquad\qquad (-2.367)$$

Fig. 5-2


PLOT OF ACTUAL(*) AND FITTED(+) VALUES
15%
10%
'66
3
'67
3
'68
3
'69
3
'70
3
'71
3
'72
3
'73
3

$R^2 = .8527$ $s = .0271$ $DW = 1.64$

$B_0 = .1059$ $B_2 = -.03142$ $\sum_{i=0}^{3} B_i = .0538$

(8.192) (-5.252)

$B_1 = -.05546$ $B_3 = .0348$

(-3.877) (3.310)

Local Banks: $H_1 = -.4314 + \sum_{i=0}^{4} B_i r_{t-i} + .0438 R_{Lt}$

(-2.871) (2.148)

$R^2 = .8533$ $s = .0205$ $DW = 2.20$

$B_0 = .05929$ $B_3 = .02324$

(4.997) (2.193)

$B_1 = -.03765$ $B_4 = -.0096$

(-3.369) (-.962)

$B_2 = -.01788$ $\sum_{i=0}^{4} B_i = .0174$

(-2.705)

As the numbers indicate, the city bank results are substantially the same as the aggregate data reported above. The third degree polynomial proves to have a similar basic shape. The coefficient on R_{LT} is significantly negative as the data would suggest.

However, the local bank sector does not appear to correspond with the aggregate equation. The coefficient on R_{Lt} is positive and significant at about the 5% level. This would appear to offer evidence counter to the null hypothesis. However, upon consideration two alternative explanations for this result can be offered. First, on the supply side, local banks have two distinct alternative uses of funds, both of which may be viewed as prime areas. It may extend credit to prime industrial customers, or alternatively it may extend credit to city commercial banks through the call loan market. As the loan rate rises relative to the call rate, funds will shift away from the call market into the regional loan market forcing both the numerator and the denominator of H_1 upward. Essentially the H_1 ratio, while relevant for the city bank and the aggregate banking sector, excludes call loans, and, therefore, is an inappropriate index of prime lending for the local bank.[18/] A second explanation can be offered from the demand-for-loans side of the market. As the differential between R^*_{Lt} and R_t decreases the present model suggests that rationing will decrease and more "normal" conditions would reappear in the loan market. This may well lead to the prime borrower shifting back to normal loan channels, associated with its main banking relationship, a phenomenon quite prevalent in Japanese financial circles. Using this rationale the positive coefficient on R_t may actually represent the comparative advantage of large city banks with large prime customers.

IV. Summary And Concluding Comments

This paper set out to do two distinct tasks. Firstly, it attempted to offer new empirical testing of the Jaffee-Modigliani model of credit rationing. Secondly it attempts to analyse the Japanese financial structure to see if, as had been suggested, credit rationing is indeed a wide-spread phenomenon. It concludes having answered affirmatively to both queries.

APPENDIX ON DATA

$$H_1 = \frac{\text{Loans granted at prime rate or lower rate}}{\text{Total Loans}}$$

Loans granted at prime rate or lower rate (total banks, city banks and local banks) = Monthly. Three month moving average (ESM).

Total Loans (total banks, city banks and local banks) = Monthly. Three month moving average (ESM).

$$H_2 = \frac{\text{Loans to big and medium firms}}{\text{Total Loans}}$$

Loans to big and medium firms (total banks, city banks and local banks) = Quarterly. Four quarter moving average (ESM).

Total Loans (total banks, city banks and local banks) = Quarterly. Four quarter moving average (ESM).
- different data from the previous total loans.

r_t: (A) Weighted average of call rate monthly. (Twelve month moving average to eliminate seasonal trends) - (Before 1972, weighted average of overnight, unconditional and over-month-end, after 1972 weighted average of overnight, unconditional and discount rate) (ESM).

(B) Weighted average of call rate quarterly. (Point estimates of March, June, September, December monthly average).

Effective rate (R_{LT}) =

$$\frac{\text{Quoted rate x loans to firms - time deposit rate x time deposits of firms}}{\text{Loans to firms - time deposits of firms}}$$

- Monthly (ESM).

where (ESM): "Economic Statistics Monthly," by Statistics Department, the Bank of Japan.

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FOOTNOTES

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1. See, for example, Tucker [1968].

2. See, for example, Hodgman [1960], Kane and Malkiel [1965], and recently Wood [1974].

3. The disturbance selected to demonstrate the properties of dynamic credit rationing is clearly arbitrary. In JM pp. 863-864 several alternatives are presented, with identical conclusions.

4. See JM pp. 867-872 for empirical results.

5. This section relies heavily upon Federation of Bankers Associations of Japan [1974].

6. The present study centers on the commercial banking system to the exclusion of other financial institutions, as the focal point of the analysis is the relative size of outstanding intermediate term loans to different groups of borrowers, However, other institutions are relevant in any discussion of the financial structure. Particularly, savings and loan associations, while not legally classified as commercial banks offer a substantial set of bank services. Long term credit banks and trust banks, as well, have substantial impact. The size of the members of this group often equals the city bank stature. Yet because their principal dealings are long term loans financed by bond insurance their role and position in the market is significantly different.

7. Of this total only 12 actually engage in domestic operations. The Bank of Tokyo is a specialized foreign exchange bank, chartered under a special act, the Foreign Exchange Bank Law of 1954. However, all banks may engage in foreign exchange transactions, and most of the remaining dozen do so. In addition, as most of the largest firms have international activities the restriction on the Bank of Tokyo operation's does not exclude it from a viable competitive role in the lending activity market.

8. It should be noted that all interest rates which are adopted in this study are nominal, not real. As for the problems associated with nominal and real rates, see Santomero [1973] and Mundell [1963].

9. See Suzuki [1966] p. 186, [1974] Kaizuka and Onodera [1972] pp. 9-21 and Komiya [1963].

10. The movement of internationally mobile capital, and the tendency for interest rate equalization across countries somewhat negates this objection. Yet, given the structure of Japanese international capital flow legislation, the dependence upon international capital flows seems too heroic.

11. See Tachi and Hamada [1972] pp. 291-292, Royama [1971] p. 8, Suzuki [1966] p. 250.

12. See Modigliani and Sutch [1966] [1967] for a detailed derivation of the estimated form presented here.

13. For the present purposes it will be assumed that the polynomial lag function includes r_t to r_{t-T}, so that current data is evaluated consistently with the underlying weighting structure, rather than separately.

14. The actual estimates of $\hat{\alpha}_i$ are contained in the $\hat{B}_i$ estimates below, see page 23.

15. Since all time deposits are not necessarily compensating deposits for present loans, there is not an exact equivalence between the estimated actual effective rate and the true effective rate. However, the bias, if any, appears to be in a direction against the present study as including time deposit balances increases variability of the actual rate to the detriment of the credit rationing hypothesis. Yet the results seem sufficiently clear to suggest that the errors resulting from such approximations would not account for the relative movement of rates as shown in Figure 3.

16. There is evidence of inconsistency in the three equations reported as the coefficient of adjustment for the sectors, local and city banks, both are above the total bank coefficient. However, the confidence interval of the α_1 coefficients span the local estimates.

17. This equation is also estimated in direct linear form without reference to the difference between r_t and R^*_{Lt}. This result is the following:

$$\text{(F. 17)} \qquad H_1 = \underset{(4.921)}{1.0715} + \underset{(5.813)}{.0376r_t} - \underset{(-5.2194)}{.1681R_{Lt}}$$

$$R^2 = .7280 \qquad s = .0251 \qquad DW = 1.780.$$

As reported in the text all a priori hypotheses are satisfied. While theoretical justification has been offered which suggests equation (13) superior and the relative goodness-of-fit favors the equation reported in the text, this is reported to show the relative robustness of the results. While similar results have been obtained for other equations below these will not be reported here.

18. Presumably an alternative ratio, $K = \frac{P+C}{P+C+N}$ where call loans (C) enter explicitly, could be constructed to capture this trade off for the local bank. However, given our a priori interest in aggregate loan characteristics this is left to those interested.